Modelling health care utilization:
an applied Geographical Information Systems approach

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Kenneth Spencer Field B.Sc

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ABSTRACT

MODELLING HEALTH CARE UTILIZATION: AN APPLIED GEOGRAPHICAL INFORMATION SYSTEMS APPROACH

Kenneth Field B.Sc

This research has emanated from the geographical concerns raised by organisational change in the British National Health Service (NHS), namely the ongoing debate relating to health and health care inequalities. This thesis develops a flexible, portable and predictive model of health care utilization capable of assisting improved health care planning and analysis. In so doing it contributes to the current resurgence in medical geography.

An applied approach to this research is identified which builds upon methods of modelling spatial patterns and processes in geography and the upsurge of interest in Geographical Information Systems (GIS) technology. In these terms, the use of GIS is central to the research; it supports construction and application of the model; facilitates a wide range of analyses; and provides a basis for visualisation and interpretation of model results.

The value of modelling in analysing relationships between health inequalities and the location and allocation of health care is identified through a discussion of previous NHS policy initiatives and previous research. From this, a conceptual model of utilization is developed which incorporates components of need, accessibility and provision. A patient survey of asthmatics and diabetics informs the development of the model and validates the choice of indicators used to measure utilization. Indicators of need, accessibility and utilization are thus defined and subsequently measured using a signed chi-square scoring method. The model was developed and tested for primary care General Practitioner services in the Northampton District Health Authority area and outcome measures are proposed and evaluated.

Rigorous testing of the model's sensitivity and robustness is undertaken and potential for its simplification explored. Components are critically evaluated through a comparison with alternative methods of determining spatial inequalities in disadvantage. The potential of the model of utilization for health care planning and analysis is extensively demonstrated through the application of a variety of modelled scenarios.

Emergent issues from the research are considered and potential for future geographical research in this area of study, and the impact upon research agendas more generally, is explored.

The approximate length of the thesis is 100,000 words (including appendices and footnotes but excluding preliminaries and bibliography)

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ABBREVIATIONS

The following abbreviations are used in this thesis:

AAT	Arc Attribute Table
AHA	Area Health Authority
CDROM	Compact Disk Read Only Memory
CPD	Central Postcode Directory
DALY	Disease Affected Life Years
DEM	Digital Elevation Model
DHA	District Health Authority
DHSS	Department of Health and Social Security
DoE	Department of the Environment
DoH	Department of Health
DIME	Dual Independent Map Encoding
DTM	Digital Terrain Model
ED	Enumeration District
ESRI	Environmental Systems Research Institute
EU	European Union
FHSA	Family Health Service Authority
GB	Great Britain
GCSE	General Certificate of Secondary Education
GDP	Gross Domestic Product
GIS	Geographical Information System
GP	General Practitioner
GPFH	General Practitioner Fund-Holding practice
HA	Health Authority
HMSO	Her Majestys Stationary Office
IDW	Inverse-Distance Weighted
ILC	Index of Local Conditions
IT	Information Technology
LBS	Local Base Statistics
LDSAG	Local Diabates Strategy Advisory Group
LHPC	London Health Planning Consortium
LLTI	Limiting Long-Term Illness
M	Manual (i.e. Social Class IIIM)
NDHA	Northampton District Health Authority
NHS	National Health Service
NM	Non-Manual (i.e. Social Class IIINM)
ONS	Office of National Statistics
OPCS	Office of Population, Censuses and Survey
OS	Ordnance Survey
OSGR	Ordnance Survey Grid Reference
PAC	Pinpoint Address Code
PAF	Postcode Address File
PAT	Polygon Attribute Table
PC	Personal Computer
PCA	Principal Components Analysis
PCG	Primary Care Group
RAWP	Resource Allocation Working Party
RHA	Regional Health Authority
SAS	Small Area Statistics
SEG	Socio-Economic Group
SMR	Standardised Mortality Ratio
TIGER	Topologically Integrated Geographical Coding and Referencing
TPP	Total Purchasing Project
UK	United Kingdom
UPA	Underpriveliged Area
WHO	World Health Organisation
YPSI	Young Persons' Support Index

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1 BACKGROUND TO THE RESEARCH

1.1 INTRODUCTION

There has for a considerable time been interest and research in geographical aspects of health and health care. Work undertaken by geographers has provided valuable contributions in two broad areas. The first is concerned with spatial epidemiology: the incidence and prevalence of disease and factors influencing ill-health (Allen-Price, 1960; Howe, 1963; Lovett and Gatrell, 1988) and the spatial transmission of disease (Pyle, 1979; Cliff et al, 1981). The second considers the links between disadvantage and ill-health (Girt, 1972; Townsend and Davidson, 1982; Marmot et al, 1984; Townsend et al, 1988; Eyles and Donovan, 1990) and the relationship between need, accessibility and utilization (Coates and Rawstron, 1971; Knox, 1982; Mayhew and Leonardi, 1982). As Birkin et al (1996, see also Joseph and Phillips, 1984; Eyles, 1987; Haynes, 1987; Jones and Moon 1987 for general reviews) points out, much of this research is essentially descriptive with the broad aim to understand the relationships between observed geographical patterns, for instance the spatial distribution of deprivation and social class. This, in itself, is valuable since it has contributed significantly to improved understanding of the structures and mechanisms that influence spatial patterns of inequality in health status, utilization and service provision. However, a further dimension to the geographical analysis of health and health care can be developed through the application of computer-based modelling and Geographical Information Systems (GIS). Such a development, adding to underlying theories, offers a means by which a prescriptive approach can evolve. The development of such methods offers health care planners a vital tool in their quest for effective service provision, particularly in the current climate of major changes in the organisation and provision of health care.

The past decade has seen major shifts in the organisation and provision of health care services in Great Britain, leading in April 1991 to the introduction of an 'internal market' into the British National Health Service (NHS). This has altered the role of the District Health Authority (DHA), with separation of 'purchaser' and 'provider' functions and the creation of different responsibilities and administrative structures. DHAs now negotiate contracts to purchase health care services from the provider which offers best value for money. In order that DHAs can effectively provide services for the population they serve the assessment - or at best accurate estimation - of inequalities is vital. This, in turn, requires consideration of patterns of need, access and provision as components of utilization.

The changes in health service organisation have therefore created new requirements for information about the extent and spatial distribution of need for services and the flow of patients who use the services. To address these information demands, considerable emphasis has been placed on the use of Information Technology (IT). Particular interest has focused on the potential of GIS. These offer the capabilities for 'capturing, storing, checking, manipulating, analysing and displaying data which are spatially referenced' (DoE, 1987 p132), and as such can help analyse and interpret spatial patterns and processes, thus assisting more effective health care planning (Wrigley, 1991).

The principal aim of the research undertaken here is to establish a basis for creating a decision support system which will assist resource managers in their efforts to plan General Practitioner services. A predictive model of utilization is developed within a GIS environment, which is then applied and evaluated.

This introductory Chapter outlines the background to this research in the radical changes which are under way in the organisation and operation of the British NHS and the geographical concerns this raises. It then reviews the theoretical and methodological background to the study in recent geographical enquiry. In particular, it discusses how modelling methods can be used to investigate health care planning and the extent to which GIS technology, as part of an applied geographical approach, can be used for such purposes. Finally, it summarises the research aims and concludes by defining the structure of the thesis.

1.2 ORGANISATIONAL CHANGE IN THE NHS

The NHS has undergone many alterations since its inception, the details of which have been described by Joseph and Phillips (1984), Eyles (1987), Holliday (1992), and Ranade (1994).

The National Health Service (NHS) Act was introduced into Parliament in 1946 by Attlee's Labour government with the aim of providing all essential medical care to the general public:

> "The basic intention of the National Health Service Act 1946 was to establish access to health care resources for all those in need as a human right"
> (Cooper, 1975 p8).

The NHS grew from a disparate set of private, employment and charity-based health care systems (Leathard, 1990). Fundamental to the NHS act was a recognition that access to health care was not equal for all and neither were the resources evenly or equitably distributed (Joseph and Phillips, 1984). This was due to the fact that there was no explicit relationship between need and provision or between the previously unrelated health care systems. The NHS brought these disparate systems together on 5th July 1948, when the Minister of Health became responsible for the provision of a comprehensive health service for the population of England and Wales. England was divided into 14 Regional Health Authorities (RHAs) each under the control of a board, the chairman and members of which were appointed by the Minister. The boards appointed management committees responsible for the day to day running of hospitals. The health service was thus organised in a 'tripartite' fashion comprising:

- The hospital service (administered by regional boards and management committees at a local level) and teaching hospitals;
- The family practitioner services (contracted by executive councils); and
- Local authority health services (operating under local government administration to provide public health services to control infectious disease and environmental hazard and preventive and community based services).

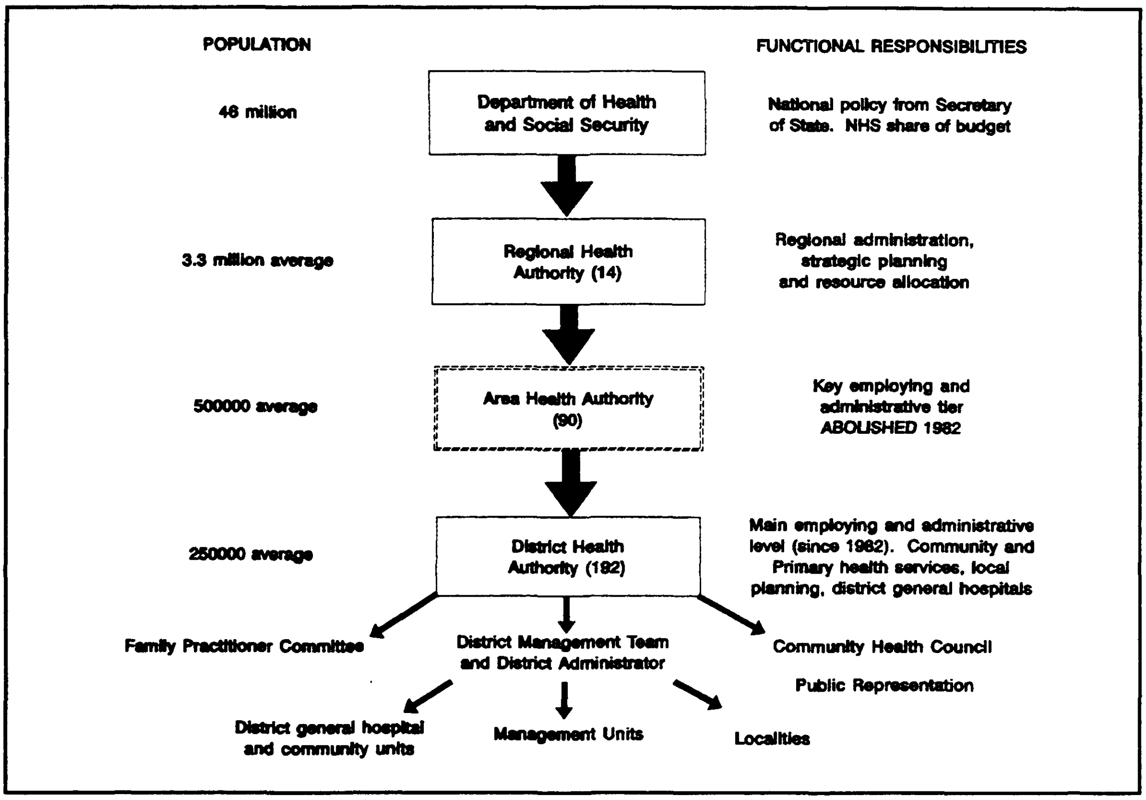
Although health care improved dramatically, the NHS did not meet its own criteria in terms of improving access and equity of provision of services. Since there was little or no relationship between the various systems prior to the NHS act, post-1948 health care services were unevenly distributed throughout the country and across cities and regions.

In addition it was thought that since health care would be free at the point of delivery and available to all irrespective of the ability to pay, more individuals would seek health care. More people would thus benefit from treatment and their health status would improve. Consequently, it was assumed that a healthier population would lead to less use of the NHS allowing funding and resources to be cut back. However, the Guillebaud Committee (HMSO, 1956), set up to investigate the costs of the NHS, showed that the reverse was happening: that there were increased demands for health care with no concomitant improvement in the nation's health (Cochrane, 1972). This scenario has impacted upon the NHS ever since and, as more resources are made available, so the demand for service also increases. With finite health care budgets being funded from the public purse this has necessarily led to rationing, creating further inequalities through prioritisation of treatment, delays in treatment and larger waiting lists.

Furthermore, in the first 25 years, its own administrative structure contributed to its problems with the 'tripartite system' of different controlling bodies tending to create poor liaison, replication of services and inefficiency. This was accentuated by the rapid development in medical technology and the rise in patient expectation about the quality and availability of health care.

During this period there was no single authority with the responsibility to provide a comprehensive health service for the population of a given area. On April 1st 1974, however, in the wake of reorganisation of local government, a major restructuring of NHS management was introduced. This established a revised structure under the Department of Health and Social Security (DHSS) (Figure 1.1).

Figure 1.1 The NHS structure since 1974, modified in 1982 with the removal of the Area Health Authorities.
(after Joseph and Phillips, 1984 p19)



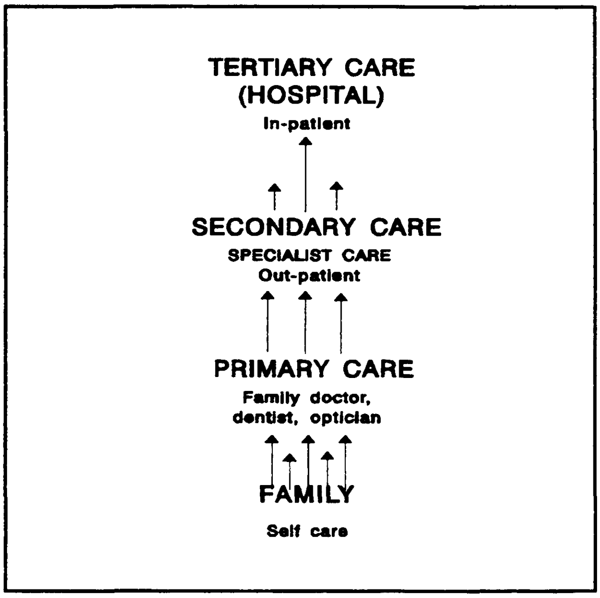
The restructuring attracted new criticism: the most widespread was that there were too many levels of responsibility, too many committees and too many administrators who had little patient contact, leading to slow decision-making. A further restructuring in 1982 removed one of the administrative tiers (the Area Health Authorities) in an attempt to solve these problems. This left a modified, two-tier, system comprising:

- Regional Health Authorities (RHAs), which had replaced the Regional hospital boards in 1974. They took over responsibilities for the hospital services and extended it to include community health services. They were accountable for the District Health Authorities under their control; and

- The District Health Authorities (DHAs) which were responsible for development and management of health services in their districts, within national and strategic guidelines.

Despite this reorganisation, the principal aims of the NHS were unchanged and the flow of the patient within the system also remained largely unaltered (Figure 1.2).

Figure 1.2 **Flow of health care in the UK**
(after Joseph and Phillips, 1984 p21)



Under this system, an individual is allowed a 'free choice' of General Practitioners (GPs) at the primary care level. The GP usually provides all types of primary care and is able to refer a patient to higher-order, specialist care if it is required. The GP is thus the point of entry into the health care system.

Considerable change has also occurred in the operational structure of primary health care. The most notable has been a shift from single doctor practices to group practices, which form a health care team incorporating practice nurses and other services. Since the early 1970s, there has also been a move towards the provision of health centre practices (DHSS, 1976) which has had the effect of grouping and centralizing primary health care. This has, perhaps, reduced the equity of access and provision in many areas, ideals upon which the NHS was founded.

More recently, following the 'Working for Patients' and 'Caring for People' White Papers (DoH, 1989a, 1989b), the existing public health care financing and delivery systems have been transformed into more market-based systems of managed competition. These major changes are seen as necessary due to steadily increasing health care provision costs which cannot be reasonably sustained (Wrigley, 1991) and, in part, attempt to address the problems of rationing highlighted earlier.

These White Papers proposed radical changes to the structure of the NHS. The NHS and Community Care Bill set up an 'internal-market' within the NHS and introduced the concepts of 'provider' and 'purchaser' in the provision of health care. 'Providers' of acute care services (e.g. hospitals), as of 1 April 1991, became dependent for their income on gaining contracts for the services they provide. The contracts come predominantly from the DHAs but also from GP Fund-Holding practices (GPFH). The role of a DHA from the old NHS framework is, essentially, converted into that of a 'purchaser' of services on behalf of the population it serves.

One of the most controversial aspects of the bill is that the DHAs have the ability to seek value for money by contracting with 'providers' outside their districts or even outside the NHS in the private sector (Wrigley, 1991). In addition, hospitals are allowed to opt out of district control and become self-governing NHS Trusts. They are free to set their own pay and contracts and can compete to serve more than one DHA. They are monitored by the Regional Health Authorities on behalf of the NHS management executive.

Since 1991 a further change in the organisation of the NHS has taken place, with the merging of various RHAs. Additionally, DHAs and Family Health Service Authorities (FHSA) have merged to form Health Authorities (HA) which are accountable for larger geographical areas. This has been undertaken to allow greater purchasing power by the HAs on behalf of the population. However, this further alters the role of a HA in that it becomes responsible for many more people over a wider area. A possible effect of this change is that local health care needs, an understanding of which provided the original rationale for DHAs, are diluted into wider catchments.

Figure 1.3 illustrates the organisation of the NHS post-1991, including the more recent merger of DHAs and FHSAs into unitary HAs[1].

Within the pre-1991 NHS both the RHAs and DHAs took strategic health decisions on behalf of the populations which they served. Since funding of various services has changed, these strategic decisions are no longer under the remit of these bodies for all primary and secondary services. As GP fundholding increases, so the role of the DHA decreases and DHAs now act, predominantly, on behalf of non-fundholding GPs. Such decentralisation is also in evidence for RHAs as they act more as regional regulators in what can be termed a decentralised NHS. RHAs will take increasing roles as arbitrators of dispute between purchasers and providers of health care in relation to contracts. Strategic health care decisions (such as health needs assessment) continue to be made by Health Authorities but, given such dramatic organisational change, these aspects of health care planning will become increasingly devolved, giving rise to the need for more appropriate decision-making tools.

When comparing the old NHS with the post 1991 initiatives it is evident that many of the problems remain. The old NHS was subject to debate relating to efficiency, access, equity and quality of provision. Indeed, the Black Report (HMSO, 1980) claimed that, whilst the initial goals of the NHS were not challenged, they failed to address such issues effectively. The recent reorganisations have taken place, in part, as a further attempt to address such issues by changing the fundamental principles of the NHS, but with the expectation that it can be achieved within broadly unchanged Regional and District organisational structures. In this context, the intention is to make the 'internal market' more purchaser driven, with the result that supplier prices are forced down resulting in savings. In terms of primary health care provision, the scenario that GP fundholders can retain the savings should also result in efficiency gains as already noted; however, the reforms have been criticised for creating extra

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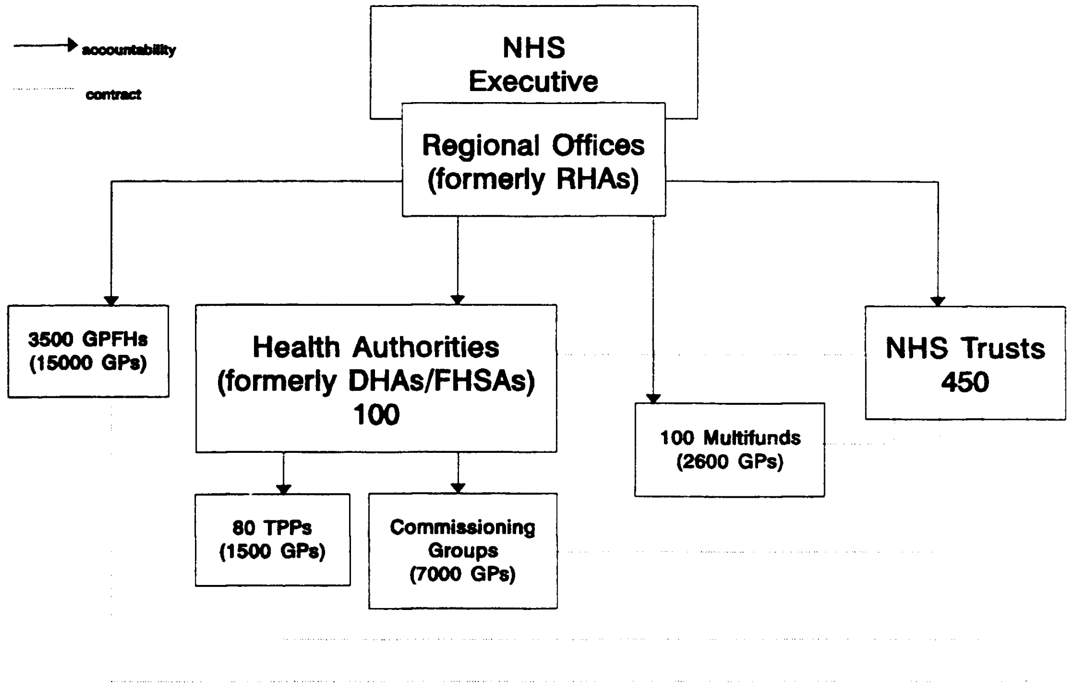
1 This research has been undertaken during the post-1991 changes but commenced prior to the change at RHA level and the merger of DHAs and FHSAs into unitary HAs. As such, the focus of this research is on DHAs and, although their name has changed, their functions remain broadly the same.

Figure 1.3 Organisation of the NHS post 1991

(after DoH, 1997)



Health Authorities (formerly DHAs and FHSAs)
: Responsible for the health needs of the population and to ensure effective availability of services. Creation of strategic plan and setting of targets to monitor performance. Provide finance to GP non-fundholders. Purchase health care through contracts.

GP Fundholding (GPFH)
: A GP whose practice manages a budget for its practice staff, certain hospital referrals, drug costs, community nursing services and management costs

GP Commissioning groups
: Pilot projects (as of April 1998) whose fundholding and non-fundholding GPs will manage a prescribing budget.

Multifunds
: Groups of GP fundholders who agree to pool their budgets and work together.

Total Purchasing projects (TPPs)
: Comprising groups of GPs who together purchase hospital and community care services not covered by the fundholding scheme.

NHS Executive
: Part of the Department of Health, monitors operational matters within policy

Regional Offices (formerly RHAs)
: Maintains central management of the NHS. Ensures policy is implemented. Post 1991 led to closer links with the NHS executive.

NHS Trusts
: Public bodies providing NHS hospital and community health care

administrative burdens through contractualism. Much more important issues are raised in relation to the utilization of the care offered to the population and the inequalities which exist between need, access and provision - themes central to this research.

1.3 CONCEPTUAL AND METHODOLOGICAL BACKGROUND

Continuing inequalities in health status and health care have contributed in recent years to a revival in medical geography (Jones and Moon, 1991). Studies in medical geography are not new and they can be traced back at least to the work of John Snow in 1854. Historically, however, geographical studies of health and health care have fallen into the two main categories outlined in Section 1.1. This research stems from the concerns developed within the broad sphere of social geographical inquiry, defined as the study of social relations in space and the spatial structures that underpin those relations (Jackson, in Johnston (ed), 1994), and the current radical changes in the NHS. As such it contributes to the second category of medical geography; that which is concerned with the problems arising from social groups' use of space, their inherent health care needs and the distribution of, and access to, scarce resources (Jones, 1975; Eyles, 1975; Eyles and Woods, 1983).

Within this context, a major focus of study is on issues of resource location and allocation, notions of territorial social justice and inequalities which differ dramatically from the view which Teitz (1968) describes:

> "Modern urban man is born in a publicly-financed hospital, receives his education in a publicly-supported school and university, spends a good part of his life travelling on publicly-built transportation facilities, communicates through the post office or through the quasi-public telephone system, drinks his public water, disposes of his garbage through the public removal system, reads his public library books, picnics in his public parks, is protected by his public police, fire and health systems; eventually he dies, again in a hospital, and may even be buried in a public cemetery. Ideological conservatives notwithstanding, his everyday life is inextricably bound up with governmental decisions on these and numerous other local public services"
> (Teitz, 1968 p36).

The emphasis of contemporary social geography, implicit in the parallel concerns of medical geography, has moved away from Teitz's (1968) description of the use of public services. It does not simply describe patterns of phenomena but focuses on their underlying social, economic, environmental and political context. In doing so, studies have become more concerned with the collective consumption of resources and the problems of unequal access experienced by individuals or disadvantaged societal groups (Harvey, 1973; Jones and Kirby, 1981; Pinch, 1985; Knox, 1987; Jones and Moon, 1987). Clarke and Prentice (1982; see also Massam, 1993) provide a contemporary counterpart to Teitz's (1968) view stating that such research is concerned with:

> "the strategic allocation of resources between and within different types of broad service types and categories of need; the allocation of services to individuals most in need of them; and the allocation of resources over time in response to changing demand"
> (Clarke and Prentice, 1982 p499).

In medical geography, Thomas (1992) draws an analogy between the location and allocation of health care and central place systems and states that:

> "at a fixed point in time, a rational set of relationships can be found to balance the public demand for health care against the supply of medical services. In essence, a health care delivery system will be the representation of some spatial allocation problem that entails finding 'optimum' assignments of patients to medical facilities"
> (Thomas, 1992 p24).

Whilst the broad nature of this aspect of medical geography is with service location and allocation, Thomas (1992) places public demand central to an understanding of the inequalities which persist in terms of need and access in relation to available provision. These inequalities disproportionately affect certain people or groups within a population which leaves them relatively disadvantaged and underpins differential use of health care services (Coates et al, 1977; Giggs, 1979; Knox, 1979; Townsend, 1979; Dicken & Lloyd, 1981; Jarman, 1983; Townsend et al, 1988; DoE, 1995). Whilst some authors place the responsibility for ill-health, and therefore inequality, with the individual (Illich, 1975; McKeown, 1979) this view has been subject to wide-ranging criticism. Inequalities in health are inextricably bound up with capitalist development and are thus an inescapable outcome of the shortcomings of a capitalist political economy from which they flow (Navarro, 1975; 1976; 1978; Doyal, 1979; Thunhurst, 1982). In this sense, geographical space plays a crucial role in explanation since the processes which lead to inequalities manifest in different ways and in different places.

A wealth of research recognises the disparity between location of health care and the populations which are most in need (Knox, 1979; Haynes and Bentham, 1982; Whitlegg, 1982; Parkin and Henderson, 1987; Reid and Todd, 1989; Hindle and Ngwube, 1990; Carstairs and Morris, 1990). Conclusions from this, and other, research draw on Hart's (1971) theory that needs and services vary inversely (see also Powell, 1990). Stimson (1981) argues that 'the spatial distribution of health care services and access opportunities of potential consumers to services typically fails to satisfy equity criteria' (Stimson, 1981 p27) and emphasises the consequent shift in medical geography's research agenda stating:

> "During the last 10-15 years research has shifted in emphasis to the application of geographical methods of analysis in studying the distribution of health care service facilities and the access-opportunity of potential consumers of those facilities"
> (Stimson, 1981 p27).

The principal components of any study into health care location and allocation relate, therefore, to the inequalities in need for a service, its supply and any intervening obstacles to accessibility. As Thomas (1992) states, the main analysis concerns itself with whether an equilibrium exists between supply and demand such that supply is of sufficient quantity and quality to satisfy demand and that barriers to access can be assessed and minimised. It is crucial to regard these questions geographically. Even given provision of a medical infrastructure, there are numerous potential obstacles to accessibility, such as societal structure, housing, education and lifestyle, which vary geographically and which mean that the service does not necessarily benefit those who have a demand for health care. Such factors lead to fundamental disequilibrium between supply and demand, creating problems in the determination of national or even regional strategic health care planning - the same problem which has plagued the NHS since its inception (Section 1.2).

1.3.1 Developing an applied approach to geographical research in medical geography

Section 1.3 identified the broad concerns of medical geography but these can be studied through a wide variety of approaches. Alternative approaches can be identified in previous medical geography although they cannot easily be categorised since different approaches are often used simultaneously. Following Pyle (1979; see also Phillips, 1981; Jones and Moon, 1987), five approaches are broadly identifiable.

Cartographic approaches in the study of spatial epidemiology are concerned with mapping the spatial incidence of disease and of the distribution and correlation of relevant data to the population and their surroundings (Pyle, 1969; Howe, 1972; Learmonth; 1978; Stimson, 1980; Curson and McCracken, 1989, Brown et al, 1991). A similar approach has also been used to study the spatial distribution of health care location and allocation (Coates and Rawstron, 1971).

A modelling approach takes the cartographic approach a stage further by seeking to quantify the relationship between variables. Cliff et al (1981) follow this approach in modelling the spread of communicable disease. Shannon and Dever (1974) take a modelling approach in examining the efficiency of hospital location.

Behavioural approaches study the effect of individual behaviour on decision-making, health care needs and subsequent actions. In spatial epidemiology, Girt (1972) investigates difference in lifestyle as a contributory factor in ill-health and the approach is similarly followed by Girt (1973) in studying the influences in the decision to seek medical care.

The use of indices as a measure of quality of life has been used to explain variation in mortality and morbidity (Knox, 1975; Smith, 1977; 1982) and is indicative of a welfare approach to research. Greater emphasis has been placed on a welfare approach, in comparison with other approaches, in studying inequitable location of health care services (Knox, 1982; Townsend, 1979).

Structuralist approaches to research, which relate health or health care location to the nature and organisation of society. These, however, are not as widespread (LHPC, 1979; 1980; Eyles and Woods, 1983).

Whilst research in medical geography therefore varies in content and approach, much of it follows a positivist methodology which enables research to seek explanation through empirical analysis. Quantification assists the development of capabilities for predicting human spatial behaviour through scientific explanation and the creation of predictive models. In the realm of medical geography, ill-health is to a large degree an observable, biological fact subject to cause and effect regularities which involve other observable factors. These other factors may include the relative disadvantage experienced by certain societal groups, lifestyle characteristics or the inequitable location and allocation of health care. In terms of medical geography, Jones and Moon (1987) state that it is the role of positivism to:

> "develop and use technical apparatus to discover the empirical evidence for the existence of particular regularities, the ultimate goal being a universally applicable model or explanation."
> (Jones and Moon, 1987 p311)

Whilst the majority of work in medical geography follows avowed positivist traditions, Jones and Moon (1987; 1991) suggest that research is, however, moving away from determining cause and effect relationships, characteristic of early positivism, towards a more applied approach to investigation.

Applied geography, as a valid approach to research, has its origins in the 1950s. It is concerned with the application of geographical knowledge and skills to the resolution of real world social, economic and environmental problems (Harrison, 1977). After a period critical of quantitative approaches to research, the 1970s brought the re-emergence of applied geography due, in part, to the fact that 'the scientist is more aware of the real-world problems around him, seems more confident that he can help to tackle them, and gratified to get his hands and concepts dirty doing so' (Briggs, 1981 p2). Relevancy was the motivation behind this re-emergence with the goal to make geographical research relevant to social needs and policy formulation (Sant, 1982; Kenzer, 1989).

Applied geographical research is pragmatic in approach and attempts not to be constrained by specific paradigms or ways of thinking. It makes use of techniques and methods which best serve a need and, consequently, it is largely positivist. Since research also attempts to develop useful and useable outcomes, the need for simplicity is paramount wherever possible in order to make results more accessible or affordable to users. The underlying philosophy is one of relevance or usefulness leading to a problem-orientated approach to geographical investigation.

Applied geography has not, though, been without contemporary criticism and critical opposition from other 'non-applied' members of the geographical community. Particular criticism has emanated from Marxist and, more recently, postmodern theorists who reject the potential of applied geography to address the major problems confronting people and places. Clearly, it is not enough for applied geographers simply to keep doing applied research; the inherent value of the approach requires that critics are engaged and response to criticism developed. Such a debate is ongoing but the nature and value of applied geography is forcefully advocated by a number of authors (Hansom, 1992; Kenzer, 1989; 1992; Sant, 1982; 1992).

For some, the idea of applied geography or useful research is a chaotic concept which does not fit within the recent 'cultural turn' in social geography or the postmodern theorising of recent years. In order to make explicit the value of an applied approach it is useful to make a comparison with an alternative, postmodern perspective. One of the major achievements of postmodern discourse has been the illumination of the importance of difference in society as part of the theoretical shift from an emphasis of economically-rooted structures of dominance to cultural 'otherness' focusing on the social construction of group identities. However, as Merrifield and Swyngedouw (1996) point out, there is a real danger that the reification of difference may preclude communal efforts in pursuit of goals such as social justice - a theme central to many studies in medical geography. A failure to address the unavoidable real-life question of 'whose is the more important difference among differences' when strategic choices have to be made represents a serious threat to constructing practical solutions. Furthermore, if all viewpoints and expressions of identity are equally valid, it is impossible to evaluate social policy and avoid segregation, discrimination and marginalisation which the postmodern appeal for recognition of difference seeks to counteract. The failure to address real issues suggests that the advent of postmodernism has done little to advance the cause of social justice, thus undermining principles upon which a great deal of medical geography is founded. As Merrifield and Swyngedouw (1996) conclude:

> "intriguing though this stuff may be for critical scholars, it is also intrinsically dangerous in its prospective definition of political action. Decoupling social critique from its political-economic basis is not helpful for dealing with the shifting realities of (urban) life at the threshold of the new millennium"
> (Merrifield and Swyngedouw, 1996 p11).

In terms of real world problems, postmodern thought would lead to inaction while the nature of the issue is considered. A similar criticism may be levelled at the Marxist critique of applied geography which reached a peak during the 1970s and 1980s. The essence of the Marxist critique of applied social research is that it produces ameliorative policies which merely serve to patch up the present system, aid the legitimation of the state, and bolster the forces of capitalism with the inherent tendencies to create inequality. This perspective suggests that participation in policy evaluation and formulation is ineffective since it hinders the achievement of the greater goal of revolutionary social change. However, to ignore the opportunity to improve the quality of life of some people in the short term, in the hope of achieving possibly greater benefit in the longer term, is not commensurate with the implicit problem-oriented approach of applied geography.

Neither does the argument that knowledge is power and a public commodity that can be used for good and evil undermine the strength of applied geography. Any knowledge could be employed in an oppressive and discriminating manner to accentuate inequalities of wealth and power, but this is no argument for eschewing research. On the contrary, it signals a need for greater engagement by applied geographers in the policy-making and implementation process.

Furthermore, access to the expertise and knowledge produced by applied geographical research is not the sole prerogative of the advantaged in society, but can be equally available to pressure groups or local communities seeking a more equitable share of society's resources.

Of course there will continue to be divergent views on the content and value of geographical research. The concept of 'useful research' poses the basic questions of useful for whom?, who decides what is useful?, and based on what criteria? All of these issues formed a central part of the 'relevance debate' in human geography of the early 1970s (Chisholm, 1971; Prince, 1971; Smith, 1971; Dickenson and Clarke, 1972; Berry, 1972). These related questions can be addressed by examining the relationship between pure and applied research.

In human geography, pure research aims to develop new theory and methods that help explain the processes through which the spatial organisation of human environments evolves. In contrast, applied research uses existing geographic theory or techniques to understand and solve specific empirical problems. While this distinction is useful at a general level, it overplays the notion of a dichotomy between pure and applied geography, which are more correctly seen as two sides of the same coin. As Frazier (1982) points out:

> "applied geography uses the principles and methods of pure geography but is different in that it analyses and evaluates real-world action and planning and seeks to implement and manipulate environmental and spatial realities. In the process it contributes to, as well as utilizes, general geography through the revelation of new relationships"
> (Frazier, 1982 p17).

Applied research provides the opportunity to use theories and methods in the ultimate proving ground of the real world, as well as enabling researchers to contribute to the resolution of real worlds problems. In this sense, the applied geographer has a greater interest than the pure researcher in taking the investigation beyond analysis into the realms of application of results and monitoring the effects of proposed strategies. The discussion here of the link between pure and applied research is not to imply the superiority of one form over the other. Rather, it focuses attention on the fundamental question of the use to which the results of geographical research may be put. The applied geographer's interest is therefore with the application of research findings. As Harvey (1984) observed:

> "geography is far too important to be left to generals, politicians, and corporate chiefs. Notions of 'applied' and 'relevant' geography pose questions of objectives and interests served....There is more to geography than the production of knowledge"
> (Harvey, 1984 p7).

In terms of undertaking applied geographical research, Habermas (1974) identified three principal kinds of scientific investigation. The first of these is relevant here: the empirical-analytical scientific investigation in which the goal is to predict the empirical world using the scientific methods of positivism. As previously noted, this type of research has particular relevance to the study of medical geography (Section 1.3). Whilst methodology can be drawn from a large pool in human geography, positivism has continuing value in spatial epidemiology and attempts to model the relationship between inequalities and the location and allocation of health care. The practical value of an applied geographical approach in medical geography, using the empirical methods of positivism, is clear.

1.3.2 Geographical Information Systems and applied geographical research

Geographical Information Systems (GIS) is a relatively new technology but is already developing an impressive history within academic geography (Longley and Clarke, 1995). Developed in Canada during the 1960s, the subsequent technical advances in computer technology have been instrumental in its rise to prominence. Politically, the government enquiry into geographical handling in the mid-1980s, and the subsequent publication of the Chorley Report (DoE, 1987), has created an environment which places GIS central to geographical research agendas. The report recommended greater use of digital cartography, greater investment in research and training (for example the Regional Research Laboratory Initiative - see Masser and Blakemore, 1991) and the setting up of organisations which could take a lead in the collection, analysis and application of geographical information (for example the setting up of the Association of Geographic Information).

In functional terms, GIS offers the geographer a wide-ranging tool box to assist geographical investigation. IT in general, and GIS specifically, are increasingly being used as a research and managerial tool for epidemiological investigation (Sarill et al, 1984; Stringer and Haslett, 1991; Gatrell and Naumann, 1992). In health service analysis use is more limited (Twigg, 1990; Sillince and Frost, 1993) although the potential of GIS for effective planning and delivery of health care has been acknowledged (Gatrell, 1988).

Data storage, retrieval, and display functions underpin many GIS applications (Martin, 1991; Rhind et al, 1991; Landis, 1993). Whilst this is not particularly creative and remains predominantly descriptive, the benefits of maintaining information within a single framework are significant. In human geography GIS has been used as a storage tool in the field of land use, population studies, employment, and housing registers (Parrott and Stutz, 1991; Huxhold, 1991; Dale, 1991). Many health authorities have been quick to realize the potential of GIS to store and retrieve spatial information and collaboration with academia has led to research mapping leukaemia clusters (Openshaw et al, 1987), morbidity (Gatrell, 1988) and spatial variations in health care provision (Brown et al, 1991; see also Dale, 1990; Hirshfield et al, 1991).

The use of data linkage tools is of prime importance in GIS. In linking data, overlay techniques can be used to analyse relationships between one data set and one or more other data sets (for example polygon overlay), often to select locations based on certain criteria (Dangermond, 1983; Cowen et al 1983). Research by Todd et al (1994) illustrates the use of overlay techniques in the location of a new Oncology service. In particular, data relating to morbidity, mortality, population, environment and cancer events were incorporated to assist the selection of suitable sites. The mapping of disease incidence in relation to population type (Wrigley et al, 1988) drew upon data linkage functions, in particular linking health data and geodemographics.

Geocoding of data allows a variety of spatial queries to be implemented. The retrieval of information related to a specific geographical feature can be undertaken by searching data on location criteria (Landis, 1993). Furthermore, complex searches of data sets, in conjunction with data linkage tools, offer a means by which more sophisticated queries can be addressed (for example point-in-polygon analysis). These GIS functions have been used by Brown et al (1990) in interpreting spatial patterns of health-related data and Gatrell and Naumann (1992) in planning hospital location.

Network analysis tools are frequently used in GIS applications, particularly in the realm of transportation and utilities (Gatrell and Vincent, 1990; Badillo, 1993; Peel, 1993; Ward, 1994). Once a network has been modelled, usually in conjunction with other GIS techniques such as buffering and overlay, network operations such as routing and resource allocation can be implemented. Arentze et al (1994) take a network analysis approach in examining the cost of journeys as part of an investigation into accessibility of services (see also Love and Lindquist, 1995; Jones and Bentham, 1995).

GIS also offers significant capabilities for spatial analysis although, in this area, the application of GIS has suffered some criticism. Such concerns have been raised from those who view GIS as being simply a re-invention of quantitative geography, in itself seemingly discredited during the 1970s. For instance, Harvey (1989), in his critique of quantitative modelling in geography, suggests that such methods fail to deliver answers to important research questions. However, comments such as Harvey's have been roundly misinterpreted to imply that quantitative techniques are inherently 'invalid' or that valid realms for quantitative analysis do not exist. In addition, since the use of GIS is, by its very nature, applied it has given rise to criticism of it not being scholarly (see the debate between Openshaw, 1991, 1992 and Taylor and Overton, 1991). Furthermore, to date, GIS has received limited attention in texts discussing major events and paradigms in geography (Johnston, 1991; Cloke et al,

1991) although increasing recognition is beginning to permeate into mainstream geography (Taylor and Johnston, 1995).

In response to criticism, Bennett (1985; see also Wilson, 1989) provides detailed considerations of the relationships between positivism, GIS and quantitative methods and shows that much of this criticism is rooted in preconceived ideas and ignorance of GIS. This criticism tends to emanate from the fact that few applications, to date, progress beyond data storage, retrieval and display or data linkage. However, this in itself does not imply that meaningful spatial analysis or modelling cannot be undertaken using GIS. Critically, GIS has provided the capability for many geographical models and techniques to make the transition from potential applications (Masser and Blakemore, 1991) into a new era of applications-led activity (Fotheringham and Rogerson, 1994; Birkin et al, 1995). The apparent lack of spatial analysis in GIS applications, giving rise to criticism, is therefore more a fault of project definition, coupled with the relatively new nature of GIS (Muller, 1993), rather than a lack of potential. Quantitative geographical techniques can be operationalised through GIS which is enhancing the status of human geography; a remarkable achievement given the significant shifts in fashion over the last 20 years which had led to a dramatic reduction in quantitative geographical modelling.

As this discussion shows, the relationship between GIS technology and applied geographical research is therefore a fundamental one. Any use of GIS is inherently empirical and follows on from traditions expounded during the quantitative revolution in the 1950s, characteristic of early positivism, and the subsequent development of applied approaches. Much empirical based research suggests theory or tests it, both actions being integral to the development process. GIS is seen as a tool that can assist the development and testing of geographical theory through application (Fotheringham and Rogerson, 1994). Thus, despite contemporary criticism of positivism, the increasing use of GIS as a tool in an applied sense to examine geographical patterns and processes has led to a re-emergence of quantitative methodologies. Taylor (1990) states that:

> "It is on this practical terrain that the quantifiers were able to put aside the critiques and win the 1980s. Enter GIS"
> (Taylor, 1990 p211).

Goodchild (1995) also acknowledges that the increasing use of GIS has signalled a resurgence in positivist methodology and argues its value:

> "however strong the case against positivism in the social sciences may be, I also believe that quantification, analysis, numerical models, and related concepts provide us with valuable points of reference...that make debate and intellectual progress possible"
> (Goodchild, in Pickles (ed) 1995 p34-35).

GIS is therefore clearly underpinned by empirical analysis and spatial modelling and, within these limits, there is an opportunity to utilize the power of GIS technology. GIS can facilitate such analyses and may provide insights which would otherwise be missed. Furthermore, it is possible that the representation of data within a GIS could lead to an improved understanding both of the attributes being examined and of the procedures used to examine them. In these terms, Taylor and Johnston (1995) have acknowledged the value of an applied geographical approach, and the opportunity which GIS affords:

> "The proponents of GIS combine the early technical concerns of quantifiers with the latter social, economic, and political concerns of those who advocate applied geography. Hence, although they derive their positions from trends set in motion by the quantitative revolution, as a major tendency in contemporary geography GIS practitioners constitute a new grouping of ideas. They are strictly applied quantitative geographers"
> (Taylor and Johnston, in Pickles (ed), 1995 p54).

What is clear from criticism is that there is an increasing demand for systems that 'do something' other than display and organize data (Fotheringham and Rogerson, 1994) and the analytical functionality of GIS is rarely utilised (Gatrell, 1988). It is necessary for an applied approach to analyse data and produce 'solutions' which are, at least, 'better' than the present situation in terms of efficiency, cost-minimization or utilitymaximization. Fotheringham and Rogerson (1994) summarise the use of GIS technology stating that:

> "The next decade should see a surge in interest in spatial analysis within geography and other academic disciplines, as well as in the private sector...It is perhaps fair to say that we have to this point spent a large amount of time 'reinventing the wheel', that is, getting methods that are already operational running in a GIS environment. It is now time, and the future seems promising, to go beyond this to use the capabilities of GIS to enhance models and methods and to make them more efficient"
> (Fotheringham and Rogerson, 1994 p9).

In health care terms, Wrigley (1988) recognised the reservoir of NHS data which is massively under-utilized and rarely linked to other national data. For example, little use is made of the postcode data which is attached to secondary care NHS records. GIS is seen as a route to unlock data and provide health care planning and analysis with more appropriate information from which to develop effective strategies. Moreso, Wrigley (1991) sees an increasing need for GIS in the new market-based system of the NHS with GIS 'becoming a major IT tool of the demand or "purchaser" side of the internal health care market in the U.K.' (Wrigley, 1991 p7; see also van Oers, 1993).

1.3.3 Linking modelling and GIS

The approach taken within this research is firmly based in the relationship between positivism, GIS, quantitative methods and applied approaches to research as the previous sections have identified. It is clear, though, that there has been a dearth of research which implements methods of spatial analysis, in particular modelling, with GIS in a truly applied sense. As such, GIS only serves a limited number of potential requirements. In this section, links between modelling and GIS are outlined to show how the resulting application can be enhanced to provide a more effective and powerful application.

A drawback of many proprietary GIS is that they do not offer full spatial analytical functionality. This is, perhaps, one reason why so few applications have extended beyond descriptive analysis (Section 1.3.2). The development of GIS based models usually involves the creation of models outside of GIS and then the application of GIS techniques as required. Some GIS software (for example Arc/Info) does offer the user a tool box capable of supporting some spatial interaction and location-allocation models in its network analysis and spatial analyst modules. However, the user is often limited to routines and algorithms pre-programmed in the software and, as such, an alternative route to modelling is still more effectively achieved by development outside of GIS. Whilst this is undoubtedly a drawback of current GIS software, data transfer between the modelling environment and GIS is seamless. In this way, model outputs can be transferred between the modelling environment and GIS, for mapping, data query, data linkage, network analysis etc.

One of the fundamental functions of both GIS and models is to provide a framework in which data can be manipulated and transformed. Where information is not immediately available in the form that is required it is often necessary to manipulate two or more items of data into a useable form. For instance, data on population and service characteristics can be manipulated to examine the relationship between service supply and utilization. In so doing, data are transformed by means of modelling to create outcomes more appropriate to health care planning. Such model-based data transformation is of immediate benefit to health care planning and analysis: it allows data to be manipulated in new ways, gives new insights into data, and provides a basis for the implementation of further modelling and/or GIS techniques.

Section 1.3.2 has already discussed the potential for GIS to combine different data sets through overlay techniques. This is of particular utility given the variation in levels of spatial resolution, aggregation and classification which is characteristic of geographical data. Many data sets are not collected at a suitable spatial disaggregation, or have missing components. Integrating such data with other data sets, using GIS techniques, can help to model and estimate missing information. Furthermore, data linkage GIS techniques may be applied to model outcomes to assist interpretation.

Perhaps the principal function of a model is in its ability to forecast or predict future events. The examination of future change, particularly in terms of health and health care, is crucial. It is important to be able to determine changes in the structure of population, and subsequent changes in patterns of need or ill-health, and the nature of change required of health care to maintain an appropriate service. Any such forecasting, even if it is only trend extrapolation, must be model-based. Furthermore, an extension of the principle of forecasting is in assessing the impact of change. The use of 'what if' simulations to model the effects of change is clearly beneficial. For instance, the location of a new health care centre is a large capital investment and it is important to locate it appropriately. Using appropriate inputs, suitable site location and the potential impact upon the population can be modelled within a GIS through the techniques of buffering and overlay.

Optimisation methods such as location-allocation modelling seek to determine the most appropriate solution to a problem. Clearly, GIS can assist in the identification of optimal sites through its query functions. However, current GIS do not offer a wide range of solutions to optimisation modelling scenarios. Links between modelling and GIS are thus invaluable in order that appropriate models are designed, constructed and applied drawing upon GIS techniques as necessary.

1.4 RESEARCH AIMS

This research emanates from the geographical concerns raised by organisational change in the NHS (Section 1.2). Consequently, it contributes to the resurgence in medical geography and the current debate relating to health and health care inequalities (Section 1.3).

The research develops, creates and applies a model of health care utilization for primary care GP services capable of assisting improved health care planning and analysis. It takes an applied approach to geographical research (Section 1.3.1) and builds the model within a GIS framework (Section 1.3.2). In so doing it addresses inequalities in need, accessibility and provision of primary health care services and the extent to which current supply reflects patterns of disadvantage through the examination of a case study. Furthermore, it extends the use of GIS from data storage, query and linkage into spatial analysis (Section 1.3.2 and 1.3.3) to support construction and application of the model of utilization.

In summary the research aims are:

- to design a flexible, portable, predictive model of health care utilization for GP services;
- to validate the conceptual components of the model through a survey of patient utilization;
- to construct the model within a GIS framework to provide a powerful analytical system;
- to derive a number of useful model outcomes;
- to test the sensitivity of the model for conceptual and technical robustness;
- to investigate the potential for simplifying the model or making use of alternative data;
- to illustrate and critically evaluate the application of the model through a series of 'what if' scenarios; and
- to evaluate the potential for applying the model of GP utilization as a decision support tool in comparison with current methods of health care planning and analysis.

1.5 STRUCTURE OF THE THESIS

This chapter has provided an overview of organisational change in the British NHS and identified a need for improved information to assist decision-making in health care planning health and analysis. It has outlined relevant geographical research and identified an appropriate conceptual and methodological background. It has also put forward the aims of this research. The rest of this thesis is organised as follows.

In Chapter Two, the concepts of utilization are examined with particular emphasis on primary health care and GP provision. Attention is drawn to the theoretical and practical methods of addressing health care inequalities, and differential utilization, implemented in the NHS through planning and policy. A review of previous models of utilization provides a platform from which to determine the components of the utilization process. Specifically, this entails a discussion of the components of need, accessibility and provision.

Chapter Three explores the conceptual development of the model of GP utilization. It builds upon the previous discussion of modelling utilization (Chapter Two) and reviews how components can be measured and related to the overall process.

The aims and research design of a survey of patient utilization are discussed in Chapter Four. The design of the structured questionnaire, sampling, piloting and distribution in the case study area are addressed in the light of specific ethical and logistical considerations and the survey response is analysed.

An in-depth analysis of the survey results is presented in Chapter Five. In particular, the influence of patients' socio-economic, material and locational status is examined in relation to their effect on utilization in the case study area.

In Chapter Six, the construction of the model of utilization is undertaken. Initial consideration is given to the design criteria and a framework model is developed. Alternative methods of constructing a model are formulated and a suitable method determined. Measures of need, accessibility and provision are then determined using the results of the patient survey (Chapter Five) to validate and inform the conceptual discussion of components of utilization (Chapters Two and Three). Useful model outcomes are subsequently calculated and presented for the case study area.

The first stage of model testing, a sensitivity analysis of the model of utilization, is undertaken in Chapter Seven. This examines stability, robustness and any gross redundancy of data in the model involving the use of correlation and multiple regression analysis. Furthermore, the extent to which the model may be simplified is explored.

Chapter Eight presents the second stage of model testing and compares results from the model of utilization against current methods of determining and measuring inequalities, such as alternative methods of measuring disadvantage.

Chapter Nine illustrates and critically evaluates the application of the model, in the case study area, to health care planning and analysis through a series of 'what if' scenarios. In particular the model is used, along with GIS techniques of spatial analysis, to examine individual GP catchment areas, methods of financial allocation, and the combination of model outcomes with other useful data sets. It then explores the potential impact of closing a GP surgery, alternative methods of locating a new GP surgery, and the impact of a population increase.

A summary of the research and conclusions are offered in Chapter Ten. In particular, the focus is on the benefits that can accrue when modelling and GIS are linked as part of an applied approach to geographical research and the potential for applying the model in contemporary health care planning and analysis. Chapter Ten also discusses emergent issues and suggests how these may be addressed as part of future geographical research agendas.

2 THE SCOPE OF HEALTH CARE UTILIZATION

2.1 INTRODUCTION

As Stimson (1981) and Whitelegg (1982) have emphasised, the concepts of utilization and associated accessibility are at the heart of health care provision and uptake (see also Joseph and Phillips, 1984; Jones and Moon, 1987). Accessibility can be defined in two ways: physical accessibility and socio-economic accessibility (Joseph and Phillips, 1984). Physical accessibility is the relationship between the location of the person in need and the point of service delivery, particularly in the means of reaching it (Moseley, 1979). Socio-economic accessibility is the extent to which obstacles are created by factors such as the effect of an individual's material circumstance or organisational restriction. Utilization is the overall relationship between social and spatial differences in health care needs, components of accessibility and the availability of services:

> "The proof of access is use of service, not simply the presence of a facility. Access can, accordingly, be measured by the level of use in relation to need"
> (Donabedian, 1973 p211).

Numerous studies have undertaken patient surveys in order to analyse utilization and accessibility (Phillips 1980, Williams et al 1980, Ritchie et al 1981, Haynes and Bentham 1982). Models of utilization and conceptual frameworks for the study of access to health care provision have also been proposed (Andersen and Newman 1973, Aday and Andersen 1974, Stimson 1981, Taket 1989). Many of these studies focus on accessibility; only more rarely do they give detailed attention to issues of utilization, and questions of how to match health care provision to demand.

As these authors agree, to study the spatial aspects of accessibility independently from other aspects of society is not possible. Dicken and Lloyd (1981) point out that the role of geographical location in the determination of health should always be set within the broad context of the social, economic and political forces operating in society. The fact that a service is available does not guarantee its use. By the same token, equal amounts of health care do not guarantee a population of uniformly healthy individuals (Joseph and Phillips, 1984), and whilst the demand for a service is by individuals, who are dispersed across geographical space and differ in their mobility and other characteristics, the service is available at fixed locations (Pinch, 1985). Disparities in utilization thus tend to occur since there can never be a situation of uniform availability and uninterrupted potential access for every individual, who articulates a need, in a population.

In addressing these issues, and identifying the scope of utilization, this chapter falls into two main parts. Firstly, it discusses the concept of health care inequalities in the NHS and methods used to address these through planning and policy. Components of utilization are identified and, in particular, the review highlights the complexity of utilization when these are introduced as a formal part of health care policy. The second part examines previous attempts to measure and model utilization, identifying both commonality and variation in approach to research and application.

2.2 UTILIZATION, HEALTH CARE INEQUALITY AND PLANNING AND POLICY IN THE NHS

The issue of equity of provision of health care services is central to the basic tenets of the NHS, in line with its welfarist orientation, although it has been widely recognised that this has never adequately been achieved through any of the previous health service structures (Section 1.2). In order to achieve effective utilization of health care, appropriate spatial planning and policy initiatives are required. Such initiatives have developed alongside organisational changes in the NHS, in an attempt to redress problems of inequality in need and accessibility.

The recognition that utilization is more than just a function of service location has been increasing over a number of years. Spatial differentiation in use of health care services is not simply explained through the presence or absence of a reasonably local GP: there are wider social, demographic and environmental factors which play a significant part, at different scales. A range of initiatives has been implemented, including offering incentives to GPs to direct them to particular areas, the use of location-allocation modelling techniques and facility impact studies. Two particular initiatives are worthy of special note, in view of their widespread implementation: those designed to direct allocation of financial resources to areas of need and the calculation of area workload assessment.

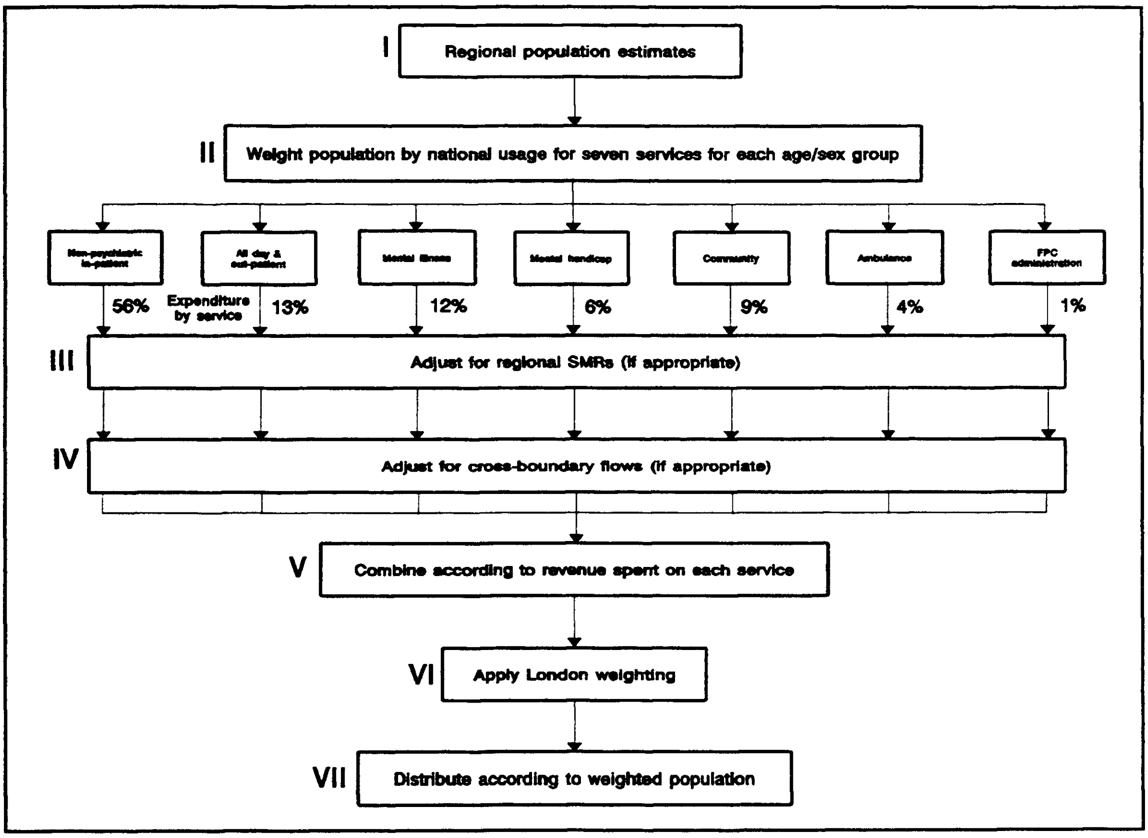
Recognition of inequalities between need and provision in the NHS was a prime consideration in the setting up of the Resource Allocation Working Party (RAWP) in 1975. This initiative provides a classic example of the attempts to address spatial differentiation of need with the aim:

> "to review the arrangements for distributing NHS capital and revenue to RHAs, AHAs and Districts respectively with a view to establishing a method of securing as soon as practicable a pattern of distribution responsive objectively, equitably and efficiently to relative need" (DHSS, 1976 p5).

The methodology for assessing differential need, at a RHA level, as a basis for deciding appropriate levels of funding is summarised in Figure 2.1. This was operationalised through the creation of the 'RAWP formula', a measure taken as indicative of need. Crucially, in determining the formula, the Working Party acknowledged that the administrative structure alone would not provide a solution and that an explicit consideration of need of the population was required. The intention was to re-allocate funds appropriately rather than maintain the simple incremental system of distributing financial resources based on the previous year plus a percentage increase for population growth. The formula used a 'revenue target', to inform the re-allocation of funds from those RHAs defined as over-funded to those which were under-funded in relation to need.

Whilst the use of the RAWP formula was designed to examine differential need it was not without its criticisms (Geary, 1977; Knox, 1978; Palmer et al, 1979). In summary, these were that:

Figure 2.1 Resource Allocation Working Party (RAWP) process (after Jones and Moon, 1987 p277)



- the formula did not allow for a levelling of the under-funded regions to the standards of the over-funded regions; rather it ensured that all regions were brought together at a medium standard. Whilst this was an obvious improvement for some regions, it worked to the dis-benefit of others;

- the use of mortality information rather than morbidity (due to the structural difficulties inherent in deriving suitable morbidity data) as a measure of need is not entirely appropriate since illness generates a much greater burden on health services than death. Knox (1978) suggests that the use of morbidity data would probably have yielded different results and, consequently, a different resource allocation;

- the use of the Standardised Mortality Ratio (SMR) as a measure of mortality may, in itself, have biased the calculation and other indices of mortality may have significantly altered the outcome;

- the regional basis for calculation ignored the large variations in expenditure within regions (although each region subsequently employed similar techniques to address local issues); and

- the measure was ill-founded since it attributed the outcome of good health to the increased allocation of finance to hospital-based medical care. In doing so it did not consider primary health care services or the social basis to inequalities in health.

Jarman (1983, 1984) proposed a different method of addressing inequalities through the creation of his Underprivileged Area (UPA) score. The method was designed to determine GP workloads (and, by proxy, a measure of differential need) through a consideration of the social and economic status of local populations. The method made extensive use of decennial census data based on the principle that social and demographic factors were likely to lead to differential health needs and therefore differential rates of utilization. A survey of a sample of GPs was used to identify the socio-economic variables which needed to be considered, and to suggest appropriate weights. The final index illustrated the inequality of GP working environments, and provided a basis for modelling spatial differentiation in need for health care planning purposes.

The Jarman UPA score undoubtedly addressed some of the criticisms of the RAWP formula by focusing attention on primary health care services, by being more sensitive to local variation and by incorporating social and demographic variables. Nevertheless, this approach, too, has attracted criticisms. Carr-Hill and Sheldon (1991) and Davey Smith (1991), for example, argue that:

- the choice of variables will have a clear impact in determining the final score, possibly to the exclusion of other factors not included;

- the process of determining indices and their outcome is static and cannot be used to determine future needs;

- through necessity, the indices make use of out of date census data and are therefore debatable in their application;

- the indices are biased towards London, since this was the site of the GP workload survey, and away from the North of England, which may result in doubtful interpolations of workload to other parts of the country; and

- considerable heterogeneity of social and economic circumstances occur within the areas defined for the index calculation, the so-called 'ecological fallacy'.

However, as Jones and Moon (1987, p289) state, 'the calculation and use of indices has a considerable pedigree, particularly in geography' and there has been no shortage of similar attempts to produce indices of disadvantage and social deprivation as proxies for measuring levels of ill-health in a population to assist policy making (for example, DoE, 1983: Indicators of Urban Deprivation; Carstairs and Morris, 1989a, 1989b: Carstairs Index; Townsend et al, 1988: Townsend Index; Balarajan et al, 1993: Deprivation and GP workload indices; DoE, 1995: 1991 Deprivation Index). Each different index addresses essentially the same ideals yet includes different indicators (Table 2.1).

In response to the criticisms levelled at the Jarman UPA score, several authors have explored the effect of choice of indicator (Thunhurst, 1985; Townsend et al, 1986; Morris and Carstairs, 1991; Townsend et al, 1992). Morris and Carstairs (1991) note, however, that there is a high degree of inter-correlation between the alternative measures they review, implying that the differences in outcome, depending on which index is used, are not as great as criticism had suggested.

Table. 2.1 Range of variables in five alternative measures of deprivation (after Morris and Carstairs, 1991 p318&320)

	SCOTDEP	JAR	TOWN	DoE	SDD
Unemployment	✓	✓	✓	✓	✓
youth unemployment					✓
No car	✓		✓		
Low social class	✓				
unskilled		✓			✓
Overcrowding	✓	✓	✓	✓	
below occupancy norm					✓
Not owner-occupied			✓		
Lacking amenities				✓	✓
Single parent		✓		✓	✓
Under age 5		✓			
Elderly households					✓
Lone pensioners		✓		✓	
1-year migrants		✓			
Ethnic minorities		✓		✓	
Vacant dwellings				✓	
Level and access (old)				✓	
Level and access (<5)				✓	
Permanent sickness				✓	
Large households				✓	

SCOTDEP: developed by Carstairs and Morris for the analysis of Scottish health data.
TOWN: as used by Townsend et al in an analysis for the Northern Region.
JAR: Jarman developed this measure in relation to need for primary care services.
DoE: Department of Environment measure developed mainly in relation to urban policies.
SDD: Scottish Development Department measure developed mainly in relation to urban policies.

Other refinements have also been suggested in an attempt to improve these indices, including the use of more sophisticated statistical techniques, the use of further surveys to assess the validity of the method or the discounting of certain measures from composite indices and measuring them separately (DoE, 1995). However, despite continuing debate about the relative merits of each index, and the variables they use, there is widespread recognition that they provide valuable tools in examining inequalities in health, accessibility and utilization, for health analysis, policy and planning.

2.2.1 Health care demand and allocation in the 'internal market'

Despite the changes which have been introduced in the organisational structure of the NHS in recent years, there is little to suggest that organisation alone is able to address the social, economic and environmental variables which Jarman, and others, agree have an impact on utilization of health care services.

One of the main issues relating to the emergence of the purchaser-driven 'internal market' in the NHS is that health care allocation will become based more on demand for the service, rather than the underlying needs of the population. Services will be purchased to meet demand rather than provided to meet a postulated need. Additionally, health service planning was controlled at a regional level under the old NHS and merely administered locally by the DHAs. This, at least, maintained some form of territorial social justice in that equal access to health care for all was a main priority. Even so, as the Black Report (DHSS, 1980) indicated, access was far from equal under this system. Under the current system, the fragmentation of the planning function has shifted the balance to a significant extent, as Holliday (1992) has argued. Firstly, there has been a change from a service which was regulated centrally to one where GP fundholders have far greater decision-making power, creating the illusion, at least, of a disunified service. Secondly, GP fundholders have licence to implement innovations and thus to change their service according to their own perceptions of need or advantage. Together, these new freedoms are likely to create a more diverse service. In principle this should enable GPs to better match service to local need. In practice, without a common approach to needs assessment and priority-setting, the changes are likely to increase inequalities in service provision and availability.

2.3 MODELLING HEALTH CARE UTILIZATION

As the preceding discussion has indicated the principle of social justice is one on which the NHS was founded. Under the new NHS, however, there is an apparent shift from an emphasis on equality to a focus on increased choice and autonomy. The issue of rationing of health care services was evident throughout the old NHS, in which strategic decisions were taken based on 'professional judgment' but with the goal of addressing financial constraints. Admittedly, this did not wholly remove inequalities, either in terms of the quality or of the relative amount of the service provided to various populations. The recent changes in NHS structures, however, are unlikely to improve the situation. Indeed, increased consumerism, coupled with a more financially accountable NHS at a devolved level, could simply exacerbate these inequalities. The ability to identify and measure inequalities, and determine their effect on utilization is, therefore, of even greater importance than previously, not least to help inform the decisions of individual service providers. Central to this process is the use of modelling techniques.

This section outlines the broad approaches to modelling in human geography building upon the previous discussion of the utility of modelling as part of an applied approach to geographical research (Section 1.3). As such, it then examines previous attempts to model utilization.

2.3.1 Modelling in human geography

Modelling has long been a technique used in human geography to represent spatial processes, drawing upon quantification as a method of constructing statistical and mathematical models. Haggett et al, (1977 p18-19) provides a three-fold taxonomy of modelling and its inherent value:

1. Its inevitability. Models are theories, laws, equations or hunches which state our beliefs about the universe we think and see and so we cannot avoid them.
2. Its efficiency. Model-building is economical because it enables the

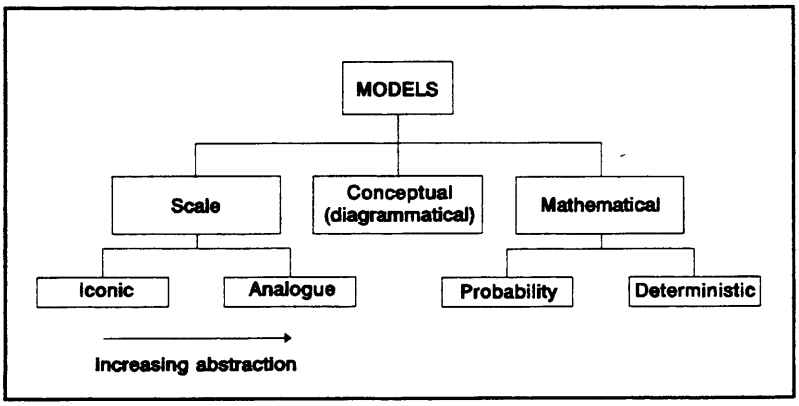
development of generalised information in a highly compressed form.

3. Its stimulus. Models may 'over-generalise' but in so doing they highlight areas where 'improvement' is necessary.

Haines-Young and Petch (1986 p145) define modelling as 'any rule that generates outputs from inputs', or, 'any device or mechanism which generates a prediction' (ibid, p144). As such, a model is not, as Haggett et al (1977) suggested, a theory, law or hypothesis, but a device or mechanism constructed with respect to a theoretical basis. Models can subsequently be used to test the theories on which they are based or to make useful predictions about the concepts which they examine. In human geography, models have tended to be used to interpret a particular scenario by measuring variables and determining parameters in a mathematical form. In so doing they are used as predictive tools for given conditions. However, it is worth noting that the predictive capability of any model is firmly based in the accuracy of the underpinning theories and concepts.

Models are, therefore, 'simplified representations of reality in which a complex state of affairs is reduced to something more simple but containing key characteristics' (Robinson, 1998 p190). Such characteristics are normally summaries of phenomena and are part of a generalisation of the concepts modelled. A great deal of variation in models exists and, as such, models can take different forms (Figure 2.2).

Figure 2.2 Different forms of model
(after Thomas and Huggett, 1980 p4)



In their simplest form, models can be used to represent a change in the scale of abstraction. These can be either iconic (simply smaller versions of reality), or analogue, where reduction in size is accompanied by a change of properties. In geography, the map is an analogue model of reality representing, at a reduced scale, spatial characteristics but incorporating necessary generalisation, simplification and symbolisation.

A greater degree of generality occurs in conceptual modelling. Here, the focus is on the relationship between components of the model often as a basis for diagrammatic conceptualisation of the system of interest. Examples of their application in human geography include the portrayal of movement of produce to consumer (Robinson, 1988) and the development of causal interaction models in spatial epidemiology (Armstrong, 1980; Dorn 1980; Jones and Moon, 1987). Conceptual models are often used as a step to the creation of a mathematical model.

Mathematical models represent concepts as formulae or equations, the nature of which incorporates measurement of the model's components and translates them into new information. Woods (1979), for example, made use of mathematical models in a demographic analysis of population structure and change to determine an expected population size, given geometrical growth.

Mathematical models can be subdivided into two main types: deterministic and probabilistic models. Deterministic models are based on the concept of prediction by measuring observed relationships between components, determined primarily through a process of normative assumption. Such a model generally allows comparison of a predicted optimum outcome against reality. Such spatial interaction models have commonly been employed to allocate goods to markets and people to places (for example Hay, 1979) and location-allocation models in the use of recreational services (Wagner and Falkson, 1975).

Probability models also take a mathematical form but, rather than using observed relationships between model components on which to base formulae, probabilities are used instead. The development and application of these types of model in human geography has been more recent and includes a range of methods including microsimulation (Clarke and Holm, 1987), methods based on artificial intelligence concepts such as neural networks (Openshaw, 1992), fractal models (Batty and Longley, 1994) and the theories of 'competing destinations' (Fotheringham, 1983; 1986).

Despite the conceptual differences between deterministic and probalistic modelling, their purpose remains essentially the same: to develop an improved understanding of geographical issues through the transformation of processes into a mathematical structure.

2.3.2 Modelling the concept of utilization

Research into the various components of utilization is diverse and comes from many different disciplines. The central themes in a study of utilization are, inevitably, inequality in need and accessibility in relation to provision of medical facilities. There is, however, a danger in attempting to develop an all-encompassing model of health service utilization (Penchansky, 1976). As mentioned earlier, service utilization is a complex process which depends upon a range of factors. As such, most previous research has tended to focus on modelling specific aspects of utilization, rather than examining the concept more holistically.

Rosenstock (1966) was one of the first to propose a conceptual model capable of identifying different components of utilization. He highlights psychological and motivational determinants of health service utilization and argues that emotional rather than cognitive 'beliefs' of an individual are an essential part of understanding utilization. Individuals will be likely to use a service if they believe themselves to be susceptible to a certain illness. However, the action of seeking health care must not be more troublesome and disturbing than the illness itself, and Rosenstock argues that once the psychological state is achieved a 'cue' may trigger action. He also accepts that barriers to effective accessibility such as distance, inconvenience and cost may act as a deterrent and reduce utilization even though a psychological readiness to use a health care service exists.

The model developed by Suchman (1964; 1965a; 1965b; 1966) highlights the socio-cultural and environmental determinants of utilization and, specifically, the social network of family and friends within which an individual finds him or her self. Suchman sees the level of health knowledge of these people as being vital in influencing utilization, and recognises that this will vary amongst different socio-economic, ethnic and minority groups. In doing so, he extends the scope of utilization to include group-based and societal forces which act to influence behaviour.

The Anderson model (1968) referred to as the 'life-cycle determinants' model, focuses on the conditions which affect the level of service use. Factors which predispose towards utilization include family composition (age, sex, size and marital status), social structure (occupation, social class, education, ethnicity), and health beliefs relating to attitudes towards physicians, health care and disease. Other factors have an enabling role - for example family resources (income, savings, insurance and access to a regular source of care) and whether the local community has appropriate resources (local service provision). Viewed together, these factors would enable or hinder utilization depending on predisposition and the balance of enabling or constraining influences. Notably, however, Anderson's model neglects to incorporate physical accessibility. Factors such as proximity, transport availability and mobility are omitted, thereby limiting the model to a measure of potential rather than actual utilization.

Also in 1968, Andersen and colleagues proposed a model of access to medical care (published later in Aday and Andersen, 1975). In it, they hypothesised that three sets of factors exist related to an individual's decision to seek and use health care services: predisposing factors which existed prior to ill-health, enabling factors which related to the individual's ability to make use of health care, and need for health care. The model clearly focused on the characteristics of individual behaviour, these being seen as central to the process of utilization. The model was designed to be able to identify factors which could be improved in order to enhance the opportunity of an individual's ability to utilize health care (see also Andersen and Newman, 1973).

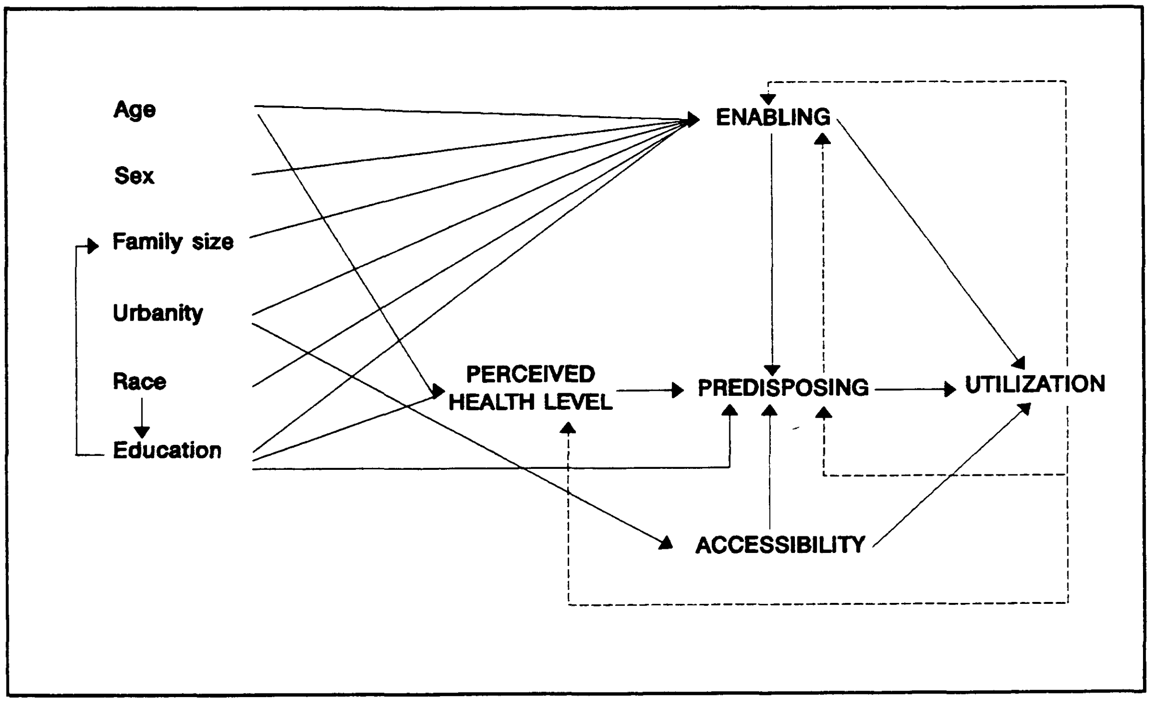
Whilst this conceptual model made a valuable contribution to the understanding of factors which affect individuals, it required substantial development to incorporate components of health care delivery. The re-worked model, commonly referred to as the Framework for the Study of Access (Aday and Andersen, 1974), also moved the theoretical focus from the individual to populations. Aggregate measures of age, sex, race, and attitude towards illness were included along with enabling characteristics of personal income and mobility. Furthermore, the previous conceptual framework was developed empirically in order that the model would measure access and utilization. The model essentially provided two outcomes. Firstly, potential access for a population measured the variables which created a demand for health care and, secondly, realized access measured these against the actual use of services. However, Penchansky (1976; 1977) was critical of the model and pointed out that the definition of access was too narrow and that other factors, such as availability of service, housing tenure, and affordability of care showed greater correlation with use of service. Furthermore, the Aday and Andersen (1974) model was considered somewhat of a failure when it was subsequently critically evaluated through application (Shortell et al, 1984; Patrick et al, 1988).

Penchansky and Thomas (1981) subsequently developed their own empirical model of access. They included a measure of inequality in the availability of resources and, in measuring accessibility, indices were based on distance and travel time, perceived distance, and opportunity costs. Despite the apparent improvements, Ricketts et al (1994) note that this model failed to gain as much recognition as Aday and Andersen's (1974) model since it was never conclusively tested.

In a British context, Ingram (1970) also recognised some of the omissions from Aday and Andersen's (1974) model and concentrated on measuring accessibility in terms of the physical determinants of an individual's access. Haynes and Bentham (1979) developed a model of accessibility to community hospitals in East Anglia, England, as part of research into the effects of changes in the distribution of facilities. Robertson (1974) also emphasised the physical components of utilization in modelling optimum locations for facilities based on accessibility in terms of road distances and population data.

The Gross model (1972) addresses some of the weaknesses in the early models by presenting a much more holistic approach to modelling utilization; in particular it includes physical accessibility components. Crucially, in the context of this research, it was one of the first attempts to present a conceptual framework diagrammatically and a formula for the calculation of a deterministic model (Figure 2.3). However, in doing so it creates a conceptual framework which is difficult to apply in practice due to its demanding data requirements and the problems in quantifying many of the inter-relationships involved. The model has also been criticised since it is static, whilst the variables it attempts to describe are, in fact, dynamic (Veeder, 1975; Joseph and Phillips, 1984). Nevertheless, change over time could be monitored by implementing the model at appropriate time intervals.

Figure 2.3 The Gross model of health care utilization (after Gross, 1972)



The model can be expressed as an equation, as follows:

$$U = \int [E;P;A;H;X] + e$$

where
- U = Utilization.
- E = Enabling factors, such as family size, occupation, education and income.
- P = Predisposing factors, such as attitudes of the individual towards health care, health services and physicians; health behaviour and knowledge of the existence of services.
- A = Accessibility factors, such as distance and/or time of individual from facility, appointment delay, waiting times, availability of services and regular source of care.
- H = Perceived health level, of the individual or the family
- X = Individual and areal variables, such as age, sex, family size, race, education and location.
- e = residual error term.

Limitations of the early models were also identified by Veeder (1975), who examined health service utilization models in detail and saw the need for a more integrated approach to modelling, especially if the models were to inform decision-making. He argued that:

> "The greater the predictive power concerning consumer use patterns, the more efficient will be the planning of urban services and the more effective will be their delivery"
> (Veeder, 1975 p101).

The use of spatial interaction modelling, sometimes referred to as spatial allocation modelling, would seem to offer scope in this respect. These models focus on aggregates and groups of the population to analyse the flow of goods and services, seeking to ascertain the optimal pattern of interaction given a number of suppliers of that good and a number of market or demand points (Robinson, 1998). Much of the impetus for using these models has come from the work of Mayhew and Leonardi (1982). They described the complex interaction of population groups and resource-allocation in terms of the concepts of equity, efficiency and accessibility and the way in which they can be optimised in a practical approach to planning of health service resources. More recently, Taket (1989) used spatial allocation modelling to provide information on options for future provision of in-patient hospital facilities. The analysis incorporated both physical components and socio-demographic data to classify population types in different parts of a region, in terms of their relative ease of geographical access to facilities.

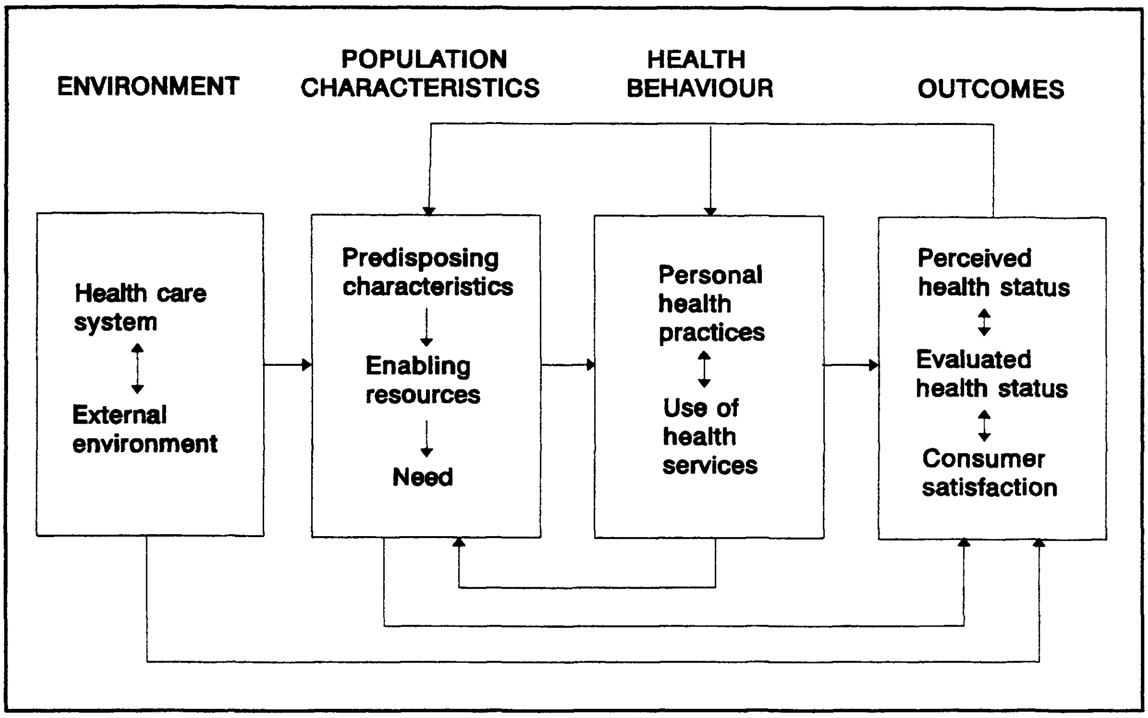
Thomas (1992) reviewed a range of different approaches to the modelling of health care delivery and highlighted trends in model design (see also Veeder, 1975; Joseph and Phillips, 1984). He contrasts the approach of econometricians in proposing models which tackle the equilibrium between a patient's utility for health care and the profit maximising behaviour of providers, with geographers who tend to place greater emphasis on spatial statistical relationships in patients' use of health care services.

This discussion has presented a, broadly chronological, summary of the concepts upon which models of utilization have been formulated and some of the critical review of such work. In the context of this research, however, a further model is worthy of particular consideration. Andersen (1995) has, recently, re-considered his earlier work (including his involvement in developing the Aday and Andersen (1974) model) and provided a further model which draws together both his, and others, research into a comprehensive conceptual framework. The Andersen (1995) model is thus outlined below.

2.3.3 The Andersen (1995) model

Andersen (1995) provides an updated definition of what he sees as an emerging behavioural model of health care utilization. This new model provides a rare attempt at synthesising the disparate components of utilization (Figure 2.4) with the purpose of bringing together research into a single conceptual framework. The model combines both a behavioural and welfare approach, in common with the majority of utilization research, and emphasises the role of individuals and societal groups in the utilization process. However, it also incorporates a detailed consideration of structural components in summarising the concepts related to health care provision.

Figure 2.4 An emerging behavioural model of health care utilization (Andersen, 1995 p8)



The major components in Andersen's model relate to environment, population, health behaviour and health outcomes. These four sub-models each consider specific components of health service utilization. Andersen (1995) suggests that each sub-model encompasses a number of indicators, which in turn relate to a number of variables.

The environment sub-model examines the environment within which individuals are constrained, and over which they have no direct control (Table 2.2). Key components are the health care system and external environment.

The policies of a health care system, in terms of organisation and spatial partitioning, lead to provision of services, and determine the location and allocation of the resource. The organisation of the resource is also critical, since the availability of a local GP surgery, for example, does not necessarily imply effective accessibility and must be considered in relation to the organisation of the services they offer, such as the timing and extent of consultation hours.

Table 2.2 The environment sub-model
(after Andersen, 1995)

SUB-MODEL	INDICATORS	VARIABLES
Environment	Health care system	Policy
		Resources
		Organisation
	External environment	Physical
		Political
		Economic

The external environment compares relevant aspects of an individual's physical, political and economic circumstance. The physical variable is a measure of proximity of an individual to the resource. The political variable relates to the underlying ideological structure of society but only becomes important when comparing areas with different political structures, which thereby leads to differences in provision or access (e.g. in international comparisons). The economic variable relates to the economic policy providing funding for health care services, and again is relevant mainly in international comparisons.

The population sub-model defines the characteristics of the population being investigated. It models predisposing and enabling characteristics which influence ability to utilise a service, as well as providing a measure of need for that service (Table 2.3).

Important predisposing characteristics are demographic variables such as age and gender which act to determine an individual's biological need for health care. Social factors (such as ethnicity and occupation) are seen to influence an individual's ability to react to this need, and to call upon the resources they require. Health beliefs variables consider the attitudes and values which people attach to issues pertaining to their health and the services available to them. They may influence their perceived need for health care and the expression of this need through utilization. Levels of education are calculated to influence an individual's awareness about their health care needs and the availability of the health care services.

Table 2.3 The population sub-model
(after Andersen, 1995)

SUB-MODEL	INDICATORS	VARIABLES
Population	Predisposing characteristics	Demographic
		Social
		Health beliefs
		Education
	Enabling resources	Personal
		Community
	Need	Perception of need
		Evaluated need

Enabling (or disenabling) resources are defined on the principle that certain personal resources create differential potential utilization of health care. Individuals must have suitable means to get to the services at their point of supply in order to be able to make use of them. Enabling variables thus include income and means of travel (either by private care or public transport). A key factor in this sub-model is the relationship between predisposing characteristics and relative exposure to enabling characteristics. Andersen's (1995) community based variables indicate that services must be available close to where people live and work in order that they can be utilised. This is true, but it can be argued that their inclusion in this part of the model may lead to double-counting since measures of resource location and allocation are also considered in the environment sub-model. Perhaps more justifiable here is the incorporation of other community services such as the provision of public transport in general.

Any model of health service utilization must consider an assessment of need since this clearly determines the underlying demand for access. Andersen suggests the way in which individuals view their own health and the expression of this view via seeking professional help is closely related to predisposing characteristics. It is these which may shape the way in which an individual assesses the severity of any illness and translates this into an expressed need for health care. Need is not only a function of an individual's predisposing and enabling characteristics, however; it is also dependent on what might be termed perceived need and evaluated need.

Perceived need relates to an individual's perception of their own health. One drawback of including this in any model, of course, is that diagnosis of one's own health will, at best, be subject to very limited medical knowledge. In practical terms, also, this type of information is not readily available and can normally only be obtained through purpose-designed studies. Evaluated need represents a professionally determined judgement of an individual's health and their need for health care, for example by a GP or specialist.

The health behaviour sub-model characterises behaviours considered to influence use of health services (Table 2.4). Key components are personal health practices (e.g. diet, exercise) and use of available health services (e.g. site, purpose, type).

Table 2.4 The health behaviour sub-model
(after Andersen, 1995)

SUB-MODEL	INDICATORS	VARIABLES
Health behaviour	Personal health practices	Diet
		Exercise
		Self care
	Health service availability	Type
		Size
		Purpose
		Time interval

Andersen (1995) views indicators of personal health practices as being an important part of the utilization process, contributing to an individual's level of health and, consequently, their underlying need for health care. They undoubtedly have an impact on levels of health, but they are more often measured in studies of spatial epidemiology. The inclusion of diet, exercise and self care variables are not normally incorporated in models of utilization (see Section 2.3.2) since they are not easily measured without specifically designed studies.

Behaviour is also partly dependent upon the availability of health services. As noted, Andersen's (1995) model was mainly designed to compare services between different areas or to compare different service modes. In this context, health service type is an important consideration. Clearly, however, it is less appropriate when considering a single type of service, such as GP services. The measure of size of service relates to the tendency of individuals to make use of certain sizes of resource in terms of the number of GPs available at any one surgery or the number of consultation hours available and the differential use of services. Including these measures may again lead to double-counting since they are also incorporated at an earlier stage when considering resource and organisational characteristics in the environment sub-model. The 'purpose' variable relates to the patient's diagnosed condition or awareness of their own health requirements and the threshold at which they are expressed (i.e. the purpose for which treatment is sought and the availability of services to meet that purpose). If the model is to be applied to a more general assessment of utilization, the 'purpose' variable may relate to a wider range of health needs. However, such measures are rarely included, again, since routine data are not normally available.

The health outcomes sub-model recognises the requirements, in a free-market health care system, to measure the effectiveness of a service against targets. The various indicators and associated variables are summarised in Table 2.5. This sub-model includes measures of both perceived and evaluated health, as defined above, as well as consumer satisfaction.

Measurement of changes in perceived health status, attributable to the health care service, is clearly problematic. It implies detailed patient surveys, covering the period before, during and after treatment. Retrospective surveys for this purpose are notoriously unreliable, due to inconsistencies in patient recall; longitudinal studies may therefore be required which are expensive to administer.

Table 2.5 The health outcomes sub-model
(after Andersen, 1995)

SUB-MODEL	INDICATORS	VARIABLES
Health outcomes	Perceived health status	Improved health perceived by individual's
	Evaluated health status	Improved health determined professionally
	Consumer satisfaction	Convenience
		Availability
		Financing
		Provider characteristics
		Quality

Even then, it may be difficult to separate changes genuinely attributable to treatment from other influences on the patient's perceived health. In addition, there may be long latency times between treatment and health outcomes, so that the timing of any such evaluation is important. Measurement of changes in evaluated health is, perhaps, easier, if only through analysis of health care records.

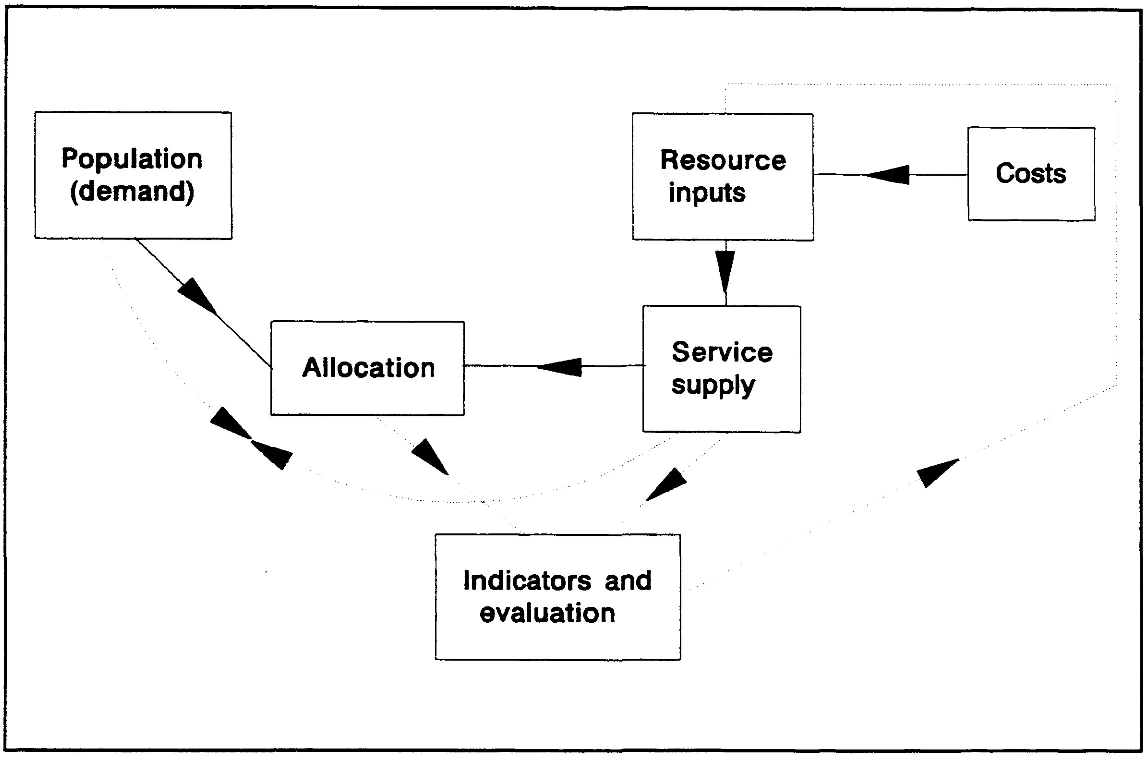
As with any market-based system, the measurement of consumer satisfaction of the health care provided for their needs is of considerable importance although problems of definition and measurement remain. The variable 'convenience' incorporates measurement of a patient's satisfaction with ease of access to the health care services. 'Availability' measures patient satisfaction with the overall level of provision; this may relate to the availability of their doctor and the waiting times experienced between both making an appointment and the consultation, and at the surgery. The variable 'financing' measures patient satisfaction in relation to the expenses they necessarily incur in arranging and obtaining consultation or treatment. Important elements are likely to include costs of travel and lost income (e.g. due to the need to take time off work). Provider characteristics relate to the characteristics of the surgery at which patients are registered, such as the administrative systems in place at the surgery and the approachability of the doctor. The final variable, quality, is a common measure of satisfaction. In health service terms, however, it is not necessarily possible for a patient accurately to determine the quality of service they receive. Such a measure would necessarily present an assessment of the professional competence of a GP which could be subject to erroneous personal judgement from an individual not trained to the same level. It also presents problems since quality is normally considered in comparison to a predetermined level or target level, neither of which may be easy to define in relation to health care.

2.3.4 Towards an applied model of utilization

The models discussed above (sections 2.3.2 and 2.3.3) show increasing sophistication over time yet also face increasing problems for application. Joseph and Phillips (1984) note that the Gross model provides à valuable description of the factors involved but view its implementation as extremely difficult. Stimson (1981) sees the models as representing the attempt to specify the nature of variables influencing utilization rather than a clarification of the effects of each, or an attempt at application. Andersen's (1995) conceptual model offers an especially detailed perspective in this respect, and has been considered in greater detail in the review above. However, as it stands, it cannot easily be implemented: there are a large number of variables, many of which are not clearly defined and several of which appear to overlap; it is not clear how to quantify many of the variables; methods for combining the different variables have not yet been specified; and the model is as yet untested in operational conditions.

Nevertheless, the models do help to illustrate the range of factors affecting health care utilization, and which thus need to be taken into account in the model of utilization designed in this research. This is highlighted by Clarke (1984) who recognises that such models offer an important role as an adequate base from which to select quantifiable variables. In operational terms, though, Clarke (1984) suggests a much simpler framework for a model of utilization (Figure 2.5).

Figure 2.5 Framework for a model of utilization
(source: after Clarke, 1984 p27)



Three key concepts of utilization are evident in almost all the models developed to date: need, accessibility and provision. At a broad scale of analysis, these provide a simple framework within which to structure an operational model, as Clarke (1984) suggests. The detailed consideration of the components of the proposed model in this research are the focus of the next chapter.

2.4 SUMMARY

This chapter has reviewed the major foci of this research: namely the pedigree of geographical studies of inequalities in uptake of health care; and the conceptual basis of the process of utilization. It has commentated on major attempts at modelling utilization in order to identify both the broad scope of analysis and the conceptual approaches taken to adequately summarise the process.

In particular, it has identified that:

- there is still a need to address, and reduce, inequalities in health care utilization;
- there is a danger in attempting to create one all-encompassing definition of utilization, but it is possible to discern common approaches and components; and
- in order to formulate a model of utilization it must include appropriate components but, unlike previous attempts, be able to be operationalised.

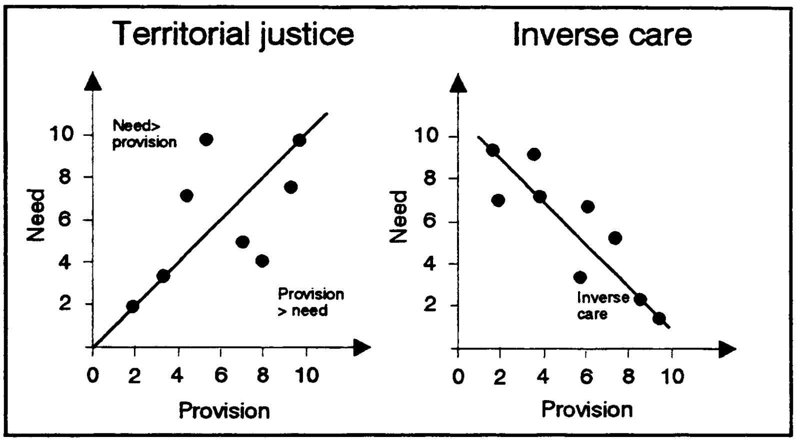
The next chapter examines the impact of components of utilization, selected as a result of the critical examination of previous models presented in this chapter.

3 DEVELOPING A MODEL OF GP UTILIZATION

3.1 INTRODUCTION

The utilization process, discussed in Chapter Two, is built around the concept of inequality. Inequalities are manifest in terms of need for health care, accessibility to it and provision (Section 2.3.7). In broad spatial terms, Figure 3.1 illustrates the concept of inequality applicable to the utilization process. The principle of territorial justice suggests that when need and service provision are quantified on comparable scales of measurement, equality of use occurs along a line at 45° to the graph axes, passing through its origin (Davies, 1968). A deviation from equality of use represents a departure from territorial justice - inequitable provision relative to need. Such inequality will lead to differential rates of utilization.

Figure 3.1 Territorial justice and Inverse care
(after Jones and Moon, 1987 pp222-223)



The counterpart of territorial justice, inverse care, suggests that areas with higher need receive proportionately less of the available resources in terms of provision. Hart (1971) identified inverse care in relation to need and service provision stating:

> "In areas with most sickness and death, general practitioners have more work, larger lists, less hospital support and inherit more traditions of clinically ineffective consultation than in the healthiest areas. These trends can be summed up as the inverse care law: that the availability of good medical care tends to vary inversely with the need of the population served"
> (Hart, 1971 p412).

Both of these concepts are constructed with reference to need and provision but an assessment of the extent to which territorial justice is achieved, or where inverse care may be manifest, can only be made through appropriate measurement. The purpose of this chapter is to discuss methods by which measurement of these concepts can be achieved.

The discussion of utilization in Chapter Two provides a basis from which to consider the specific components of utilization and, subsequently, the identification of methods of measuring inequalities. Measurement is achieved by using indicators which describe levels of need, accessibility and provision among a population. Applied spatially, indicators of need allow variations in the underlying need for health care to be mapped, and areas of excess or particularly high need to be identified. Similarly, indicators reflecting potential hindrances to accessibility can be defined which can be used to show spatial variations in levels of accessibility. Indicators of provision can likewise be used to examine geographic patterns in health service delivery and their relationship to spatial patterns of need, accessibility or, when combined, levels of multiple disadvantage.

In order to model spatial patterns of health service utilization, therefore, relevant indicators need to be defined which can describe the various components of need, accessibility and provision in quantitative terms. The following sections of this chapter thus define in more detail the components of utilization, and develop potential indicators based upon a review of relevant empirical research.

3.2 DEFINING COMPONENTS OF NEED

Before methods of measuring differences in need can be discussed, the definition of the concept must first be clarified since it can be interpreted, and measured, in different ways. Bradshaw (1972) suggests four alternative definitions:

- Felt need: need perceived by the individual.
- Expressed need: felt need which has developed into a demand for a

service through utilization.

- Normative need: professionally determined need.
- Comparative need: similar to normative need but with respect to characteristics of a group rather than an individual.

Felt need is probably the most appropriate in terms of planning a health care delivery system but it is also difficult to gauge due to problems of measuring patient perception and any comparable means of self-diagnosis. Expressed need is the representation of a need through the utilization of a service. This still leaves open the question of which individual factors lead to utilization and how they can effectively be assessed. In the case of both felt and expressed need, difficulties also exist in studying changing patterns of need over time due to the effect of socio-psychological factors. The definition of normative need may change due to changes in medical practice. Additionally, such a measure is more appropriately used in relation to an individual rather than entire social groups. Comparative need allows the inclusion of professionally determined measurements but is more readily applicable to the analysis of health care planning since such measures are derived in relation to societal groups rather than individuals.

Since data for studies investigating inequalities are generally available only at an aggregated level, the most appropriate definition of need is a comparative one. An alternative term commonly used in contemporary research is relative need, which Harvey (1973) argues as being fundamental to understanding territorial social justice. Relative need is widely used in health and health care based research, particularly in defining indices of disadvantage (Jarman 1983, 1984; Townsend 1984; DoE, 1995). Such a definition allows differences to be identified between and amongst societal groups but clearly does not provide a basis for measuring need in absolute terms.

Drawing upon previous attempts to model need (Chapter Two), three key components can be identified: health status, social and economic disadvantage and environmental factors. These components provide a focus for identifying which indicators should be used to model relative need in a population as part of the model of utilization.

3.2.1 Health status

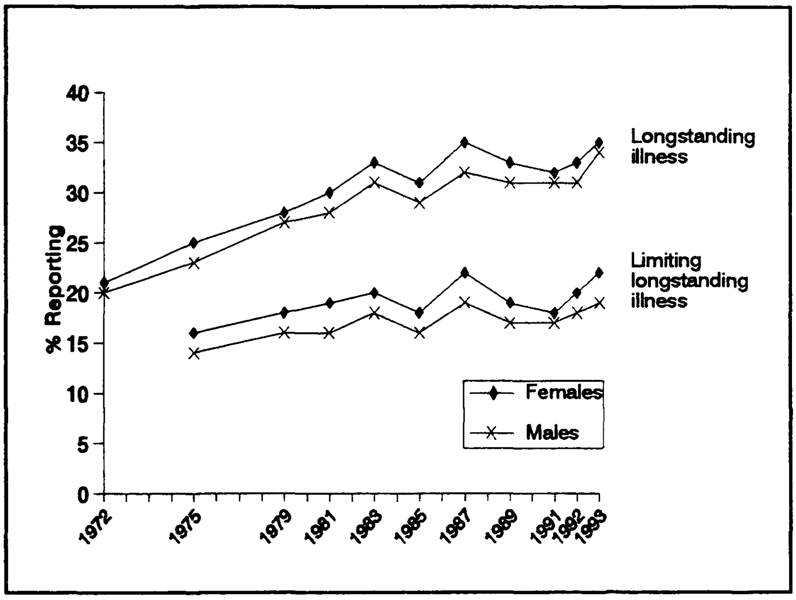
Health status refers to those factors which may predispose individuals to increased need for health care, relative to others. Clearly the main measure of health status is the prevalence or incidence of ill-health. Data on morbidity are, however, limited and are, by their very nature, retrospective: they define existing or past levels of need but do not necessarily give reliable measures of future need. Data on mortality are more readily available, but give only a weak measure of health service need. Furthermore, the RAWP formula was criticised for measuring differences in need based on the use of mortality rather than morbidity data (Section 2.2). Routine data sources do not include detailed information on levels of ill-health but one potentially useful measure of morbidity, which is widely available, measures levels of permanent sickness (Limiting Long Term Illness). Such measures have occasionally been used in developing indices of disadvantage (DoE, 1983) and Morris and Carstairs (1991) show a moderate correlation between its use in measuring higher relative need and broader health outcomes such as Standardised Mortality Ratios (SMRs) and hospital inpatient data.

As a basis for modelling, however, it is in many ways more appropriate to use proxy measures of health status - i.e. indicators relating to the underlying demographic factors which act to determine health status. Both age and gender are important in this respect. Different age groups and genders exhibit differences in relative need for health care and gender and age are therefore often used as standard measures of need. The assessment of such inequalities is, however, complex since life expectancy estimates, mortality rates between sexes of different ages, types of illness and causes of death do not relate to either age or gender combinations in the same way. For instance, new born girls may expect to live longer than boys, there are higher rates of accidental death for boys and there are different causes of premature middle age death between the sexes; in contrast, women tend to record higher levels of chronic and acute sickness (Central Statistical Office, 1992). These patterns are even more complicated when examined in greater detail and when considered in association with factors such as social class and occupation.

However, rather than examining the complexities of age and sex in conjunction with other discriminating variables, to discern detailed health differentials, it is more appropriate initially to determine their discrete effect. Other variables such as social and economic disadvantage can be incorporated into the model elsewhere (Section 3.2.2).

Differences in gender suggest that younger females will require more contact with health care services for childbirth and contraceptive advice. Rates of utilization of health care services is higher for young females than males of the same age, for these reasons. Furthermore women, in general, report illness to a greater extent (Joseph and Phillips, 1984). Figure 3.2 illustrates this difference in reporting.

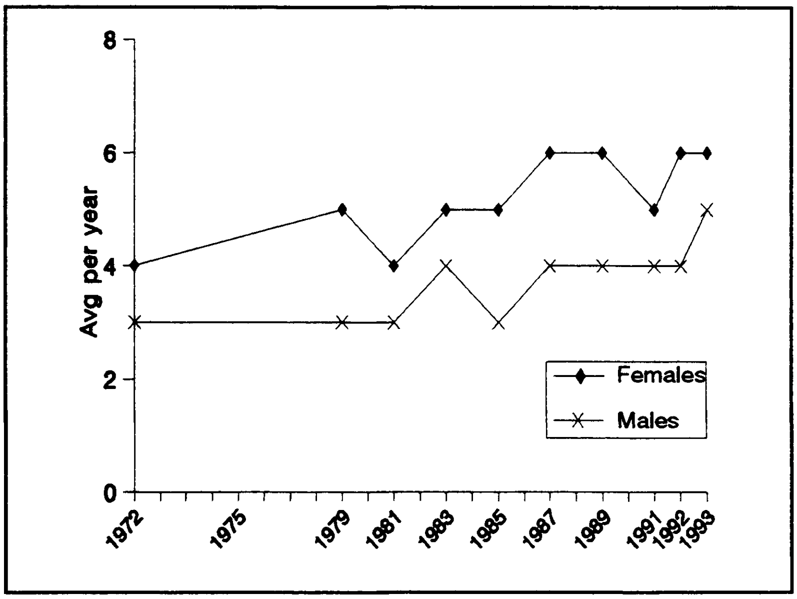
Figure 3.2 Differences in health for the two sexes
(OPCS 1995, p85)



The measure of 'Longstanding Illness' used here relates specifically to chronic conditions, disability or infirmity, whereas the measure of 'Limiting Longstanding Illness' includes acute sickness (i.e. the restriction of normal activities through illness or injury). Regardless of which measure is examined, women report illness to a greater extent than men. However, the difference in reporting cannot be taken as an accurate measure of a difference in health. It may be that these differences in reporting are more a function of gender differences in perception of health matters rather than higher levels of ill-health.

The effects of gender are difficult to quantify and generalisations about differences in need for health care must be made with care. However, frequency of GP consultations in the UK support the assertion that females consistently consult to a greater extent than males (Figure 3.3).

Figure 3.3 Differences in average number of consultations (per year) for the two sexes (OPCS, 1995 p91)



In terms of age, as people get older they will require increased health care for chronic conditions. An ageing population exerts increased pressure on health care resources, an important aspect to consider in the planning of resource allocation. As such, age is a widely acknowledged measure of relative need. Jarman (1983) showed that age is of considerable importance in differentiating need. In particular, older people (aged 65 and over) and children (under 5) tend to have higher levels of need than other age groups (Section 2.2).

3.2.2 Social and economic disadvantage

The need for health care is to a large extent socially and economically determined. Many of the factors which affect health - such as diet, lifestyle, exposure to hazards in the occupational and domestic environment and hygiene - are related to social status, levels of affluence and income. For a wide range of illnesses, therefore, socio-economic disadvantage is seen to be an important risk factor, for instance lung cancer (Pukkala et al, 1983; Pukkala and Teppo, 1986) and coronary heart disease (Marmott et al, 1992). Indeed, Haan et al (1989) go so far as to suggest that people lower down in social class have higher rates of virtually every disease and condition.

For these reasons, measures of socio-economic disadvantage provide valuable indicators of health service need, and as noted earlier the Jarman UPA score - which is used as a basis for resource allocation in the NHS - is largely based on such measures. Nevertheless, the relationship between socio-economic disadvantage and health care need is complex and socio-economic measures of need must be applied with caution as Blane et al (1996) note.

Single parents, for example, have been identified by Jarman (1983) as being a societal group which exhibits increased frequency of health care utilization. The reasons for this are not entirely clear, however, since single parenthood does not, in itself, create a higher need for health care. It may be that single parents exhibit an increased awareness of their child's health needs and express these to a greater extent. Alternatively, lack of another parent in the home may mean that the lone parent turns more often to their GP for assistance. Whichever is the case, single parenthood does show a moderate correlation with health outcomes (Morris and Carstairs, 1991). It thus seems to offer a useful measure of disadvantage and has been used in three of the five measures of deprivation previously reviewed (Section 2.2).

Unemployment is also a widely used measure of disadvantage in relation to health and is included in all of the measures of deprivation previously reviewed (Section 2.2). There is clear evidence of links between unemployment and ill-health (Smith, 1987;

Iverson, 1989). The unemployed tend to have poorer health with areas of high unemployment also having worse health records and higher death rates (Whitehead, 1992). Evidence also suggests a link between suicide and unemployment (Kreitman and Platt, 1984; Hawton and Rose, 1986; Platt et al, 1988). In relation to morbidity, Arber (1991) examined rates of consultation in relation to reporting of 'Longstanding Illness' and illustrated that the unemployed are more likely to report. Several studies also relate child morbidity with low birth weight and show their correlation with parental unemployment (Maclure and Stewart, 1984; Dowding, 1981). Warr (1985) found significant deterioration in mental health in people becoming unemployed, a trend which tended to reverse following re-employment. Moser et al (1987) also showed that unemployment does have an effect on mortality rates and Beale and Nethercott (1985, 1986a, 1986b) indicate stress of unemployment as the principal reason for increased consultation. Furthermore, they also found a decline in health in people who have been threatened with unemployment. Nevertheless, this relationship between unemployment and health outcomes needs to be interpreted with care. Unemployment may contribute to ill-health, but equally people in poor health are at an increased risk of becoming unemployed (Whitehead, 1992).

Whether unemployment leads to increased ill-health or whether it is simply indicative of wider disadvantage, Jarman (1983) found that, in his study of GP consultation, unemployed people were the third most often consulting group. This outcome is supported by Morris and Carstairs (1991) who showed that unemployment exhibited the strongest association when correlated against health outcomes. For these reasons unemployment is clearly a useful socio-economic indicator of health care need.

Social class of an individual, based upon occupation, is also a widely used measure of disadvantage and health care need. The most widespread categorization in the UK has been the Registrar General's classification (OPCS, 1970), which has since been adapted (HMSO, 1992) following the 1991 census of the population survey (Table 3.1).

Table 3.1 Changes in classifying social class
(after OPCS, 1970; HMSO, 1992)

Social Class	1970	1991
I	Professional e.g. accountant, doctor	Professional/higher administrative e.g. Lawyer, doctor
II	Intermediate e.g. manager, nurse	Intermediate professional and administrative e.g. Manager, teacher, nurse
III	Skilled non-manual e.g. cleric, secretary	III (N) Skilled non-manual e.g. Clerk, police, secretary
		III (M) Skilled manual e.g. Chef, bus driver, baker
IV	Skilled manual e.g. bus driver, butcher	Partly skilled e.g. Post worker, farm worker
V	Unskilled e.g. cleaner, labourer	Unskilled e.g. Cleaner, car park attendant

Occupational classification can be ambiguous and can also be difficult to apply consistently both over time and for different social groups (Townsend et al, 1988). However, it is one of the most widespread classification systems used and, in the absence of a suitable alternative, probably provides the best available framework for defining social and economic disadvantage. In this respect, Townsend et al (1988) endorse its use as a research tool, and it is commonly employed as an indicator of deprivation in health related studies.

Social class is an indicator which reflects social and economic conditions affecting households (although it should be remembered that social class categorisation more accurately reflects that of the head of the household and should not necessarily be imputed to every resident). The indicator is derived from a categorisation of occupational status but, indirectly, provides a proxy measure of affluence. Affluence allows opportunity within society although, conversely, it may also hinder others. As with the measure of unemployment, there may not be a direct causal relationship between social class and levels of health. However, differences in behaviour, associated with particular social groups, leads to socio-economic health differentials

(Carroll et al, 1993).

A wide range of studies has shown that lower social classes exhibit increased levels of morbidity and mortality (Whitelegg, 1982; DoE, 1983; Jarman, 1983; Townsend and Davidson, 1983; Carstairs and Morris, 1989a, 1989b). Such trends are illustrated by levels of SMR in relation to social class. Table 3.2 shows that a strong association is evident in relation to social class for men (Morris and Carstairs, 1991). The association is evident regardless of age at death or whether upper and lower classes or the broader manual/non-manual categories are evaluated.

Table 3.2 Trends in mortality of men by social class and age group, 1976-83 (after Whitehead, 1992 p272)

Age at death						
	25-64		65-74		75 and over	
Social class	1976-81 SMR	1981-83 SMR	1976-81 SMR	1981-83 SMR	1976-81 SMR	1981-83 SMR
I and II	75	78	79	81	82	81
IV and V	114	115	108	111	109	109
Non-manual	84	83	81	87	86	84
Manual	103	107	103	105	107	107

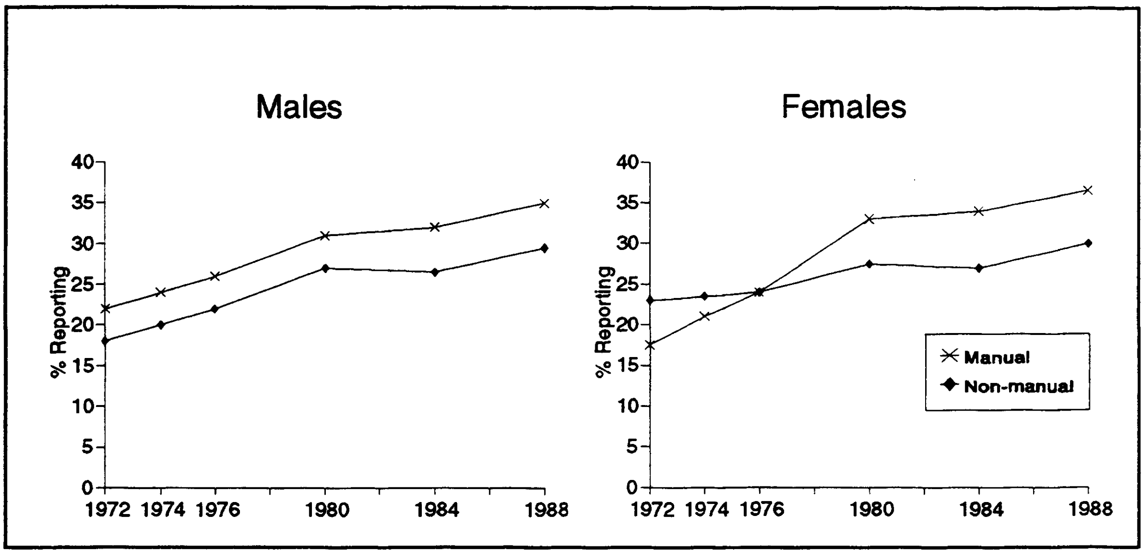
Rates of long-standing illness which restrict activity are also higher among manual social classes, although differences between the sexes are evident (Figure 3.4). However, changes in female reporting between 1972 and 1980 can be partially attributed to the increase in employment opportunity.

Manual social groups are therefore at a relative disadvantage and exhibit a greater relative need for health care. The reasons for differences in need between social classes, especially for males, relates predominantly to characteristics of occupation. The Black Report thus summed up the use of social class as an indicator of inequality in health as follows:

"[social class] tends to show broadly how strenuous or unhealthy it [occupation] is, what are the likely working conditions - for example whether it is indoors or outdoors and whether there is exposure to noise, dust or vibration - and what amenities and facilities are available, as well as levels of remuneration and likely access to various fringe benefits"
(Townsend & Davidson, 1982, p39-40).

These inequalities apply directly to the head of household but effects on health may also be seen for other family members.

Figure 3.4 Percentage of males and females reporting long-standing illness in relation to their social class
(source: after Whitehead, 1992 p274)



Manual occupations carry a higher risk due to the physical nature of work and the resultant risk of injury. Inequalities experienced by manual groups are exacerbated since it is also these groups who tend to work outdoors and will experience more hazardous conditions.

The effect of social class, however, is strongly modified by age. Health deteriorates more rapidly in elderly people who are also socially disadvantaged and who are grouped in lower social classes (Blaxter, 1990; Whitehead, 1992). Phillimore (1989) also investigated these compound problems and suggested that people in poorer areas were more likely to die prematurely or suffer a greater number of health problems than their counterparts in more affluent areas.

Other factors often considered as measures of socio-economic disadvantage include ethnicity, education and access to a car. Ethnic minorities, for example, show markedly higher rates of morbidity and mortality for a wide range of health outcomes including ischaemic heart disease (Marmott et al, 1995), coronary heart disease (Balarajan, 1991) and diabetes (NDHA, 1995). Equally, level of education has been found to show a negative correlation with levels of morbidity (Whitehead, 1992) and mortality (Kunst and Machenbach, 1994). Goldblatt (1990) also shows that those with no qualifications or no access to cars experience higher than average mortality rates when compared to those who are defined as more advantaged. Davey Smith et al (1990) suggest that this differential is even greater when related to occupation, with a more than fourfold difference in mortality for lower occupational classes without access to a car than for higher occupational classes with a car. Nevertheless, Morris and Carstairs (1991) warn against using these measures uncritically as indicators of need, for they have only weak associations with health outcomes, are highly correlated with other socio-economic indicators (such as social class) and do not, therefore, necessarily add any great value to the other measures of social and economic disadvantage. However, indicators such as ethnicity, education and access to a car are useful in other ways since they reflect important barriers to utilization. Their significance in these terms is much more widely acknowledged; they are consequently discussed further as measures of accessibility to health care in Section 3.3.

3.2.3 Home environment

A general association between poor environmental conditions and higher levels of ill-health is known to exist which may contribute to variations in service need. Many different aspects of the environment may affect health, including exposure to chemicals, physical injury and other risk factors in the outdoor, occupational and home environment. Links with the outdoor environment are commonly weak, complex and highly confounded (Taubes, 1995) and are not easily modelled at the aggregate level.

They are therefore not considered further here. Risks associated with the occupational environment are often stronger, though these can be modelled to some extent through the proxy of social class, since many occupational risk factors tend to be greater in manual and unskilled jobs (Blaxter, 1981; 1990; Townsend et al, 1986; Townsend et al, 1992). In many ways, however, the home environment represents the major source of risk. People spend the majority of their lives at home and conditions in their home - e.g. dampness, dust, environmental tobacco smoke, emissions from appliances, and the appliances themselves - may all pose significant health risks. Few of these risk factors can be directly measured, but housing tenure, availability of amenities and overcrowding all provide useful measures of the effect of the home environment on health and thus on health care need.

Measuring conditions in the home environment is nevertheless difficult, for few direct indicators are available. Housing tenure perhaps offers one of the best possibilities. Housing tenure has not previously been widely used although it is one of the indicators used in the Townsend Index. The indicator used by Townsend et al (1988) was the proportion of private households not owner-occupied, which Morris and Carstairs (1991) show to have a moderate correlation with higher levels of mortality and morbidity. The direct effects of tenure are not obvious, although it is reasonable to suggest that rented, and other non-owner occupied, accommodation is not maintained to the same level of upkeep as privately owned housing. Effects of dis-repair may include damp and poorly heated properties, resulting in a higher incidence of illness; Townsend and Davidson (1982) provide evidence to suggest that people who live in houses that they own have lower rates of mortality than those who rent homes from private landlords, who in turn have lower rates than tenants of local authorities (see also Blaxter, 1990; Whitehead, 1992). Housing tenure may also be an indirect measure of a wide range of other socio-economic conditions, such as income and level of education. As such, it may act in much the same way as occupational class, since it informs about fixed property or assets and complements the use of indicators to measure the effect of income and social status on health (Section 3.2.2).

Two measures of deprivation make use of an alternative indicator, the lack of basic amenities. This is defined as households who lack or share the use of basic amenities such as showers or inside WCs. The health effects of this disadvantage are, again, predominantly related to the link between housing standard and affluence. In terms of direct effects on health, the standard of amenities may be associated with health in a variety of ways, such as inadequate heating giving rise to hypothermia, particularly in the elderly (Townsend and Davidson, 1982), or poorer sanitation and increased exposure to micro-organisms.

A third indicator which can be used to measure quality of the home environment, and the effect on health, is overcrowding. This indicator is defined as the proportion of households with more than a certain number of people per room, on average. The normal measure identifies households with more than one person per room. Such measures are almost as widely used as unemployment and are highly correlated with mortality and morbidity (Morris and Carstairs, 1991). Overcrowding results in poorer living conditions and may contribute to higher levels of ill-health, including respiratory disease, infectious disease and mental illness.

3.3 DEFINING COMPONENTS OF ACCESSIBILITY

Whatever level of need for health care services exists in a population, it can only be adequately catered for when provision is appropriate, and the means to access it are available. Health care provision is not equally available to all, primarily due to the fact that access depends on the ability of individuals to reach the point of delivery (Massam, 1975). This depends not only on the physical mobility of those concerned, but also their level of awareness about the service. Differences in awareness and mobility across the population lead to spatial inequalities in accessibility to the available service.

Accessibility can be defined and measured in a variety of ways. Physical accessibility is a function primarily of the distance between the place of residence of the user and the surgery. However, an individual's ability to cross the space depends upon transport availability. In addition, personal mobility (as determined, for example, by physical disability) may affect accessibility. Income, free time and a range of other personal and lifestyle factors may also be important: as Joseph and Phillips (1984) note, accessibility depends in part on whether the service 'is socially or financially available to people, and whether a person's time-space budget permits him to use the service' (Joseph and Phillips, 1984).

In this section attention is focused on material, socio-economic and cultural constraints on access to health care. The physical dimension of accessibility - the relationship between service and patient location in terms of time or distance - is not considered here since this is inextricably linked to the overall measurement of provision. This is therefore considered in Section 3.4.

As noted, accessibility can be measured in terms of the transport modes available, an individual's personal mobility and an assessment of the impact of different levels of service awareness. Indicators are discussed which give relative measures of the extent to which these factors may hinder accessibility.

3.3.1 Transport availability

Distance between individuals and the health care point of delivery is, undoubtedly, a factor which has an impact on rates of utilization. Distance decay effects clearly exist in the utilization of health care - people who live further away from the point of delivery having greater difficulty of access - but it has been questioned whether distance itself is the most important influence or whether it merely acts as an intervening obstacle to health care (Joseph and Phillips, 1984). More important in this context is access to suitable transportation facilities.

With increasing numbers of GP surgeries being group based and their tendency for urban centralisation, the availability of public and private transport is crucial in allowing people the opportunity to get to their GP surgery conveniently and at an acceptable cost. Such factors are particularly important in rural areas where the lack of a private motor vehicle, coupled with poor public transport provision, can create a very real obstacle to access. Evidence for the benefits of car ownership has been provided by Knox (1979) who noted that high levels of car ownership in outlying areas of Aberdeen extended potential accessibility to surgeries which were more centrally located. Whitehouse (1985) also showed that accessibility to GP surgeries is affected by transport difficulties experienced.

Whilst the vast majority of journeys make use of private motor vehicles (87%) there is still some reliance on public transport, which make up 13% of all journeys (ONS, 1997). The availability and frequency of public transport will thus influence access to health care for a significant proportion of people. These effects are most severe in rural areas where distances to GP surgeries can be large (Whitlegg, 1982). De-regulation of public transport provision has tended to fragment services, resulting in rural bus services which lack coordination and are not regular enough to allow patients to be able to seek health care or other services when needed. This places more emphasis on car ownership in rural areas. Car ownership has thus commonly been used as an indicator of disadvantage (Carstairs and Morris, 1989a; 1989b; Townsend et al, 1988). Morris and Carstairs (1991) illustrate the importance of lack of car ownership by noting that it provides the strongest relationship of all indicators, in their study of five deprivation indices, when compared to measures of ill-health.

3.3.2 Personal mobility

The most direct determinant of personal mobility is likely to be level of physical disability. Typically, people suffering from incapacitating disabilities have greater difficulties in accessing and using public transport or in using alternative modes of transport. They are often multiply disadvantaged because of reduced income, and lack of access to a car, or the cost deterrent of public transport. As with some other health-related factors, data on disability at an appropriate spatial resolution for modelling are scarce. For most purposes, therefore, recourse has to be made to alternative indicators, relating to 'upstream' determinants of personal mobility such as age. However, many other factors influence personal mobility, including affluence (the ability to afford to use the available transport) and family and work commitments (i.e. available time).

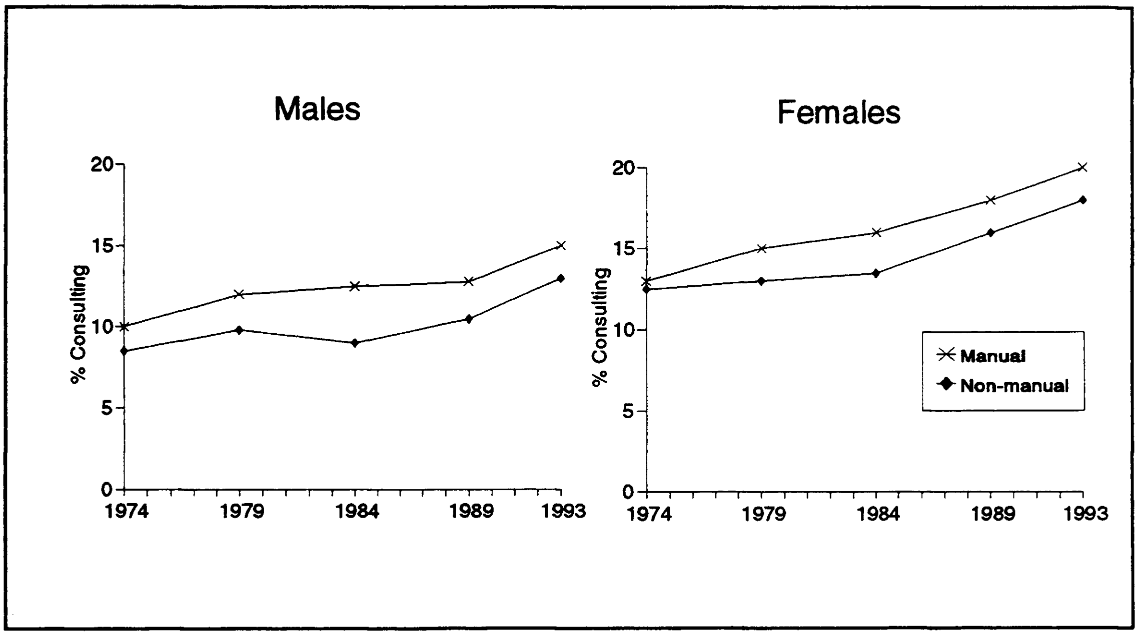
Age has already been considered as an indicator to measure those persons who have higher relative need for health care (Section 3.2.1) but age also acts in a different way to further disadvantage those same people. Those who are very young or very old are doubly disadvantaged since they not only require increased health care but they are excluded from driving, limiting their ability to access health care. Those who are young are not eligible to drive and are therefore reliant on other forms of transport and parental time-space budgets, whilst those over 80 may only drive subject to further tests and may also be reliant on assistance to get to their GP. Although studies suggest that those over the age of 65 tend to consult GPs to a greater extent (Section 3.2.1) it is not clear whether they consult as often as they should given the increasing needs they express. Problems of access may be masked by the apparent increase in consultation for these age groups. It is therefore appropriate to incorporate indicators which measure the extent to which age may hinder potential accessibility.

Furthermore, age also has a significant effect on personal mobility. Those who are very young or very old will not necessarily have high levels of personal mobility. In particular, the elderly may not be able to undertake the journey due to the obvious effects of old age, perhaps placing a reliance on assistance with the journey or home visits from their GP.

Single parenthood also has an impact upon personal mobility. It is commonly used as an indicator of disadvantage, and was identified in Section 3.2.2 as one of the socio-economic measures of need. However, single parent households can also be considered to be at a disadvantage due to the extra constraints placed upon their mobility. These may include greater demands on their time as the only family provider and carer and, consequently, less opportunity within their overall time-space budget which will lessen their potential accessibility.

The relationship between social class and accessibility is complex. It might be expected that lower social classes experience greater barriers to accessibility, because of their reduced command of resources. The higher rates of consultation shown by lower social classes (DHSS, 1980) nevertheless suggests that, if so, these barriers are insufficient to outweigh their higher need for health care (Figure 3.5).

Figure 3.5 Percentage of males and females consulting an NHS GP by social class (after Townsend et al, 1992 p282 and OPCS, 1995)



There is also some evidence to suggest that the assumption of reduced accessibility for lower social classes might be false. OPCS (1986), for example, in an analysis based on General Household Survey data, found that, for given rates of sickness, those in manual socio-economic groups were more likely to consult a GP than those in non-manual groups. This finding is supported by several other authors (Crombie, 1984; Whitehead, 1992). It implies that it is those in non-manual social classes that suffer a relative hindrance in their accessibility, despite their acknowledged higher levels of affluence and command of resources. The reasons for this hindrance are not entirely clear and, as Whitehead (1992) notes, much more research is required in this area to determine the exact processes involved. Nevertheless, Whitehead (1992) suggests a possible relationship with lifestyle characteristics and available time. Those in non-manual occupations may experience greater pressures on their time with the consequence that they have less time available for health matters. The lack of time may also be, partly, a function of the fact that people in non-manual occupations are more likely to be in full-time employment. Furthermore, GPs may make a conscious attempt to make themselves more available to lower social classes, through spending more time with patients, to compensate for what Crombie (1984) terms the lower coping skills of people in manual classes. If this were the case, it may lead to a disproportionate amount of time being made available for manual social classes in comparison with those in non-manual classes. This would effectively reduce the available time in which non-manual classes can consult and exacerbate problems they experience in relation to their time-space budget. If true, this suggests that non-manual social classes do experience relatively lower potential accessibility, contradicting conventional understanding of class-related differences in utilization.

3.3.3 Service awareness

Socio-psychological influences on accessibility derive principally from people's attitudes and values in relation to their own health and their knowledge of the availability of health services. Such so-called 'health beliefs' might influence perceptions of need, contributing to differences in levels of felt and expressed need. They may also provide a means of explaining how social structure or cultural differences either enables, or alternatively hinders, utilization (Andersen, 1995). Green et al (1980), for example, developed a health beliefs model as a partial explanation of utilization of services. However, other researchers argue that to fully understand relationships between beliefs and utilization requires the ability to match beliefs and need against types of health care use (Tanner et al, 1983). This implies the capability to measure need associated with a specific illness and relate this directly to associated service use.

Analysis of beliefs against use of specific health services, rather than general health beliefs is certainly likely to be more effective in examining differences in health outcomes, since health beliefs may be illness specific. Nevertheless, it faces a fundamental drawback in the lack of detailed information relating specific health needs to utilization for groups where health beliefs can be assessed. Furthermore, the method by which health beliefs can be quantified, and evaluated in relation to need, has only recently been considered and attempts to define procedures for investigation are still at a conceptual stage (Andersen, 1995).

Given these difficulties of relating general health beliefs to morbidity, it may be more appropriate to examine the effect of health beliefs on potential accessibility via the intermediary of service awareness. Indicators of service awareness measure differences in the way individuals in different societal groups perceive the availability of a service. Whitehead (1992; 1995) suggests this offers a means of explaining how differences in utilization may partly be due to the tendency of lower social groups to express lower levels of interest in protecting their future health. However, the way in which these problems can be measured for lower social groups is problematic. A wide range of personal factors, for instance diet, exercise or risk-taking behaviour interact to influence human health and behavioural, socio-economic or cultural differences may influence awareness of health care provision. Andersen (1995) suggests that analysis of these factors on service awareness is only feasible through detailed longitudinal studies. Few detailed studies of this type have yet been completed, and no opportunity to undertake a detailed longitudinal investigation was available as part of this research. For this reason, recourse is made to more general measures of societal characteristics, such as ethnicity and educational attainment.

Joseph and Phillips (1984) recognise that differences in service awareness can be partially explained by ethnicity, which may lead to linguistic or cultural impediment. Such difficulties may create barriers to accessibility and compound problems of disadvantage already experienced by these groups. Underutilization of health care, by ethnic minority groups, may therefore be related to the combined effects of socio-economic disadvantage, a lack of faith in the health care system or poor communications between GP and patient. The proportion of ethnic minorities in the population provides a useful indicator in this respect although it is acknowledged that this relates not only to service awareness but also wider effects of disadvantage.

Levels of educational attainment can also be used as an indicator of service awareness. Blane et al (1996), for example, provide evidence of a strong association between GCSE examination results and both the Townsend Index and the Carstairs Index. They suggest that, whilst The Black Report (DHSS, 1980) cited smoking, leisure time, physical activity, dietary preferences and the informed use of health services as behavioural-cultural factors which may create differences in health and health behaviour:

> "More than these specific risk factors, the educational attainment of a community's children may also act as a summary measure of its general cultural level"
> (Blane et al, 1996 p183).

As such, educational attainment is a useful indicator of culture. Those who have lower levels of educational attainment are thus more likely to have a lower level of interest in protecting their own health and less ability to access or interpret relevant information on the service available. This manifests as a barrier to accessibility. However, one of the difficulties in making use of such a measure is the lack of data at the required resolution. Consequently, research into the links between education, service awareness and accessibility is not widespread.

3.4 DEFINING COMPONENTS OF SERVICE PROVISION

Together, need and accessibility define the effective demand for health care. Provision of health care represents the other side of the equation - i.e. supply. Rates of utilization are dependent on the extent of demand but also on location and allocation of health care. Trends in the organisation and location of health care (broadly discussed in Section 1.2) will have an impact upon the spatial and temporal availability of the service. In order to measure the availability of health care, the effect of cross-boundary flows between neighbouring authorities and the effects of distance decay between consumer and provider must also be assessed. This final component has, more commonly, been incorporated into measures of accessibility rather than provision. However, as indicated in Section 3.3, accessibility here is viewed in terms of socio-economic and material disadvantage along with behavioural hindrance. Distance, on the other hand, can be seen as a component of provision, for it reflects the physical location of the service relative to demand; as such, it is not something over which users have any direct control.

The measurement of provision therefore consists of four components - namely spatial availability, temporal availability, cross-boundary flow effects and distance decay effects.

3.4.1 Spatial availability

In assessing factors which play a part in determining spatial availability of GPs it is necessary to draw together different approaches to explanation of organisational change. Inequality of provision exists at a variety of scales, but is particularly manifest at the regional and local level. Joseph and Phillips (1984) identified two approaches to explaining physician location. The ecological approach attempts to determine the characteristics of areas with more favourable GP to population ratios; the behavioural approach attempts to examine the factors relevant to the locational decision-making of individual physicians. A consideration of these approaches, with reference to different scales of analysis and organisational constraint, allows an examination of factors influencing spatial location of GP services.

The most important correlate of physician supply, in terms of an ecological approach, is population size (Benham et al, 1968). Other demographic and socio-economic factors may, however, also influence physician location. Joroff and Navarro (1971), for example, found that population over 65 was the most accurate predictor of GP location.

Spatial inequalities in ratios of GP to population are evident. Bosanquet (1971) described inequalities at the regional level and showed that northern England was less well off in health care resources. Knox (1979) found similar patterns, using location quotients. These take the form:

$I_i = \dfrac{(Gi/Pi)}{(\sum Gi/\sum Pi)}$	I_i = location quotient for region i Gi = number of GPs for region i Pi = population for region i

A drawback of this measurement, and hence of the ecological approach, is that there is no direct relationship established with need. The measure does not therefore show whether regions are catered adequately in relation to need. It may be that those areas with proportionally higher levels of GPs also have higher levels of need. The simplistic assessment of GP provision in relation to population size may thus mask important differences in need.

Studies have attempted to address this limitation by linking these simple models of GP provision with measures of social and economic disadvantage. These have shown that the distribution of GPs does not reflect patterns of disadvantage (West and Lowe, 1976); in particular rural areas tend to be proportionally worse off for provision in comparison with urban areas (Navarro, 1976). As implied by the Inverse Care law (Hart, 1971), therefore, inequalities in provision are evident not only spatially but also socio-economically.

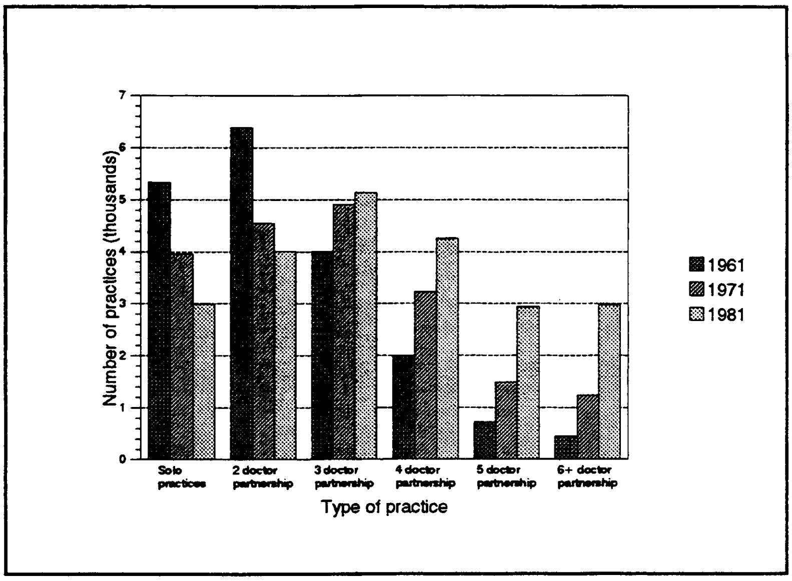
The issue of inverse care is even more acute when primary care provision is considered at a local level. Knox (1978), for example, found evidence of inverse care in a study of inner city health care provision and also showed that rural areas and peripheral local authority housing estates are disadvantaged. Such areas suffer from proportionally less health care provision.

Ecological investigation of these inequalities only measures the spatial components of provision and can only be used to assess correlation with population size or socio-economic characteristics. On the other hand, a behavioural approach incorporates GP behaviour as a component of health care delivery. GP location is dependent not only on population distribution but also on characteristics of the population such as social class and lifestyle (Joseph and Phillips, 1984) and behavioural characteristics of providers. Benham et al (1968, p339) state 'it is widely believed that medics have strong locational preferences, preferring to be near hospitals and other facilities. Like other professionals, they desire to locate where cultural facilities (schools, theatres etc.) are available'. This would suggest that those areas which suffer higher levels of relative need and socio-economic and material disadvantage in terms of access are often further disadvantaged due to under-provision, partially due to the locational choices made by GPs. A preference for urban, as opposed to rural, practice is manifest for similar reasons and Bernstein et al (1979) suggest that practices run by one GP, particularly in rural areas, are less favoured as opposed to group practices where deputizing and out of hours work can be shared.

Knox and Pacione (1980) support these behavioural approaches to explaining spatial location in their study of locational decision-making by physicians. They suggest that financial considerations are not a priority for locational choice, rather that an avoidance of more remote areas, inner city and public housing areas and concern for personal lifestyle (e.g. access to leisure facilities, proximity to relatives/friends) tend to determine location. Interestingly, the fact that GPs do not place remuneration highly as an influence on locational choice is counter to the policy of offering financial workload incentives to GPs who practise in deprived areas.

Whatever locational preferences individual GPs may have, they are not made in isolation but are constrained to some extent by the organisational characteristics of health care delivery systems and policy within which they are set. Major policy initiatives for informing location and allocation of GP resources were discussed in Section 2.2 and various policy attempts have been made to redress inequality in spatial provision of GP services. The opportunity for individual choice of location in General Practice is limited by such policies. Furthermore, the practice of negative controls on location, coupled with financial incentives and the move towards group practices, has created considerable constraint on locational choice. Such policies are designed to alleviate inequality although this is not always the outcome. For example, centralization of primary health care facilities and reorganisation of GP services into group practices (Figure 3.6) has changed the nature of provision, in some cases creating further under-provision. Although the overall GP supply may be no different or may have increased, grouping of provision leads to its availability at fewer points of supply. As previous evidence suggests, these supply points do not necessarily match need and may compound socio-economic accessibility difficulties.

Figure 3.6 Trends in medical practice organisation
(after Jones and Moon, 1987)



As a result, GP behaviour and increasing centralisation may lead to some areas becoming significantly under-provided (Jones and Moon, 1987). One administrative response already noted is to provide financial incentives (such as those based on workload indices) to attract personnel to under-provided areas, although Knox and Pacione (1980) suggest this is not effective. The alternative is to introduce sanctions or patient quotas to limit recruitment in over-provided areas. This policy of directed-manpower allocation is based around patient list size and, in areas where average list size is small, applications to set up a practice would be refused. There is little evidence to suggest that such a policy is effective. Jones and Moon (1987) suggest cautionary success in a British context in that, by April 1986, only one designated area (where the right to practise was encouraged) remained. However, they also suggest that the policy of amalgamating practices may obscure the true extent of localised under-provision.

The evidence of inequalities in spatial organisation of GP services is clear. These inequalities can be investigated through the measurement of spatial distribution as a function of ecological and behavioral components of locational choice. The location of GP services often fails to match the distribution of need or disadvantage. These inequalities are evident at both local and regional scales, and planning and policy initiatives of resource redistribution do not appear to provide any clear improvement.

Provision of health care is fixed at the point of supply yet appropriate measurement of provision requires more than just calculating GP supply, as a ratio of GPs to population size, for a given region. In order to assess the quantity of provision, provider characteristics must be measured in far more detail. Indicators for achieving this are developed in subsequent sections.

3.4.2 Temporal availability

Temporal availability of provision reflects the length of time during which surgeries are open, and the timing of those periods relative to need. Limited temporal availability may create disadvantage for certain societal groups, for instance those who are employed and find difficulty in arranging time off work to visit the doctors. Stimson (1980) indicated that spatial disparities in potential access to GP surgeries are compounded by the extent and timing of surgery opening hours. These can be particularly acute due to a lack of early morning or evening surgery hours. Whilst the practice of grouping GPs may increase overall supply, it will not necessarily increase available consultation hours if surgeries take place concurrently or surgeries are not available at different times.

Studies which incorporate temporal characteristics of service provision tend to take an aggregate view of space which masks local variation in provider characteristics (Joseph and Phillips, 1984). Measures of regional availability of provision, measuring supply against demand, tend to follow this approach (Stimson, 1981). A measurement such as average number of consultations per hour is used to weight GP availability in relation to the population served. This leads to the creation of location quotients, following Knox (1979), but with adjustments made for temporal aspects of provision. Despite the inclusion of a temporal dimension, however, measures of regional availability suffer due to their level of spatial aggregation which can only provide an indicator of average provision in relation to average population characteristics.

One notable study which attempted to overcome the shortfalls of the regional approach to determining provision was presented by Knox (1978, 1979; see also Joseph and Bantock, 1982). The research was notable for two reasons. Firstly, the effect of distance on utilization was measured, a dimension which is considered in section 3.4.4; secondly, temporal provider characteristics were measured in terms of size of surgery rather than timing of surgery hours. Rather than measuring GP supply in terms of either numbers of surgeries or number of GPs, the research used a measure of size of surgery facilities. This was taken to be the total consultation time available in a particular neighbourhood. It provides a method by which spatial and temporal provision could be appropriately identified and measured interdependently.

3.4.3 Cross-boundary flow effect

The organisational partitioning of a health care system has a considerable impact on inequality of health care provision (Jones and Moon, 1987). Administrative areas, be they RHAs, DHAs or localities, form the general basis for examination of inter-regional inequalities in provision and can also be used for intraregional study. A major drawback of using such areas is that they are artificial in the sense that all such boundaries are arbitrary. Regional approaches to investigating health care inequalities tend to be based on the premise that these boundaries are impermeable and that the population of each region only has access to the GP services available in the same area. Such an assumption cannot be applied since health service boundaries do not correspond with autonomous administrative units and patients are, to some extent, given a choice on where to obtain health care. Furthermore, patient choice is not constrained by these boundaries, and if a patient resides on or near the boundary between two DHAs it may be expected they will use neighbouring provision if it is more reasonable to do so. Boundaries between regions and districts are thus permeable and some account of cross-boundary flow needs to be taken into account.

If a regional analysis is based on large areas, then the problem of measuring cross-boundary flow may not be so critical since it is reasonable to assume that the vast majority of inhabitants in a large area will also use the provision in the same area (Joseph and Phillips, 1984) although boundary effects will still occur. However, with increasing disaggregation of service areas this assumption becomes less tenable. At the small area scale, where low levels of spatial aggregation occur, permeability of borders needs to be considered and the flows in each direction between neighbouring districts should be modelled. Such flows might not need to be modelled if the number of patients from one area using services from another area, and vice versa, counterbalanced. Rarely, however, will this situation exist. Furthermore, cross-boundary flows are not equal at any given point along a border, due to population distribution and the provider characteristics of neighbouring districts. It would therefore be erroneous to examine provision for a DHA without incorporating adjustments to determine the quantity of provision used by people from outside the DHA or the amount of extra provision available from neighbouring DHAs. This is particularly crucial in boundary zones.

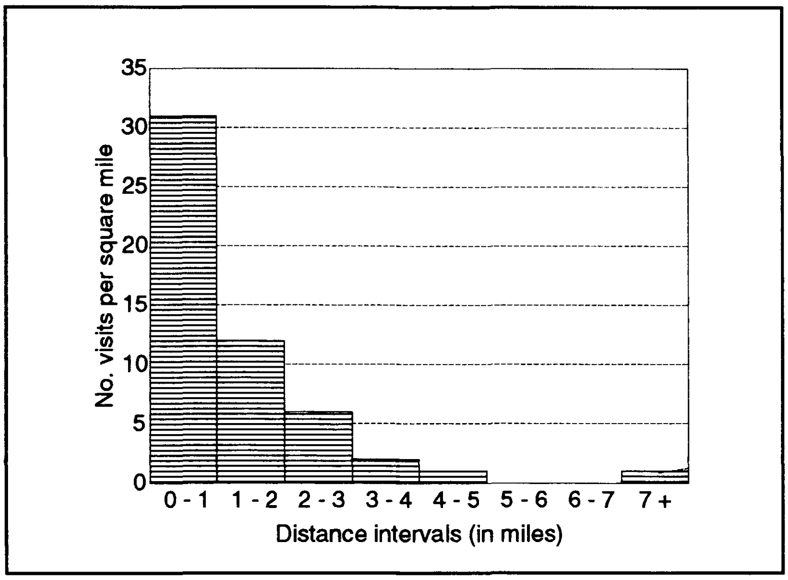
3.4.4 Distance decay effect

In addition to the inverse care relationship between location of provision and population characteristics, spatially discrete provision leads to differential physical accessibility (Fiedler, 1981). Distance between provider and user is a principal component of physical accessibility.

A non-linear relationship exists between distance to point of supply and consultation rates, termed the distance decay effect. This suggests that those who have further to travel to a surgery are disadvantaged in relation to those who live closer; consultation rates thus tend to be higher for closer patients. Pinch (1988) described this as a tapering effect. In quantitative terms, those who live closer may consult their GP up to three times more often than those who live over 2.5 miles (4km) away, a problem compounded by socio-economic hindrances to accessibility such as the lack of available transport (Whitehouse, 1985).

Evidence to support the effect of distance decay is widespread. Ingram et al (1978) illustrate its effect in use of emergency services, where the use of emergency departments dramatically declines for people further than one mile (1.6km) away from the service (Figure 3.7). Similar results are presented by Magnusson (1980), although decay rates were calculated here in terms of time rather than ground distance.

Figure 3.7 Distance decay effects in the use of emergency department services, Humber Memorial Hospital, Toronto.
(after Ingram et al, 1978)



Studies into distance decay effects in relation to secondary care facilities are more numerous than those of primary care provision due to the lack of available practice data (Joseph and Phillips, 1984). However, some evidence exists to explain why distance decay results in differential consultation rates for General Practice. One of the most notable studies examined respondents according to age, sex, education and mobility (Haynes and Bentham, 1982). With decreasing patient access to a surgery, GP consultation rates declined, sub-groups of patients being affected in different ways in rural areas: individuals resident in more remote areas had lower consultation rates (Table 3.3).

Table 3.3 Percentage rates of GP consultations by area type and population characteristics, Norfolk, England
(after Haynes and Bentham, 1982)

GROUP		ACCESSIBLE RURAL (%)	REMOTE RURAL (%)
Age:	18-44	22	9
	45-64	23	11
	65+	21	27
Sex:	Male	18	13
	Female	25	12
Car:	Owner	22	10
	Non-owner	26	20
Social:	Manual	22	12
	Non-manual	21	12

Distance effects differed markedly between the accessible rural areas and the remote rural areas, especially for the old and immobile. Such patterns of use cause concern since it implies that the groups which probably have a higher need for health care (such as the elderly and manual workers) do not obtain it as readily. Additionally, those who experience some form of material disadvantage, such as lack of car ownership, are also doubly disadvantaged.

As this discussion shows, distance clearly hinders accessibility and its effect exacerbates inequalities already experienced by disadvantaged consumers. Other research into disaggregation of patient characteristics supports the assertion that distance does not affect patients in the same way (see Girt, 1973; Parkin, 1979).

Size of GP practice may also be implicated in the distance effect, for with increased practice size, in terms of number of GPs, usually comes an increase in catchment area. Stimson (1981) found that, for practices with more GPs and larger catchment areas, the distance decay effect has a greater impact than a single practice GP with a smaller catchment.

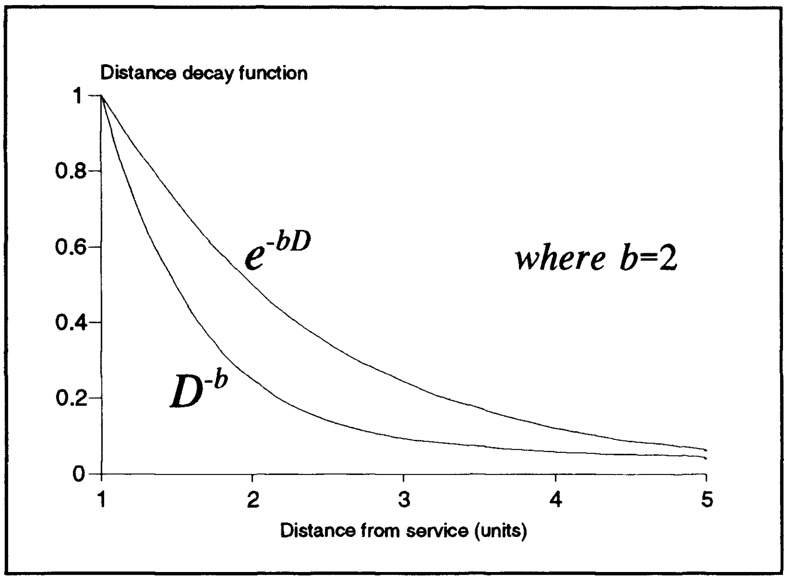
Distance decay, therefore, does not operate in isolation of either provider characteristics, in terms of size of supply, or consumer characteristics, in terms of levels of need and socio-economic accessibility. Any attempt to determine distance decay should be made with this in mind and should endeavour to incorporate wider characteristics to avoid gross generalisations in the effect of distance on consultation.

Further complications arise in the assumptions upon which measures of distance decay are based. Many attempts to model distance decay assume that, given a choice, people are most likely to use their nearest GP. This, however, may not be the case (Phillips, 1979). Since it is not possible to obtain information on which service is used from routine sources, any use of distance decay measurements must be treated with caution. Nevertheless, there is widespread agreement on the overall relevance of distance decay and its effect on utilization. In working towards a method of measuring the effect, the remainder of this section discuss the actual definition of an appropriate distance decay function, capable of measuring the relationship between location of the patient and point of delivery.

Knox (1979) notes a reasonable degree of sophistication in the construction of geographical models to examine the effects of distance. The initial evaluations of catchment areas and 'sphere of influence' of cities, shopping districts and individual shops and services by Reilly (1929) and Haggett (1965) were precursors to more quantitative measures of physical accessibility developed, for example, by Symons (1971) and Smith (1977). In modelling distance decay, measurement can take several forms; Morril and Kelley (1970, extended in Joseph and Phillips, 1984) summarise three main types of function which can be used in relation to health care delivery: firstly, power functions based on gravity modelling approaches (D^{-b}); secondly, negative exponential functions (e^{-bD}); and, thirdly, some combination of the two. As

Figure 3.8 shows, the effect of these different approaches will alter the nature of the distance decay effect such that, with *b*=2, the power function approach would result in a sharp curvilinear reduction in physical accessibility with increasing distance (1, 1/4, 1/8, 1/16, etc.). The exponential function approach results in a slower reduction in physical accessibility with each additional unit of distance (1, 1/2, 1/4, 1/8, etc.). A combined approach would produce a distance decay curve intermediate between these two functions.

Figure 3.8 Approaches to specifying distance decay functions (author, 1998)



Despite the availability of different approaches to specifying distance decay, Joseph and Phillips (1984) suggest that there is no a priori basis for selection. They note a lack of studies of GP service utilization detailed enough to define distance decay effects accurately and also note that the complex interaction of spatial and non-spatial influences on utilization makes such a task almost impossible. Given the state of knowledge in this area there is thus little value in being over-concerned about the minutiae of the distance decay function; what is clear is that a marked reduction in utilization occurs as distance increases.

In terms of incorporating distance decay into a model of health care provision, Knox (1978; 1979) provides what Jones and Moon (1987) consider to be one of the best known approaches. Initially, an index of potential accessibility is calculated as follows:

$$A_i = \sum_{j=1}^{n} \frac{S_j}{D_{ij}^{\,k}}$$

where: A_i = accessibility in neighbourhood i
S_j = total GP surgery consultation time available in neighbourhood j
D_{ij} = distance between neighbourhood i and j
k = distance decay function

and: $\sum_{j=1}^{n}$ = the summation of the term across all neighbourhoods, from the first (j) to the last (n)

This index incorporates size of surgery measured in total consultation time available (as opposed to simple number of GPs) as well as a negative exponential distance decay function. The function ($e^{-1.52D}$) was defined through regression analysis of the fall-off of patient registration data with distance, although this approach has been open to debate (Barnett, 1981; Joseph and Phillips, 1984). The choice of the exponent of distance was based on data from one GP practice in suburban Liverpool and its applicability in general terms is, possibly, questionable. Joseph and Bantock (1982) also provide a method of determining distance decay in their measure of intraregional accessibility. This method is a power function, with the distance exponent fixed at -2. As noted above, however, the choice of which distance decay function to apply, and the appropriate distance exponent, is inevitably arbitrary.

3.5 SUMMARY

This chapter has reviewed the components of utilization and the impact of certain factors as part of this process. It has emphasised differences in need and hindrance to accessibility as obstacles to utilization. It has also considered the components of provision and the extent to which spatial inequalities in provision can be measured. In particular, it has identified that:

- inequalities in ill-health exist and differences in need can be identified through an understanding of health status, social and economic disadvantage and environmental conditions;
- compounding the problem of differences in need is the effect of transport availability, personal mobility and service awareness as obstacles to accessibility; and
- provision is more accurately defined by considering GP supply in terms of its temporal as well as spatial dimension and also through an assessment of cross boundary flow effects and distance decay effects;

This chapter has discussed the components of utilization in broadly conceptual terms. The next two chapters present the design, implementation and analysis of a patient survey to enable the subsequent choice of indicators to be validated. In so doing, the conceptual discussion here is supported by primary evidence prior to the selection of indicators during the construction of the model (Chapter Six).

4 PATIENT SURVEY

4.1 INTRODUCTION

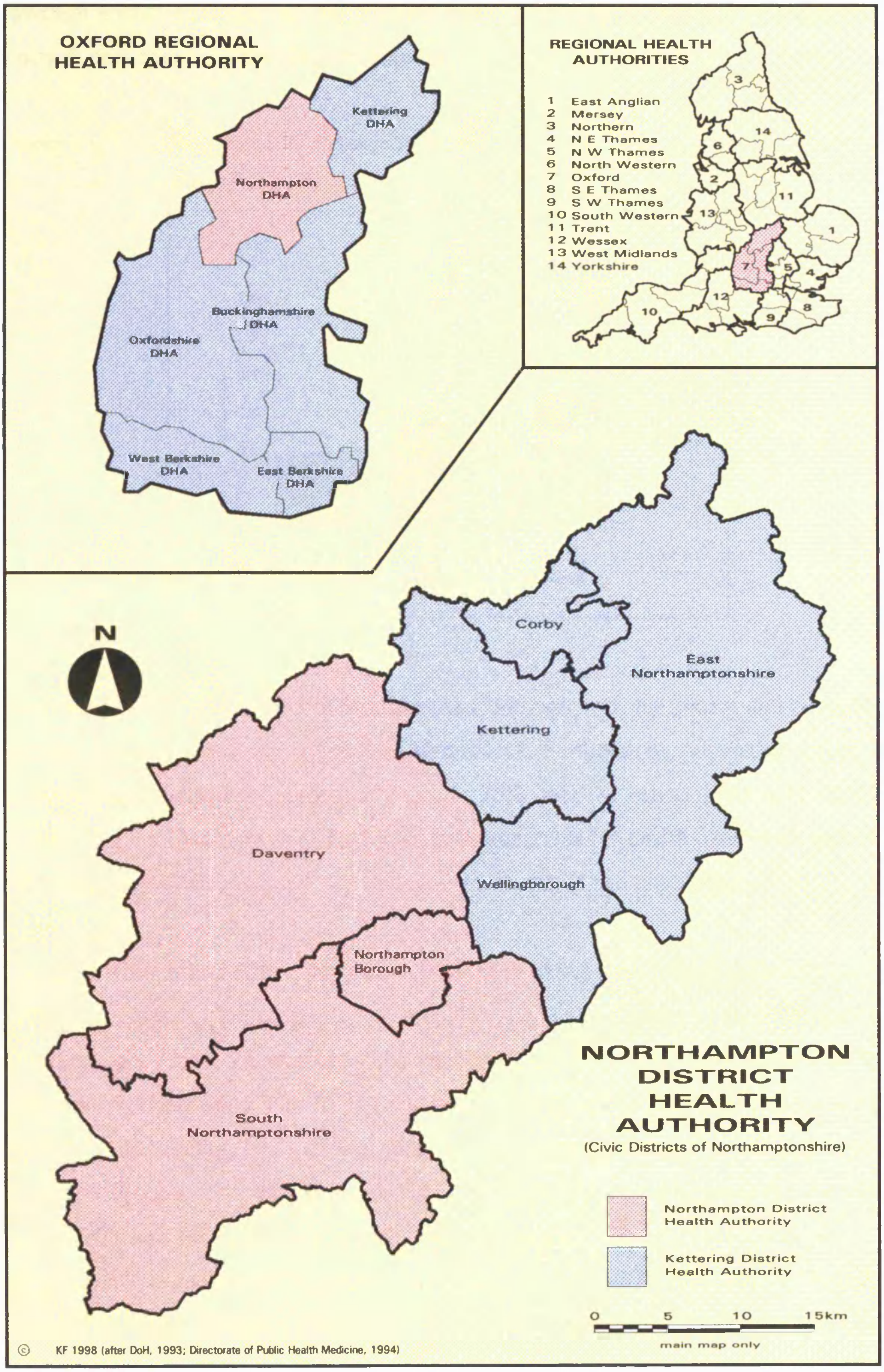
A large scale survey was undertaken to provide information on patient utilization of primary health care services in the Northampton District Health Authority area. Part of the survey was designed to investigate patterns of utilization behaviour and the obstacles they may encounter getting to their GP. This Chapter discusses the methods employed in implementing the survey and an assessment of the response. The results are then examined in Chapter Five and, in conjunction with the conceptual discussion (Chapter Three), are used to inform the selection of indicators in designing the model of utilization (Chapter Six).

4.2 NORTHAMPTON DISTRICT HEALTH AUTHORITY AREA

Chapter One highlighted current changes in health care administration, including the impact of organisational partitioning. RHAs and DHAs provide the framework which facilitate the management and organisation of the NHS resources. A DHA therefore provides an appropriate spatial framework in which to carry out the research. Importantly, it will enable an assessment to be made of the extent to which needs of the local population are catered for in relation to the provision determined by the DHA. The choice of Northampton District Health Authority (NDHA) area as the case study area is based on a number of reasons.

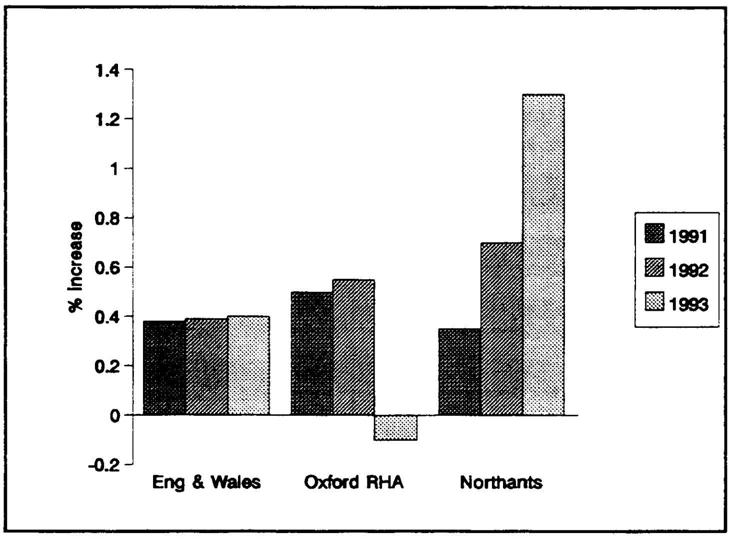
The NDHA area encompasses the civic districts of Northampton borough, Daventry and South Northamptonshire (Map 4.1) and its characteristics make it a suitable case study area. The three districts cover an area of 1380km^2 with a population of 314,138 and contains diverse rural and urban areas, industrial and agricultural environments and both relative affluence and pockets of social deprivation. The main town is Northampton which has been described as a rural market town with inner-city problems (NHA, 1995). Additionally, part of the NDHA, and surrounding, area has been designated as overspill zones for London. This has resulted in a rapid population growth, particularly of young people with young families, and the related increase in need for affordable and plentiful housing.

Map 4.1 Northampton District Health Authority



The rate of population growth in the county in recent years has been higher than the average growth for England and Wales (Figure 4.1) with the majority of population growth occurring in Northampton borough.

Figure 4.1 County population change 1990-1993 (after NHA, 1995)



Around 184,000 people live in Northampton borough with the recent and projected growth due to a net inward migration (Figure 4.2). Furthermore, population forecasts predict that growth will continue at a rate of 15% over the period 1993-2011 (NHA, 1995). Such an increase in population has implications for health care needs and the resources required to maintain or improve the health of the population.

Coupled with an increase in population have been changes to the population structure with an increase in the proportion of both the young and elderly. The proportion of children aged under 15 years has increased to 35% of the total population and the number of people aged over 65 has also risen to 14% of the total population (NHA, 1995). Additionally, NHA (1996) also predict dramatic changes to the population structure (Figure 4.3). In particular, the 0-14 year age band will gradually increase until 2003 and then slowly decrease. The 15-64 and 75+ age bands will show a steady increase and the 65-74 year band will decrease until 2001 and then rise sharply. Despite the apparent decrease in the 75+ age group the proportion of people aged over

85 is predicted to rise by over a third by the end of the century. Given the increase in health care needs exhibited by young and elderly populations these trends also have implications for health care resource planning.

Figure 4.2 District population change
(after NHA, 1995)

(a) district population total 1991 (b) district population increase 1991-1999

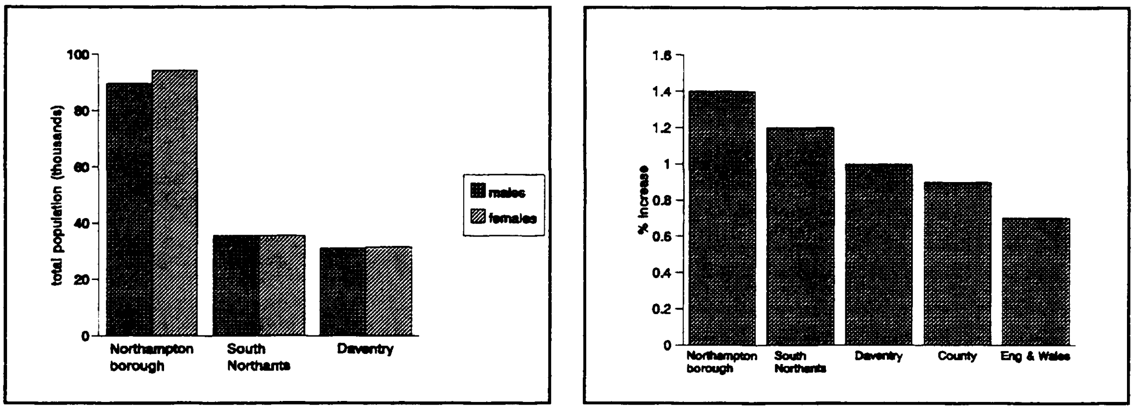
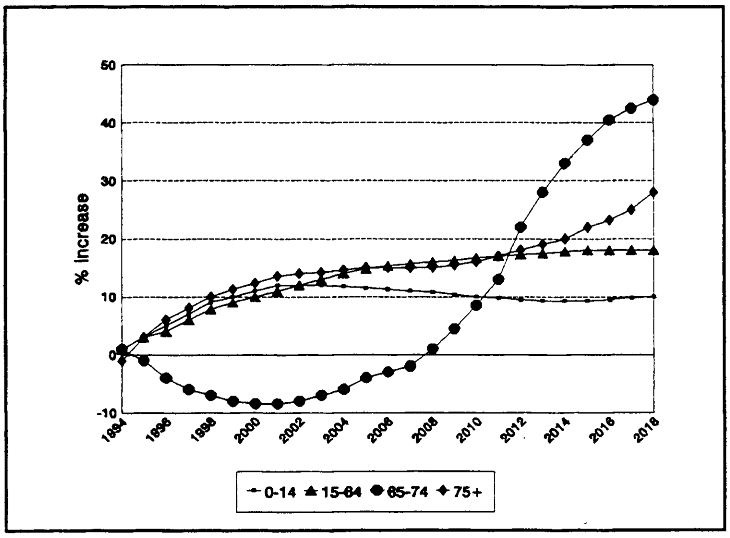


Figure 4.3 Percentage predicted changes in population by age
(after NHA, 1996)



Unemployment rates are below both regional and national averages. In December, 1994, the county rate of unemployment was 7.2% compared with 9.2% in the East Midlands and 9.9% for the United Kingdom. Economic prospects have improved since the recession of the early 1990s and Northamptonshire has experienced a sharp fall in unemployment (NCC, 1995). Despite the overall county rate falling some urban areas, particularly in Northampton, continue to exhibit high levels and a marked difference from neighbouring rural areas.

The rate of reported Limiting Long-Term Illness (LLTI) is lower, at 9.7%, than the national average of 12%. However, the increase in proportions of elderly population is expected to be matched by an increase in LLTI.

The proportion of ethnic minorities is also lower than national rates. In the county as a whole, 3.5% of the total population are within ethnic minority groups compared with a national proportion of 6.2%. Much higher rates of ethnic minorities occur in Northampton borough which will have implications for health care provision.

Finally, the NDHA area exhibits substantial social class differences. In particular, some areas in Northampton borough have high proportions of manual social class households (social classes IIIM-V). The proportion of manual social class households in some wards exceeds 80%, while the ward average for Northampton borough is 70% (NCC, 1995). Conversely, the predominantly rural districts of Daventry and South Northamptonshire have moderately high rates of non-manual households (37% and 38% respectively). At a more local level, some wards in these districts exhibit in excess of 60% of non-manual social class households.

The choice of the NDHA area therefore provides a case study which is both eclectic in character and which is in the process of demographic change. In order to maintain effective health care provision the NDHA must be able to determine differences in health care needs and respond to change. It is in this context that the development of new tools to assist health care planning are appropriate. This research enables a study to be made of the differences in health care utilization in this area to contribute to local understanding. Furthermore, the diversity of built environment and socio-economic circumstance means that the research can reflect such characteristics and is not constrained by an area with limited variation. In this way the research maintains a wider applicability.

Rapid change in the organisation of the NHS means that it is often difficult to keep pace with change. One consequence of recent changes has been the reorganisation of RHA and DHA areal units. As of 1st April 1994 the Northampton DHA merged with Kettering DHA to form Northamptonshire DHA covering the whole county. At the same time the Oxford RHA and East Anglian RHA merged to form the East Anglian and Oxford RHA. Furthermore, on 1st April 1996, the Northamptonshire Family Health Services Authority (FHSA) and the NDHA were merged into Northamptonshire Health Authority (NHA). The remit of public health care provision in the new HA has expanded to include clinical advice to primary care, clinical audit in primary care and clinical aspects of quality. The key tasks of the new authority emphasise effective management of provision to meet patient needs. These are:

- analysis of the demographic and health characteristics of the county and its localities;
- assessment of the need for health care;
- development of the strategy for health care in the county as a whole and for individual care groups and diseases;
- managing the Health of The Nation strategy in Northamptonshire;
- working with providers of health care to improve its quality and effectiveness; and
- Environmental health and the control of communicable diseases.

(Directorate of Public Health Medicine, 1996)

These very recent changes have taken place during the life of this research with the result that the areal unit under investigation no longer exists as a separate administrative unit. Whilst the recent merger may have implications, particularly the fact that purchasing of health care is now county-wide, it is not yet feasible to incorporate the effects of reorganisation into the study. As such, this research is based on NDHA as it existed prior to 1st April 1994. The case study area thus comprises the county districts of Northampton borough, Daventry and South Northamptonshire within the county of Northamptonshire.

4.3 SURVEY AIMS

The survey was administered with cooperation from the NDHA and provided an opportunity to collect data for a range of purposes to suit the needs of this and other research[1]. The broad aim of the questions pertinent to this research is to provide data which can be used to inform the selection of variables in the model of utilization. It is important to examine patient utilization to assess the extent to which the conceptual discussion of utilization (Chapter Three) is validated by actual patterns of use. More specifically, the survey aims are to:

- investigate spatial and temporal utilization of General Practitioner primary health care services for a sample of patients;

- ask patients about aspects of the methods used to get to their GP;

- ask patients about obstacles encountered in accessibility to health care services; and

- question patient views on their satisfaction of the health care service provided.

The survey is not designed to investigate any possible differentiation in the quality of services from one GP practice to another. However, it is acknowledged that differences in patient perception of their GP may impact upon their utilization behaviour and the survey attempts to discern these effects.

In order to address the aims of the survey, data must be gathered from those who regularly make use of primary health care services. Patients who have been diagnosed as having a particular condition and who therefore have an expressed need (Section 3.2) for primary health care meet this criterion. This ensures comparability of need,

1 This Chapter focuses on those parts of the survey specific to this research. A copy of the full questionnaire can be obtained from the author.

based on diagnosis, with respect to the type of health care required, albeit to different extents. A sample based on the general population would create difficulties in interpretation since they may have vastly different diagnosed or undiagnosed needs and different health care requirements. A more general survey of this type would not be as robust when comparing different patient responses and, in this sense, the diagnosed condition acts as a control for comparing the experience of different patients with the same condition.

The choice of which condition to focus on, leading to the identification of patients from which to sample, was guided by current concern and parallel research aims of the NDHA. Asthma and diabetes have been identified as a focus of concern for the NDHA who have designated them as local priorities (NDHA, 1993; 1994; 1996). Increasing attention has been given to these conditions in recent years, in particular asthma, and escalating levels of public concern are being addressed through research into causes, treatment and prevention (NHA, 1996).

The two conditions are widespread and affect a broad cross-section of the population. They are not overtly manifest in particular societal groups based on demographic or socio-economic conditions although some variation is expected. It is therefore possible to use these conditions to examine trends within the population and determine whether utilization and obstacles to accessibility differ commensurate with the conceptual discussion of utilization rather than being predominantly determined by the condition itself.

Furthermore, the use of two conditions will allow a comparison to be made of potential differences in utilization behaviour based on condition. This allows an assessment to be made of any gross differences in behaviour, across different conditions, and the extent to which these may affect wider applicability of the model.

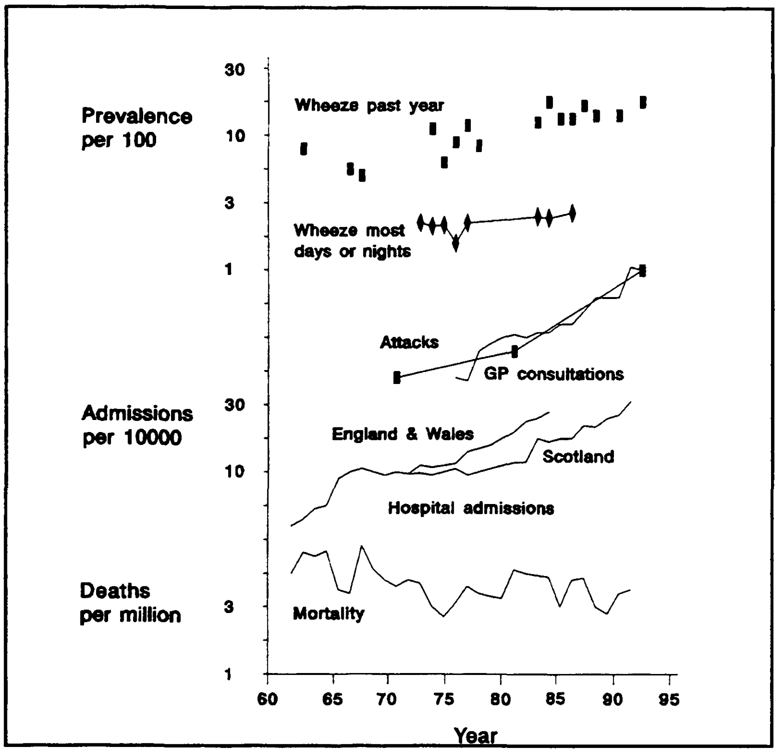
Finally, because these people have expressed a need for health care they require the use of health care services on a regular basis. This provides a group of health care users able to comment on questions of utilization and accessibility based on experience. It is questionable whether the views of a member of the general population, who may not visit the doctors regularly, would be so well-founded. Whilst it may be valuable to discern the characteristics of utilization of the general public it would also not be possible accurately to determine relative levels of need to allow comparison of response.

4.3.1 Incidence and prevalence of asthma

In recent years there has been a documented rise in the number of people suffering asthmatic symptoms and an increase in their severity. Five to seven per cent of adults and ten to fifteen per cent of children are reported to be affected by asthma (NDHA, 1996). The chronic effects of this condition disrupts everyday lives and leads to coughing, wheezing and breathlessness. Up to three million people in the United Kingdom require treatment for asthma at any one time and, in Northamptonshire, this represents approximately forty thousand people. Additionally, acute episodes lead to around two thousand deaths per year in the UK attributable to asthma (HMSO, 1995). HMSO (1995) also provide further evidence suggesting that prevalence is increasing, leading to a total cost to the NHS of approaching £1 billion per annum. Figure 4.4 illustrates these trends of temporal variation of a number of different asthma indicators in schoolchildren, the age group used for the majority of studies. In all instances the general trend is increasing, indicative of a 20-30% relative increase in prevalence of wheezing or diagnosed asthma for the period 1962-92.

Further evidence of an increase in asthma can be determined from an examination of trends in hospital admissions and general practice contacts. Whilst changes in reporting, diagnosis and referral will affect the temporal pattern of admission rates there has been a clear increase from 1958 onwards (HMSO, 1995). In the 0-4 age group hospital admission rates showed a thirteen-fold increase; a six-fold increase is evident in the 5-14 age group. The trend in adult admission rates is less marked but does, nevertheless, show an increase.

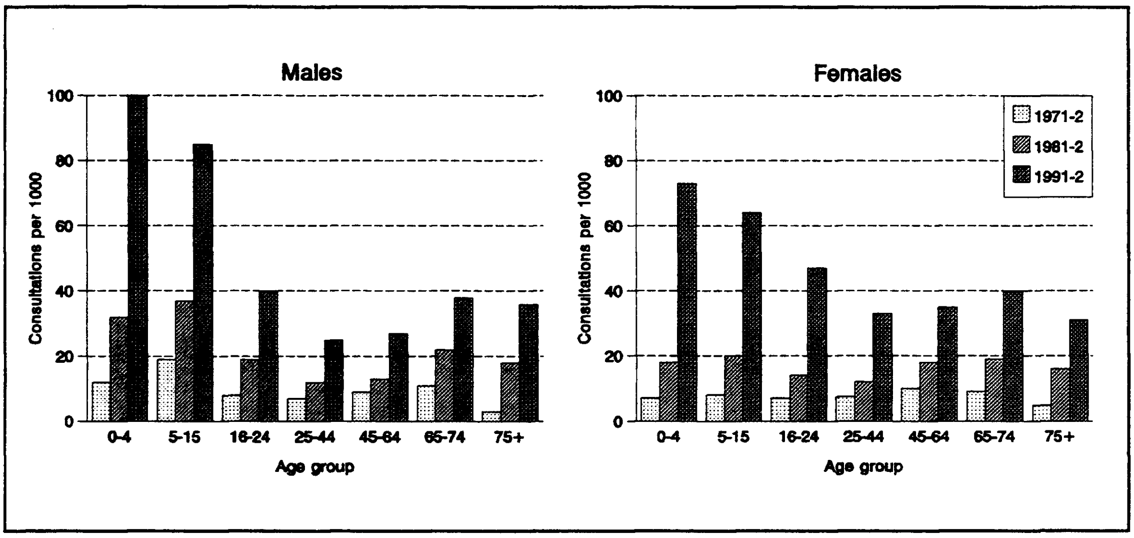
Figure 4.4 Time trends in indicators of asthma among British schoolchildren, 1962-92 (after HMSO, 1995 p3)



The number of persons consulting their GPs for asthma has also shown a marked increase for all age groups as Figure 4.5 illustrates (HMSO, 1985). Consultation rates, however, need to be interpreted with caution. They do not necessarily provide evidence of an increase in prevalence or severity; instead, the increase in consultation is more likely to be a result of changing patterns of service utilization (HMSO, 1995). However, Anderson (1989) suggests that changes of this magnitude cannot simply be explained by changes in diagnostic labelling and must be indicative of an increase in prevalence. Whether asthma has increased in prevalence, or not, hospital admissions and GP consultations have undeniably increased leading to larger asthma related workloads.

Whilst changes in disease labelling, consultation and referral are seen to be partly responsible for temporal increases in admissions and GP consultation, HMSO (1995) also note the general increase in allergic disease in industrialised countries in the postwar period. The prevalence of atopic asthma (the tendency to develop allergic

Figure 4.5 Patients consulting their GP for asthma by sex and age, England and Wales 1971-2, 1981-2, 1991-2
(after HMSO, 1995 p93)



antibodies to environmental agents) has risen similarly yet the increase may have been masked by a decline in other forms of 'wheezing' related illness. This is partly due to the major changes in air pollution in the UK over the past 40 years. Most notably, urban smoke and sulphur dioxide (SO_2: winter smog) have declined, as a result of the 1956 Clean Air Act, whereas pollutants related to vehicle emissions may be increasing.

Spatially, there is little evidence to suggest any significant regional variation, across the United Kingdom, in asthma prevalence or asthma related mortality. Furthermore, no apparent urban-rural differences in asthma prevalence exists (HMSO, 1995). Prior to 1960 an excess of urban pollution was evident but, whereas nitrogen dioxide (NO_2) levels are currently higher in urban areas, ozone (O_3) levels are higher in rural areas and there is little urban-rural variation in levels of SO_2. Prevalence of asthma is therefore more likely to be a function of 'western' culture and lifestyle characteristics rather than with urban living and the exposure to associated airborne pollutants. Such characteristics more often relate to the indoor environment and include inhalation of smoke, fumes, chemicals and allergens; house dust, mite allergen and exposure to pets; respiratory infections; certain foods; exercise; and emotional stress or excitement.

The current concern about asthma, the increase in prevalence and associated increases in hospital admissions and GP consultation make it a suitable condition to study. A survey of diagnosed asthmatics will lead to a more detailed understanding of their lifestyle characteristics and utilization behaviour. The fact that asthma does not show marked geographical variation also makes it a suitable health outcome for study since variation in patterns of medical care and utilization may be more readily evaluated.

4.3.2 Incidence and prevalence of diabetes

Diabetes is the second condition selected for study. The need for a second condition was, primarily, to act as a control for the results obtained from the asthma cohort. Despite the lack of geographical variation in incidence of asthma it is possible that the case study area may contain anomalies which are not envisaged. The use of a second condition can test for any such anomalies and ensure that the survey is not biased towards the distribution inherent in one condition.

Diabetes is a chronic disease caused by the body's inability to handle sugar properly. This leads to a raised level of glucose in the blood which can be controlled either by regular injections of insulin (insulin-dependent diabetes) or through diet or oral medication (non insulin-dependent diabetes). The cause of diabetes is not fully understood but appears to be multifactorial and very little geographical research has focused on the condition.

Insulin-dependent diabetes often starts in childhood, most commonly around the age of 10-13 (NDHA, 1995). The onset is more common during spring and autumn which has led to suggestions that it could be triggered by viral illness. Increased susceptibility is also evident where a family history of diabetes exists meaning that genetic factors are, at least partially, causal.

Non insulin-dependent diabetes tends to occur in later life and is strongly linked to increasing age and obesity (NDHA, 1995). It is also linked to genetic factors and, although it occurs across the demographic spectrum, some ethnic minorities are more susceptible than others. The Asian population, for example, reports higher levels of non insulin-dependent diabetes. Furthermore, people in affluent, well-fed populations are between two and twenty times as likely to develop non insulin-dependent diabetes as lean populations of the same ethnic background.

The onset of diabetes can lead to further problems such as blindness, renal failure or vascular disease. Early diagnosis and preventive treatment is essential to reduce the number and severity of later complications. In this sense, access to good quality primary health care is vital for effective control of the disease.

Diabetes (both forms) affects approximately 2% of the population and is therefore not as prevalent as asthma. In Northamptonshire this equates to about 11,000 people. The condition is not affected by the sort of environmental conditions which have been attributed to asthma and there is no evidence of geographical variation at either regional or local scales. This ensures that patients with diabetes can be investigated with the assumption that external environmental factors are not thought to be a major causal factor.

With preventative care being paramount, the NDHA have set up a Local Diabetes Strategy Advisory Group (LDSAG) to ensure the following:

- dissemination of education about diabetes for patients and professionals;
- monitoring and auditing of patient care;
- integrating primary and secondary care; and
- regular reviews for all diabetics.

This strategy ensures that diabetics are closely monitored and provides a cohort of patients who, therefore, require regular treatment. Utilization behaviour and the obstacles to accessibility associated with regular use of primary health care services can therefore be examined.

4.3.3 Impact of medical ethics on the survey

Since the subject matter of this thesis is based around aspects of health and health care utilization the issue of medical ethics must be considered. This inevitably leads to the acceptance of certain logistical constraints on all aspects of the survey from the choice of data collection method through its design, sampling, distribution, collection and analysis.

The fundamental difficulty of implementing a survey to investigate utilization and accessibility from the patient perspective is that patients themselves must be recruited. A survey of the general population was inappropriate for the research (Section 4.3) and patients with the particular conditions identified therefore provide the most appropriate population from which a sample can be taken. This in turn presents difficulties given the confidential nature of the doctor-patient relationship which stipulates that at no time must the identity of an individual patient be discernible from the survey.

The maintenance of patient anonymity was monitored and approved by the NDHA Committee of Ethics. All stages of the survey were put before the committee for approval and various aspects of the survey amended to meet the committee's requirements and recommendations. The final research design thus represents a compromise between the initial aims of the study and ethical constraints.

The specific nature of the impact of ethical restrictions on the survey is detailed in the following Sections (Sections 4.4-4.6) which detail the method of data collection, survey design and sampling and distribution.

4.4 RESEARCH DESIGN

The purpose of the survey is to gather data from selected groups of patients, considered to be indicative of the wider population of health care users, to be used to inform the selection of variables in the model of utilization. The research strategy must therefore enable relevant information to be gathered in a form suitable for empirical comparative analyses. An examination of the applicability of different research methods will lead to an appropriate selection. Crucially, the method employed must be compatible with the positivist methodology allied to this research, namely the creation of an empirical model within a GIS. The initial choice of research design is between qualitative and quantitative methods.

The aim of a qualitative approach is primarily to gain insight into processes, and studies typically involve using unstructured and semi-structured interviews based on themes designed to draw out the respondents' experiences and views. In this sense this approach is conversational, or a narrative, and resulting evidence is examined using textual analysis. Typical methods used are in-depth interviews and ethnography which produce a narrative account of events, actions and feelings which can be subsequently used to develop theoretical understanding. They do not aim to be representative and choose individual cases that will yield insights about the processes and contexts involved. Qualitative research methods are 'tested' by corroboration rather than replication.

Whilst a growing acceptance of these methods exists in geographical research they are not considered appropriate in this case due, in the main, to the issue of medical ethics (Section 4.3.3). Whilst it is possible to maintain some form of anonymity in the presentation of results from such studies - e.g. by substituting descriptive labels for places and people - the methods themselves are fundamentally interview-based. The very process of interviewing patients thus contravenes medical ethics since medical records would have to be consulted to determine individual cases, and patients selected according to their diagnosed condition. In this case, interview-based methods would provide qualitative data which would not be suitable for rigorous testing of the model of utilization, although they would, of course, help to explore the underlying issues and might help to develop more ethnologically-based models.

In contrast, quantitative methods of research design have their origins in 'scientific method', following positivist methodology and empirical analysis. A number of assumptions are made in the process of conducting quantitative research in that:

- the researcher is impartial;
- the research poses objective questions;
- the samples surveyed are representative; and
- statistical analysis can be used to understand the findings.

Typical methods are surveys of populations or samples, formal questionnaires and statistical techniques. These methods produce descriptive accounts and representative generalisations which can be tested through replication with explanation being discussed in statistical terms. Explanation is normally determined by establishing significant associations between variables, or by testing for differences between samples representing different conditions or populations.

Quantitative methods of research design were considered more appropriate than qualitative methods for this research due to both the issue of medical ethics and the need for quantitative data to inform variable selection under reasonably controlled conditions. Nevertheless, it is important to recognise that quantitative methods do contain limitations which need to be taken into account in the research design. These are summarised as follows:

- Despite the stated impartiality of the researcher, the questions asked and answers may be influenced by the researcher's values.

  Intrusion into the social context within which individual behaviour exists is inherent in a quantitative approach. Purely by the action of administering a survey, the social context of individual behaviour is removed which may create changes in perception in response to certain pre-determined questions. These effects cannot easily be accounted for or quantified (although methods such as test-retest strategies can help to assess their potential impacts).

- The degree to which the sample is representative may be questioned.

  The majority of surveys make use of samples of particular populations of interest since it is not normally feasible to undertake a 100% survey. This leads to the assumption that the sample is, indeed, similar in profile to the host population. Significant differences between the sample and host population weakens (or ultimately invalidates) any attempt at extrapolating from the results. This is an important consideration because of the serious difficulties often encountered in sampling human populations (especially in circumstances such as this, where ethical considerations limit access to individuals).

- Difficulties exist in generalising the results to other populations both temporally and spatially.

  A survey undertaken at a particular point in time is only representative at that time. Attempts to make use of survey results to assist explanation for different time periods may be erroneous since conditions may have changed. Furthermore, a sample taken at a particular place may not be representative of a sample taken from another place and attempts to interpret wider geographies may also be subject to error. The problem of non-representative samples may also exacerbate these generalisation difficulties.

- Interpretation of preset questions may vary between respondents.

  Problems may exist in the interpretation of questions by different taxonomic groups. This may subsequently lead to responses being erroneously compared based on the assumption that they have been considered on equal merit and understanding by the respondent. The validity of responses is a problem that cannot easily be predicted or assessed but which must be considered during design and piloting of the survey. Use of repeat or dummy questions, or test-retest strategies can help to evaluate these effects.

- Testing of the survey results is problematic since the events in question are not directly observable.

  Responses are based upon an individual's perception and their observation of the events in question. Inherent in this method of data collection is that observation of the actual events and processes they describe cannot be made by the researcher, since they are not in themselves directly observable. There is, therefore, no method by which the results of each response can be checked for their individual accuracy. Again test-retest methods, or comparisons of results across different samples of the same population, may help.

- The 'unique' aspects of results may be just as important to accurate explanation as general patterns or skewed characteristics.

  The implementation of quantitative methods assumes that representative generalisations are determined from an analysis of taxonomic groups, i.e. people sharing common attributes. However, it is possible to design open-ended questions to provide a more qualitative response which may be used to assist explanation and illuminate other analyses. In particular, these may provide individual insights which can help interpret statistical outcomes or further information not previously considered in the survey design.

Despite these limitations, quantitative methods have a strong pedigree in positivist geographical research. The use of a structured questionnaire, for instance, to elicit behavioural responses has been a fundamental instrument of research in geography (Gould and White, 1974), and use of these methods is widespread in medical geography and epidemiology where the focus of attention is often human groups (Ritchie et al, 1981; Whitelegg, 1982; Haynes and Bentham, 1982). Given the aims and ethical and logistical constraints of this study, the use of a structured questionnaire thus seems appropriate.

4.5 DESIGNING THE STRUCTURED QUESTIONNAIRE

The design of the questionnaire was undertaken in several stages. Initial consideration was given to the general focus and range of questions needed to meet the objectives of the survey. Questions needed to be devised which would inform and validate the conceptual discussion of variable selection (Chapter Three). In this respect, they should be able to elicit responses which can be used to validate the various components of need, accessibility and utilization incorporated in the model, as well as providing relevant background information on the respondents. Five themes were thus identified, namely:

- Background information

  Questions are designed to provide factual information on the socio-demographic characteristics of patients. These would be used to define the taxonomic groups for analysis purposes, thus allowing comparison with the differences in utilization behaviour identified in Chapter Three.
- Visiting the doctor

  Questions are designed to provide factual information on the utilization behaviour of patients.
- Getting to the doctors

  Questions are designed to provide factual information on the methods used by patients in getting to the GP surgery.
- The doctor's surgery

  Questions are designed to discuss the attributes of the doctor's surgery and the extent to which they influence decisions to consult. The questions assess patient knowledge of the services provided, including subjective styled questions which examine attitudes towards provision.
- Obstacles in getting to the doctor

  Questions are designed to identify possible obstacles to accessibility and the extent to which they influence decisions to consult. The form of the questions is subjective to examine attitudes towards the impact of potential difficulties in utilization and accessibility.

The second consideration was question format. The decision was taken to present the majority of questions in a closed format. In this way the patient is given a choice of pre-determined answers from which to select one. The following example illustrates the factual style of question used in the questionnaire with patients being asked to tick the appropriate response:

15. How far away is the surgery from your home?

Less than 1 mile	
1 to 3 miles	
4 to 5 miles	
More than 5 miles	

The decision to use closed format questions, in the main, was taken to reduce the problems associated with open-ended questions. Firstly, some patients may be able to articulate their ideas more easily than others which creates inevitable bias towards fuller, more articulate answers. Secondly, open-ended questions are both time consuming and problematic to code and subsequently classify for comparative analysis. Furthermore, open questions may allow greater inaccuracy and inconsistency in response. Using question 15 (above), for example, problems could exist where a patient is asked to indicate the distance to their doctor's surgery. Inaccuracy or uncertainty may be introduced due to an individual's ability to estimate distance. The closed format of this question should help to reduce such problems, by focusing responses within clearly defined ranges. Nevertheless, the limitations of closed format questions need to be recognised. In particular, they may inhibit respondents' choice of answers and may to some extent result in loss of potentially useful information. To counteract this effect, a number of open-ended questions were included inviting patients to add further information which they felt was not part of the structured questions but which they, nevertheless, deemed important. For example:

24. Are there any other difficulties you encounter when arranging to see a doctor?

(Please state)

In designing the questionnaire the language used was kept to its simplest form and questions were expressed in a way which patients could easily understand. For example, the use of the word 'doctor' replaced 'general practitioner' or 'GP'. Questions were kept short to avoid any possible confusion in the meaning. Furthermore, questions were designed so they could not be seen to be leading or prompting patients for particular responses. This principle was also applied to the order of questions to reduce the possibility of the sequence leading the patient to answer in particular ways.

Prior to its implementation, the questionnaire was submitted to the NDHA Committee of Ethics for approval. The Committee approved the questionnaire with a few changes to the wording. Due to the nature of the questions relating to the patient's view of their doctor, the Committee did not allow choices of answer which could be interpreted in a way which may imply a level of competence. In particular this related to question 25 with the change being effected as follows:

Draft question:

25. Do you find your doctor easy to approach?

If No, please state your reasons:

Yes	
No	

Approved question:

25. Do you find your doctor easy to approach?

Very easy	
O.K.	
Difficult	

Unfortunately, this change blurred the meaning of this question and although it was included in the questionnaire the semantic difference between 'very easy' and 'O.K.' is not clear and leads to difficulties in interpretation. It was not, therefore, used for analysis purposes but provides an example of the difficulties experienced in obtaining ethical approval of the questionnaire.

The approved questions used in the survey are presented in Appendix One. They are presented in the order in which they were designed, under the five themes identified earlier. The original question numbers are maintained. These numbers reflect the circumstance that the questions used for this study were part of a larger survey, and the different order of questions imposed to avoid leading responses.

4.5.1 Locating patients

In order for the survey responses to be used to validate variable selection or test the model of utilization it was necessary to devise a method of spatially locating each response in the GIS. Crucially, each response needed to have a spatial component but be at a resolution sufficient to ensure that identification of individual patients was not possible. This issue was of particular concern to the NDHA Committee of Ethics. The use of patient postcodes was agreed as a suitable method in this context.

An increasing number of health and health care studies now use the postcode as a means of location, within GIS, since there is no other suitable device to reference patients or points of service delivery spatially. Software which can spatially reference a patient based on the centroid of their home is by no means complete and remains commercially expensive. The postcode provides a suitable proxy to which an Ordnance Survey Grid Reference (OSGR) can be assigned allowing data to be spatially referenced with other useful data sets.

Compliance with medical ethics dictates that the location of individuals based on their health outcomes is a doctor-patient relationship and in that sense is strictly private and confidential. The postcode offers a degree of location acceptable to the NDHA Committee of Ethics (Section 4.3.3) since it does not identify individuals. It gives a reasonably accurate spatial reference for any point location (e.g. a patient's place of residence) without infringing requirements for individual anonymity. It is also a standardised and nationally recognised system of georeferencing, which facilitates integration of different data sets and comparisons across studies.

The postcode is constructed in two parts, the outward code and the inward code. In a hypothetical code, AB1 2CD, AB1 is the outward code and 2CD is the inward code (Figure 4.6).

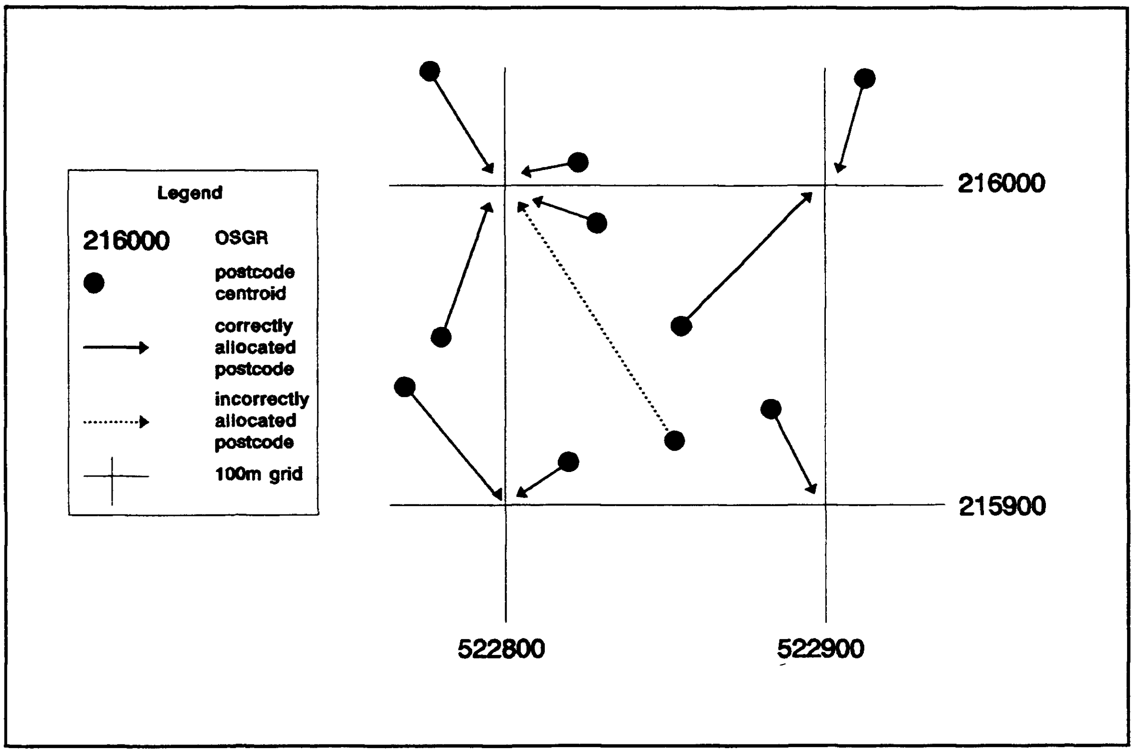
Figure 4.6 Structure of the UK postcode
(after Raper et al, 1992)

Outward code		
AB	-	Postcode area
AB1	-	Postcode district (within the postcode area)
Inward code		
2	-	Postcode sector (within the postcode district within the Postcode area)
CD	-	Code given to identify a street or group of houses within the Postcode sector (within the postcode district within the Postcode area)

The outward code comprises codes to locate the postcode area and the district which identifies the town or district to which mail is sent. The largest unit area is the postcode area, usually an area centered on nodes in the transport infrastructure, identified by the initial alphabetic characters. The numeric character in the outward code defines the postcode district. The remainder of the postcode, the inward code, defines the sector within the district and also the street or address to which the mail should be delivered.

In order to use the postcode as a spatial identifier it must be manipulated to georeference it with other data sets in the database. The postcode must be translated into another code in order to analyse it with other data sets using the OSGR spatial frame. It is possible to attach an OSGR to a postcode for this purpose despite difficulties due to the fact that the OSGR represents a point feature whereas a postcode represents a small area. The OSGR approximates to the centroid of the area covered by the postcode, though in actual fact it is defined not by the centre of the geographic area, but by the location of the first address in the postman's beat. The location of postcode area centroids and, hence, the derivation of OSGRs has been the subject of some discussion in terms of the accuracy which is implied by a point feature, particularly within a GIS (Gatrell, 1989). Software is available which spatially references postcodes to OSGRs (for example, Postzon, PAF and GB Profiler) but they all contain widely acknowledged errors since centroid locations are derived from the Post Office's Central Postcode Directory (CPD). Errors have been summarised by Raper et al (1992) who illustrate the accuracy of the OSGR to be 100m due to the fact that the northing and easting coordinates of postcode centroids in the CPD end in zeros (Figure 4.7). In other words, the postcode centroid is rounded to the south-west corner of the 100x100m grid square in which the first address in the postman's beat is located.

Figure 4.7 Allocation of postcodes to 100m OSGRs (after Raper et al, 1992 p76)



Although there are sufficient OSGR digits to allocate a postcode to a resolution of 10m, the fact that the grid coordinates used in the CPD are at 100m intervals means that postcode centroids are approximated to their nearest 100m grid intersection. Furthermore, Gatrell (1989) suggests that only 72% of Postcodes within the CPD are actually located to within 100m of their actual location. The pecked line in Figure 4.7 illustrates the possibility of incorrect assignment of OSGRs. To overcome the problem of resolution and inaccuracy, he suggested that the Pinpoint Address Code file (PAC, which plots the centroid of each house) should be used. This reduces the errors and avoids the regular distribution of postcodes which otherwise tends to occur at large scales. Other databases are also available, for example the Ordnance Survey's Addresspoint, which could provide a similar service.

Whilst the benefits of more accurate data are acknowledged, using PAC or Addresspoint in relation to patient information would be unethical. It would make easy identification of an individual possible, contravening patient-doctor confidentiality. The use of the 100m resolution OSGR translation results in loss of accuracy but maintains patient anonymity. For this study, the loss of spatial accuracy was considered acceptable in return for ensuring adequate anonymity.

The questionnaire therefore asked patients to provide their postcode at the unit postcode (6-7 digit) level (Question 3). The letter of introduction (Appendix One) briefly discussed the nature of the postcode and the level of anonymity it provided. These comments were included to allay any perceived public fear about the locational qualities of their property's postcode.

4.6 SAMPLING, PILOTING AND DISTRIBUTION

Sampling, piloting and distribution of the questionnaire involved logistical assistance from NDHA. The group of patients identified for sampling are asthmatics and diabetics who make use of NDHA GP services. As noted, the aim of the research method adopted was to obtain a representative sample in which characteristics of the sample groups reflect the wider population of health care users. Ideally a sampling frame is required from which a random sample can be taken. This would normally be a list of all patients on NDHA GP lists who had been diagnosed as asthmatic or diabetic. However, ethical constraints meant that this was not available. Initial attempts were made to obviate this difficulty by obtaining lists of all patient postcodes from GPs to provide the sampling frame, but responses to this request from GPs was limited[2].

The lack of a complete patient list meant that a truly random sample, where each member of the population has an equal chance of being sampled, was not achievable. Nor was it possible to administer a stratified random sample since the distribution of socio-demographic groups in the population of asthmatics and diabetics was also unknown. The most suitable sampling system which was feasible was, thus, a systematic method. This method would require the selection of, say, every tenth asthmatic on a GPs list to provide a 10% sample. Since the patient list remains confidential, the GPs themselves are the only people able to administer the sampling system, and this method is the most appropriate given this constraint.

Initial contact was made with the 52 GP practices in the NDHA area (Appendix One), asking for their cooperation in the research and also for information relating to the total numbers of asthmatics and diabetics on their patient lists (along with lists of postcodes originally designed to provide the sampling frame although these were not forthcoming). In the event, only 13 practices agreed to take part and returned the total number of asthmatics and diabetics on their patient lists (Appendix One). This inevitably limited the subsequent analysis severely, for it meant that, instead of having a sample covering the whole of the study area, data were available only for a limited number of practice areas (Map 4.2). It also raises possibilities of sampling bias, in that collaborating practices might not be representative of the full population of practices in the area. Since the survey depended upon the co-operation of the GPs, however, it was not felt possible either to re-approach practices which had declined to take part, or to survey their patients by other means.

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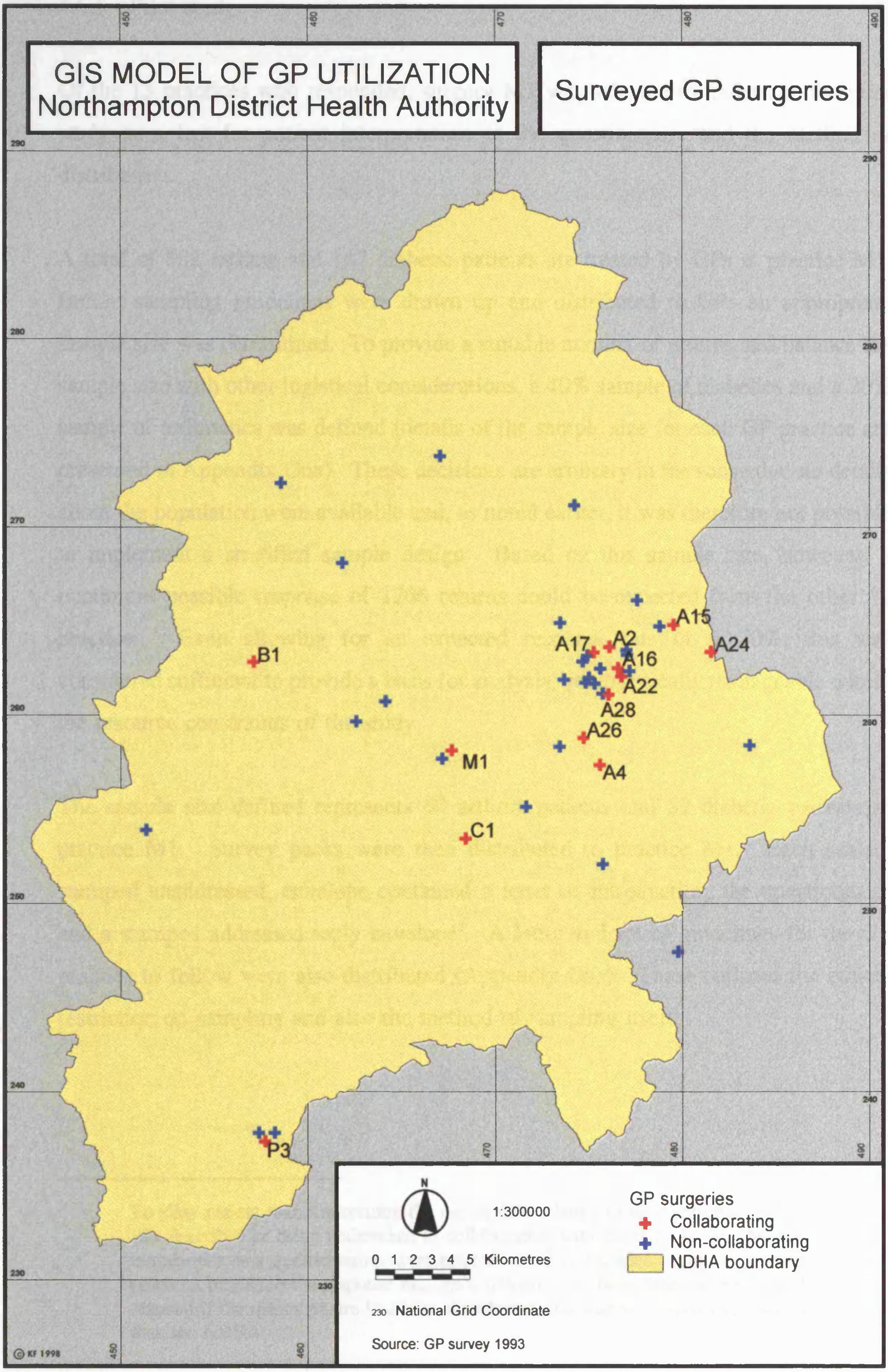
2 Different methods of patient record management exist with some GPs returning computer printouts simply selected from their database, whereas others were returned as lists produced on a manual typewriter. Only a few GPs returned lists, and the extent of returns is indicated in Appendix One.

Map 4.2 Surveyed GP surgeries



4.6.1 Pilot study

Of the 13 practices who responded, surgery M1 was selected to undertake the pilot study as a test for patient interpretation of the questionnaire and the method of distribution.

A total of 302 asthma and 147 diabetic patients are treated by GPs at practice M1. Before sampling guidelines were drawn up and distributed to GPs an appropriate sample size was determined. To provide a suitable number of returns and balance the sample size with other logistical considerations, a 40% sample of diabetics and a 20% sample of asthmatics was defined (details of the sample size for each GP practice are presented in Appendix One). These decisions are arbitrary in the sense that no details about the population were available and, as noted earlier, it was therefore not possible to implement a stratified sample design. Based on this sample rate, however, a maximum possible response of 1206 returns could be expected from the other 12 practices. Even allowing for an expected response rate of 40-70%, this was considered sufficient to provide a basis for analysis, yet logistically manageable within the resource constraints of the study.

The sample size defined represents 60 asthma patients and 59 diabetic patients in practice M1. Survey packs were then distributed to practice M1. Each sealed, stamped unaddressed, envelope contained a letter of introduction, the questionnaire and a stamped addressed reply envelope[3]. A letter and set of guidelines for the GP practice to follow were also distributed (Appendix One). These outlined the ethical restriction on sampling and also the method of sampling itself:

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3 To allay patient fears concerning the use of data relating to their personal health, research was described as being undertaken in collaboration with the NDHA. The letter of introduction and questionnaires were printed on NDHA headed stationary. This was also of potential benefit to the response rate since patients may have been more reluctant to respond if the questionnaire had been distributed, and was to be used by, a source other than the NDHA.

- the total patient list for each condition should be used[4];
- for asthma patients, every fifth patient on the patient list should be surveyed;
- for diabetic patients, every third and fifth patient on the patient list should be surveyed;
- the survey pack should be addressed accordingly and sent to the patient by post; and
- completed questionnaires should be returned directly to the researcher to avoid further administrative work by the GP practice.

The GP practice reported no difficulty in administering the questionnaire distribution. It should be acknowledged, however, that since sampling was undertaken by a third party, it is not possible to verify completely that sampling has been performed according to the guidelines.

A total of 93 questionnaires (78%) were returned. Of these, 43 were returned by asthma patients, 48 by diabetic patients and two were counted as spoiled returns (since no postcode was provided which rendered them unusable). The usable response rate was thus 76%, evidence that the method of distribution was effective and that patients did not appear to be unwilling to respond. Furthermore, patients appeared to be reassured that the postcode could not identify them since only two returns did not indicate their postcode. This may have been through refusal or simply that they did not know their postcode. An extra question was included, along with space to comment, asking patients to identify any problems they encountered in completing the questionnaire or where they did not understand the question. No difficulties were expressed in this section although a small number of patients took the opportunity to provide more comment than space allowed elsewhere. The only modification made to the questionnaire, on the basis of the pilot, was therefore provision of larger tick boxes and increased space for response. Furthermore, patients were asked to state

[4] One group of patients is excluded from the survey. Those resident in institutions (such as hospitals and residential homes) are excluded since they have their own arrangements for the provision of health care services. In this respect the survey was limited to people who had a personal address.

how long the questionnaire took to complete, which allowed an approximate completion time to be identified on the questionnaire used in the actual survey.

Having successfully piloted the questionnaire, the full survey was then conducted during February 1993 by distributing survey packs to the remaining 12 GP practices for onward distribution to the sampled patients.

4.7 SURVEY RESPONSE

From the 1206 questionnaires distributed to GP practices, 668 returns were obtained giving an overall response rate of 55.4%. However, one of the GP practices (A28) failed to distribute their quota of questionnaires and this reduced the maximum possible number of returns to 1057, giving an actual response rate of 63.2%.

A total of 76 returns were spoiled or were not of use within the survey due to inadequate information (for example the lack of a postcode or other important classifying information). This is approximately 7% of the questionnaires distributed. The total number of returns which could be used was therefore 592, amounting to a usable response rate of 56%, as illustrated in Figure 4.8 (a more detailed breakdown of response to the survey is presented in Appendix One).

The 592 useable responses were coded and input into a database file. The postcode of each return was also processed (Section 4.5.1) to create an Arc/Info coverage of patient postcodes based on their associated OSGR. Map 4.3 shows the distribution of postcodes of respondents. The incomplete spatial coverage of the study area, reflecting the distribution of collaborating practices (Map 4.2), is evident.

The predominant use of the survey response is as a data set to inform variable selection for the model of utilization (Chapter Six). This requires the responses to be examined in three ways. Firstly, the sample is investigated to assess the extent to which responses reflect expected socio-demographic distributions in the host population. Secondly, asthmatic responses are compared with diabetic responses to

Map 4.3 Surveyed patients

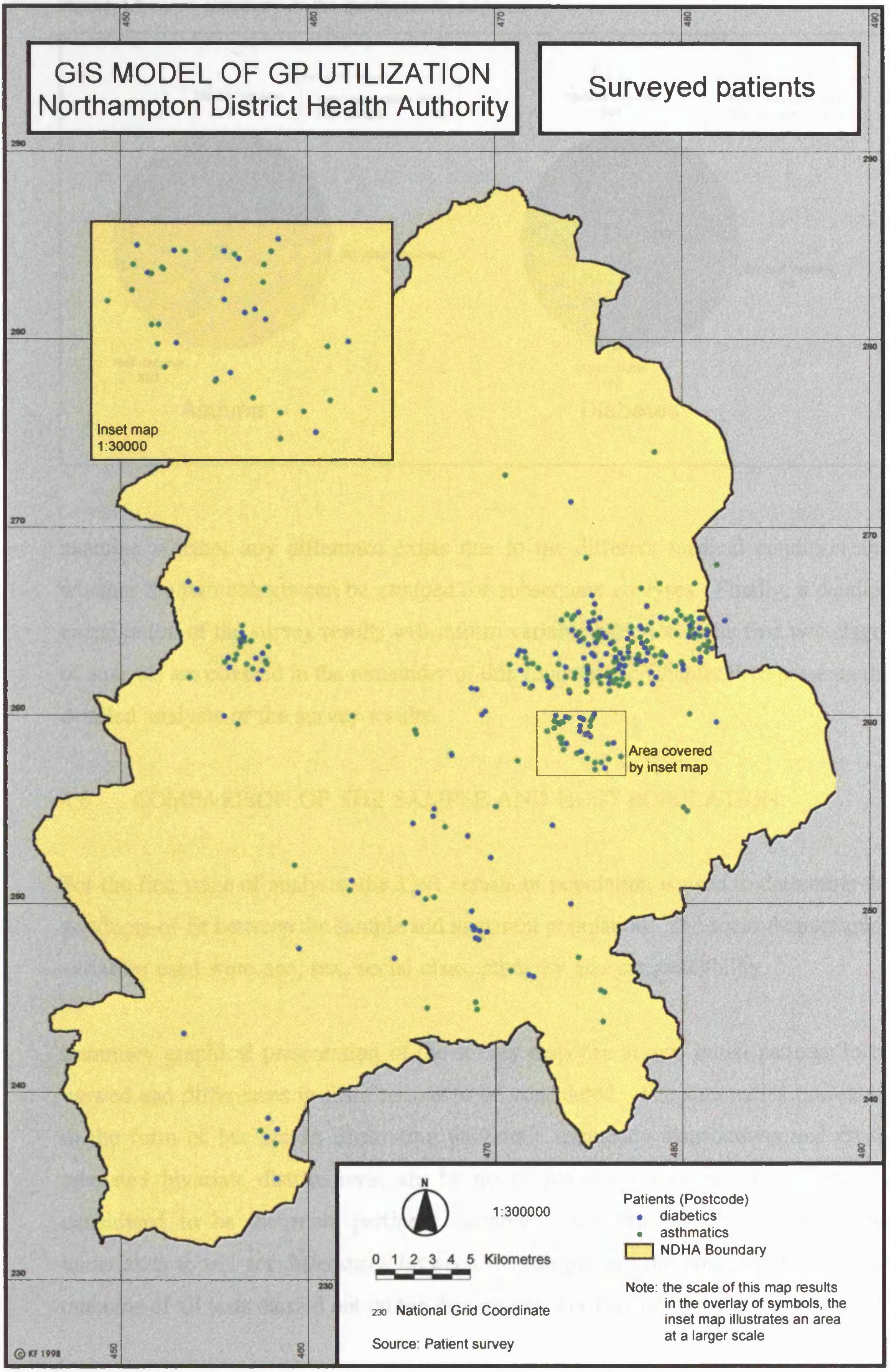
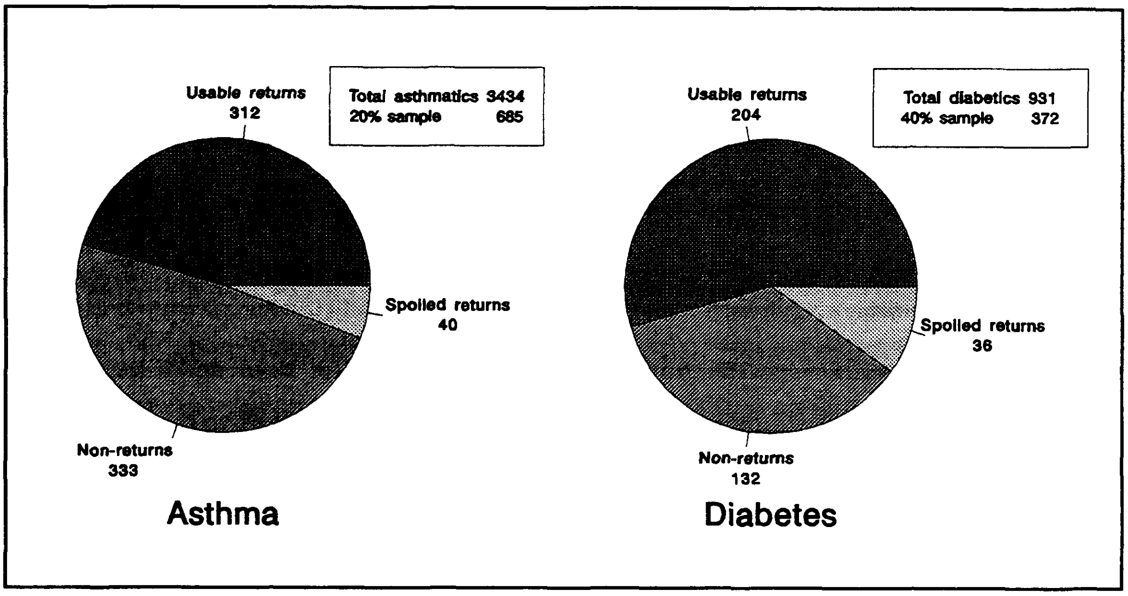


Figure 4.8 Summary of the questionnaire response



examine whether any difference exists due to the different medical condition and whether the two cohorts can be grouped for subsequent analyses. Finally, a detailed examination of the survey results will inform variable selection. The first two stages of analysis are covered in the remainder of this Chapter and Chapter Five presents the detailed analysis of the survey results.

4.8 COMPARISON OF THE SAMPLE AND HOST POPULATION

For the first stage of analysis, the 1991 census of population is used to determine the goodness-of-fit between the sample and its parent population. The socio-demographic variables used were age, sex, social class, ethnicity and car availability.

Summary graphical presentation of the survey response allows initial patterns to be viewed and differences in distributions to be considered. The summaries presented, in the form of bar graphs illustrating univariate frequency distributions and cross-tabulated bivariate distributions, are by no means exhaustive but show what are considered to be the most pertinent variables. Chi-square (x^2) tests were also undertaken to test for differences between the sample and the host population. The outcome of all tests carried out on the data and the corresponding results are tabulated in Appendix Two.

4.8.1 Age and sex

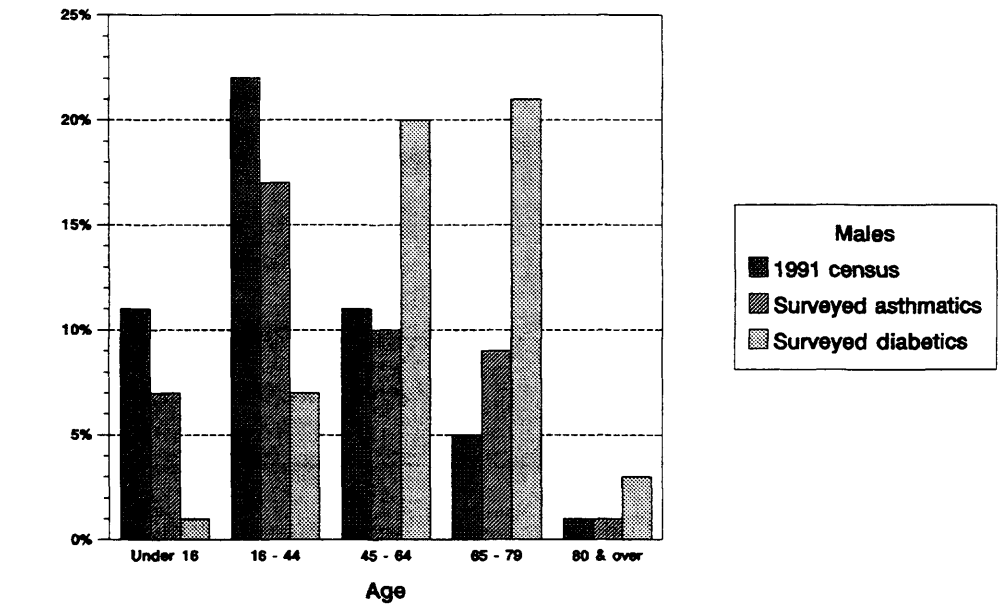
Approximately 54% (314193) of the population of Northamptonshire live in the NDHA area. Age and sex are acknowledged as being determinants of differential utilization and accessibility (Chapter Three). They therefore form one of the main classifying criteria in analysing the results of the survey. Figures 4.9 and 4.10 illustrate the distribution of age amongst the population and the asthmatic and diabetic cohorts.

In terms of the host population, there is very little difference of age distribution between males and females. A small difference in the 80 and over age group occurs due to the tendency for females to live longer than males. A x^2 value of 1.49 (p=0.22) indicates that the combined sample does not differ significantly from the overall population as far as the relative frequency of males and females is concerned (Appendix Two).

The sample does not, however, reflect the host population in terms of age distribution. Comparison of the age profile of the sample and the host population (for males and females combined) gives a x^2 value of 171.2 (p<0.0001), meaning that the sample is not representative of the age distribution of the host population (Appendix Two). The sample comprises a larger number of people age 45 to 79 for both sexes and a larger proportion of females aged 16-44 than males of the same age.

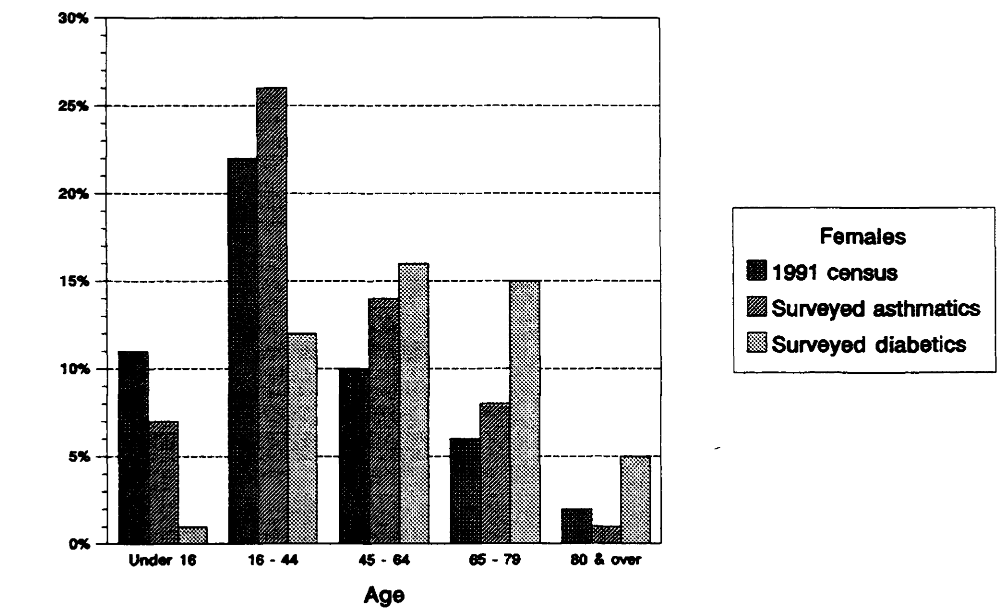
The distributions are slightly different for asthmatics and diabetics. A much larger proportion of young asthmatics is evident with the trend reversing with increasing age where larger proportions of diabetics are evident. This is expected due to the nature of the conditions.

Figure 4.9 Age (males)



Source: 1991 LBS/SAS (C) Crown copyright 1991 & Patient survey 1993

Figure 4.10 Age (females)



Source: 1991 LBS/SAS (C) Crown copyright 1991 & Patient survey 1993

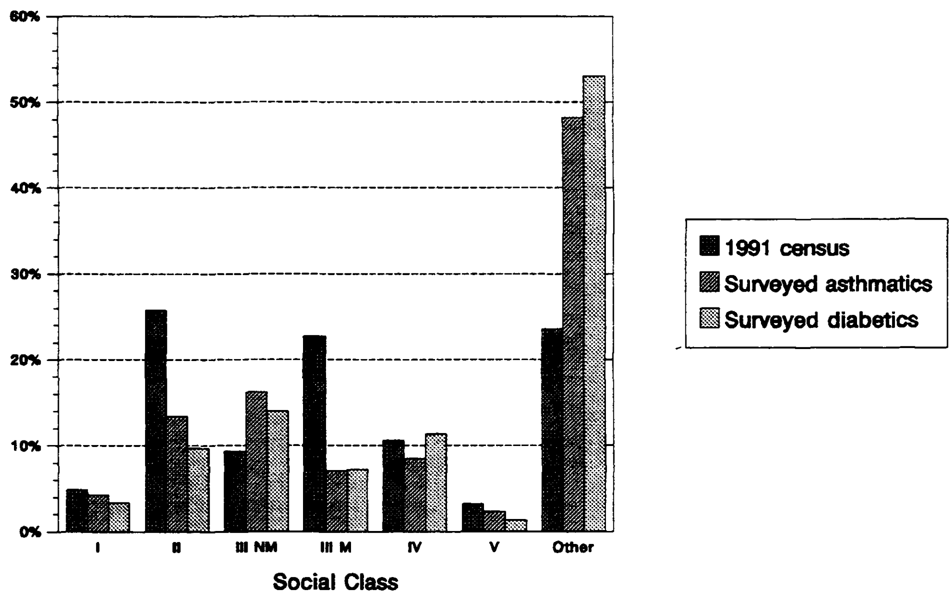
4.8.2 Social class and employment

The incidence or prevalence of many diseases can be associated with occupational social class. Such relationships are also vital in identifying areas of deprivation or disadvantage in relation to service provision (Chapter Three). The Registrar General's classification is used in the survey analysis:

Class I	Professionals
Class II	Intermediate occupations
Class III (NM)	Non-manual skilled occupations
Class III (M)	Manual skilled occupations
Class IV	Semi-skilled occupations
Class V	Unskilled occupations
Other	(e.g. students, armed forces or people whose occupation is poorly described)

Measures of social class and economic activity in the NDHA area are derived from a 10% sample of the census data based on the response of the head of household. It does not, therefore, give information relating to all residents but provides a suitable measure which can be taken as an estimate of the social and economic status of households. Figure 4.11 illustrates the distribution of social class.

Figure 4.11 Social class



Source: 1991 LBS/SAS (c) Crown copyright & Patient survey 1993

The use of social class as a means of categorising patient responses in the questionnaire survey proved to be problematic due to the fact that for 48% of returns it was not possible to assign the respondent to a particular social class based on occupation. Those who could not be assigned a social class included those who gave insufficient information, students and housewives/husbands (who had never been employed) and those who indicated their occupation as being retired. 93% of those who could not be classified (due to them not having a usual occupation) were also currently unemployed which further impeded the social class categorisation.

Comparison of the social class composition of the survey respondents with that of the NDHA population as a whole suggests a number of differences. Apart from the high proportion of unclassified/other in the sample data (mentioned above) the main differences are a reduced number of IIIM and increased number of IIINM respondents compared to the host population and a raised proportion of class II. These differences are statistically significant, with a x^2 value of 277.98 ($p<0.0001$).

Several factors may account for these differences. One, undoubtedly, is the effect of including non 'head of household' in the survey, which is an inevitable difference from the census. Another may be that the two conditions surveyed are socially biased (there is, for example, some evidence that asthma in children is more prevalent in higher social classes). In addition, it may reflect the social characteristics of collaborating practice areas and biases in the social class of those who responded to the questionnaire. Whatever the reason, these differences need to be considered in interpreting and using the results from the survey.

The economic activity of the population of NDHA is illustrated in Figures 4.12 and 4.13. For economically active males there is an unemployment rate of approximately 8% with females having a lower unemployment rate of approximately 5%. There is also a high proportion of economically inactive residents which includes under 16s, housewives/husbands, students and retired residents. This accounts for approximately 26% of the male population and 80% of the female population.

Figure 4.12 Economic activity

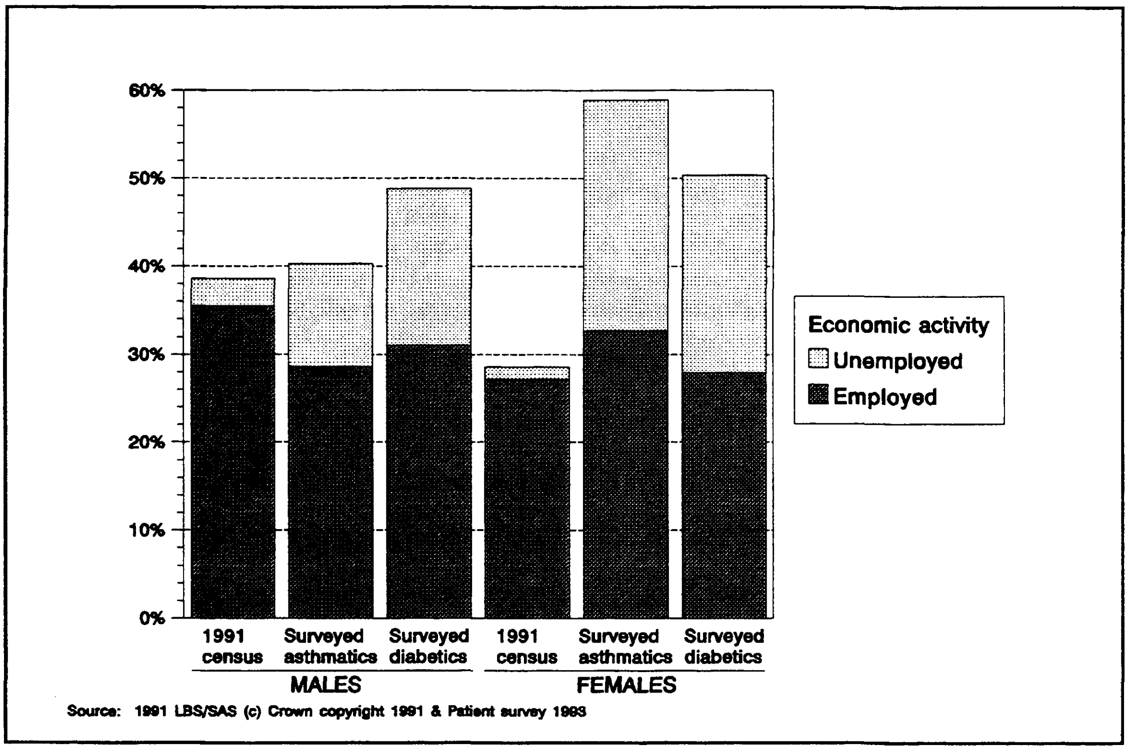
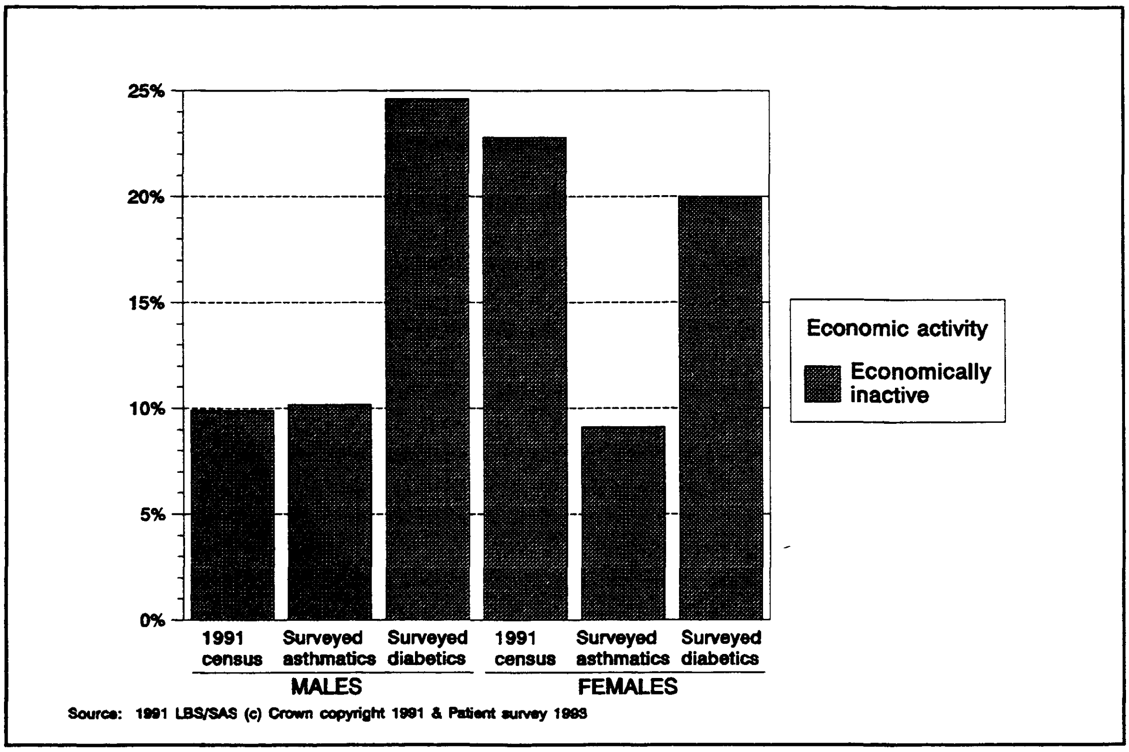


Figure 4.13 Economic inactivity



When compared to the census, a higher proportion of responses have been received from economically active age groups overall. This is particularly true for females. Additionally, there are much higher proportions of unemployment, approaching 23%, than the host population for both males and females and for both conditions. The employment differences between the host population and sample are statistically significant, with a x^2 value of 2575.47 ($p<0.0001$). Of those that are economically inactive, there is a much larger proportion of male diabetics in the sample and a much lower proportion of female asthmatics.

One reason could be that both asthma and diabetes reduce employment opportunity. Thus, the sample population may contain a higher proportion of unemployed. Furthermore, distribution of the conditions varies with age and this has an impact upon the relative proportions of economically inactive respondents. Differences could also again be partly due to preferential response rates from unemployed people who have more time available in which to complete questionnaires.

4.8.3 Ethnicity

Table 4.1 provides a breakdown of the population of NDHA in relation to the ethnic origin of individuals. Such information is regularly used for health planning purposes due to the fact that the rates of some illnesses vary between different ethnic groups (Section 3.2.2). In the NDHA area there is a small proportion of ethnic groups other than white (totalling approximately 4%) which is low by national standards (NNC, 1995).

The frequency of responses from the survey sample is generally similar and no statistically significant difference exists between the sample and the host population, with a x^2 value of 6.65 ($p=0.47$, Appendix Two). Whilst the sample is in accord with the host population, the small number of respondents of ethnic minority origin means that it is not feasible to examine ethnic minorities as separate groups or to test rigorously the effect of ethnicity on health service utilization.

Table 4.1 Ethnicity

	Population	Population %	Surveyed asthmatics	Surveyed diabetics	Total sample %
White	301671	96	356	220	97.3
Black Caribbean	2845	0.9	2	4	1
Black African	509	0.2	0	0	0
Black other	1354	0.4	0	0	0
Indian	2928	0.9	2	2	0.7
Pakistani	555	0.2	0	0	0
Bangladeshi	1232	0.4	0	1	0.2
Chinese	848	0.3	0	0	0
Other Asian	693	0.2	0	0	0
Other	1267	0.4	2	1	0.5
Unclassified	291	0.1	1	1	0.2

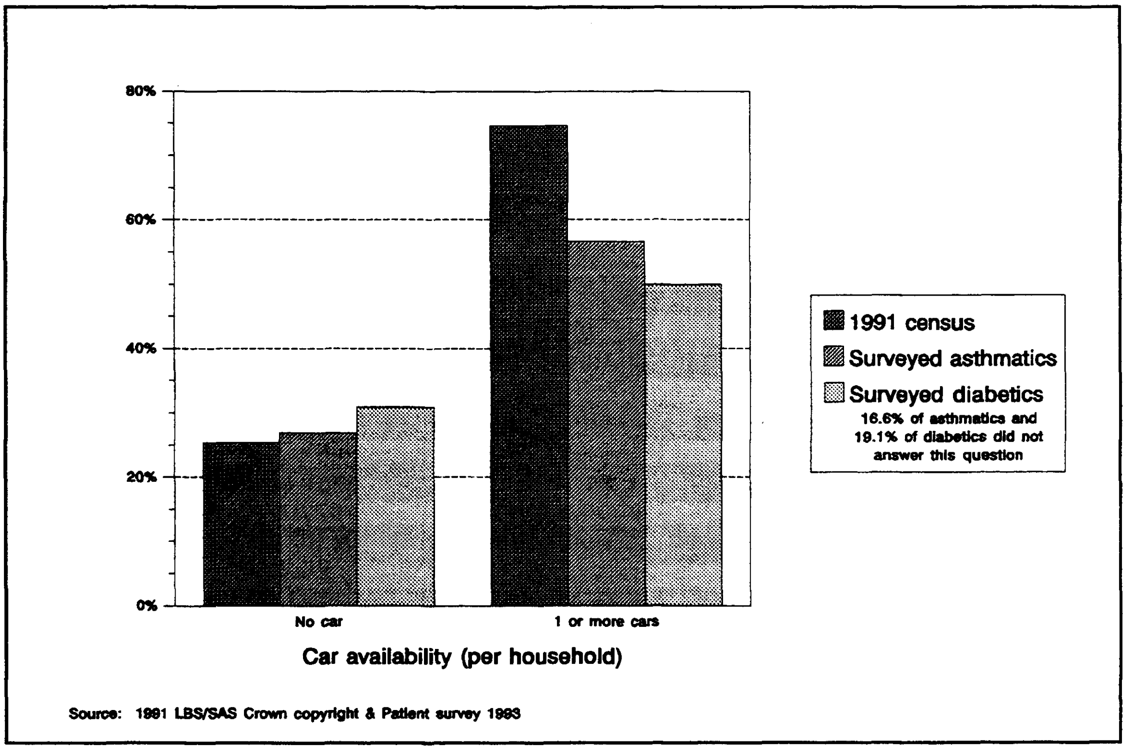
Source: 1991 LBS/SAS (c) Crown copyright & Patient questionnaire 1993

4.8.4 Car availability

Mode of transport and, in particular, a patient's accessibility to a privately owned car is an important part of the investigation into utilization behaviour. Comparisons were therefore made of lack of car ownership amongst the sample and host population.

The 1991 census indicates car availability by household rather than individual ownership. Approximately 25% of the 121363 households in the NDHA area do not own a car, 44% own one car, 25% own 2 cars and approximately 6% own three or more cars. Households in the NDHA area have fairly high levels of car ownership by national standards (NCC, 1995). Figure 4.14 illustrates car availability, by household, for the host population and sample.

Figure 4.14 Car availability



The sample population tends to have a lower level of car availability than the host population, although the relatively large proportion of non-response to this question may bias the results. A statistically significant difference exists between the sample and the host population, with a x^2 value of 344.82 ($p<0.0001$). The higher levels of lack of car availability in diabetics may, again, be age related. Since the condition is more prevalent in the elderly it may be that these age groups are also less likely to be car owners. The same could be true for young asthmatics.

4.9 COMPARISON OF ASTHMATIC AND DIABETIC RETURNS

As noted earlier, the use of two patient cohorts was to enable the model to be informed by two independent population groups. Whether or not the two groups sampled vary in terms of their underlying socio-demographic characteristics can be determined by comparing respondents on the basis of sex, age, social class and ethnicity.

The sex structure of the two cohorts was broadly similar, with approximately equal numbers of males and females in both groups (50% male diabetics compared with 45% asthmatics). This is, to some extent, surprising, for nationally asthma shows a significant bias towards males, while no sex bias has generally been reported for diabetes.

Figure 4.15 shows a comparison of the two sets of respondents in terms of age profile. As can be seen, marked differences in age occur. In general, diabetic responses are more elderly, with 80% of respondents being age 45 or over. In comparison, the majority of asthmatic responses are below age 45 (56%). The explanation for this may be partly due to the prevalence of the condition in different age groups. Specifically, asthma has been identified as being increasingly prevalent in younger people, while diabetes is more prevalent in the elderly (Sections 4.3.1 and 4.3.2).

The social class of asthmatics and diabetics was, however, similar (Figure 4.16). Of the proportion of patients whose social class could be determined the distribution of response between asthmatics and diabetics was comparable with a predominance of class II, IIINM and IV in both groups. Of those who could not be categorised, the main difference, albeit a small one, is that a greater proportion of students and a lower proportion of retired/other patients responded in the asthmatic cohort. This may be due again to the fact that asthma is more prevalent in younger people.

Since a higher proportion of diabetic respondents could only be categorised as retired/other it is no surprise that these patients also indicated a slightly lower employment rate. 64% of diabetic returns were from patients currently not in employment as opposed to 56% of asthmatics currently not in employment.

The proportion of overall ethnic minority returns was small and, when disaggregated into asthmatic and diabetic returns, the only difference is that there were slightly more diabetic ethnic minority patients (8 returns as opposed to 6 asthmatics). Despite the small number of returns this is consistent with the tendency for diabetes to be more prevalent in ethnic minority groups, particularly Asians (Section 4.3.2).

Figure 4.15 Age comparison (asthma & diabetes)

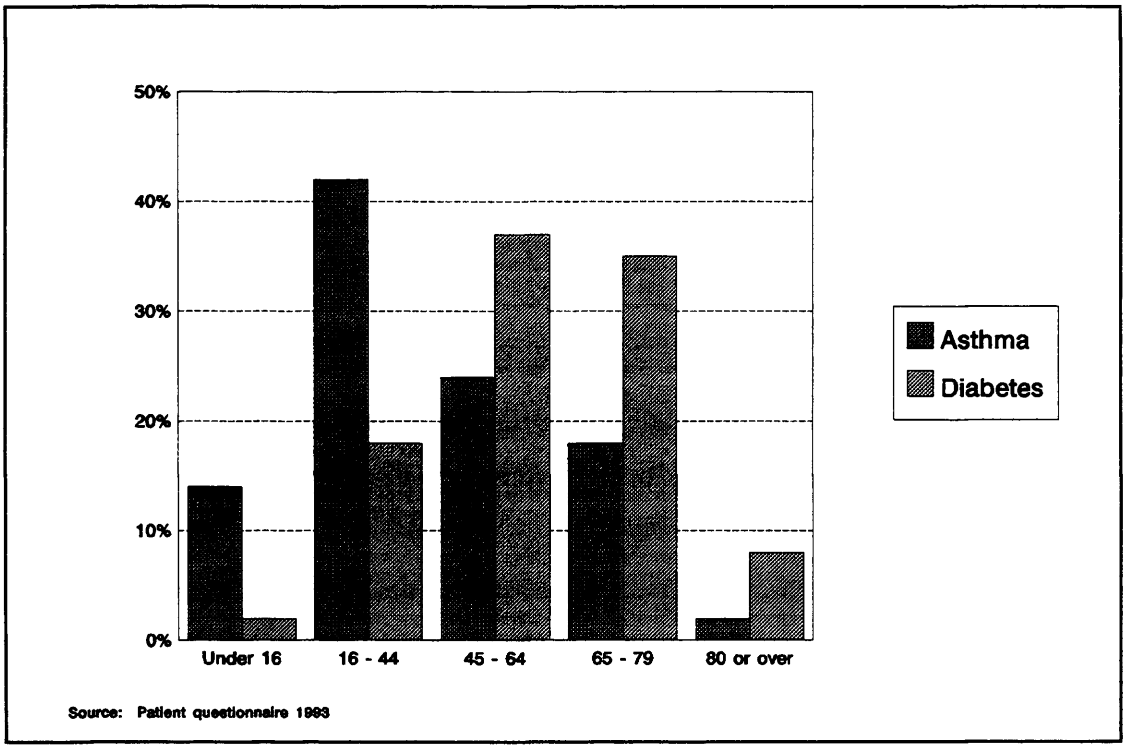
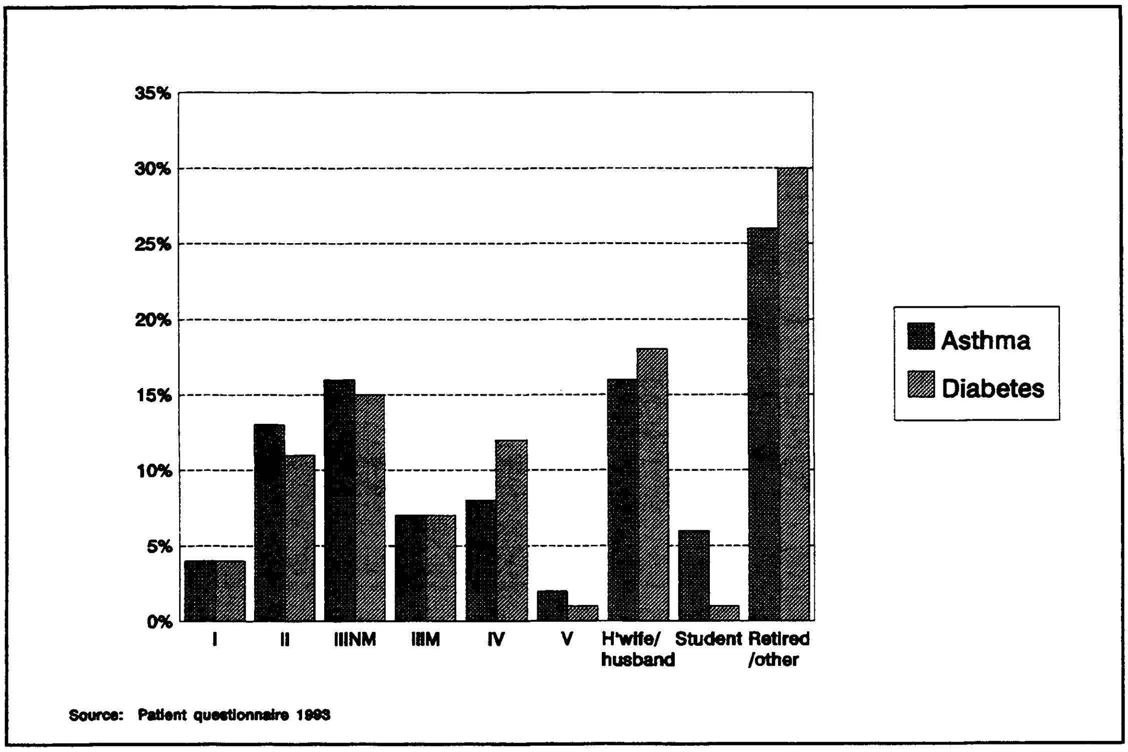


Figure 4.16 Social Class comparison (asthma & diabetes)



4.9.1 Comparing survey outcomes

The next stage of survey analysis compares the response of asthmatics and diabetics for a range of questions to discern any difference in their respective utilization behaviour: whilst they may be socially and demographically similar in some respects, the two conditions may lead to varying utilization behaviour.

A number of questions were selected from the survey to allow a comparison of utilization behaviour to be made. Figures 4.17 and 4.18 illustrate the frequency and usual reason for consultation of the asthmatic and diabetic cohorts.

Very few patients consult their GP more than once a month (Figure 4.17). Additionally, the majority of patients consult a given number of times during the year rather than only consulting when necessary. There is very little difference between the frequency of consultation exhibited by asthmatics and diabetics. A chi-square test to determine the significance of differences between the two cohorts, with respect to the response to this question, reveals a x^2 statistic of 3.99 (p=0.78). This suggests that there is no significant difference between the response of asthmatics and diabetics.

The usual reason for consultation is not, however, similar for asthmatics and diabetics. For this question, a larger proportion of asthmatics indicate that they consult after an 'episode of illness' whereas diabetics tend to consult more regularly. This difference in utilization behaviour is expected since diabetics are more likely to make regular consultations for repeat treatment whereas asthmatics are more likely to consult in response to an acute asthma attack. A x^2 statistic of 46.82 (p<0.0001) suggests that there is a significant difference between the usual reason for consultation of asthmatic and diabetic patients.

Figure 4.19 illustrates the extent to which the two groups of patients rely upon home visits by their GP in relation to their condition. The majority of patients (>65%) do not rely upon home visits. Approximately 30% of both asthmatics and diabetics rely upon home visits only occasionally. Overall there is very little difference between the

Figure 4.17 Frequency of consultation

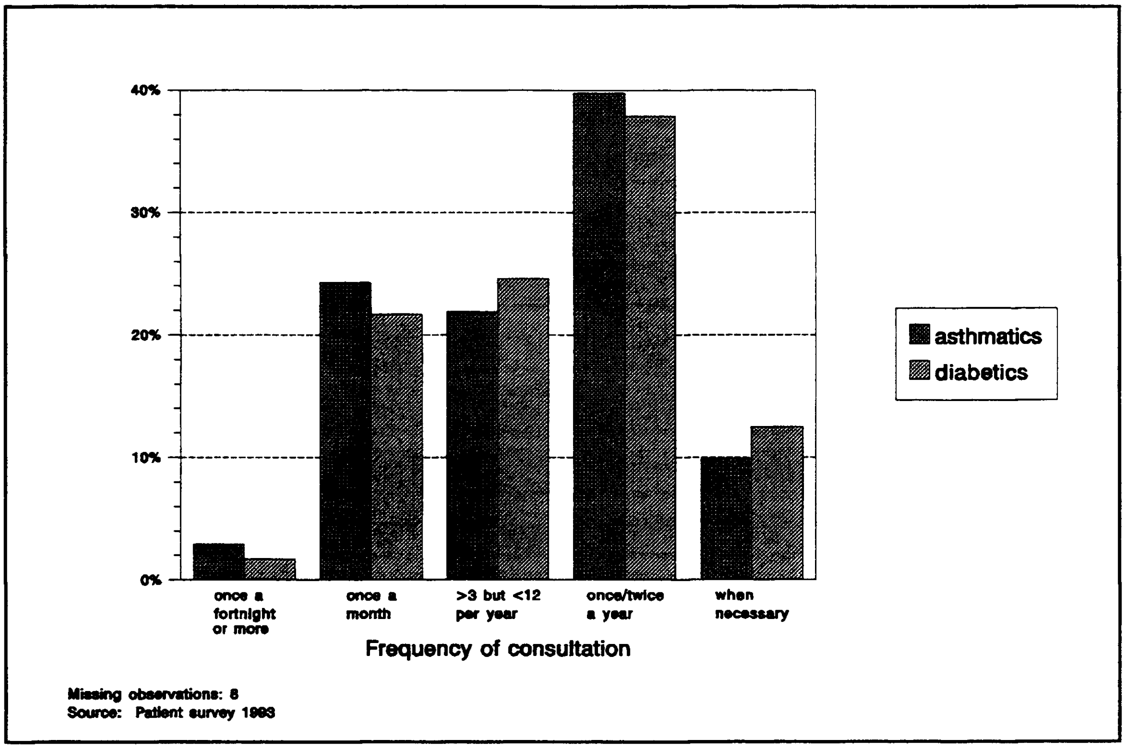


Figure 4.18 Usual reason for consultation

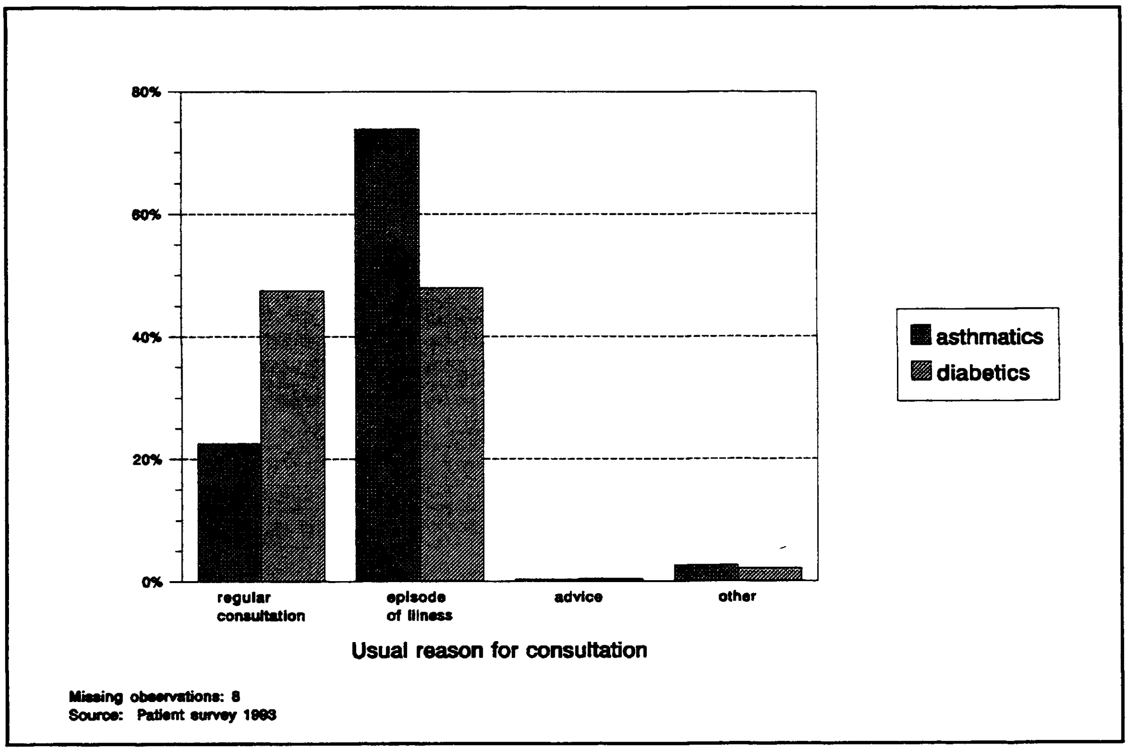
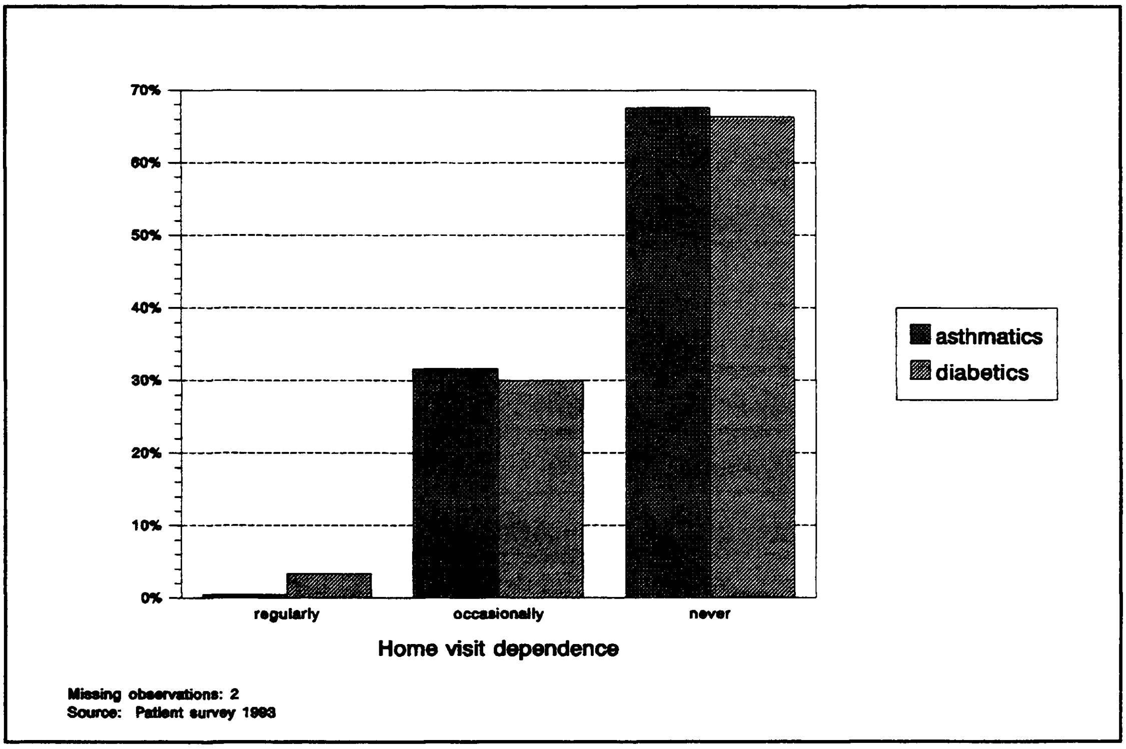


Figure 4.19 Home visit dependence



reliance exhibited by the two groups and a x^2 statistic of 7.29 (p=0.06) suggests that there is no significant difference between the response of asthmatic and diabetic patients to this question.

When considering the method of transport used by patients to get to their GP's surgery the majority (>50%) of both asthmatics and diabetics use their own car (Figure 4.20). A fairly high proportion of patients walk to the surgery whereas a relatively small proportion make use of public transport. The trends are similar for the two cohorts although a x^2 statistic of 11.42 (p=0.04) suggests that there is a significant difference between the method of transport used by asthmatic and diabetic patients.

Figure 4.21 illustrates the extent to which patients feel their GP service is accessible. The majority of both asthmatic and diabetics patients (>55%) indicated that they found their GP service to be 'very accessible'. Only 3% of all patients indicated that accessibility was less than satisfactory to some extent. The distribution of responses for asthmatic and diabetic patients is similar and a x^2 statistic of 4.8 (p=0.31) suggests that there is no significant difference in response to this question.

Figure 4.20 Usual method of transport

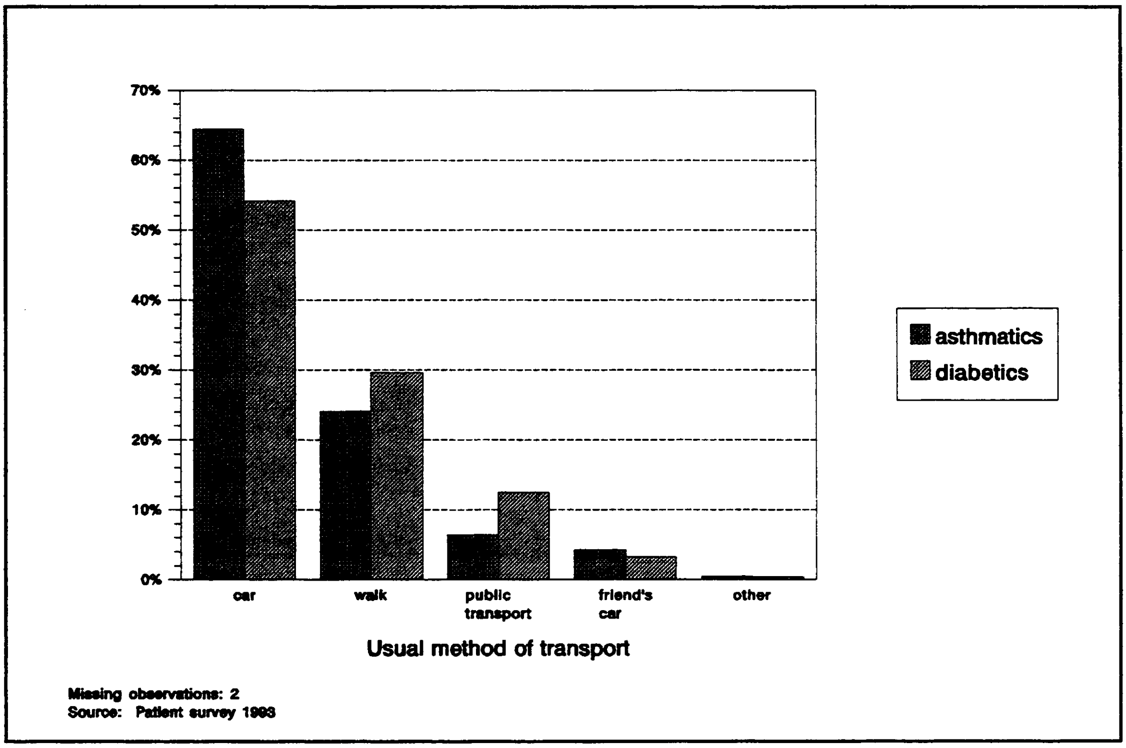
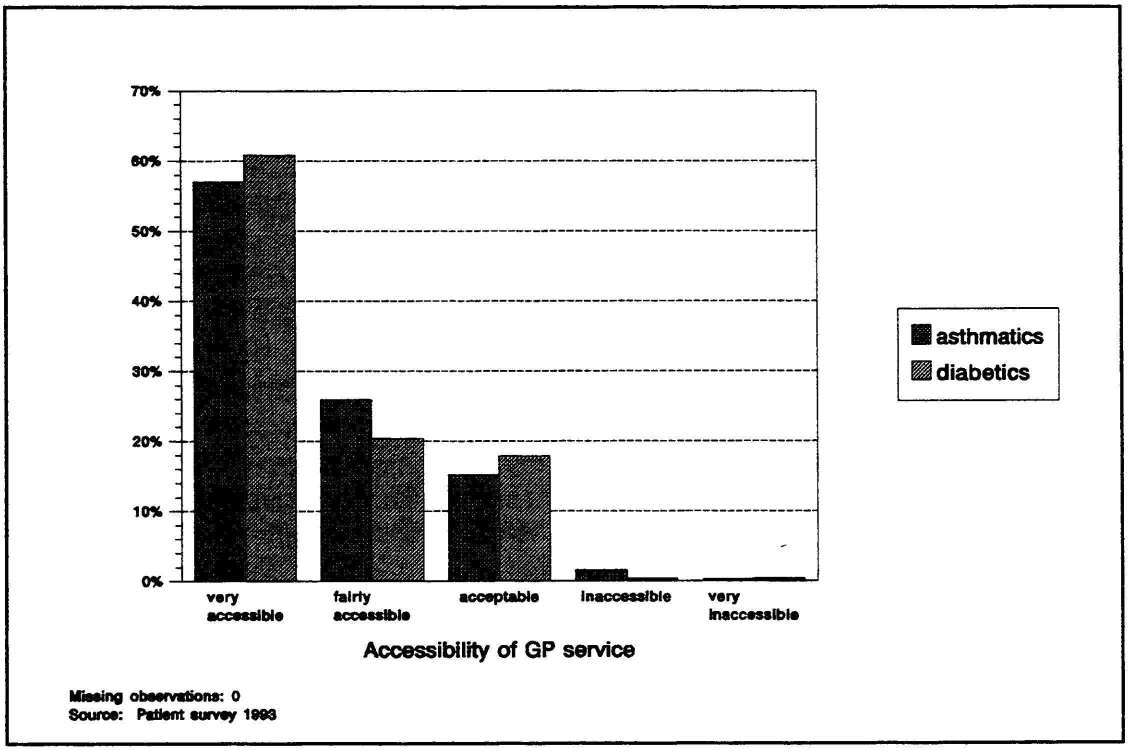
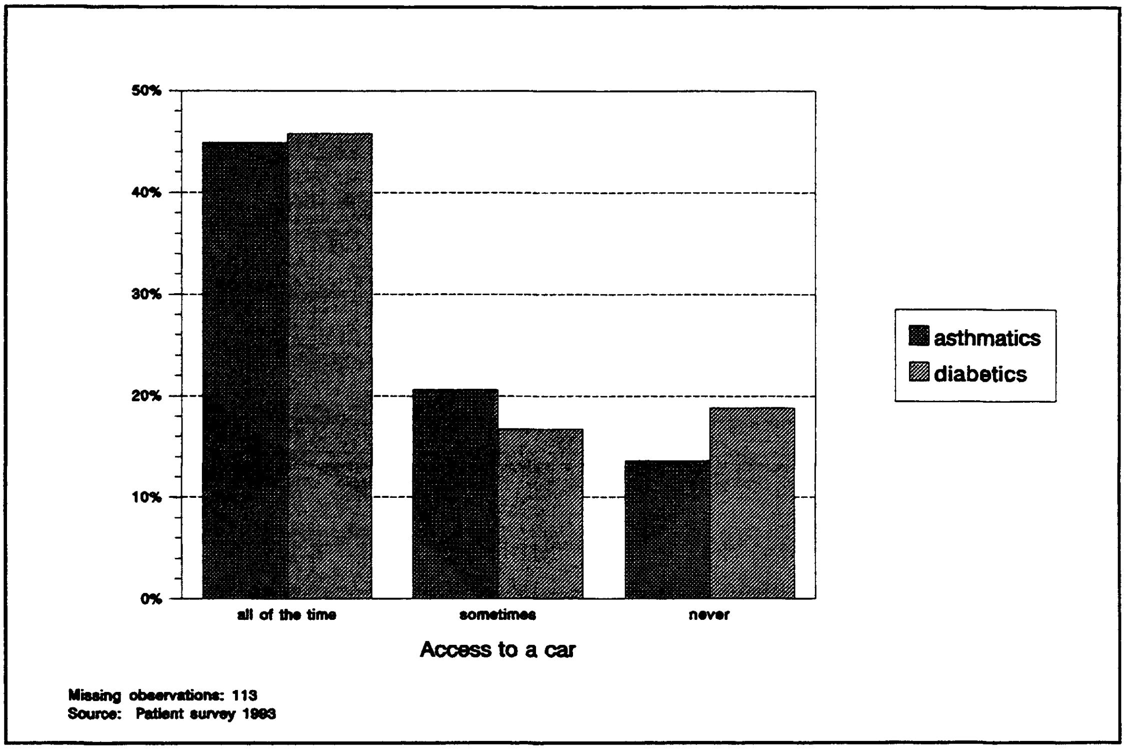


Figure 4.21 Accessibility of GP service



Given the predominance of use of a car to travel to a GP, the extent to which a family car is available may have an impact on the ease of access. Figure 4.22 illustrates the response of patients to this question indicating that less than 14% of asthmatics and 19% of diabetics never have access to a car. The majority of patients have at least some access to a car for use to get to their GP. Transport method is explored further in Chapter Five but it is important to note here that there is no significant difference between the access to a car for asthmatics and diabetics (x^2 statistic of 3.98, p=0.27).

Figure 4.22 Access to a car



The final two comparisons relate to obstacles which may be experienced in gaining effective access to a GP. Figures 4.23 and 4.24 illustrate the extent to which aspects of the journey can hinder accessibility.

The time taken to get to the surgery (Figure 4.23) does not create an obstacle for 87% of asthmatics and 89% of diabetics. Only a small proportion of patients in either cohort indicate some level of hindrance. Furthermore, a x^2 statistic of 2.28 (p=0.52) suggests that there is no significant difference between asthmatics and diabetics in

Figure 4.23 Journey time as an obstacle to accessibility

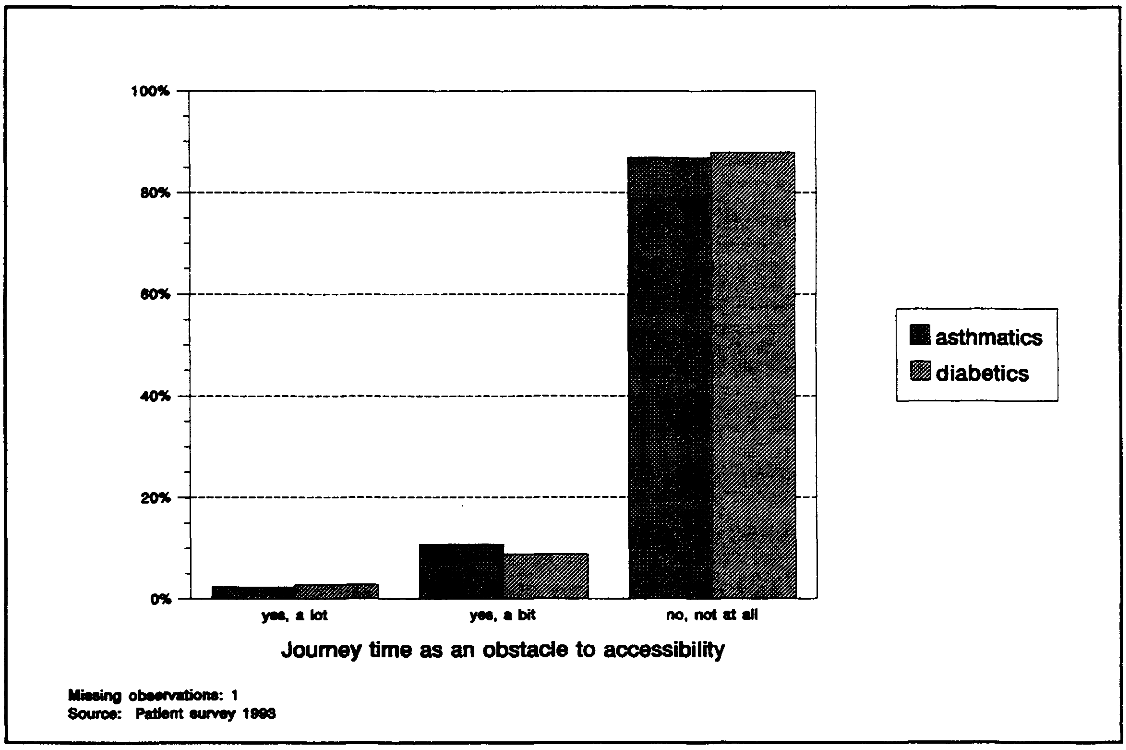
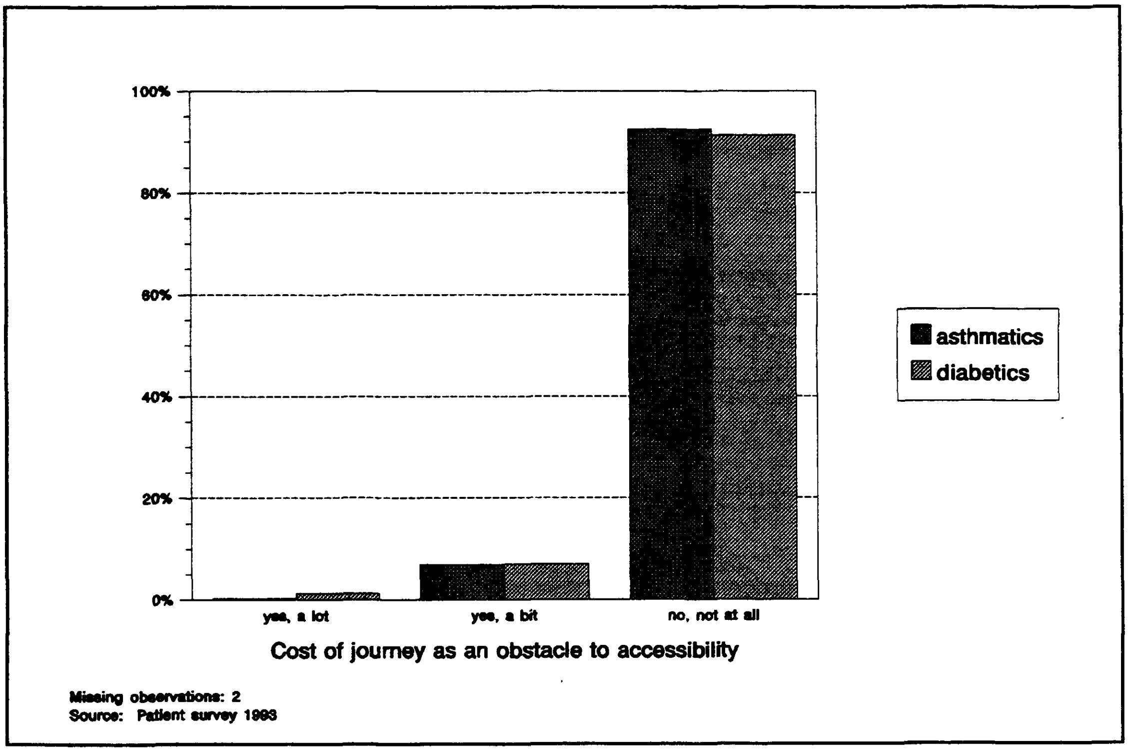


Figure 4.24 Cost of journey as an obstacle to accessibility



response to this question.

Cost of journey is even less problematic (Figure 4.24) with over 90% of both sample groups expressing no hindrance. Again, a x^2 statistic of 2.3 (p=0.51) suggests that there is no significant difference between patient cohorts in response to this question.

These comparisons, between the asthmatic and diabetic cohorts, indicate a similar distribution for these questions with no statistically significant differences between the sample groups. The only exceptions are 'usual reason for consultation' (Figure 4.18) and 'usual method of transport' (Figure 4.20). The reason for consultation is, in many ways, not a factor which holds much importance in the context of this study although it is worthwhile noting that a difference exists due to the nature of the conditions. Furthermore, differences in method of transport were only marginally statistically significant at the 0.05 level (p=0.4) and it is not clear how differences between the two conditions may give rise to use of different transport modes. Responses of much greater value are those which provide an insight into the extent to which patients experience difficulties in utilization and accessibility. It is these that show no significant difference between asthmatic and diabetic patients and it is therefore possible to group the cohorts for subsequent analysis.

4.10 SUMMARY

The design and execution of the survey was restricted by several factors, including resources available to the study, the nature of the population to be questioned and ethical constraints imposed. Several aspects of sampling had to be modified to take account of the special circumstances involved in administering a survey to patients.

The survey was successfully administered and elicited a good response rate, generating sufficient returns to allow statistical analysis and provide a data set for subsequent use to inform variable selection and test the model of utilization. Preliminary analysis of the frequency distributions of the sample, compared with the NDHA population, have been undertaken for the following characteristics

- age;
- sex;
- social class and economic activity;
- ethnicity; and
- car availability.

The x^2 tests of goodness-of-fit suggest that:

- the sample is in accord with the population overall as far as proportions of the sexes and ethnic origins is concerned.
- there are differences relating to age, social class and employment composition between the sample and the population as a whole.

These differences may reflect both aetiological factors and effects of these diseases in the general population, but may also imply some sampling bias (e.g. due to the characteristics of the collaborating practices or to preferential response rates of patients). These effects need to be taken into account in using the survey data.

Additionally, initial analysis was undertaken to examine differences between the response profile of asthmatic as opposed to diabetic respondents. The age profile differed somewhat, although the other taxonomic groups were broadly similar.

Further disaggregation of the survey data allowed the extent to which the two samples differed in utilization behaviour to be examined. This revealed that utilization behaviour, discerned through a comparison of the distribution of response of asthmatics and diabetics, shows no significant difference. This allows the samples to be merged in subsequent analyses.

The initial survey results presented in this Chapter provide a platform from which to undertake a more detailed examination of utilization behaviour of patients in Chapter Five. This will then be used, in conjunction with the conceptual discussion in Chapter Three, to inform the selection of indicators for construction of the model of utilization in Chapter Six.

5 PATIENT SURVEY ANALYSIS

5.1 INTRODUCTION

This Chapter presents the results of the patient survey. It examines the utilization behaviour and accessibility to health care for the sample of asthmatics and diabetics. In doing so, the investigation of primary data adds to the conceptual discussion of utilization presented in Chapter Three. Furthermore, it allows the subsequent design of a model of utilization which can be supported by an investigation of actual patterns of use.

For the purposes of the subsequent analyses, the asthmatic and diabetic cohorts are grouped to represent the wider community of health care users (Section 4.9.1). The results are analysed to reflect the following important socio-demographic and locational differences:

- age;
- sex;
- social class;
- employment;
- ethnicity;
- proximity of surgery (distance); and
- proximity of surgery (time).

Each of these characteristics is discussed in relation to the following dimensions:

- utilization behaviour;
- mobility characteristics; and
- obstacles to accessibility.

Data are presented as tables, representing the results of cross-tabulations, showing the percentage of each cell as a proportion of the row total. Visual interpretation of results is corroborated by evaluating the statistical significance of differences in response by using x^2 tests. Where possible, x^2 tests are implemented using the original categories since these were defined on a legitimate and justifiable basis. Where it is appropriate, categories have been collapsed to obtain a more meaningful x^2 test statistic. However, some tests remain unreliable due to a high proportion of low cell counts but this is unavoidable, particularly when collapsing categories has already been undertaken or where it would mask important variation in the data. Where a test is considered unreliable for this reason the p-value stated is marked with an asterisk. Survey results, x^2 analyses and graphs are presented in Appendix Two.

5.2 INFLUENCE OF AGE ON UTILIZATION

The analyses in this section examine utilization behaviour and obstacles to accessibility exhibited by the surveyed patients in relation to their age. Age has been identified as a factor which leads to differential utilization behaviour. In particular, the health status of young and elderly people leads to increased need for health care (Section 3.2.1). Unhindered, this would lead to increased levels of utilization for these age groups although they are also disadvantaged in their accessibility to health care due to constraints of personal mobility related obstacles (Section 3.3.2).

Tables 5.1-5.3 illustrate the influence of age on utilization behaviour. Table 5.1 shows that for each age group the majority of patients consult more than 3 times a year. Of those patients age 0-15, 36% consult at least once a month which is a higher proportion than exhibited in the other age groups. This provides some evidence to suggest that younger patients consult more often. However, of those age 80 or over frequency of consultation does not increase in comparison with the other age groups. This is perhaps a function of the sampling frame, since all patients will require treatment whatever their age and the expected increased consultation rate for the elderly may be masked. A x^2 test for these variables indicates a statistically significant difference with respect to their classifications (p=0.03*). It is likely that frequency of consultation therefore differs with respect to age.

Differences in regularity of consultation also exist when examined in relation to the age of patients (Table 5.2). For patients age 0-15, 41% make regular consultations and for patients age 80 or over the proportion making regular consultations is 42%. Patients age 65-79 actually make more regular consultations (55%) than non-regular. These proportions are higher than both the 16-44 and 45-64 age groups which suggests that regularity of consultation is associated with age and that it is the young and elderly who tend to consult more regularly. A x^2 test corroborates this, indicating a

Table 5.1 **Influence of age on utilization behaviour: frequency of consultation (% of age group)**

	once a fortnight	once a month	3-12 per year	1 or 2 per year	when necessary	missing
0-15	1.7	34.5	51.7	3.4	6.9	1.7
16-44	2.5	21.3	62.4	5.1	8.1	0.5
45-64	2.4	24.1	57.6	5.9	8.8	1.2
65-79	2.1	20.3	49.7	11.9	14.0	2.1
80 or over	4.2	16.7	37.5	8.3	29.2	4.2

Source: patient survey, 1993 missing observations (frequency of consultation): 8
missing observations (age): 0

Table 5.2 **Influence of age on utilization behaviour: regularity of consultation (% of age group)**

	regular	non-regular	missing
0-15	41.4	56.9	1.7
16-44	23.9	75.1	1.0
45-64	42.9	55.9	1.2
65-79	55.2	42.0	2.8
80 or over	41.7	54.2	4.2

Source: patient survey, 1993 missing observations (regularity of consultation): 10
missing observations (age): 0

Table 5.3 **Influence of age on utilization behaviour: home visit dependence (% of age group)**

	regularly	occasionally	never	missing
0-15	0	43.1	56.9	0
16-44	0	23.4	76.6	0
45-64	0.6	22.4	77.1	0
65-79	4.2	40.6	53.8	1.4
80 or over	12.5	54.2	33.3	0

Source: patient survey, 1993 missing observations (home visit dependence): 2
missing observations (age): 0

statistically significant difference (p<0.0001).

Home visit by GPs is a method of utilization which may be more heavily relied on by certain age groups, and as such provides further evidence of differential utilization behaviour. Table 5.3 indicates that the proportion of home visits is larger for the age groups 0-15, 65-79 and 80 or over than for those age 16-44 or 45-64. There is a statistically significant difference between the age groups (p<0.0001*). An increased dependence on home visits by the young and elderly may indicate that they make use of health care in different ways and that the surgery location is possibly not as critical for these groups. Alternatively, it may indicate that the location is absolutely critical and that they are not able to get there. Either way, this result supports the assertion that it is these age groups who are more likely to be restricted in their personal mobility and who rely on home visits to a greater extent.

The mobility characteristics of patients in relation to age are illustrated in Tables 5.4-5.7. Ownership of a driving licence clearly places holders at an advantage in their ability to get to the surgery since it means they are able to drive themselves, reducing the reliance on other forms of transport or other people. Table 5.4 indicates that it is those age 65 or over who are less likely to hold a driving licence. In particular, there is a larger proportion of non-holders (71%) for those age 80 or over which reduces their personal mobility, creating an obstacle to accessibility. The difference between age groups is statistically significant ($p<0.0001$).

Lack of car ownership also creates an obstacle to accessibility and Table 5.5 indicates a similar pattern to that of driving licence ownership. Again, it is those patients age 65 and over who are less likely to be car owners and who will experience a greater degree of hindrance in accessibility. A statistically significant difference exists between age groups ($p<0.0001$) to support this interpretation.

A further indicator of personal mobility is provided by information on access to a car. Table 5.6 shows that, again, the young and elderly are disadvantaged in this respect. Of those age 0-15, 17% never have access to a car. This proportion is much lower for those age 16-44 (8%), but it then rises progressively for those age 45-64 (15%), 65-79 (23%) and those age 80 or over (33%). This may reflect the lack of driving licence ownership and car ownership of the young and elderly. It also implies that they are not able to use a car at all to get to their GP. There is a statistically significant difference between age groups ($p=0.002$).

Patterns of car ownership and access to a car are reflected in data on method of transport (Table 5.7). This shows that the elderly (65-79 and 80 or over) are

Table 5.4 Influence of age on mobility characteristics: driving licence ownership (% of age group)

	holder	non-holder	missing
16-44	71.1	27.6	1.0
45-64	72.4	27.1	0.6
65-79	50.3	47.6	2.1
80 or over	29.2	70.8	0

Source: patient survey, 1993
under 16s excluded from analysis
missing observations (driving licence ownership): 6
missing observations (age): 0

Table 5.5 Influence of age on mobility characteristics: car ownership (% of age group)

	owner	non-owner	missing
16-44	58.4	21.8	19.8
45-64	63.5	21.2	15.3
65-79	40.6	40.6	18.9
80 or over	25.0	58.3	16.7

Source: patient survey, 1993
under 16s excluded from analysis
missing observations (car ownership): 96
missing observations (age): 0

Table 5.6 Influence of age on mobility characteristics: access to a car (% of age group)

	always	sometimes	never	missing
0-15	50.0	19.0	17.2	13.8
16-44	44.2	23.4	7.6	24.9
45-64	50.0	14.1	14.7	21.2
65-79	42.0	20.3	23.1	14.7
80 or over	29.2	20.8	33.3	16.7

Source: patient survey, 1993
missing observations (access to a car): 118
missing observations (age): 0

Table 5.7 Influence of age on mobility characteristics: method of transport (% of age group)

	car	walk	public transport	friend's car	other	missing
0-15	63.8	27.6	5.2	3.4	0	0
16-44	62.4	27.9	5.6	3.0	1.0	0
45-64	69.4	20.6	7.1	2.4	0	0.6
65-79	47.6	29.4	16.8	6.3	0	0
80 or over	41.7	33.3	12.5	8.3	4.2	0

Source: patient survey, 1993
missing observations (method of transport): 1
missing observations (age): 0

proportionally less likely to travel using their own car and are more likely either to walk or use public transport. The difference between the age groups is statistically significant (p=0.001*).

Age-related patterns of driving licence and car ownership, and access to a car, might also be expected to affect the levels of hindrance to access reported by different age groups. Tables 5.8-5.14 present comparisons of age with a number of obstacles.

Table 5.8 Influence of age on obstacles to accessibility: transport method (% of age group)

	a lot	a bit	not at all	missing
0-15	12.1	15.5	69.0	3.4
16-44	6.1	13.7	79.7	0.5
45-64	10.0	11.2	78.2	0.6
65-79	12.6	15.4	72.0	0
80 or over	16.7	16.7	67.7	0

Source: patient survey, 1993 missing observations (transport method): 4
missing observations (age): 0

Table 5.9 Influence of age on obstacles to accessibility: journey time (% of age group)

	a lot	a bit	not at all	missing
0-15	5.2	8.6	84.5	1.7
16-44	1.0	9.1	89.8	0
45-64	2.9	10.0	87.1	0
65-79	2.8	11.2	86.0	0
80 or over	4.2	12.5	83.3	0

Source: patient survey, 1993 missing observations (journey time): 1
missing observations (age): 0

Table 5.10 Influence of age on obstacles to accessibility: cost of journey (% of age group)

	a lot	a bit	not at all	missing
0-15	0	6.9	91.4	1.7
16-44	0	5.6	93.9	0.5
45-64	1.2	4.7	94.1	0
65-79	1.4	11.2	87.4	0
80 or over	0	8.3	91.7	0

Source: patient survey, 1993 missing observations (cost of journey): 2
missing observations (age): 0

No statistically significant differences between age groups are evident for method of transport (Table 5.8; p=0.42), journey time (Table 5.9; p=0.79*) or cost of journey (Table 5.10; p=0.29*) as obstacles to accessibility. In each case, however, there is some suggestion that the young and elderly are the most disadvantaged.

A statistically significant difference (p<0.0001) between age groups is found for time constraints as an obstacle (Table 5.11). As is to be expected, this does not present a problem to elderly age groups; only 6% of those age 65-79 experience some form of hindrance and none of those age 80 or over are hindered. Of those age 0-15, however, 36% experience some form of hindrance while for those age 16-44 42% report a hindrance. Whilst the young may have some difficulty in relation to the possible need to miss school in order to consult their GP, this hindrance may also reflect parental time constraints. Additionally, for the 16-44 age group, time constraints may be related to difficulties in consulting their GP during the working day. This would limit their opportunity for consultation.

Table 5.11 Influence of age on obstacles to accessibility: time constraints (% of age group)

	a lot	a bit	not at all	missing
0-15	3.4	32.8	62.1	1.7
16-44	8.6	33.0	56.3	2.0
45-64	6.5	19.4	73.5	0.6
65-79	0	6.3	93.0	0.7
80 or over	0	0	100.0	0

Source: patient survey, 1993 missing observations (time constraints): 7
missing observations (age): 0

As expected, the extent to which work commitments affect accessibility also differs with age (Table 5.12) and presents a similar pattern to the previous assessment of time constraints. The elderly do not find work commitments to be a hindrance: 1% of those age 65-79 and none of those age 80 or over report the factor as an obstacle; 14% of those age 0-15 indicate some form of hindrance although, again, this may be a product of school attendance or parental work commitments. Of those age 16-44, 34% report a hindrance compared with 17% of those age 45-64 , suggesting that those of employable age have some difficulty in arranging to see their GP during the working day. The difference between age groups is statistically significant (p<0.0001).

Table 5.12 Influence of age on obstacles to accessibility: work commitments (% of age group)

	a lot	a bit	not at all	missing
0-15	1.7	12.1	75.9	10.3
16-44	10.7	22.8	66.0	0.5
45-64	3.5	13.5	78.8	4.1
65-79	0	0.7	86.0	13.3
80 or over	0	0	95.8	4.2

Source: patient survey, 1993 missing observations (work commitments): 34
missing observations (age): 0

The extent to which family commitments affect accessibility decreases with age (Table 5.13). 21% of those age 0-15 indicate difficulties in accessibility due to the impact of their family, presumably largely due to parental commitments. 13% of those age 16-44 indicate a hindrance but, as expected, the impact of the family then reduces such that 5% of those age 45-64, 3% of those age 65-79 and none of those age 80 or over are affected. The x^2 test indicates that the difference is statistically significant (p=0.0004*).

Table 5.13 Influence of age on obstacles to accessibility: family commitments (% of age group)

	a lot	a bit	not at all	missing
0-15	3.4	17.2	77.6	1.7
16-44	2.0	10.7	87.3	0
45-64	0	5.3	94.1	0.6
65-79	0	2.8	95.1	2.1
80 or over	0	0	100.0	0

Source: patient survey, 1993 missing observations (family commitments): 5
missing observations (age): 0

The extent to which the location of the patient's GP surgery creates a hindrance, compared with age, is presented in Table 5.14. Only a small proportion of patients of all ages (10%) reported a problem with location of the surgery and this is broadly the proportion reporting for the first four age groups. However, for those age 80 or over the proportion reporting surgery location as an obstacle rises to 17%. This is also the age group which may experience greater difficulty in relation to car ownership or the transport method used to get to their GP. The difference between age groups is not, however, statistically significant (p=0.83*).

Table 5.14 Influence of age on obstacles to accessibility: surgery location (% of age group)

	a lot	a bit	not at all	missing
0-15	0	8.6	89.7	1.7
16-44	1.5	8.6	89.8	0
45-64	1.2	9.4	88.8	0.6
65-79	2.8	7.0	90.2	0
80 or over	4.2	12.5	83.3	0

Source: patient survey, 1993 missing observations (surgery location): 2
missing observations (age): 0

5.3 INFLUENCE OF GENDER ON UTILIZATION

Section 3.2.1 identified women as a group of health care users who have higher rates of utilization due to differences in their health status and family responsibilities. The following analysis of the utilization behaviour and obstacles to accessibility experienced by the patients surveyed, in relation to gender, will provide a means of assessing the extent of such differences.

The influence of gender on utilization is illustrated in Tables 5.15-5.17. Female consultation tends to be more frequent than for males (Table 5.15) with 30% of females consulting at least once a month compared with 20% of males. The difference in frequency is most evident in the 'once a month' category with similar proportions of males and females consulting in the other categories. Results of the x^2 test, however, suggest that no statistically significant differences exist (p=0.84).

Regularity of consultation in relation to gender (Table 5.16) also suggests no statistically significant difference in utilization behaviour (p=0.30), although the proportion of females who make regular consultations is slightly higher (41%) than for males (38%). Similarly, there is no significant difference between the genders in terms of their dependence on home visits (Table 5.17; p=0.88)

Table 5.15 Influence of gender on utilization behaviour: frequency of consultation (% of gender)

	once a fortnight	once a month	3-12 per year	1 or 2 per year	when necessary	missing
male	1.8	18.5	60.9	6.5	11.6	0.7
female	2.8	26.9	51.6	7.3	9.5	1.9

Source: patient survey, 1993 missing observations (frequency of consultation): 8
missing observations (gender): 0

Table 5.16 Influence of gender on utilization behaviour: regularity of consultation (% of gender)

	regular	non-regular	missing
male	37.7	62.0	0.4
female	40.8	56.3	2.8

Source: patient survey, 1993 missing observations (regularity of consultation): 10
missing observations (gender): 0

Table 5.17 Influence of gender on utilization behaviour: home visit dependence (% of gender)

	regularly	occasionally	never	missing
male	1.4	30.1	68.5	0
female	1.9	30.7	66.8	0.6

Source: patient survey, 1993 missing observations (home visit dependence): 2
missing observations (gender): 0

Tables 5.18-5.21 show the mobility characteristics of males and females. Table 5.18 shows a significant difference ($p<0.0001$) in driving licence ownership, a much larger proportion of females (48%) being non-holders compared to males (19%). This will impact upon female accessibility, increasing their reliance on other forms of transport.

Table 5.18 Influence of gender on mobility characteristics:
driving licence ownership (% of gender)

	holder	non-holder	missing
male	79.4	19.0	1.6
female	50.9	48.4	0.7

Source: patient survey, 1993 missing observations (driving licence ownership): 6
under 16s excluded from analysis missing observations (gender): 0

The high proportion of females who do not own a driving licence is mirrored by the level of car ownership (Table 5.19). A larger proportion of females do not own a car (33%) compared to males (23%). The difference is statistically significant ($p<0.0001$) and, as with driving licence ownership, may hinder female accessibility.

Table 5.19 Influence of gender on mobility characteristics: car ownership (% of gender)

	owner	non-owner	missing
male	66.8	23.1	10.1
female	42.5	32.8	24.7

Source: patient survey, 1993
under 16s excluded from analysis
missing observations (car ownership): 96
missing observations (gender): 0

There is also a statistically significant difference (p=0.002) in male and female access to a car (Table 5.20). A lower proportion of females (41%) 'always' have access to a car compared to males (50%) although a larger proportion of females (24%) 'sometimes' have access to a car in comparison with males (14%). A higher proportion of females (18%) never have access to a car compared to males (12%), providing further evidence to suggest that females are disadvantaged in terms of their mobility characteristics.

Table 5.20 Influence of gender on mobility characteristics: access to a car (% of gender)

	always	sometimes	never	missing
male	50.4	14.1	12.3	23.2
female	40.8	24.1	18.0	17.1

Source: patient survey, 1993
missing observations (access to a car): 118
missing observations (gender): 0

Table 5.21 shows that a lower proportion of females (58%) make use of a car compared to males (63%). For the other methods of transport, the proportion of males and females who walk is similar (27% and 26% respectively) but slightly more females make use of public transport (10% compared to a male proportion of 8%) and a friend's car (6% compared to a male proportion of 2%). The differences are, however, small and are not statistically significant at the 5% level (p=0.09).

Table 5.21 Influence of gender on mobility characteristics: method of transport (% of gender)

	car	walk	public transport	friend's car	other	missing
male	63.0	26.8	7.6	1.8	0.7	0
female	57.6	25.9	10.1	5.7	0.3	0.3

Source: patient survey, 1993
missing observations (method of transport): 1
missing observations (gender): 0

The preceding results suggest that differences exist in the mobility characteristics of the two sexes although they do not seem to affect the method of transport used to get to the GP surgery. However, it may be that these mobility characteristics do create some degree of hindrance, but that this is overcome through necessity. The extent to which transport method, and other, obstacles to accessibility are reported by males and females is illustrated in Tables 5.22-5.28.

Table 5.22 shows the extent to which the transport method used affects accessibility, by gender. In these terms, 12% of females indicated that the transport method used hinders their accessibility 'a lot' compared to 8% of males in this category; similarly, 18% of females report that the transport method hinders accessibility 'a bit' compared with 9% of males. The difference between male and female hindrance, with respect to transport method, is statistically significant (p=0.001).

Table 5.22 Influence of gender on obstacles to accessibility: transport method (% of gender)

	a lot	a bit	not at all	missing
male	7.6	8.7	82.6	1.1
female	11.7	18.0	69.9	0.3

Source: patient survey, 1993 missing observations (transport method): 4
missing observations (gender): 0

The extent to which journey time hinders accessibility is illustrated in Table 5.23. A statistically significant difference exists (p=0.02) between males and females with females reporting greater hindrance caused by the journey time (16% compared with a male proportion of 8%). This may reflect the marginal increase in reliance on public transport exhibited by females.

Table 5.23 Influence of gender on obstacles to accessibility: journey time (% of gender)

	a lot	a bit	not at all	missing
male	1.8	6.5	91.3	0.4
female	3.2	13.0	83.9	0

Source: patient survey, 1993 missing observations (journey time): 1
missing observations (gender): 0

The cost of journey is not considered an obstacle to any great extent by either sex (Table 5.24). Whilst a higher proportion of females indicates some extent of hindrance (10% compared to 6% for males) there is no statistically significant difference between the overall frequency of responses reported (p=0.14*).

Table 5.24 Influence of gender on obstacles to accessibility: cost of journey (% of gender)

	a lot	a bit	not at all	missing
male	0.7	4.7	94.2	0.4
female	0.6	8.9	90.2	0.3

Source: patient survey, 1993 missing observations (cost of journey): 2
missing observations (gender): 0

The problem of time constraint as an obstacle to accessibility is illustrated in Table 5.25. The proportion of females who indicate some form of hindrance is 31% compared to 21% of males. The difference between the frequency of response for males and females is statistically significant (p=0.02), supporting the assertion that females experience greater hindrance in relation to constraints on their time. In contrast, there is no significant difference between males and females in relation to work commitments (Table 5.26; p=0.78).

Table 5.25 Influence of gender on obstacles to accessibility: time constraints (% of gender)

	a lot	a bit	not at all	missing
male	5.1	16.3	77.2	1.4
female	5.1	25.6	68.4	0.9

Source: patient survey, 1993 missing observations (time constraints): 7
missing observations (gender): 0

Table 5.26 Influence of gender on obstacles to accessibility: work commitments (% of gender)

	a lot	a bit	not at all	missing
male	4.7	12.0	78.6	4.7
female	4.7	13.6	75.0	6.6

Source: patient survey, 1993 missing observations (work commitments): 34
missing observations (gender): 0

A statistically significant difference (p=0.001*) is, however, evident in reporting of family commitments as an obstacle to accessibility (Table 5.27). The proportion of females who indicate a hindrance is 12% compared to 4% of males, possibly due to restrictions related to child care commitments.

Table 5.27 Influence of gender on obstacles to accessibility: family commitments (% of gender)

	a lot	a bit	not at all	missing
male	0	4.3	95.3	0.4
female	1.9	10.1	86.7	1.3

Source: patient survey, 1993 missing observations (family commitments): 5
missing observations (gender): 0

The extent to which the location of surgery affects accessibility is illustrated in Table 5.28. The proportion of females who indicate that the location of their GP's surgery creates a hindrance is 13% compared with 7% of males. This is a statistically significant difference (p=0.006) and may relate to the disadvantage females experience in their mobility characteristics.

Table 5.28 Influence of gender on obstacles to accessibility: surgery location (% of gender)

	a lot	a bit	not at all	missing
male	2.2	4.7	92.4	0.7
female	1.3	12.0	86.7	0

Source: patient survey, 1993 missing observations (surgery location): 2
missing observations (gender): 0

5.4 INFLUENCE OF SOCIAL CLASS ON UTILIZATION

Manual social classes (classes IIIM-V) have been identified as having higher relative levels of need (Section 3.2.2) and, unhindered, are more likely to exhibit increased rates of utilization. The rates of utilization could, however, be affected by a range of hindrances due to the social and economic disadvantage experienced by these classes, masking true levels of need. Additionally, non-manual social classes (classes I-IIIN) have been shown to experience relative disadvantage in terms of their potential accessibility to health care due to restrictions of mobility and time availability (Section 3.3.2).

Prior to an examination of the survey results, it is worth reiterating that a large proportion of the surveyed patients could not be assigned to a class due to them not providing details of current or previous occupation (Section 4.7.2). These patients have therefore been classified as either 'housewife/husband', 'student' or 'retired/other'. Furthermore, for the purposes of analysis, survey responses have been grouped into class I-IIIN (non-manual) and class IIIN-V (manual) to assist statistical testing (i.e. to remove the low counts in some social classes).

Tables 5.29-5.31 show the influence of social class on utilization behaviour. For each category, the majority of patients consult 3-12 times per year (Table 5.29). In terms of consultation, 26% of patients in non-manual classes consult at least once a month compared to 18% for manual classes. By comparison, a larger proportion of students tend to consult at least once a month (37%). Nevertheless, these differences are not statistically significant (p=0.12*).

Table 5.29 Influence of social class on utilization behaviour: frequency of consultation (% of social class)

	once a fortnight	once a month	3-12 per year	1 or 2 per year	when necessary	missing
class I-IIIN	2.4	23.6	54.1	7.3	11.0	1.6
class IIIM-V	1.6	16.5	65.9	6.0	9.3	0.5
h'wife/husband	9.1	9.1	63.6	18.2	0	0
student	4.3	32.6	46.7	5.4	9.8	1.1
retired/other	0	26.9	50.0	7.7	11.5	3.8

Source: patient survey, 1993
missing observations (frequency of consultation): 8
missing observations (social class): 35

Table 5.30 Influence of social class on utilization behaviour: regularity of consultation (% of social class)

	regular	non-regular	missing
class I-IIIN	41.1	56.9	2.0
class IIIM-V	33.0	66.5	0.5
h'wife/husband	45.5	54.5	0
student	46.7	50.0	3.3
retired/other	19.2	80.8	0

Source: patient survey, 1993
missing observations (regularity of consultation): 10
missing observations (social class): 35

A statistically significant difference does exist ($p<0.0001$) when regularity of consultation is examined in relation to social class (Table 5.30). Non-manual classes tend to consult more regularly (41%) than their manual counterparts (33%) while both housewife/husbands and students report equal proportions of regular and non-regular consultations.

The frequency of consultation and regularity of consultation exhibited by the surveyed patients does not support the assertion that higher levels of need amongst manual classes causes them to consult at a higher rate than non-manual classes. However, nor do the analyses contradict this convincingly, and it may be that manual classes are simply being hindered to a greater extent in their utilization, so that they are unable to express this need.

Home visit dependence, in relation to social class, is presented in Table 5.31. This indicates that non-manual classes tend to be more reliant on home visits (33%) than patients in manual classes (24%). The category with the highest proportion of home dependence is students (47%). The differences in frequency of response are statistically significant ($p<0.0001$*). The increase in the proportion of non-manual classes who depend on home visits may reflect the lower potential accessibility they experience.

Table 5.31 **Influence of social class on utilization behaviour: home visit dependence (% of social class)**

	regularly	occasionally	never	missing
class I-IIIN	2.8	30.1	66.7	0.4
class IIIM-V	0	23.6	76.4	0
h'wife/husband	0	36.4	63.6	0
student	3.3	43.5	52.2	1.1
retired/other	0	15.4	84.6	0

Source: patient survey, 1993 missing observations (home visit dependence): 2
missing observations (social class): 35

An examination of the surveyed patients' mobility characteristics, by social class, is illustrated in Tables 5.32-5.35. Table 5.32 indicates that, somewhat surprisingly, a slightly higher proportion of patients in manual classes are driving licence holders

(79%) compared to those in non-manual classes (72%). Unsurprisingly, students and retired/other patients have higher proportions of non-licence holders. Overall, the differences are statistically significant (p<0.0001).

Table 5.32 **Influence of social class on mobility characteristics: driving licence ownership (% of social class)**

	holder	non-holder	missing
class I-IIIN	71.9	27.6	0.5
class IIIM-V	78.7	20.2	1.1
h'wife/husband	54.5	45.5	0
student	33.0	67.0	0
retired/other	41.7	54.2	4.2

Source: patient survey, 1993 missing observations (driving licence ownership): 6
under 16s excluded from analysis missing observations (social class): 27

Table 5.33 illustrates the level of car ownership by social class. A similar profile exists to that of driving licence holder status. Again, a higher proportion of manual patients' own cars (71%) compared to those categorised as non-manual (60%). As expected, the other categories all show a higher proportion of non-ownership. The differences are statistically significant (p<0.0001).

Table 5.33 **Influence of social class on mobility characteristics: car ownership (% of social class)**

	owner	non-owner	missing
class I-IIIN	60.1	29.1	10.8
class IIIM-V	70.8	13.5	15.7
h'wife/husband	36.4	45.5	18.2
student	26.4	47.3	26.4
retired/other	20.8	33.3	45.8

Source: patient survey, 1993 missing observations (car ownership): 96
under 16s excluded from analysis missing observations (social class): 27

A broadly similar pattern is seen in access to a car, by social class (Table 5.34): 16% of non-manual patients report that they never have access to a car compared to 6% of manual patients. This compares with 46% of housewife/husbands, 22% of students and only 8% of retired/other patients - the proportion of which would be expected to be higher to reflect the high rate of non-ownership. The differences of frequency of response are statistically significant (p<0.0001*) suggesting that the socio-economic status of patients does have an effect on their mobility characteristics.

Table 5.34 Influence of social class on mobility characteristics: access to a car (% of social class)

	always	sometimes	never	missing
class I-IIIN	50.4	15.0	16.3	18.3
class IIIM-V	52.7	16.5	6.0	24.7
h'wife/husband	27.3	18.2	45.5	9.1
student	31.5	33.7	21.7	13.0
retired/other	30.8	38.5	7.7	23.1

Source: patient survey, 1993 missing observations (access to a car): 118
missing observations (social class): 35

When the method of transport is examined with respect to social class (Table 5.35), the influence of mobility characteristics becomes evident. A higher proportion of manual patients (71%) make use of a car to get to their GP's surgery than non-manual patients (61%); they also make proportionally less use of all other methods. This is consistent with the patterns of driving licence holder status and car ownership. Expectedly, the other categories make proportionally more use of methods of transport other than a car. The differences are statistically significant (p<0.0001*).

Table 5.35 Influence of social class on mobility characteristics:
method of transport (% of social class)

	car	walk	public transport	friend's car	other	missing
class I-IIIN	61.4	24.0	10.6	4.1	0	0
class IIIM-V	71.4	20.3	5.5	2.2	0.5	0
h'wife/husband	36.4	54.5	9.1	0	0	0
student	47.8	31.5	12.0	6.5	1.1	1.1
retired/other	46.2	38.5	0	11.5	3.8	0

Source: patient survey, 1993 missing observations (method of transport): 1
missing observations (social class): 35

The preceding discussion has suggested that there are no differences in utilization behaviour or that any such differences are masked. Much stronger differences are, however, evident in the mobility characteristics amongst different social classes. The extent to which these, and other, obstacles to accessibility affect utilization illustrated in Tables 5.36-5.42. It should be noted, however, that very high proportions of low cell counts occur in these data, so the results of x^2 analyses are often unreliable.

Table 5.36 shows a comparison of social class with the extent to which the method of transport affects accessibility. The overall proportion of those reporting some form of hindrance is low (24%) and there are, marginally, no statistically significant differences (p=0.06*). However, 25% of patients in non-manual classes report hindrance to some extent compared with 16% of manual patients. The proportion of the other categories which report hindrance due to the transport method is also higher than that for the manual class. This would be expected given the limitations inflicted by their mobility characteristics.

Table 5.36 Influence of social class on obstacles to accessibility: transport method (% of social class)

	a lot	a bit	not at all	missing
class I-IIIN	13.0	12.2	73.6	1.2
class IIIM-V	6.0	9.9	83.5	0.5
h'wife/husband	9.1	9.1	81.8	0
student	10.9	18.5	70.7	0
retired/other	3.8	30.8	65.4	0

Source: patient survey, 1993 missing observations (transport method): 4
missing observations (social class): 35

Table 5.37 Influence of social class on obstacles to accessibility: journey time (% of social class)

	a lot	a bit	not at all	missing
class I-IIIN	3.3	10.2	86.6	0
class IIIM-V	1.1	6.6	91.8	0.5
h'wife/husband	9.1	9.1	81.8	0
student	2.2	16.3	81.5	0
retired/other	0	11.5	88.5	0

Source: patient survey, 1993 missing observations (journey time): 1
missing observations (social class): 35

There are no statistically significant differences (p=0.46*) when analysing frequency of social class response in relation to the journey time as an obstacle to accessibility (Table 5.37). A higher proportion of non-manual classes (14%) than manual classes (8%) do, however, report journey time as presenting an obstacle to their accessibility.

The proportion of hindered patients in the other categories is also higher than for manual patients.

A small number of patients (8%) reported a hindrance with respect to the cost of journey (Table 5.38). The difference is statistically significant (p=0.01) with 8% of non-manual patients reporting a hindrance compared with 4% of manual patients. Of the other categories, the major difference is the response of housewife/husbands where 9% report that the cost affects their accessibility 'a lot' - a much higher proportion than for other categories.

Table 5.38 Influence of social class on obstacles to accessibility: cost of journey (% of social class)

	a lot	a bit	not at all	missing
class I-IIIN	0.8	7.7	91.5	0
class IIIM-V	0	4.4	94.5	1.1
h'wife/husband	9.1	0	90.9	0
student	0	9.8	90.2	0
retired/other	0	3.8	96.2	0

Source: patient survey, 1993   missing observations (cost of journey): 2
missing observations (social class): 35

Table 5.39 shows that a higher proportion of manual patients (32%) report that time constraints affect their accessibility compared with non-manual patients (26%). Surprisingly, of those categorised as retired/other, 41% indicate a hindrance in accessibility in relation to time constraints. The difference between response is statistically significant (p=0.0003*).

Table 5.39 Influence of social class on obstacles to accessibility: time constraints (% of social class)

	a lot	a bit	not at all	missing
class I-IIIN	5.7	19.9	73.6	0.8
class IIIM-V	7.1	25.3	64.8	2.7
h'wife/husband	9.1	18.2	72.7	0
student	0	16.3	83.7	0
retired/other	7.7	34.6	57.7	0

Source: patient survey, 1993   missing observations (time constraints): 7
missing observations (social class): 35

The extent to which work commitments affect accessibility also differs between the different classes (Table 5.40) and is statistically significant (p<0.0001*). Whereas 13% of non-manual patients report a hindrance in accessibility based on work commitments, this compares with 33% of manual classes. The proportion for other categories is, as expected, low by comparison. This would suggest that it is the manual classes who experience greater difficulty in arranging a consultation either during or around their working day. This may partially account for the lower rate of utilization exhibited by this group of patients (Table 5.29).

Table 5.40 Influence of social class on obstacles to accessibility: work commitments (% of social class)

	a lot	a bit	not at all	missing
class I-IIIN	4.1	9.3	80.9	5.7
class IIIM-V	8.2	24.7	63.7	3.3
h'wife/husband	9.1	27.3	63.6	0
student	0	1.1	90.2	8.7
retired/other	7.7	7.7	80.8	3.8

Source: patient survey, 1993

missing observations (work commitments): 34
missing observations (social class): 35

The frequency of responses on the extent to which family commitments affect accessibility (Table 5.41) show no statistically significant difference (p=0.85*). The proportion of manual and non-manual patients reporting a difference is similar, being 6.5% and 9% respectively. Housewife/husbands do not report any hindrance.

Table 5.41 Influence of social class on obstacles to accessibility: family commitments (% of social class)

	a lot	a bit	not at all	missing
class I-IIIN	1.2	7.7	89.8	1.2
class IIIM-V	0.5	6.0	93.4	0
h'wife/husband	0	0	100.0	0
student	1.1	13.0	83.7	2.2
retired/other	3.8	7.7	88.5	0

Source: patient survey, 1993

missing observations (family commitments): 5
missing observations (social class): 35

The categories with the largest proportions of hindrance related to family commitment are students (14%) and retired/other (12%). This may reflect the fact that students (including, in this instance, schoolchildren) may be reliant on parents or guardians to enable them to access health care and, similarly, retired people may be equally reliant on others.

Table 5.42 illustrates the extent to which the location of the surgery creates a hindrance to accessibility. There is no statistically significant difference between the frequency of responses (p=0.63*). A slightly higher proportion of non-manual patients report a hindrance (11%) compared with manual patients (7%). In the case of housewife/husbands, 18% report a hindrance, possibly because disadvantage in terms of mobility creates a perception that the surgery location is inadequate. The same may be true of students and retired/other patients who report a hindrance due to the location of the surgery (14% and 12% respectively).

Table 5.42 Influence of social class on obstacles to accessibility: surgery location (% of social class)

	a lot	a bit	not at all	missing
class I-IIIN	2.4	8.9	88.2	0.4
class IIIM-V	1.1	6.0	92.9	0
h'wife/husband	9.1	9.1	81.8	0
student	1.1	13.0	85.9	0
retired/other	0	11.5	88.5	0

Source: patient survey, 1993

missing observations (surgery location): 2
missing observations (social class): 35

5.5 INFLUENCE OF EMPLOYMENT ON UTILIZATION

Section 3.2.2 identified unemployment as one of the components which lead to increased social and economic disadvantage. Those who are disadvantaged in this way exhibit an increased need for health care which, unhindered, would manifest as a higher rate of utilization. This section investigates the utilization behaviour and obstacles to accessibility of the surveyed patients in relation to their employment status.

Tables 5.43-5.45 illustrate the influence of employment on utilization behaviour. Unemployed patients tend to consult more often than those who are employed (Table 5.43). Whilst 18% of employed patients consult at least once a month this compares to 31% of those who are unemployed. This is a statistically significant difference ($p<0.0001$), supporting the assertion that the unemployed have a higher rate of utilization as a result of their increased levels of need.

Table 5.43 **Influence of employment on utilization behaviour: frequency of consultation (% of employment group)**

	once a fortnight	once a month	3-12 per year	1 or 2 per year	when necessary	missing
employed	1.3	16.3	68.3	5.4	7.9	0.8
unemployed	3.2	27.8	47.2	7.8	12.2	1.7

Source: patient survey, 1993 missing observations (frequency of consultation): 8
missing observations (employment): 7

Regularity of consultation, in comparison with employment status, suggests a similar pattern (Table 5.44) with a higher proportion of unemployed patients (46%) making regular consultations compared to those who are employed (30%). There is, again, a statistically significant difference ($p<0.0001$), providing further evidence for the higher rate of utilization reported by unemployed patients.

Table 5.44 **Influence of employment on utilization behaviour: regularity of consultation (% of employment group)**

	regular	non-regular	missing
employed	30.0	69.6	0.4
unemployed	46.1	51.3	2.6

Source: patient survey, 1993 missing observations (regularity of consultation): 10
missing observations (employment): 7

The relationship between home visit dependence and employment status (Table 5.45) is also statistically significant ($p<0.0001$). A much larger proportion of unemployed patients use home visits compared with employed patients (41% and 20% respectively). This heavier reliance on home visits by unemployed patients may act to create pressure on health care provision in areas with high percentages of unemployment.

Table 5.45 **Influence of employment on utilization behaviour: home visit dependence (% of employment group)**

	regularly	occasionally	never	missing
employed	0	19.6	80.4	0
unemployed	2.9	38.0	58.6	0.6

Source: patient survey, 1993 missing observations (home visit dependence): 2
missing observations (employment): 7

As noted previously, social and economic disadvantage not only leads to increased need for health care but may also reduce mobility and hinder accessibility. The influence of employment status on patient mobility is illustrated in Tables 5.46-5.49. From Table 5.46, it is clear that a larger proportion of those who are unemployed do not hold a driving licence (48%) compared to employed patients (18%). The difference is statistically significant ($p<0.0001$).

Table 5.46 **Influence of employment on mobility characteristics: driving licence ownership (% of employment group)**

	holder	non-holder	missing
employed	82.0	17.6	0.4
unemployed	50.3	48.3	1.4

Source: patient survey, 1993 missing observations (driving licence ownership): 6
under 16s excluded from analysis missing observations (employment): 5

Table 5.47 shows a similar pattern for car ownership: 16% of employed patients do not own a car whereas 38% of those who are unemployed are non-owners. The result is statistically significant ($p<0.0001$) and creates a mobility disadvantage for the unemployed.

Table 5.47 **Influence of employment on mobility characteristics: car ownership (% of employment group)**

	owner	non-owner	missing
employed	72.5	15.9	11.6
unemployed	39.5	37.5	23.0

Source: patient survey, 1993 missing observations (car ownership): 96
under 16s excluded from analysis missing observations (employment): 5

Access to a car by employment status is shown in Table 5.48. A statistically significant ($p<0.0001$) difference exists between the two groups; with 22% of the unemployed never having access to a car compared with 5% of those who are employed.

Table 5.48 **Influence of employment on mobility characteristics: access to a car (% of employment group)**

	always	sometimes	never	missing
employed	52.5	14.2	5.4	27.9
unemployed	40.6	22.6	22.3	14.5

Source: patient survey, 1993 missing observations (access to a car): 118
missing observations (employment): 7

The effect of the differences in mobility characteristics exhibited are manifest when a comparison is made between employment status and the method of transport used to get to the GP's surgery (Table 5.49). A much larger proportion of unemployed patients make use of a method of transport other than their own car (49%) compared with employed patients (27%). The usage of all modes, other than car, is correspondingly higher for unemployed patients than for employed. The difference is statistically significant ($p<0.0001$), giving a clear indication of the mobility difficulties the unemployed experience.

Table 5.49 **Influence of employment on mobility characteristics: method of transport (% of employment group)**

	car	walk	public transport	friend's car	other	missing
employed	73.3	19.2	4.6	2.5	0.4	0
unemployed	51.3	31.0	11.9	4.9	0.6	0.3

Source: patient survey, 1993 missing observations (method of transport): 1
missing observations (employment): 7

Whilst the evidence thus shows that unemployed patients have an increased rate of utilization and reduced levels of mobility, it is important to determine the extent to which mobility, and other, obstacles affect their accessibility to health care. The comparison of a range of obstacles with employment status is indicated in Tables 5.50-5.56.

Table 5.50 shows the extent to which transport method is an obstacle to accessibility, by employment status. As expected, a large proportion of unemployed patients reported that the method of transport they use causes them a hindrance (29%). This compares to 15% of employed patients, and is a statistically significant difference (p=0.0004).

Table 5.50 **Influence of employment on obstacles to accessibility: transport method (% of employment group)**

	a lot	a bit	not at all	missing
employed	5.4	10.0	83.3	1.3
unemployed	13.0	16.2	70.4	0.3

Source: patient survey, 1993 missing observations (transport method): 4
missing observations (employment): 7

Journey time (Table 5.51) likewise shows a statistically significant difference (p=0.03): twice as many unemployed patients (16%) indicate hindrance compared to those who are employed (8%).

Table 5.51 **Influence of employment on obstacles to accessibility: journey time (% of employment group)**

	a lot	a bit	not at all	missing
employed	1.7	6.7	91.3	0.4
unemployed	3.2	12.5	84.3	0

Source: patient survey, 1993 missing observations (journey time): 1
missing observations (employment): 7

Table 5.52 **Influence of employment on obstacles to accessibility: cost of journey (% of employment group)**

	a lot	a bit	not at all	missing
employed	0	2.9	96.3	0.8
unemployed	1.2	9.9	89.0	0

Source: patient survey, 1993 missing observations (cost of journey): 2
missing observations (employment): 7

The cost of the journey, in relation to employment status, is illustrated in Table 5.52. As expected, cost is more of a hindrance to unemployed patients than employed. Of those patients who report cost as an obstacle, 11% are unemployed compared with 3% of those who are employed. The difference is statistically significant (p=0.001). As well as being a function of reduced income, these results may reflect the increased reliance on other forms of transport (such as public transport) that the lower level of mobility leads the unemployed to use.

As is to be expected, time constraints are less severe for unemployed patients than for employed (Table 5.53). A statistically significant difference ($p<0.0001$) exists, with 38% of employed patients reporting hindrance (38%) compared to 18% of unemployed.

Table 5.53 Influence of employment on obstacles to accessibility: time constraints (% of employment group)

	a lot	a bit	not at all	missing
employed	10.4	28.3	59.2	2.1
unemployed	1.4	16.5	81.4	0.6

Source: patient survey, 1993 missing observations (time constraints): 7
missing observations (employment): 7

The effect of work commitments on accessibility supports the suggestion that employed patients are hindered to a greater extent (Table 5.54). The proportion of employed patients reporting a hindrance is 37% compared to only 4% of those who are unemployed. This is a statistically significant difference ($p<0.0001$).

Table 5.54 Influence of employment on obstacles to accessibility: work commitments (% of employment group)

	a lot	a bit	not at all	missing
employed	10.4	26.3	61.7	1.7
unemployed	0.9	3.5	87.2	8.4

Source: patient survey, 1993 missing observations (work commitments): 34
missing observations (employment): 7

Table 5.55 Influence of employment on obstacles to accessibility: family commitments (% of employment group)

	a lot	a bit	not at all	missing
employed	0.8	5.8	93.3	0
unemployed	1.2	8.7	88.7	1.4

Source: patient survey, 1993 missing observations (family commitments): 5
missing observations (employment): 7

The extent to which family commitments affect accessibility (Table 5.55) shows no statistically significant difference between the groups (p=0.37*). The proportions of employed and unemployed patients reporting hindrance is similar (7% of employed and 10% of unemployed patients).

There is also no statistically significant difference (p=0.09) between employed and unemployed patients reporting surgery location as an obstacle to accessibility (Table 5.56): 5% of employed patients report a hindrance compared with 12% of unemployed patients.

Table 5.56 Influence of employment on obstacles to accessibility: surgery location (% of employment group)

	a lot	a bit	not at all	missing
employed	1.3	5.8	92.5	0.4
unemployed	2.0	10.7	87.0	0.3

Source: patient survey, 1993

missing observations (surgery location): 2
missing observations (employment): 7

5.6 INFLUENCE OF ETHNICITY ON UTILIZATION

Ethnic minorities may be expected to be disadvantaged in their potential accessibility to health care as a result of reduced service awareness and a range of social, economic and cultural impediments to utilization (Section 3.3.3). This section presents the results of the patient survey examining utilization behaviour differences between non-white and white populations. Due to the low number of total returns from ethnic minority patients (Appendix Two) they have been grouped into a single 'non-white' category. The proportion of ethnic minority patients in the sample shows no statistically significant difference with the host population (Section 4.7.3) and it is worthwhile commenting on the results. The small number of returns does, however, render x^2 tests very unreliable due to high proportions of low cell counts and they are not reported here (Appendix Two).

Tables 5.57-5.59 show the relationship between ethnicity and utilization behaviour. Several distinct differences can be seen. For example, 48% of non-white patients consult at least once a month compared to 25% of white patients (Table 5.57). Larger proportions of non-white patients make regular consultations (57%) compared to white patients (39%), as illustrated in Table 5.58. The proportion of patients who depend on home visits, however, is the same for white and non-white patients (Table 5.59).

Table 5.57 Influence of ethnicity on utilization behaviour: frequency of consultation (% of ethnic group)

	once a fortnight	once a month	3-12 per year	1 or 2 per year	when necessary	missing
white	2.3	22.6	56.4	7.1	10.4	1.2
non-white	7.1	42.9	28.6	0	14.3	7.1

Source: patient survey, 1993 missing observations (frequency of consultation): 8
missing observations (ethnicity): 2

Table 5.58 Influence of ethnicity on utilization behaviour: regularity of consultation (% of ethnic group)

	regular	non-regular	missing
white	39.1	59.2	1.7
non-white	57.1	42.9	0

Source: patient survey, 1993 missing observations (regularity of consultation): 10
missing observations (ethnicity): 2

Table 5.59 Influence of ethnicity on utilization behaviour: home visit dependence (% of ethnic group)

	regularly	occasionally	never	missing
white	1.7	30.2	67.7	0.3
non-white	0	35.7	64.3	0

Source: patient survey, 1993 missing observations (home visit dependence): 2
missing observations (ethnicity): 2

The influence of ethnicity on mobility is illustrated in Tables 5.60-5.63. Whereas 35% of white patients do not hold a driving licence, 46% of non-white patients are non-holders (Table 5.60). Table 5.61, however, shows that similar proportions of white and non-white patients (28% and 31% respectively) do not own a car. At first sight, this is somewhat at odds with the previous result with the suggestion that there is a larger proportion of non-white car owners than there are driving licence holders. This anomaly is largely because some non-white patients failed to respond to this question; the actual number of non-white car owners does not exceed the number of driving licence owners.

Table 5.60 Influence of ethnicity on mobility characteristics: driving licence ownership (% of ethnic group)

	holder	non-holder	missing
white	64.4	34.5	1.2
non-white	53.8	46.2	0

Source: patient survey, 1993 missing observations (driving licence ownership): 6
under 16s excluded from analysis missing observations (ethnicity): 2

Table 5.61 Influence of ethnicity on mobility characteristics: car ownership (% of ethnic group)

	owner	non-owner	missing
white	53.9	28.1	17.9
non-white	46.2	30.8	23.1

Source: patient survey, 1993 missing observations (car ownership): 96
under 16s excluded from analysis missing observations (ethnicity): 2

Table 5.62 Influence of ethnicity on mobility characteristics: access to a car (% of ethnic group)

	always	sometimes	never	missing
white	45.1	19.3	15.1	20.5
non-white	50.0	28.6	21.4	0

Source: patient survey, 1993 missing observations (access to a car): 118
missing observations (ethnicity): 2

Table 5.63 Influence of ethnicity on mobility characteristics: method of transport (% of ethnic group)

	car	walk	public transport	friend's car	other	missing
white	60.4	26.6	8.9	3.6	0.3	0.2
non-white	50.0	21.4	14.3	7.1	7.1	0

Source: patient survey, 1993 missing observations (method of transport): 1
missing observations (ethnicity): 2

When access to a car is examined in relation to ethnicity (Table 5.62) a higher proportion of non-white patients are seen to have access to a car to some extent (78%) compared with white patients (64%). Furthermore, the method of transport, by ethnicity, is illustrated in Table 5.63. Reflecting the pattern of licence-holding, 50% of non-white patients do not use their own car, compared to 41% of white patients.

The extent to which transport method, and other obstacles, affect accessibility is presented in Tables 5.64-5.70. Table 5.64 shows that a higher proportion of non-whites (29%) report a hindrance due to the method of transport compared with white patients (23%). Table 5.65 indicates that 29% of non-white patients, compared with 12% of white patients, report that the journey time causes them a hindrance. A higher proportion of non-white patients also report that the cost of the journey is an obstacle to accessibility (Table 5.66): 14%, compared with 7% of white patients. A similar pattern is seen in terms of time constraints (Table 5.67): 27% of white patients state that time constraints cause them a hindrance, compared with 21% of non-whites.

Table 5.64 Influence of ethnicity on obstacles to accessibility: transport method (% of ethnic group)

	a lot	a bit	not at all	missing
white	9.7	13.5	76.0	0.7
non-white	7.1	21.4	71.4	0

Source: patient survey, 1993 missing observations (transport method): 4
missing observations (ethnicity): 2

Table 5.65 Influence of ethnicity on obstacles to accessibility: journey time (% of ethnic group)

	a lot	a bit	not at all	missing
white	2.3	9.7	87.8	0.2
non-white	7.1	21.4	71.4	0

Source: patient survey, 1993 missing observations (journey time): 1
missing observations (ethnicity): 2

Table 5.66 Influence of ethnicity on obstacles to accessibility: cost of journey (% of ethnic group)

	a lot	a bit	not at all	missing
white	0.5	6.9	92.2	0.3
non-white	7.1	7.1	85.7	0

Source: patient survey, 1993 missing observations (cost of journey): 2
missing observations (ethnicity): 2

Table 5.67 Influence of ethnicity on obstacles to accessibility: time constraints (% of ethnic group)

	a lot	a bit	not at all	missing
white	4.9	21.7	72.2	1.2
non-white	14.3	7.1	78.6	0

Source: patient survey, 1993 missing observations (time constraints): 7
missing observations (ethnicity): 2

A higher proportion of white patients also find work commitments an obstacle to accessibility (Table 5.68). Here, 18% of white patients report work commitments as a hindrance compared with 7% of non-whites. In contrast, broadly similar proportions of whites and non-whites report family commitments as an obstacle to accessibility (Table 5.69): 7% non-white, compared with 9% white. As Table 5.70 shows, a higher proportion of non-white patients (14%) report the location of the surgery as being a hindrance compared with white patients (10%).

Table 5.68 Influence of ethnicity on obstacles to accessibility: work commitments (% of ethnic group)

	a lot	a bit	not at all	missing
white	4.7	13.2	76.2	5.9
non-white	7.1	0	92.9	0

Source: patient survey, 1993
missing observations (work commitments): 34
missing observations (ethnicity): 2

Table 5.69 Influence of ethnicity on obstacles to accessibility: family commitments (% of ethnic group)

	a lot	a bit	not at all	missing
white	1.0	7.5	90.6	0.9
non-white	0	7.1	92.9	0

Source: patient survey, 1993
missing observations (family commitments): 5
missing observations (ethnicity): 2

Table 5.70 Influence of ethnicity on obstacles to accessibility: surgery location (% of ethnic group)

	a lot	a bit	not at all	missing
white	1.6	8.5	89.6	0.3
non- hite	7.1	7.1	85.7	0

Source: patient survey, 1993
missing observations (surgery location): 2
missing observations (ethnicity): 2

Overall, these analyses suggest that non-white patients tend to experience greater hindrance in relation to the physical components of accessibility (transport method, journey time, cost of journey and surgery location). They are not hindered to the same extent in relation to other constraints and commitments (time, work and family).

5.7 INFLUENCE OF PROXIMITY (DISTANCE) ON UTILIZATION

Analyses in this section examine the effect of proximity to the surgery, in terms of distance, on utilization behaviour. Distance from the surgery may be expected to disadvantage those living further away, potentially leading to a distance decay effect in terms of utilization (Section 3.4.4). Such difficulties are often compounded by other aspects of the utilization process such as the availability of suitable transport methods (Section 3.3.1) and lack of rural service provision (Section 3.4.1).

Tables 5.71-5.73 show the effect of distance between the surgery and a patient's home on patterns of utilization. The majority of patients in the survey (82%) live within 3 miles (4.8km) of the surgery (Table 5.71). The proportion of those who consult at least once a month, and who live less than 1 mile (1.6km) from the surgery, is 26%. For those who live between 1 and 3 miles the proportion is similar (28%). However, only 11% of patients who live 4 or 5 miles (6.4-8km) away consult at least once a month. Unexpectedly, for patients who live more than 5 miles away from the surgery the proportion who consult at least once a month is higher (39%). The frequency of utilization does not therefore decrease for each distance category and there is little evidence to support the concept of a distance decay effect in utilization. The differences are, marginally, not statistically significant (p=0.08*).

Table 5.71 **Influence of proximity (distance) on utilization behaviour: frequency of consultation (% of distance category)**

	once a fortnight	once a month	3-12 per year	1 or 2 per year	when necessary	missing
< 1 mile	3.2	23.2	53.2	6.3	11.6	2.6
1-3 miles	2.0	25.7	53.0	6.8	11.5	1.0
4-5 miles	1.2	9.5	72.6	9.5	7.1	0
> 5 miles	5.6	33.3	55.6	5.6	0	0

Source: patient survey, 1993
missing observations (frequency of consultation): 8
missing observations (distance): 4

Several explanations are adducible for the unexpected effect of distance on frequency of utilization. Firstly, the nature of health care needs exhibited by the patient cohort may lead to a pattern of utilization determined more by the need for treatment than distance. Secondly, as noted, Table 5.71 also shows a large fall in frequent consultation for a distance of 4 or 5 miles. The use of broad distance categories in the survey may, therefore, mask differences which may have been more evident if data was disaggregated and analysed for every 1 mile of distance (although this would have raised the risk of errors in reporting distance from surgery, Section 4.4). Furthermore, in the review of the effect of distance decay (Section 3.4.4), it appears that, above a certain distance, utilization may tend to increase slightly although this does not account for the magnitude of increase exhibited by the patients.

The regularity of consultation, illustrated in Table 5.72, shows that there is a statistically significant difference (p=0.05) in frequency of response for the different distance categories. The largest proportion of regular consultations (45%) is exhibited by patients who live between 1-3 miles from the surgery. The lowest proportion of regular consultations (32%) is reported by patients 4-5 miles away from the surgery although, as with the frequency of utilization analysis, the proportion of regular consultations increases to 39% for those over 5 miles away.

Table 5.72 **Influence of proximity (distance) on utilization behaviour: regularity of consultation (% of distance category)**

	regular	non-regul	missing
< 1 mile	34.2	64.7	1.1
1-3 miles	44.6	53.4	2.0
4-5 miles	32.1	65.5	2.4
> 5 miles	38.9	61.1	0

Source: patient survey, 1993
missing observations (regularity of consultation): 10
missing observations (distance): 4

Table 5.73 **Influence of proximity (distance) on utilization behaviour: home visit dependence (% of distance category)**

	regularly	occasionally	never	missing
< 1 mile	1.6	22.1	76.3	0
1-3 miles	2.0	33.1	64.5	0.3
4-5 miles	1.2	41.7	57.1	0
> 5 miles	0	22.2	72.2	5.6

Source: patient survey, 1993
missing observations (home visit dependence): 2
missing observations (distance): 4

The extent to which patients rely on home visits, in relation to distance, is presented in Table 5.73. 24% of patients who live within a mile of the surgery depend on home visits to some extent. This proportion rises to 35% for patients living between 1-3 miles and, again, to 43% of those who live 4-5 miles away. The differences are statistically significant (p=0.04*), and thus indicate that, as distance increases, so does dependence on home visits. The anomaly in this analysis is that, unexpectedly, the dependence falls to 22% for those who live more than 5 miles away. The reason for this is unclear, but it may be that GPs are reluctant to travel such distances given the amount of time it would take.

Alternatively, it may reflect the pattern of socio-economic characteristics of the population around surgeries. Most surgeries are located in towns or larger villages; those living at greater distances are thus likely to live in suburban or rural areas, and may be more middle-class, less needful of health care and less inhibited in their access to it. Some support for this interpretation comes from an analysis of mobility characteristics with increasing distance from surgeries (Tables 5.74-5.77).

Table 5.74 shows that, as distance increases, the proportion of driving licence holders also increases. 55% of patients who live within 1 mile of the surgery are driving licence holders. This compares to 66% of those who live between 1-3 miles, 71% of those who are 4-5 miles away and 88% of those who live over 5 miles from the surgery. The differences are statistically significant (p=0.01).

Table 5.74 **Influence of proximity (distance) on mobility characteristics: driving licence ownership (% of distance category)**

	holder	non-holder	missing
< 1 mile	55.3	43.5	1.2
1-3 miles	66.2	32.3	1.5
4-5 miles	70.5	29.5	0
> 5 miles	87.5	12.5	0

Source: patient survey, 1993
under 16s excluded from analysis
missing observations (driving licence ownership): 6
missing observations (distance): 4

The proportion of car owners shows no trend with increasing distance (Table 5.75). Levels of reported ownership rise from 46% within a mile of the surgery, to 56% for those who live between 1-3 miles, 59% for those 4-5 miles away and 81% for those who are more than 5 miles away from the surgery, but the differences are not statistically significant (p=0.17).

Table 5.75 Influence of proximity (distance) on mobility characteristics: car ownership (% of distance category)

	owner	non-owner	missing
< 1 mile	45.9	29.4	24.7
1-3 miles	55.6	29.7	14.7
4-5 miles	59.0	24.4	16.7
> 5 miles	81.3	12.5	6.3

Source: patient survey, 1993 missing observations (car ownership): 96
under 16s excluded from analysis missing observations (distance): 4

A clear pattern does, however, occur in relation to patient access to a car (Table 5.76). As distance increases, so does access to a car: 38% of patients living within a mile of the surgery always have access to a car compared with 48% of those who live between 1 and 3 miles, 45% of those who live 4-5 miles away and 83% of those who live more than 5 miles away. Indeed, none of the surveyed patients who live more than 5 miles away reported that they 'never' have access to a car. The differences are statistically significant (p=0.005) and clearly support the view that car ownership and availability is important for those who live at increasing distances away from the surgery.

Table 5.76 Influence of proximity (distance) on mobility characteristics: access to a car (% of distance category)

	always	sometimes	never	missing
< 1 mile	37.9	25.8	17.4	18.9
1-3 miles	48.0	18.6	14.5	18.9
4-5 miles	45.2	11.9	16.7	26.2
> 5 miles	83.3	5.6	0	11.1

Source: patient survey, 1993 missing observations (access to a car): 118
missing observations (distance): 4

The use of different methods of transport, illustrated in Table 5.77, further emphasises the reliance on a privately owned car for transport with increasing distance. Of those patients who live within 1 mile of their GP's surgery, the largest proportion (63%) are more likely to walk than use any form of transport. Only 33% of these patients make use of their own car and 3% use public transport. As distance increases so does reliance on a car. For patients who live between 1 and 3 miles away, 70% use a car, 11% walk and a further 11% make use of public transport. Of those who live 4-5 miles away, 79% of patients use their own car while 14% use public transport (the highest of any zone). For patients who live more than 5 miles away, 94% use their own car and 6% use public transport. Again, these differences are significantly different (p<0.0001*). The results show that, as distance increases, so does dependence on the car. At the same time, whilst the use of public transport increases for distances up to 5 miles, a much smaller proportion of patients use it over 5 miles away. This may reflect the availability of suitable public transport for journeys of some distance where the service may be infrequent or the journey may be inconvenient and time consuming. Alternatively, it may be a function of social status and travel preferences.

Table 5.77 Influence of proximity (distance) on mobility characteristics: method of transport (% of distance category)

	car	walk	public transport	friend's car	other	missing
< 1 mile	32.6	63.7	3.2	0	0.5	0
1-3 miles	70.3	11.1	11.1	6.4	0.7	0.3
4-5 miles	78.6	2.4	14.3	4.8	0	0
> 5 miles	94.4	0	5.6	0	0	0

Source: patient survey, 1993

missing observations (method of transport): 1
missing observations (distance): 4

The extent to which transport, and other obstacles, affects accessibility in relation to distance is presented in Tables 5.78-5.84. Table 5.78 shows the extent to which the transport method is considered by respondents to affect accessibility. For patients who live less than 1 mile away from the surgery (those who are more likely to walk), 11% report some form of hindrance. At 1-3 miles away, the proportion reporting a hindrance rises to 30%, then falls to 29% for patients 4-5 miles away and 28% for those who are more than 5 miles away. When considering patients who report 'a lot' of hindrance, the highest proportion (18%) is reported in the 4-5 miles category. This may be associated with the use of public transport since patients in this category also reported the highest rate of public transport usage. The differences are statistically significant (p<0.0001) with nearly a third of patients who live over 1 mile away suggesting that the method of transport is an obstacle to accessibility.

Table 5.78 **Influence of proximity (distance) on obstacles to accessibility: transport method (% of distance category)**

	a lot	a bit	not at all	missing
< 1 mile	2.1	8.9	87.9	1.1
1-3 miles	12.2	17.6	69.6	0.7
4-5 miles	17.9	10.7	71.4	0
> 5 miles	11.1	16.7	72.2	0

Source: patient survey, 1993 missing observations (transport method): 4
missing observations (distance): 4

The extent to which journey time is perceived as a hindrance to access is shown in Table 5.79. Of those who live within 1 mile of the surgery, 7% report journey time as an obstacle to accessibility. This proportion rises to 15% for those who are 1-3 miles away, 16% for those 4-5 miles away and 17% for those who are more than 5 miles away. These differences are, however, small and are not statistically significant at the 5% level (p=0.13*).

Table 5.79 **Influence of proximity (distance) on obstacles to accessibility: journey time (% of distance category)**

	a lot	a bit	not at all	missing
< 1 mile	1.6	5.3	93.2	0
1-3 miles	3.4	11.8	84.5	0.3
4-5 miles	2.4	13.1	84.5	0
> 5 miles	0	16.7	83.3	0

Source: patient survey, 1993 missing observations (journey time): 1
missing observations (distance): 4

Table 5.80 **Influence of proximity (distance) on obstacles to accessibility: cost of journey (% of distance category)**

	a lot	a bit	not at all	missing
< 1 mile	0	2.1	97.4	0.5
1-3 miles	1.0	9.1	89.5	0.3
4-5 miles	1.2	10.7	88.1	0
> 5 miles	0	5.6	94.4	0

Source: patient survey, 1993 missing observations (cost of journey): 2
missing observations (distance): 4

The cost of the journey, in relation to distance, is illustrated in Table 5.80. Journey cost does not present a hindrance for those who live within 1 mile of the surgery with only 2% reporting 'a bit' of difficulty. Of those who live 1-3 miles away, 10% indicate that cost can be a problem, a similar proportion to those who live 4-5 miles away (12%). The proportion of hindrance then falls to 6% for patients who live over 5 miles away. The difference is statistically significant (p=0.04*) and it is clear that the pattern of hindrance due to journey cost reflects that of use of public transport (Table 5.77).

When distance is related to time constraints, a trend can be seen of increasing hindrance with increasing distance (Table 5.81). Of those who live less than 1 mile away from the surgery, 22% indicate hindrance to some extent; this increases to 27% for patients who are 1-3 miles away, 32% for those who are 4-5 miles away and 44% for those who live more than 5 miles away. The difference is statistically significant (p=0.01*) and supports the assertion that the longer the period of time needed to make a consultation the greater the hindrance experienced. This disadvantages those who live further away.

Table 5.81 Influence of proximity (distance) on obstacles to accessibility: time constraints (% of distance category)

	a lot	a bit	not at all	missing
< 1 mile	3.7	18.4	76.3	1.6
1-3 miles	4.4	22.3	72.0	1.4
4-5 miles	11.9	20.2	67.9	0
> 5 miles	0	44.4	55.6	0

Source: patient survey, 1993

missing observations (time constraints): 7
missing observations (distance): 4

There is no statistically significant difference (p=0.72*) when work commitments are examined in relation to distance from the surgery (Table 5.82). The proportion of patients who report a work commitment related hindrance is similar for patients who live within 1 mile and 1-3 miles away (18% and 17% respectively). A marginal increase in reported hindrance occurs at 4-5 miles (20%) and, again, for those who live more than 5 miles away (22%).

Table 5.82 **Influence of proximity (distance) on obstacles to accessibility: work commitments (% of distance category)**

	a lot	a bit	not at all	missing
< 1 mile	5.3	12.6	76.8	5.3
1-3 miles	4.1	12.5	77.4	6.1
4-5 miles	7.1	13.1	73.8	6.0
> 5 miles	0	22.2	72.2	5.6

Source: patient survey, 1993 missing observations (work commitments): 34
missing observations (distance): 4

There is also no statistically significant difference (p=0.44*) when family commitments are analysed as on obstacle to accessibility in relation to distance (Table 5.83): 9% of those who live within 1 mile report a hindrance, 10% of those 1-3 miles, 4% of those 4-5 miles and 11% of those who live more than 5 miles away.

Table 5.83 **Influence of proximity (distance) on obstacles to accessibility: family commitments (% of distance category)**

	a lot	a bit	not at all	missing
< 1 mile	1.6	6.8	90.5	1.1
1-3 miles	0.7	9.7	89.2	1.0
4-5 miles	1.2	2.4	96.4	0
> 5 miles	0	11.1	88.9	0

Source: patient survey, 1993 missing observations (family commitments): 5
missing observations (distance): 4

Table 5.84 **Influence of proximity (distance) on obstacles to accessibility: surgery location (% of distance category)**

	a lot	a bit	not at all	missing
< 1 mile	1.1	2.1	96.8	0
1-3 miles	1.0	11.5	86.8	0.7
4-5 miles	4.8	14.3	81.0	0
> 5 miles	5.6	5.6	88.9	0

Source: patient survey, 1993 missing observations (surgery location): 2
missing observations (distance): 4

The extent to which the location of the surgery causes an obstacle to accessibility is shown in Table 5.84. For patients who live within 1 mile of the surgery, 3% report a hindrance to some extent. The proportion rises to 13% of those between 1 and 3 miles and 19% of those who live 4-5 miles away. The proportion then falls to 11%

for patients who live more than 5 miles away. The difference is statistically significant (p=0.0004*).

Overall, these results suggest an important, but complex, relationship between distance to the surgery and utilization. In general terms, increasing distance - and as a function of that, increasing journey cost and time - causes an increasing hindrance to access. This effect is modulated, however, by the socio-economic distribution of population and surgeries, which means that many of those at greatest distances have better access to a car. The result is that the most severe difficulties are often encountered at intermediate distances (4-5 miles away), where a high proportion of patients need to rely on public transport.

5.8 INFLUENCE OF PROXIMITY (TIME) ON UTILIZATION

In the previous section, the effect of surgery location was analysed in terms of physical distance. Further insights into the effects of location can, however, be obtained by considering travel time.

Tables 5.85-587 illustrate the influence of proximity to the surgery, in terms of the time it takes to get to the surgery. Similar rates of consultation are seen for journey times up to 3 minutes: 27% of those patients whose journey time is less than 5 minutes consult at least once a month (Table 5.85); 24% of those whose journey takes between 5 and 10 minutes, and 25% of those whose journey time is 11-30 minutes. Above a journey time of 30 minutes the proportion consulting at least once a month rises to 33%. Nevertheless, the differences in frequency of consultation are, marginally, not statistically significant (p=0.08*).

When regularity of consultation is examined in relation to the time taken for the journey (Table 5.86) the differences are statistically significant (p=0.04). The proportion of patients who do not make regular consultations decreases with increasing journey time. 70% of patients whose journey takes less than 5 minutes do not make regular consultations. This proportion decreases to 57% for the patients who are 5-10 minutes away and 56% for those who are 11-30 minutes away and then, a further decrease to 47%, for those who are more than 30 minutes away. This suggests that journey time has a significant impact upon utilization behaviour.

Table 5.85 Influence of proximity (time) on utilization behaviour: frequency of consultation (% of time category)

	once a fortnight	once a month	3-12 per year	1 or 2 per year	when necessary	missing
< 5 mins	1.5	25.2	59.5	5.3	7.6	0.8
5-10 mins	2.5	21.6	59.0	6.1	9.4	1.4
11-30 mins	1.8	23.4	49.7	9.0	15.0	1.2
> 30 mins	13.3	20.0	40.0	13.3	6.7	6.7

Source: patient survey, 1993 missing observations (frequency of consultation): 8
missing observations (time): 1

Table 5.86 Influence of proximity (time) on utilization behaviour: regularity of consultation (% of time category)

	regular	non-regular	missing
< 5 mins	29.0	70.2	0.8
5-10 mins	42.1	56.5	1.4
11-30 mins	41.9	55.7	2.4
> 30 mins	46.7	46.7	6.7

Source: patient survey, 1993 missing observations (regularity of consultation): 10
missing observations (time): 1

Home visit dependence increases with increasing journey time (Table 5.87): 14% of patients who live less than 5 minutes away depend upon home visits to some extent compared with 33% of those who are 5-10 minutes away, 41% of those who are 11-30 minutes away and 60% of those who live more than 30 minutes away. The difference is statistically significant (p<0.0001*).

Table 5.87 Influence of proximity (time) on utilization behaviour: home visit dependence (% of time category)

	regularly	occasionally	never	missing
< 5 mins	0	13.7	86.3	0
5-10 mins	1.8	32.4	65.5	0.4
11-30 mins	3.0	37.7	58.7	0.6
> 30 mins	0	60.0	40.0	0

Source: patient survey, 1993 missing observations (home visit dependence): 2
missing observations (time): 1

As Section 5.7 illustrated, effects of distance on utilization are modulated by socio-economic factors such as car ownership. It might, therefore, be expected that the same interactions are evident in relation to journey time. However, this is not necessarily the case since increasing distance does not always lead to increased journey times. It may be that those who live further away, in terms of distance, make more use of their own cars which actually shortens the journey time in comparison with someone who may live closer but who has to rely on a much slower form of transport (i.e. shorter distance but longer journey time). This seems to be the case when comparing the effect of journey time on patient mobility (Tables 5.88-5.91).

The proportion of patients who do not hold a driving licence increases with increasing journey time, from 24% for those living within 5 minutes of a surgery, to 33% for those who are 5-10 minutes away, 43% of those living 11-30 minutes away and 67% of those beyond 30 minutes (Table 5.88). The difference is statistically significant (p=0.0006).

Table 5.88 Influence of proximity (time) on mobility characteristics: driving licence ownership (% of time category)

	holder	non-holder	missing
< 5 mins	74.8	24.3	0.9
5-10 mins	65.8	32.5	1.6
11-30 mins	56.3	43.1	0.6
> 30 mins	33.3	66.7	0

Source: patient survey, 1993 missing observations (driving licence ownership): 6
under 16s excluded from analysis missing observations (time): 1

Table 5.89 Influence of proximity (time) on mobility characteristics: car ownership (% of time category)

	owner	non-owner	missing
< 5 mins	67.0	18.3	14.8
5-10 mins	58.0	25.1	16.9
11-30 mins	42.5	36.9	20.6
> 30 mins	6.7	66.7	26.7

Source: patient survey, 1993 missing observations (car ownership): 96
under 16s excluded from analysis missing observations (time): 1

This pattern is repeated in relation to car ownership (Table 5.89): 18% of patients who live less than 5 minutes from their GP's surgery do not own a car compared with 25% of patients who live between 5 and 10 minutes away, 37% who live 11-30 minutes away and 67% who live more than 30 minutes away. The difference is, again, statistically significant (p<0.0001).

Access to a car also decreases with increasing journey time (Table 5.90): 7% of those who live less than 5 minutes from the surgery report that they 'never' have access to a car. This proportion is higher for each subsequent category of journey time. The proportion of patients 5-10 minutes away who 'never' have access to a car is 9%, for those 11-30 minutes away it is 27% and for those who live more than 30 minutes away it is 87%. Indeed, in this final category no-one reported that they 'always' have access to a car. The difference in the frequency of response between the journey time categories is statistically significant (p<0.0001) and, along with the previous two analyses, shows that the combined effect of a lack of proximity is compounded by lower levels of mobility.

Table 5.90 **Influence of proximity (time) on mobility characteristics: access to a car (% of time category)**

	always	sometimes	never	missing
< 5 mins	53.4	16.0	6.9	23.7
5-10 mins	46.8	21.6	8.6	23.0
11-30 mins	40.7	19.8	26.9	12.6
> 30 mins	0	6.7	86.7	6.7

Source: patient survey, 1993

missing observations (access to a car): 118
missing observations (time): 1

The effect of journey time on the method of transport is presented in Table 5.91. Use of a car is the most predominant method of transport for people who live less than five minutes away from the surgery (59%), those who live 5-10 minutes away (69%) and those who live between 11 and 30 minutes away (52%). The proportion of car use drops to 7% of those who live more than 30 minutes away. The length of journey time for these patients is most probably a function of the transport method they use, with 67% using public transport. The difference in method of transport reported for the different categories of journey time is statistically significant (p<0.0001*).

Table 5.91 **Influence of proximity (time) on mobility characteristics: method of transport (% of time category)**

	car	walk	public transport	friend's car	other	missing
< 5 mins	58.8	38.9	0.8	0.8	0.8	0
5-10 mins	68.7	18.7	5.8	6.1	0.7	0
11-30 mins	51.5	29.9	15.6	3.0	0	0
> 30 mins	6.7	20.0	66.7	0	0	6.7

Source: patient survey, 1993 missing observations (method of transport): 1
missing observations (time): 1

When comparing the results illustrated in Tables 5.85-5.91 it appears that, whilst patients who live more than 30 minutes away have lower levels of mobility, they make use of public transport to a much greater extent. This does not, in itself, impact to a great extent on their utilization behaviour. However, these results are not wholly conclusive since the time it takes to get to the surgery is mode dependent. In this sense, these analyses may be as much a reflection of the effect of mode on journey time, as they are the effect of journey time on the choice of mode.

The extent to which journey time, and other obstacles, affect accessibility is illustrated in Tables 5.92-5.98. Table 5.92 shows that the transport method increasingly becomes a hindrance with increasing journey time. For patients who live less than 5 minutes away, 11% report a hindrance (the predominant method of transport being a car but with a high proportion of walking also reported). This compares with 24% of those who live between 5 and 10 minutes away (the vast majority of whom use a car) and 29% of those who live 11-30 minutes away (the majority of whom use a car). Of those who live more than 30 minutes away, 67% report a hindrance based on the method of transport used (the majority of whom use public transport). The difference is statistically significant (p<0.0001) and supports the assertion that the transport method used creates an obstacle to accessibility. In particular, non-car users experience greater levels of hindrance, corroborating the earlier examination of journey time in relation to the mobility characteristics of patients (Tables 5.88-5.91).

Table 5.92 Influence of proximity (time) on obstacles to accessibility: transport method (% of time category)

	a lot	a bit	not at all	missing
< 5 mins	5.3	5.3	88.5	0.8
5-10 mins	10.8	12.9	75.2	1.1
11-30 mins	11.4	18.0	70.7	0
> 30 mins	13.3	53.3	33.3	0

Source: patient survey, 1993 missing observations (transport method): 4
missing observations (time): 1

As expected, the extent to which journey time creates a hindrance also increases with increasing time (Table 5.93). 5% of patients who live less than 5 minutes from the surgery report a hindrance compared to 10% of those who live between 5 and 10 minutes, 20% of those who live 11-30 minutes away and 47% of those who live more than 30 minutes away. The difference is statistically significant ($p<0.0001$*) indicating that perceptions of journey time as a hindrance rise in line with actual journey time - although the hindrance generally appears to be overcome given the lack of difference exhibited in utilization behaviour (Tables 5.85-5.87).

Table 5.93 Influence of proximity (time) on obstacles to accessibility: journey time (% of time category)

	a lot	a bit	not at all	missing
< 5 mins	2.3	3.1	94.7	0
5-10 mins	2.5	7.2	89.9	0.4
11-30 mins	2.4	17.4	80.2	0
> 30 mins	6.7	40.0	53.3	0

Source: patient survey, 1993 missing observations (journey time): 1
missing observations (time): 1

The cost of the journey also increases as a hindrance with increasing journey time (Table 5.94). This, most probably, again reflects the inevitable increase in costs as distance from the surgery increases, creating an obstacle for some people. It is also related to mode of transport. For patients who live less than 5 minutes away (who either drive or walk) only 3% indicate cost as a hindrance. This compares with 5% of those who live between 5 and 10 minutes away (mostly car users), 13% of those patients who are 11-30 minutes away (the majority of whom use a car but with an increasing proportion of public transport users) and 40% of those who are more than

30 minutes away (mostly public transport users). The difference in response is statistically significant (p<0.0001*).

Table 5.94 **Influence of proximity (time) on obstacles to accessibility: cost of journey (% of time category)**

	a lot	a bit	not at all	missing
< 5 mins	0	3.1	96.2	0.8
5-10 mins	0.4	4.7	94.6	0.4
11-30 mins	1.2	11.4	87.4	0
> 30 mins	6.7	33.3	60.0	0

Source: patient survey, 1993 missing observations (cost of journey): 2
missing observations (time): 1

The extent to which time constraints hinder patient accessibility, in comparison with journey time, is illustrated in Table 5.95. Similar proportions of patients indicate some extent of hindrance and there is no statistically significant difference (p=0.61). 28% of patients who live less than 5 minutes and between 5 and 10 minutes away report a hindrance. This compares with 28% of those who are 11-30 minutes away and 27% of patients who are more than 30 minutes away. Limitations of free time, therefore, do not seem to become more acute for those facing increasing journey times.

Table 5.95 **Influence of proximity (time) on obstacles to accessibility: time constraints (% of time category)**

	a lot	a bit	not at all	missing
< 5 mins	2.3	25.2	71.0	1.5
5-10 mins	5.8	19.1	74.1	1.1
11-30 mins	6.0	22.2	70.7	1.2
> 30 mins	6.7	20.0	73.3	0

Source: patient survey, 1993 missing observations (time constraints): 7
missing observations (time): 1

The same is true in relation to work commitments (Table 5.96): 22% of patients who live within 5 minutes of the surgery report a hindrance compared with 18% of patients who live 5-10 minutes away and 15% of patients who live 11-30 minutes away. Additionally, none of the patients whose journey time takes more than 30 minutes reported any hindrance. The difference is not statistically significant (p=0.48).

Table 5.96 **Influence of proximity (time) on obstacles to accessibility: work commitments (% of time category)**

	a lot	a bit	not at all	missing
< 5 mins	6.1	16.0	76.3	1.5
5-10 mins	5.4	12.6	74.8	7.2
11-30 mins	3.0	12.0	80.2	4.8
> 30 mins	0	0	73.3	26.7

Source: patient survey, 1993 missing observations (work commitments): 34
missing observations (time): 1

No statistically significant difference (p=0.83*) also exists when family commitments are examined in relation to journey time (Table 5.97). The proportion of patients reporting a hindrance is similar for all of the journey time categories. Of patients who live within 5 minutes of the surgery, 10% report a hindrance. This compares with 8% of those who are between 5 and 10 minutes away and 11-30 minutes away and 13% who are more than 30 minutes away.

Table 5.97 **Influence of proximity (time) on obstacles to accessibility: family commitments (% of time category)**

	a lot	a bit	not at all	missing
< 5 mins	0.8	9.2	90.1	0
5-10 mins	1.4	6.5	90.6	1.4
11-30 mins	0.6	7.2	92.2	0
> 30 mins	0	13.3	80.0	6.7

Source: patient survey, 1993 missing observations (family commitments): 5
missing observations (time): 1

Table 5.98 **Influence of proximity (time) on obstacles to accessibility: surgery location (% of time category)**

	a lot	a bit	not at all	missing
< 5 mins	0.8	3.1	95.4	0.8
5-10 mins	1.1	5.8	93.2	0
11-30 mins	2.4	15.6	81.4	0.6
> 30 mins	13.3	33.3	53.3	0

Source: patient survey, 1993 missing observations (surgery location): 2
missing observations (time): 1

The extent to which surgery location creates a hindrance, in relation to journey time, is illustrated in Table 5.98. Increasing proportions of hindrance are reported with increasing journey time: 4% of patients who are within 5 minutes of the surgery report a hindrance which rises to 7% of those 5-10 minutes away, 18% of those who are 11-30 minutes away and 47% of those who are more than 30 minutes away. The differences are statistically significant ($p<0.0001$*) and the results provide further evidence to suggest that the location of the surgery, compounded by the transport method and associated length of journey time, is a major obstacle to accessibility. Indeed, the extent of the obstacle increases at an increasing rate with journey time, supporting the distance decay concept.

5.9 SUMMARY

The effects of important socio-economic and locational characteristics of patients have been examined in depth in relation to health care utilization behaviour, mobility and obstacles to accessibility.

Analyses examining the influence of age show that:

- the young and elderly tend to consult more frequently, more regularly and also depend on home visits to a greater extent;
- the young and elderly experience relative disadvantage in their mobility;
- the elderly make proportionally more use of methods of transport other than their own car;
- method of transport causes some hindrance to the young and elderly;
- family commitments create an obstacle to accessibility for the young;
- time and work commitments hindered those age 16-44 to the greatest extent;
- family commitments and time constraints do not adversely affect the elderly; and
- surgery location affects the elderly to the greatest extent.

These results support the discussion in Section 3.2.1 that it is the young and elderly who exhibit increased need for health care, and thus report increased utilization. They are also disadvantaged in their mobility and accessibility, supporting the discussion in Section 3.3.2.

In relation to gender, the following results have been obtained:

- no statistical differences in utilization rates or regularity of visits exist between genders although frequency of consultation is higher for females for the 'once a month' category;
- females experience much lower levels of driving licence and car ownership and lower levels of access to a car; and
- method of transport, journey time, time constraints, family commitments and surgery location are all obstacles which hinder females to a greater extent than males.

Section 3.2.1 suggested that women have a higher need for health care; the results of this survey fail to support this, although there is evidence of increased utilization by females in the 'once a month' category. In part, this lack of difference may be due to the illnesses chosen (asthma and diabetes) both of which may be rather more prevalent in males. The survey also indicated that females experience greater levels of mobility disadvantage and other obstacles although their utilization behaviour suggests that these difficulties are largely overcome.

The influence of social class was as follows:

- no statistically significant differences in frequency of utilization is evident for different social classes (although reported rates for non-manual classes are 30% higher than manual);
- non-manual classes consult more regularly and are more dependent on home visits than manual classes;
- manual classes have higher proportions of driving licence holders and car ownership and increased access to a car than non-manual classes;
- manual classes make more use of a car as the method of transport than non-manual classes;

- non-manual classes report greater levels of hindrance in relation to transport method, journey time and cost of journey; and
- manual classes report greater levels of hindrance for time constraints and work commitments.

Section 3.2.2 suggested that manual classes (classes IIIM-V) have higher relative need for health care which, unhindered, would be expected to be evident through increased levels of utilization. The surveyed patients do not reflect this, possibly due to the effects of hindrance or some sample bias. Indeed, it is the non-manual patients who exhibit increased utilization. Section 3.3.2 proposed that relative mobility disadvantage is experienced by non-manual classes (classes I-IIIN) and this is supported by the survey.

The analyses of employment status suggest the following:

- unemployed patients exhibit more frequent and more regular consultation and depend upon home visits to a greater extent;
- higher proportions of unemployed patients do not hold a driving licence and do not own a car;
- a larger proportion of unemployed patients do not have access to a car and make use of alternative methods of transport;
- higher proportions of unemployed patients report method of transport, journey time, cost of journey and surgery location as a hindrance; and
- higher proportions of employed patients suggest that time constraints and work commitments are obstacles to accessibility.

Unemployment has been widely identified as a component of utilization which leads to socio-economic disadvantage and higher relative need for health care (Section 3.2.2). The survey results support this with unemployed patients exhibiting both increased utilization and increased hindrance in relation to mobility and a range of obstacles determined by their socio-economic status.

An interpretation of the influence of ethnicity is hindered by low returns from ethnic minority patients, reflecting the low proportion of ethnic minorities in the study area. Results are consequently not as reliable as other analyses but suggest the following:

- non-white patients exhibit increased frequency of consultation and more regular consultations;
- non-white patients exhibit lower levels of driving licence and car ownership but increased access to a car compared with white patients;
- non-white patients make more use of alternative methods of transport;
- non-white patients experience greater hindrance in relation to transport method, journey time, cost of journey and surgery location; and
- white patients are hindered to a greater extent by time constraints, work and family commitments.

Section 3.3.3 showed ethnic minorities to be socially, economically and culturally disadvantaged, potentially reducing their accessibility to health services. This is not supported by the survey which showed that non-white patients exhibit higher levels of utilization, suggesting either that obstacles to accessibility are overcome or that higher inherent need more than compensates for any problems of accessibility. The results, however, need to be viewed with caution because of the low levels of ethnic minority patients reporting.

The influence of proximity to the surgery, in terms of distance, revealed the following:

- frequency of consultation does not decrease significantly with increasing distance;
- regularity of consultation and home visit dependence decline with increasing distance but then rise for patients more then 5 miles away;
- driving licence and car ownership increase with increasing distance;
- access to a car increases with increasing distance;
- reliance on a car as the method of transport increases with increasing distance;
- transport method tends to hinder patients at intermediate distances;

- journey time and time constraints are an increasing hindrance as distance to surgery increases; and
- surgery location and cost of journey are increasingly reported as a hindrance with distance, though not for those who live more than 5 miles away.

Distance has been identified as a factor which disadvantages those further away, leading to a distance decay effect in terms of utilization (Section 3.4.4). The survey does not fully support this and, whilst the proportion of total consultation declines with increasing distance, frequency of consultation per distance category remains similar. This is possibly a function of the geographic patterns of health care needs or social status and mobility exhibited by the patient cohort.

The impact of distance is often compounded by other obstacles to accessibility (Sections 3.3.1 and 3.4.1). In particular, unsuitable, infrequent or inconvenient public transport is a factor which is likely to exacerbate problems of distance. For those living at greater distances from the surgery, access to a car is seen to be an important factor, as are journey time, time constraints and cost of journey.

The analysis of proximity, in relation to time, revealed the following:

- frequency of consultation shows no statistically significant difference;
- the proportion of patients who make non-regular consultations decreases with increasing journey time;
- home visit dependence increases with increasing journey time;
- driving licence and car ownership declines with increasing journey time;
- access to a car declines with increasing journey time;
- car usage is the most predominant method of transport for lower journey times with public transport predominant for the higher journey times;
- non-car owners experience a greater level of hindrance; and
- journey time, cost of journey and surgery location are reported hindrances with increasing journey time.

Consideration of time, independently from that of distance, as a measure of proximity to surgery is necessary since journey time is not solely a function of distance, but also of available route and travel mode. Whilst frequency of utilization does not vary in relation to journey time, regularity of consultation and the proportion of respondents making non-regular consultations both decline with increasing journey time. There is also an increase in home visit dependence, supporting the assertion that journey time is a negative influence on utilization behaviour.

The reduction in mobility, with increasing distance, shows that those who are disadvantaged are also affected by the longest journeys. Patients who do not own a driving licence or car are more reliant on other, slower, forms of transport. Those who are subject to lengthy journey times also cite transport related obstacles as hindering their accessibility. However, these mobility difficulties and obstacles do not seem to result in significantly different rates of utilization.

Overall, this analysis confirms many of the propositions drawn from the previous literature discussed in Chapter Three. The results will be used in Chapter Six to inform the selection of appropriate components in the model of utilization.

6 CONSTRUCTING A MODEL OF GP UTILIZATION

6.1 INTRODUCTION

Chapter Three examined the scope of utilization and components which can be analysed empirically. Chapters Four and Five examined the extent to which some of these components affect utilization for a group of health care users. This chapter draws upon the conceptual discussion and survey results and constructs the model of GP utilization, applied to the NDHA area.

Firstly, the criteria for designing the model are defined. The framework of the model is then presented followed by sections identifying generic data requirements, the methods employed in construction and the selection of indicators. These sections present the construction of the model and their outcomes for the NDHA area. The Chapter concludes by combining indicators into appropriate outcome measures.

6.2 CASE STUDY DESIGN

The design of the model falls into two parts: firstly, the consideration of a set of design criteria to guide objective construction; and, secondly, the definition of the framework model based on the conceptual discussion in Chapter Three and the results of the patient survey (Chapter Five).

6.2.1 Model design criteria

Clear design criteria are essential in the construction of empirical models to ensure objectivity. The following criteria, adapted from DoE (1995), provide a focus for ensuring that the construction of the model is effective in meeting the research objectives:

- Robustness

  Each data source incorporated in the research model must be sound and valid. Chapter Three indicated the extent of use of routine sources in constructing models. The use of routine sources of data such as the 1991 census of population is appropriate in this context. This, and other, data sets are widely used and limitations can be identified and considered. Furthermore, the model must not be affected by minor differences in data.

- Relevance

  A broad range of measures representing utilization should be included. The significance of the data must be understood. The extensive discussion in Chapters Two and Three identified the scope of utilization and the relevance of various components. Furthermore, the derivation of indicators, and their measurement were also discussed. In these terms, the patient survey has provided a further means of validating the utility of some indicators.

- Flexibility

  Each measure must be capable of study independently to discern its relative importance to the overall model. In this way components of the model can be validated and the overall model optimised. This allows the data to be manipulated to provide a variety of outcomes for different purposes. The 'model' in this case is a collection of data sets brought together in a GIS framework, linked by a set of combinatorial procedures, designed to address certain management issues. Measures can be simply queried or mapped on their own or in association with one or more other measures. The creation of a measure of GP utilization is one way of manipulating the assembled data and the model will also provide the opportunity for manipulation to derive further outcomes. Flexibility is implicit in the applied GIS approach taken. The use of GIS allows manipulation of data in a variety of ways and at a variety of spatial scales and levels of aggregation.

- Scalability

  Each measure must be derived at an appropriate scale of analysis to allow comparability and should be able to be combined at different geographical scales if required. However, in most cases, the spatial unit of analysis is data-led. Since routine sources are organised spatially, then the corresponding areal units must be used as a spatial framework in the model to ensure comparability. The use of the smallest area of analysis, the ED, maximises compatibility of routine sources and makes combination into other scales possible by using the ED as a building block for aggregation. This will be necessary for more general analysis or for comparison with data which is available only in aggregated form.

- Dynamism

  The data sources used should either be generally available or be able to be repeated to allow periodic updates of the model. In this way the model can be used when appropriate and in response to the availability of updated information. The use of routine sources of data allows a dynamic model to be constructed and minimises costs of data collection. It will be capable of periodic update given the availability of new sets of both spatial and attribute data.

- Portability

  The model should be able to be repeated for other areas. The case study provides a spatial framework in which to develop and test the model but the data used may equally be derived for other areas and the combinational procedures used in the model have general validity. This ensures that the model is portable to other areas.

6.2.2 Framework model of utilization

Patterns of health service use can be expressed and measured in a number of alternative ways. In this sense, the model developed here is designed to provide different outcome measures relevant to health service management, including measures of utilization, disadvantaged demand and realized demand. These outcome measures are defined in this research as follows:

- *utilization* is the extent to which people use GP services based on supply of health care and local demand;

- *disadvantaged demand* is the extent to which people are impaired in their exigency for health care; and
- *realized demand* is the extent to which people in disadvantaged areas are able to satisfy their demand by local provision.

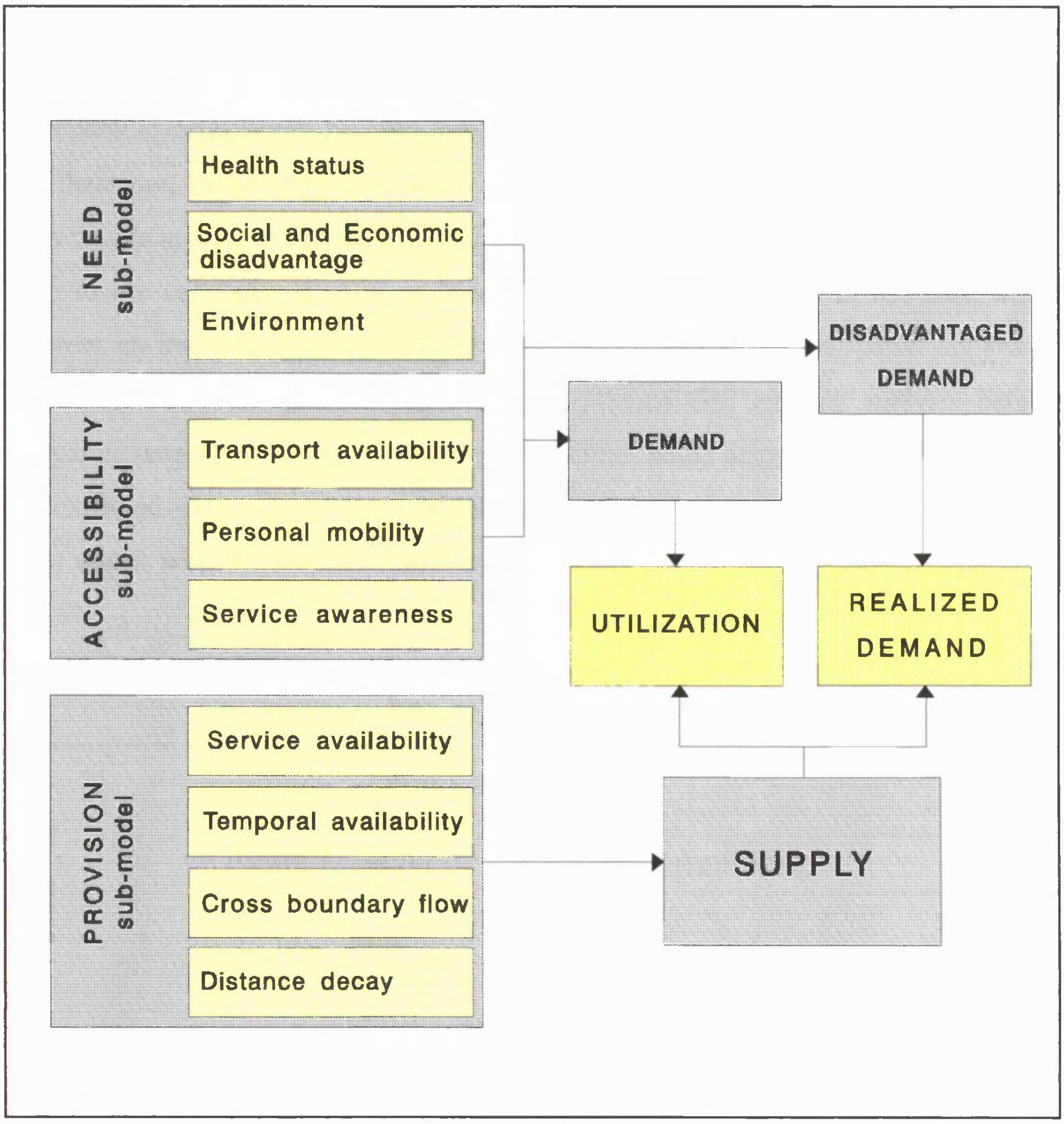
Each of these outcomes is a function of three basic factors: need, accessibility and provision (Chapter Three). These can be defined as follows:

- *need* for health care is the extent to which different societal groups (Section 3.2) vary in need based on biological, socio-economic and environmental differences;
- *accessibility* is the extent to which health care is socially, financially or culturally available for different societal groups (Section 3.3); and
- *provision* of health care services is defined by their location and allocation and their spatial and temporal availability (Section 3.4).

Figure 6.1 shows these three components, as three sub-models, and their relationship with model outcomes. The need sub-model comprises measures relating to health status, socio-economic disadvantage and environment, designed to measure increased relative need for health care. The accessibility sub-model incorporates measures which reflect obstacles to potential access to health care, namely levels of transport availability, personal mobility and service awareness. The provision sub-model incorporates measures of service availability, in spatial and temporal terms, adjusted to reflect cross-boundary flow effects and distance decay effects. This can be termed the supply of health care.

The need and accessibility sub-models can be combined to form overall measures of demand for health care. High relative rates of demand will occur where high levels of need and good accessibility exist. High relative rates of disadvantaged demand will occur in areas of high need and poor accessibility.

Figure 6.1 Framework model of utilization (author, 1998)

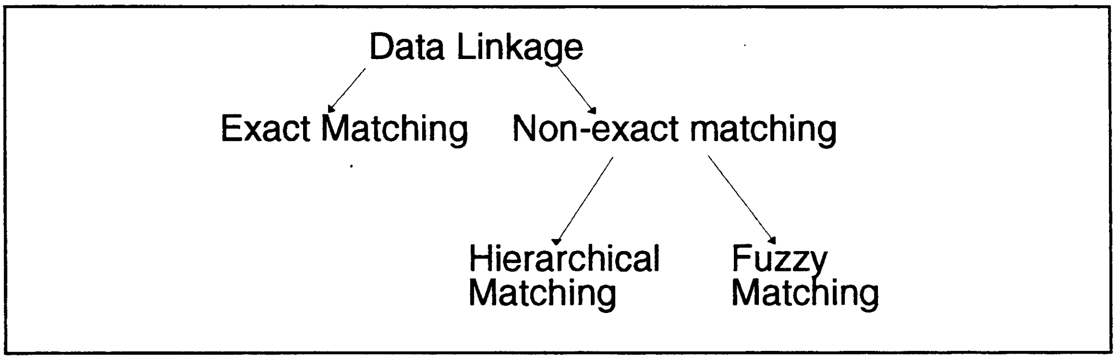


Demand is most appropriately combined with provision to give a measure of utilization: high relative rates will be evident where high levels of need, good accessibility and the availability of high levels of provision exist. Realized demand measures levels of disadvantaged demand relative to supply as a ratio. In these terms, it measures the extent to which those people who are disadvantaged can satisfy their exigency by local provision.

6.3 GENERIC DATA REQUIREMENTS

Construction and application of the model of utilization requires the use of a number of generic spatial and attribute data sets. As far as possible, contemporaneous and comparable data should be used to ensure that results are up-to-date and consistent. Furthermore, an understanding of the weaknesses inherent in data is valuable in order that results are not falsely interpreted. This is particularly important when using GIS due to the capability of GIS to hide inconsistencies or errors in the data, and to present an inappropriate appearance of accuracy. The extent of spatial congruence between data must therefore be evaluated. Since GIS enables analysis between disparate data sets, derived from different sources, some degree of mis-matching is to be expected. The type of data linkage that exists is predetermined by the data (Figure 6.2) which will, in turn, determine the extent of non-matching.

Figure 6.2 Different ways of linking together data using geographical position (after Raper et al, 1992 p17)



Exact matching refers to data linkage where one set of data is spatially congruent with another - for example different census variables derived for the same spatial unit. Non-exact matching occurs when data is derived from different sources based on different spatial units, which are then referenced to each other. Two types of non-exact matching are normally recognised. An example of hierarchical matching would be the use of census data derived for one spatial unit together with data for the same area but based on a more aggregated unit. Assuming that the data was derived from the same source the external boundaries would in this case match in a hierarchical fashion. Fuzzy matching may occur where different data are derived from different sources. When these are georeferenced, a degree of mis-match is likely to occur. The matching of census boundaries with postcode boundaries is one example.

Selecting appropriate attribute data to measure utilization requires a balance between research aims (Section 1.4), design criteria (Section 6.2.1) and data availability. Data sets required include population characteristics, GP characteristics and transport infrastructures. In order to guide appropriate choice and maintain compatibility between data sets a set of selection criteria was established. Attribute data should be:

- conceptually and statistically sound;
- directly indicative of the health care utilization process;
- normally based on 100% SAS census data where area based population data is required, except where appropriate data is only available in the 10% LBS data set;
- based on GP provision data where point-based provision data is required;
- based on appropriately derived network data sets where transport data is required;
- derived at ED level (for the area data); and
- derived at postcode level (for the GP data).

Data sources and spatial accuracy are discussed in the following sections which outline the collection and manipulation of generic data sets. Data manipulation is detailed in Appendix Three and details of the database are in Appendix Four

6.3.1 Boundary data

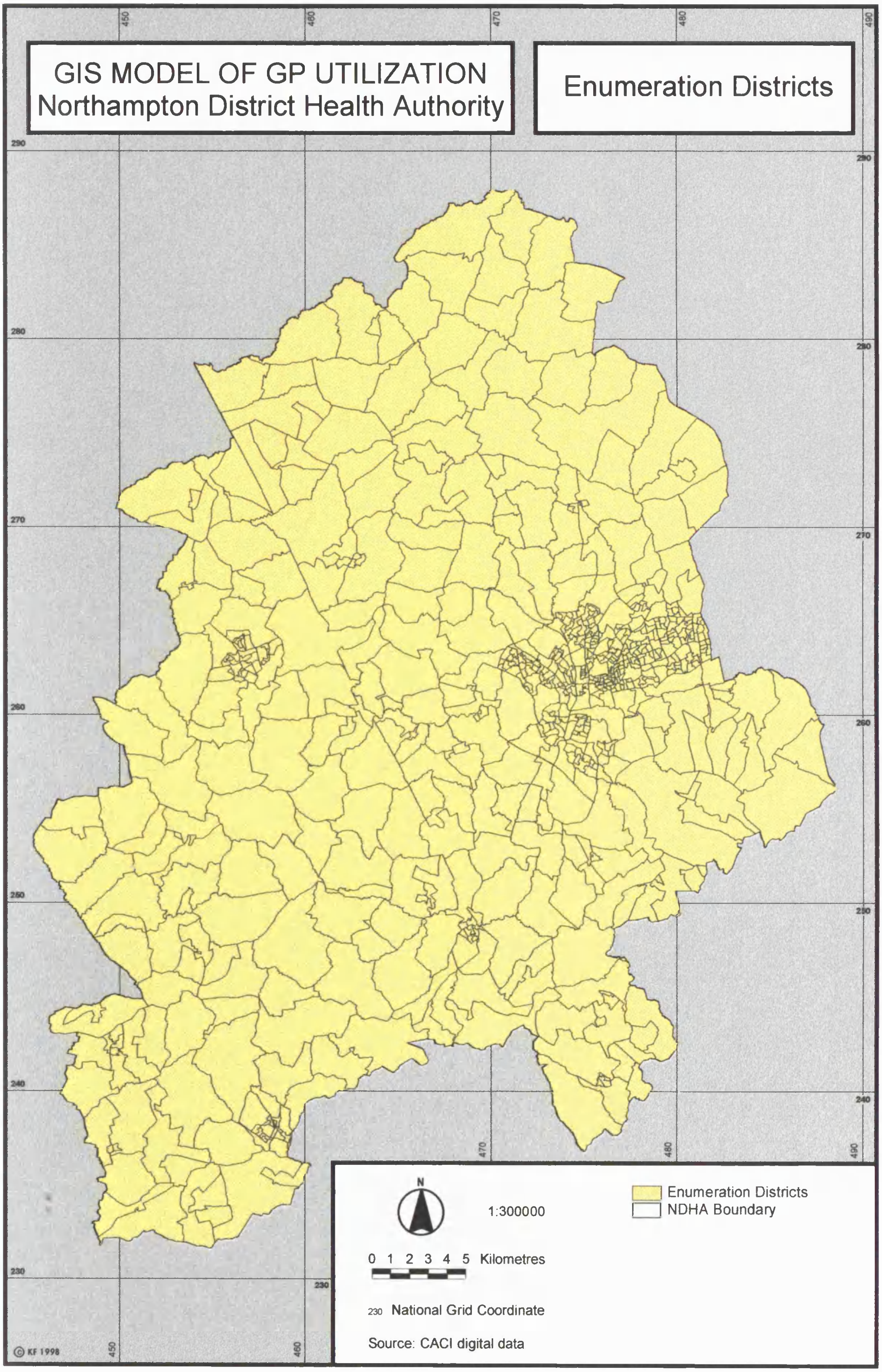
The boundaries required are a function of the attribute data to be used. The use of routine sources of data, particularly the 1991 census of population, is fundamental to the research so the key need is for boundaries of relevant census units. Census data are, however, available at several different levels of aggregation. In this study, the finest scale of analysis is the enumeration district (ED), and this is used as the basic spatial building block for all aggregated scales such as ward or district. There are debates about the validity of using such arbitrary administrative constructs since they may not necessarily represent spatial variation accurately, perpetuating ecological fallacy, particularly when aggregated. This has been termed the Modifiable Areal Unit Problem (Openshaw, 1984a; 1984b) and arises because different types and levels of aggregation can produce wholly different representations of geographical phenomena. However, EDs provide the spatial framework for most of the routine sources of data used here and they thus help to ensure that data are both spatially consistent and obtained at the lowest possible level of aggregation. ED data can then be readily generalised within the GIS to provide more aggregated data if required.

The boundary data was obtained in digital format, under licence from the NDHA. The data covered a large area of Northamptonshire and extended into neighbouring areas by approximately 50km.

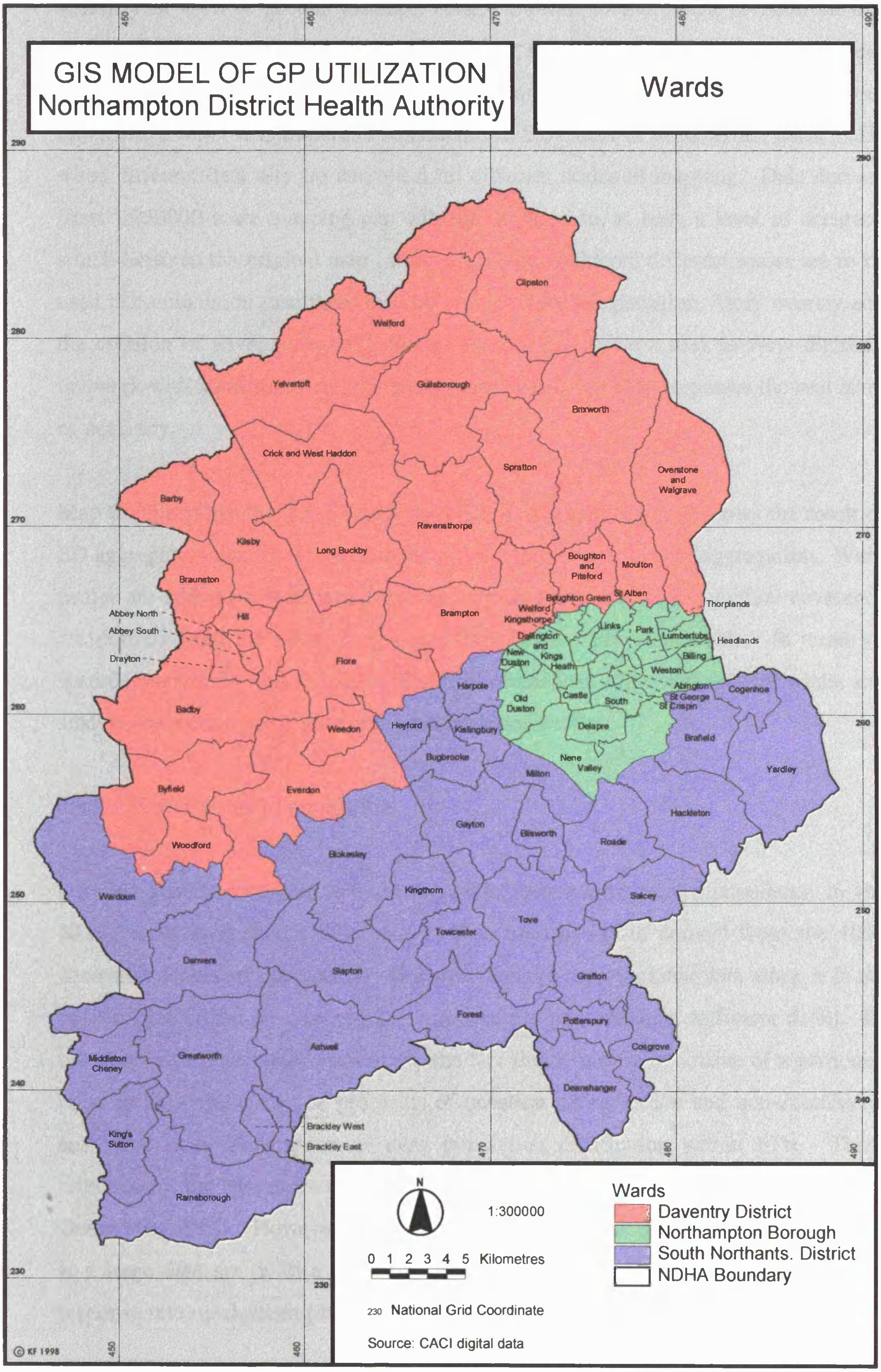
Some manipulation of boundary data was required in the GIS to eliminate EDs not in the study area. Subsequent manipulation prepared it for use by building appropriate topological relationships, Polygon Attribute Tables (PATs) and adding the ED codes to PATs to allow database join operations. Different boundary data sets were also created by merging EDs and dissolving shared boundaries to derive ward, district and NDHA outline coverages (GIS operations are detailed in Appendix Three). The boundary data is registered to the Ordnance Survey Grid Reference (OSGR). All data sets to be used must therefore either be obtained registered to the OSGR or must be converted appropriately. This is vital to ensure that GIS operations between coverages derived from different data sets, such as overlay, can be accurately performed.

Scaling is the process of inferring the size of a mapped feature from the real-world size of the feature it represents. The digitised linework which represents ED boundaries is only as accurate as the scale at which it was digitised, based on the number of sampled points digitised and the accuracy of locating the points. The ED boundaries used are based on Ordnance Survey 1:10000 scale mapping with a claimed

Map 6.1 ED boundary data



Map 6.2 Ward boundary data



accuracy of ±4m of ground distance. Since a linear measurement of 1mm on this scale of map represents 10m of ground distance, the digitising accuracy is in the order of ±0.4mm. The use of pre-existing digital data sets in GIS is accepted along with inevitable errors. It is important to understand the extent of such errors, particularly when different data sets are derived from different scales of mapping. Data derived from 1:250000 scale mapping can only be digitised to, at best, a level of accuracy which exists in the original map. If coverages derived from different scales are to be used in combination then there may be problems with registration, fuzzy overlay and the creation of sliver polygons. In this sense, GIS allows a user to view digitised linework with an apparent degree of accuracy which possibly surpasses the real level of accuracy.

Map 6.1 illustrates the 700 EDs for the NDHA area and Map 6.2 shows the result of ED aggregation into 79 wards, also identifying the district level of aggregation. Ward names are added for reference purposes. Since ward, district and outline coverages are derived from the same data source they are directly comparable. In terms of spatial congruence, data linkage at ED level of analysis will match exactly whilst any analysis between spatial units will match hierarchically.

6.3.2 1991 Census of population

Detailed social, economic and demographic information of the population in the NDHA area is integral to the study. This information is derived from the 1991 decennial census of population. This provides the most suitable data since it is the only available data set covering the whole of the population in sufficient detail. Its use does have drawbacks, particularly the fact that it is only indicative of a particular point in time, there may be problems of question interpretation and non-submission and there is an assumption of even population distribution within EDs. These criticisms of the census are covered elsewhere in more depth (Dale and Marsh, 1993; Openshaw, 1995). However, the benefits of using census data lie in the fact that it is a large data set (with a projected 100% coverage of households), it has a high response rate mechanism (due to the illegality of non-response) and the complex data is taken to be coded, checked and processed with care. It represents an extremely valuable data set for geographical research (Townsend, 1979; 1988).

The Small Area Statistics (SAS) and Local Base Statistics (LBS) data sets were obtained on CD ROM allowing selection of variables for user-defined areas. Since the research uses a GIS approach the ability to extract data, with ED codes and item names, and transfer it into a usable format was paramount.

The 1991 census was not designed specifically for use within a GIS environment although the availability of GIS has undoubtedly contributed to a rapid expansion of the use of census data (Charlton et al in Openshaw, 1995). It is therefore no longer necessary to rely upon standard population statistics supplied by the OPCS (now ONS) and a census user may now have access to raw data for their own analyses.

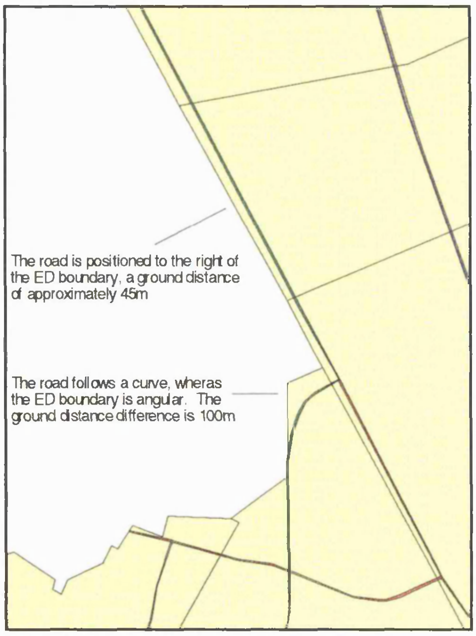
Census geography is based on assigning census data to relevant spatial units. Since the 1991 census was not designed with GIS in mind the only explicit spatial information in the data set is a grid reference identifying the centroid of each ED. This is accurate to 100m and, particularly in urban areas with small EDs, it is possible that data could be wrongly attributed to a neighbouring ED. This grid reference is redundant for locating census data; the use of ED codes provides a more appropriate method of spatially referencing attribute data to their correct spatial unit (Appendix Three). This is achieved due to codes being present as a component of both attribute and spatial data. Consequently, an item of attribute data can be correctly assigned to its appropriate spatial unit (for instance a polygon representing an individual ED) through the process of matching codes. This is a fundamental process of the organisational database structure which underpins many GIS.

6.3.3 Topographic data sets

Data was derived from the Bartholomews Digital Data set and manipulated to create separate coverages in the GIS database. Roads and urban areas were registered with ED boundary data to ensure spatial consistency in subsequent analysis.

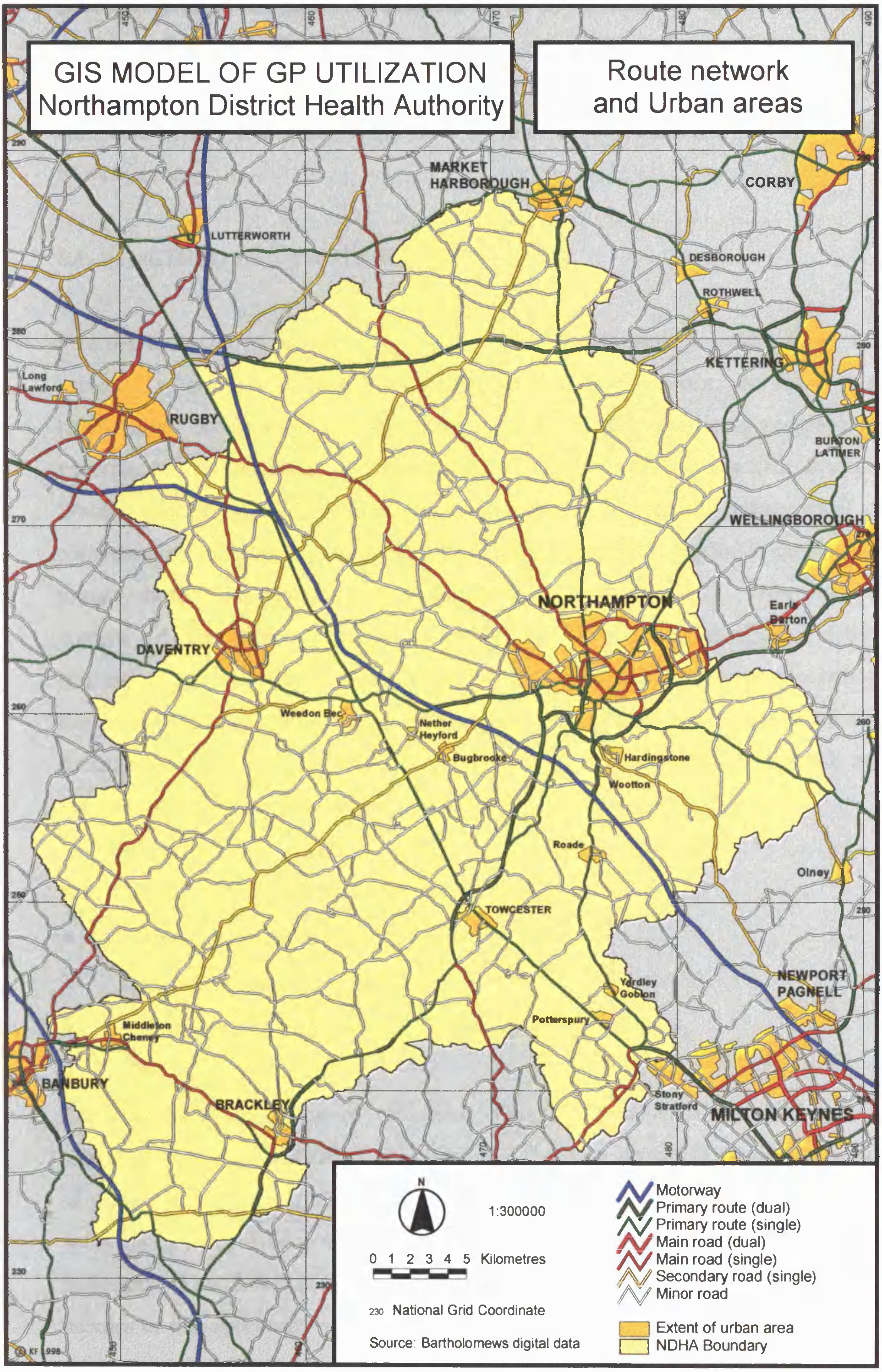
The Bartholomews data is based on 1:250000 scale mapping and contains a greater degree of inaccuracy than the ED boundary data. This inaccuracy is two-fold. Firstly, larger digitising errors will be inevitable since the scale of symbolisation in relation to ground distance is much more generalised. Secondly, the amount of detail and sinuosity at 1:250000 is much less than for larger scales of mapping for the same area. These limitations are particularly acute in urban areas where the detail for roads is no greater than in rural areas despite obvious differences in network complexity. Furthermore, any analysis between the Bartholomews data sets and ED boundary data would need to consider the effects of overlay and the inevitable degree of error arising through fuzzy matching. Figure 6.3 illustrates the problem of overlaying route network data with ED boundaries in an area where it is known that the road itself lies on an ED boundary.

Figure 6.3 Overlay error for non-matching data sets
(author, 1998; based on CACI digital data and Bartholomews digital data)



These problems inevitably limit analytical use of the topographic data, for example using network or buffering techniques to investigate physical accessibility. Nevertheless, the data provides a useful illustration of the broad topographical characteristics of the case study area (Map 6.3). It provides a reference to assist

Map 6.3 Topographic map of NDHA area



discussion later in the thesis showing the extent of the main urban areas and route network characteristics in relation to the NDHA area. Principally it acts to locate the main towns of Northampton, Daventry, Brackley and Towcester and their interconnectivity. It also highlights the location of urban areas which fall outside the NDHA area.

6.4 METHOD OF CONSTRUCTION

In order to create an effective and realistic model, data must be manipulated and combined to create an index for each outcome measure of interest. As Jolley et al (1996) note, the development of indices to measure socio-economic geographical variation has its origins in cluster analysis of the 1971 census data (for example Webber and Craig, 1978), which was made possible through the enhancement of computing power. Since then, indices have been successfully applied in the field of primary health care delivery and social deprivation (Section 2.2). However, the content and construction of indices, in general, has been the subject of much debate (for instance: Senior, 1991; Morris and Carstairs, 1991). Critics accuse research of developing arbitrary indicators, suffering poor conceptualisation and often compounded by pragmatic combination techniques. There is no commonality of approach and variations arise in the following aspects of index development:

- selection of indicators and conceptualisation;
- manipulation and weighting (standardisation);
- transformation of data; and
- method of combining indicators into an overall measure.

The conceptual discussion of utilization (Chapter Three) provides the basis for selecting appropriate indicators of utilization. There are no global measures capable of reflecting major factors in the utilization process. The different factors of need, accessibility and provision can only be assessed by combining a number of component indicators. The choice of appropriate component indicators is clearly crucial to the success of this approach.

Regardless of the indicators chosen, one measure is unlikely to be statistically compatible with another. Bias will be inherent in any method which simply aggregates variables in their raw state, due to differences in their scales of measurement, statistical range and relative importance to the outcome measures of interest. Care is therefore essential in defining methods for calculating and aggregating the component indicators. These clearly need to be informed by the results of previous research.

6.4.1 Standardising indicators

Several different methods for standardising indicators have been developed. One of the most widely used is through the construction of Z-scores. Examples include the Townsend Deprivation Index (Townsend, 1988), Scottish Deprivation Index (Carstairs and Morris, 1989a; 1989b) and the Underprivileged Area score (Jarman, 1983; 1984). In this approach, data is first normalised, to convert skewed distributions into normal distributions, prior to being standardised. Townsend (1988), for instance, makes use of the log (natural) transformation for this process. Thus, each variable is standardised to have a mean value equal to zero and a standard deviation equal to one. The indicators can then be additively combined to produce a final composite score. The method is advantageous in that it is simple to understand and reproduce for any given set of indicators, and provides results which are explicitly referenced to the overall mean for the study area as a whole.

Criticism of these indices are that they are based on percentage counts for each geographical area (DoE, 1995). This tends to distort small geographical areas with very small absolute values, presenting problems in comparison. To overcome this problem, indices are usually derived for larger, aggregated areas such as wards. As Openshaw (1995) points out, however, this may create further problems. Wards are 'a relatively poor level of census geography since they vary greatly in size and internal heterogeneity. The calculation of a Z-score tends to be biased by spatial autocorrelation (which reduces the standard deviation and inflates the Z-score). Additionally, any ranking process will emphasise those areas with small counts (the so-called 'small numbers' problem) and mask those with high degrees of internal difference, compounding difficulties of comparison. Problems of this nature are particularly acute where only relatively few indicators are used.

An alternative approach is to create normalised, standardised signed chi-square values, representing the deviation of each indicator away from the expected average value inherent in the data. An example of this is the DoE 1991 Deprivation Index (DoE, 1995). This alleviates the 'small numbers' problem because it relates the observed values in any area to a population-weighted expected value. The DoE 1991 Deprivation Index is based on the absolute values themselves, rather than a percentage, which maintains the variance of each indicator. The chi-square value indicates deviation from an expected value for every ED. If a value is greater than expected, then the sign of the x^2 statistic will be positive; if it is less than the expected then it will be negative. It is therefore a more appropriate method for the ED scale of analysis.

6.4.2 Aggregation methods

In order to construct a single index for the outcome measure of interest, the various component indicators must be aggregated or combined. This may be done in various ways. Possibly the most commonly used is arithmetic aggregation: the indicators are either added or multiplied together to give a final index. Additive combination of indicators takes no account of interactions between the indicators - for example, where the effect of the two acting together is greater than the effect of both, acting separately. Multiplicative aggregation implies interactions. In either case, decisions also have to be made about the weight to attach to each indicator. The simplest approach is to apply a unit weight: each indicator is, effectively, equally weighted during manipulation. This may not always be appropriate, in that some indicators may be more important than others. The alternative, therefore, is to use a process of weighted aggregation. This involves first assigning weights to each indicator, according to its relative importance or quality, then aggregating the indicators, normally additively. An example is provided by Jarman's UPA score (1983; 1984).

A survey of GPs aimed to identify patient characteristics which tended to increase workloads. GPs were asked to score a list of characteristics from 0 (no problem) to 9 (very problematical). Average scores were calculated for GP responses and these scores were used to weight appropriate census data (Table 6.1). DoE (1983) also employed a weighting factor which doubled the weight of unemployment, in its basic index, and single parents and lone pensioners in its Social Index.

Table 6.1 Weightings derived for the Jarman UPA score
(after Jarman, 1983 p1706)

Variable	No. of GPs scoring	Average score (weight)
Elderly living alone	1802	6.62
Children (aged under 5)	1784	4.64
Single parent households	1754	3.01
Lower social classes	1742	3.74
Unemployment	1743	3.34
Overcrowding	1712	2.88
Highly mobile people	1705	2.68
Ethnic minorities	1670	2.50

Weights for indicators may be determined in a number of ways. One of the most common is through expert opinion. Although the opinion of experts may be valuable, this method of identifying relationships is subject to the problem of who, indeed, is viewed as an appropriate 'expert'. Subjective opinion and bias may be unavoidably introduced into the weighting of indicators. Criticism of the UPA score has focused on this, with GP's experience and locational bias being questioned (Davey Smith, 1991). The GP survey was undertaken in London and, therefore, the decision on what patients create undue extra workload is to some extent biased towards the patient characteristics in this area. It is therefore no surprise to find that the UPA score subsequently shows that seven of the ten most deprived DHAs are in London and none in the Northern RHA area: Whitehead (1992) suggests that this is wholly inaccurate. Thunhurst (1985) sees the problem with the UPA score as being predominantly a function of highly skewed variables, such as ethnic minority and one-parent family households, which are more highly concentrated in inner London Boroughs. Even given the relative low weighting attributed to ethnic minority it clearly plays an important part and a correction factor, based on more sophisticated statistical techniques, or further surveys to check and extend the results would be beneficial (Thunhurst, 1985).

An alternative means of devising weights is to base them on relevant literature. Whilst this method of weighting may help to avoid some of the problems outlined above, other difficulties exist. In particular, it is not easy to impute weights from disparate and often qualitative studies in the literature.

A further alternative is to base weights on the opinion of non-experts, for example, through surveys of public perceptions. This affords possible benefits in that weightings reflect real users or those directly affected. However, naïvety and lack of understanding of the complex concepts involved may reduce the validity of such weights. Additionally, the problem of obtaining a representative sample may lead to bias towards specific interest groups: the time and cost of such a survey may also prove unworkable.

Weightings can also be derived through statistical modelling. This might involve the use of regression analysis to evaluate the relative contribution of each indicator to the outcome variable. Balarajan et al (1992), for example, used logistic regression to calculate the influence of indicators on the probability of consulting a GP. This then allowed the outcome measure of consultation to be adjusted, based on the weighted component indicators derived from variation exhibited by different societal groups. However, determining a single independent measure of the outcome variable against which indicators can be related is, in itself, problematic. In many cases, the outcome vaiiable of interest is, by its very nature, not directly measurable, or subject to significant inaccuracies. The measure used by Balarajan et al (1992) was derived from the General Household Survey which can be criticised for the limited sample from which it is drawn.

More complex statistical techniques such as factor or principal components analysis, multi-criteria analysis or cluster analysis are available to derive measures based on multi-variate data.

Factor and principal components analysis are methods for isolating the main differentiating components of a group of variables. They are used to calculate a small number of variables in order to represent a much larger set of variables and to summarise the original variance in the data set. Factor analysis can be undertaken using a single factor solution, where one all-encompassing factor is taken to represent the variance within the dataset; a first factor solution, where the first factor is taken from each representative set of variables; or a multi-factor solution, where more than one factor is extracted from each representative set of variables. Factor analysis has not been widely used in the creation of indices of disadvantage. Principal components analysis (PCA), however, has been used to derive weightings in the Scottish Development Department measure defining areas of special need (Duguid & Grant, 1983). The extent of inter-correlation between indicators was derived and the weights were obtained by taking the factor score coefficient on factor one, household deprivation. Similar techniques of weighting were also used in the Scottish Deprivation Index (Carstairs and Morris, 1989a; 1989b).

Whilst factors, or principal components, assist in simplifying an often complex concept, drawbacks are predominantly concerned with the extraction of the factors themselves and the statistical methods employed. Factor analysis includes a form of statistical weighting in determining factors representative of variables, but methodological decisions (e.g. over choice of factors and rotation) must be taken which influence factor selection, and these may bias the results. Additionally, a single factor solution is not appropriate for use where there are a large number of variables to consider, since it is unlikely that a single factor will explain the variance.

It has been argued that much geographic behaviour may be interpreted as optimising behaviour involving multiple objectives and subject to numerous diverse constraints (Senior, 1981). As such, many problems of data integration involve not a single objective but one which may be a function of multiple, conflicting and possibly incommensurate objectives. In this sense, the implementation of factor analysis could provide the basis for undertaking multi-criteria analysis. Each factor score selected through factor analysis can be standardised to create Z-scores, allowing multiple disadvantage to be recognised by calculating a composite score. However, the execution of multi-criteria analysis is more complicated and subject to the criticisms previously identified for factor analysis. It could also be argued that the process of selecting indicators to reflect utilization, by reviewing relevant research and undertaking a patient survey to validate indicator selection, in itself is a method of identifying those factors which are important. In this sense, the implementation of factor analysis or multi-criteria analysis is unsuitable.

Cluster analysis involves the statistical manipulation of variables to classify areas into new groups. Advantages of cluster analysis are, firstly, that they provide a means of combining areas into views of reality not necessarily constrained by arbitrary boundaries and, secondly, weighting of the variables is achieved through the inherent statistical manipulation. A fundamental disadvantage is that the method is highly dependent on the choice of input scales and methodological decisions, such as choice of similarity index, clustering algorithm and number of clusters sought. These affect the ultimate classification and may bias the outputs. Secondly, it is not possible to rank the classes recognised. The cluster analysis only identifies areas which are similar in terms of the chosen indicators; it does not rank or quantify these in absolute or relative terms.

6.4.3 Choosing the most appropriate method

The model created in this research is intended to be widely applicable and the design criteria (Section 6.2.1) reflect this aim. The method employed to combine indicators of utilization is therefore of prime consideration. The preceding discussion has shown that this involves three main choices: how to scale or score the component indicators; how to weight these; and how to aggregate them. The main options for scaling are seen to be the use of Z-scores or chi-square values. Various methods of weighting and aggregation are available which allow the relative impact of different indicators to be incorporated, although each method discussed has drawbacks.

Three main issues need to be considered in selecting a suitable approach. Firstly, it is inappropriate to use complex techniques without a sound understanding of the interaction between component indicators to be modelled. Whilst indicators are selected to measure different factors it is possible that some interaction exists. This is not readily assessed prior to the application of the model (although the model will be subsequently tested for gross data redundancy in Chapter Seven). Consequently, the use of such techniques may be inherently erroneous. Secondly, the intention is that the model should be easily usable by health care managers (Section 6.2.1) and therefore needs to be as simple and transparent as possible. Finally, the model needs to be customisable and portable to other areas (Section 6.2.1), so that it can be adjusted to address local circumstances. It therefore needs to be capable of direct manipulation and control. This is not possible with many statistical methods.

For the purpose of scaling indicators, the signed chi-square method is considered to be more reliable. This method offers a means of scoring absolute values and is more appropriate for smaller geographical areas and small absolute values. Weighting will not be incorporated into the model due to difficulties in defining accurate weights (except for the calculation of the transport indicators in the accessibility sub-model which is considered in the appropriate section).

The detailed calculation of signed chi-square scores is described in Appendix Five (after DoE, 1995). As part of this process, data are standardised, in the same way that Z-scores are used by Jarman (1983; 1984) and Townsend (1988). This manipulation ensures comparability and reduces the effect of large absolute values in the data. Transformation of data into a normal distribution, to reduce skewness, by taking the logarithmic value of the x^2 statistic is a practice also common in calculating indices. The use of logarithmic values lessens the impact of skewed values, although, by definition, the range of values is reduced. However, the transformation still maintains the variance for any one variable and therefore those variables which illustrate greater variation still have the same impact when combined in the overall model.

In summary, the process of data manipulation for each indicator is:

i. Obtain absolute values of data at the ED level of analysis;
ii. Standardise values by calculating the x^2 statistic where observed values are those exhibited per ED and expected values are those expected for the NDHA area as a whole (where possible the value expressed as a proportion of the total, otherwise, a mean expected value in relation to the total).
iii. Transform the x^2 statistic into a normal distribution by calculating the logarithmic values.
iv. Combination of indicators through addition to create composite scores for each of the three sub-models reflecting the dimensions of utilization.

In interpreting the scores positive, standardised, transformed x^2 values are indicative of a higher relative measure and negative values indicative of a lower relative measure.

6.5 MEASURING NEED

Section 3.2 identified three main components of need: namely health status, social and economic disadvantage and environment. This section constructs each component systematically, selecting indicators based on the discussion in Sections 3.2.1-3.2.3 and the results of the patient survey (Chapter Five). It examines the data source, meaning, spatial distribution and outcome of indicators and their initial combination. It should be noted that, for discussion purposes, reference is made to the spatial distribution of indicators as a proportion of the total for the case study. However, the calculation of x^2 scores is based on the absolute values of data (Appendix Five). Ward and district averages are also calculated to identify the broad distribution and these are compared with county and national averages. ED scale maps show more local scale variations and patterns. A map of ward and district names is presented earlier in this Chapter for reference (Map 6.2). The section concludes by presenting an overview of the need sub-model. The detailed manipulation of data in the GIS is presented in Appendix Five.

6.5.1 Measuring health status indicators

Health status clearly represents the influence of a wide range of different factors, and varies substantially across the population. The key factors identified in Section 3.2.1 are age, gender and level of illness. These factors are supported by comparable results from the patient survey. In particular, differences in the consultation behaviour were evident for different age groups (Section 5.2) and women tended to consult more frequently (Section 5.3). Indicators capable of measuring these differences are derived in this section.

In terms of age, increased need for health care is evident for the very young and for ageing people (Section 3.2.1). Section 5.2 also showed that the young and elderly tend to consult more frequently. Indicators for these factors are derived from the 1991 census and are comparable with those used by Jarman (1983) and Townsend (1988).

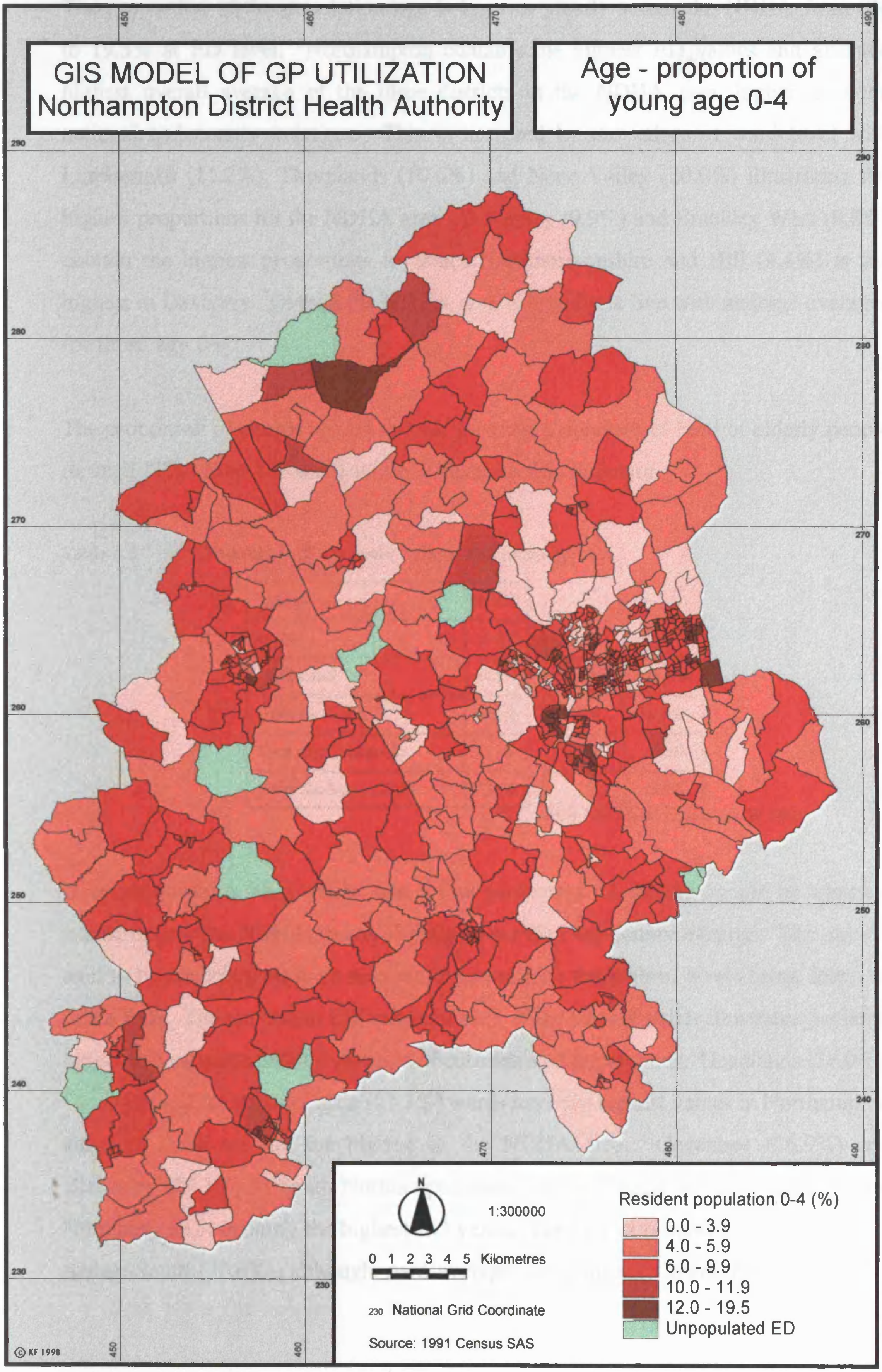
The measurement of the proportion of the population age 0-4 provides an appropriate indicator for the young (termed indicator N1 in the model). The spatial distribution of this measure, at ED scale, is illustrated in Map 6.4 and comparative data is presented in Table 6.2.

Table 6.2 Population 0-4 comparison (average)

		ED min	ED max
national	6.7%		
county	7.0%		
NDHA area	6.9%		
Daventry district	6.5%	1.1%	14.0%
Northampton Borough	7.7%	1.5%	19.5%
South Northants. district	6.5%	0.0%	13.8%

(Note: ED values exclude special EDs)

Map 6.4 Age 0-4


GIS MODEL OF GP UTILIZATION
Northampton District Health Authority
Age - proportion of young age 0-4
450
460
470
480
490
290
280
270
260
250
240
230
1:300000
0 1 2 3 4 5 Kilometres
230 National Grid Coordinate
Source: 1991 Census SAS
Resident population 0-4 (%)
0.0 - 3.9
4.0 - 5.9
6.0 - 9.9
10.0 - 11.9
12.0 - 19.5
Unpopulated ED
© KF 1998

The proportion of the population age 0-4 varies greatly across the NDHA from 0% to 19.5% at ED level. Northampton contains the highest ED values and also the highest overall average of the three districts in the NDHA area, higher than the national and county averages. This is mirrored by the values at ward level with Lumbertubs (11.2%), Thorplands (10.6%) and Nene Valley (20.0%) illustrating the highest proportions for the NDHA area. Blakesley (9.9%) and Brackley West (9.8%) contain the highest proportions in South Northamptonshire and Hill (9.4%) is the highest in Daventry. Overall the NDHA area is broadly in line with national averages for those age 0-4.

The proportion of people age 65 or over provides a measure of need of elderly people (termed N2). Map 6.5 and Table 6.3 illustrate this indicator.

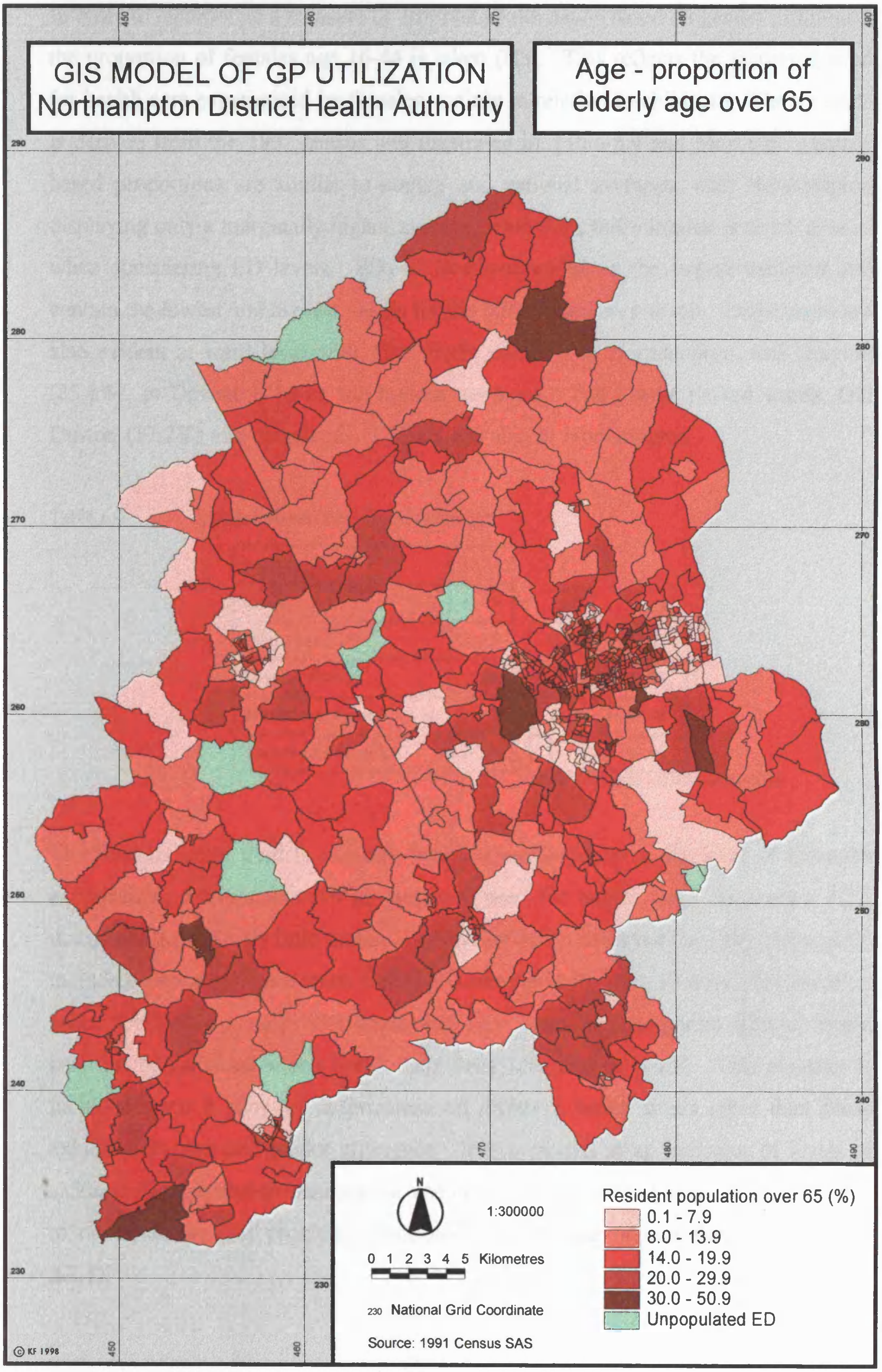
Table 6.3 Population 65 and over comparison (average)

		ED min	ED max
national	15.9%		
county	14.5%		
NDHA area	14.2%	ED min	ED max
Daventry district	13.6%	2.1%	39.6%
Northampton Borough	15.3%	0.6%	50.3%
South Northants. district	13.6%	0.2%	38.6%

(Note: ED values exclude special EDs)

Northamptonshire, as a whole, has a low percentage of elderly people by national standards and the NDHA area is slightly lower than the county average. The elderly tend to be concentrated in or near major towns with the highest levels being found in urban EDs. The maximum ED values in each of the three districts illustrates the large intra-ward variation and is indicative of concentrated populations. Headlands (24.0%), Old Duston (22.8%) and Castle (21.1%) wards have the highest values in Northampton although these are not the highest in the NDHA area. Cogenhoe (26.9%) and Blakesley (25.1%) in South Northamptonshire are the highest wards overall, despite Northampton containing the highest ED value. The largest proportion in Daventry is Abbey South (20.6%), although ward averages are generally lower in this district.

Map 6.5 Age 65 and over



In order to incorporate a measure of different health needs based on gender difference, the proportion of females age 16-44 is taken (N3). This reflects the increased need for health care experienced by females, mainly in relation to childcare. The measure is derived from the 1991 census and illustrated in Table 6.4 and Map 6.6. District based proportions are similar to county and national averages, with Northampton displaying only a marginally higher average. However, this variation is much greater when considering ED levels. EDs in Northampton show the largest variation and contain the lowest and highest values for the NDHA area as a whole. Differences are also evident at ward level with Thorplands (26.7%), in Northampton, and Drayton (25.8%), in Daventry, being the highest averages. The lowest ranked wards, Old Duston (17.2%) and Headlands (17.0%), are also in Northampton.

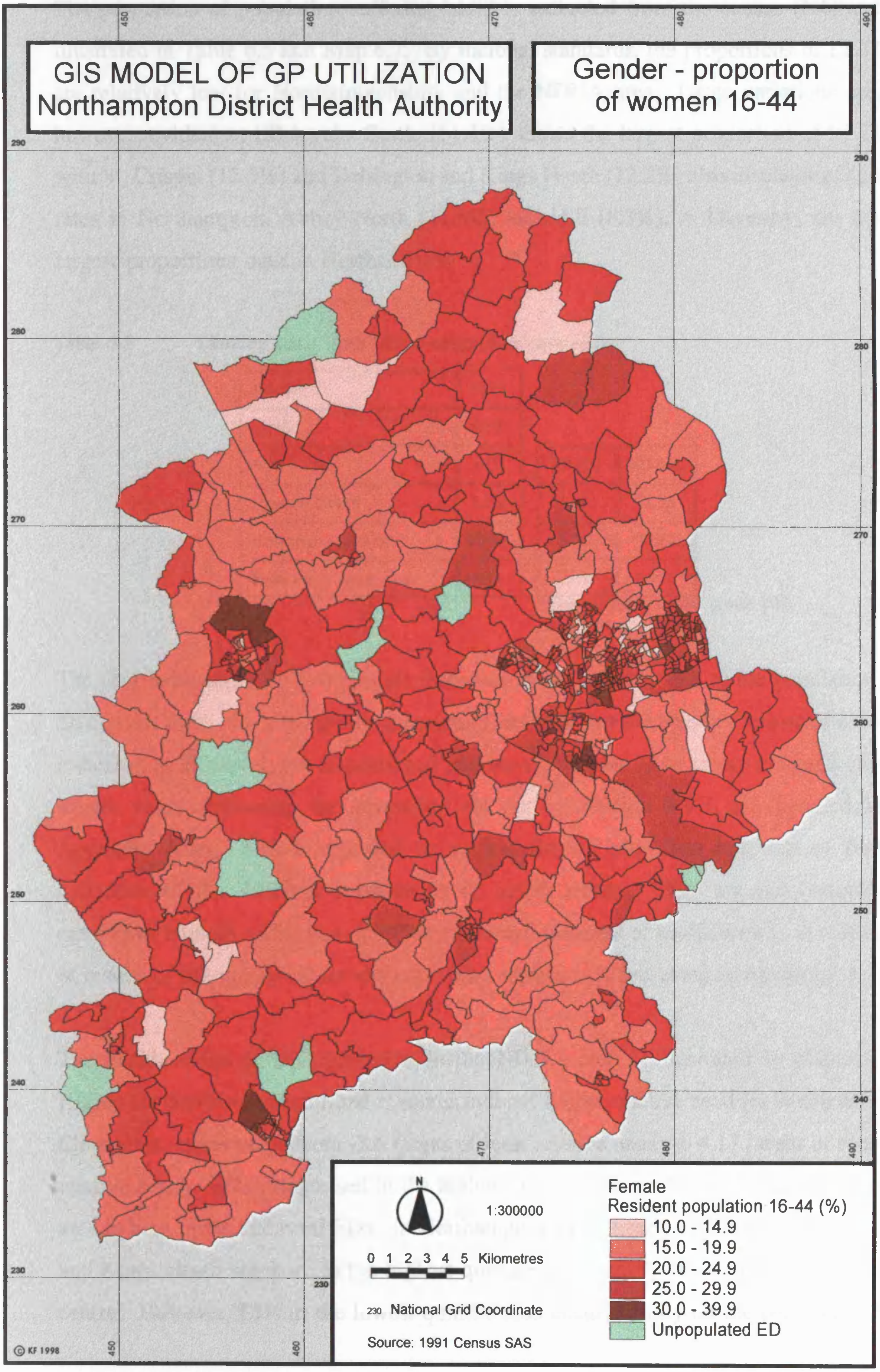
Table 6.4 Females 16-44 comparison (average)

		ED min	ED max
national	21.1%		
county	21.7%		
NDHA area	21.3%		
Daventry district	20.9%	11.3%	32.8%
Northampton Borough	22.4%	10.8%	37.0%
South Northants. district	20.7%	11.7%	30.9%

(Note: ED values exclude special EDs)

The final indicator used to measure health status is based on the level of ill-health experienced, representative of an increased need for health care. As section 3.2.1 discussed, there is very little routine data on morbidity levels but the 1991 census does include a measure of permanent sickness (Limiting Long Term Illness). The question asked whether a person considered that they have 'any long-term illness, health problem or handicap which limits their daily activities or work'. This measure is included since it provides information on different health needs other than those exhibited by age and gender difference. It is preferred as an indicator of levels of sickness in a population than similar use of mortality data may provide. This is due to the acknowledged problems associated with the use of mortality data (Section 2.2.1).

Map 6.6 Females 16-44



The proportion of population suffering LLTI is extracted from the census (N4) and illustrated in Table 6.5 and Map 6.7. By national standards, the proportions of LLTI are relatively low for Northamptonshire and the NDHA area. Large variations are, however, evident at ED level. Castle (14.4%) shows the largest proportion of LLTI with St. Crispin (12.5%) and Dallington and Kings Heath (12.2%) also displaying high rates in Northampton. Abbey North (11.5%) and Hill (8.3%), in Daventry, are the largest proportions outside Northampton.

Table 6.5 Limiting Long Term Illness comparison (average)

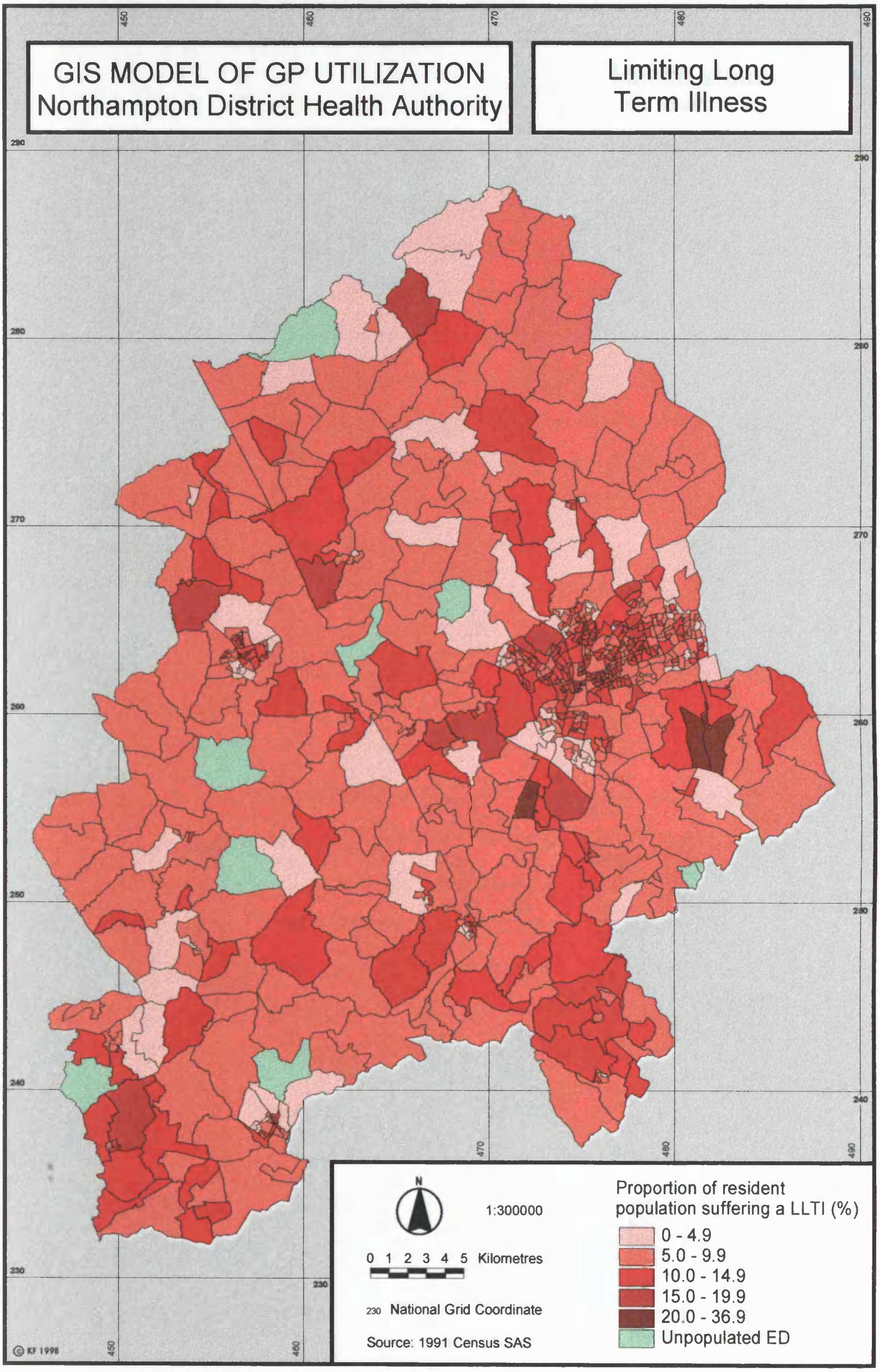
		ED min	ED max
national	12.3%		
county	9.9%		
NDHA area	9.1%		
Daventry district	8.3%	2.1%	22.1%
Northampton Borough	10.5%	1.7%	36.0%
South Northants. district	8.5%	1.4%	23.0%

(Note: ED values exclude special EDs)

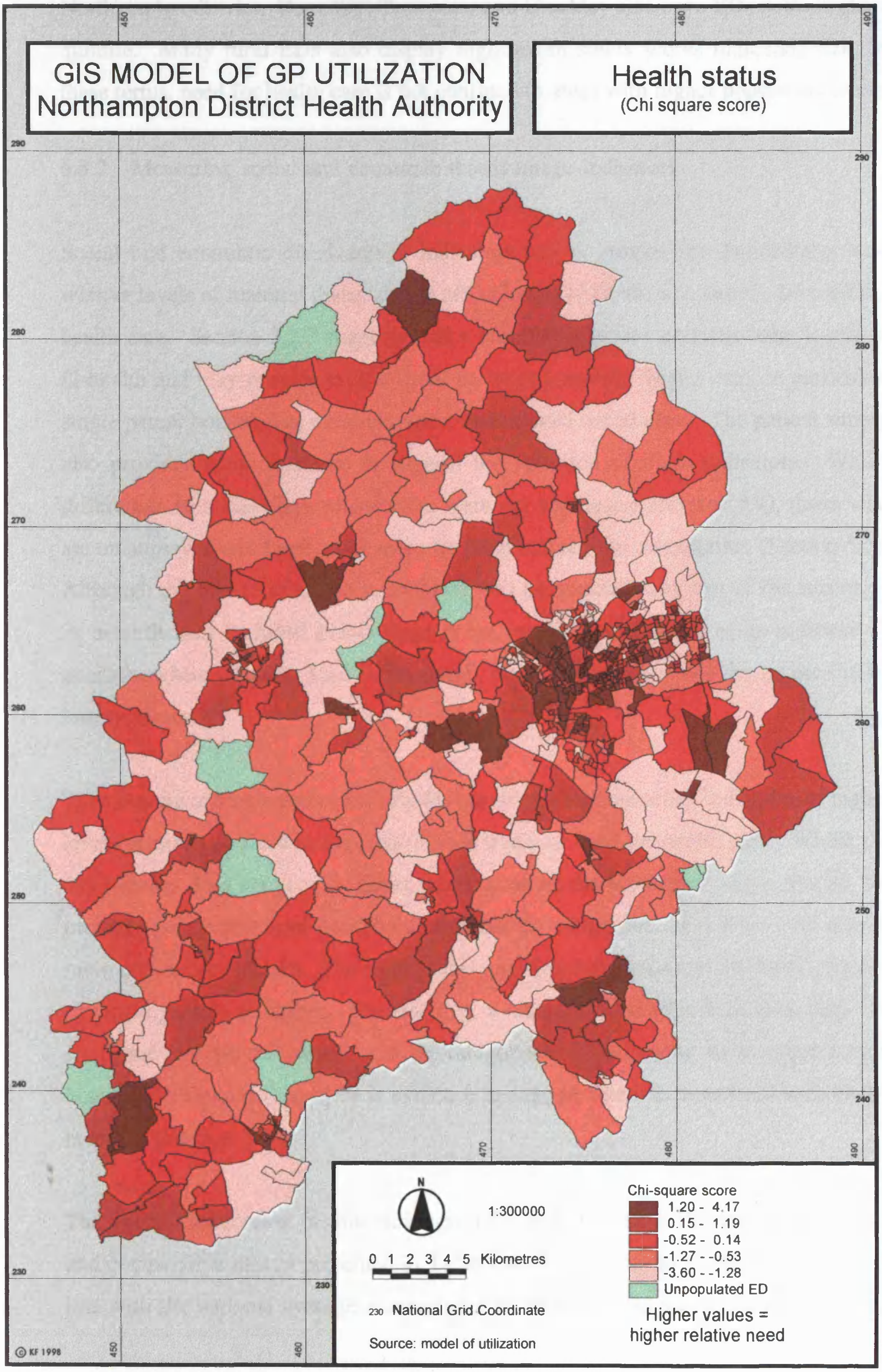
The four indicators (N1-N4) provide measures of the health status of the population. To convert them into a composite measure of health status the absolute values of each indicator, at ED level, are standardised and then transformed to create a signed chi-square value (following the procedure set out in Section 6.4.3 and detailed in Appendix Five). This is repeated for each indicator, providing four sets of data indicative of the different components of health status. They are subsequently combined, through addition, to provide an overall measure of health status. A matrix of results of chi-square values and composite measures is presented in Appendix Six.

The health status of the population in the NDHA area is illustrated in Map 6.8. Higher standardised transformed x^2 scores indicate higher relative need for health care. Chi-square scores range from -3.6 (areas of least relative need) to 4.17 (areas of most relative need). EDs categorised in the highest quintile are evident across the NDHA area in both urban and rural EDs. In Northampton itself, nearly all EDs in Dallington and Kings Heath ward are in the highest quintile as are many other EDs in the town centre. However, EDs in the lowest quintile also occur, mainly on the periphery of

Map 6.7 Limiting Long-Term Illness



Map 6.8 Health status composite score



Northampton district. Daventry, Towcester and Brackley also have EDs in the highest quintile. Many rural EDs also display high health status scores indicating that, in these terms, need for health care is not confined to areas with higher population totals.

6.5.2 Measuring social and economic disadvantage indicators

Social and economic disadvantage indicators act as proxies for determining how relative levels of material disadvantage affect levels of health and, hence, the need for health care. Section 3.2.2 suggests that a number of factors correlate with levels of ill-health and may provide indicators of increased need for health care, in particular, single parent households, unemployment and manual social class. The patient survey also provides some evidence to support the selection of these indicators. Whilst differences in social class consultation were not conclusive (Section 5.4), those who are unemployed exhibited much more frequent and regular consultation (Section 5.5). Although the impact of single parenthood was not examined as part of the survey, it is, nevertheless, included at this stage in the model due to its use as an indicator of need elsewhere (Section 3.2.2) - its overall value will be examined during the model testing stages.

The measure of single parent households provides a suitable proxy indicative of higher levels of material disadvantage and higher levels of need for health care. Whilst the 1991 census does not provide direct information on the number of single parents, the measure is inferred from household composition where one adult lives with one or more dependent children. The style of this question may mean that the actual number of single parents is higher. For instance, a single mother who lives with both her child and her parents would not be categorised as belonging to a single parent household. Despite this, there is evidence to suggest that it is associated with health outcome (Section 3.2.2).

The spatial distribution of this indicator (N5), at ED level, is illustrated in Map 6.9 and comparative data is presented in Table 6.6. The county as a whole is broadly in line with the national average although the NDHA area has a much lower average.

Map 6.9 Single parent households

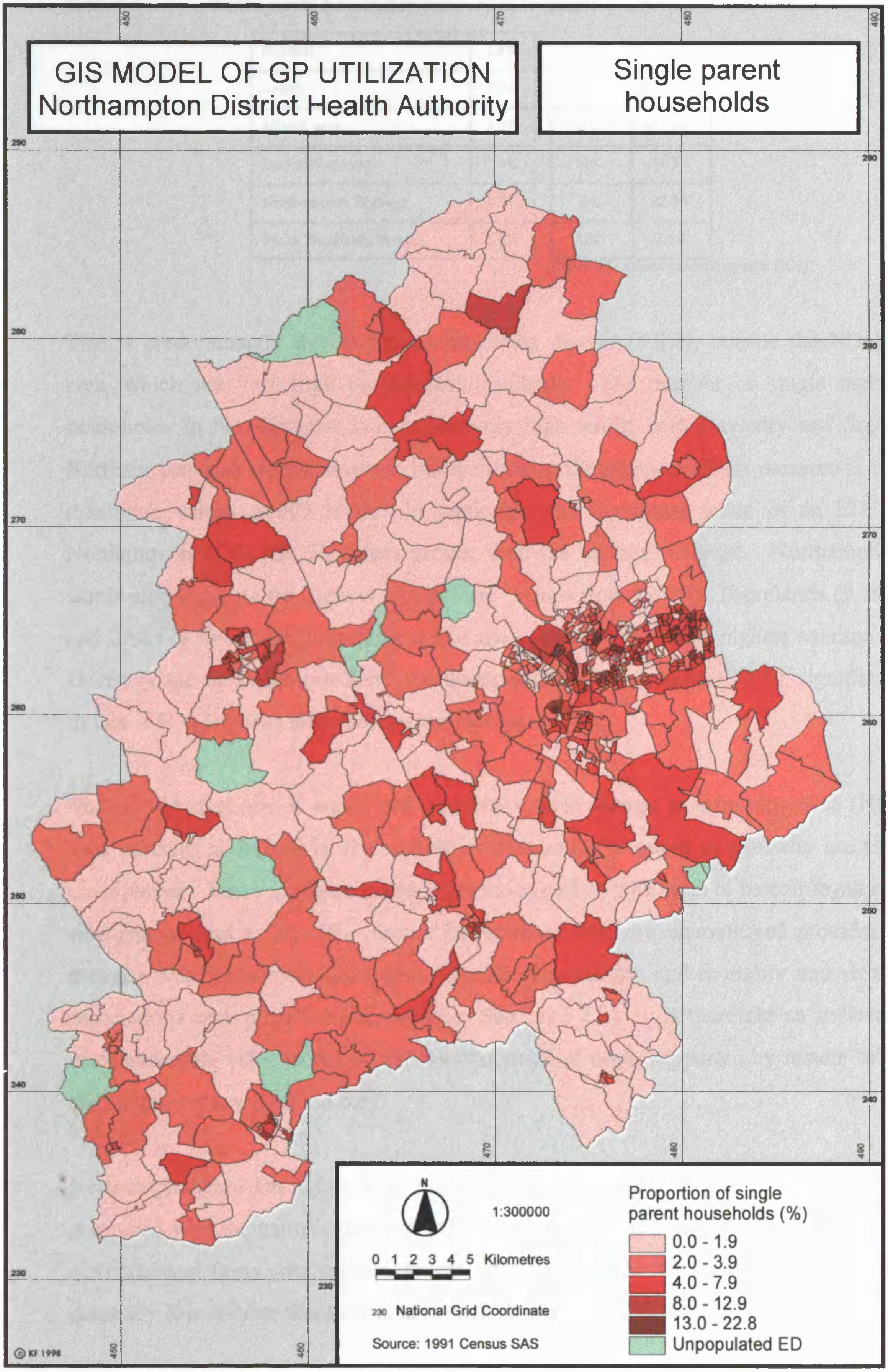


Table 6.6 Single parent households comparison (average)

		ED min	ED max
national	3.8%		
county	3.9%		
NDHA area	3.0%	ED min	ED max
Daventry district	2.4%	0%	11.5%
Northampton Borough	4.7%	0%	22.8%
South Northants. district	1.9%	0%	7.3%

(Note: ED values exclude special EDs)

This is predominantly due to figures for Corby district (5.8%), outside the NDHA area, which are very high by national standards. The number of single parent households in Northampton is comparatively high whilst both Daventry and South Northamptonshire are much lower, but the most striking aspect of this measure is the maximum values at ED level. In particular, the maximum value of an ED in Northampton is 22.8%, six times greater than the national average. Northampton wards also illustrate the highest proportions. Lumbertubs (9.6%), Thorplands (9.1%) and Links (8.7) are the three highest averages. Hill (6.7%) is the highest average in Daventry and the highest in South Northamptonshire is Towcester (3.2%), significant in that it is still lower than the national average.

The second measure of social and economic disadvantage is unemployment (N6). This measure is defined as the number of economically active people who are also unemployed. These are those people over the age of 16 who wish to be employed but who cannot find a job. The proportion of those who are unemployed provides a measure which has clear links with patterns of morbidity and mortality and strong associations with other health outcomes (Section 3.2.2). It is therefore an indicator of considerable value to the overall measurement of need, supported by results from the patient survey (Section 5.5).

Northamptonshire has a relatively high rate of economically active people (65.9%) compared with the national average (61.0%). Table 6.7 and Map 6.10 shows that its districts have fairly low unemployment rates by national standards. Despite these generally low results, there are areas which display significantly higher averages. At

Map 6.10 Economically active unemployed

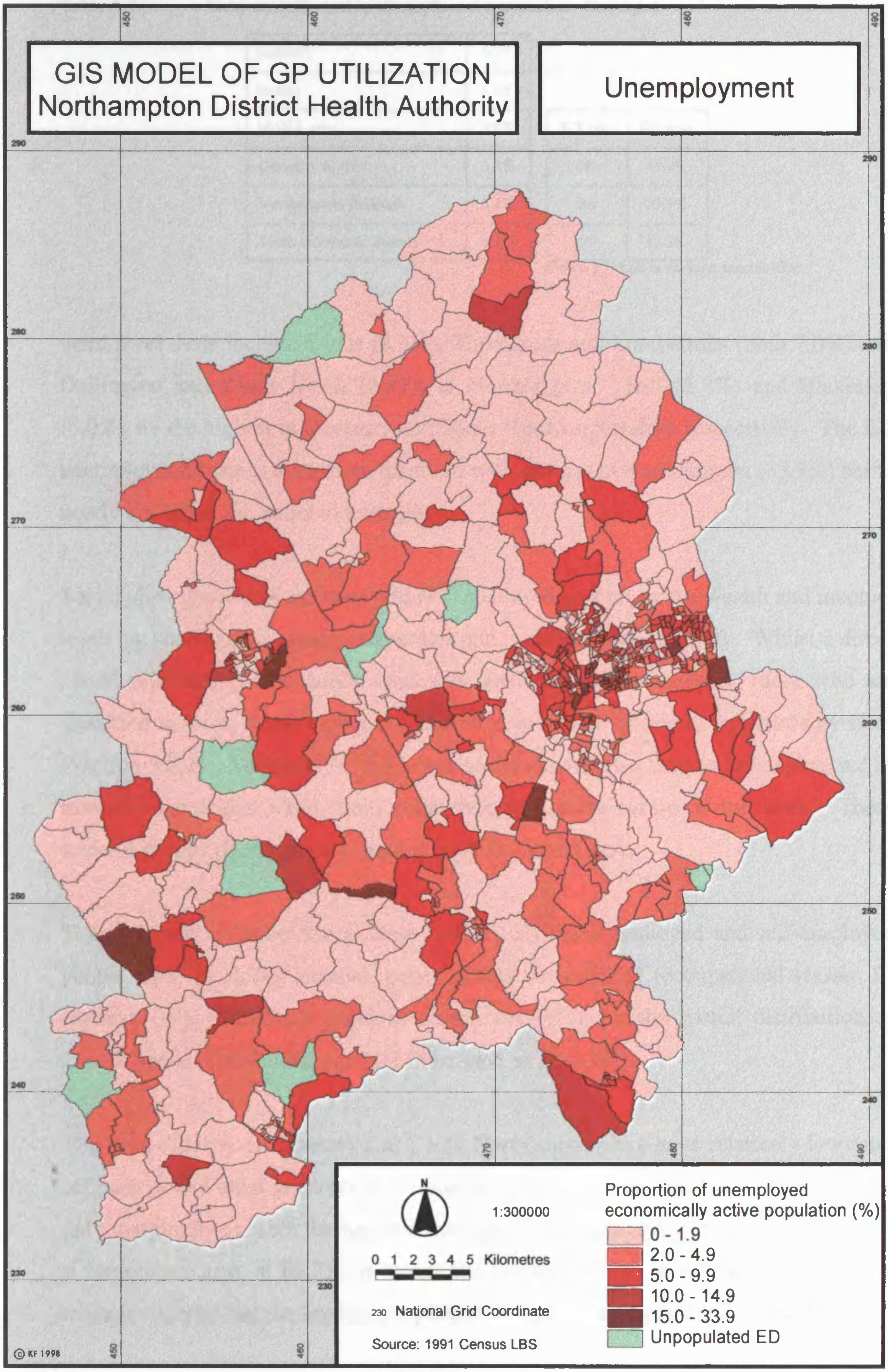


Table 6.7 Economically active unemployed comparison (average)

		ED min	ED max
national	5.7%		
county	4.6%		
NDHA area	3.9%		
Daventry district	3.3%	0%	17.9%
Northampton Borough	5.4%	0%	33.9%
South Northants. district	3.1%	0%	18.3%

(Note: ED values exclude special EDs)

ward level these include Castle (8.3%), Thorplands and Lumbertubs (both 7.0%) and Dallington and Kings Heath (6.8%) in Northampton. Hill (6.8%) and Blakesley (6.0%) are the highest in Daventry and South Northamptonshire respectively. The ED unemployment rate is even more localised with one ED in Northampton (33.9%) being nearly six times the national average.

Social class provides a measure which can be used as a proxy for wealth and income, implying social and economic disparities and variation in opportunity. Whilst a direct causal relationship with health cannot be attributed to the measure, those who are classified in lower social classes do tend to have higher morbidity and mortality rates (Section 3.2.2). Additionally, the lower social classes also tend to be emphasised in manual occupations which carry more risk due to the nature of the work. These societal groups thus exhibit a greater need for health care.

The definition of lower social class includes all those employed and self-employed people who are skilled manual, partly skilled or unskilled (occupational classes III Manual - V). Table 6.8 provides comparative data for the spatial distribution of Lower Social Class (indicator N7) illustrated in Map 6.11.

The rural districts of Daventry and South Northamptonshire have relatively low rates of lower social class residents in comparison with national standards. Northampton only marginally exceeds the national average. The addition of data for Corby district is important since, at 82.7%, it brings the county average in line with the national average. Corby has the highest proportion of lower class residents of any district in

Map 6.11 Manual social class

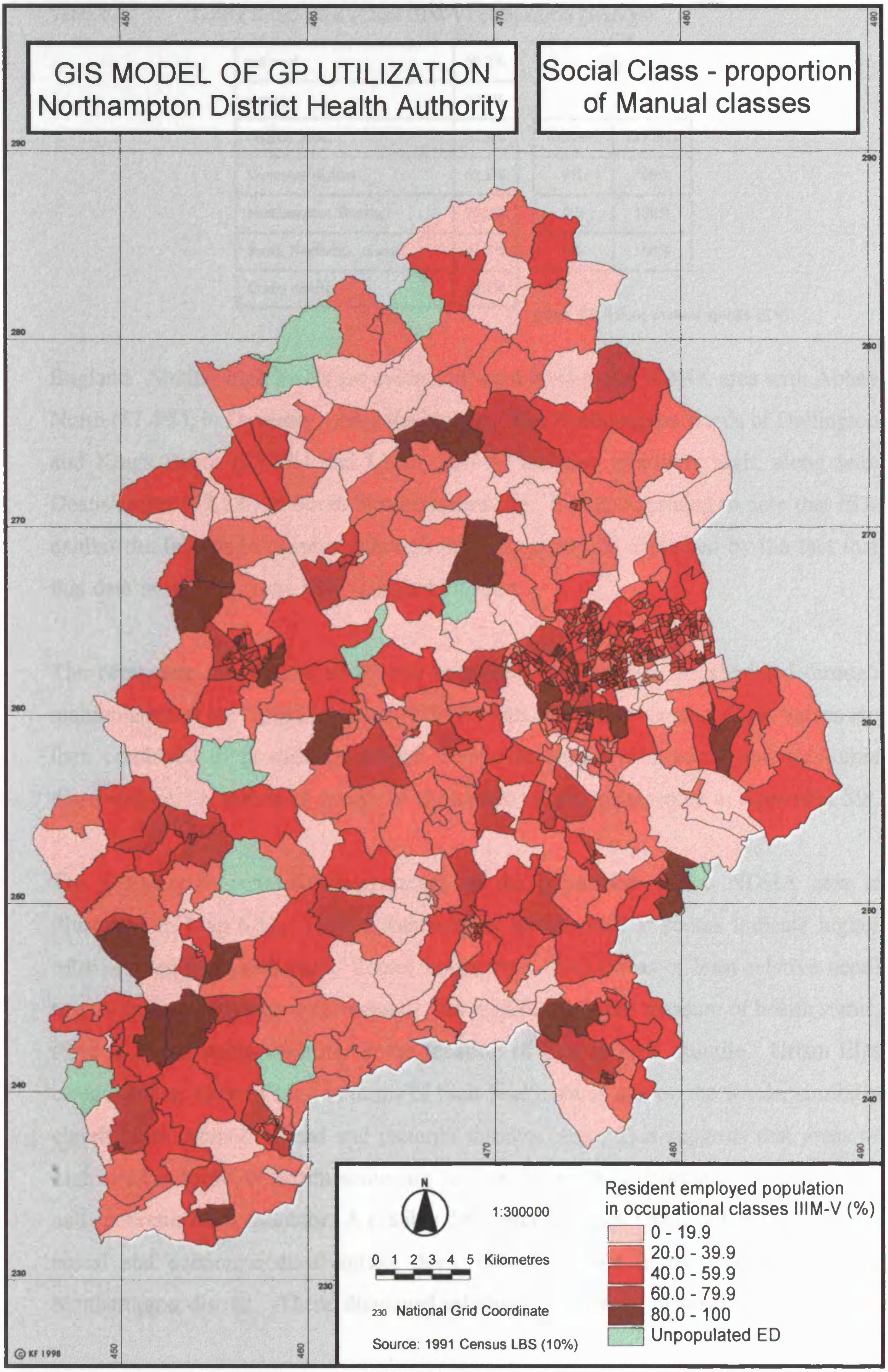


Table 6.8 Lower social class (Class IIIM-V) comparison (average)

		ED min	ED max
national	69.2%		
county	69.4%		
NDHA area	64.6%		
Daventry district	62.1%	0%	100%
Northampton Borough	70.3%	0%	100%
South Northants. district	61.3%	0%	100%
Corby district	82.7%		

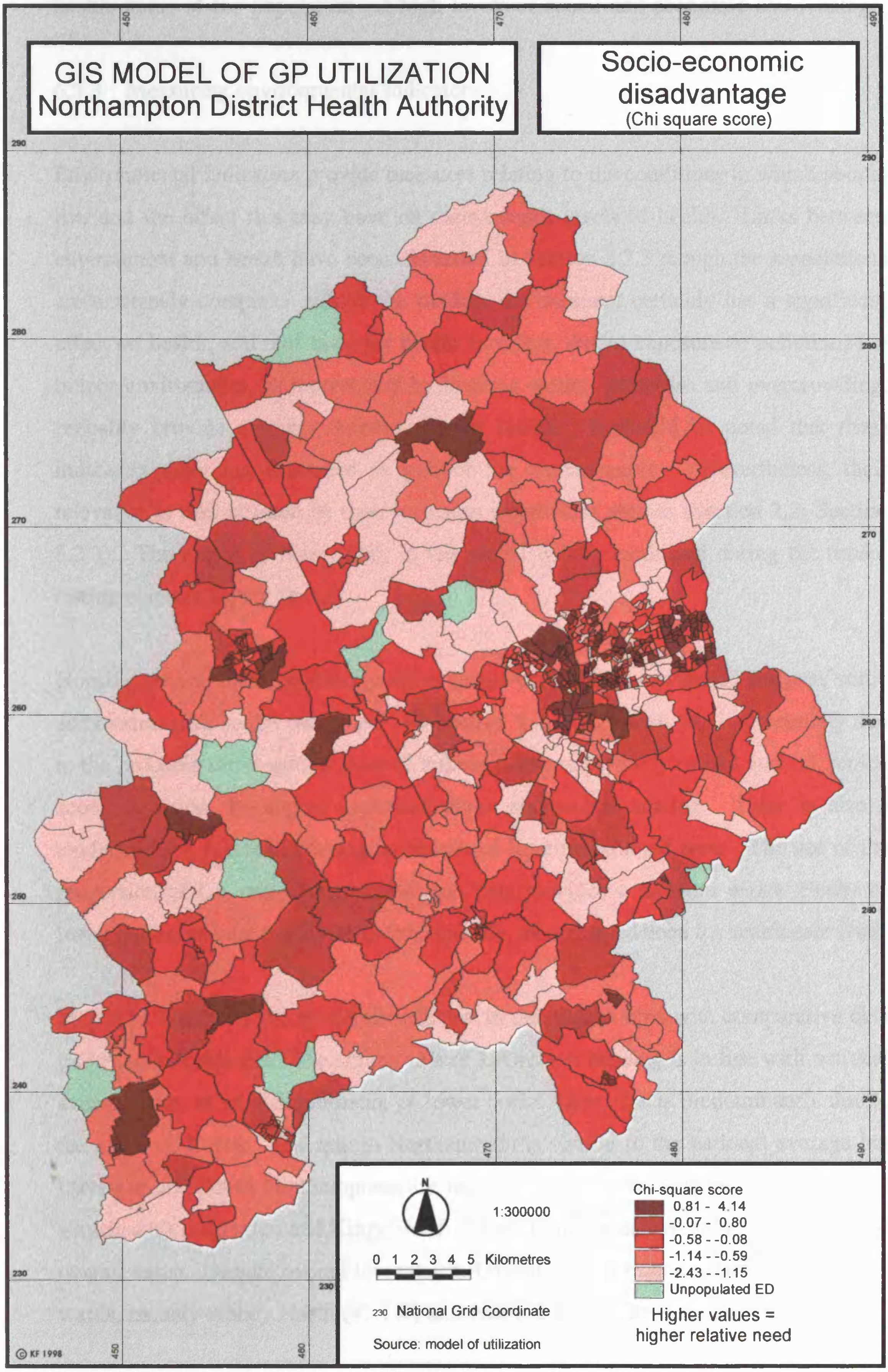
(Note: ED values exclude special EDs)

England. Similar high levels are evident at ward level in the NDHA area with Abbey North (87.4%), in Daventry, being the highest. The Northampton wards of Dallington and Kings Heath (83.2%) and Links (80.4%) are also relatively high, along with Deanshanger (79.1%) in South Northamptonshire. It is unsurprising to note that EDs exhibit the full range of rates although this may partly be explained by the fact that this data is derived from 10% sample LBS data.

The composite measure of social and economic disadvantage is calculated through manipulation of the three indicators (N5-N7) into chi-square scores. These values are then combined to provide an overall composite measure of social and economic disadvantage. A matrix of results of chi-square values is presented in Appendix Six.

The social and economic disadvantage of the population in the NDHA area is illustrated in Map 6.12. Higher standardised transformed x^2 scores indicate higher relative need for health care. Scores range from -2.43 (areas of least relative need) to 4.14 (areas of highest relative need). As with the previous measure of health status, there is considerable variation in the location of EDs in each quintile. Urban EDs categorised as most in need in terms of their health status are, on the whole, similarly classified in terms of social and material disadvantage. This suggests that areas of high need in terms of health status are further disadvantaged because of their social and economic circumstances. A notable difference between levels of health status and social and economic disadvantage does, however, exist in the eastern wards of Northampton district. These displayed relatively low levels of need in terms of the

Map 6.12 Social and economic disadvantage composite score



health status of the population yet high levels of social and economic disadvantage.

6.5.3 Measuring environmental indicators

Environmental indicators provide measures relating to the conditions in which people live and the effect this may have on their overall levels of health. Links between environment and health have been discussed in Section 3.2.3 though the associations are extremely complex. Whilst the outdoor environment certainly has a significant effect on health, and thus need for health care (e.g. due to exposure to pollution) the indoor environment, as represented by housing tenure, amenities and overcrowding, probably provide stronger determinants of health. It should be noted that these indicators were not examined as part of the patient survey. Nevertheless, their relevance is well attested by their inclusion in previous studies (Section 2.2; Section 3.2.3). The extent of their utility in the model will be evaluated during the model testing stage (Chapter Seven).

Housing tenure does not directly affect levels of health but evidence suggests some association with health outcomes. As Section 3.2.3 discussed, this is potentially due to the probable difference in level of upkeep between privately owned and LA rented accommodation, leading to increased damp and poorer heating. There is also a tendency for LA rented housing to be located in more polluted areas. The use of the proportion of LA rented accommodation thus provides a measure which illustrates lower environmental quality and, consequently, an increased need for health care (N8).

Map 6.13 illustrates the spatial distribution in the NDHA area with comparative data indicated in Table 6.9. The county rate of LA rented housing is in line with national averages but, as with the measure of lower social class, this is predominantly due to the effect of Corby. The rate in Northampton is similar to the national average but Daventry and South Northamptonshire fall well below. At ward level the pattern is similar with Dallington and Kings Heath (51.1%), in Northampton, having the highest overall value. Despite overall low rates in Daventry it does contain two of the highest wards, namely Abbey North (47.1%) and Hill (42.0%). There are no wards in South

Map 6.13 LA housing tenure

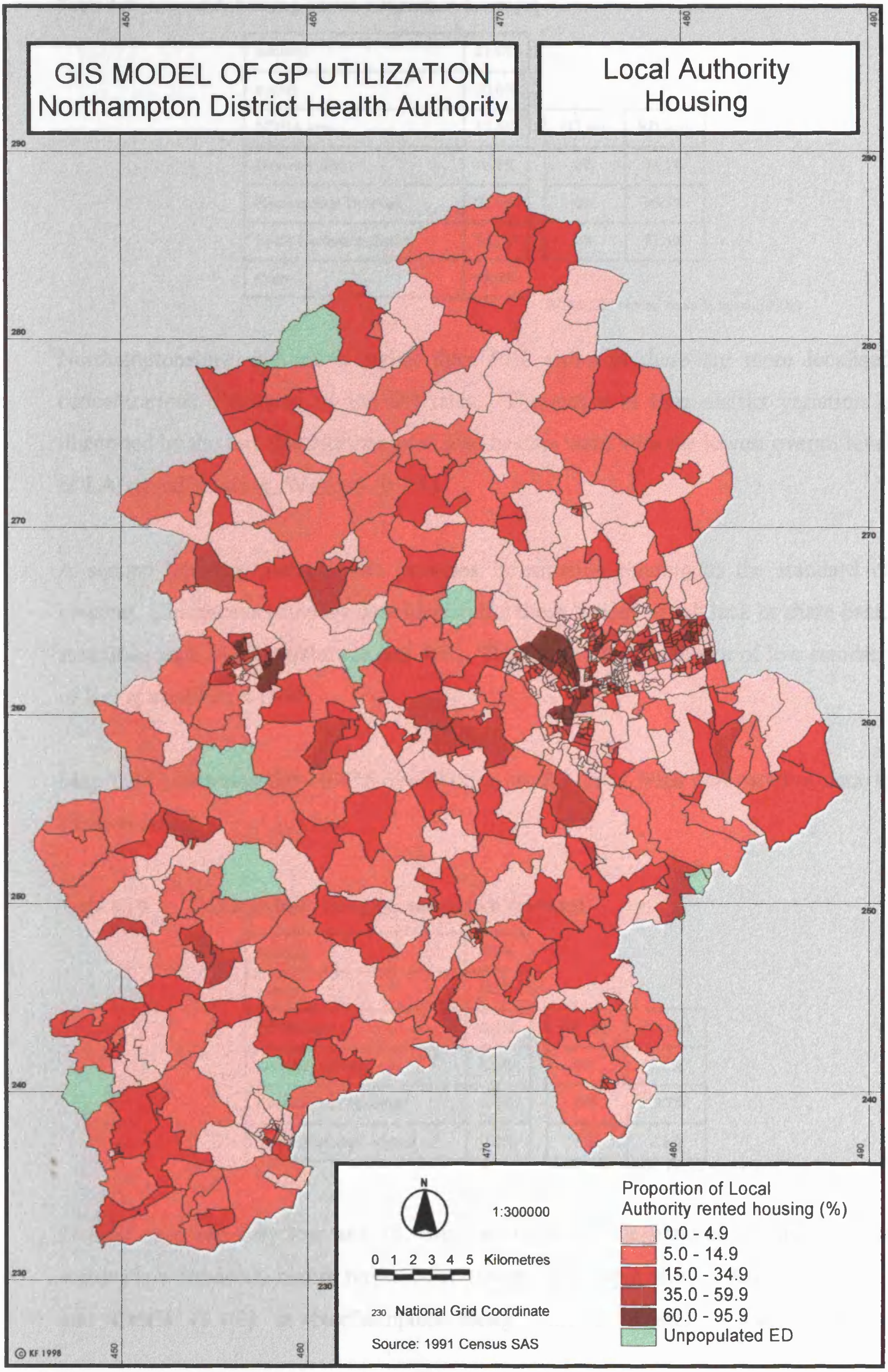


Table 6.9 LA housing tenure comparison (average)

		ED min	ED max
national	21.0%		
county	20.6%		
NDHA area	17.6%		
Daventry district	16.8%	0%	74.1%
Northampton Borough	21.7%	0%	95.5%
South Northants. district	14.2%	0%	81.5%
Corby	38.7%		

(Note: ED values exclude special EDs)

Northamptonshire with rates higher than 30% although there are more localised concentrations illustrated by the ED rates. The extent of intra-district variation is illustrated by the fact that Northampton also has the ward with the lowest overall level of LA rented housing, Welford (0.1%).

A second housing characteristic provides information relating to the standard of housing. The census provides data identifying those houses which lack or share basic amenities such as a bath/shower and WC. This provides an indicator of low standard of living conditions (N9).

Map 6.14 illustrates the NDHA distribution at ED level with comparative data in Table 6.10.

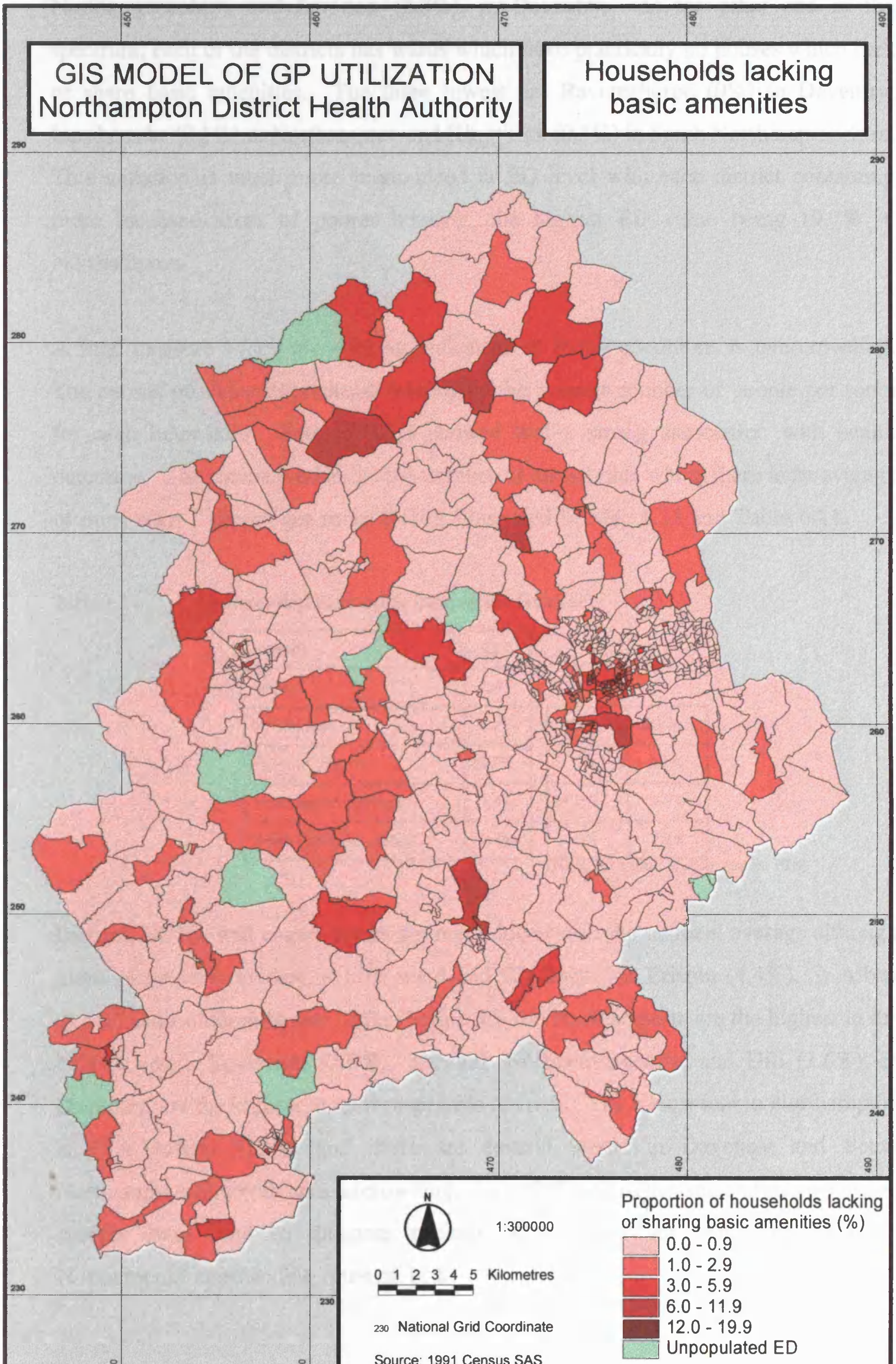
Table 6.10 Lacking basic amenities comparison (average)

		ED min	ED max
national	0.8%		
county	0.5%		
NDHA area	0.4%		
Daventry district	0.3%	0%	9.4%
Northampton Borough	0.6%	0%	19.7%
South Northants. district	0.3%	0%	7.1%

(Note: ED values exclude special EDs)

Overall rates are very low and all districts fall below the national average. Some wards show modestly higher rates: in particular, St Crispin (4.9%), Abington (3.9%) and Castle (2.4%) in Northampton along with Towcester (4.5%), in South

Map 6.14 Lacking basic amenities



Northamptonshire, and Spratton (2.3%), in Daventry. At the other end of the spectrum, each of the districts has wards which have practically no houses which lack or share basic amenities. The three lowest are Ravensthorpe (0%) in Daventry, Lumbertubs (0.1%) in Northampton and Kingthorn (0.1%) in South Northamptonshire. This variation is much more pronounced at ED level with each district containing more localised areas of poorer housing, the highest ED value being 19.7% in Northampton.

A final measure which provides an indication of living conditions is overcrowding. The census provides information relating to the average number of people per room for each household. Section 3.2.3 showed that a strong association with health outcomes. The measure taken is the number of households where there is an average of more than 1 person per room (N10), illustrated in Map 6.15 and Table 6.11.

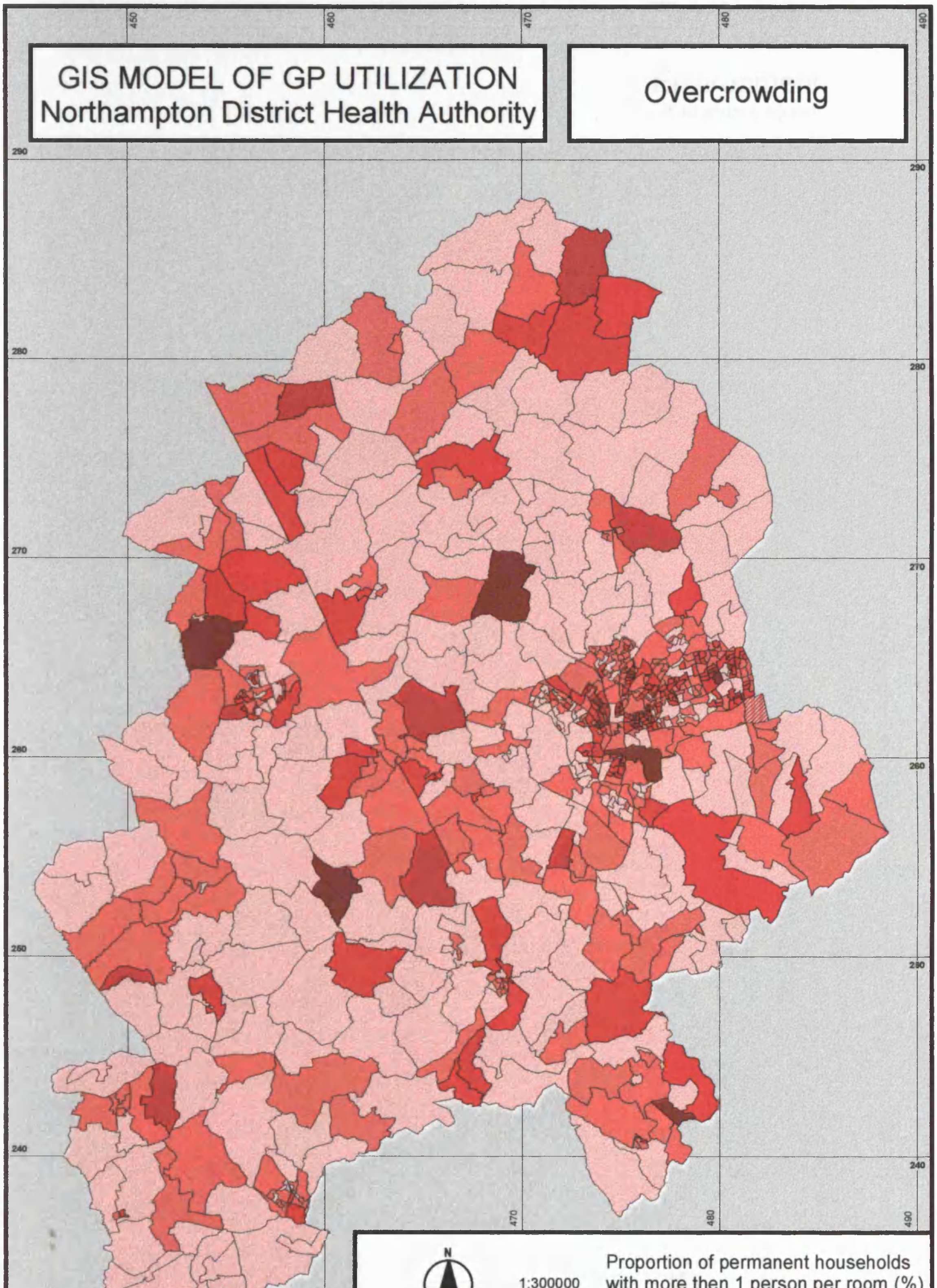
Table 6.11 Overcrowded households comparison (average)

		ED min	ED max
national	2.2%		
county	1.4%		
NDHA area	1.2%		
Daventry district	0.9%	0%	6.7%
Northampton Borough	1.9%	0%	9.8%
South Northants. district	0.8%	0%	7.1%

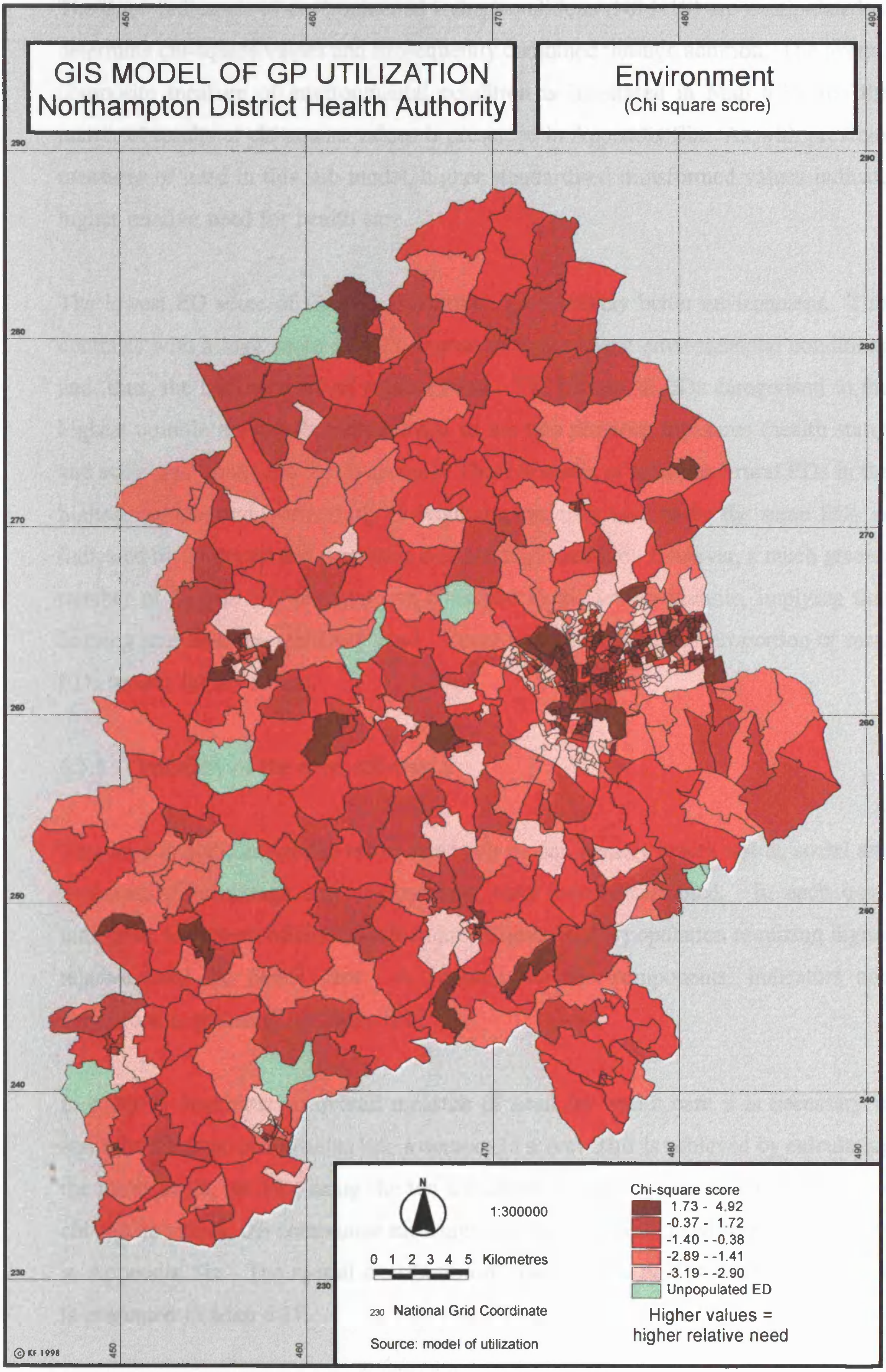
(Note: ED values exclude special EDs)

District, NDHA and county levels are much lower than the national average although more variation is evident at both ward and ED level. St Crispin (4.4%), St Alban (3.4%) and Lumbertubs and Links (both 3.3%), in Northampton, are the highest in the NDHA area. Towcester (2.9%), in South Northamptonshire, and Hill (2.6%), in Daventry, are the highest in their respective districts. The lowest rate in Northampton is Old Duston (0.3%) and there are several wards in Daventry and South Northamptonshire with no overcrowding. As with the other measures of Environment, smaller areas tend to illustrate pockets of overcrowding with some EDs in Northampton approaching rates of 10%.

Map 6.15 Overcrowding



Map 6.16 Environment composite score



The three indicators of environmental living conditions (N8-N10) are manipulated to determine chi-square values and subsequently combined through addition. The overall composite measure of environmental condition is illustrated in Map 6.16 and the matrix of results of chi-square values is presented in Appendix Six. As with previous measures of need in this sub-model, higher standardised transformed values indicate higher relative need for health care.

The lowest ED score of -3.19 is indicative of a relatively better environment. This contrasts with a high score of 4.92, representing the worst environmental conditions and, thus, the highest level of relative need. The pattern of EDs categorised in the highest quintile remains broadly similar to the two previous measures (health status and social and economic disadvantage). There is a mix of urban and rural EDs in the highest quintile and, particularly in Northampton, they tend to be the same EDs as indicated by the social and economic disadvantage measure. However, a much greater number of EDs in Northampton are classified in the lowest quintile, implying that housing standards are relatively good. Countering this is a higher proportion of rural EDs having higher scores.

6.5.4 Overview of the need sub-model

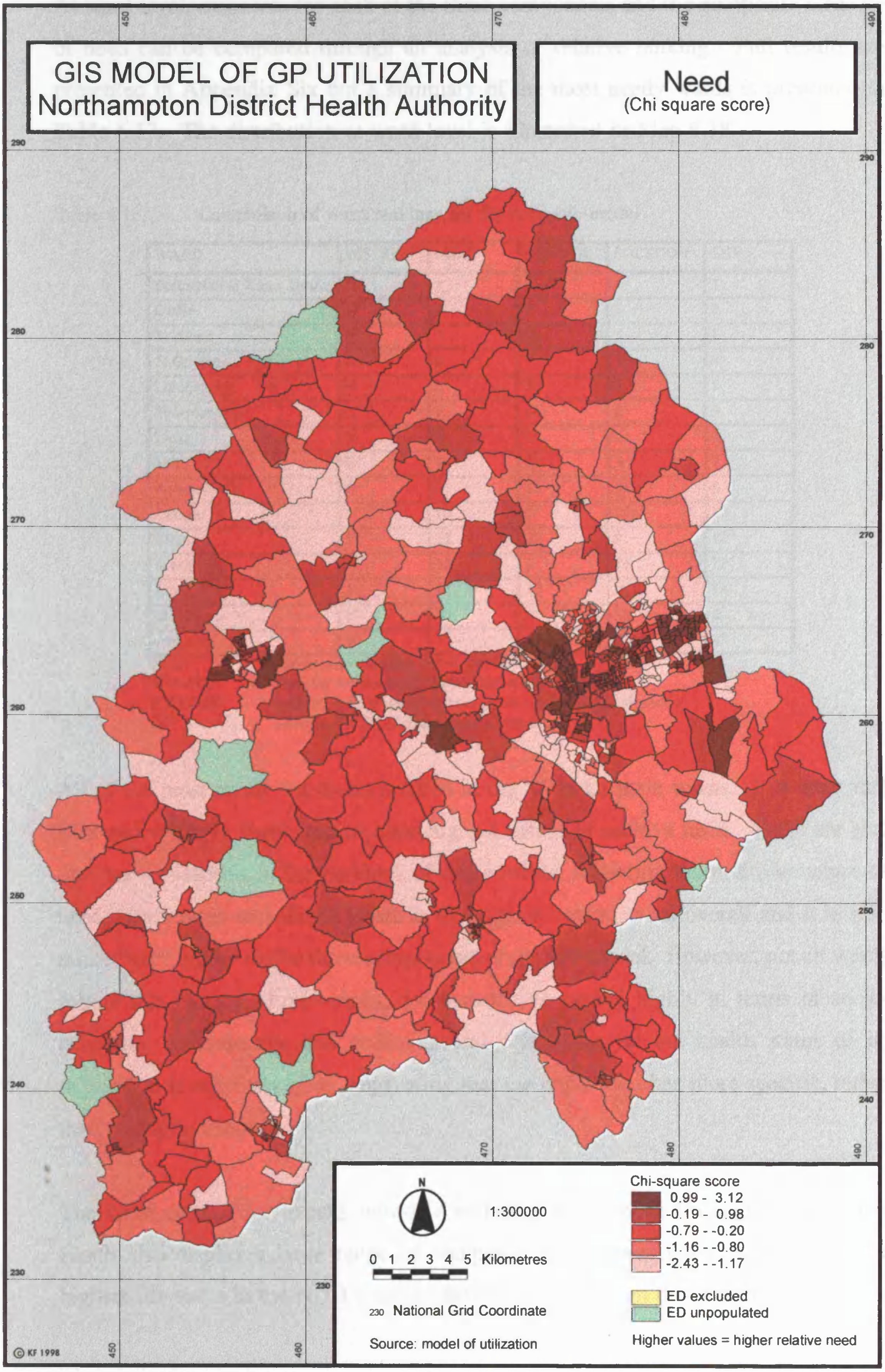
The three major components of the need sub-model, namely health status, social and economic disadvantage and environment, have been determined. In each case, indicators have been calculated which are indicative of a population requiring higher relative need for health care. A summary of the components, indicators and definitions is presented in Table 6.12

In order to determine an overall measure of need for health care it is necessary to combine the three components into a composite score. This is achieved by calculating the mean score, per ED, using the ten indicators of need. A summary of all of the chi-square values, the component measures and the composite need score is presented in Appendix Six. The spatial distribution of need for the NDHA area, at ED level, is presented in Map 6.17.

Table 6.12 Summary of the need sub-model

Sub-model	Component	Indicator		Definition (calculated using absolute values)
Need	Health Status	Young population	N1	Population age 0-4
		Elderly population	N2	Population age 65 & over
		Gender	N3	Females age 16-44
		Illness	N4	Population suffering Limiting Long Term Illness
	Social & Economic disadvantage	Single parenthood	N5	Single parent households
		Unemployment	N6	Economically active, unemployed population
		Lower Social Class	N7	Occupational social classes IIIM-V
	Environment	House ownership	N8	LA housing tenure
		Lower standard housing	N9	Households lacking or sharing basic amenities
		Overcrowded households	N10	Households with more than 1 person per room

Map 6.17 Need composite score (ED)



At ward level, measures for each of the three components and the composite measure of need can be compared through an analysis of relative ranking. Full results are presented in Appendix Six but a summary of the most needy wards is presented in Table 6.13. The distribution at ward level is illustrated in Map 6.18.

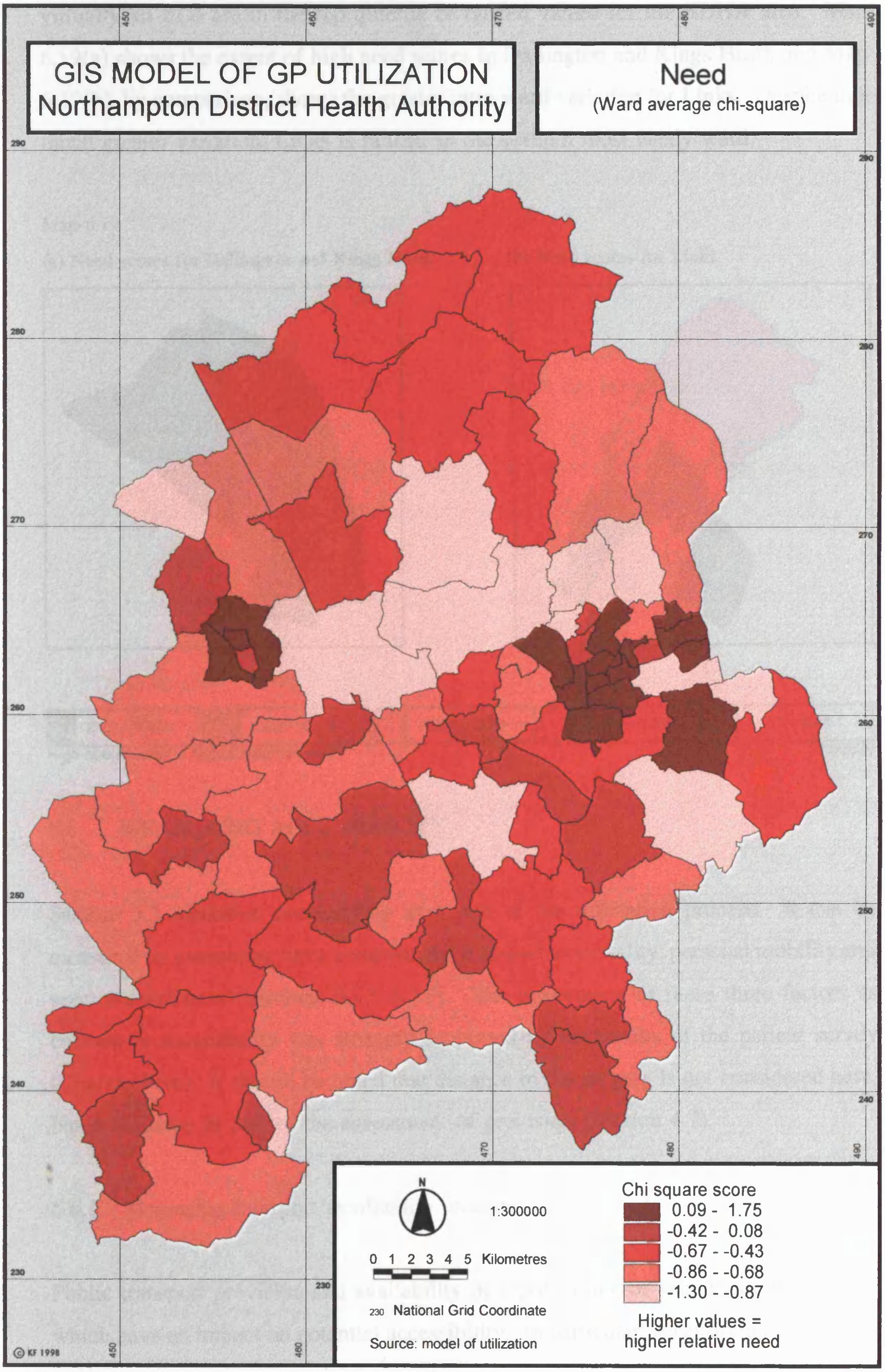
Table 6.13 Comparison of ward rankings for the need sub-model

WARD	DISTRICT	NEED	HEALTH	SOCECON	ENV
Dallington & Kings Heath	N	1	2	4	1
Castle	N	2	1	8	3
St Alban	N	3	11	5	2
St Crispin	N	4	3	10	4
Lumbertubs	N	5	20	1	5
Thorplands	N	6	18	2	9
Links	N	7	13	6	8
Hill	D	8	41	3	7
Abbey North	D	9	15	11	6
Delapre	N	10	5	15	10
Billing	N	11	27	9	12
South	N	12	4	26	22
Brafield	S	13	10	31	13
St George	N	14	6	23	20
Abington	N	15	12	20	15

NEED - ranking for the need sub-model
HEALTH - ranking for the health status component
SOCECON - ranking for the social and economic disadvantage component
ENV - ranking for the environmental component

All of the most needy wards are located in the NDHA's main towns. It is clear that EDs and wards in Northampton have highest values of relative need. There are also obvious similarities in the rankings of components, reflecting the multiple nature of need. Dallington and Kings Heath is the highest ranked ward overall and it is also ranked very highly on the three components of the sub-model. However, not all wards follow this pattern. Lumbertubs, for instance, is ranked highly in terms of socio-economic disadvantage and environmental conditions yet the health status of its population is relatively good, suggesting that the population has more specific, rather than multiple, needs.

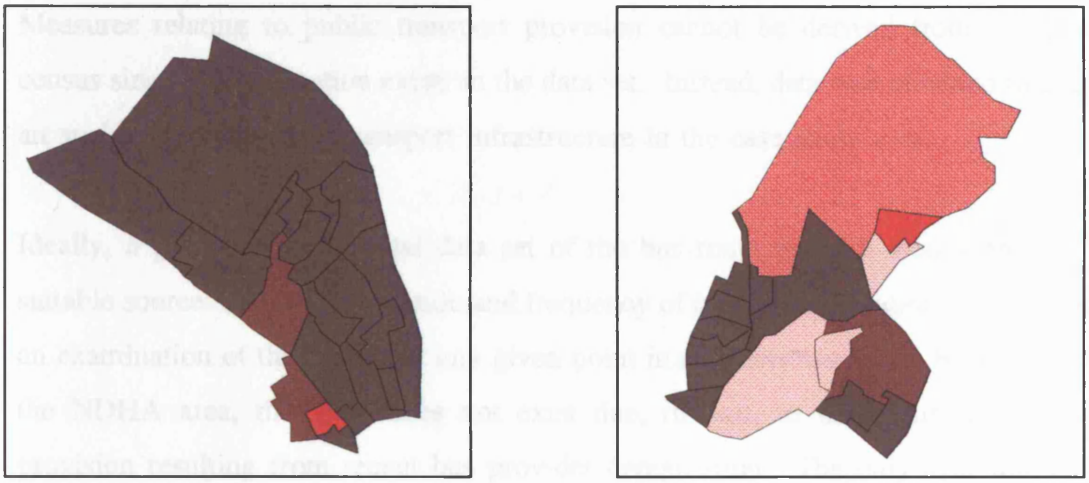
The ward comparison masks intra-ED variation and EDs in Dallington and Kings Heath also display a large range of composite need scores from -1.9 to 3.12 (the highest ED value in the NDHA area). However, even given this apparent difference, Map 6.18 Need composite score (ward)



virtually all EDs are in the top quintile of ranked values for the NDHA area. Map 6.19(a) shows the extent of high need scores in Dallington and Kings Heath and Map 6.19(b), by comparison, shows the greater intra-ward variation for Links. Despite this much greater variation, Links is ranked as the seventh most needy ward.

Map 6.19

(a) Need scores for Dallington and Kings Heath (b) Need scores for Links



3.12 - 0.99 | 0.98 - -0.19 | -0.20 - -0.79 | -0.80 - -1.16 | -1.17 - 2.43

High need scores = higher relative need 1:60000

6.6 MEASURING ACCESSIBILITY

Section 3.3 identified accessibility as a part of the utilization process. It can be measured by examining three components: transport availability, personal mobility and service awareness (Sections 3.3.1-3.3.3). The importance of these three factors as barriers to accessibility was strongly supported by the results of the patient survey (Chapter Five). It should be noted that distance to the surgery is not considered here, but is included as part of the assessment of provision (Section 4.7).

6.6.1 Measuring transport availability indicators

Public transport provision and availability of a private motor vehicle are two factors which have an impact on potential accessibility. In particular, accessibility difficulties are experienced where there is both poor public transport provision and a lack of access to a car (Section 3.3.1). Relatively poor transport provision in rural areas is countered to some extent by the increased access to a car (Section 5.7). Section 5.2 showed that the young and elderly, in particular, experience hindrance due to the method of transport. Furthermore, females tend to experience greater difficulty than males (Section 5.3).

Measures relating to public transport provision cannot be derived from the 1991 census since no information exists in the data set. Instead, data was obtained through an analysis of the public transport infrastructure in the case study area.

Ideally, a georeferenced digital data set of the bus route network would provide a suitable source. Origin, destination and frequency of service information would allow an examination of the service at any given point in the route network. However, for the NDHA area, this data does not exist due, in part, to uncoordinated service provision resulting from recent bus provider deregulation. The only available data source is standard timetables published by bus companies, coupled with sketch maps of the routes taken[1].

To derive a measure of availability, the spatial extent of the bus route network must first be determined. In the absence of a ready made digital version, two possibilities are available. The first option would be to add attributes relating to bus service provision to Bartholomews digital route network data. However, this data set was derived from 1:250000 scale mapping and does not provide an adequate resolution for urban areas (Section 6.3.3). Instead, the bus network was manually digitised from the published route maps. Routes were transcribed onto a 1:25,000 base map and then street centrelines were digitised. This created the bus route coverage, BUSROUTE,

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1 It should be noted that Northamptonshire County Council are currently attempting to coordinate bus service provision by creating their own GIS application. This will make use of Ordnance Survey EDLINE data coupled with a database of frequency of service. At the time of writing this was still very much at a conceptual stage although possibilities for data sharing may be available in the future.

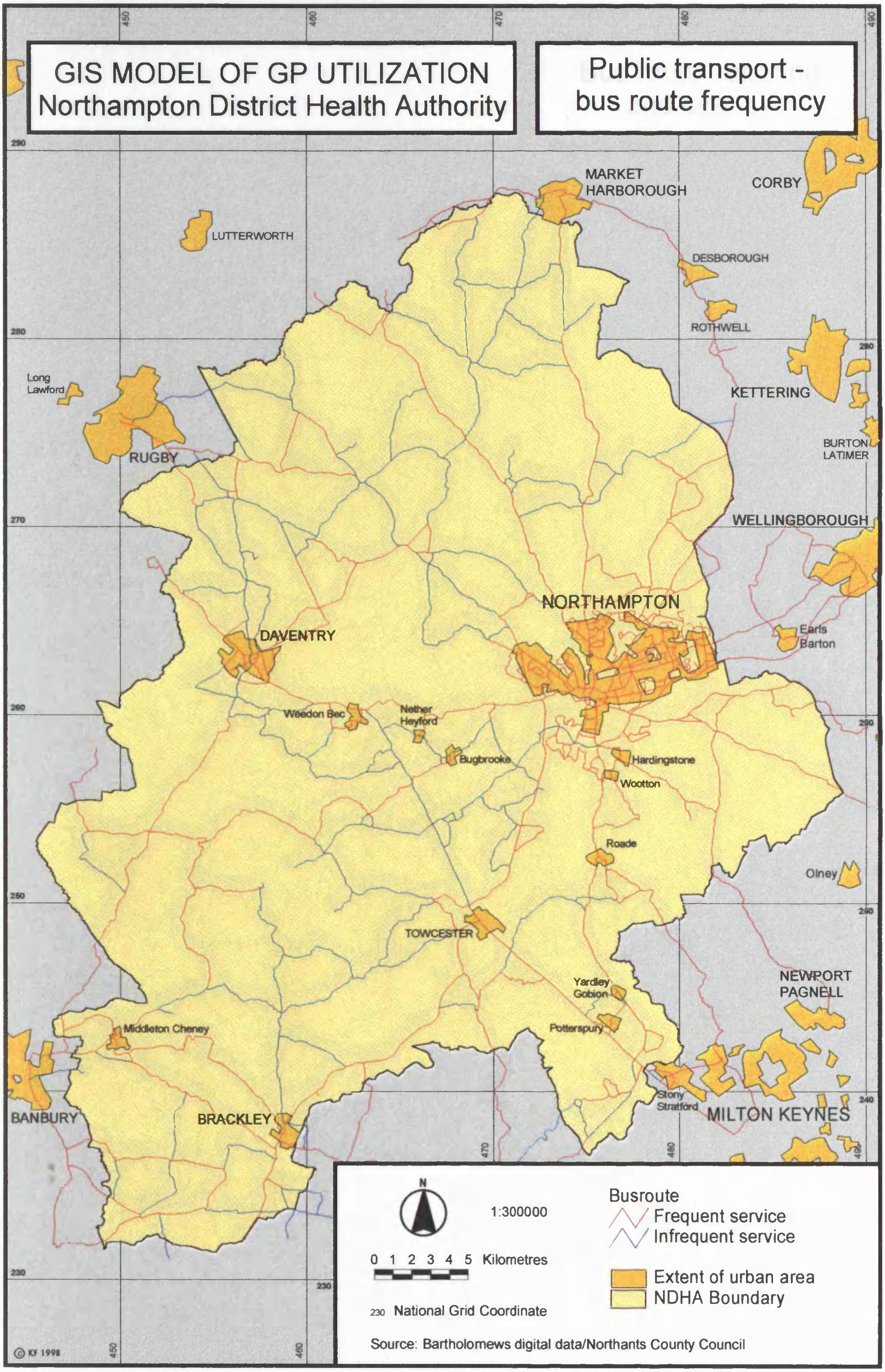
which was added to the spatial database (Appendix Four).

Frequency of service data was extracted from timetable information and added to the AAT of BUSROUTE. Northamptonshire County Council definitions of 'frequent' and 'infrequent' were used since it was not feasible to model the complexities of the entire bus timetable for each route segment. These definitions nevertheless allow bus routes to be weighted according to the level of service. Map 6.20 illustrates the digitised bus route network for the NDHA area and frequency of service.

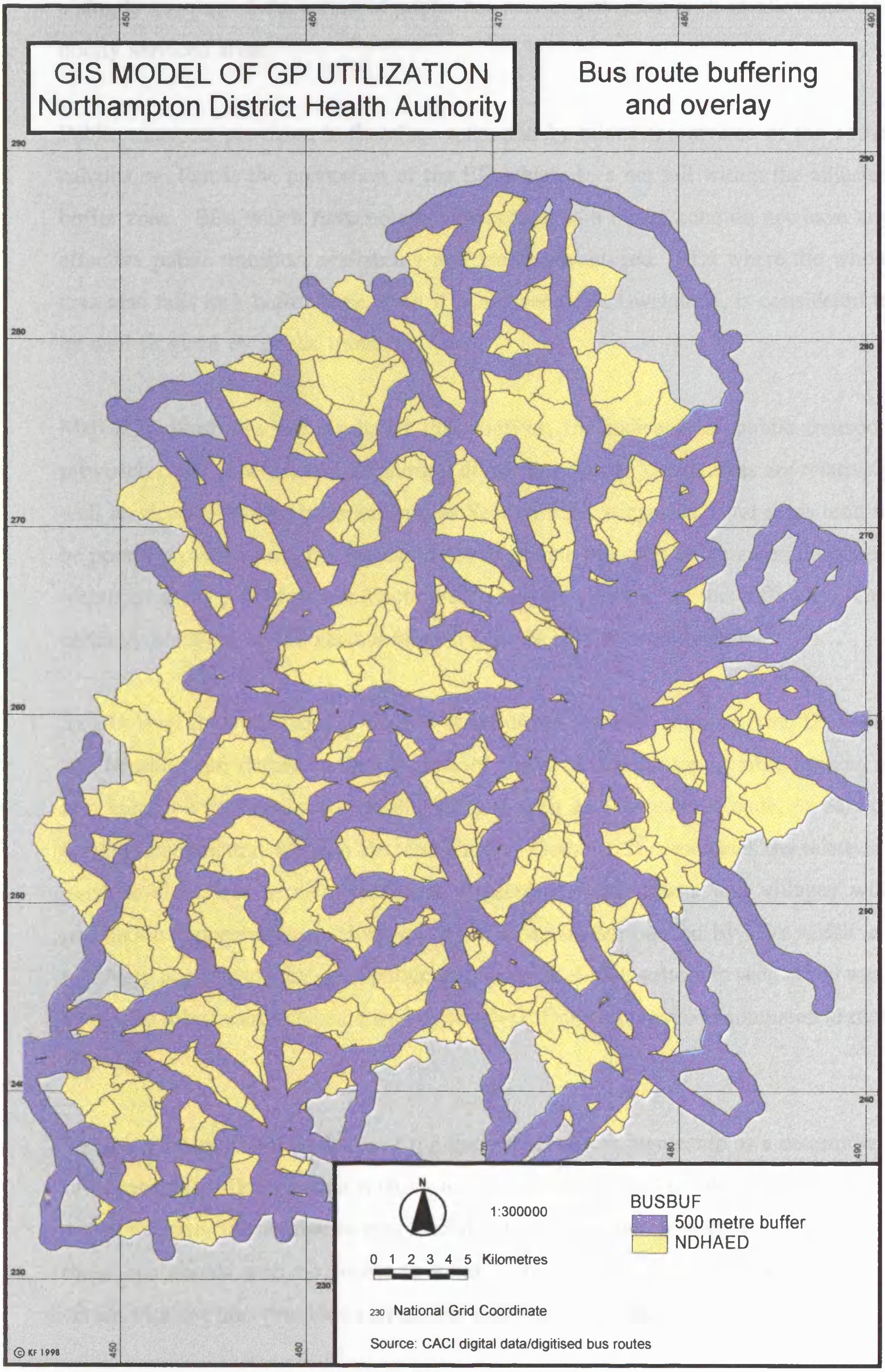
The conversion of this network data to be compatible with other ED based indicators in the model required two further stages of GIS manipulation. The first stage involved buffering BUSROUTE by 500 metres, to create BUSBUF, representing the area within an average walking distance to the bus route at any one point in the network. BUSBUF and the ED coverage NDHAED were then overlayed (using ARC/INFO's UNION command) to create a spatially joined coverage called BUSED (Map 6.21). From the attribute table of BUSED, the proportion of each ED which was also in the bus route network buffer zone was calculated. This provided a measure of the proportion of each ED with reasonable potential access to a bus route.

The second stage of the process calculated whether the bus route available to each ED was 'frequent' or 'infrequent'. This would normally involve line-in-polygon analysis to determine the characteristics of routes passing through EDs. However, it is not an appropriate method since some EDs may not have routes passing through them even though a proportion of their area is within 500m of a bus route. An alternative method was used based on examining the nearest bus route to each ED. The nearest bus route was established by calculating the nearest arc to each ED centroid using the ARC/INFO command NEAR. This determined whether the nearest service to each ED was 'frequent' or 'infrequent' and was then used to down-weight EDs with 'infrequent' service provision. Down-weighting was achieved by multiplying the proportions of ED which fall in the bus route buffer zone by 0.5 where the nearest bus route was 'infrequent'. This has the effect of reducing the availability of public transport in poorly serviced areas. Although an approximation, this method provides

Map 6.20 Public transport - bus route frequency



Map 6.21 Bus route buffered overlaying ED



a simple measure of the extent of public bus service provision with an allowance for poorly serviced areas.

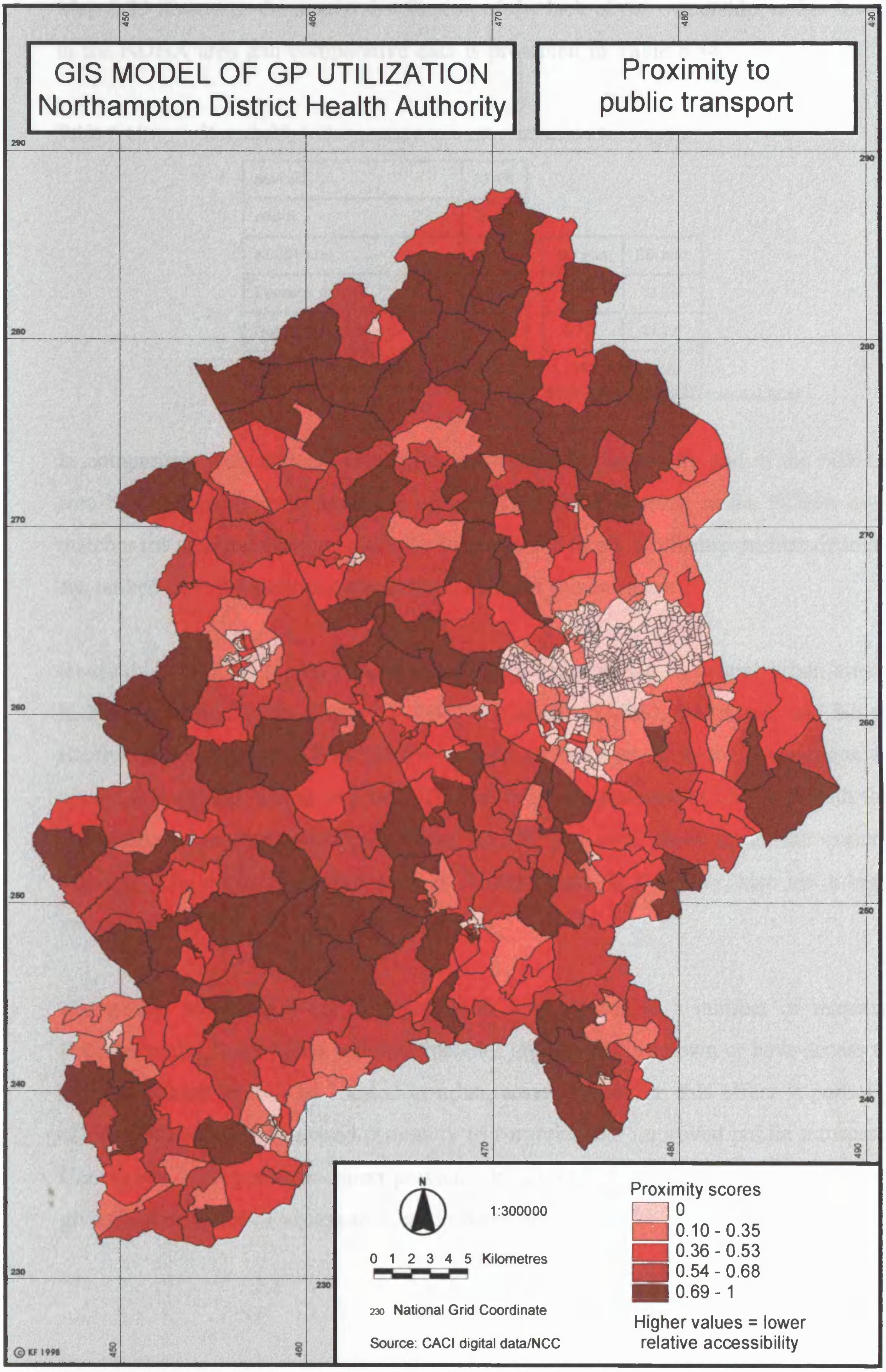
Public transport provision is therefore estimated by taking the inverse of the above calculation, that is the proportion of the ED which does not fall within the adjusted buffer zone. EDs which have no areal proportion in a buffer zone do not have any effective public transport availability and are disadvantaged. EDs where the whole area also falls in a buffer zone, even if it has been down-weighted, is considered to be well serviced by public transport.

Map 6.22 illustrates the results of this analysis, the indicator of public transport provision (A1). The general urban/rural divide is evident. Urban areas are relatively well serviced by public transport but, as Section 3.3.1 suggested, rural areas tend to be poorly provided for. The increased use of private transport at increased distances, identified in the patient survey (Section 5.7), may be indicative of this difficulty. This certainly seems to be the general trend for the NDHA area as a whole.

At ED level the vast majority of EDs in the urban areas of Northampton, Daventry and Brackley are ranked in the top 20% of EDs. A similar top quintile ranking is also achieved for smaller towns and villages such as Towcester, Roade, Middleton Cheney, Potterspury, Weedon Bec and Yardley Gobion. This indicates the relatively good level of bus service provision, targeted at those towns and villages with population concentrations. However, these areas are surrounded by EDs which are relatively poorly provided with public transport. A similar pattern is seen at the ward level with urban wards characterised by relatively frequent provision compared to rural wards.

Section 3.3.1 provided evidence of the importance of car ownership as a determinant of accessibility. Information relating to car ownership is available from the census which indicates the number of cars available per household. Importantly, it identifies those households with no access to a car. The proportion of households with no access to a car thus provides a measure of accessibility (A2).

Map 6.22 Proximity to public transport



Map 6.23 illustrates the spatial distribution of the lack of car ownership, at ED level, in the NDHA area and comparative data is presented in Table 6.14

Table 6.14 Households with no access to a car comparison (average)

		ED min	ED max
national	33.4%		
county	26.9%		
NDHA area	21.8%		
Daventry district	17.9%	0%	52.2%
Northampton Borough	31.2%	0.7%	83.2%
South Northants. district	16.4%	0%	50.0%

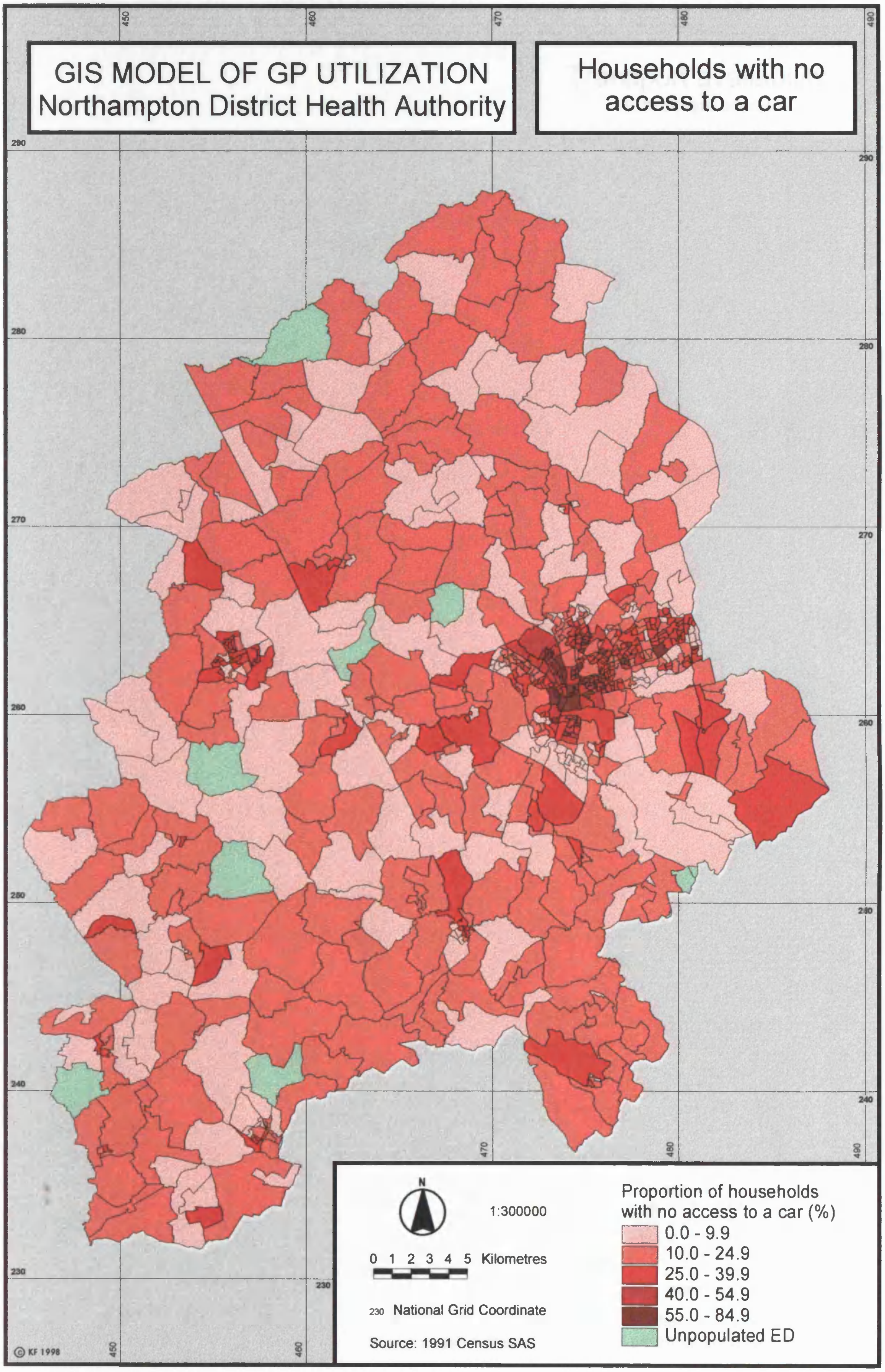
(Note: ED values exclude special EDs)

In comparison with national standards, households in the county and in the NDHA area have relatively high access to cars. None of the districts in the NDHA area matches the national average, and both Daventry and South Northamptonshire districts are ranked near the bottom on a national scale of this measure.

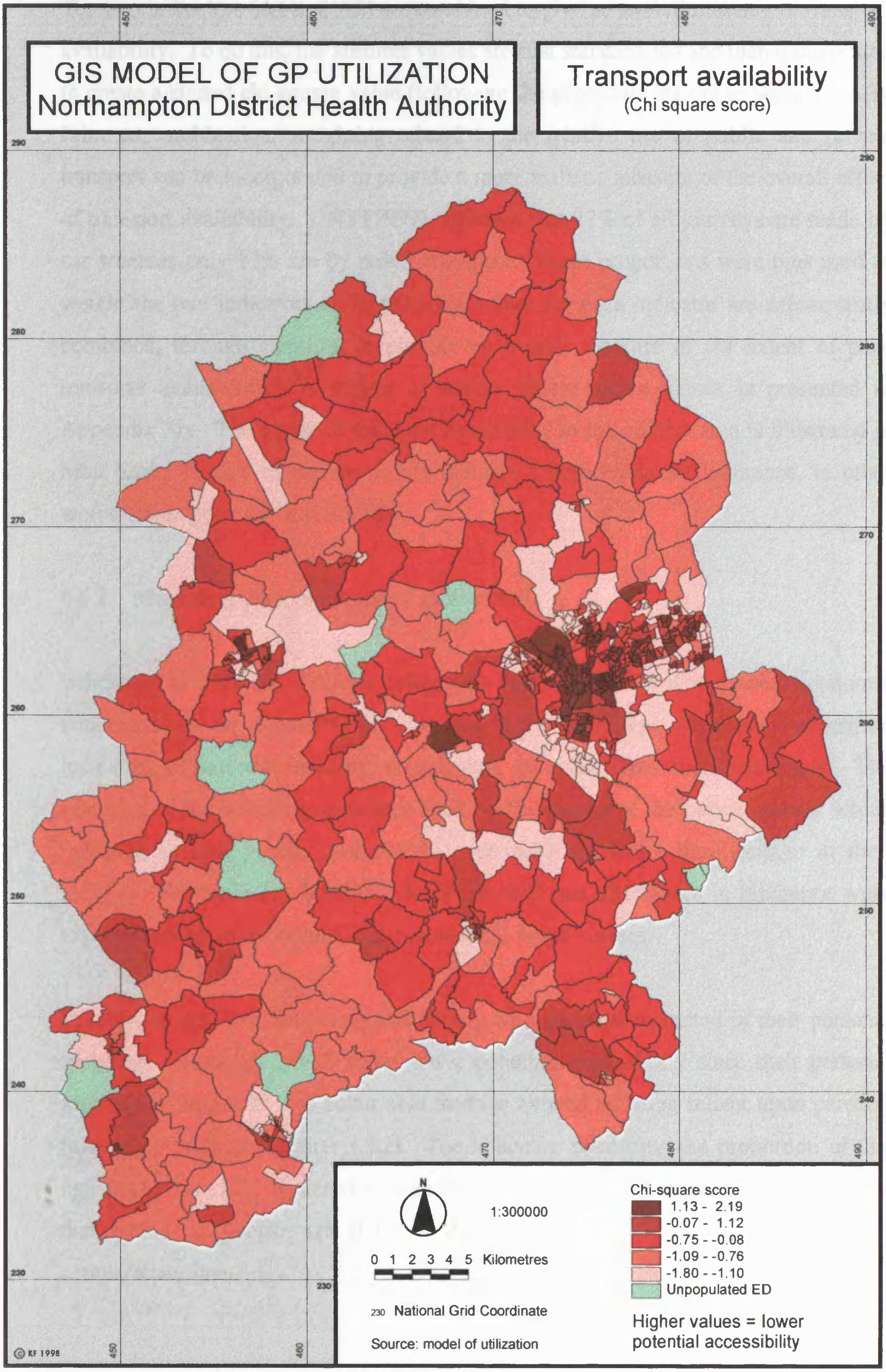
Households with no access to a car are largely concentrated in central urban areas. In Northampton district, Castle (57.0%), St Crispin (53.3%), Dallington and Kings Heath (50.2%) and St Alban (45.6%) wards all have much larger proportions of households without access to a car. This is further emphasised at ED level with the maximum value in Northampton being 83.2%, just over three times the county average. The centrally located ward of Abbey North, in Daventry, also has a high proportion (38.0%).

The poorer access to a car in urban areas may be due to a number of reasons. Fundamentally, households with low incomes are less likely to own or have access to a car and these tend to be located in urban areas. However, this effect is partially offset by benefits of increased proximity to surgeries and improved public transport. Conversely, poor public transport provision in rural areas may not be such a problem given higher levels of access to a car in these areas.

Map 6.23 Households with no access to a car



Map 6.24 Transport availability composite score



The two indicators (A1 and A2) are combined to give an overall measure of transport availability. To do this, the absolute values are first standardised and then transformed to create a signed chi-square value (following the procedure set out in section 6.4.3). Prior to combination, weighting related to the relative use of public and private transport can be incorporated to provide a more realistic measure of the overall effect of transport availability. ONS (1997) indicated that 87% of all journeys are made by car whereas only 13% are by public transport. These proportions were thus used to weight the two indicators. The resulting values for each indicator are subsequently combined, through addition, to provide an overall measure of the extent of poor transport availability. A matrix of results of chi-square values is presented in Appendix Six. The extent of transport availability in the NDHA area is illustrated in Map 6.24. Higher chi-square values indicate a higher relative hindrance, in other words lower potential accessibility.

6.6.2 Measuring personal mobility indicators

Indicators of personal mobility reflect the effect of personal and socio-economic circumstances on accessibility. Section 3.3.2 identified three socio-economic indicators of personal mobility: namely age, parental status and social class. The selection of these indicators is supported by the results of the patient survey which indicated that the young and elderly experience a relative disadvantage in their mobility (Section 5.2). Section 5.4 also showed that differences in hindrance were experienced between manual and non-manual social classes.

In terms of age, it is the young and elderly who are most restricted in their personal mobility. Those aged 0-15 suffer lower potential accessibility since their personal mobility is limited by not being able to drive as well as being reliant upon parental time-space budgets (Section 3.3.2). The indicator, measuring the proportion of this age group per ED, is derived from the census (A3). Map 6.25 illustrates the distribution of people age 0-15 in the NDHA area and Table 6.15 provides comparative data.

Map 6.25 Age 0-15

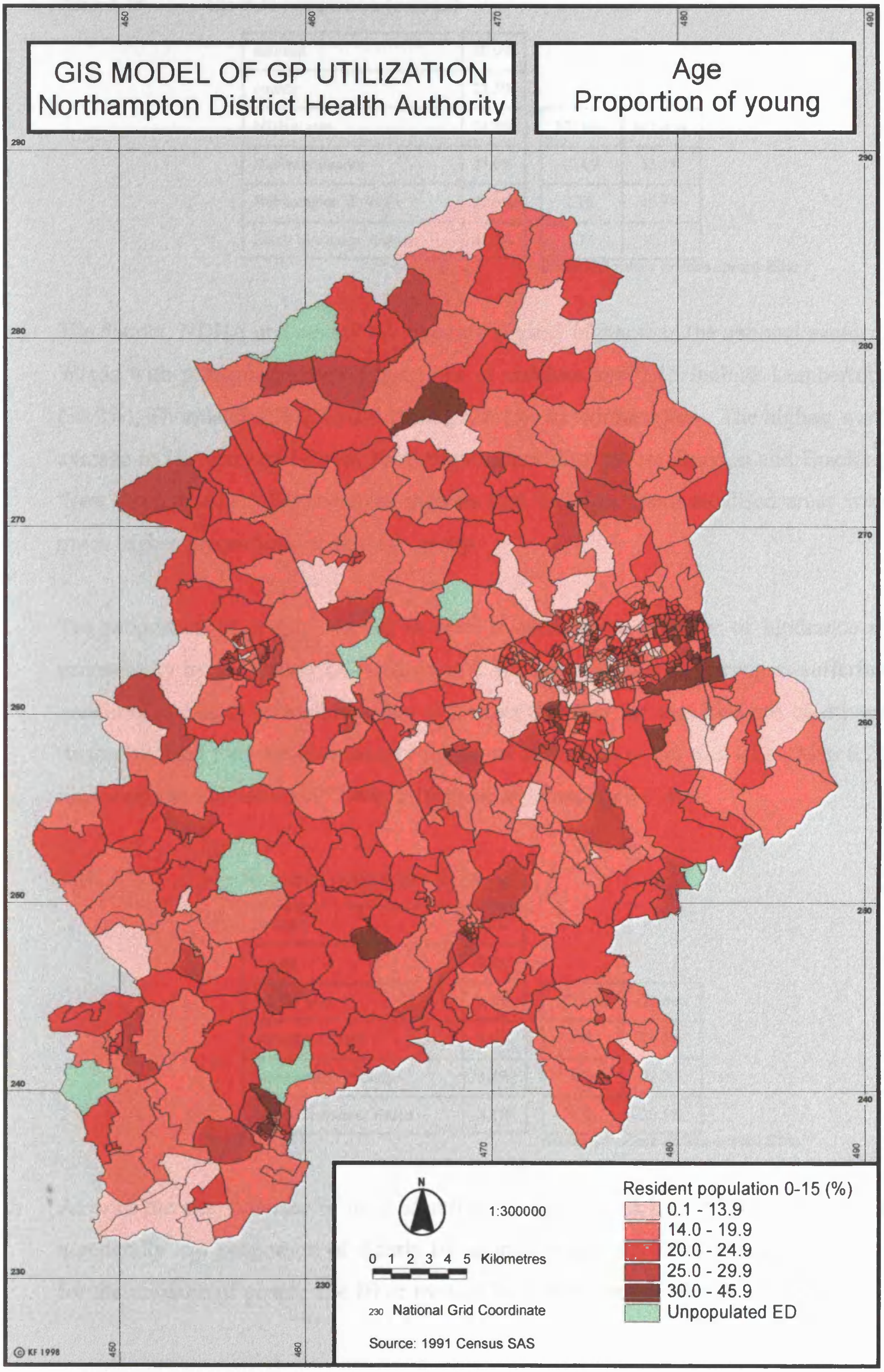


Table 6.15 Age 0-15 comparison (average)

			ED min	ED max
national	20.0%			
county	21.5%			
NDHA area	21.5%		ED min	ED max
Daventry district	21.0%		10.4%	33.9%
Northampton Borough	21.9%		2.7%	45.9%
South Northants. district	21.7%		2.7%	38.7%

(Note: ED values exclude special EDs)

The district, NDHA and county averages are slightly higher than the national average. Wards with particularly high proportions of children age 0-15 include Lumbertubs (30.2%), Thorplands (28.2%) and Billing (28.1%) in Northampton. The highest ward average in Daventry and South Northamptonshire districts are Drayton and Brackley West (both 25.8%). ED averages indicate that there are more localised areas with much higher proportions of this age group.

The proportion of people age 80 or over is used as an indicator of hindrance to accessibility by the elderly (A4). Section 3.3.2 identified this age group as suffering greater obstacles to accessibility due to the fact that they are less likely to be drivers themselves and they are increasingly reliant on assistance to get to a GPs. Map 6.26 illustrates the indicator and Table 6.16 provides comparative data.

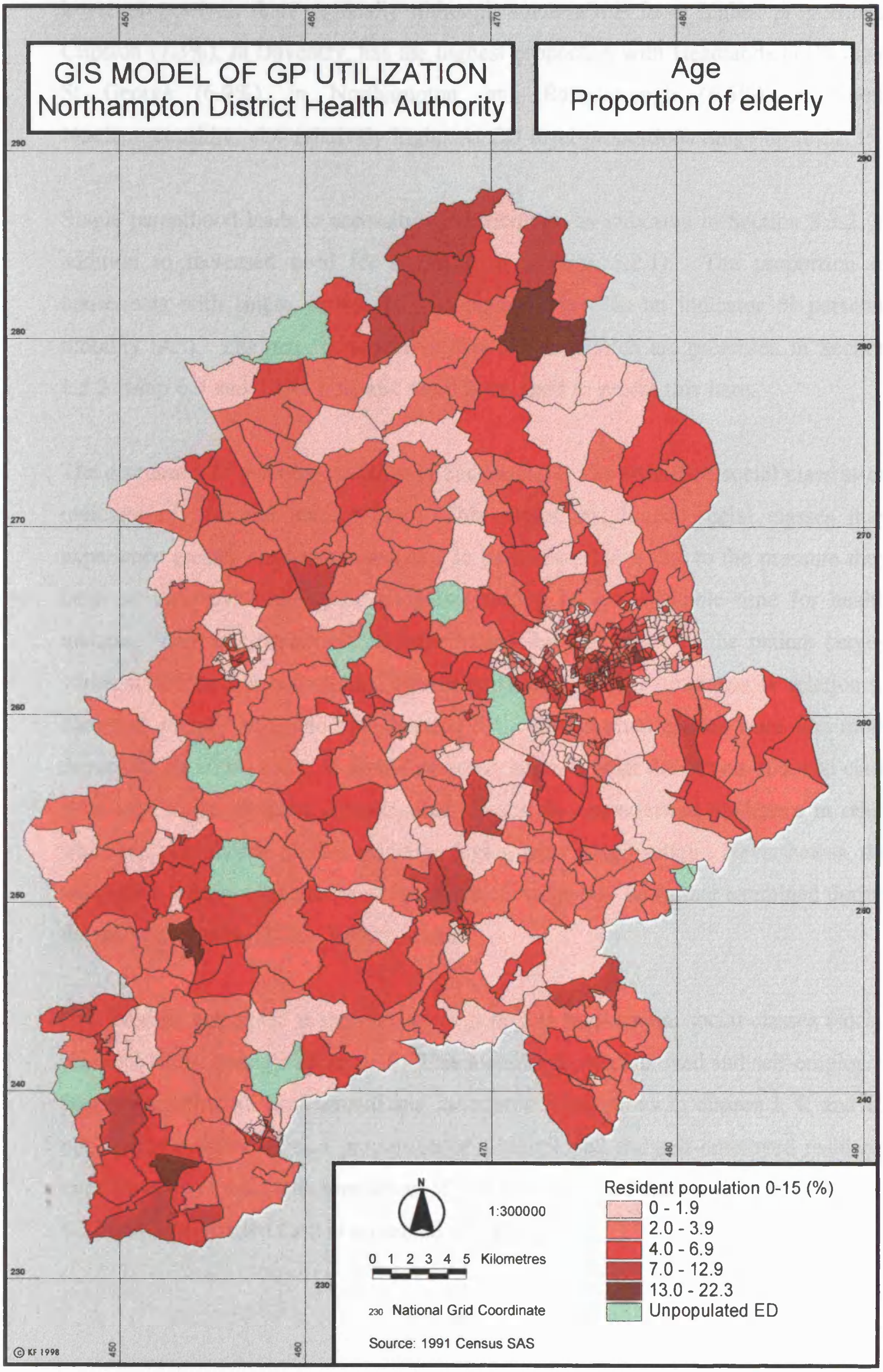
Table 6.16 Age 80 or over comparison (average)

national	3.7%			
county	3.3%			
NDHA area	3.2%		ED min	ED max
Daventry district	3.0%		0%	20.8%
Northampton Borough	3.3%		0%	22.3%
South Northants. district	3.2%		0%	20.5%

(Note: ED values exclude special EDs)

As with the age indicator of need identified in Section 6.5.1, Northamptonshire has a generally low proportion of elderly by national standards. This is equally evident for the measure of people age 80 or over. The districts in the NDHA area all exhibit

Map 6.26 Age 80 or over



lower proportions than nationally although some wards have higher proportions. Clipston (7.3%), in Daventry, has the highest proportion with Headlands (7.0%) and St George (6.9%), in Northampton, and Rainsborough (6.6%), in South Northamptonshire, also relatively high. At ED level proportions range up to 22.3%.

Single parenthood leads to accessibility difficulties, as indicated in Section 3.3.2, in addition to increased need for health care (Section 3.2.1). The proportion of households with single parents is thus included here as an indicator of personal mobility (A5). The map, comparative data and discussion are presented in Section 6.5.2 (Map 6.9 and Table 6.6) and there is no need to repeat this here.

The discussion of personal mobility in Section 3.3.2 also identified social class as an indicator of potential accessibility. This shows that higher social classes may experience greater obstacles to access. In particular, this is due to the pressure they have on their own time-space budgets resulting in less available time for health matters. This was supported, to some extent, by the results of the patient survey which indicated that non-manual classes experience greater hindrance in relation to transport, journey time and cost (Section 5.4). Non-manual classes were also more dependent on home visits. It should be noted, however, that the effects of social class were seen to be complex, since manual classes also experienced hindrance in other ways and non-manual classes exhibited higher rates of utilization. Nevertheless, the measure is worthy of inclusion at this stage, its value will be further examined during the sensitivity analysis in Chapter Seven.

The measure calculated is the number of people in non-manual social classes (social classes I-IIIN), giving indicator A6. This includes those employed and self-employed people including all professional and associated occupations in classes I, II and III non-manual, expressed as a proportion of all employed and self-employed residents over 16 years of age. The proportion of non-manual social class is illustrated in Map 6.27 and comparative data is presented in Table 6.17.

Map 6.27 Non-manual social class

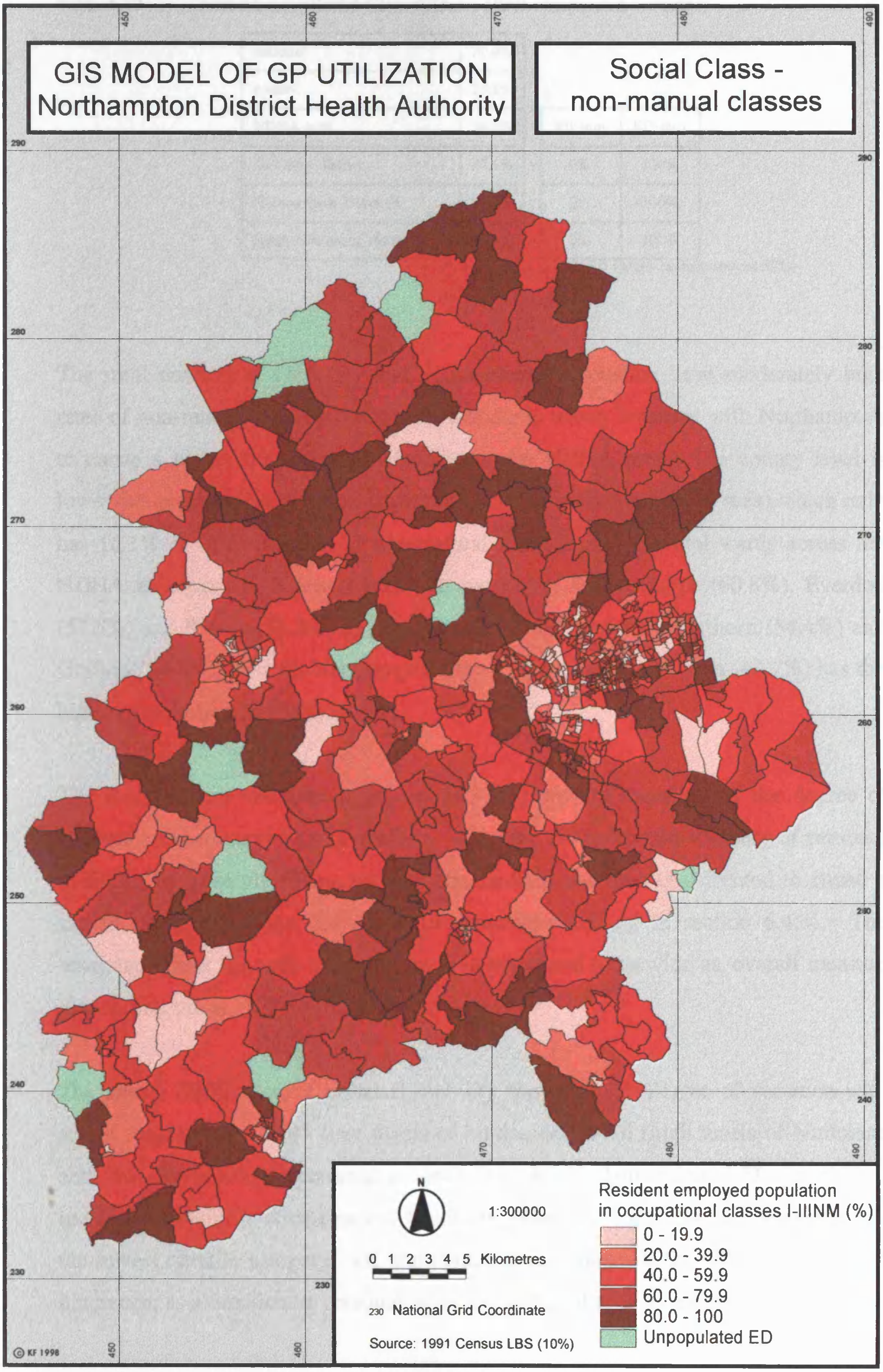


Table 6.17 Non Manual Social Class (Class I-IIIN) comparison (average)

			ED min	ED max
national	30.0%			
county	29.8%			
NDHA area	34.6%		ED min	ED max
Daventry district	37.1%		0%	100%
Northampton Borough	28.8%		0%	100%
South Northants. district	38.0%		0%	100%

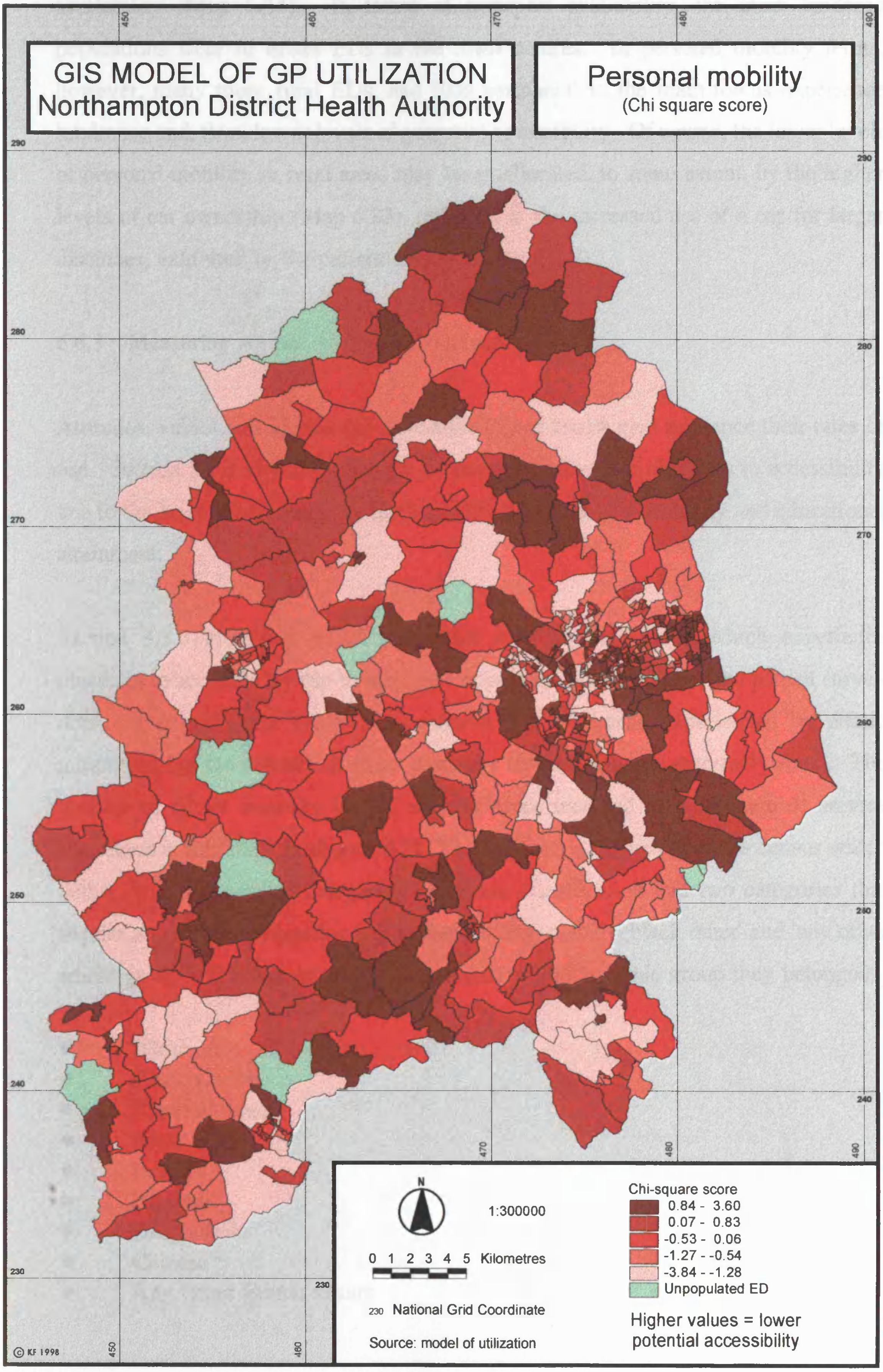
(Note: ED values exclude special EDs)

The rural districts of Daventry and South Northamptonshire have moderately high rates of non-manual classes by national standards which balances with Northampton to create a higher than national average for the NDHA area. The county level is lower due predominantly to the district of Corby (outside the NDHA area) which only has 16.1% of its population in non-manual occupations. Several wards across the NDHA area have high proportions. In particular, Ravensthorpe (60.8%), Everdon (57.5%) and Kilsby (56.3%) in Daventry and Tove (54.6%), Kingthorn (54.4%) and Grafton (53.6%) in South Northamptonshire. The ward of Abington (42.7%) has the highest proportion in Northampton.

The four personal mobility indicators (A3-A6) provide measures of the degree of hindrance experienced in accessibility. To create the composite measure of personal mobility, the absolute values are first standardised and then transformed to create a signed chi-square value (following the procedure set out in section 6.4.3). The resulting values for each indicator are then combined to provide an overall measure of personal mobility (Map 6.28).

The spatial distribution of personal mobility shows a high degree of variation with scores ranging from -3.84 (low levels of hindrance) to 3.6 (high levels of hindrance and, thus, lower relative potential accessibility). Both urban and rural EDs are ranked in the upper quintile of categories. Similarly, urban and rural EDs are categorised in the lowest quintile category. Of importance here, though, is the difference between hindrance, as a function of personal mobility, and hindrance as a function of transport

Map 6.28 Personal mobility composite score



availability (Map 6.24). In terms of transport availability, the most hindered populations were in urban EDs in the town centres. In personal mobility terms, however, many more rural EDs, and EDs peripheral to the main towns experience hindrance and, thus, lower levels of potential accessibility. Of course, the lower levels of personal mobility in rural areas may be ameliorated, to some extent, by the higher levels of car ownership (Map 6.23), reflected in the increased use of a car for larger distances, exhibited in the patient survey (Section 5.7).

6.6.3 Measuring service awareness indicators

Attitudes, values and knowledge of availability of health care influence their rates of use. Section 3.3.3 identified two main factors which create obstacles to accessibility due to the level of awareness of service availability: namely ethnicity and educational attainment.

Section 3.3.3 identified ethnic minorities as a societal group which experience obstacles to accessibility due to linguistic or cultural impediments. The patient survey does not provide any evidence to support any hindrance experienced by ethnic minorities, but the number of ethnic minority respondents was extremely small. The number of ethnic minority people was therefore included as a measure of service awareness at this stage (indicator A7). The measure is derived from the census which defines seven pre-coded categories for ethnic classification and two categories that require a descriptive response and further coding, namely 'black other' and 'any other ethnic group'. The census asked respondents to which ethnic group they belonged:

- White
- Black-Caribbean
- Black-African
- Black other
- Indian
- Pakistani
- Bangladeshi
- Chinese
- Any Other Ethnic Group

Map 6.29 illustrates the proportion of ethnic minority (all responses other than white) for the NDHA area and Table 6.18 provides comparative data.

Table 6.18 Ethnic minority comparison (average)

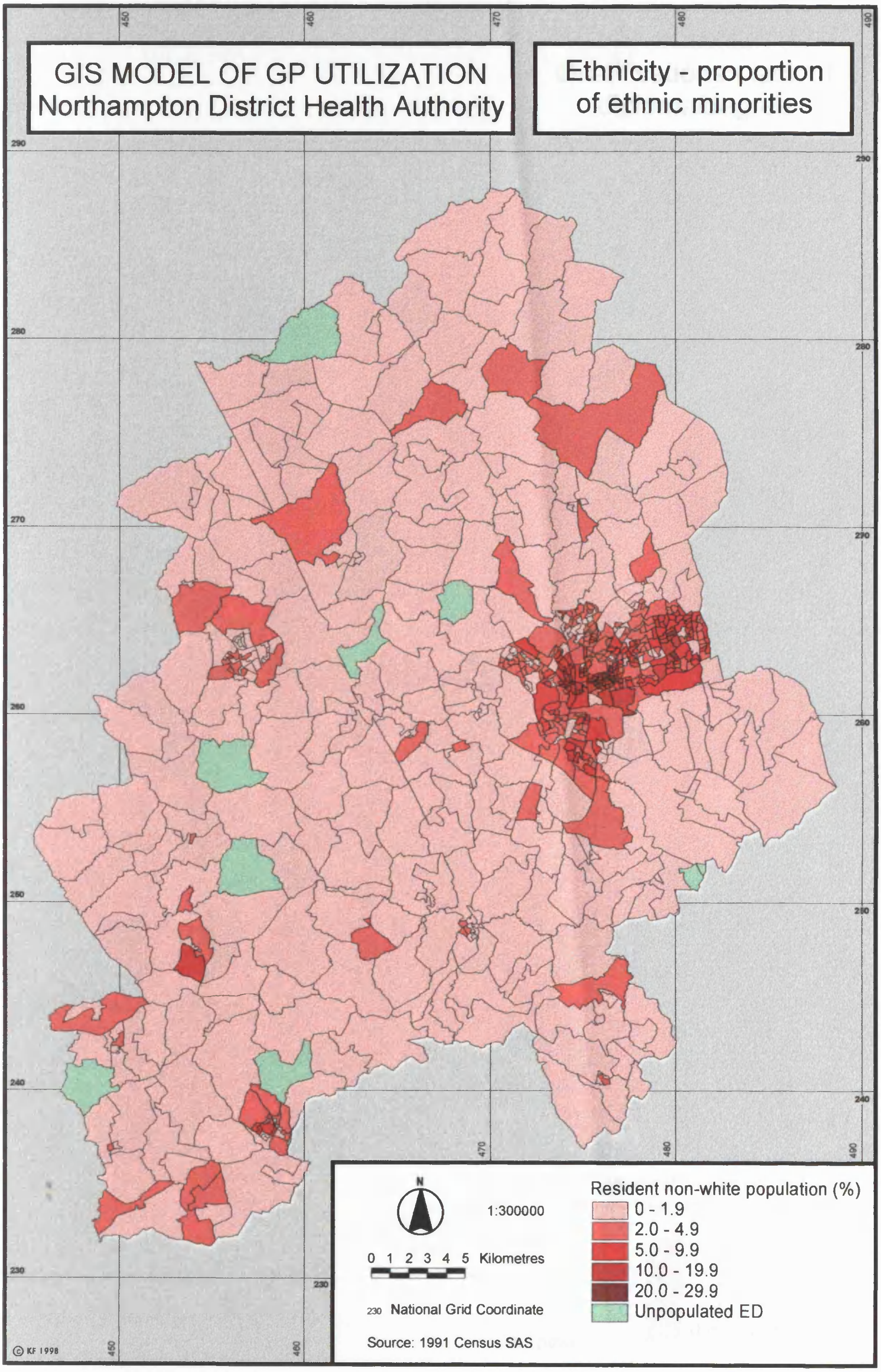
		ED min	ED max
national	5.5%		
county	3.5%		
NDHA area	1.3%		
Daventry district	0.8%	0%	6.7%
Northampton Borough	5.9%	0%	29.0%
South Northants. district	1.3%	0%	8.0%

(Note: ED values exclude special EDs)

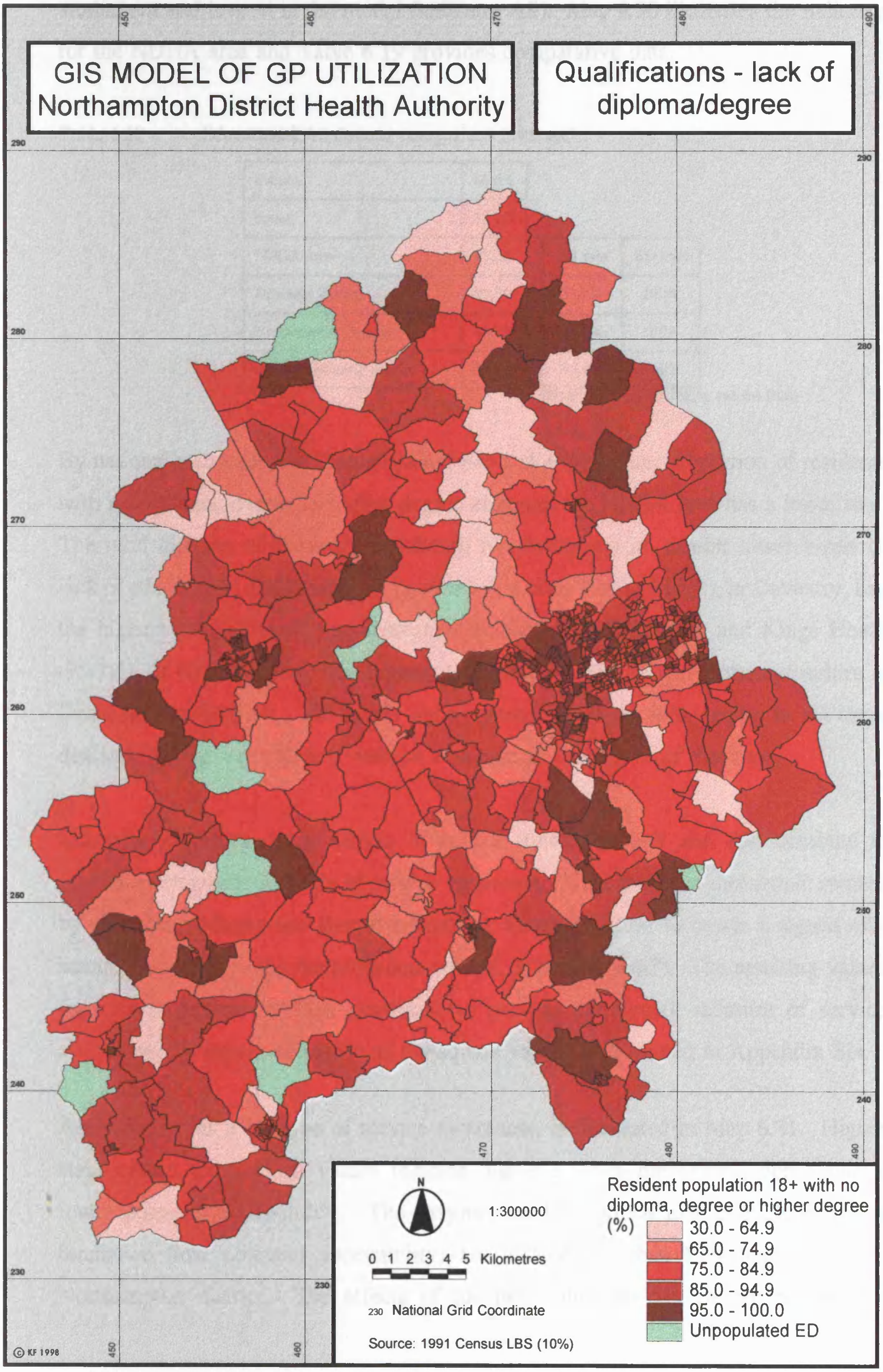
In Northamptonshire, ethnic minority groups are concentrated almost entirely in urban areas with the largest proportions being resident in Northampton (and Wellingborough, outside the NDHA area). Averages at county and district level are low by national standards. Only a few wards in the NDHA exhibit rates of over 10% and these are all in Northampton district. St Crispin (19.4%) is the highest which is almost double the next highest ward, Abington (11.2%). Lumbertubs (10.2%) is the only other ward with a proportion greater than 10%. Rates in Daventry and South Northamptonshire are much lower. The ward with the highest rate in South Northamptonshire is Brackley West (4.2%) and, in Daventry, Drayton (2.4%). Rural wards typically have levels of less than 1%. The concentration of ethnic minorities in urban areas is further emphasised at ED level: the highest ED rate of 29.0% is found in Northampton.

Differences in potential accessibility, based on service awareness, are also measurable by identifying different levels of educational attainment (Section 3.3.3). Lower educational attainment leads to lower service awareness. The census provides information relating to post-compulsory educational attainment, in particular the award of diplomas, degrees and higher degrees. Although information relating to school attainment may be of greater benefit (Section 3.3.3), such data are not available from the census and alternative sources do not provide much detail below district levels of aggregation. The proportion of people who have not gained a diploma, degree or higher degree therefore provides the best available measure of lack of educational

Map 6.29 Ethnic minority



Map 6.30 Educational attainment



attainment and is used in the model (indicator A8). Map 6.30 illustrates the indicator for the NDHA area and Table 6.19 provides comparative data.

Table 6.19 Educational Attainment comparison (average)

		ED min	ED max
national	86.6%		
county	88.1%		
NDHA area	85.2%		
Daventry district	83.7%	33.3%	100%
Northampton Borough	88.7%	47.2%	100%
South Northants. district	83.2%	33.3%	100%

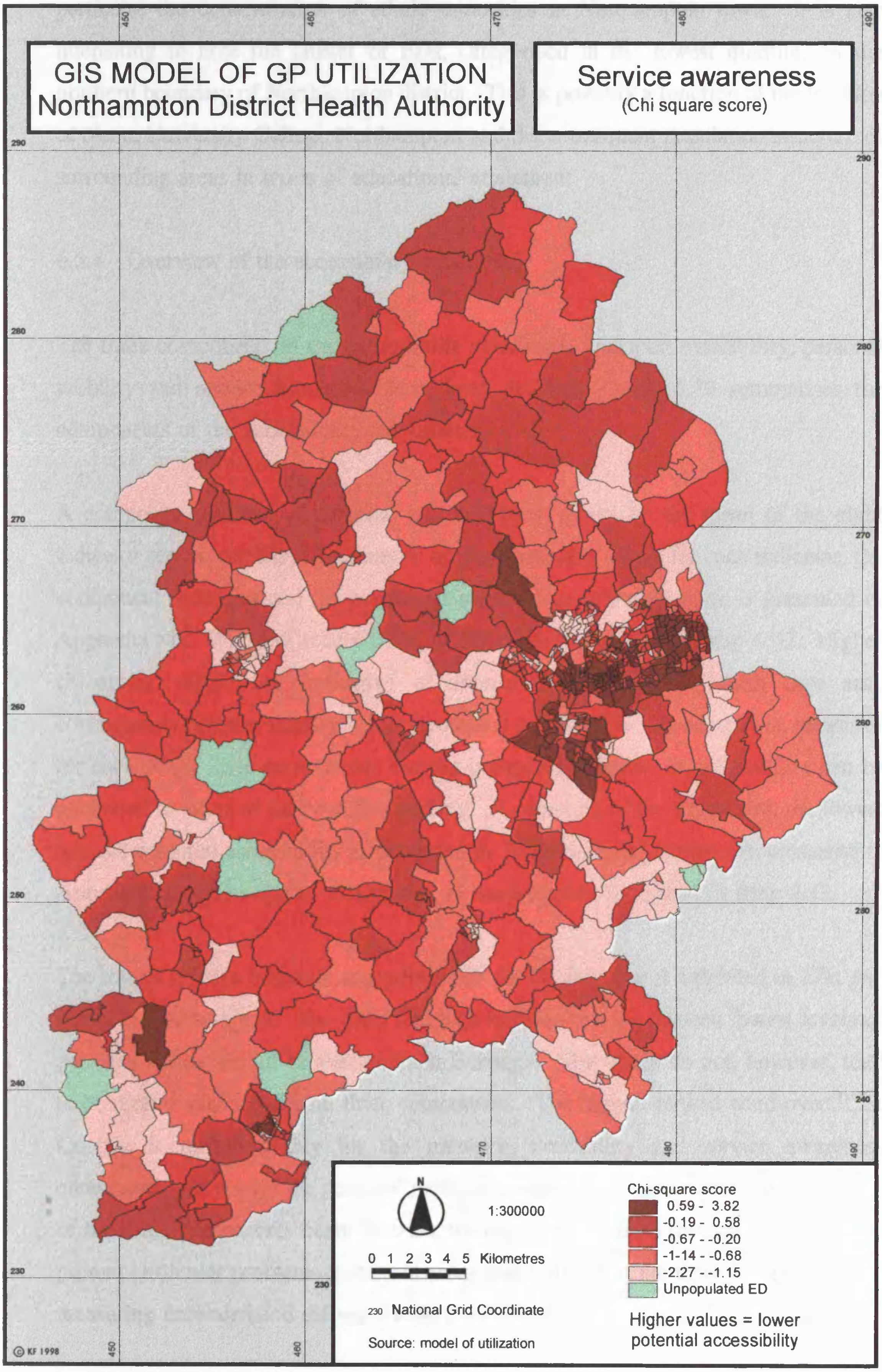
(Note: ED values exclude special EDs)

By national standards, Northamptonshire has a slightly higher proportion of residents with no diploma, degree or higher degree although the NDHA area has a lower rate. The rural districts of Daventry and South Northamptonshire exhibit lower levels of lack of educational attainment. At ward level, Abbey North (96.8%), in Daventry, has the highest proportion of non-attainment followed by Dallington and Kings Heath (95.7%), in Northampton. The highest rate for a ward in South Northamptonshire is Deanshanger (94.0%). ED levels show greater variation with some, in all three districts, having a population with no educational attainment of this type.

The two indicators of the effects of service awareness (A7 and A8) combine to provide a composite measure of service awareness. The composite measure is created by first standardising and then transforming absolute values to create a signed chi-square value (following the procedure set out in Section 6.4.3). The resulting values for each indicator are then combined to provide the overall measure of service awareness. A matrix of results of chi-square values is presented in Appendix Six.

Accessibility, as a function of service awareness, is illustrated in Map 6.31. Higher standardised transformed values indicate higher relative hinderance, consequently lower potential accessibility. The majority of EDs which exhibit high levels of hindrance (low potential accessibility) are located in urban EDs, particularly in Northampton district. The effects of the two indicators can clearly be seen; in

Map 6.31 Service awareness composite score



particular the concentration of ethnic minorities in Northampton town. It is also interesting to note the cluster of EDs, categorised in the lowest quintile, on the northern boundary of Northampton district. This is possibly a function of the location of Nene, University College Northampton and the consequent population structure of surrounding areas in terms of educational attainment.

6.6.4 Overview of the accessibility sub-model

The three components of the accessibility sub-model, transport availability, personal mobility and service awareness have been defined. Table 6.20 summarises the components of the accessibility sub-model.

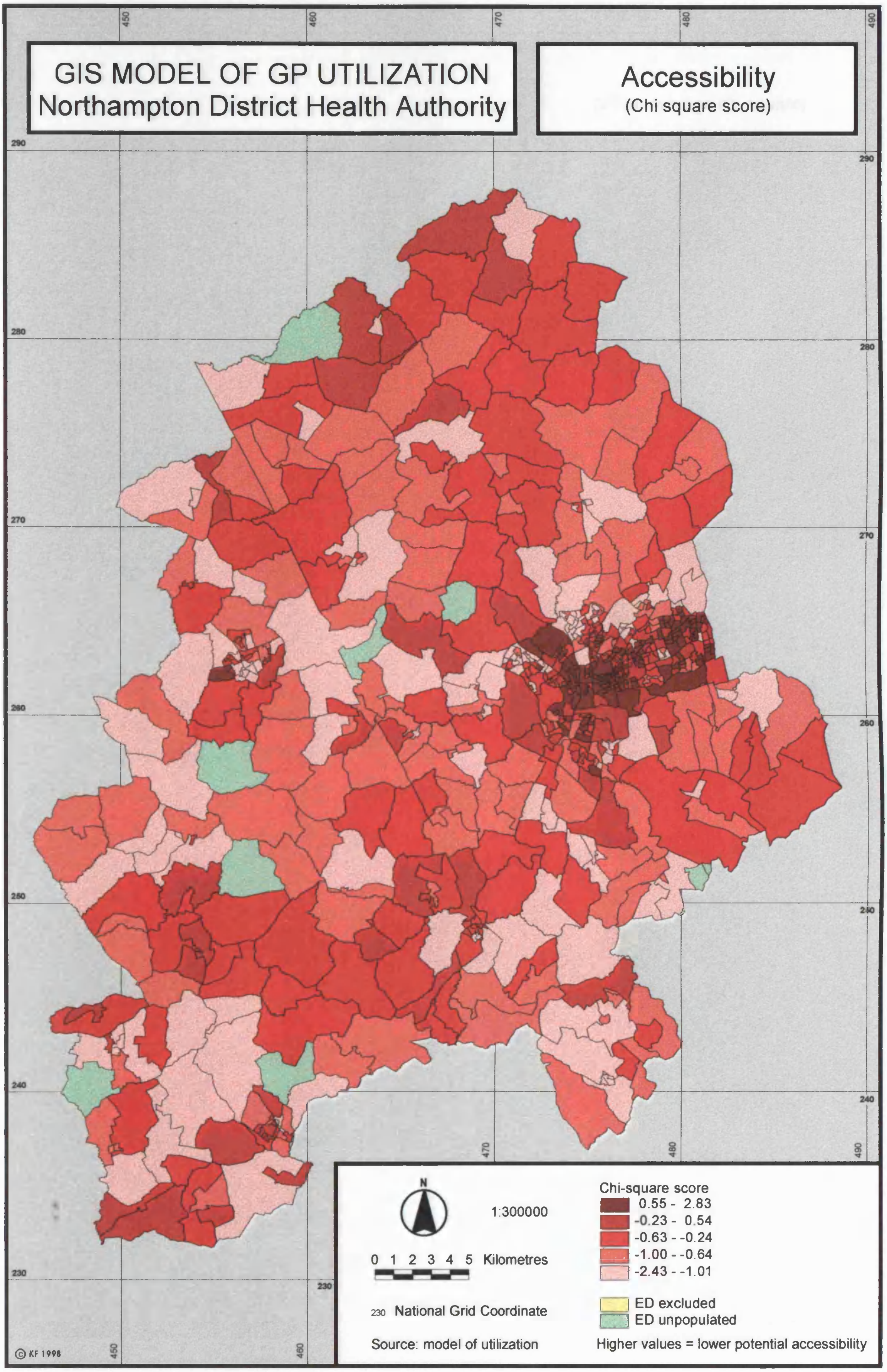
A composite measure of potential accessibility is given by the mean of the eight indicator scores, per ED. A summary of the chi-square values for each indicator, the component measures and the composite potential accessibility score is presented in Appendix Six. Potential accessibility, at ED level, is presented in Map 6.32. Higher chi-square values are indicative of increased obstacles to health care and, consequently, a lower relative level of potential accessibility. At ward level, measures for each of the three components and the composite measure of accessibility can be compared in terms of their relative ranking. A summary of the wards with the lowest relative potential accessibility is presented in Table 6.21; full results are presented in Appendix Six. The spatial distribution at ward level is illustrated in Map 6.33.

The lowest relative potential accessibility in the NDHA area is exhibited in EDs and wards in Northampton. The ward rankings indicate that the thirteen lowest levels of potential access are all in Northampton Borough. The wards do not, however, tend to be ranked similarly for all three components. The highest ranked ward overall, St Crispin, is ranked highly for the transport availability and service awareness components but not for the personal mobility measures. Similar variations in ranking of the three components occur in other wards. This suggests that specific obstacles present particular problems in certain areas and shows that the three components are measuring unrelated and different aspects of accessibility.

Table 6.20 Summary of the accessibility sub-model

Sub-model	Component	Indicator		Definition (calculated using absolute values)
Accessibility	Transport availability	Public transport	A1	Lack of access to public transport
		Private transport	A2	Households with no access to a car
	Personal mobility	Young population	A3	Population 0-15
		Elderly population	A4	Population 80 or over
		Single parenthood	A5	Single parent households
		Social Class I-IIIN	A6	Occupational social classes I-IIIN
	Service awareness	Ethnicity	A7	Ethnic minority population
		Educational attainment	A8	Low educational attainment

Map 6.32 Accessibility composite score (ED)



Map 6.33 Accessibility composite score (ward)

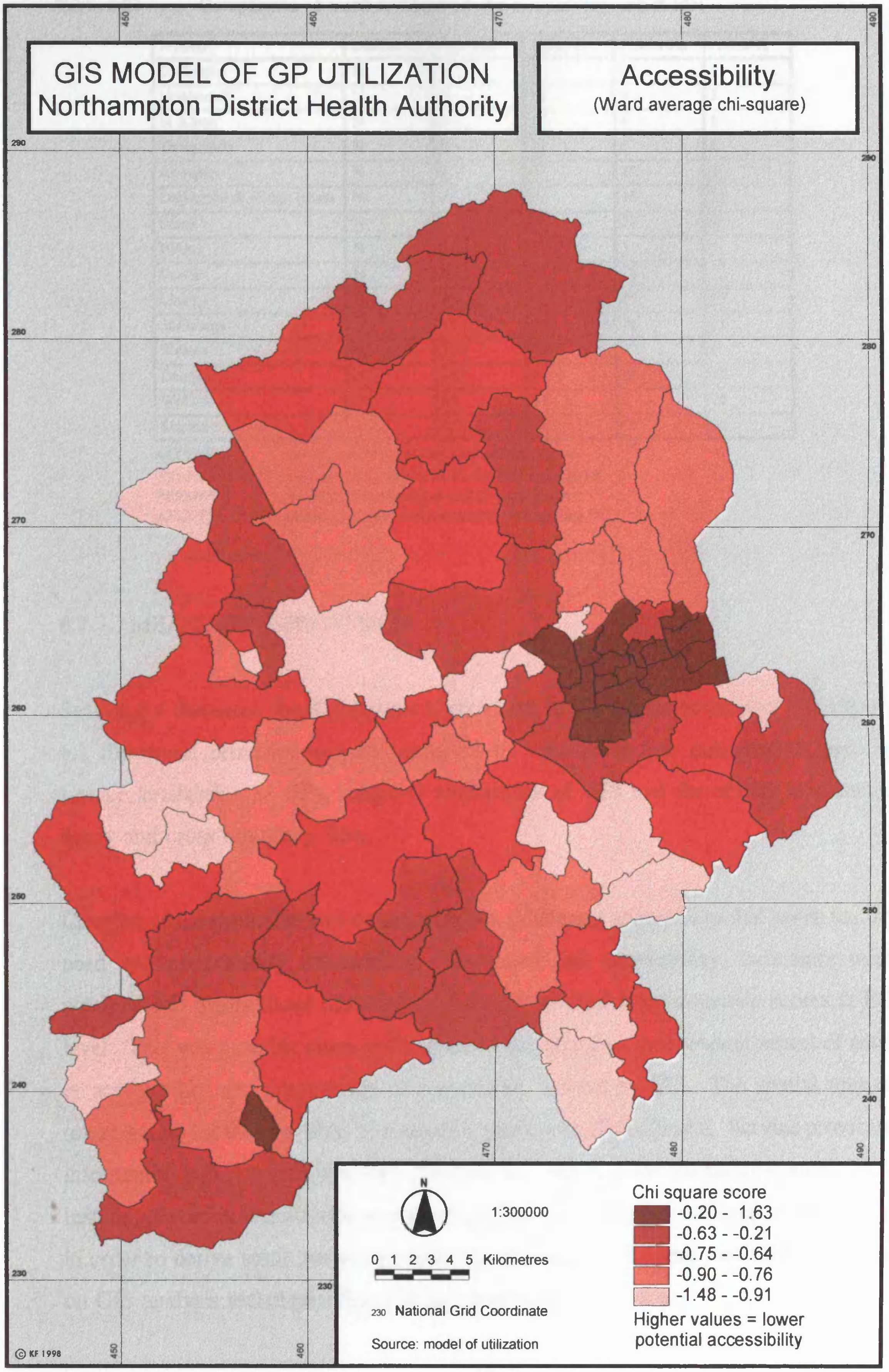


Table 6.21 Comparison of ward rankings for the accessibility sub-model

WARD	DISTRICT	ACCESS	TRANSP	PERMOB	AWARE
St Crispin	N	1	2	63	1
Lumbertubs	N	2	12	4	3
St Alban	N	3	4	6	8
Thorplands	N	4	13	3	6
Abington	N	5	9	32	2
Dallington & Kings Heath	N	6	3	16	12
South	N	7	7	27	5
Billing	N	8	20	1	9
Castle	N	9	1	70	7
Links	N	10	8	14	19
St George	N	11	11	18	13
Weston	N	12	69	26	4
Delapre	N	13	6	45	18
Welford	D	14	54	2	25
Slapton	S	15	32	7	32

ACCESS - ranking for the composite accessibility score
TRANSP - ranking for the transport availability component
PERMOB - ranking for the personal mobility component
AWARE - ranking for the service awareness component

6.7 MEASURING PROVISION

Section 3.4 discussed the dimensions of provision in the utilization process. As Figure 6.1 illustrates, provision can be modelled by measuring four components, namely service availability of GPs, temporal availability of GPs and the effects of distance decay and cross-boundary flow.

Creation of the provision sub-model requires a different approach to that taken for the need and accessibility sub-models. For need and accessibility, indicators were obtained and manipulated discretely and then combined into composite scores at ED level. This was possible since each indicator measured an independent aspect of need or accessibility and comparable data could be derived by ED. The spatial unit of investigation for the provision sub-model is fundamentally different. Service provision information is not readily available for EDs or, indeed, other identifiable areal units. Instead, provision is defined at a point of supply. This requires different manipulation in order to derive measures comparable with the other indicators, and relies far more on GIS analysis techniques than the previous two sub-models.

6.7.1 Measuring surgery availability (stage 1)

The location of surgeries clearly has more of an impact upon some people more than others by virtue of their relative proximity. Indeed, the patient survey revealed that regularity of consultation decreased with increasing distance between patient and surgery (Section 5.7). Additionally, the location of the surgery, and associated cost of travelling to the surgery, were increasingly reported as a hindrance with increasing distance (Section 5.7). Increased distances also seemed to affect the elderly more severely than other age groups (Section 5.2).

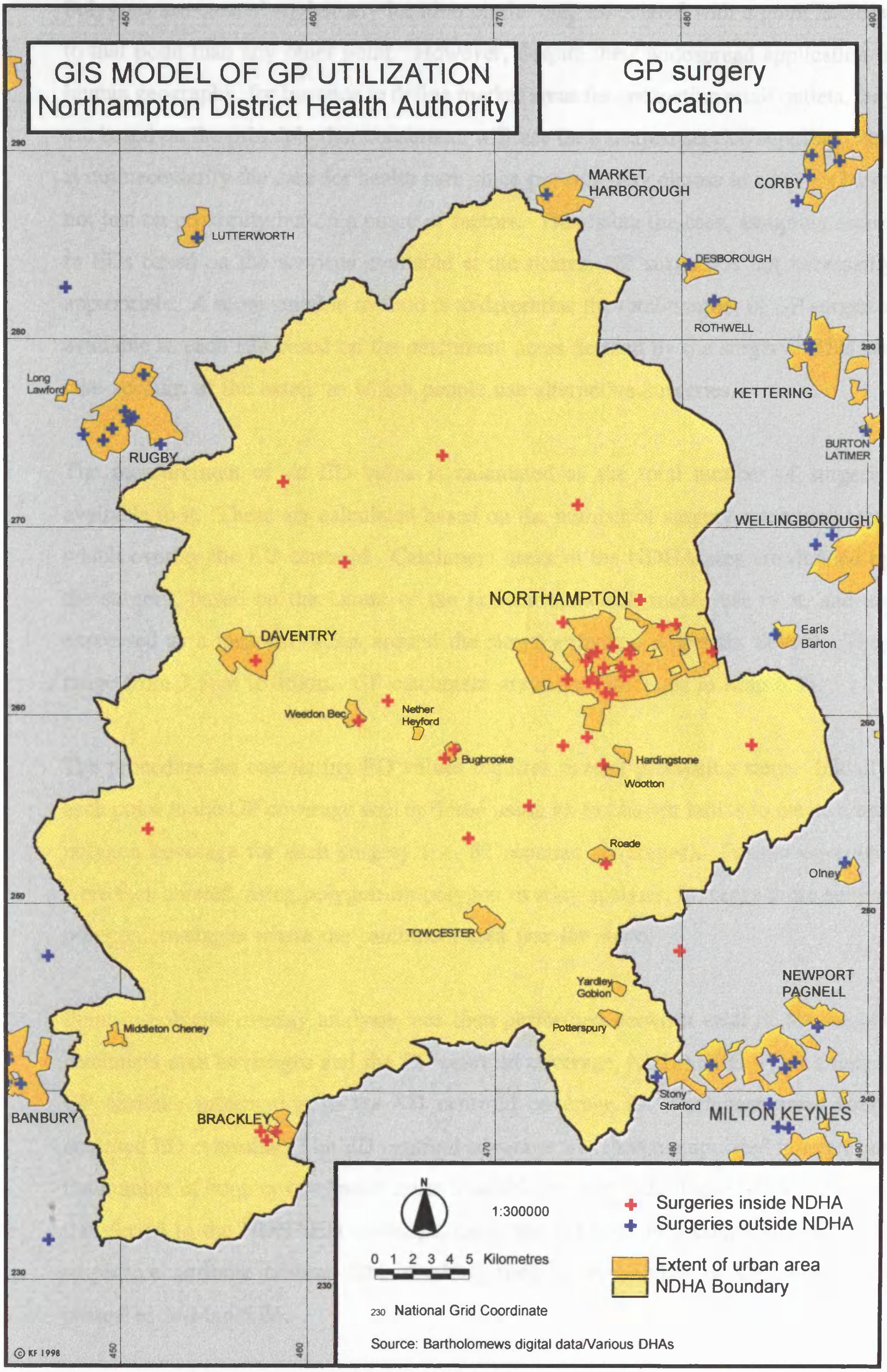
Section 3.4.1 discussed methods of defining and measuring availability of surgeries. The use of location quotients was one widely used method. This gives a measure of availability relative to total population. Here, however, it needs to be further developed to provide a measure of overall service availability which can be related to need and accessibility.

Availability of surgeries is determined by using the surgery postcode. The postcodes were obtained from the Northampton FHSA which provided details of surgery characteristics for all GPs in the NDHA area (Appendix Seven). There are a total of 52 surgeries in the NDHA area. The coverage created, GP, and its associated attributes are detailed in Appendix Four. Map 6.34 illustrates the coverage GP and a further coverage, GPOUT, which illustrates surgeries provided by neighbouring DHAs

Whilst GP service delivery is defined at a discrete point, its service area extends into the surrounding area and is more appropriately considered as a continuous zone. The service area for each surgery must therefore be defined then converted to an ED score.

Different methods could be employed for this purpose. One way would be to determine a service area based on the construction of Thiessen polygons. Areal subdivisions (polygons) are created around the point data. The area around each point is related to it such that it is mutually exclusive and exhaustive across the whole area.

Map 6.34 GP surgery location



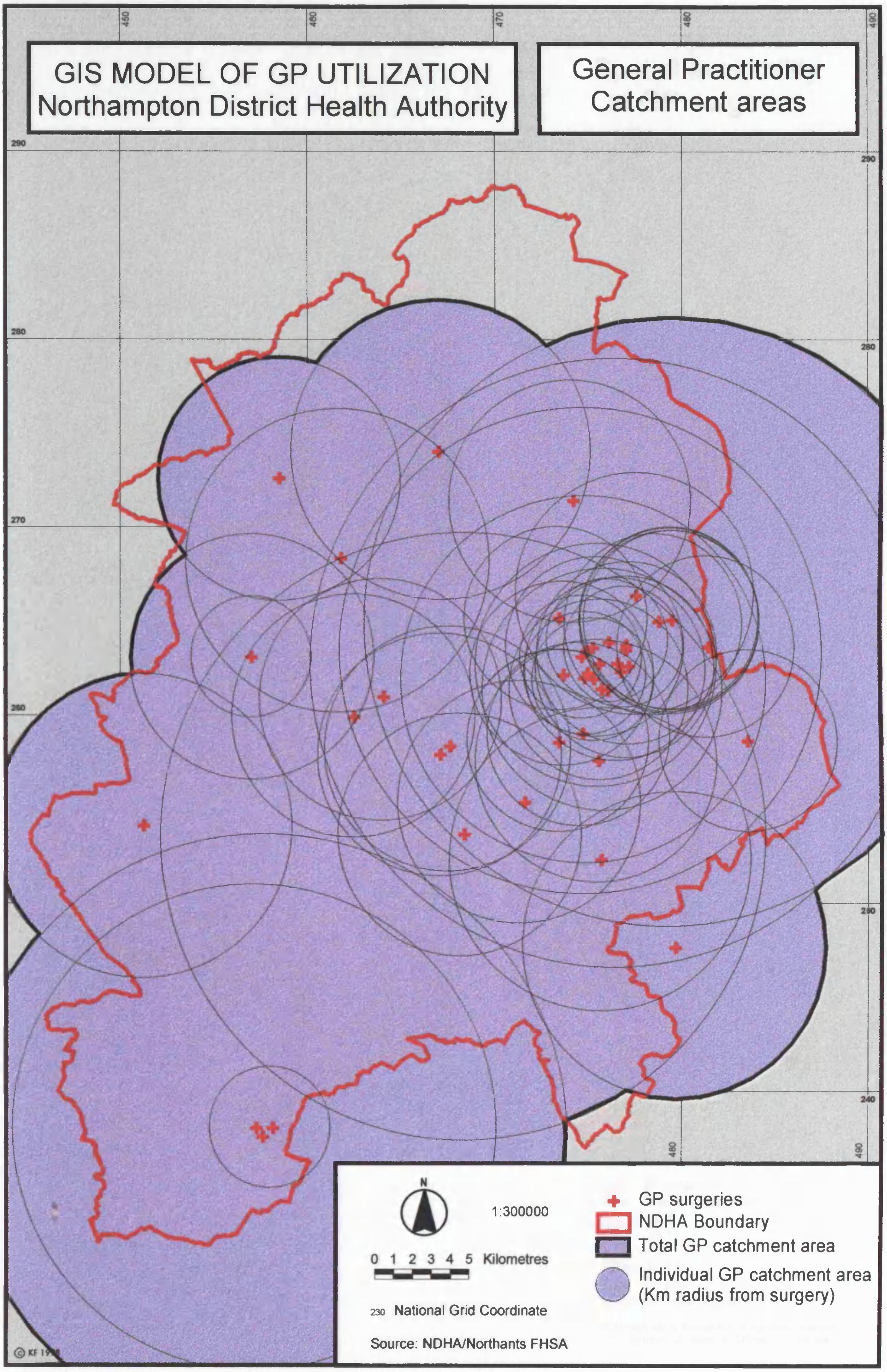
Polygons are created so that any location on the map associated with a point is closer to that point than any other point. However, despite their widespread application in human geography, for instance to define market areas for competing retail outlets, they are based on the principle that consumers will use their nearest service supplier. This is not necessarily the case for health care since patients may choose to use GPs based not just on proximity but on a range of factors. This being the case, assigning scores to EDs based on the services available at the nearest GP surgery is not necessarily appropriate. A more suitable method is to determine the total number of GP surgeries available to each ED based on the catchment areas defined by the surgery. This can take account of the extent to which people use alternative surgeries.

The measurement of an ED value is calculated as the total number of surgeries available to it. These are calculated based on the number of surgery catchment areas which overlay the ED centroid. Catchment areas in the NDHA area are defined by the surgery, based on the extent of the population which makes use of it, and are expressed as a uniform radius around the surgery (in km, Appendix Seven). They range from 3.5km to 16km. GP catchment areas are illustrated in Map 6.35.

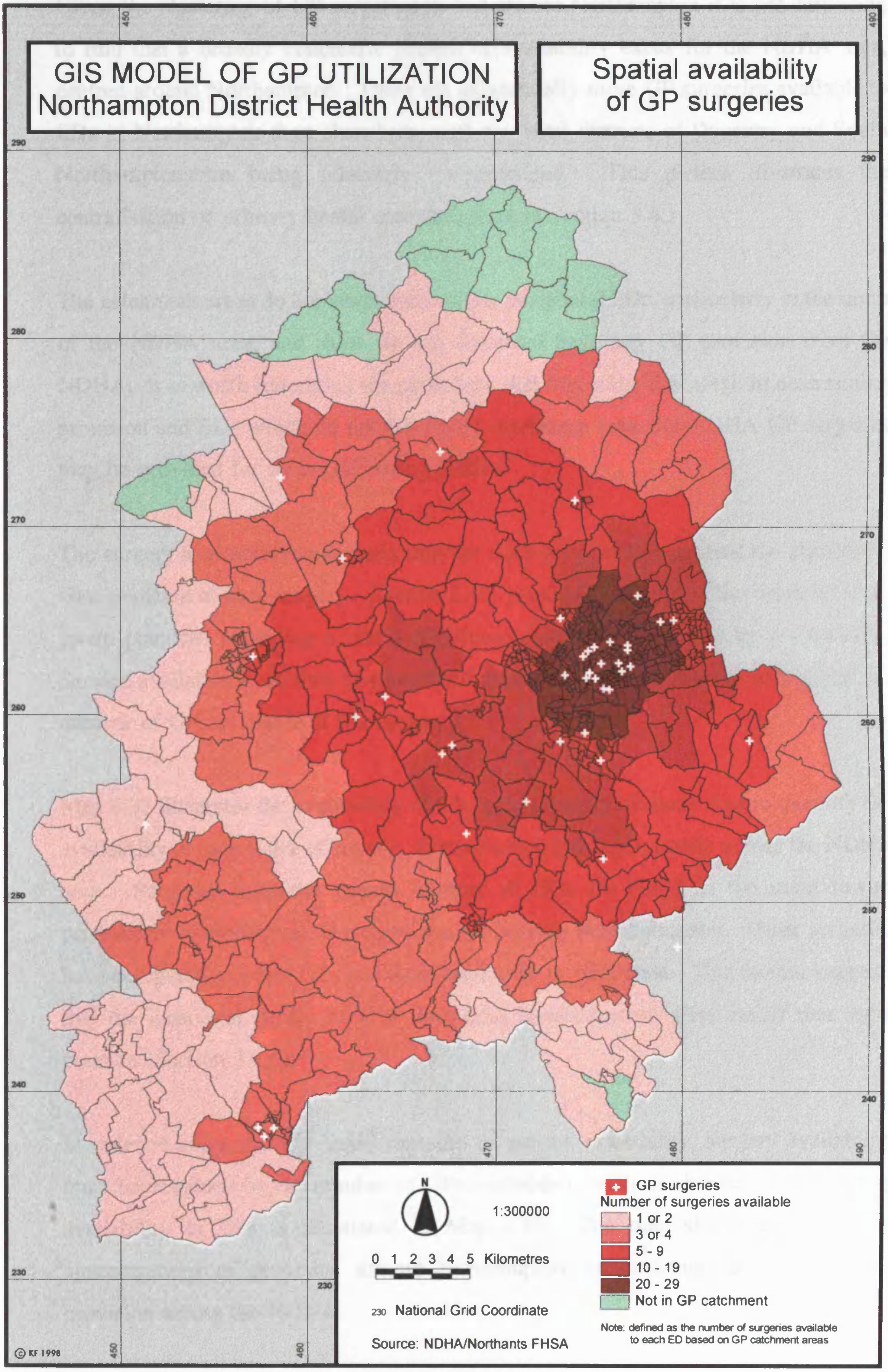
The procedure for calculating ED values requires several processing steps. Initially, each point in the GP coverage was buffered using its catchment radius to create a new polygon coverage for each surgery (i.e. 52 separate coverages). Further coverages were then created, using polygon-on-polygon overlay analysis, to merge those surgery polygon coverages where the catchment area was the same.

Point-in-polygon overlay analysis was then performed between each of the merged catchment area coverages and the ED centroid coverage, NDHAEDC. This attached GP attribute information to the ED centroid coverage for catchment areas which enclosed ED centroids. The ED centroid coverage was then manipulated to aggregate the number of surgery catchment areas available to each ED. These totals were then transferred to the NDHAED coverage, using the ED code as a common item in the respective attribute tables. The resulting map of availability of GP surgeries is presented in Map 6.36.

Map 6.35 GP catchment areas



Map 6.36 Spatial availability of surgeries



Given the clustering of GP surgeries in and around Northampton it is not surprising to find that a broadly concentric pattern of availability exists for the NDHA area, centred around Northampton. There are substantially more GP surgeries available to EDs in Northampton than elsewhere, with the rural districts of Daventry and South Northamptonshire being relatively underserviced. This pattern illustrates the centralisation of primary health care discussed in Section 3.4.1.

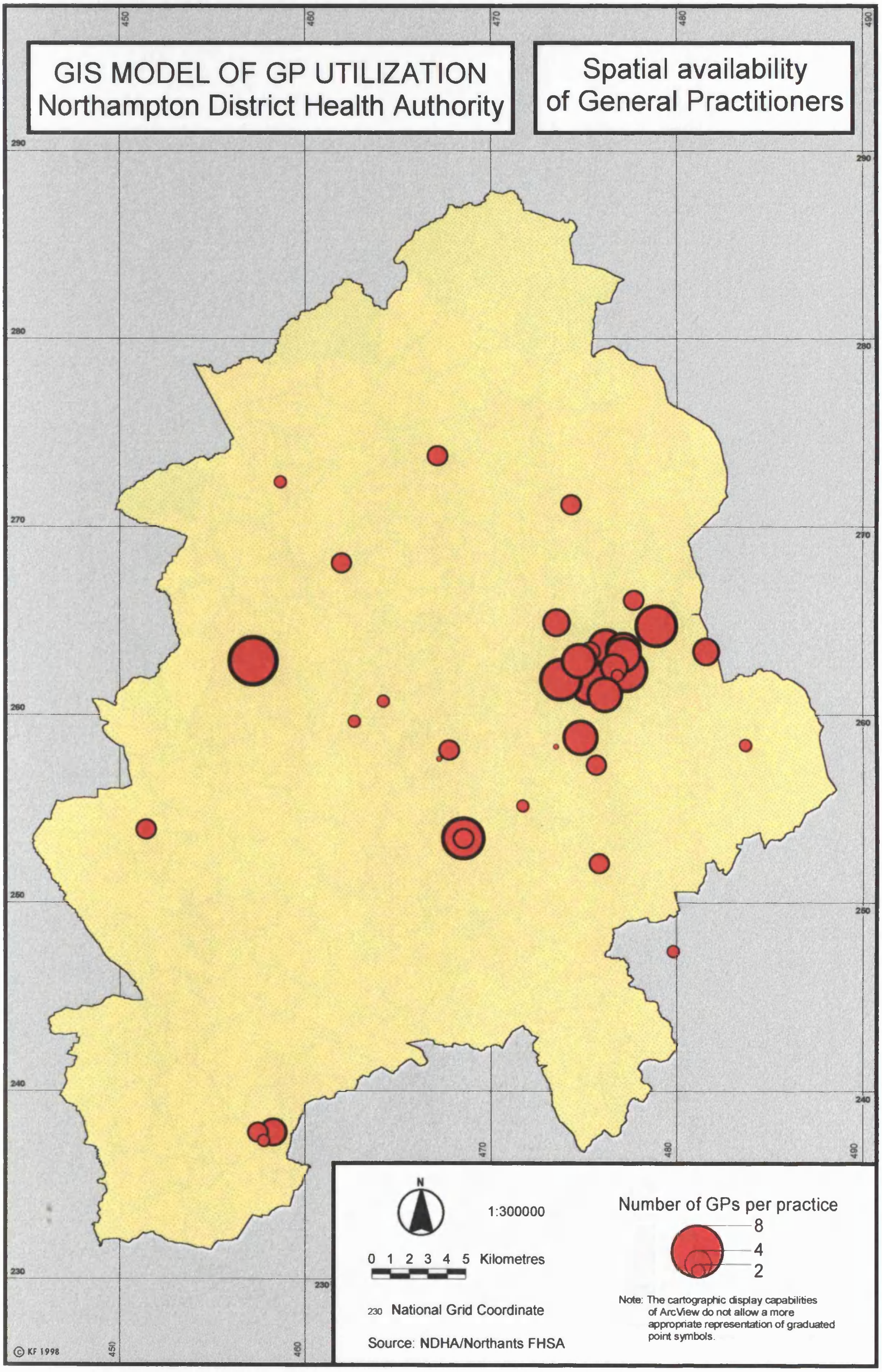
The catchment areas do not cover some of the peripheral EDs, particularly in the north of the NDHA area, and these do not therefore have any GP provision from the NDHA. It is worth reiterating the point here that this is the first stage in determining provision and EDs which do not fall inside catchment areas for NDHA GP surgeries may be provided for by neighbouring DHAs.

The surgery availability calculated thus far does not take into account the number of GPs available at each surgery. Section 3.4.1 provided evidence of the move towards group practices providing a range of primary health care services by several GPs. Service availability can thus be more accurately determined if account is taken of the number of GPs available at the surgery.

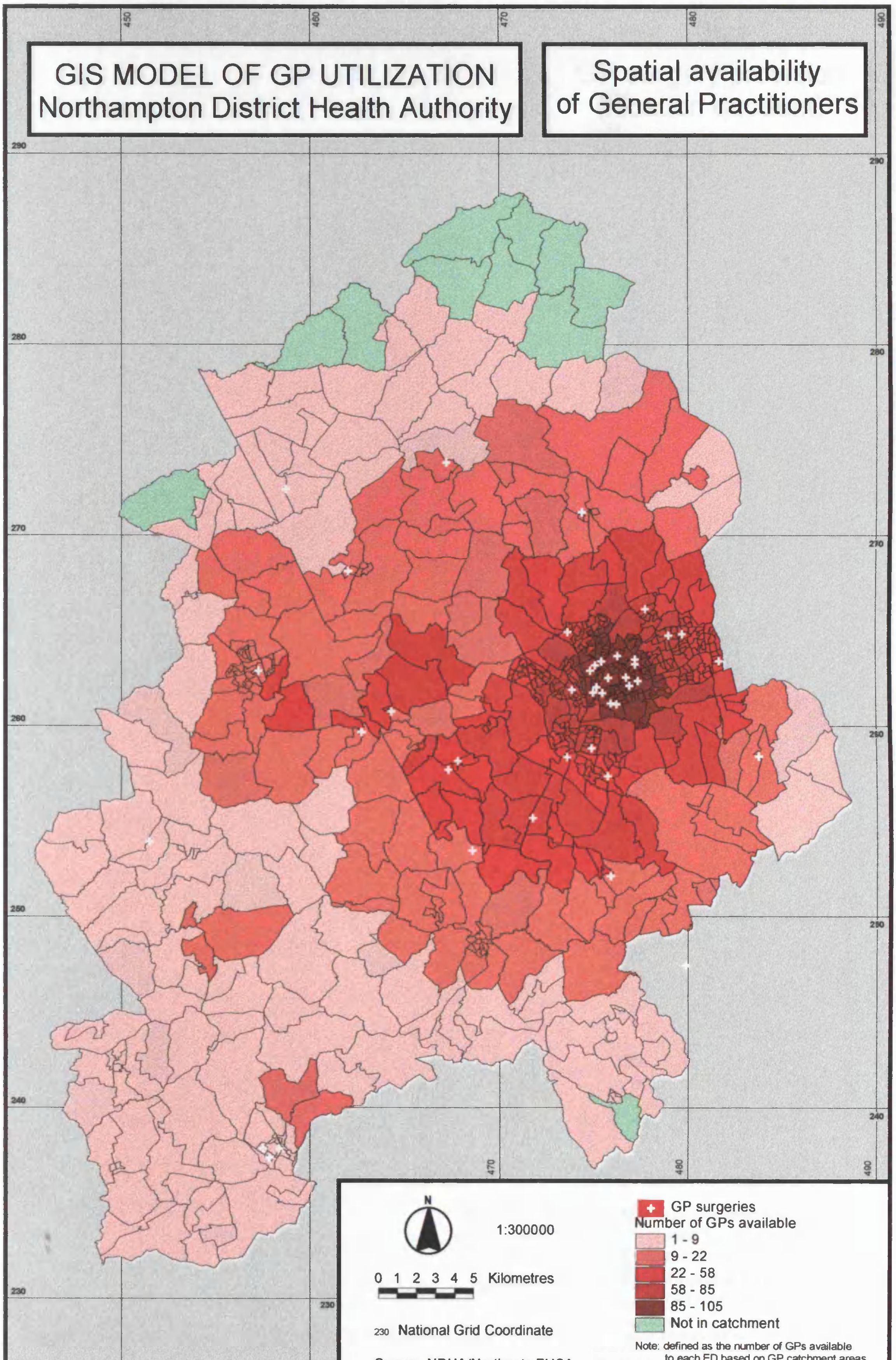
Map 6.37 illustrates the availability of GPs using surgery attribute data to quantify GP availability at each point of supply. Size of surgeries varies greatly across the NDHA area. Surgeries with the largest number of GPs are based in the main towns, particularly Northampton, Daventry and the surgery near Towcester. Other surgeries have comparatively few GPs and these tend to be in rural areas. This pattern suggests that the locational choice of GPs does tend towards urban areas rather than rural practice (Section 3.4.1).

In order to adapt the ED based measure of service availability, surgery availability must be weighted by the number of GPs available in each catchment. The resulting availability of GPs is illustrated in Map 6.38. The map shows even stronger concentrations of provision around Northampton, emphasising the disparities in provision across the NDHA.

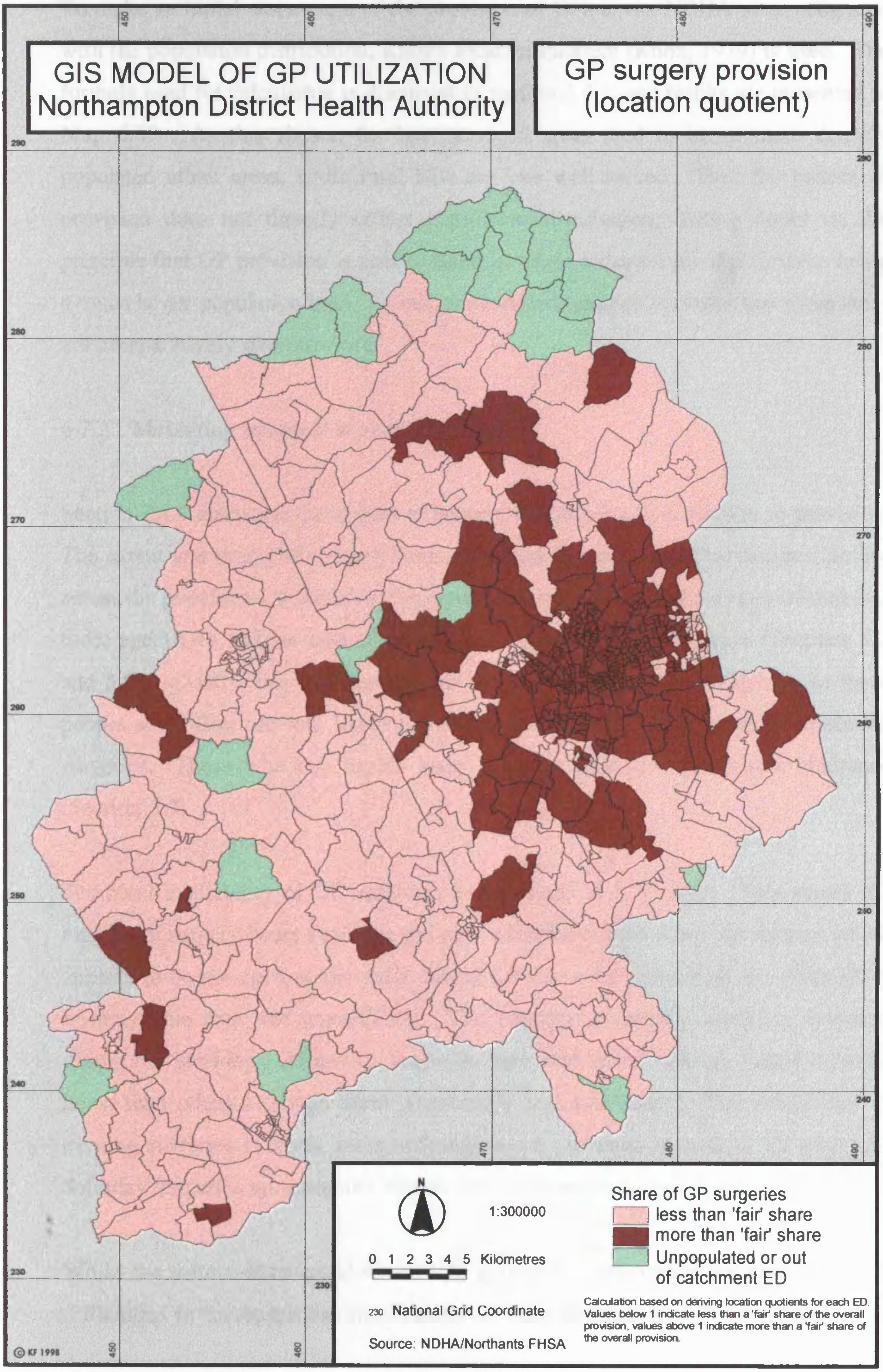
Map 6.37 Spatial availability of GPs (point)



Map 6.38 Spatial availability of GPs (area)



Map 6.39 Location quotient of spatial availability of GPs



To make an initial assessment of the provision of GPs in the NDHA area, compared with the population distribution, Knox's location quotient (Knox, 1979) is used. The formula used for calculation is discussed in section 3.4.1, and results are presented in Map 6.39. As this shows, the best serviced areas tend to be in more densely populated urban areas, while rural EDs are less well served. Thus the pattern of provision does not directly reflect population distribution, casting doubt on the principle that GP provision is concentrated in urban areas simply due to there being a much larger population base. Indeed, the location quotient indicates that these areas are comparatively over-serviced.

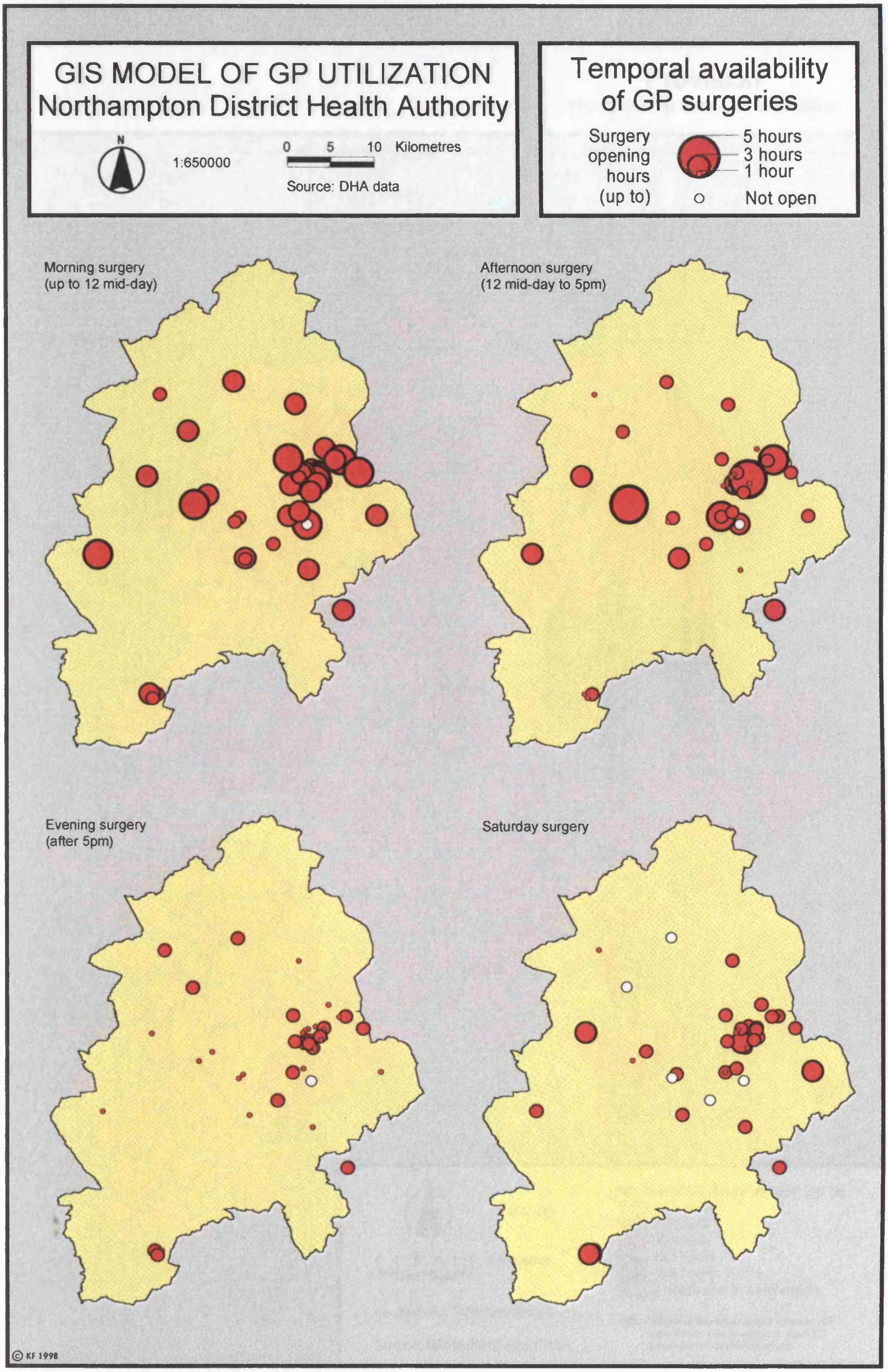
6.7.2 Measuring temporal availability (stage 2)

Section 3.4.2 discussed the impact of surgery opening hours in relation to provision. The extent and timing of surgery hours may lead to variations in service availability across the population, disadvantaging certain groups. The patient survey revealed that those age 16-44 and the unemployed experienced particular hindrance (Sections 5.2 and 5.5). Clearly, this has implications for the availability of health care to these people since they are less likely to be able to make use of morning or afternoon surgeries. Those who live further away also cite time constraints as a hindrance (Section 5.7).

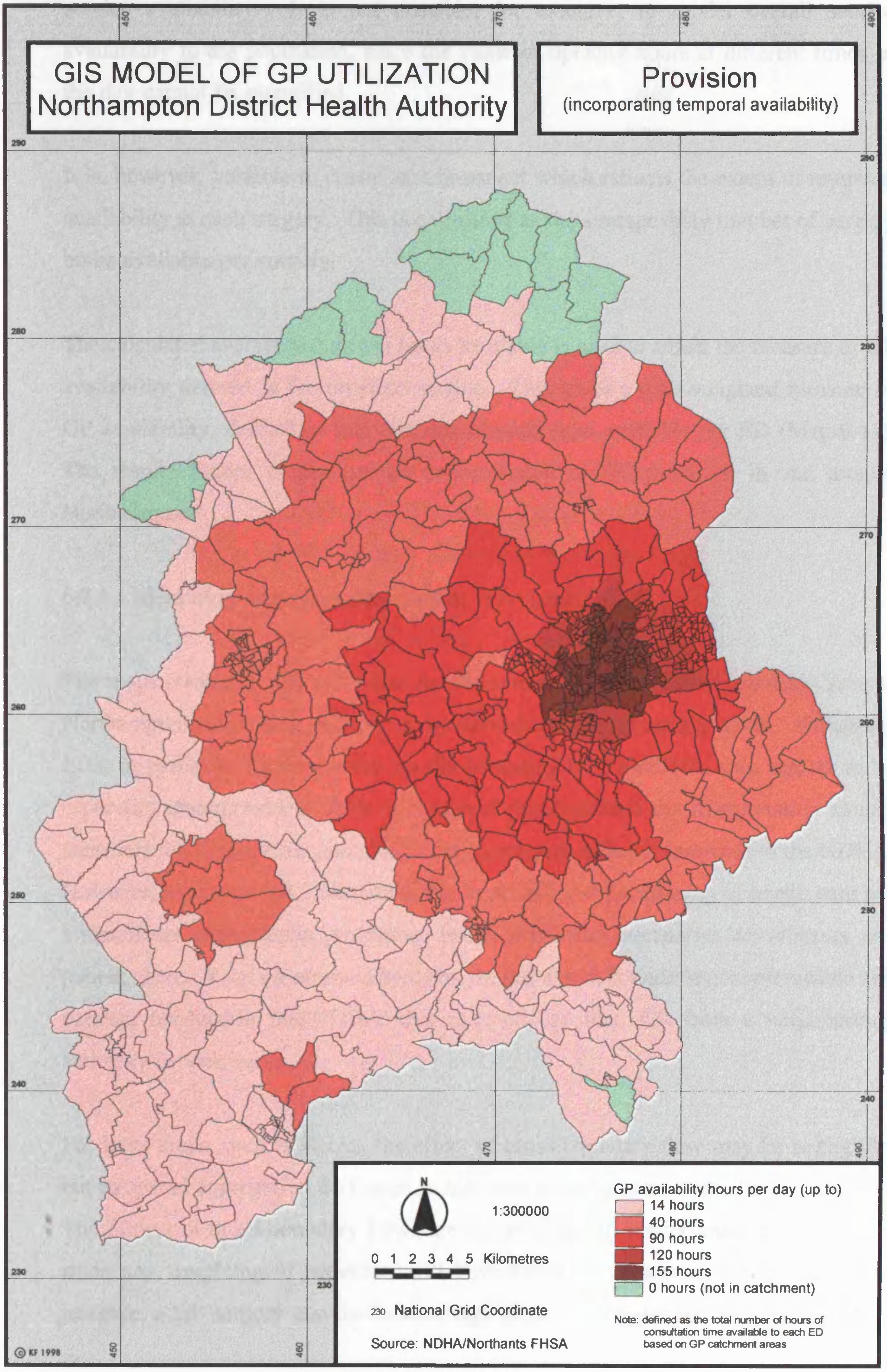
Temporal availability of GP surgeries is illustrated in Map 6.40. This shows the number of surgery hours available and also when they occur (note: the surgery which appears to be not open at any point during the day is excluded from the study since opening time data was unavailable). The majority of surgery hours are available during the morning. Afternoon surgeries vary with some offering longer opening hours than others although there is generally less availability. The availability of evening surgeries is much lower, although some provision is made at all surgeries. Saturday surgeries are generally shorter and a few are not open at all.

Whilst the pattern of temporal availability is useful for discussion purposes, there are difficulties in incorporating the diversity of temporal data into the ED measure of

Map 6.40 Temporal availability of GPs (point)



Map 6.41 Temporal availability of GPs (area)



service availability. It is not possible, for example, to model overall service availability to the population, since the value of opening hours at different times of the day cannot be quantified.

It is, however, possible to create an adjustment which reflects the extent of temporal availability at each surgery. This is calculated as the average daily number of surgery hours available per surgery.

The calculated average number of hours available is used to adjust the measure of GP availability derived in the previous section. This gives a time-weighted measure of GP availability, defined as the total consultation time available per ED (Map 6.41). The results further emphasise the concentration of GP provision in and around Northampton.

6.7.3 Measuring cross-boundary patient flow (stage 3)

The maps created in this section so far illustrate a concentration of provision around Northampton, indicating relative under-servicing of surrounding areas. Peripheral EDs, in particular those that are on the boundary of the NDHA area, appear to be especially underprovided. This is a correct assumption if the interpretation simply considers the GP services provided under the organisational framework of the NDHA. However, as section 3.4.3 identified, the organisational partitioning of health care has a significant impact upon provision. Health Authority boundaries are arbitrary and patient choice is not constrained by them. In this sense, boundaries are permeable and patients resident in the NDHA area may choose their GP from a neighbouring authority or vice versa.

For large areas, such as RHAs, the effect of cross-boundary flow may be negligible, but as spatial aggregation decreases so the need to incorporate such effects increases. The impact of cross-boundary flows are not confined to border areas in this respect since any weighting of provision will have knock-on effects on other areas. For instance, a GP surgery may be located very close to a border but the majority of its patients could be resident in a neighbouring DHA area. This would have the effect of reducing the total provision available to the population inside the authority by a similar proportion.

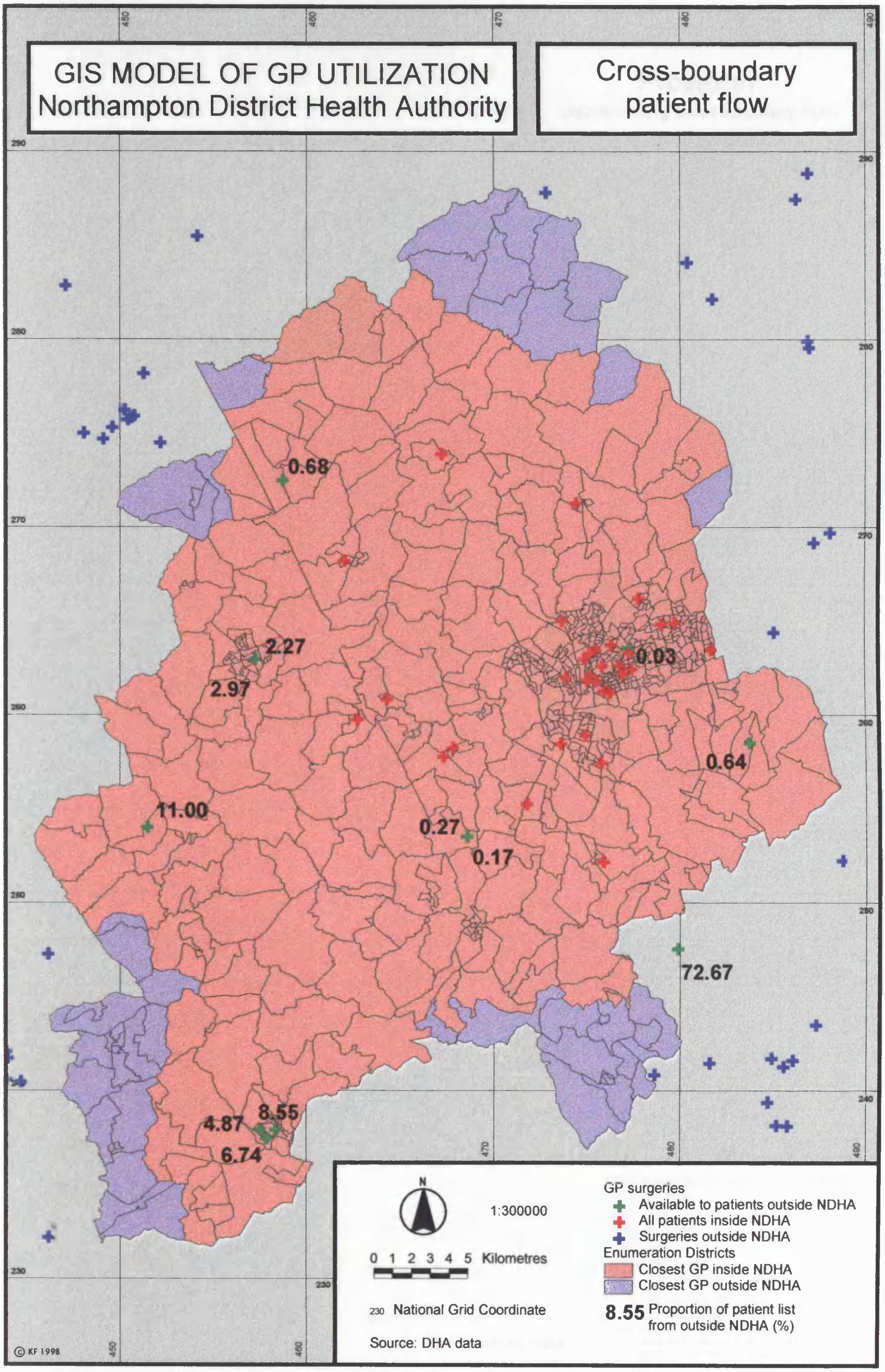
An adjustment to GP availability must be incorporated to measure the effects of the cross-boundary flows. The adjustments measure the quantity of provision used by people from outside NDHA and the amount of extra provision available from neighbouring DHAs.

The procedures employed to make these adjustments are dependent upon data availability. Information relating to the overall size of GP patient lists, and the proportion of the list representing patients from different DHAs, is not readily available in the public domain. It has been possible to obtain these details from the NDHA for GPs in the NDHA area but surrounding DHAs have been unwilling to provide similar data. Modelling patient flow into NDHA and patient flow out of NDHA is therefore restricted, and different methods must be employed for the two factors.

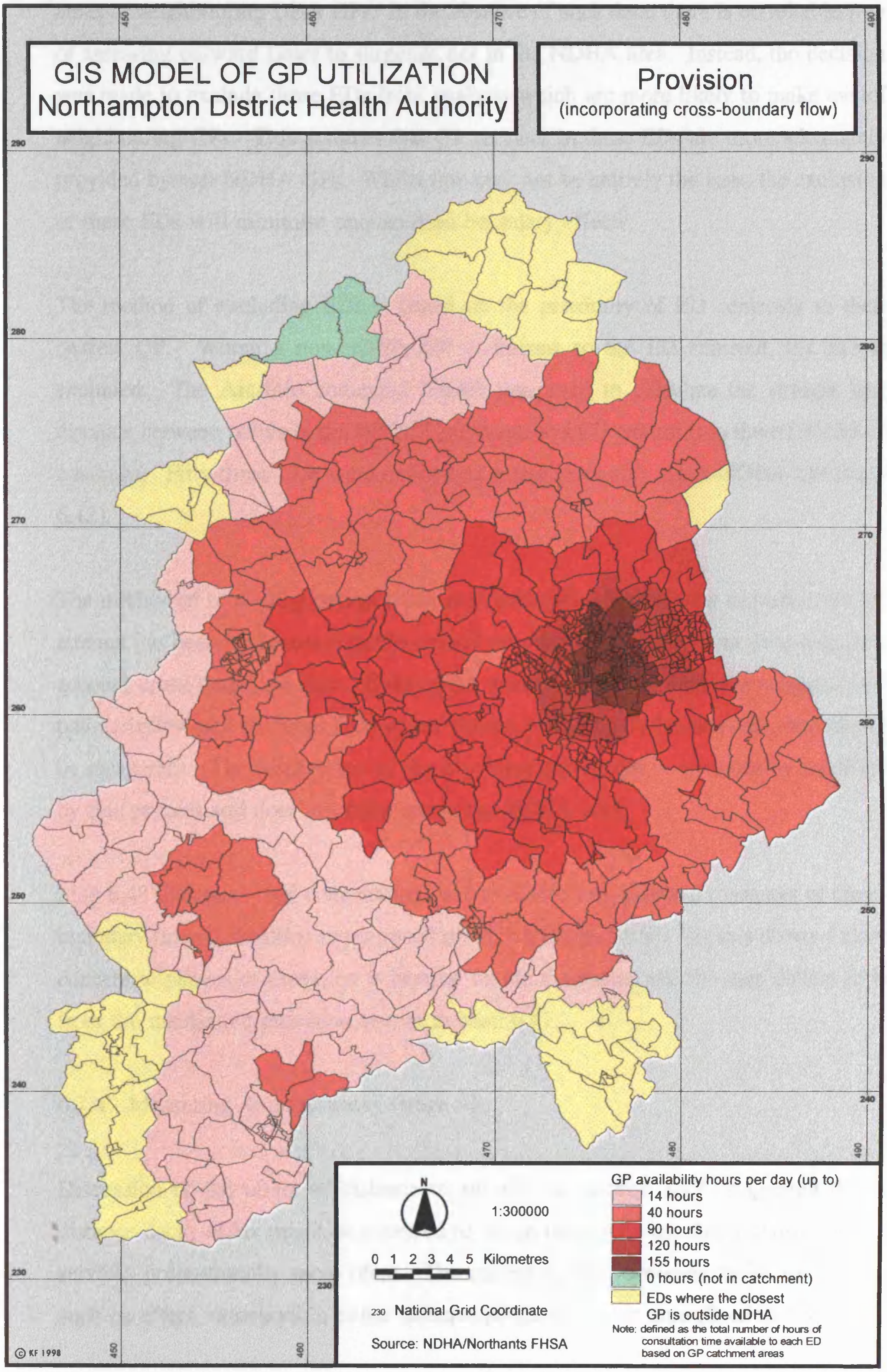
Patient flow into the NDHA area (i.e. the use of an NDHA GP for a non-NDHA area patient) is assessed based on the proportion of the NDHA GP's list size which takes patients from neighbouring DHAs. This is simply calculated as a percentage and then used to down-weight the total consultation hours available at the surgery involved. Of the 52 GP surgeries in the NDHA area, 12 receive a proportion of their patient list from neighbouring DHAs, as indicated on Map 6.42. The proportions are small, with 8 GP surgeries having less than 5% of patients from neighbouring DHAs. Only one surgery has a large proportion (72.67%) and this is due to the fact that it is a branch surgery actually located outside the NDHA area.

Measuring patient flow out of the NDHA area cannot be undertaken using the same method, since data indicating the proportion of NDHA patients on their list is not available for surrounding GPs. Ideally, if data were available, then total consultation hours could be increased proportionally for those EDs which fall in the catchment

Map 6.42 Cross-boundary patient flow



Map 6.43 Provision (incorporating cross-boundary flow)



areas of neighbouring DHA GPs. In the absence of such data, there is no reliable way of assessing outward flows to surgeries not in the NDHA area. Instead, the decision was made to exclude those EDs from analysis which are more likely to make use of neighbouring GPs. This assumes that GP services in these EDs are more adequately provided by non-NDHA GPs. Whilst this may not be entirely the case, the exclusion of these EDs will minimise unquantified boundary effects.

The method of excluding EDs is based on the proximity of ED centroids to their nearest GP. Where a non-NDHA GP is nearest to the ED centroid, the ED is excluded. The Arc/Info command NEAR was used to calculate the straight line distance between points in the GPOUT coverage and ED centroids in the NDHAEDC coverage. Fifty-three EDs were defined as being closest to a non-NDHA GP (Map 6.42).

The method of modelling patient outflow is acknowledged as being imperfect but an attempt has been made to weight the overall provision sub-model measure to take into account cross-boundary flow. Subsequent analysis therefore includes a measure of patient inflow and excludes EDs where patient outflow may be expected (but cannot be measured). The areal extent of the provision sub-model is unavoidably modified by this process and does not fully match the NDHA area.

Map 6.43 illustrates total consultation time available incorporating measures of cross-boundary flow. Like other measures of provision (Maps 6.36-6.38), this shows a clear concentric pattern of provision is centred on Northampton, and the map differs little from the unadjusted provision shown in Map 6.41.

6.7.4 Measuring distance-decay (stage 4)

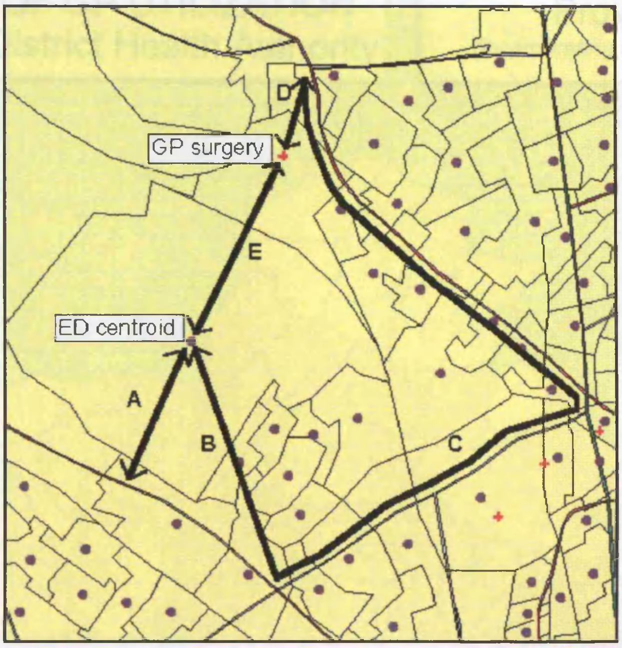
Discussion of the effect of distance to surgery, in Section 3.4.4, suggested that a distance-decay effect might be expected to occur, those who are closer consulting GP services proportionally more often. The patient survey, however, failed to confirm such an effect, measured in either distance (Section 5.7) or time (Section 5.8). This may be because, in the patient sample (patients who were required to seek health care based on their illness) the effect of distance is over-ridden by need. Alternatively it might reflect a socio-economic zonation of the population with distance from town centres, where most surgeries are located. In particular, regularity of consultation and home visit dependence generally decline with increasing distance whilst the location of surgery is regarded as a greater hindrance by those who live further away (Section 5.7).

Section 3.4.4 highlighted the problem of finding an ideal method of measuring distance decay. On the other hand, the importance of this variable is such that it cannot be ignored. With this in mind, the Knox (1978; 1979) method is used here to determine distance decay based on a negative exponential function. The method was discussed in detail in section 3.4.4.

The first steps in applying this method is to calculate the distances to the surgery for all people in the area. The journey taken to a GP surgery will normally follow defined route networks, most often the road system. In principle, the distance along this network could be measured in the GIS, using network analysis techniques. This would involve the calculation of distance between each ED centroid, taken as the point of demand for each ED, and the GP location along the shortest path in the road network (Figure 6.4).

This approach is, however, inappropriate for a number of reasons. Firstly, the calculation of distance is based on the topological relationships of the points and arcs involved. The first link in the route is thus defined as the straight-line distance from the ED centroid to the nearest node in the road network (length B in Figure 6.4). This may not be the same as the distance between the centroid and the nearest road arc (length A). Road length is then measured between this node and the nearest node to the GP (length C); a further straight line distance is then taken to the surgery (length D); again this may not define the shortest access route from the road to the surgery. Additionally, the distances are entirely determined by the spatial resolution of the road network used. The Bartholomews road network, derived from 1:250000 scale

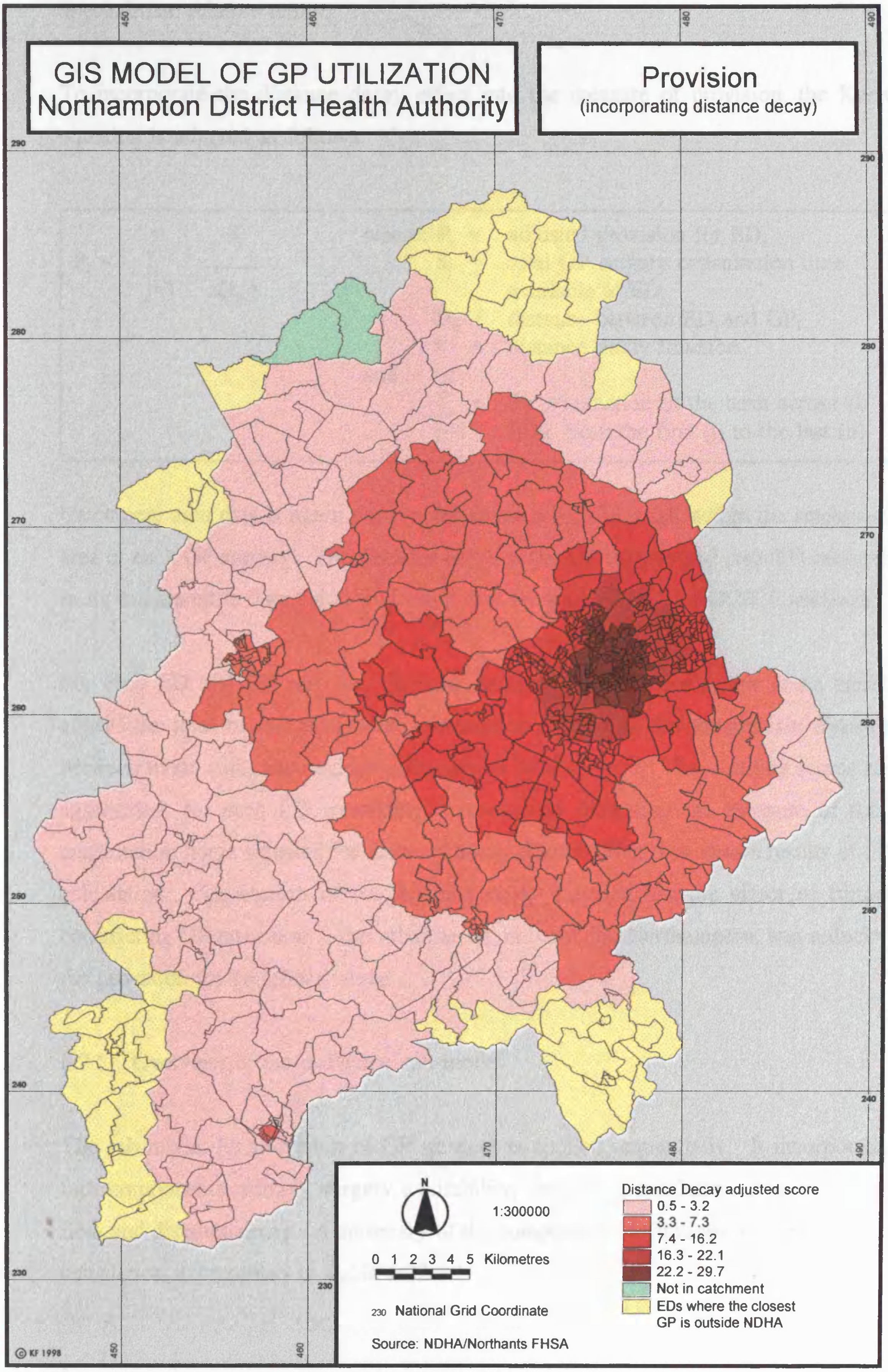
Figure 6.4 Measuring distance between EDs and GPs (author, 1998)



mapping, clearly has a relatively large degree of error (Section 6.3.3), and does not include all the minor roads in the study area. It is therefore likely seriously to over-estimate travel distances. Better results could clearly be obtained with higher resolution data, such as OSCAR or EDLINE street centre lines, but cost prevented their use in this study. Moreover, since the ED centroid is being used as an approximation of the place of residence of all patients in an ED, the added accuracy provided by using network analysis would be largely illusory.

The alternative is to take the straight line distance between ED centroids and GP location (length E in Figure 6.4). This method was used by Knox (1978; 1979) in determining his distance decay function and is taken here to represent a measure of proximity of EDs to GPs rather than road distance. When used in the example in Figure 6.4, it gives a distance score of 1170 metres. This compares with a distance of 6590 metres using the network lengths. Whilst not, in reality, a true measure of travel distance, it is considerably easier to calculate and can be assumed to give a reasonable measure of relative distance. EDs may thus be expected to be scored in

Map 6.44 Provision (incorporating distance decay)



approximate relative terms.

To incorporate the distance decay effect into the measure of provision, the Knox equation is adapted as follows:

$$P_i = \sum_{j=1}^{n} \frac{S_j}{D_{ij}^{\,k}}$$

where:	P_i	=	adjusted provision for ED_j
	S_j	=	total GP surgery consultation time available to ED_j
	D_{ij}	=	distance between ED_j and GP_i
	k	=	distance decay function
and:	$\sum_{j=1}^{n}$	=	the summation of the term across all EDs, from the first (j) to the last (n)

Catchment area data is again used to determine which EDs fall within the catchment area of each GP surgery. The distance between the GP surgery and each ED centroid in its catchment is then calculated using the Arc/Info POINTDISTANCE command.

For each ED and GP pair, the distance decay formula creates a new score which adjusts the total consultation hours available in relation to the straight line distance between them, using the negative exponential function $e^{-1.52}$. The resulting scores are aggregated, for each ED, providing a new score indicating the measure of total consultation hours adjusted for distance decay effects. Map 6.44 shows results of the calculation. Application of the distance decay function has the effect of further constricting GP provision to the urban areas, in particular Northampton, and reducing the provision for peripheral areas.

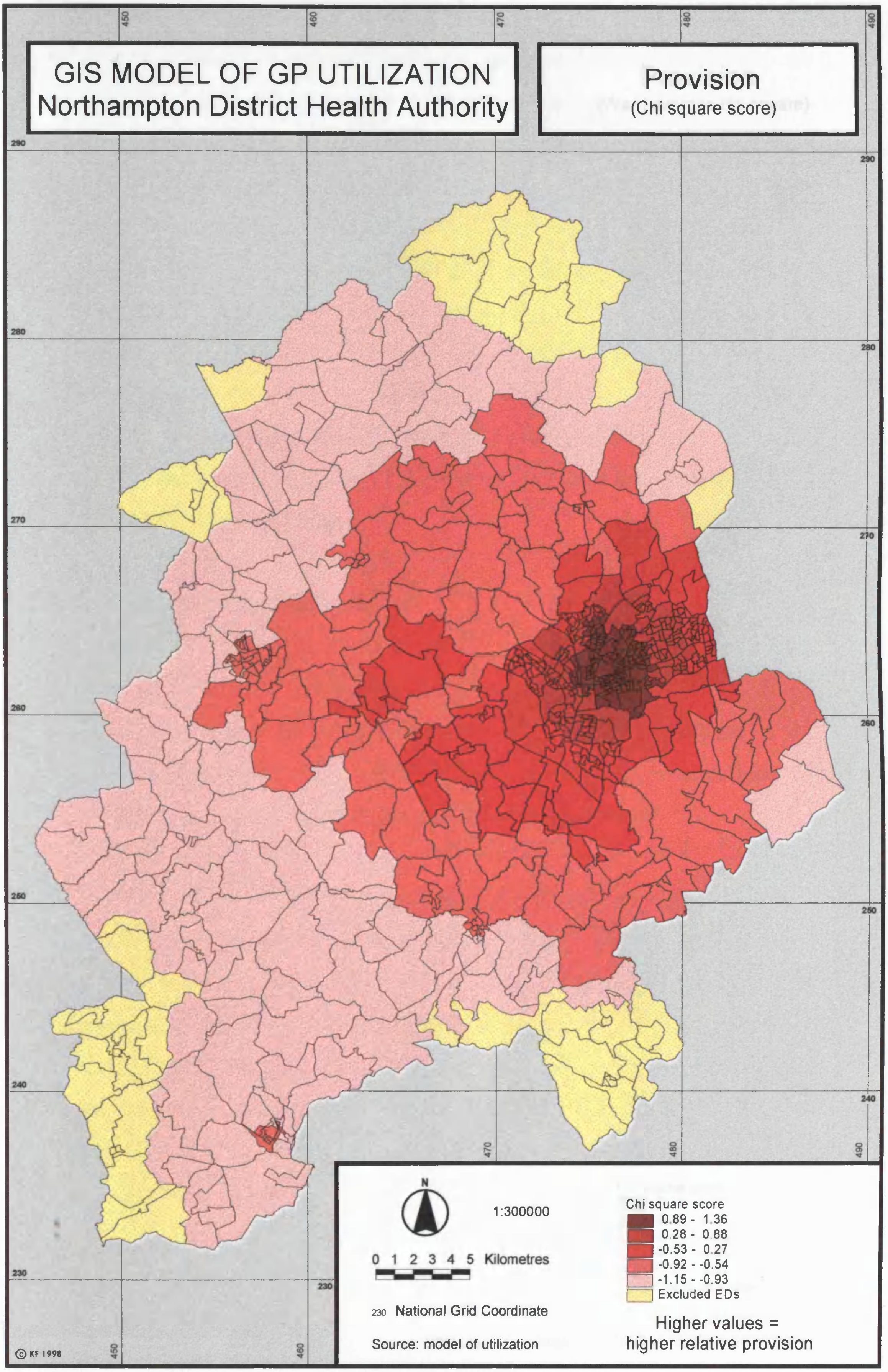
6.7.5 Overview of the provision sub-model

The sub-model for provision of GP services is applied sequentially. It incorporates four components, namely surgery availability, temporal availability, cross-boundary flow and distance decay. A summary of the components, definitions and sequence of calculation is presented in Table 6.22.

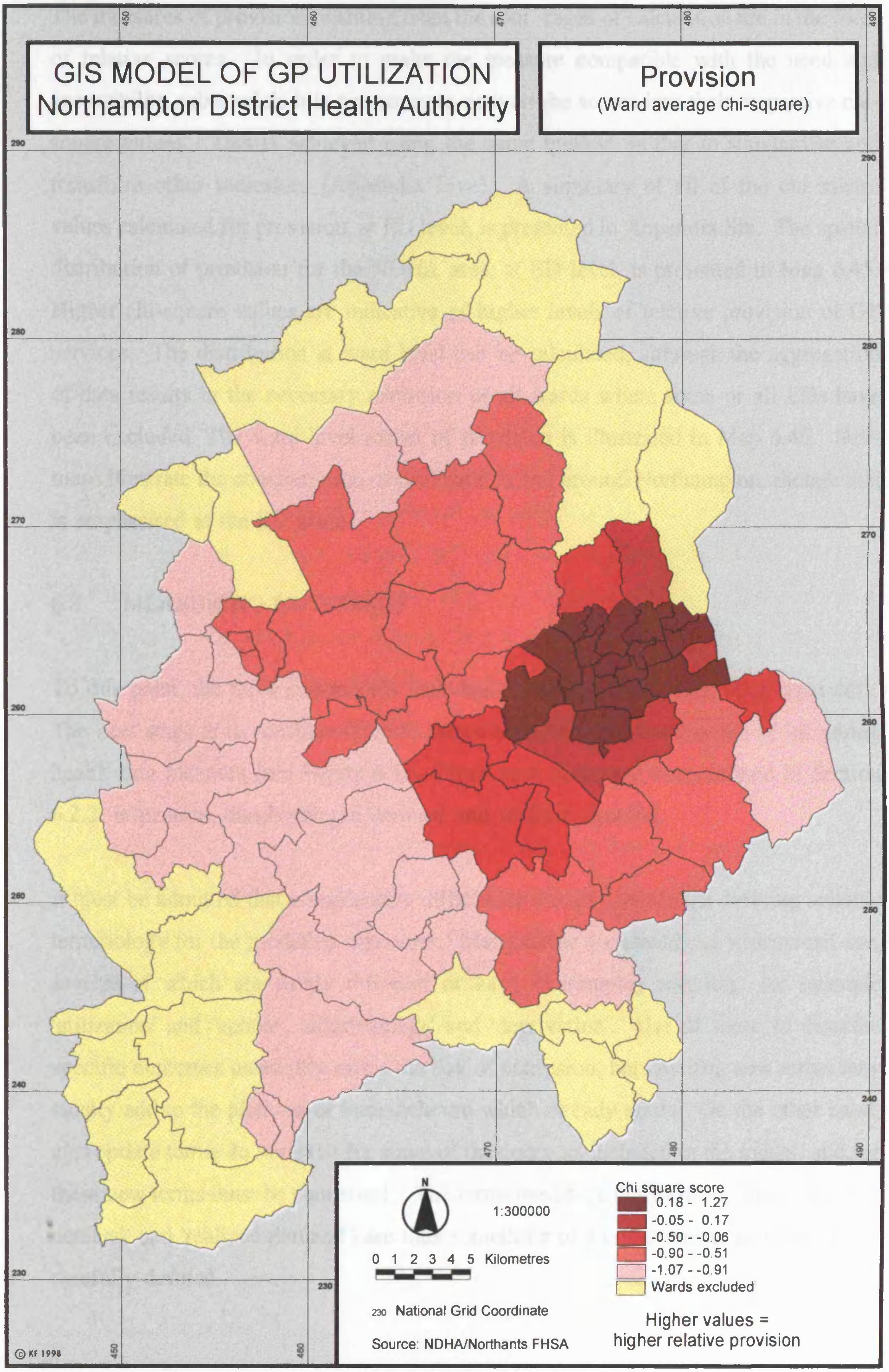
Table 6.22 Summary of the provision sub-model

Sub-model	Component	Indicator	Stage	Definition
Provision	Service availability	Surgery supply	1	Number of surgeries available per ED based on GP catchment
		GP supply		Number of GPs available per ED based on GP catchment
	Temporal availability	Total consultation hours	2	Total number of consultation hours available per ED based on GP catchment
	Cross boundary flow	Patient inflow	3	Proportion of list size of NDHA GPs allocated for non-NDHA patients used to down-weight stage 2 results
		Patient outflow		Location of non-NDHA surgeries used to identify NDHA EDs whose nearest surgery is outside NDHA (EDs excluded)
	Distance decay	Distance decay function	4	Scores calculated as a measure of total consultation hours (stage 3) in relation to an exponential distance decay function

Map 6.45 Provision composite score (ED)



Map 6.46 Provision composite score (ward)



The measures of provision resulting from the four stages of calculation are in the form of relative scores. In order to make the measure compatible with the need and accessibility sub-models it is necessary to convert the scores into their respective chi-square values. This is achieved using the same method as that to standardise and transform other indicators (Appendix Five). A summary of all of the chi-square values calculated for provision, at ED level, is presented in Appendix Six. The spatial distribution of provision for the NDHA area, at ED level, is presented in Map 6.45. Higher chi-square values are indicative of higher levels of relative provision of GP services. The distribution at ward level can be calculated, although the aggregation of data results in the necessary exclusion of all wards where some or all EDs have been excluded. The ward level extent of provision is illustrated in Map 6.46. Both maps illustrate the concentration of provision in and around Northampton, though this is emphasised at the ED scale.

6.8 MEASURING OUTCOMES

To this point, the three sub-models have been developed and interpreted separately. The next stage is to combine them to create specific outcomes capable of informing health care planners (see Figure 6.1). Three such measures were defined in Section 6.2.2: utilization, disadvantaged demand and realized demand.

It must be admitted that considerable difficulties are encountered in defining suitable terminology for the modelled outcomes. Many terms are already in widespread use, several of which are subtly different or have overlapping meaning: for example 'utilization' and 'uptake', 'disadvantage' and 'deprivation'. Use of these to describe specific outcomes inevitably raises the risk of confusion, but devising new terms may simply add to the plethora of nomenclature which already exists. On the other hand, appropriate terms do not exist for some of the concepts included in the model, and for these new terms must be conceived. The terms used here ('utilization', 'disadvantaged demand' and 'realized demand') are thus something of a compromise, and need to be carefully defined.

Utilization is thus defined as follows:

$$\text{Utilization} = \Sigma\ (\text{Demand}+\text{Provision})$$

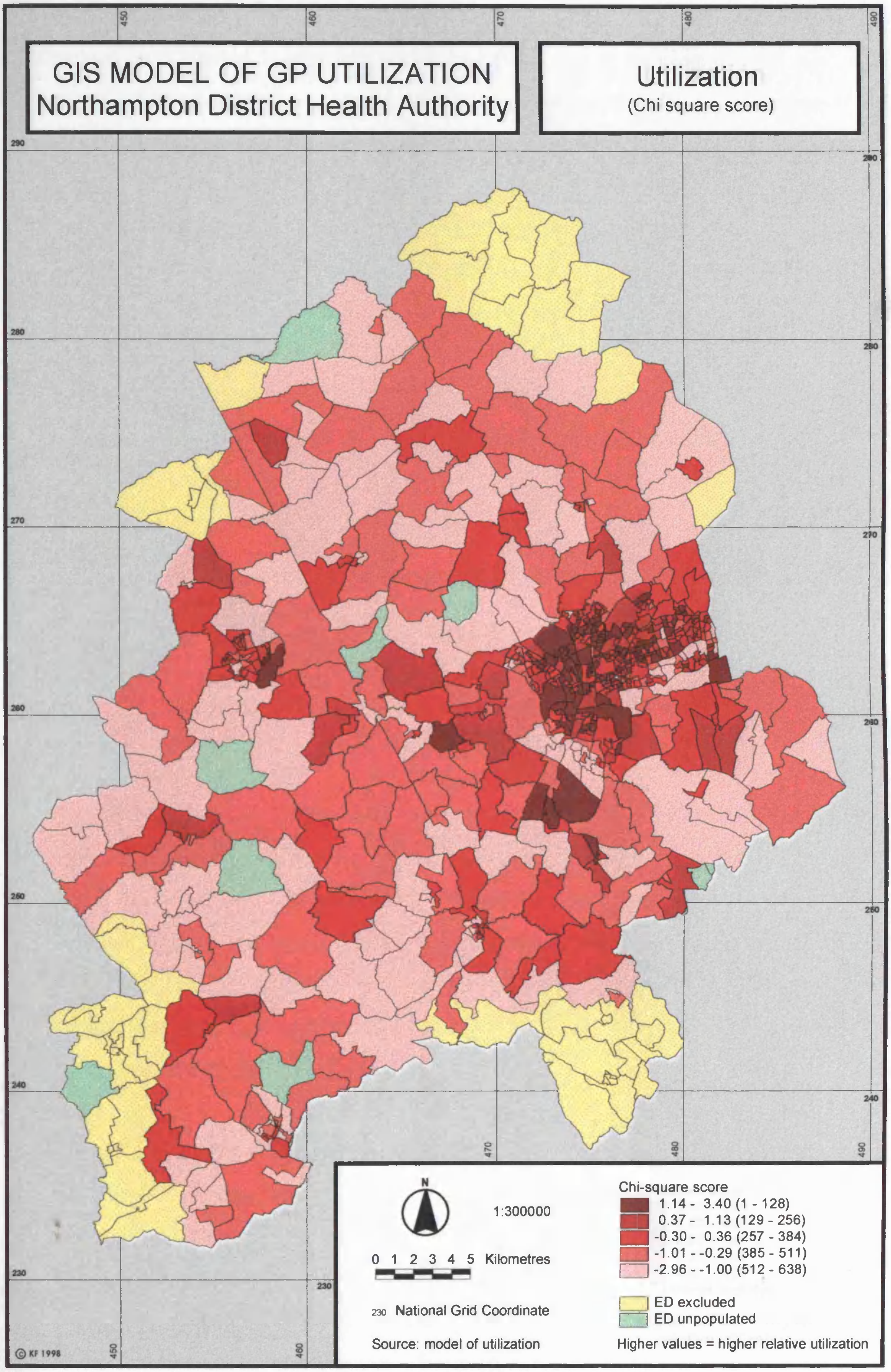
where, Utilization is the extent to which people use GP services;
Demand = (need-accessibility);
for need, higher x^2 values = higher levels of need;
for accessibility, higher x^2 values = higher levels of accessibility; and
for provision, higher x^2 values = higher levels of provision.

The need sub-model is based on indicators which reflect increased utilization rates. High x^2 values therefore indicate higher levels of need and higher levels of utilization. The accessibility sub-model is based on indicators which reflect obstacles to accessibility, with higher x^2 values indicating lower relative accessibility. The sign of this component is thus reversed in the calculation (i.e. it is incorporated by subtraction). The combination of need and accessibility, in this way, can be termed demand (Figure 6.1). Higher levels of provision provide opportunity for increased rates of utilization. The provision sub-model reflects this, with high x^2 values indicating higher levels of provision.

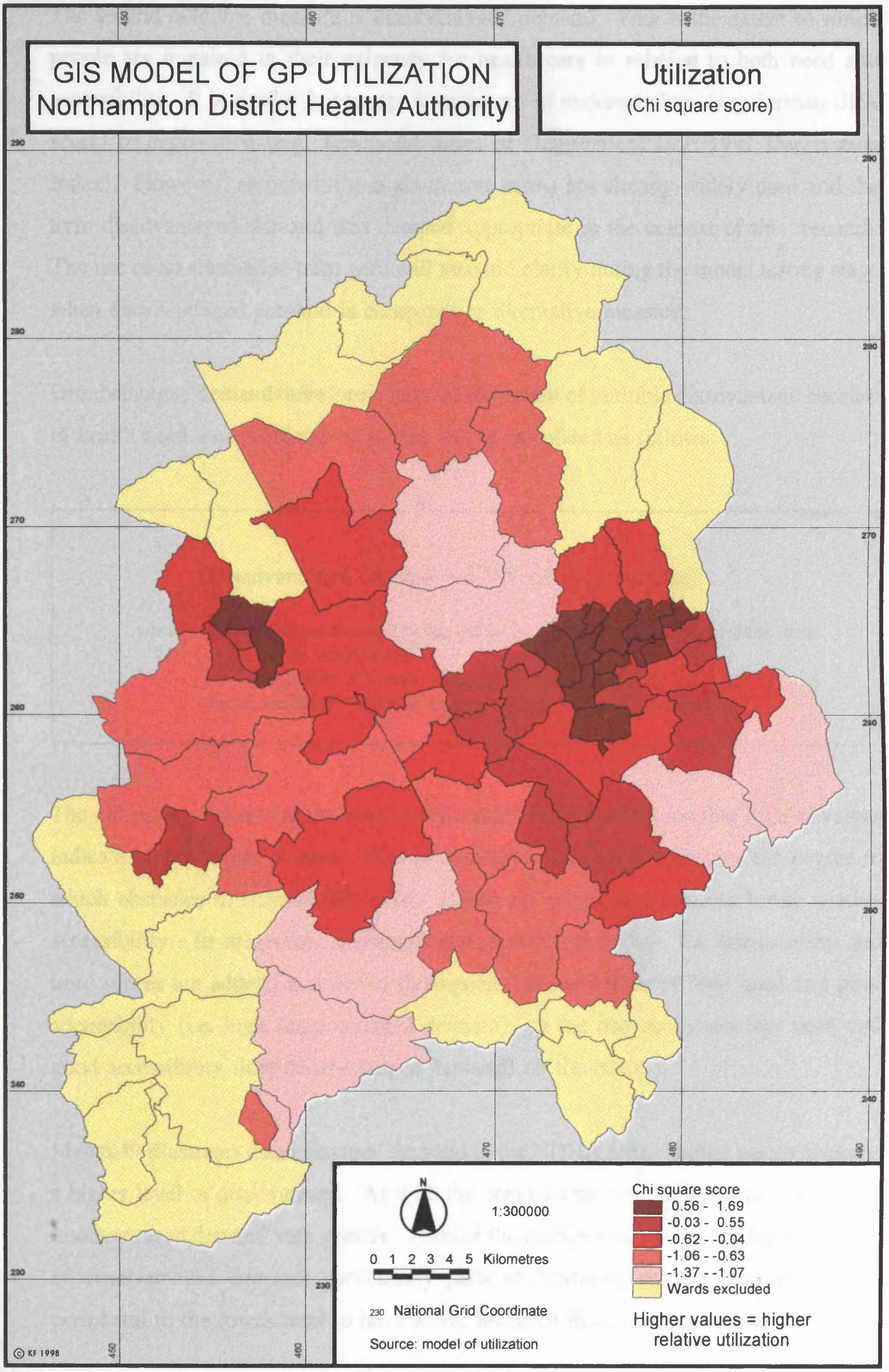
The measure of utilization is a composite score calculated by summing the need, accessibility and provision scores. High values represent increased levels of relative utilization (Maps 6.47 and 6.48). The maps show variations in predicted levels of use of health care services. It is clear from the ED scale of analysis that levels of utilization vary greatly both in urban and rural levels, though highest rates of utilization tend to be found in the main towns.

At the ward scale of analysis, levels of high utilization tend to be concentrated in Northampton and Daventry, although there are also some rural wards with reasonably high levels.

Map 6.47 Utilization (ED)



Map 6.48 Utilization (ward)



The second outcome measure is disadvantaged demand. This is the extent to which people are impaired in their exigency for health care in relation to both need and accessibility. It is similar in concept to measures of underprivilege (e.g. Jarman UPA score) or deprivation (e.g. Townsend Index of Deprivation; DoE 1991 Deprivation Index). However, as noted, these alternative terms are already widely used and the term disadvantaged demand was deemed appropriate in the context of this research. The use of an alternative term here will also aid clarity during the model testing stage when disadvantaged demand is compared to alternative measures.

Disadvantaged demand therefore measures the extent of multiple disadvantage because of health need and problems of access and is calculated as follows:

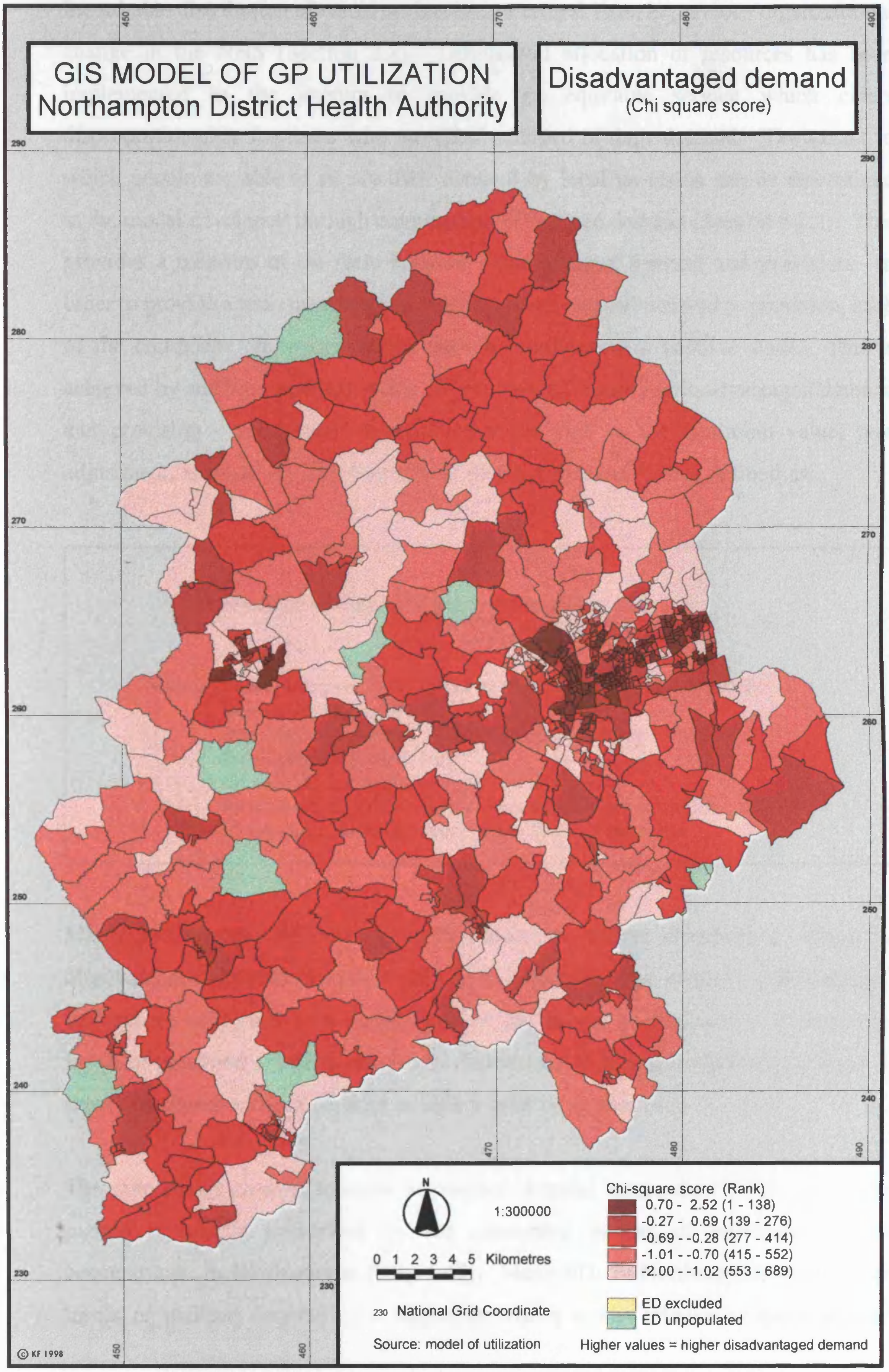
Disadvantaged demand = Σ (Need+Accessibility)

where, Disadvantaged demand is the extent to which people are impaired in their exigency for health care;
for need, higher x^2 values = higher levels of need; and
for accessibility, higher x^2 values = lower levels of accessibility.

The chi-square values for the need component are measured such that high x^2 values indicate higher levels of need. The accessibility component measures the degree to which obstacles to accessibility exist. Higher x^2 values thus indicate lower relative accessibility. In measuring disadvantaged demand, therefore, the accessibility and need scores are added, in order to distinguish between areas of high need and poor accessibility (i.e. high disadvantaged demand), on the one hand, and low need and good accessibility (low disadvantaged demand) on the other.

Map 6.49 illustrates disadvantaged demand in the NDHA area. Higher values indicate a higher level of disadvantage. As with the previous measure of utilization, levels of disadvantaged demand vary greatly. Parts of the main towns exhibit the highest levels of disadvantaged demand; particularly parts of Northampton and Daventry. EDs peripheral to the towns tend to have lower levels of disadvantaged demand.

Map 6.49 Disadvantaged demand (ED)



Inequitable distribution of resources has been a central issue in previous organisational change in the NHS (Section 2.2). Differential allocation of resources has been implemented in the attempt to provide an equitable service which caters disproportionately for those who are disadvantaged in their demand. The extent to which people are able to satisfy their demand by local provision can be determined in the model developed through computation of realized demand (Section 6.2.2). This provides a measure of the ratio between disadvantaged demand and provision. In order to provide a ratio measurement relating disadvantaged demand to provision, each of the composite chi-square scores must be rescored to a positive scale. This is achieved by adding a nominal value, 10, to every ED score for disadvantaged demand and provision - taking care to ensure that the sign of the minimum value, post adjustment, is positive. The measure of realized demand is thus defined as:

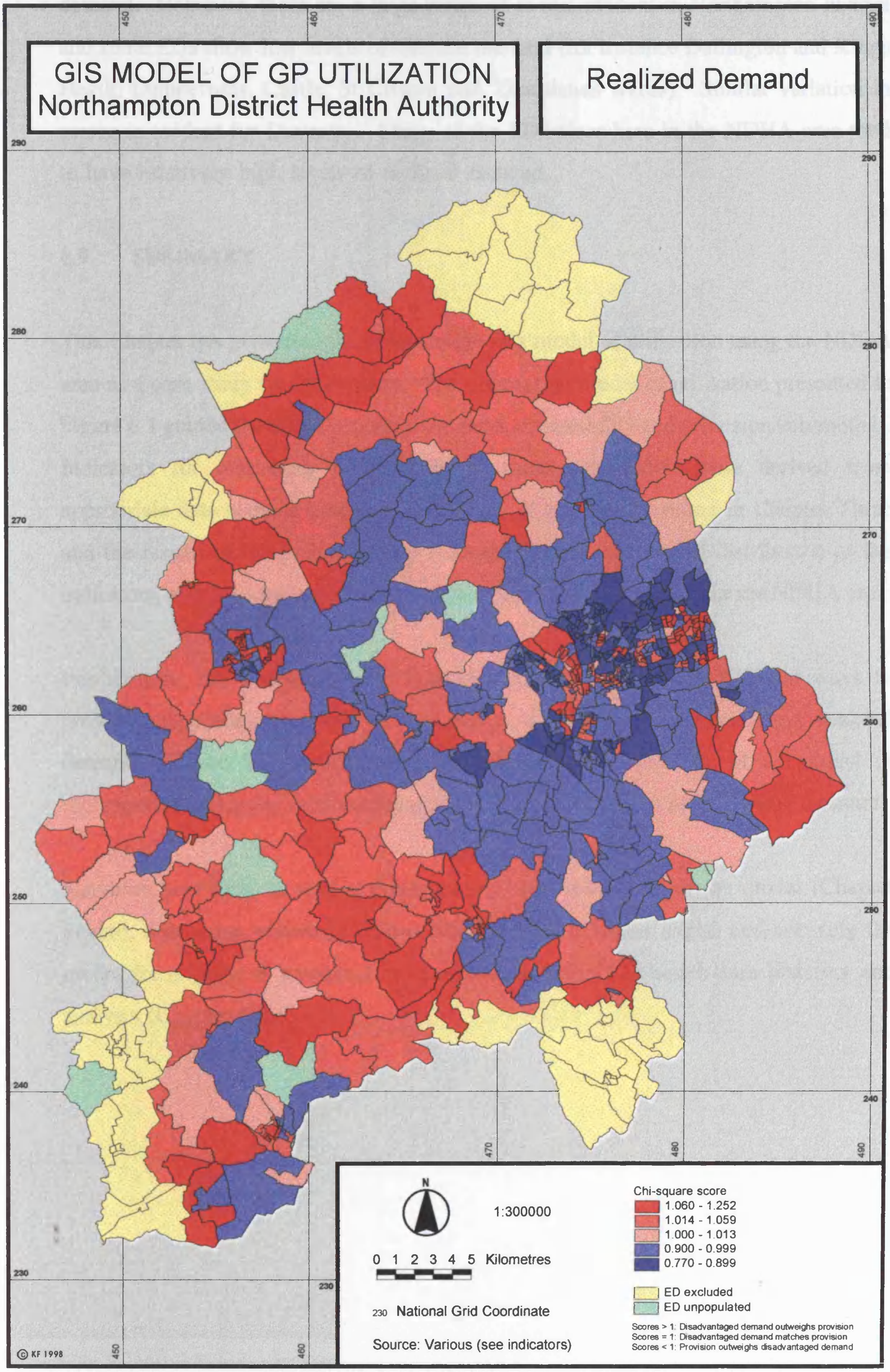
$$\text{Realized demand} = \frac{\text{Disadvantaged demand}}{\text{Provision}}$$

where, Realized demand is the extent to which people are able to satisfy their demand by local provision;
Disadvantaged demand = ((need+10)+(accessibility +10))/2;
Provision = (provision+10);
for need, higher scores = higher levels of need;
for accessibility, higher scores = lower levels of accessibility; and
for provision, higher scores = higher levels of provision.

Map 6.50 illustrates the outcome of this measure. Scores of exactly 1, where the disadvantaged demand:provision ratio is 1:1, indicate that areas of disadvantaged demand are being met by a similar level of provision. Scores below 1 indicate that levels of provision are good relative to disadvantaged demand, while scores above 1 show that disadvantaged demand is higher relative to provision.

The map shows clear differences in realized demand across the NDHA area. The pattern is clearly influenced by the concentric pattern of provision and its concentration in Northampton (Map 6.45). Many EDs in Northampton exhibit high levels of realized demand - i.e. higher provision scores relative to disadvantaged

Map 6.50 Realized demand (ED)



demand. However, there are a large range of scores evident in Northampton district and some EDs show low levels of realized demand (for instance Dallington and Kings Heath, Lumbertubs, Castle, St Crispin and Thorplands wards). Similar variation in scores is evident for Daventry. Many of the EDs elsewhere in the NDHA area tend to have relatively high levels of realized demand.

6.9 SUMMARY

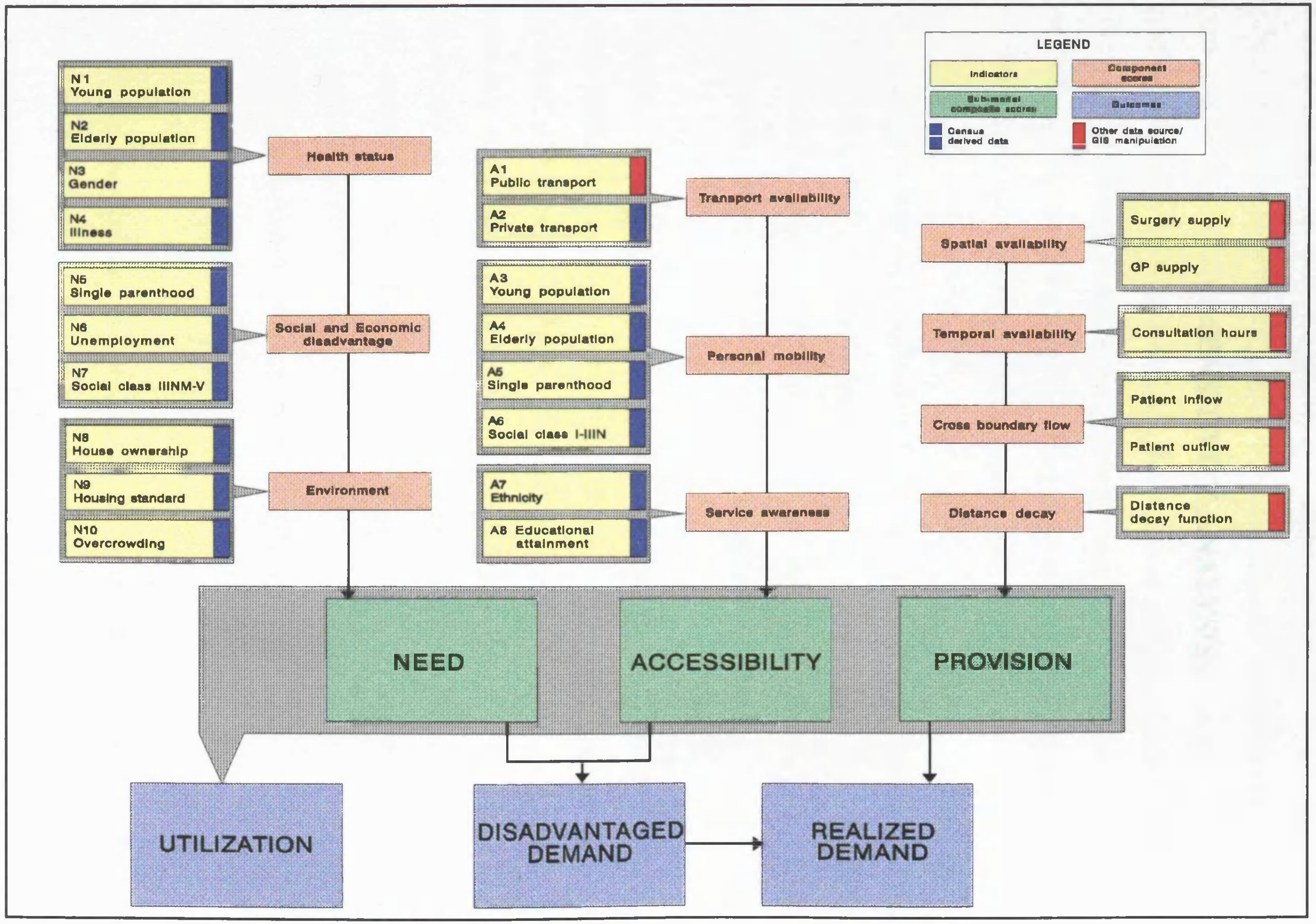
This Chapter has presented the construction of a model of utilization using the NDHA area as a case study for application. The conceptual model of utilization presented in Figure 6.1 guided the development of the need, accessibility and provision sub-models. Indicators for measuring components of these sub-models were derived from appropriate data sources based on the review of relevant literature in Chapter Three and the results of the patient survey (Chapter Five). The spatial distribution of the indicators, and the components they measure, have been discussed for the NDHA area.

Furthermore, the indicators have been combined in a number of useful ways to provide composite measures of utilization, disadvantaged demand and realized demand. Figure 6.5 presents a more comprehensive schematic of the model of utilization showing the relationship of indicators, components and outcome measures.

Attention now turns to testing the sensitivity and robustness of the model (Chapter Seven), comparing outcomes with existing indices (Chapter Eight) and applying the model for a range of scenarios to determine its utility for health care planning and analysis (Chapter Nine).

Figure 6.5 Model of utilization

(author, 1998)



7 SENSITIVITY ANALYSIS

7.1 INTRODUCTION

The content and calculation of the model of utilization (Chapter Six) was developed based on both a detailed review of previous research (Chapters Two and Three) and results from the patient survey (Chapters Four and Five). The indicators have been combined to form an overall index of utilization and, through various combinations, various other outcomes. In general terms, criticism of such indices is that they often suffer from poor conceptualisation and arbitrary selection of indicators (Morris and Carstairs, 1991). Furthermore, limited testing often weakens the extent to which they can be relied upon, substantially reducing their value and utility.

This Chapter addresses these criticisms by examining the stability and robustness of the model of utilization. It is part of a two stage testing process, the second part of which compares the outcomes from the model of utilization with other methods of determining spatial patterns of health service need and disadvantage (Chapter Eight).

In the absence of independent data with which to test outcomes from this model, it is inevitably difficult to evaluate model performance under controlled conditions (on the other hand, of course, if such data was readily available, there would be no real need to develop the model: the primary purpose of the model is to provide a tool for assessing health care utilization where information is not otherwise available). Sensitivity analysis can be used, however, to provide an assessment of:

- the stability and robustness of the model;
- the extent to which the model can be simplified; and
- any gross redundancy of data in the model.

These sensitivity analyses are performed on the need and accessibility sub-models using different techniques:

- correlation analyses to assess the effect of simplifying the model; and
- multiple regression analysis to verify the usefulness of indicators.

7.2 CORRELATION ANALYSES

The full model of utilization is a collection of 24 indicators which have been manipulated and subsequently combined to provide several different outcomes (Section 6.8). As noted, indicators were initially selected on the basis of the conceptual discussion and patient survey results. However, it is possible that the outcomes might be calculated by using a reduced number of indicators, allowing a simplified model to be defined. Simplifying the model would not only reduce complexity but also limit the amount of data required for calculating the outcomes.

In order to compute outcomes from a reduced model, indicators are removed and the composite scores are recalculated for each ED in the case study area. To assess the effect of removing indicators it is necessary to compare the composite scores for reduced versions of the model against those derived from the full model for both the need and accessibility sub-models.

Correlation analysis provides a suitable method for assessing whether a relationship exists between two versions of an outcome x^2 score. In this instance it is used to determine the association between the full model (i.e. where all indicators are used to determine the composite scores) and alternative reduced versions of the model (i.e. where some indicators have been removed prior to the calculation of composite scores).

The analysis is undertaken in two parts: firstly for the need sub-model and, secondly, for the accessibility sub-model. These two sub-models are derived from, respectively, 10 and 8 indicators which are combined to form the composite score. It is not appropriate to perform similar analyses on components of the provision sub-model since this is a more dynamic model, comprising only a small number of component variables.

7.2.1 Correlation analysis: need sub-model

The need sub-model is based on 10 equally weighted indicators reflecting health status, social and economic disadvantage and environment, summarised in Figure 7.1.

Figure 7.1 Summary of need sub-model

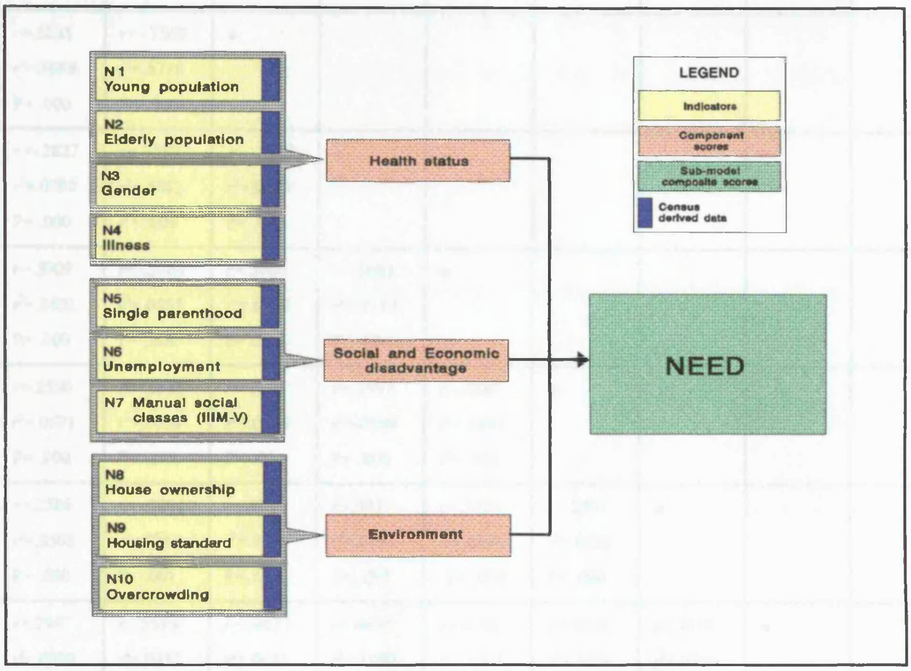


Table 7.1 shows Pearson product moment correlations between these 10 component variables at the ED level. As expected, there is not a great deal of inter-correlation between the indicators in the need sub-model. Most indicators are weakly correlated with each other, suggesting that the indicators chosen are measuring different aspects of need.

A few exceptions exist, where relatively high correlations are found, all of which are to be expected. The correlation between N1 (population age 0-4) and N3 (females age 16-44) is positive, with r=.6235. This reflects the circumstance that the presence of a high proportion of females of child-bearing age is related to a high proportion of those age 0-4. N1 is quite strongly positively correlated (r=.5909) with N5 (single parenthood) for similar reasons. Indicator N2 (population age 80 or over) and N3

Table 7.1 Correlations between need sub-model indicators

	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
N1	•									
N2	r=-.5551 r^2=.3081 P= .000	•								
N3	r=.6235 r^2=.3888 P= .000	r=-.7562 r^2=.5718 P= .000	•							
N4	r=-.2827 r^2=.0799 P= .000	r=.7538 r^2=.5682 P= .000	r=-.5375 r^2=.2889 P= .000	•						
N5	r=.5909 r^2=.3492 P= .000	r=-.2464 r^2=.0607 P= .000	r=.3000 r^2=.0900 P= .000	r=.1083 r^2=.0117 P= .004	•					
N6	r=.2590 r^2=.0671 P= .000	r=-.0589 r^2=.0034 P= .122	r=.1691 r^2=.0286 P= .000	r=.1997 r^2=.0399 P= .000	r=.4342 r^2=.1885 P= .000	•				
N7	r=.2384 r^2=.0568 P= .000	r=-.1264 r^2=.0160 P= .001	r=.1828 r^2=.0334 P= .000	r=.0817 r^2=.0067 P= .032	r=.2926 r^2=.0856 P= .000	r=.2281 r^2=.0520 P= .000	•			
N8	r=.2997 r^2=.0898 P= .000	r=.1538 r^2=.0237 P= .000	r=-.0637 r^2=.0041 P= .095	r=.4416 r^2=.1950 P= .000	r=.6709 r^2=.4501 P= .000	r=.3800 r^2=.1444 P= .000	r=.2818 r^2=.0794 P= .000	•		
N9	r=-.0846 r^2=.0072 P= .026	r=.2037 r^2=.0415 P= .000	r=.0172 r^2=.0003 P= .652	r=.2096 r^2=.0439 P= .000	r=-.0466 r^2=.0022 P= .222	r=.1247 r^2=.0156 P= .001	r=-.0580 r^2=.0034 P= .129	r=-.0731 r^2=.0053 P= .055	•	
N10	r=.3775 r^2=.01425 P= .000	r=-.1093 r^2=.0119 P= .004	r=.1675 r^2=.0281 P= .000	r=.1625 r^2=.0264 P= .000	r=.5461 r^2=.2982 P= .000	r=.4165 r^2=.1735 P= .000	r=.2753 r^2=.0758 P= .000	r=.4049 r^2=.1639 P= .000	r=.2285 r^2=.0522 P= .000	•

(females age between 16-44) are negatively correlated (r=-.7562) reflecting their mutual exclusivity. N2 (population age 80 or over) and N4 (Limiting long term illness) are positively correlated (r=.7538), the elderly being more likely to exhibit higher levels of illness. N5 (single parenthood) is positively correlated (r=.6709) with N8 (LA rented properties), indicating the multiple nature of socio-economic disadvantage experienced by single parents.

Nevertheless, the results of the correlation between indicators does not suggest any gross redundancy in the model since no one indicator is strongly correlated with all others, nor any clusters of strongly correlated indicators.

The second correlation analysis involves removing indicators from the model to examine model stability and potential simplification. Each indicator was removed in turn and the overall need composite score recalculated. This resulted in ten alternative need scores which were then correlated with the full model version. Table 7.2 tabulates correlation coefficients between the need composite score (full model) and the ten recalculated (reduced) model versions.

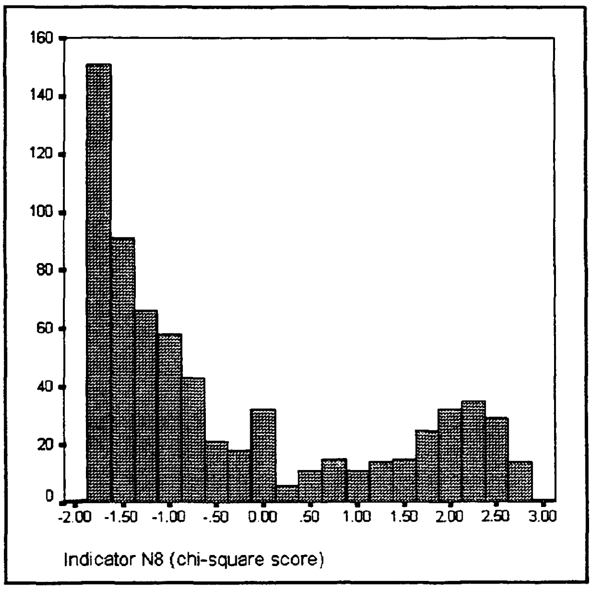
Table 7.2 Correlations between composite need scores derived from the full model version and reduced model versions

		need score (reduced model) calculated with the exception of the indicator(s) stated					
		N1 (n=9)	N2 (n=9)	N3 (n=9)	N4 (n=9)	N5 (n=9)	N6 (n=9)
need score (full model n=10)	r	.9784	.9657	.9795	.9861	.9856	.9916
	P-value	.000	.000	.000	.000	.000	.000
	r^2	.9571	.9326	.9536	.9724	.9714	.9833

		need score (reduced model) calculated with the exception of the indicator(s) stated					
		N7 (n=9)	N8 (n=9)	N9 (n=9)	N10 (n=9)	N4;N6; N10 (n=7)	N3;N4; N5;N6; N9;N10 (n=4)
need score (full model n=10)	r	.9845	.9236	.9820	.9867	.9709	.8982
	P-value	.000	.000	.000	.000	.000	.000
	r^2	.9692	.8530	.9643	.9736	.9426	.8068

As the results show, the removal of any one of the indicators does not greatly alter the model performance, recalculated need scores all maintaining a strong, statistically significant (p<0.001) positive correlation with the original need score. The coefficient of determination for all recalculated need scores, except the score calculated without indicator N8, is above 90% indicating that a very high proportion of the variance is explained by the reduced model in each case. Even when indicator N8 is removed, the r^2 value is still relatively high at 85%. The possible reason for the somewhat lower r^2 value in this case is that the x^2 distribution for indicator N8 is bi-modal (Figure 7.2) whereas all other variables approximate to normal distributions.

Figure 7.2 Frequency distribution of x^2 score for indicator N8



The results of these analyses suggest two things: that the original need sub-model is relatively robust, and not sensitive to the inclusion or removal of any individual variable; but that there may be some redundancy in the model in that several indicators can be removed without affecting the overall score.

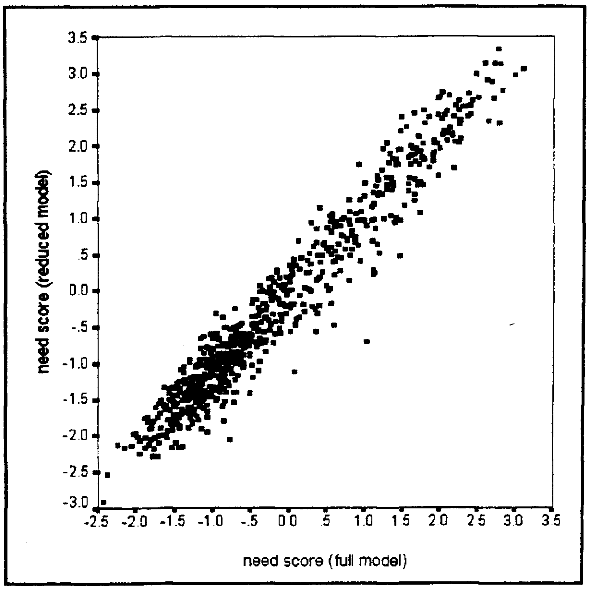
In order to investigate these issues more fully, further need scores were calculated based on the omission of more than one variable. Several alternatives were investigated, two analyses being reported here.

Firstly, the model was recalculated with the removal of indicators N4, N6 and N10.

The removal of each of these indicators, individually in the previous analysis, returned the three strongest positive correlations. Thus, their removal had the least impact upon the need score. Furthermore, the three indicators are designed to reflect different aspects of need and contribute to different components of the need sub-model. Indicator N4 is a constituent of the health status composite score, N6 reflects part of the socio-economic disadvantage composite score and N8 is part of the environment composite score. Removing these variables allows one variable to be deleted from each of the three components of the final need score, maintaining an element of balance in the overall need sub-model.

The resulting need score is a composite of indicators N1, N2, N3, N5, N7, N8 and N9. When correlated with the full model estimate of need, an r value of .9709 is obtained (Table 7.2). The correlation is statistically significant ($p<0.001$) and 94% of the variance is explained by the correlation between the scores. Figure 7.3 illustrates the bivariate distribution of the two scores and shows the strong, positive association between the scores for the full need sub-model and the reduced need model. These results suggest that the three selected indicators might be removed, without greatly altering the outcomes from the model.

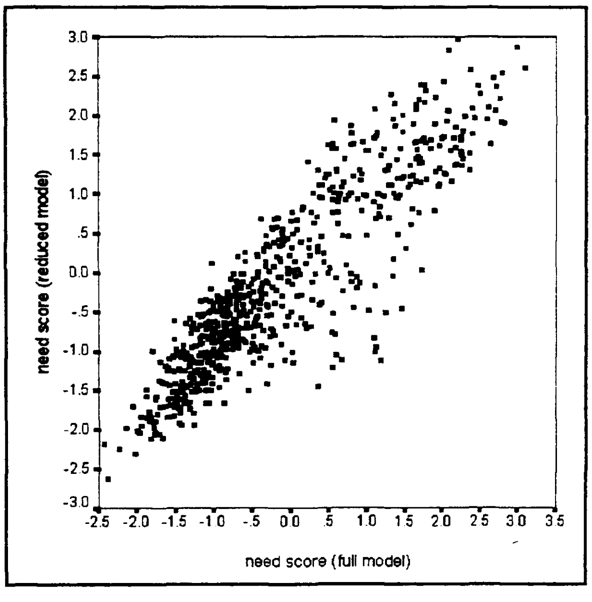
Figure 7.3 **Relationship between need score (full model) and need score (reduced model: N4, N6, N10 omitted)**



In order to test the effects of further simplification of the sub-model, the analysis was repeated, eliminating two variables from each component. Again, variables to be removed were those which had least effect in the initial analysis (Table 7.2). In this case, indicators N3 and N4 were removed from the health status component, N5 and N6 were omitted from the socio-economic disadvantage component and N9 and N10 were removed from the environment component. This resulted in a composite need score calculated from the remaining indicators (N1, N2, N7 and N8) but with each of the three components being represented.

As might be expected, Table 7.2 shows that the correlation between the recalculated need score and the full model version was not as strong (r=.8982). Whilst the correlation remained statistically significant ($p<0.001$) only 81% of the variance is explained by the correlation between the two scores. This weaker association is illustrated in Figure 7.4.

Figure 7.4 Relationship between need score (full model) and need score (reduced model: N3, N4, N5, N6, N9, N10 omitted)

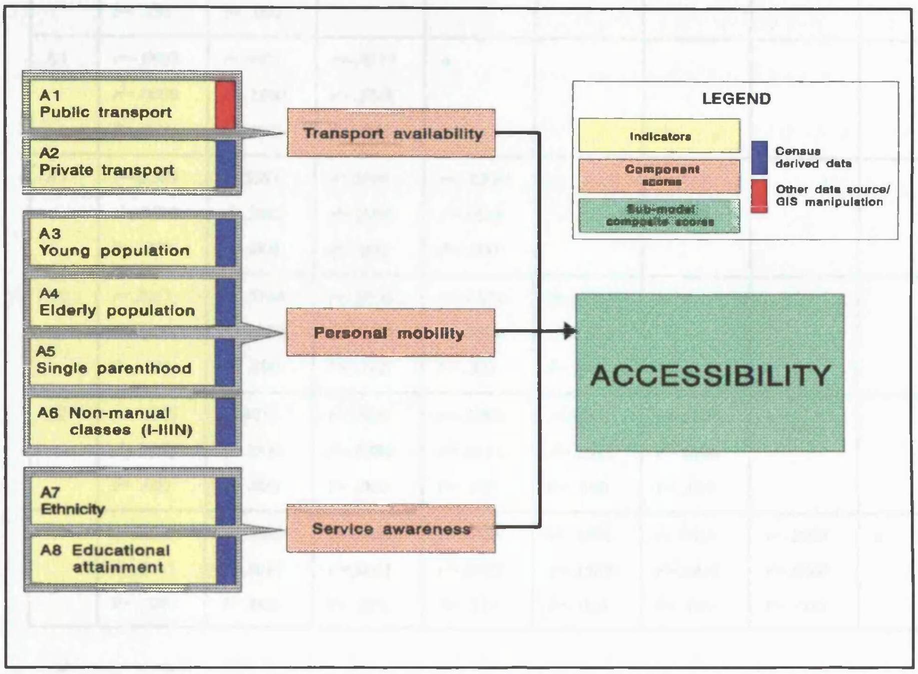


The lower r^2 values, and the wider scatter in the relationship between the full and reduced sub-model, especially at higher need scores, thus suggests that the sub-model is becoming unstable at this point. The removal of these six variables is consequently considered inappropriate.

7.2.2 Correlation analysis: accessibility sub-model

The accessibility sub-model comprises 8 indicators, reflecting the disadvantage caused by obstacles to accessibility. This sub-model is summarised in Figure 7.5. Table 7.3 shows Pearson product moment correlations between these indicators computed for the EDs in the case study area.

Figure 7.5 Summary of accessibility sub-model



As with the analysis undertaken on the need sub-model, there is generally a low degree of inter-correlation between the indicators in the accessibility sub-model. A few correlations do exhibit modest associations, with *r* values above 0.6. The correlation between A3 (population age 0-15) and A4 (population age 65 or over) is negative (r=-.6219), reflecting the mutual exclusivity of these two age groups. A3 also shows a modest positive correlation (r=.5404) with indicator A5 (single parenthood). This association is expected since a high proportion of single parents will be associated with a high proportion of those age 0-15. Indicator A2 (households with no access to a car) shows some negative correlation (r=-.5744) with indicator A6 (non-manual households) reflecting the tendency for less affluent populations to have

Table 7.3 Correlations between accessibility sub-model indicators

	A1	A2	A3	A4	A5	A6	A7	A8
A1	•							
A2	r=-.4045 r^2=.1636 P= .000	•						
A3	r=-.0576 r^2=.0033 P= .131	r=-.1344 r^2=.0180 P= .000	•					
A4	r=-.0003 r^2=.0000 P= .994	r=.3605 r^2=.1300 P= .000	r=-.6219 r^2=.3868 P= .000	•				
A5	r=-.2589 r^2=.0670 P= .000	r=.5387 r^2=.2902 P= .000	r=.5404 r^2=.2920 P= .000	r=-.2299 r^2=.0529 P= .000	•			
A6	r=.2957 r^2=.0874 P= .000	r=-.5744 r^2=.3300 P= .000	r=-.0533 r^2=.0028 P= .162	r=-.0379 r^2=.0014 P= .321	r=-.4031 r^2=.1625 P= .000	•		
A7	r=-.4645 r^2=.2158 P= .000	r=.4833 r^2=.2336 P= .000	r=.1949 r^2=.0380 P= .000	r=-.1063 r^2=.0113 P= .005	r=.4260 r^2=.1815 P= .000	r=-.2974 r^2=.0884 P= .000	•	
A8	r=.3228 r^2=.1042 P= .000	r=-.5520 r^2=.3047 P= .000	r=-.0462 r^2=.0021 P= .226	r=-.0469 r^2=.0022 P= .219	r=-.3981 r^2=.1585 P= .000	r=.6663 r^2=.4440 P= .000	r=-.2021 r^2=.0408 P= .000	•

higher proportions of non-car ownership. A2 is also positively correlated (r=.5387) with indicator A5, suggesting that the multiple nature of socio-economic disadvantage experienced by single parents reduces their transport availability.

Finally, indicator A6 is positively correlated (r=.6663) with indicator A8 (low educational attainment). At first sight this is an apparent anomaly, since it might be expected that a high proportion of low educational attainment is more likely to be associated with manual social classes. In this case, however, high proportions of non-manual classes tend to occur in suburban and rural EDs (Section 6.6.2) with manual classes more prevalent in the main towns (Section 6.5.2). The converse is true for low educational attainment (Section 6.6.3). The reasons for this may be partly due to the residency characteristics of large proportions of undergraduate and postgraduate students who are concentrated in particular locations (for instance Abington ward). These areas exhibit much lower scores for a lack of educational attainment (i.e. higher educational attainment) but, additionally, display low proportions of non-manual households.

This relationship casts some doubt on the indicator lack of educational attainment, based on the lack of diploma/degree or higher degree. As calculated, this indicator is restricted to those who engage in higher education, and does not consider other forms of attainment perhaps achieved by a larger proportion of the population. To address this effect, it would be more appropriate to use secondary education qualifications; as noted in Section 6.6.3, however, this data is not routinely available.

Despite these exceptions, the majority of indicators only weakly correlate with each other. No one indicator is strongly correlated with all others, suggesting that there is no gross redundancy in the accessibility sub-model.

As with the analyses undertaken on the need sub-model, indicators were removed in turn and the overall accessibility composite score recalculated. This resulted in eight alternative accessibility scores which were then correlated with the full model version of accessibility. The correlation coefficients between the accessibility sub-model composite score (full model) and the eight reduced sub-model versions are presented in Table 7.4.

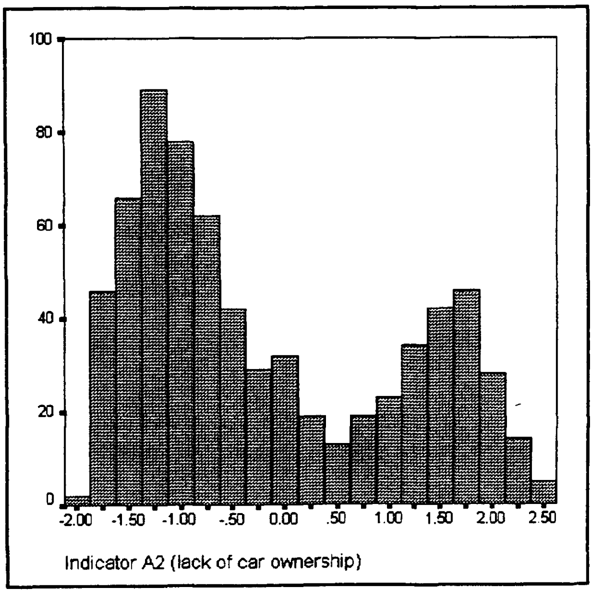
The majority of the recalculated sub-model composite scores for accessibility show a strong, statistically significant ($p<0.001$), positive correlation with the full model accessibility score. Additionally, the coefficient of determination for all but one of the recalculated need scores is above 90%, indicating that removal of the indicators does not destabilise the model. Where indicator A2 is omitted, however, the correlation coefficient falls to .7989 (r^2 is 64%). As with indicator N8 in the need sub-model, the frequency distribution for A2 shows a bi-modal distribution, unlike other variables (Figure 7.6).

Table 7.4 Correlations between composite accessibility scores derived from the full model version and reduced model versions

		accessibility score (reduced model) calculated with the exception of the indicator(s) stated					
		A1 (n=7)	A2 (n=7)	A3 (n=7)	A4 (n=7)	A5 (n=7)	A6 (n=7)
accessibility score (full model n=8))	r	.9584	.7989	.9629	.9506	.9793	.9764
	P-value	.000	.000	.000	.000	.000	.000
	r^2	.9185	.6382	.4801	.9036	.9590	.9534

		accessibility score (reduced model) calculated with the exception of the indicator(s) stated				
		A7 (n=7)	A8 (n=7)	A1;A5; A7 (n=5)	A5;A6; A7 (n=5)	A5;A6 (n=6)
accessibility score (full model n=8)	r	.9696	.9470	.8231	.7109	.9666
	P-value	.000	.000	.000	.000	.000
	r^2	.9401	.8968	.6775	.5054	.9343

Figure 7.6 Frequency distribution of x^2 score for indicator A2



The results suggest that the accessibility sub-model is generally robust but shows some sensitivity to the loss of indicator A2. With the exception of this variable, it should thus be possible to simplify the sub-model, without affecting the outcomes.

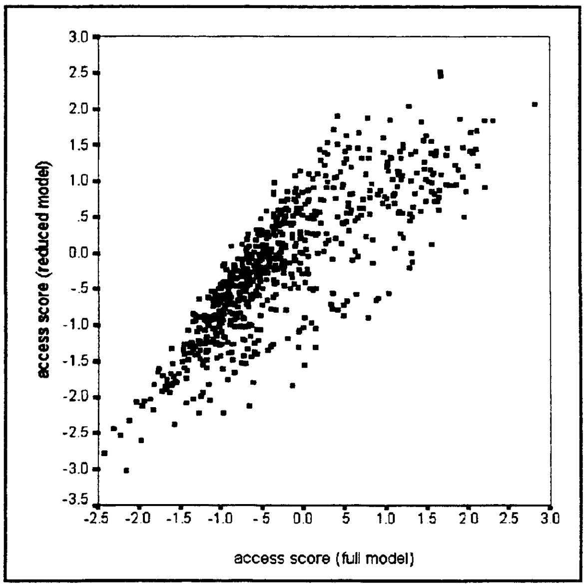
To investigate this possibility further, analyses were conducted removing a combination of several indicators simultaneously. Several different combinations were eliminated in this process. Three alternatives are reported here.

The first attempt followed the same principle as previously used in the need sub-model, whereby the recalculated accessibility scores (with single indicator omissions) were used to identify variables which could be removed with least effect on the sub-model outcomes. One variable was thus omitted for each component, in order to retain the general balance between components established in the full model. On this basis, three indicators were initially removed - variable A1 from the transport availability components, variable A5 from the personal mobility components and variable A7 from the service awareness component. Removing variable A1 has the added advantage that it is the only variable not derived from the census data - and so is the most difficult data to obtain. This provides a composite accessibility score derived from indicators A2, A3, A4, A6, and A8 (Table 7.4).

When the recalculated accessibility score is correlated with the full accessibility sub-model score it yields an *r* value of .8231. The correlation is statistically significant ($p<0.001$) but only 68% of the variance is explained by the correlation between the scores (Table 7.4), and a relatively large scatter occurs in the bivariate distribution, especially at higher accessibility scores (Figure 7.7). These results suggest that removal of these three variables begins to destabilise the model.

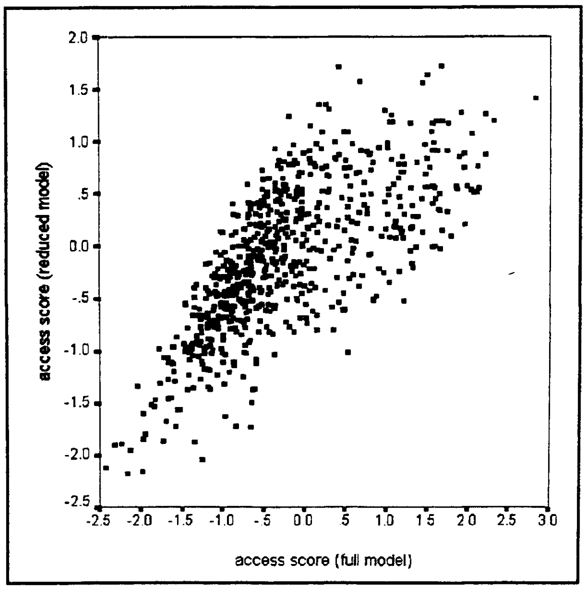
In a second analysis, A6 was removed in place of indicator A1. In this case, therefore, the three indicators which individually had least effect on the model outcome are removed, but a different number of variables have been removed for each component. This leaves a composite accessibility score based on indicators A1, A2, A3, A4 and A8 (Table 7.4).

Figure 7.7 Relationship between accessibility score (full model) and accessibility score (reduced model: A1, A5, A7 omitted)



The recalculated accessibility score exhibits a weaker correlation (*r*=.7109) with the full model accessibility score than the previous analysis. The correlation remains statistically significant (p<0.001) but only 51% of the variance is explained by the correlation between the scores (Table 7.4). The weaker bivariate association is reflected in the increased scatter in the bivariate distribution illustrated in Figure 7.8.

Figure 7.8 Relationship between accessibility score (full model) and accessibility score (reduced model: A5, A6, A7 omitted)



Neither of these attempts at simplifying the accessibility sub-model is wholly successful. In the full model, both the transport availability and service awareness components are a combination of two indicators and the previous two attempts to simplify the model have reduced the number of indicators to one. In practice, however, it is not appropriate to let a component of accessibility be based on only one indicator for two important reasons.

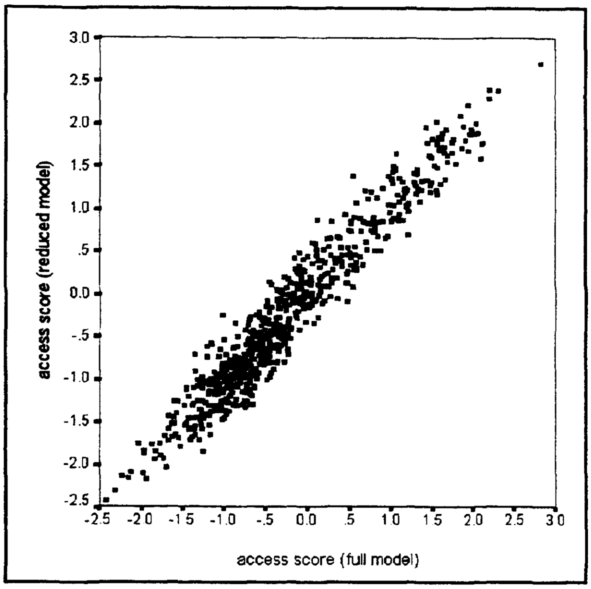
The first is that this makes the accessibility measure extremely vulnerable to variations or errors in that indicator, potentially creating instability in the model. The second is that accessibility is a complex phenomenon, the components of which cannot be expected to be fully described by any single variable.

For these reasons, the final attempt at simplification does not omit indicators from either the transport availability or service awareness components. This maintains their calculation based on two indicators. The indicators chosen for omission are, instead, A5 and A6, from the personal mobility component. When omitted individually, the resulting accessibility scores exhibited strong positive correlations with the full model version of the accessibility score. It may thus be expected that they can both be removed without serious effect on the accessibility score. The resulting composite accessibility score is therefore based on indicators A1, A2, A3, A4, A7 and A8 - i.e. two indicators for each component (Table 7.4).

A much stronger positive correlation with the full model is produced using this reduced set of indicators (r=.9666). The correlation is statistically significant ($p<0.001$) and 93% of the variance is explained by the correlation between the scores (Table 7.4). Figure 7.9 shows that the omission of these two indicators results in a recalculated accessibility score which has a strong and linear association with the full model version.

The results of these analyses thus suggest that it is possible to simplify the sub-model of accessibility by removing indicators A5 and A6 from the personal mobility component.

Figure 7.9 Relationship between accessibility score (full model) and accessibility score (reduced model: A5, A6, omitted)



7.3 MULTIPLE REGRESSION ANALYSIS

The correlation analyses, in the previous section, suggested ways in which the sub-models could be simplified. Indicators were removed on the basis of a number of criteria, and the reduced models tested by comparison with results from the full sub-models. Another way of testing the contribution of the various indicators in the model is through the use of multiple regression analysis.

For the need and accessibility sub-models, multiple regression analysis can be used to assess the extent to which the independent indicators account for variability in the composite score. The analysis determines the most appropriate combination of indicators to predict the composite score. Stepwise multiple regression analysis adds indicators in a cumulative manner, commencing with the single indicator which most closely correlates with the full model composite score. Indicators are subsequently added according to the strength of their partial correlation with the full sub-model composite score. At each step an adjusted correlation coefficient (*R*) is calculated between the included indicators and the full sub-model composite score. At each step of the calculation, it is possible to identify and verify the contribution provided by the additional indicator and assess the extent to which its inclusion improves the sub-model (i.e. improves the strength of correlation with the full model composite score). In this way, it is possible to identify redundant or minor indicators which might legitimately be removed.

7.3.1 Multiple regression analysis: need sub-model

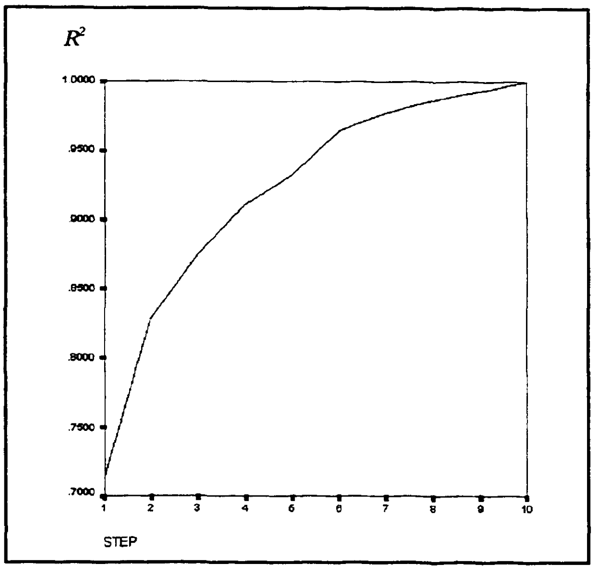
Summary results of a stepwise multiple regression on the need sub-model are shown in Table 7.5 and illustrated in Figure 7.10. Of all indicators in the need sub-model, N8 (LA rented homes) exhibits the strongest positive correlation with the full model composite score and is thus the first to be included (*R*=.8452) representing 71% of the full model variance (Table 7.5). As additional indicators are incorporated into the multiple regression the correlation coefficient improves.

Table 7.5 Stepwise multiple regression: need sub-model
Dependent variable: need score (full sub-model version)

Step	1	2	3	4	5	6	7	8	9	10
Variable entered	N8	N10	N9	N7	N4	N1	N6	N5	N2	N3
R	.8452	.9105	.9354	.9546	.9656	.9821	.9885	.9932	.9967	1
R^2	.7144	.8289	.8749	.9112	.9324	.9645	.9772	.9865	.9935	1
ΔR^2	.7144	.1145	.046	.0363	.0212	.0321	.0127	.0093	.003	.0065

Indicator N10 (*R*=.9105) is the second variable to be included, adding 11.5% to r^2. This is followed by variable N9 (R=.9354), adding 4.6%. At step 3, therefore, the need sub-model is defined by the three environment variables, which together explain 87.5% of the variation in the full sub-model. At step 4, variable N7 is included, adding 3.6% followed by variable N4 at step 5 (adding 2.1%), N1 at step 6 (adding 3.2%) and N6 at step 7 (adding 1.3%). At this stage, three of the social and economic disadvantage indicators have been included and only one of the health status indicators (N1) has been included. Indicator N5 is included at step 8 (adding 0.9%) followed by indicator N2 at step 9 (adding 0.3%) and, finally, N3 at step 10 (adding 0.7%). The inclusion of indicators N2 and N3 in the last two steps of the analysis suggests

Figure 7.10 Stepwise multiple regression: need sub-model



that these are the least important. In terms of the sub-model, this means that the health status component is the least important, with none of the indicators being included until step 6 and two indicators being included last.

The analysis indicates that it is possible to run the need sub-model with fewer indicators and achieve a reasonably accurate prediction which correlates with the full model score. The minimum number of variables required to achieve a reasonable proxy for the full sub-model is four (N8, N10, N9, N7). These represent the three indicators used to measure aspects of the environment and manual social class, part of the socio-economic disadvantage component. The use of six indicators improves the correlation further and incorporates two indicators from the health status component.

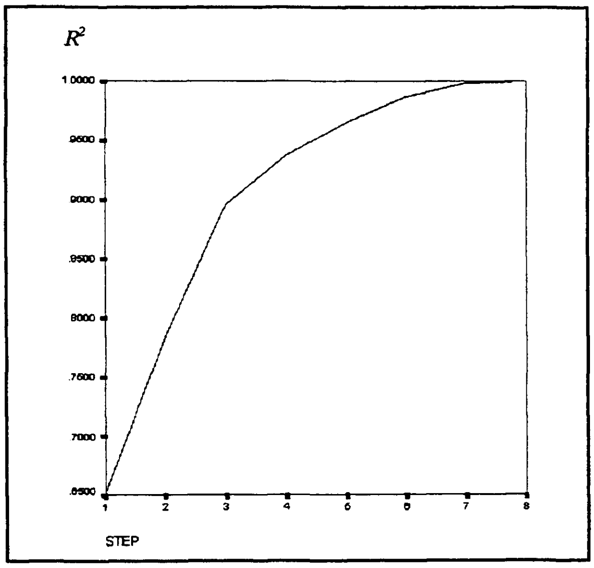
7.3.2 Multiple regression analysis: accessibility sub-model

Table 7.6 and Figure 7.11 summarise results from a similar stepwise multiple regression analysis on the accessibility sub-model.

Table 7.6 Stepwise multiple regression: accessibility sub-model
Dependent variable: accessibility score (full model version)

Step	1	2	3	4	5	6	7	8
Variable entered	A7	A2	A8	A3	A4	A6	A5	A1
R	.8078	.8856	.9461	.9678	.9823	.9936	.9993	1
R^2	.6525	.7843	.8951	.9367	.9650	.9872	.9985	1
ΔR^2	.6525	.1318	.1108	.0416	.0283	.0222	.0113	.0015

Figure 7.11 Stepwise multiple regression: accessibility sub-model



Indicator A7 (ethnicity) exhibits the strongest positive correlation with the full model accessibility score (.8078) accounting for 65% of the variance, and so is the first variable to be introduced. This is followed by indicator A2 (R=.8856) which adds 13.2% to the R^2 value, and variable A8 (R=.9461) which adds 11.1%. Subsequent variables add relatively little to the level of explanation, as shown by the change in slope in Figure 7.11.

As with the need sub-model analysis, the accessibility sub-model can thus be simplified to only 3 indicators (A7, A2, A8) with relatively little effect on the outcome. At this stage, however, only indicators from the service awareness and transport availability components are included. Addition of the fourth indicator (A3) incorporates a measure of personal mobility, and the R^2 value increases by 4.2% to 93.7%.

Simplification of the model in these ways offers potential savings in terms of data needs. Indicators derived from the census will, normally, be equally available and will not present a problem in the construction of the model. However, in the accessibility sub-model, the inclusion of an indicator measuring the impact of lack of public transport (A1) may present greater problems. The data may also require considerable manipulation in order make it comparable with other indicators (Section 6.6.1). The multiple regression analysis shows that the loss of this indicator has a negligible effect on model performance: it is the last to be included and the correlation between the remaining seven indicators and the full score is extremely strong (R=.9993; R^2=.9985).

Given the difficulties involved in using this indicator, it may thus be worthwhile to remove it from the sub-model. However, omission of this indicator should be considered with care, since public transport provision may differ considerably from the case study area used here, possibly having a greater impact elsewhere.

7.4 IMPACT OF MODEL SIMPLIFICATION ON OUTCOMES

As the previous two sections have indicated, simplification of the need and accessibility sub-models is possible. However, any simplification cannot be undertaken without considering the effect on the model outcomes, namely utilization, disadvantaged demand and realized demand (Section 6.8). This section examines the robustness of the model in terms of these outcomes, by comparing results from the full model with those from a reduced version.

As the correlation and multiple regression analyses suggested there are a number of different ways in which the two sub-models can be simplified. For the purposes of the following analysis, the need score is recalculated without indicators N4, N6 and N10. As Section 7.2.1 indicated, the omission of these indicators results in a correlation between the recalculated score and the full model score of R=.9709 (explaining 94.3% of variation). The accessibility score is recalculated without indicators A5 and A6, which resulted in a correlation with the full model score of R=.9666 (explaining 93.4% of variation; Section 7.2.2).

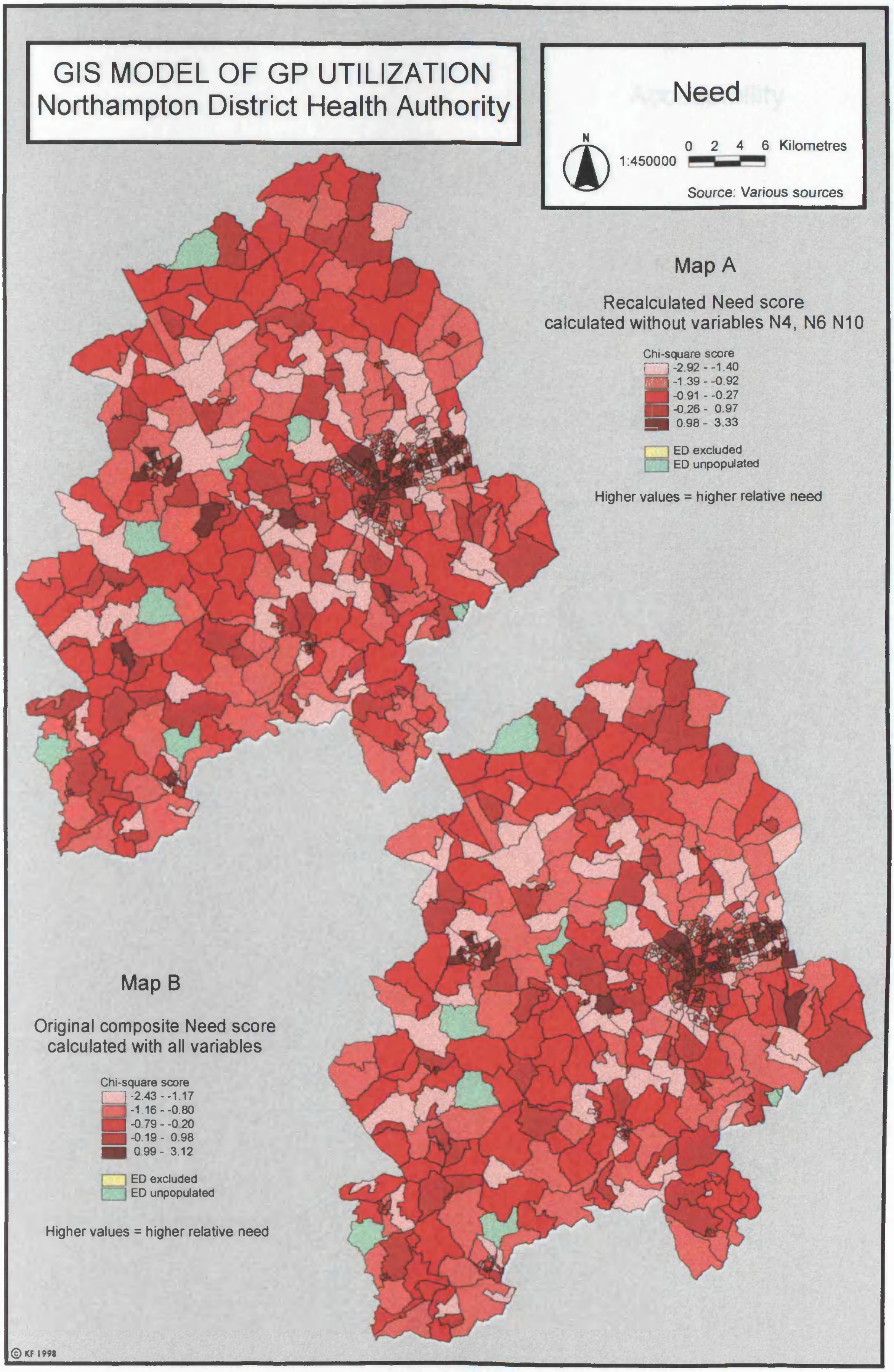
Maps 7.1 and 7.2 illustrate the effect of recalculating the need and accessibility x^2 scores for the NDHA area using the reduced sub-models. Scores for Maps 7.1(a) and (b) are classified into quintiles. Very little variation exists between the two maps with only a few EDs being reclassified in the class immediately above or below due to the recalculation of the score. The different class widths show that the x^2 scores vary in absolute terms from the full model but, since the score is relative, this does not alter the spatial pattern. Maps 7.2(a) and (b) are also very similar, again with only a few EDs changing class.

The sub-model maps are thus similar, but the effect of using the recalculated need and accessibility scores in the overall model can only be assessed by recalculating outcome scores.

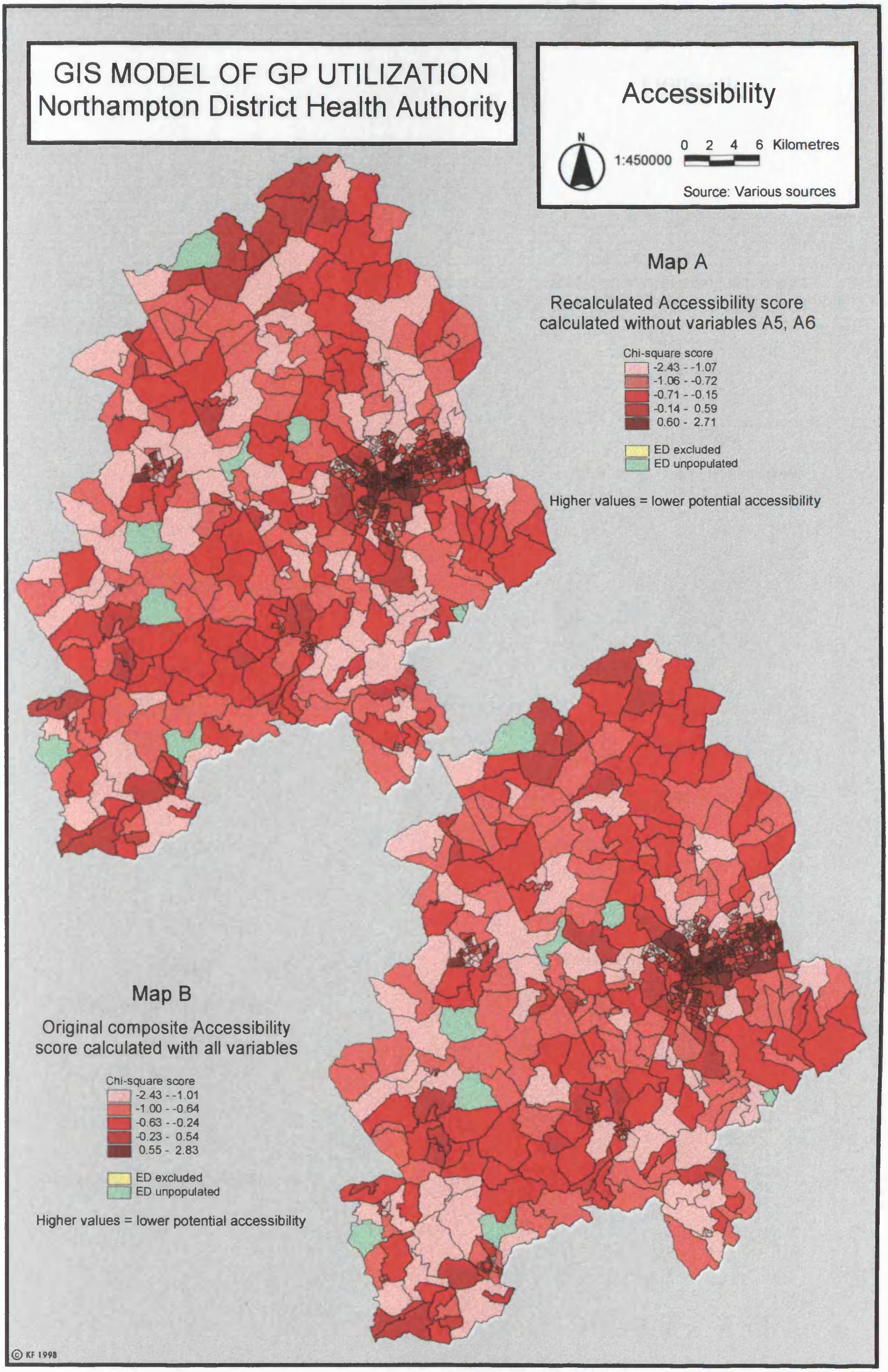
The comparison of the full model utilization score with the reduced model version is illustrated in Map 7.3. The difference between Map 7.3(a) and (b) is more marked than the differences between need and accessibility maps. The use of recalculated need and accessibility scores has increased the range of scores. Furthermore, many more EDs have changed quintile class, resulting in an apparent increase in utilization in many EDs, particularly those which are in rural South Northamptonshire and Daventry districts. Conversely, some EDs in Northampton district show an apparent decrease in utilization.

A correlation analysis between the full model utilization score and the reduced model score shows that, despite the visual differences, a strong positive correlation exists (R=.9428, R^2=.89). This suggests that the use of recalculated need and accessibility scores does not alter the utilization score to any significant extent (Figure 7.12).

Map 7.1 Comparison of need (full and reduced models)



Map 7.2 Comparison of accessibility (full and reduced models)



Map 7.3 Comparison of utilization (full and reduced models)

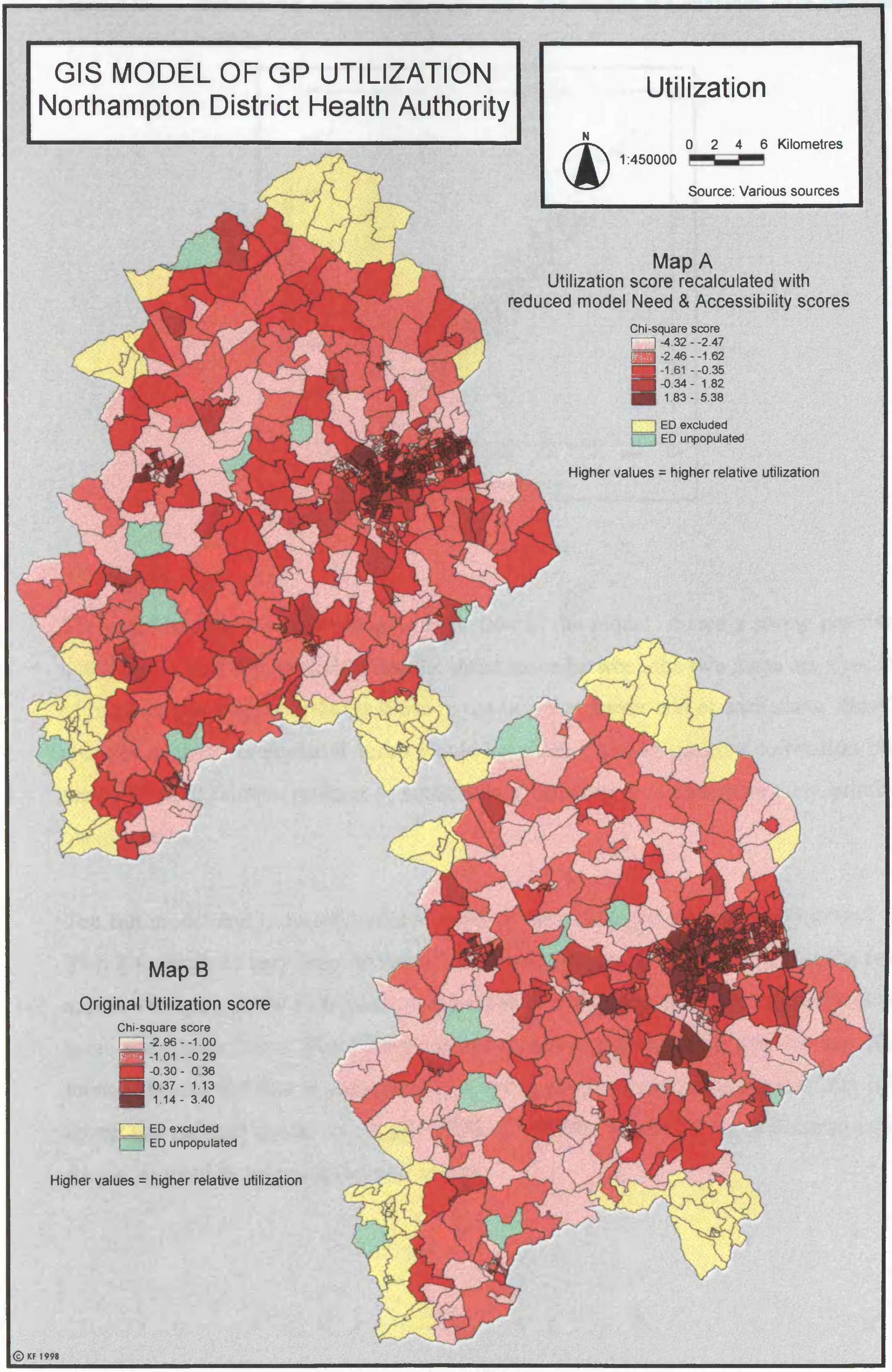
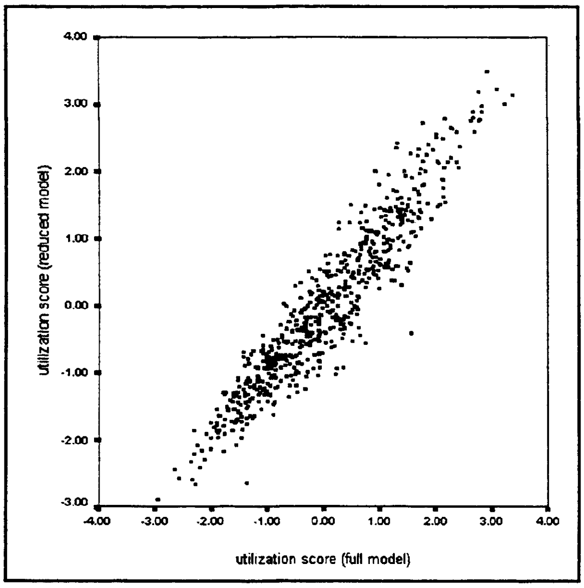


Figure 7.12 Relationship between utilization score (full model) and utilization score (reduced model)



The outcome remains stable despite reduction in the model. Since a strong positive correlation exists it is probable that the differences between the two maps are a result of many scores originally being close to the upper or lower end of each class. Small changes in their recalculated score would result in a strong positive correlation but may alter their relative ranking to some extent, resulting in a change in their quintile classification.

The full model and reduced model version of disadvantaged demand is illustrated in Map 7.4. There is very little difference between the quintile classifications of the two scores with only a few EDs being represented in a different class on the recalculated score map (Map 7.4a). The relative scores therefore remain stable with the use of a reduced model and this is supported by a strong positive correlation between the full model and reduced model scores (R=.9798, R^2=.9600). Figure 7.13 also illustrates the strong correlation between the two scores.

Map 7.4 Comparison of disadvantaged demand (full and reduced models)

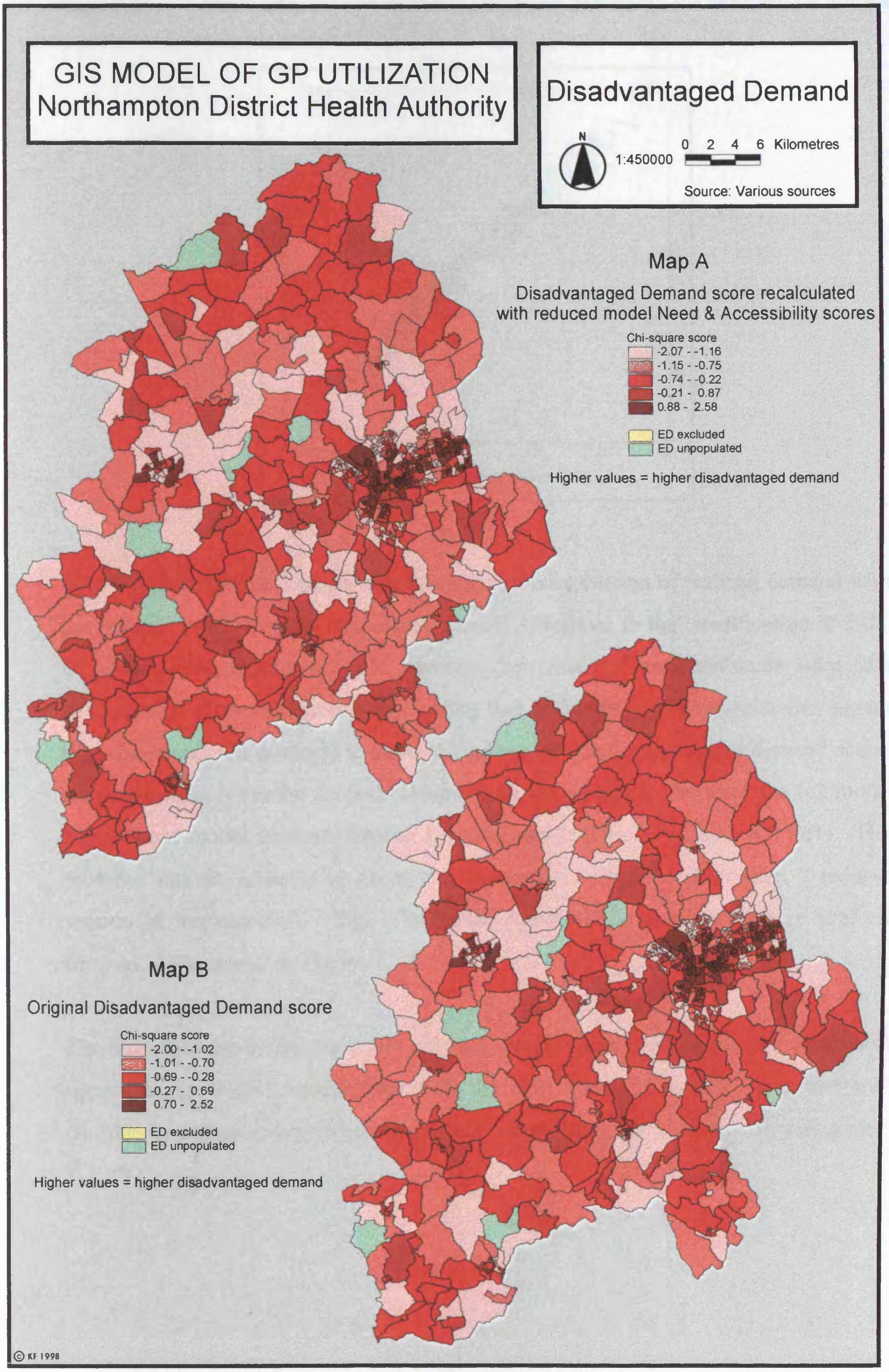
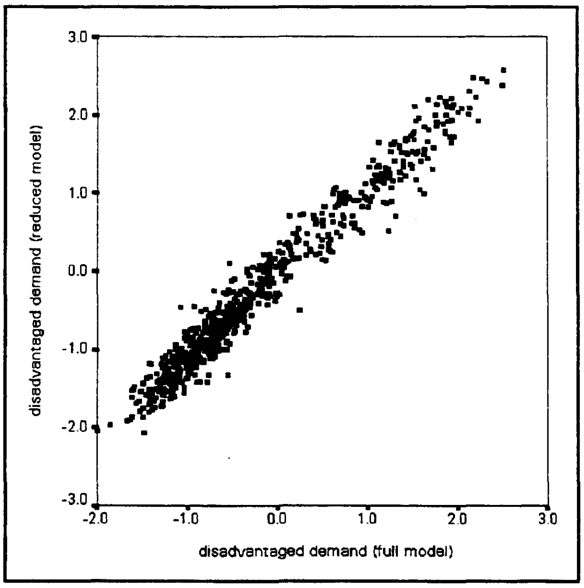


Figure 7.13 Relationship between disadvantaged demand (full model) and disadvantaged demand (reduced model)



Map 7.5 illustrates the comparison of the full model version of realized demand with the reduced model version and shows a small difference in the classification of EDs. Of perhaps most significance is the tendency, as a result of recalculation for some EDs to shift from scores of below 1 (indicating that provision scores are relatively higher than disadvantaged demand) to above 1 (indicating that disadvantaged demand scores are greater than provision scores). Despite this, the correlation between the full model and reduced model realized demand is strong and positive (R=.9803, R^2=.961). This provides further evidence to show that the model remains stable when a reduced version is implemented. The relationship between the two versions of realized demand is illustrated in Figure 7.14.

The three reduced model outcomes are thus seen to show strong, positive, statistically significant ($p<0.001$) correlations with the full model outcomes. It is therefore possible to reduce the model and maintain outcomes in line with the original scores.

Map 7.5 Comparison of realized demand (full and reduced models)

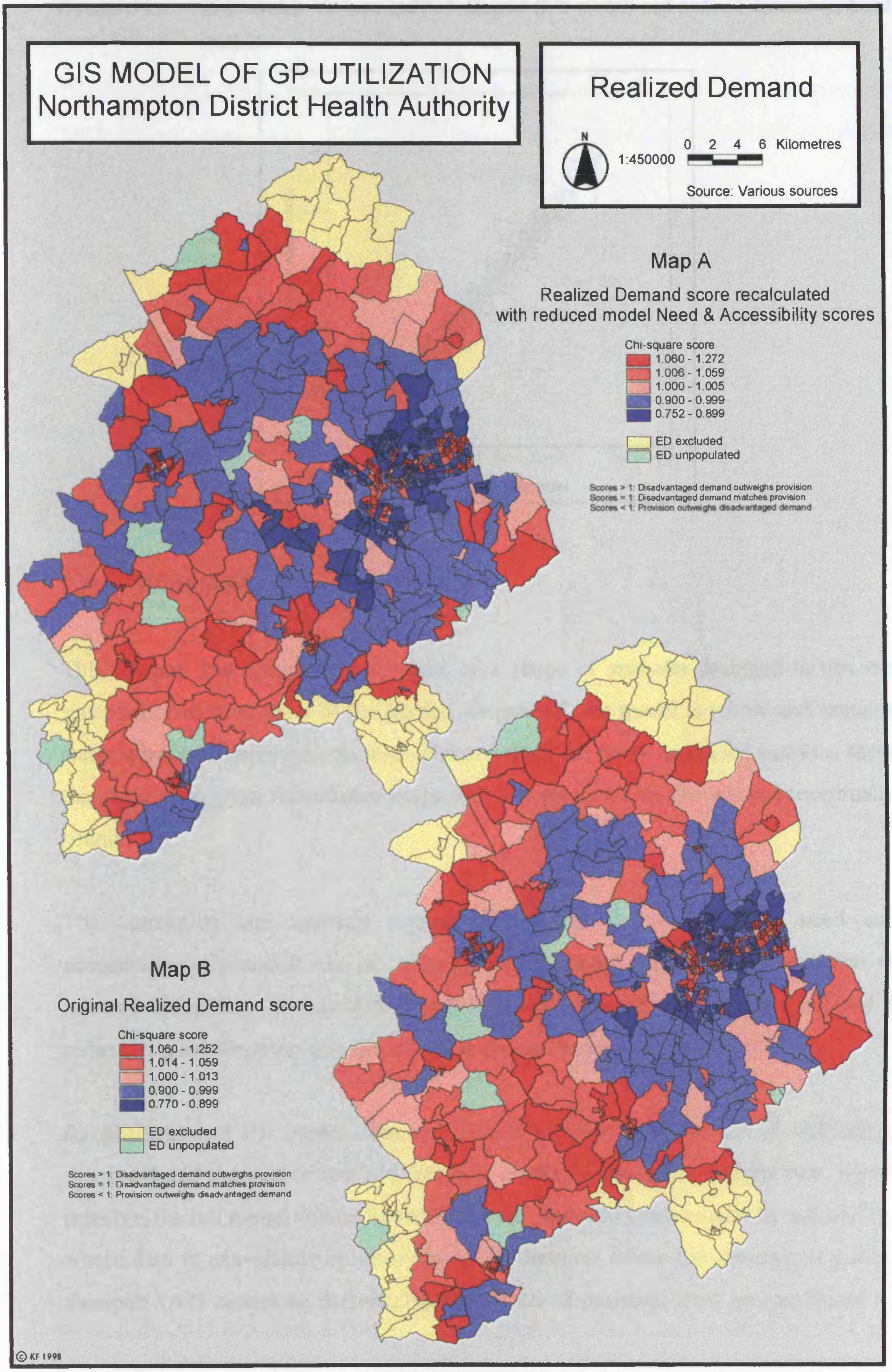
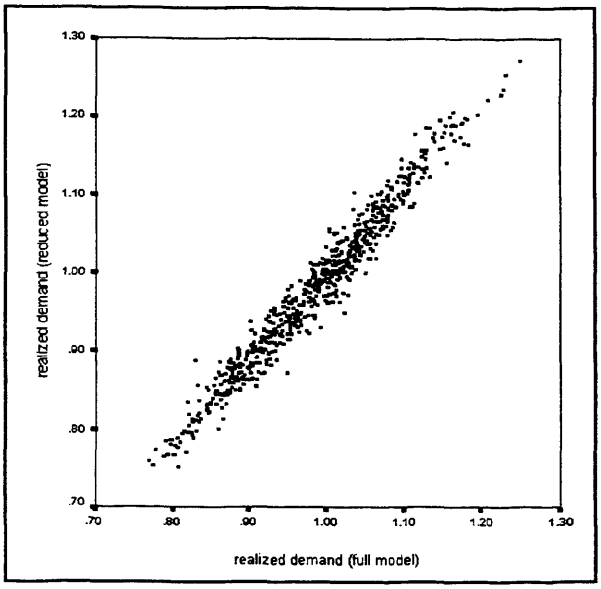


Figure 7.14 Relationship between realized demand (full model) and realized demand (reduced model)



7.5 SUMMARY

This Chapter has presented the results of a range of analyses designed to test the sensitivity and robustness of the model. In general, the model is robust and remains stable when indicators are removed. Nevertheless, the inter-correlation analyses show that there is no gross redundancy in the data and the model is, therefore, conceptually sound.

The correlation and multiple regression analyses indicate that the need and accessibility sub-models can be simplified to a certain extent by the omission of selected indicators. A comparison between outcomes derived from the full and a reduced model illustrate that the outcome measures also remain stable.

Simplification of the model does not generally affect the measures of utilization, disadvantaged demand or realized demand. However, the results suggest that, where possible, the full model should be implemented. Reduced versions may be appropriate where data is unavailable or unworkable, for instance where the measure of public transport (A1) cannot be derived, but the effects of omission must be considered as part of any attempts to simplify the model.

Chapter Eight tests the model of utilization further by assessing it in relation to other methods of examining spatial difference in inequality to determine relative disadvantage. The full version of the model is used for this purpose.

8 COMPARING INDICES

8.1 INTRODUCTION

This Chapter presents the second stage of testing the model of utilization. It compares the performance of the disadvantaged demand component of the model with a number of other, widely recognised, indices of deprivation or disadvantage.

The disadvantaged demand component of the utilization model is derived from measures of need and accessibility, each of which is broadly a measure of disadvantage: higher levels of need are assumed to reflect higher levels of disadvantage; more limited accessibility to health services, likewise, is assumed to be associated with increased disadvantage (Section 6.8). In conceptual terms, therefore, the disadvantaged demand component of the model is closely associated with other indices which measure disadvantage and deprivation.

Several such indices have been devised in recent years, and the most widely recognised were reviewed in Section 2.2. The choice of which indices to use for comparison is a pragmatic one since many alternative indices exist (for example DoE, 1983; Duguid and Grant, 1983; Carstairs and Morris, 1989a; 1989b; Balarajan et al, 1992). This Chapter examines disadvantaged demand in relation to four such indices.

- The Jarman UPA score
- The Townsend Index of Deprivation
- The Index of Local Conditions
- Young Persons' Support Index

Two of these indices have been selected due to their widespread use and recognised performance (the Jarman UPA score and the Townsend Index). A further two indices (the Index of Local Conditions and the Young Persons' Support Index) have been selected due to their use by local authorities in the NDHA area as decision-support tools.

The Jarman UPA score and Townsend Index of Deprivation were designed specifically to assess the extent of material disadvantage and the relationship with areal variations in health and health services (Jarman, 1983; 1984; Townsend et al, 1988). Both were considered as methods of measuring deprivation in the NHS review of the RAWP formula for distribution of resources (DHSS, 1988) and the Jarman UPA score was subsequently adopted as a health care planning tool as part of the 1990 contract (Health departments of Great Britain, 1989). The use of the Jarman UPA score is thus relevant here due to its adoption as a method of identifying underprivileged areas and determining subsequent allocation of funding for GPs.

A detailed discussion of the methodological differences and resulting outcomes between the Townsend Index and the Jarman UPA score, and other health related indices, is presented by Morris and Carstairs (1991; see also Senior, 1991). Results suggest that the Townsend Index (along with the Scottish Deprivation score: Carstairs and Morris, 1989a; 1989b) explains most variation in deprivation and adheres most closely to the concept of material disadvantage. Indeed, Morris and Carstairs (1991) found that the Jarman UPA score did not perform well in explaining variation and it is for this reason that the Townsend Index is also used here for comparison.

As noted earlier, the Index of Local Conditions and the Young Persons' Support Index are also used for comparison here due to their current use as methods of determining disadvantaged societal groups by Northamptonshire Health Authority (NHA) and Northamptonshire County Council (NCC). The Index of Local Conditions (DoE, 1995) is a method of determining relative levels of deprivation, based on combining census data, and complements the use of the Jarman UPA score and the Townsend Index. The Young Persons' Support Index was devised by the Policy Division of NCC (NCC, 1995). It represents an assessment of the geographical patterns of need among children and their families as a basis for targeting areas of disadvantage. The index is based on a former study by Bebbington and Miles (1989) which identified a series of personal and family characteristics found to be associated with the risk of children being taken into care. As such it provides another, locally relevant, potential measure of disadvantage and it is worthwhile examining the extent to which variation in disadvantaged demand reflects the patterns shown by this index.

The comparisons undertaken here perform two purposes: they provide a partial check on the validity of the measure of disadvantaged demand in this study; and they allow the possibility of substituting existing deprivation measures into the model, in the place of disadvantaged demand, to be examined.

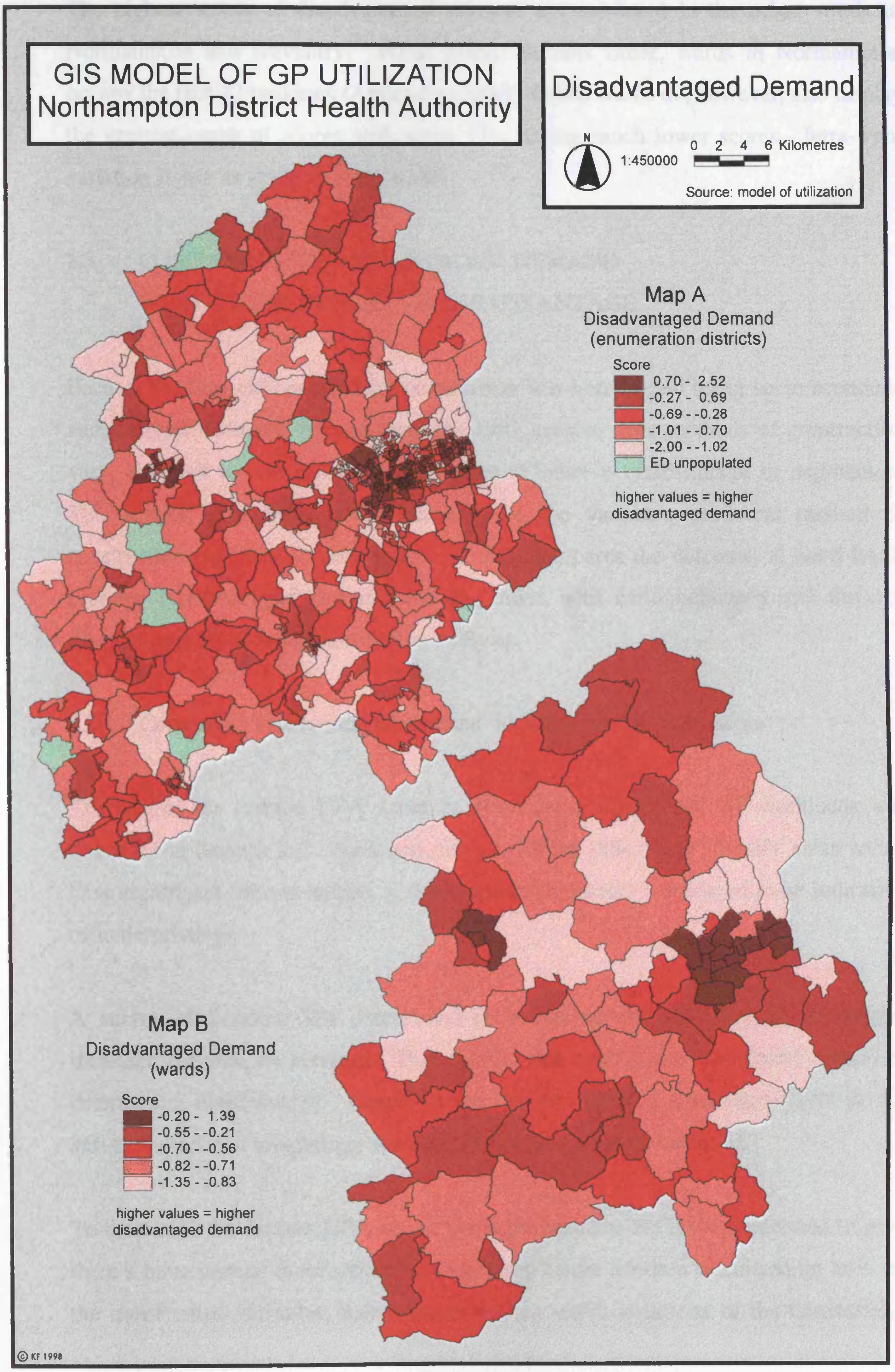
8.2 MEASURING DISADVANTAGED DEMAND AT WARD LEVEL

Census data is available at a number of different geographical scales; the development of the model of utilization was carried out at the most detailed level, the ED (Section 6.2). This was primarily in order to provide outcomes at the most detailed scale - thereby allowing aggregation to broader scales if needed - and to avoid the generalisations likely to occur in analysing spatial variations at coarser scales of analysis.

On the other hand, wards are often used for policy purposes, because of their greater convenience and because other data are often available at this scale. The four indices identified for comparison are thus normally calculated at the ward scale, despite the fact that this results in the loss of any intra-ward variation. In order to compare the various indices here, therefore, the ward level was used. Accordingly, the ward boundary coverage was generated from the ED coverage, using the dissolve and merge techniques available in the GIS (Appendix Three). The measure of disadvantaged demand, at ward scale, was then defined by taking the mean of all ED disadvantaged demand scores for each ward. Results, at both ward and ED scale, are presented in Map 8.1. Both maps are classified in quintiles, such that one-fifth of the EDs (or wards) are contained in each map class.

Loss of intra-ward variation is evident when the 700 EDs are aggregated into 79 wards across the NDHA area: it is clear from a comparison of the two maps that not all EDs in any one ward show the same level of disadvantaged demand. This warns of the danger of imputing to EDs, or individuals resident in the area, the characteristics exhibited at ward level - the classic problem of the 'ecological fallacy'.

Map 8.1 Disadvantaged demand (ED and ward)



The highest levels of disadvantaged demand are exhibited in the urban wards of Northampton and Daventry. When placed in rank order, wards in Northampton occupy the first 12 rankings (Appendix Eight). Urban wards do, however, also display the greatest range of scores with some EDs having much lower scores. Intra-ward variation is not as great in rural wards.

8.3 COMPARING DISADVANTAGED DEMAND WITH OTHER INDICES OF DISADVANTAGE

Each of the four indices used for comparison was constructed using socio-economic and material variables derived from the 1991 census. The methods of construction vary, although all are designed as proxies of relative disadvantage or deprivation. This section provides a brief summary of the variables used and method of construction pertinent to each index. It then compares the outcome, at ward level, between disadvantaged demand and the index both cartographically and through Pearson product-moment correlation analysis.

8.3.1 Comparing disadvantaged demand with the Jarman UPA score

The role of the Jarman UPA score in determining differential GP workloads was discussed in Section 2.2. As noted, the aim of the index is to identify areas which have significant concentrations of socio-economic factors considered to be indicative of underprivilege.

A survey of London GPs determined those patient characteristics which created increased pressure on services. This showed that eight factors were most critical in determining disadvantage. Based on the rate of reporting from respondents in the survey, associated weightings were attributed as shown in Table 8.1.

To determine the Jarman UPA score, the eight variables are first transformed to give them a more normal distribution. Standardised values are then calculated for each of the transformed variables, using means and standard deviations of the transformed

Table 8.1 Variables and weights used in the construction of Jarman UPA score (after Jarman, 1983; 1984)

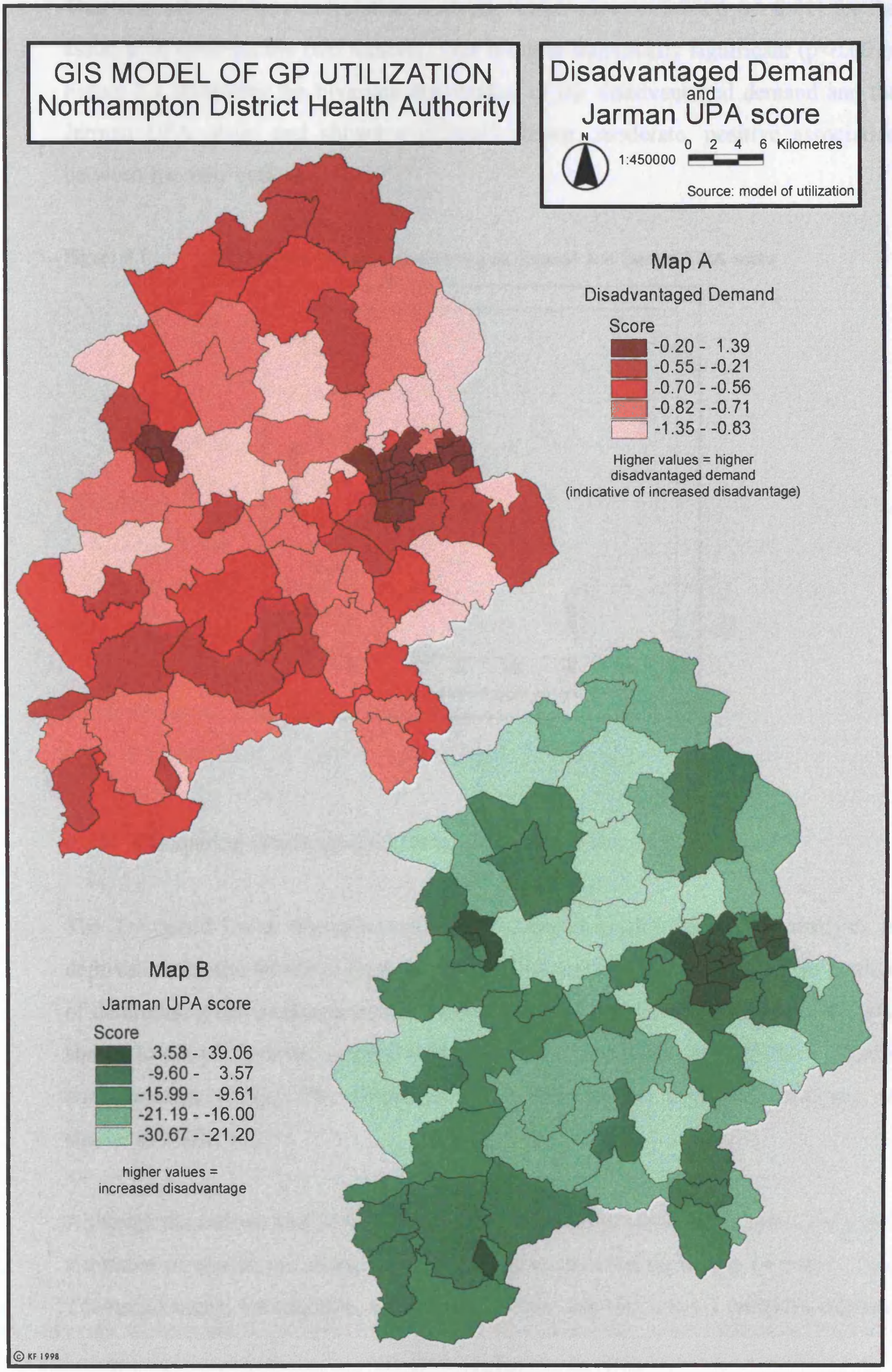
Factor (census variable)	Weighting
Elderly living alone	6.62
Children aged under 5	4.64*
Lower social classes (Class V)	3.74
Unemployment	3.34*
Single parent households	3.01*
Overcrowded households	2.88*
Highly mobile people	2.68
Ethnic minorities	2.50†

Note: variables are also used in the model of utilization although exact definitions may vary:
* - the variable is used, unweighted, in the need sub-model
† - the variable is used, unweighted, in the accessibility sub-model

values of all wards in England and Wales. These values are then adjusted by multiplying by the weight derived from the survey. The final Jarman UPA score is therefore the sum of the weighted, standardised transformed values (Jarman, 1983; 1984). Positive Jarman UPA scores indicate deprivation greater than the national average and the higher the score the greater the deprivation; negative scores show less than average deprivation, and the more negative the score the less the deprivation.

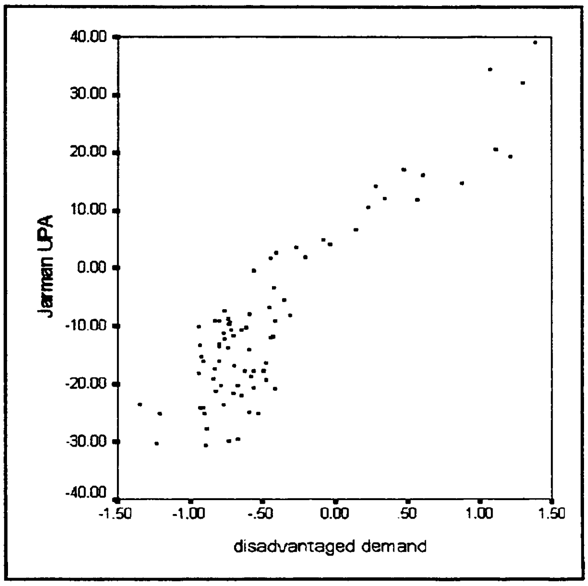
Map 8.2 illustrates the calculated Jarman UPA scores for the NDHA area, along with the measure of disadvantaged demand for comparison. It is clear that many of those wards which score highly for disadvantaged demand also score highly for the Jarman UPA score. When placed in descending rank order, with high scores ranked as 1, St. Crispin ward is ranked highest for both measures (Appendix Eight). Additionally, when the data are examined in quintiles (the 20% categories also used to display the data on Map 8.2), all but one of the wards in the highest quintile (Rank 1-16) for the measure of disadvantaged demand are also in the uppermost quintile for the Jarman UPA score. The other quintiles are not as closely matched, but overall both measures clearly give similar results, reflecting their use of many of the same census variables.

Map 8.2 Disadvantaged demand and Jarman UPA score



This is confirmed by a correlation analysis, which gives r=0.9006 (r^2=0.81) for the association between the two indices. This result is statistically significant (p<0.001). Figure 8.1 illustrates the bivariate distribution of the disadvantaged demand and the Jarman UPA score and shows a generally linear, moderate, positive association between the two indices.

Figure 8.1 Relationship between disadvantaged demand and Jarman UPA score



8.3.2 Comparing disadvantaged demand with the Townsend Index

The Townsend Index was developed by Townsend et al (1988) in an analysis of deprivation for the Northern Region. It was also considered as an alternative method of determining disadvantage in the review of the RAWP formula (DHSS, 1988) and shown to out-perform the Jarman UPA score in explaining health outcomes (Morris and Carstairs, 1991). The Townsend Index is calculated from four measures, as shown in Table 8.2.

Although the Jarman and Townsend indices are based on similar principles, and share a number of census variables, several differences between them may be noted. The Townsend Index, for example, is constructed from only four census variables whereas

Table 8.2 Variables used in construction of the Townsend Index (after Townsend et al, 1988)

Factor (census variable)
Unemployment*
Lack of car ownership†
Overcrowded households*
Non-owner occupied housing*

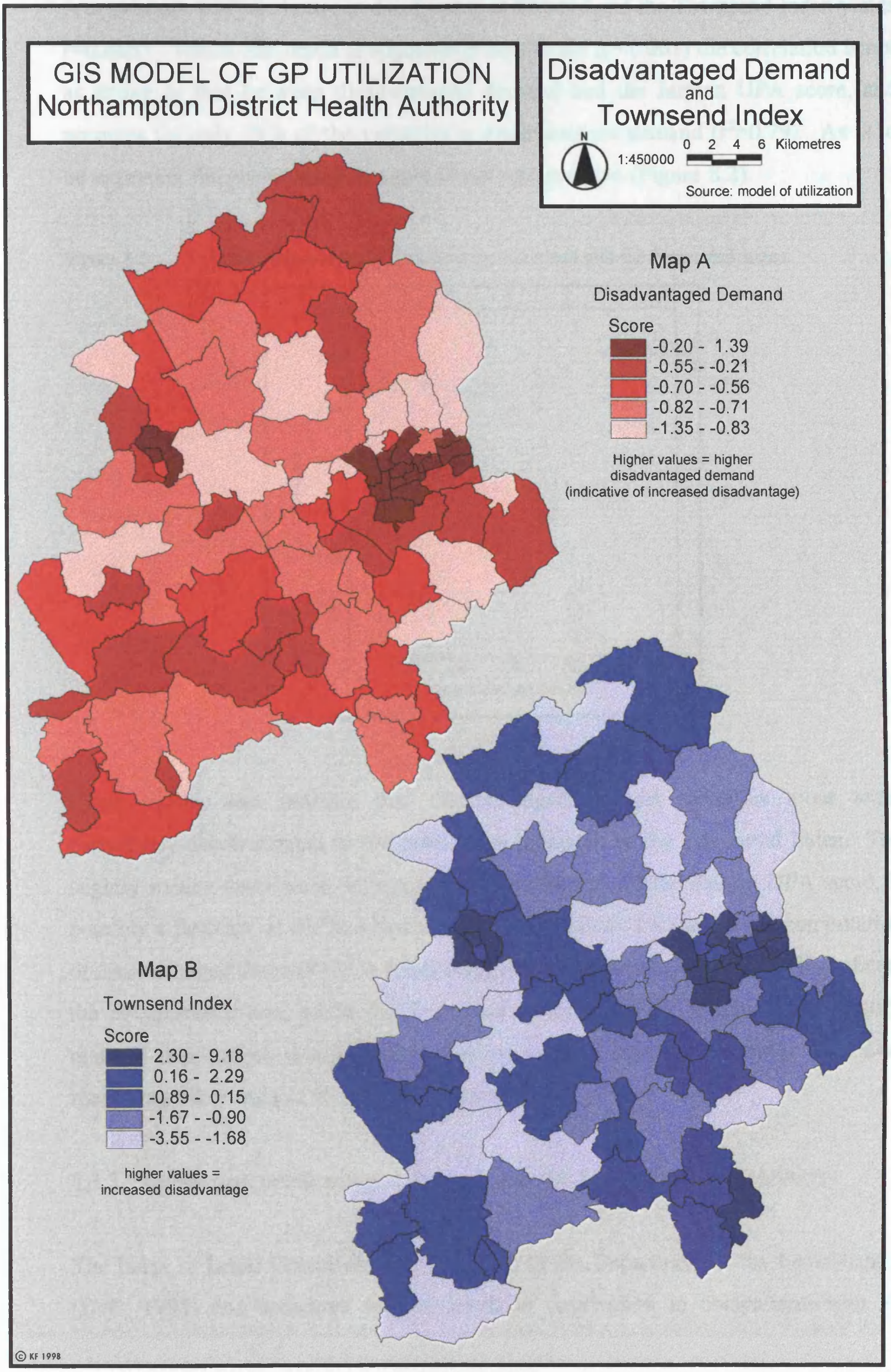
Note: variables are also used in the model of utilization although exact definitions may vary:
* - the variable is used, unweighted, in the need sub-model
† - the variable is used, unweighted, in the accessibility sub-model

the Jarman UPA score makes use of eight. The statistical treatment of these variables also varies: in the Townsend Index the unemployment and overcrowding variables are first transformed, by means of the log (natural) transform, to reduce skewness. The final score is then an unweighted combination of the four standardised variables.

Interpretation of the Townsend Index is similar to that of the Jarman UPA score: positive values indicate higher levels of relative deprivation and the more positive the value the greater the level of relative deprivation, the more negative the value the lower the relative deprivation. Unlike the Jarman UPA score, however, the Townsend Index provides values which are relative only to those obtained from the original case study area rather than a national average.

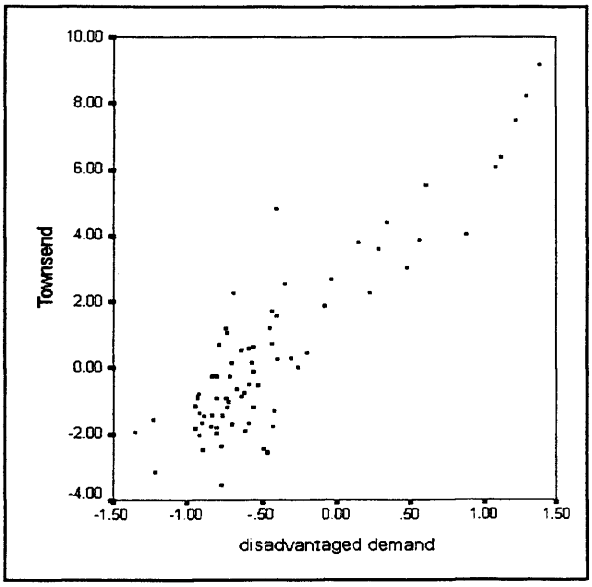
Map 8.3 illustrates the Townsend Index calculated for the NDHA area. The most disadvantaged areas are identified in many of the urban wards of Northampton and Daventry. These, again, correspond closely to those identified using the measure of disadvantaged demand. When placed in rank order, the same wards are ranked in the top five positions for both scores. Of the wards ranked 1-16 (the uppermost quintile) for disadvantaged demand, 13 are similarly ranked under the Townsend Index (Appendix Eight).

Map 8.3 Disadvantaged demand and Townsend Index



A correlation analysis between disadvantaged demand and the Townsend Index yields r=0.8885. Whilst this result is statistically significant ($p<0.001$) the correlation is not as strong as that between disadvantaged demand and the Jarman UPA score, and accounts for only 78% of the variation in disadvantaged demand (r^2=0.79). As is to be expected, the relationship is again linear and positive (Figure 8.2).

Figure 8.2 Relationship between disadvantaged demand and the Townsend Index



These results thus indicate that disadvantaged demand identifies those areas particularly disadvantaged in line with those indicated by the Townsend Index. The slightly weaker correlation, in relation to that obtained for the Jarman UPA score, is possibly a function of the fact that many more variables are used in the computation of disadvantaged demand (18 in total) compared to the Townsend Index. This reflects the circumstance that, while the Townsend Index is simply attempting to identify material deprivation, disadvantaged demand includes additional variables aimed at measuring other aspects of need and disadvantage.

8.3.3 Comparing disadvantaged demand with the Index of Local Conditions

The Index of Local Conditions was produced by the Department of the Environment (DoE, 1995) and measures relative levels of deprivation in comparison with an average for England. The index varies from both the Jarman UPA score and the Townsend Index in that it makes use of different variables dependent upon the scale of analysis. When a ward scale analysis is undertaken, the index is composed of 7 variables derived from the census. However, the index can also be calculated at district level where the original 7 variables are augmented by a further 6 variables. The extra 6 variables, included in the district scores, are derived from other data sources and cover aspects of deprivation not adequately measured by the census (Table 8.3).

Table 8.3 Variables used in the construction of the Index of Local Conditions (after DoE, 1995)

Variables used at ward level are as follows:

Factor (census variable)
Unemployment*
Children in low earning households
Overcrowded housing*
Housing lacking basic amenities*
Households with no car†
Children in unsuitable accommodation
Educational participation at age 17†

Note: variables are also used in the model of utilization although exact definitions may vary:
* - the variable is used, unweighted, in the need sub-model
† - the variable is used, unweighted, in the accessibility sub-model

Variables included in the district level index are as follows:

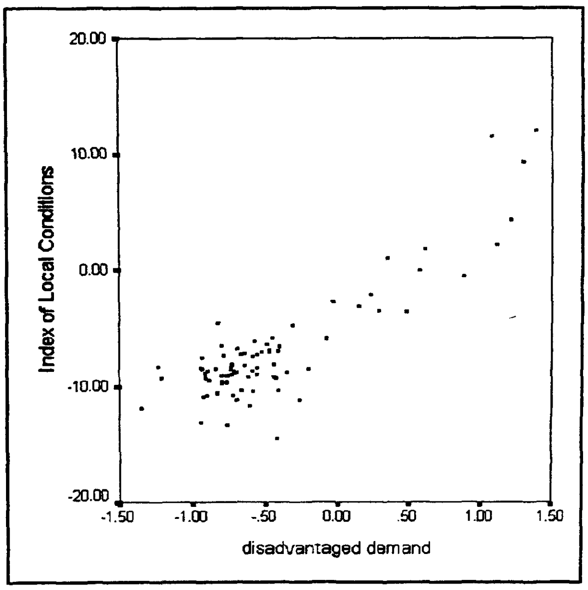
Factor
Ratio of long-term illness to all unemployed
Income support recipients
Low educational (GCSEs) attainment
Standardised mortality rates
Derelict land
House contents insurance premiums (crime proxy)

Construction of the Index of Local Conditions is by transformation, then standardisation and subsequent unweighted combination of the component variables. In standardising the variables, averages for England are used to create a national norm of 0. As with both the Jarman UPA score and the Townsend Index, positive scores show relatively higher levels of deprivation and a negative score relatively low levels of deprivation. When applied to the NDHA area (Map 8.4) the majority of values are seen to be negative since deprivation, under the definitions used in its construction, is concentrated in a small number of areas.

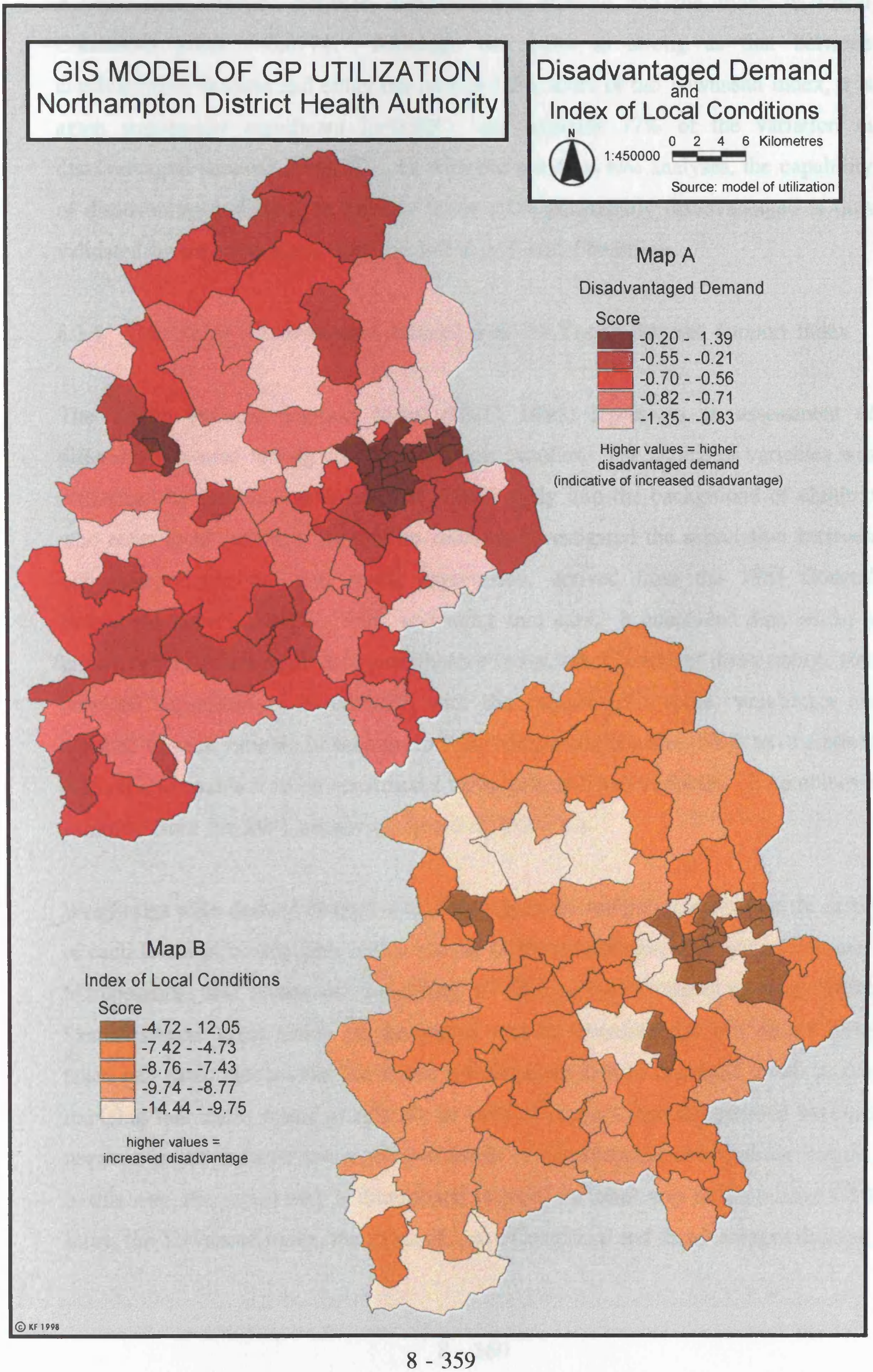
The Index of Local Conditions score identifies the most disadvantaged areas as urban wards of Northampton and Daventry. However, only seven of the wards in the NDHA are calculated as being above the national average of 0 (Appendix Eight). This contrasts with the Townsend Index, which identified 34 wards as having higher levels of deprivation than the national average.

The relationship between the two scores, illustrated in Figure 8.3, shows a moderate, broadly linear, positive association. When analysed in terms of quintiles, it is seen that 14 of the wards in the highest quintile for disadvantaged demand (Rank 1-16) are also ranked in the uppermost quintile for the Index of Local Conditions.

Figure 8.3 Relationship between disadvantaged demand and the Index of Local Conditions



Map 8.4 Disadvantaged demand and Index of Local Conditions



A correlation analysis between disadvantaged demand and the Index of Local Conditions gives $r=0.8774$. Although not quite as strong as that between disadvantaged demand and either the Jarman UPA score or the Townsend Index, it is again statistically significant ($p<0.001$), and explains 77% of the variation in disadvantaged demand ($r^2=0.77$). As with the previous two analyses, the capability of disadvantaged demand to identify those areas particularly disadvantaged is thus validated by its comparison with the Index of Local Conditions.

8.3.4 Comparing disadvantaged demand with the Young Persons' Support Index

The Young Persons' Support Index (NCC, 1995) represents an assessment of differences in need among children and their families. The choice of variables was influenced by Bebbington and Miles' (1989) study into the background of children who enter local authority care. The research investigated the association between indicators of material and social deprivation, derived from the 1985 General Household Survey (OPCS, 1988), and entry into care. It concluded that, whilst a broken family is one significant contributory factor, other factors of disadvantage also provided explanation. In common with the Jarman UPA score, weightings are attached to each variable in relation to their relative importance. NCC have adapted the index to enable it to be constructed using census-based variables. It combines 8 variables from the 1991 census as shown in Table 8.4.

Weightings were derived through a logistic regression analysis to determine the effect of each factor in comparison with a survey of the circumstances of children in care. Manipulation, and subsequent weighting, of the variables produces an index which identifies those areas which are associated with an increased risk of children being taken into care. Scores that are above 0 indicate an area of increased disadvantage, implying that more young people are in need of support than the national average; negative scores indicate lower relative levels of disadvantage and need for support. In this way, the scores may be interpreted in much the same way as the Jarman UPA score, the Townsend Index, the Index of Local Conditions and disadvantaged demand.

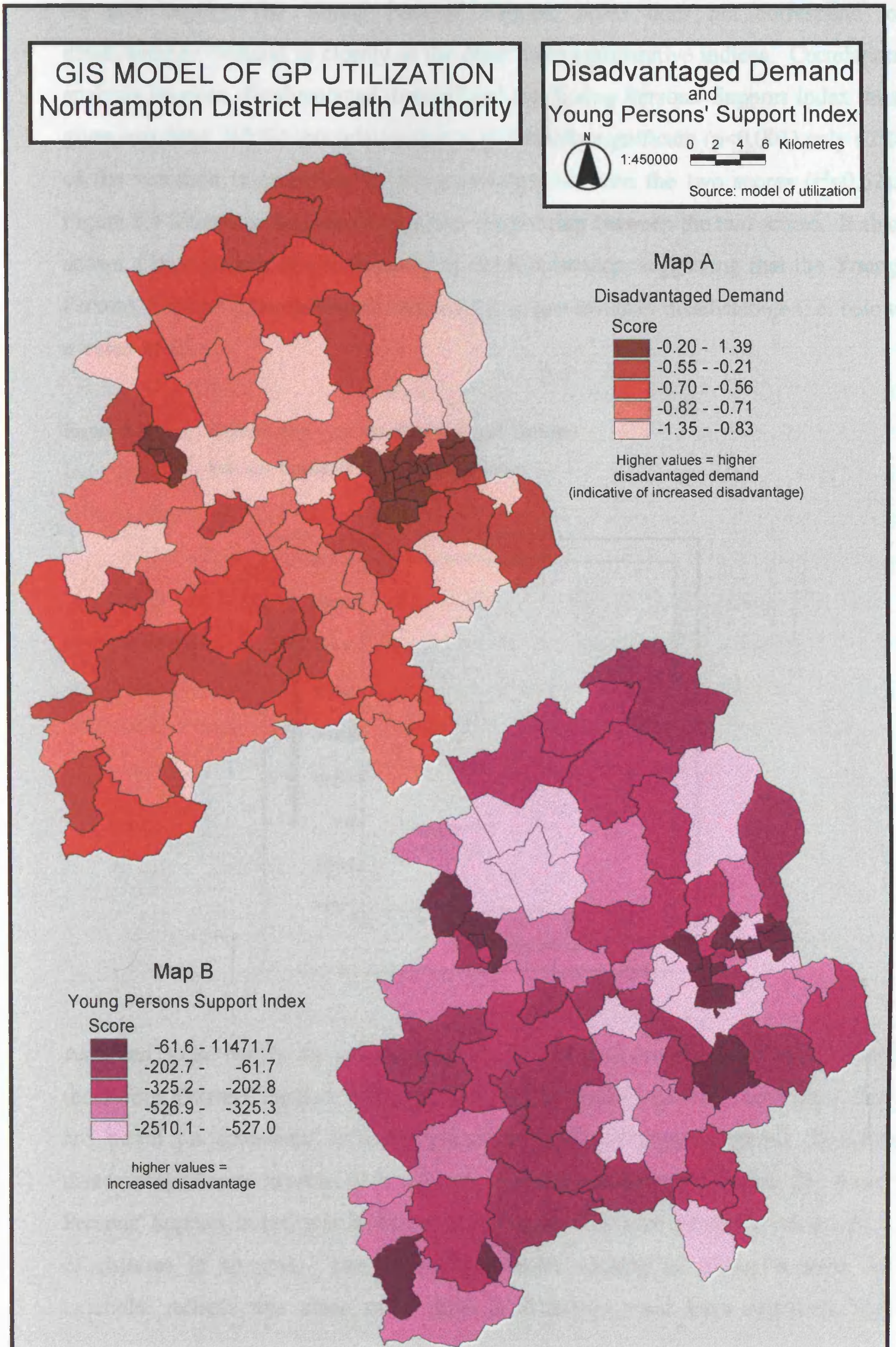
Table 8.4 Variables and weights used in the construction of the Young Persons' Support Index (after NCC, 1995)

Variables used at ward level are as follows:

Factor (Bebbington & Miles)	**Factor (NCC Policy Division)**	**Weighting**
Single parent family	Children in 1 adult households*	7.9
Four plus children in family	Children in households with 4+ children	1.3
Ethnic group (Afro-Caribbean)	Children in Black Caribbean, Black African and Black Other households	1.4
Tenure (private rented)	Children in private rented accommodation	2.9
Tenure (council rented)	Children in Council rented accommodation	2.6
Overcrowded (1+ ppr)	Children in households with 1+ ppr	3.6
Child's age (10 & over)	Children age 10-17 resident in household	2.0
Benefits	Children in households with one person economically active but unemployed	3.2

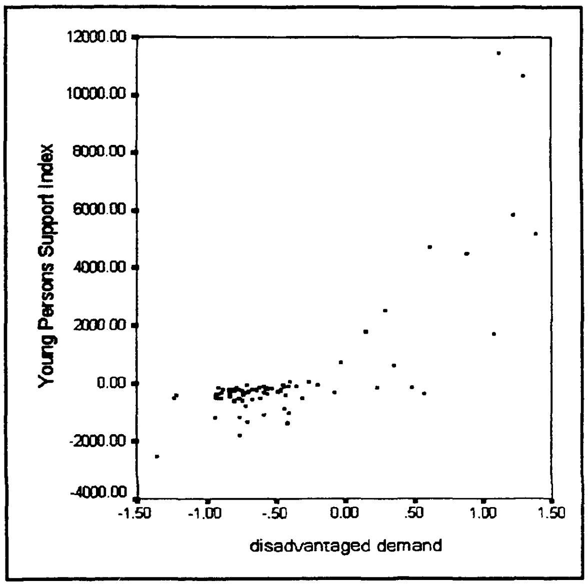
Note: variables are also used in the model of utilization although exact definitions may vary:
* - the variable is used, unweighted, in the need sub-model

Map 8.5 illustrates values of the Young Persons' Support Index for the NDHA area. Some wards identified as having greater levels of disadvantage do, expectedly, differ from those identified by disadvantaged demand. Whilst the 11 wards in Northampton classified in the uppermost quintile for disadvantaged demand are also in the highest quintile for the Young Persons' Support Index, this is fewer than the number identified by the Jarman UPA score, the Townsend Index or the Index of Local Conditions (Appendix Eight). Furthermore, the relative rankings of these wards differs more markedly than with the other indices. For instance, St. Crispin is identified as having the highest level of disadvantage under disadvantaged demand, the Jarman UPA score, the Townsend Index and the Index of Local Conditions yet it is ranked only fourth under the Young Persons' Support Index. Some wards also vary considerably in their relative ranking amongst the indices. In particular, Abington ward is identified as eighth for disadvantaged demand and the Index of Local Conditions, tenth for the Townsend Index and eleventh for the Jarman UPA score yet it is ranked fiftieth for the Young Persons' Support Index.


GIS MODEL OF GP UTILIZATION
Northampton District Health Authority
Disadvantaged Demand
and
Young Persons' Support Index
N
0 2 4 6 Kilometres
1:450000
Source: model of utilization
Map A
Disadvantaged Demand
Score
-0.20 - 1.39
-0.55 - -0.21
-0.70 - -0.56
-0.82 - -0.71
-1.35 - -0.83
Higher values = higher disadvantaged demand (indicative of increased disadvantage)
Map B
Young Persons Support Index
Score
-61.6 - 11471.7
-202.7 - -61.7
-325.2 - -202.8
-526.9 - -325.3
-2510.1 - -527.0
higher values = increased disadvantage
© KF 1998

As this implies, the Young Persons' Support Index does not correspond to disadvantaged demand as closely as the other three comparative indices. Correlation analysis between disadvantaged demand and the Young Persons' Support Index thus gives r=0.7864. Whilst this relationship is statistically significant ($p<0.001$) only 62% of the variation is explained by the correlation between the two scores (r^2=0.62). Figure 8.4 illustrates the weaker, positive relationship between the two scores. It also shows a high degree of non-linearity in the relationship, suggesting that the Young Persons' Support Index is less discriminating at low levels of disadvantage (i.e. below a value of 0).

Figure 8.4 **Relationship between disadvantaged demand and the Young Persons' Support Index**



As noted, these results are not unexpected. Whilst both disadvantaged demand and the Young Persons' Support Index are designed to identify disadvantaged areas, they are based on somewhat different principles. Disadvantaged demand identifies disadvantaged areas in terms of broad socio-economic and material factors; the Young Persons' Support Index only includes those factors which are related to the presence of children in an area. The markedly different ranking of Abington ward, for example, reflects this since many EDs in Abington ward have relatively high proportions of elderly residents and much lower proportions of young residents.

Relatively weak correlations also exist between the Young Persons' Support Index and the Jarman UPA score (r=0.6548, r^2=0.43), the Townsend Index (r=0.7320, r^2=0.54) and the Index of Local Conditions (r=0.7569, r^2=0.57). This supports the interpretation that, while disadvantaged demand, the Jarman UPA score, the Townsend Index and the Index of Local Conditions are measuring similar phenomena, the Young Persons' Support Index is identifying somewhat different aspects of disadvantage.

This comparison also serves to give warning of the dangers of considering concepts of disadvantage and deprivation too simplistically. Disadvantage is not a unitary condition but is multifaceted. Many different forms of disadvantage may be felt by different sectors of society (or by any one sector over time) and these do not necessarily vary conjointly over space. Composite scores, which attempt to define only aggregate disadvantage, thus tell only part of the story, and different indicators may be required to detect different aspects of disadvantage. In this sense, it may be appropriate and necessary to use different measures of need and accessibility in the utilization model, to derive the disadvantaged demand measure, in order to customise it to particular population subgroups, or to assess specific health care issues.

8.4 SUMMARY

This Chapter has presented a validation of the disadvantaged demand component of the utilization model by comparing this component with a number of other, well-established measures of disadvantage. Three of these - the Jarman UPA score, the Townsend Index and the Index of Local Conditions - show close correlations with the measure of disadvantaged demand. Correlations with the Young Persons' Support Index are less strong, reflecting its somewhat different purpose and construction.

Overall, these results give some confidence to the design of the disadvantaged demand component of the model. Clearly this does not differ markedly in the way it ranks wards than the other available deprivation indices, several of which have been used to help allocate health care resources. At the same time, these results suggest that - in this area at least - the measure of disadvantaged demand used in the utilization model is adding little to what is shown by these other, often somewhat simpler deprivation indices. It might thus be appropriate to substitute the disadvantaged demand component with one of these other indices. In some ways this would certainly be advantageous, for the Jarman and Townsend indices, in particular, are already widely used by Local Authorities and Health Authorities and their relative simplicity would reduce the data demands of the model. The added complexity of the disadvantaged demand factor, however, may also be seen as part of its strength. It is likely to make the index more robust, and less sensitive to extreme variations in a single indicator. It is also deliberately designed to include variables which are not considered in these other indices, including components of environmental disadvantage and personal mobility, as well as socio-economic deprivation. Whilst these had little effect in the NDHA, they may well be important in other areas, such as large inner city areas. It can also be argued that the inclusion of additional components within the disadvantaged demand indicator provides greater scope for adaptation to different health care issues or different population groups (e.g. by changing the age ranges used in the index, or by weighting variables differentially).

In the same way, this analysis has also sounded a warning about the use of indices of disadvantage, not only in this model but in other contexts likewise. The strong correlations found between most of the indices examined suggests that they are to a large extent all measuring broadly the same concept of disadvantage. As stated above, however, it is clear that disadvantage takes many different forms, depending upon factors such as the age and ethnicity of the population concerned, the social context in which they live, and the particular aspect of well-being of concern. Whether the indices currently available reflect this variability of need is far from evident. It seems likely that different indices need to be developed for different purposes. The measure of disadvantaged demand, used here, may itself need to be modified, therefore, to address different aspects of health care need, or to make it more relevant to different sections of society.

This Chapter, and Chapter Seven, have critically examined the model of utilization. The analyses undertaken have, to a large extent, validated the conceptual basis of the model, its construction and robustness. The next Chapter critically evaluates application of the model for health care planning and analysis for a number of scenarios.

9 THE POTENTIAL USE OF THE MODEL OF UTILIZATION IN HEALTH CARE PLANNING AND ANALYSIS

9.1 INTRODUCTION

This research is underpinned by the concerns raised due to the recent radical changes implemented in the NHS. Primarily these are a result of the splitting of the service into purchasers and providers and the setting up of an internal market. The first three chapters identified the ways in which geography influences the delivery of health care services and their utilization. Subsequent chapters have developed and tested a method of modelling the utilization process. As the case study has illustrated, patterns of utilization clearly exist in the Northampton DHA area, reflecting geographical variations in health care demand and service provision (Chapter Six). Changes in either the demand for health care or in its delivery will alter the pattern of utilization, and it is therefore important that any such changes can be modelled and evaluated to assist health care analysis and inform the health care planning process.

Since 1974 there has been a requirement for health authorities, at regional and district level, to develop and implement a strategic plan. Such plans determine the needs of the population, the allocation of appropriate services and the setting up of performance indicators. An understanding of the geographical aspects of resource allocation are vital to ensure the creation of an appropriate and effective plan. In this respect the model of utilization is a tool of immediate utility to health authorities.

Chapter One indicated the crucial role DHAs play as purchasers of care, with the aim of ensuring that the needs of their population are catered for to appropriate levels. DHAs therefore have an urgent requirement for information on the unique need, demand and pattern of utilization exhibited in their area, at a scale suitable for planning purposes. The model of utilization is able to meet these information requirements by making a range of outcomes available, at a variety of scales. As Chapter Six showed, the model can be manipulated to provide information on specific aspects of utilization or composite scores of need, accessibility, provision, utilization, disadvantaged demand and realized demand. These measures can be calculated at a variety of scales: the model has been created at ED level, but can readily be aggregated to ward scale (the usual scale of analysis used for health care planning at

DHA level), or broader scales as required.

This chapter demonstrates how the model of utilization can be implemented by DHAs to provide important insights into health care planning and analysis. Specifically, it illustrates the use of the model for the following purposes:

- the study of individual GP catchments;
- financial allocation; and
- to combine model outcomes with other useful data sets.

It also presents the results of a variety of 'what if' scenarios. These have been designed to show the predictive capabilities of the model. Scenarios are created to examine the change in outcomes, and implications for planning, in relation to the following:

- optimum siting of a new surgery;
- potential impact of closing a surgery; and
- impact of a population increase.

The analyses presented in this chapter are, by no means, exhaustive since the use of GIS provides a tool supportive of an extraordinary range of investigations. The examples presented, however, are selected to illustrate the information needs of DHAs, and the potential applications of the model.

9.2 STUDY OF INDIVIDUAL GP CATCHMENTS

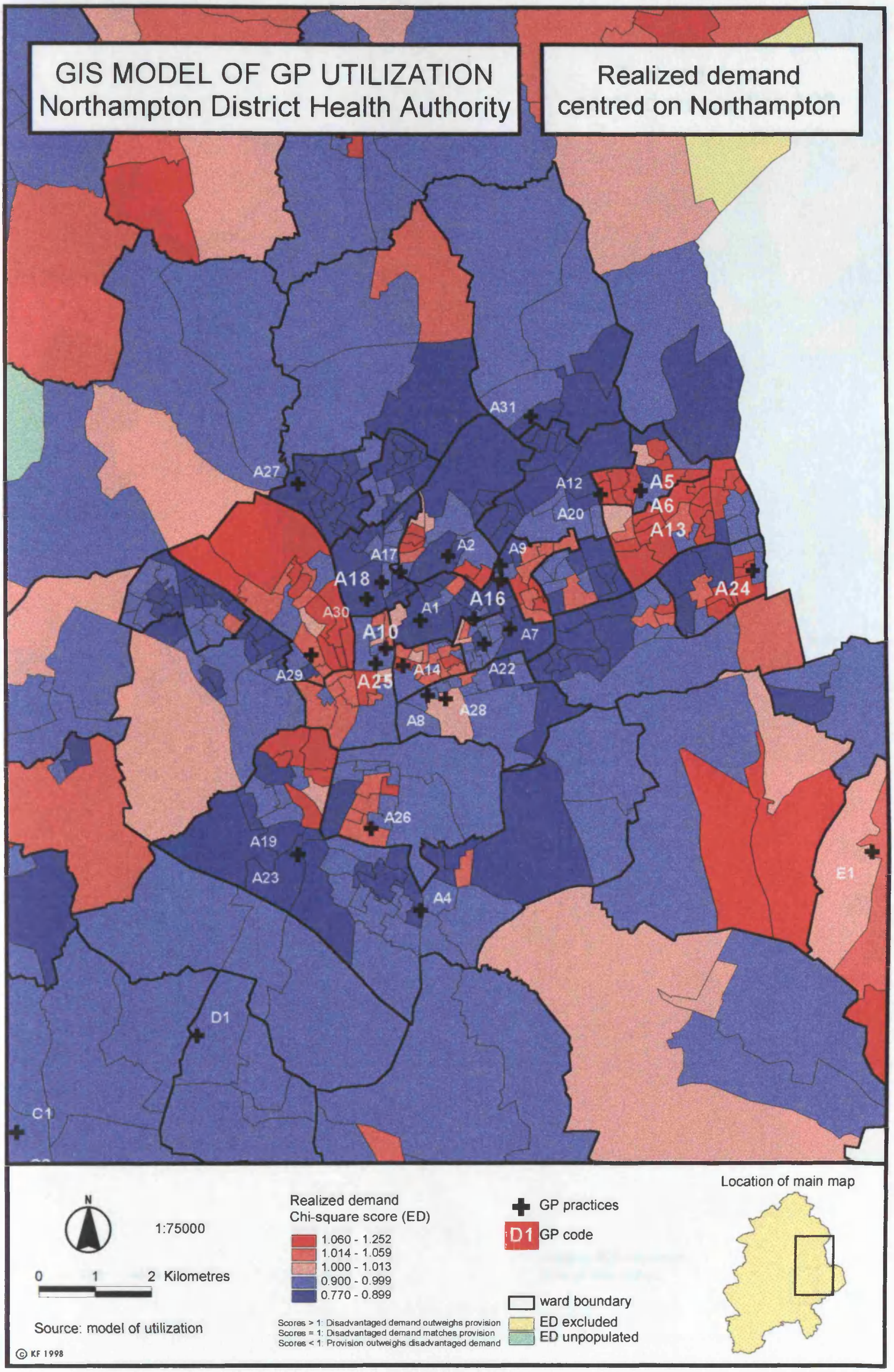
The planning role of a DHA involves determining future provision of health care services for the local population. This role requires negotiation with health care providers to determine contracts for the provision of services appropriate to the changing needs of the population. Central to this requirement is an understanding of the existing relationship between the local population and providers. The model of utilization can be used to identify the location of GP services in relation to the local population. This can simply be the actual geographical location of surgeries in relation to population concentrations or a more comprehensive measure of GP supply calculated through the composite provision score. Catchment areas of GPs can be derived and related to population (or composite measures of need or disadvantaged demand), and areas of local over - or under - provision or differential rates of utilization can be identified.

Map 9.1 illustrates the composite score of realized demand centred on Northampton. The purpose of this map is to show patterns of realized demand in relation to GP location. The map clearly highlights the apparent centralisation of GP services: a point in polygon analysis reveals that 91% of surgeries are in EDs with higher levels of provision relative to disadvantaged demand (i.e. where the provision score > disadvantaged demand score).

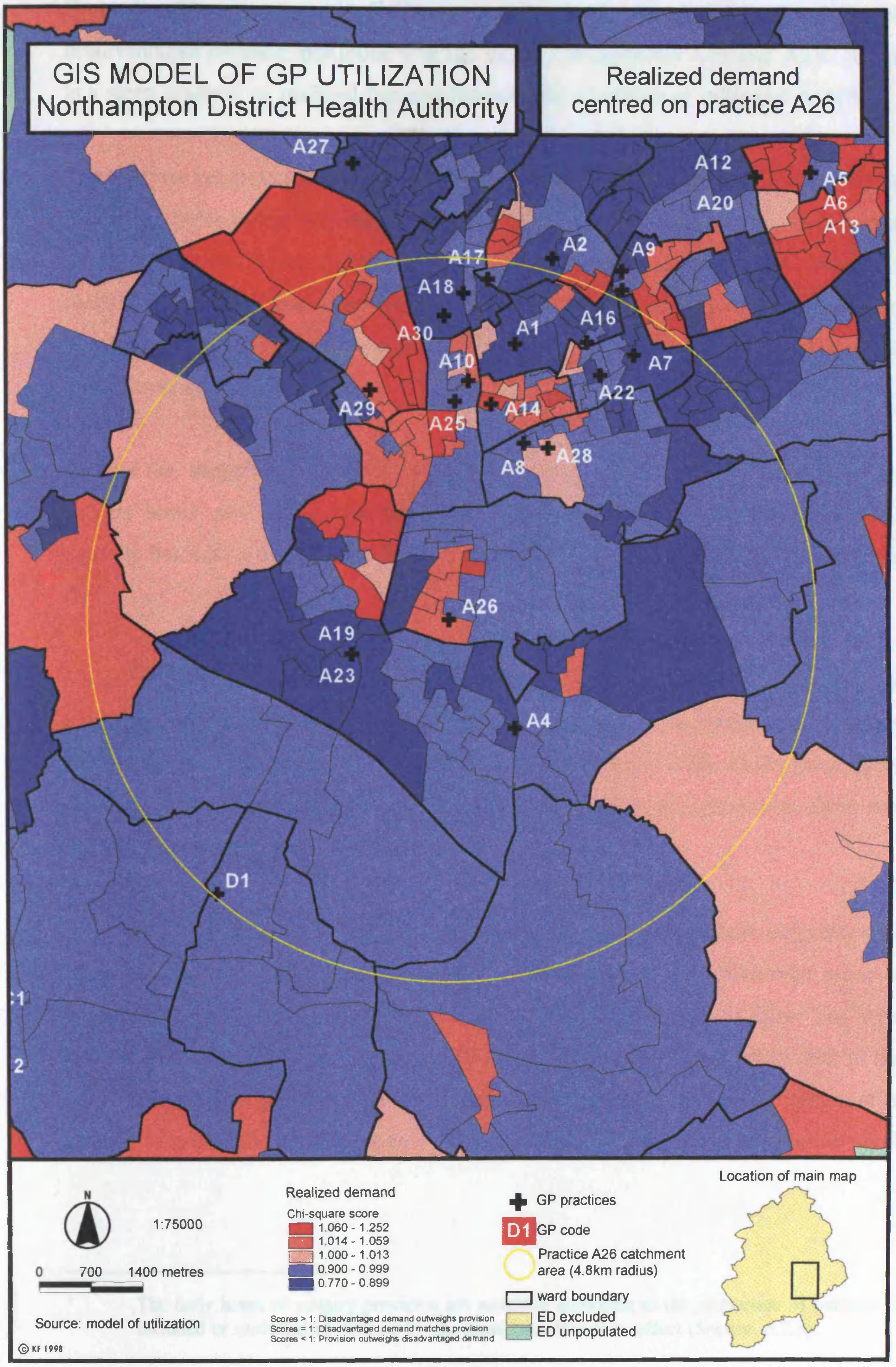
Such an analysis highlights the apparent overlap in provision, with a geographical concentration of service which does not match the spatial distribution of disadvantaged demand. It is clear from the analysis that some EDs in Northampton Borough suffer higher levels of disadvantaged demand relative to provision, often with no GP surgery located in the immediate vicinity. Whilst spatial location of the surgery is clearly only one facet of provision, a decentralisation of GP provision in Northampton might benefit these areas.

Analysis of a single GP surgery also offers an opportunity for assessing the appropriateness of its location in relation to the local population served and its proximity to other surgeries. In particular, surgery location can be examined in relation to its catchment area (Map 9.2). Surgery A26 is located in Delapre and Far Cotton in an area of EDs which have, predominantly, relatively higher levels of disadvantaged demand in relation to provision. This suggests that, whilst surgery A26 is appropriately located, it is not of itself sufficient to meet the disadvantaged demand of the population in its catchment. The catchment area of surgery A26 extends to a radius of 4.8km including East Hunsbury in the south-western area of Northampton

Map 9.1 Realized demand centred on Northampton



Map 9.2 Realized demand centred on practice A26



Borough. These areas generally have much higher levels of provision relative to disadvantaged demand, particularly in the vicinity of surgeries A19 and A23. There is a steep gradient of realized demand between the vicinities of A26 and A19/A23.

The analysis suggests that the three surgeries, A26, A19 and A23, fail to provide an equitable service across the East Hunsbury, Delapre and Far Cotton areas. In principle it might be possible to meet the needs of the population more equitably by a redistribution of services. However, it is important to note that just because provision is relatively higher in the East Hunsbury area, it does not necessarily mean that the area is over-provided for.

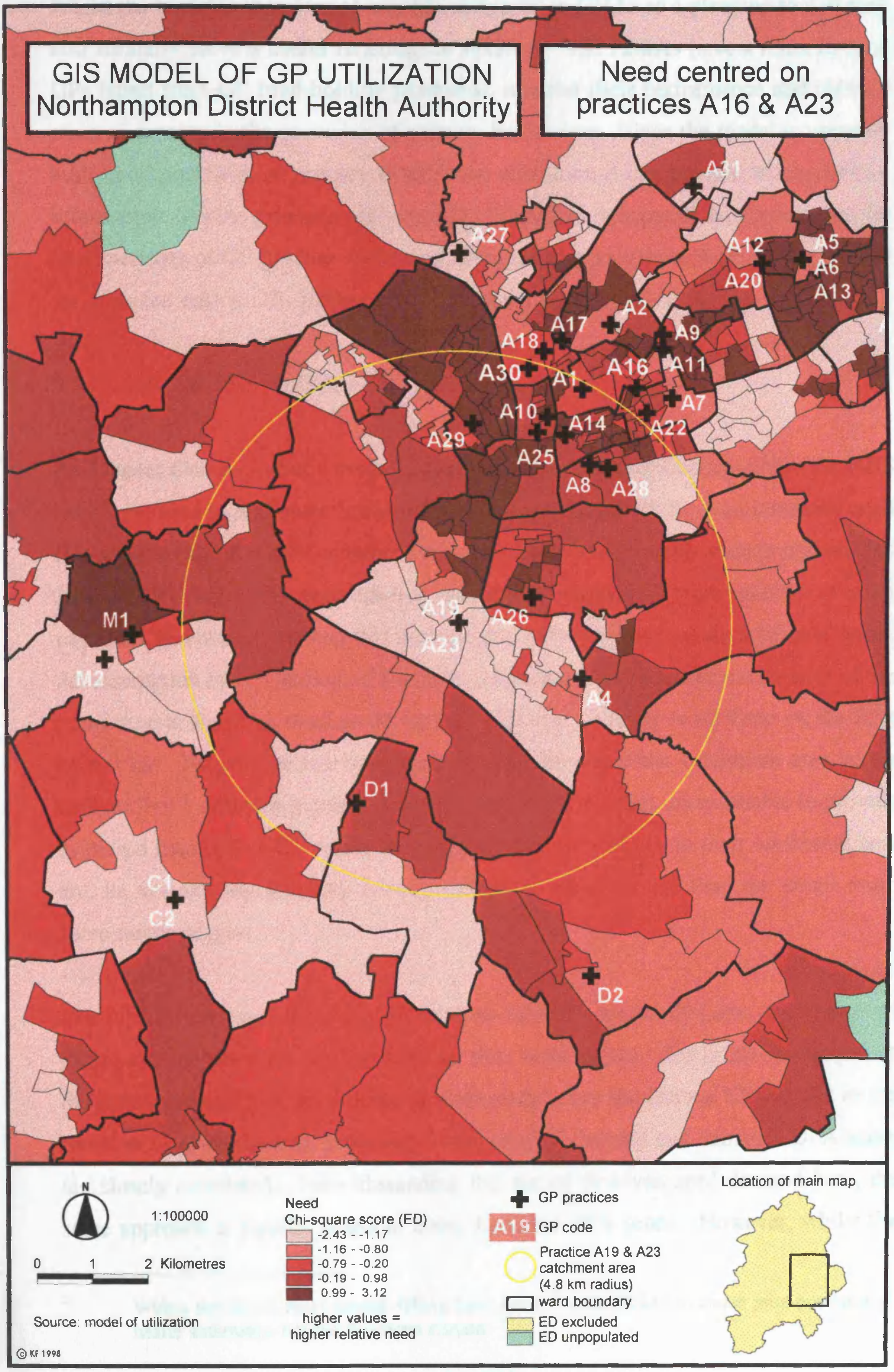
Each of the surgeries A19 and A23 are single GP practices with combined weighted surgery hours[1] of 14 hours per day. The surgery at A26 is a joint practice with 2 partners but with a much lower level of provision of 5.2 weighted surgery hours per day.

These results might be used to suggest two responses. If resources permit, a more equitable provision could be achieved by increasing surgery services at, or near, surgery A26 to a level equivalent to that at surgeries A19 and A23. Failing that, more equitable provision could be made by transferring part of the service at these two surgeries to surgery A26.

These analyses are further supported by examining the location of these surgeries with respect to the measure of need. Map 9.3 illustrates the 4.8km catchment areas of practices A19 and A23 as an overlay on the composite need score for EDs. The level of need in the EDs local to surgeries A19 and A23 is clearly much lower than in the surrounding areas, showing that the location of the two surgeries is not optimum in relation to need. In contrast, surgery A26 is located is an area of high relative need.

1 The daily hours of surgery provision are weighted according to the proportion of patients included or excluded as defined by the cross-boundary flow effect (Section 6.7.3).

Map 9.3 Need centred on practices A16 and A23



Whilst the model is therefore of immediate benefit to DHAs as a planning tool, it may also similarly serve a useful function for FHSAs[2]. The FHSAs have a remit to fund GPs (apart from GP fund-holding practices), monitor their performance and identify areas of concern in the provision of primary health care. Since the model is uniquely built upon principles of primary health care utilization it can provide much relevant information. As the previous analyses have illustrated, it is possible to investigate the characteristics of GP practice catchment areas and the population from which patients are accepted onto a GPs patient list (maintained by the FHSA).

9.3 FINANCIAL ALLOCATION

As Chapter One indicated a range of methods of distributing finance within the NHS have been used to reallocate funding to those areas deemed to have an increased need (for instance the RAWP formula). In terms of primary health care provision, the Jarman UPA score has been used to determine whether GPs are entitled to extra payments by virtue of the fact that their surgery is located in an underprivileged ward. An assumption of this method of financial reallocation is that the characteristics of the population in the same ward as the surgery will apply equally to all those on the GP's patient list. No attempt has been made to examine the wider catchment area which may portray a different picture. It would, for instance, seem unreasonable to provide increased finance to a GP where the population characteristics in their catchment area are, on average, significantly lower in terms of disadvantage than the single ward score might suggest.

The model developed here may be used to inform a more equitable distribution of extra payment based on catchment rather than ward scores. The model makes use of the composite disadvantaged demand score, rather than the Jarman UPA score: as the previous Chapter showed, however, disadvantaged demand and Jarman's UPA score are closely correlated. Notwithstanding the use of disadvantaged demand here, the same approach is equally possible using Jarman's UPA score. However, whilst the

2 Within the life of this research DHAs have merged with FHSAs to create joint purchasing health authorities but the functions remain.

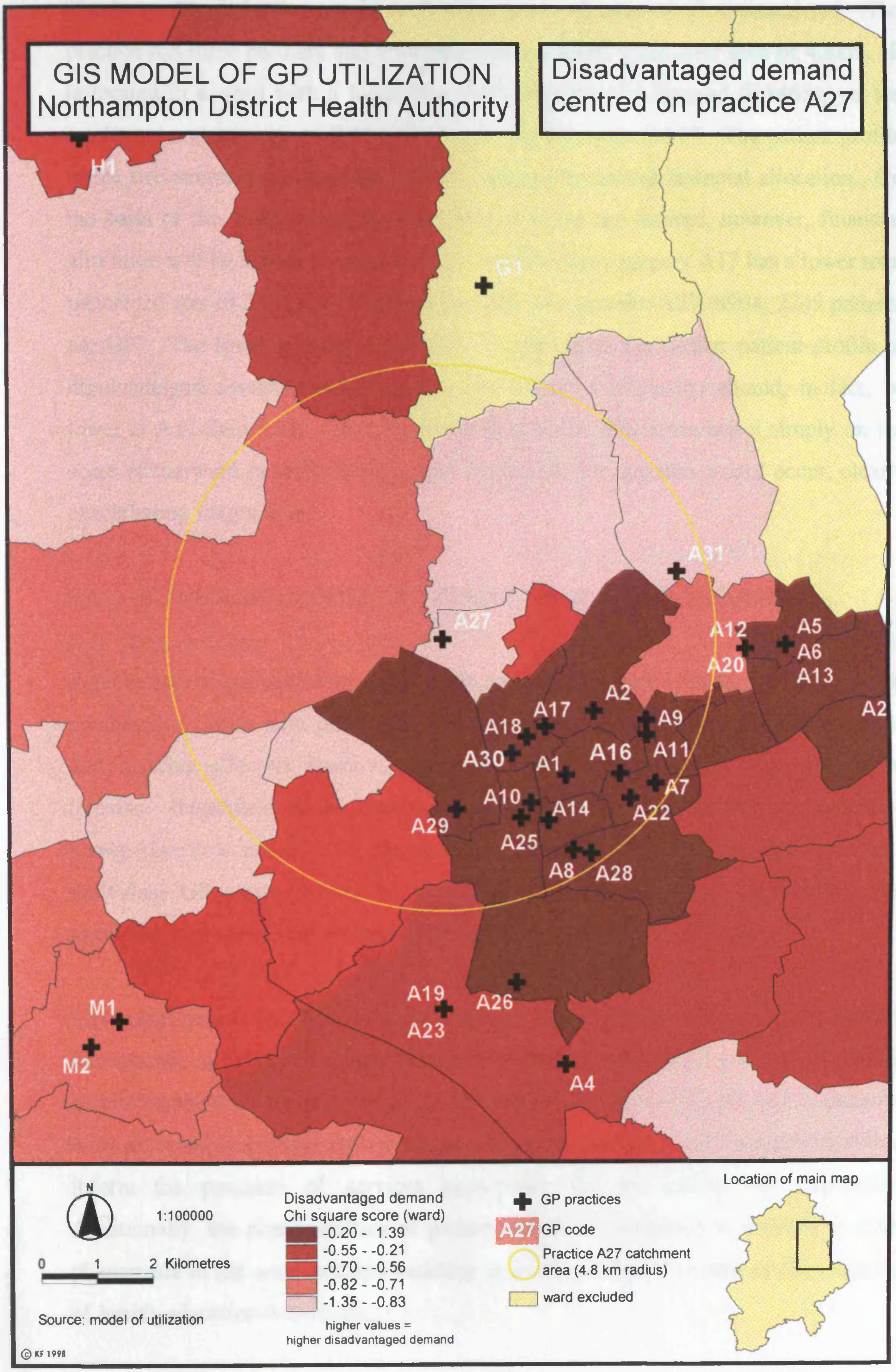
underlying measure of disadvantage is interchangeable, it is the use of GIS which makes such an analysis feasible. The overlay and query capabilities of GIS facilitate what would otherwise be a lengthy computation, providing a method of accessing such information more readily.

Map 9.4 illustrates the composite disadvantaged demand score with an overlay of GP surgery location. Disadvantaged demand has been calculated at the ward scale of analysis since it is at this level of spatial aggregation that decisions on extra payments are usually made. This analysis is centred on surgery A27, a surgery with four partners and a catchment area of 4.8km radius.

The location of surgery A27 is in the northern part of Northampton Borough, in Welford ward. It is on the periphery of the urban area with the predominantly rural wards of Boughton and Pitsford and Brampton, in Daventry district, bordering to the north. Welford ward has a relatively low level of disadvantaged demand for health care (-1.29), mirrored by a low Jarman UPA score (-23.52), yet it has a relatively high level of provision. Taken on this basis, there would seem to be no justification for extra payments based on the nature of the population characteristics in the area. However, if the basis for financial allocation is related to the catchment area of the practice as a whole, rather than the individual ward, then the outcome is somewhat different.

Whilst wards to the north of Welford ward display relatively low levels of disadvantaged demand, the wards of Dallington and Kings Heath, Kingsthorpe and Boughton Green, in the adjoining Northampton Borough, all exhibit much higher levels of disadvantaged demand, as do other wards in the practice catchment area. Indeed, the average value for all wards in the catchment is 0.33 placing it in the highest quintile. On this basis, the practice would have an appropriate claim for extra financial allocation commensurate with the average score in the practice catchment area.

Map 9.4 Disadvantaged demand centred on practice A27



The inequality is further emphasised when nearby practice A17 is considered. The practice has three partners and also maintains a similar catchment area of 4.8km. It is located in a ward with a higher level of disadvantaged demand (0.8468), yet the catchment area average of 0.42 is similar to that of practice A27. The patient profile of the two surgeries is therefore similar, suggesting similar financial allocation. On the basis of the ward scores in which the surgeries are located, however, financial allocation will be higher for surgery A17. Additionally, surgery A17 has a lower total patient list size of 5827 (1942 patients per GP) than practice A27 (8994; 2249 patients per GP). The lower patient to GP ratio, coupled with the similar patient profile of disadvantaged demand, would suggest that financial allocation should, in fact, be lower at A17 than A27. Using methods of resource allocation based simply on the score of the ward in which the practice is located, the opposite would occur, clearly exacerbating inequalities.

9.4 COMBINING MODEL OUTCOMES WITH OTHER DATASETS

Although some reorganisation is currently taking place, with FHSAa and DHAs being combined to create joint purchasing authorities, the role of monitoring GP provision and ensuring effective location and allocation in relation to the local population remains. Regardless of the organisational change, the previous two sections have shown that it is possible for the model of utilization to offer methods by which individual GP surgeries can be examined in relation to their catchment areas, providing appropriate capabilities for improved location and allocation.

The model may be extended to offer methods of monitoring individual GP practices, for example to provide a means by which patients on individual practice lists could be plotted and their specific characteristics examined. This could be used to examine more accurately the characteristics of patient lists in relation to a GP surgery, and thus inform the purchase of services appropriate for the patient list population. Additionally, the characteristics of patients could be examined in relation to other phenomena in the area, perhaps assisting in epidemiological studies or the targeting of health education initiatives.

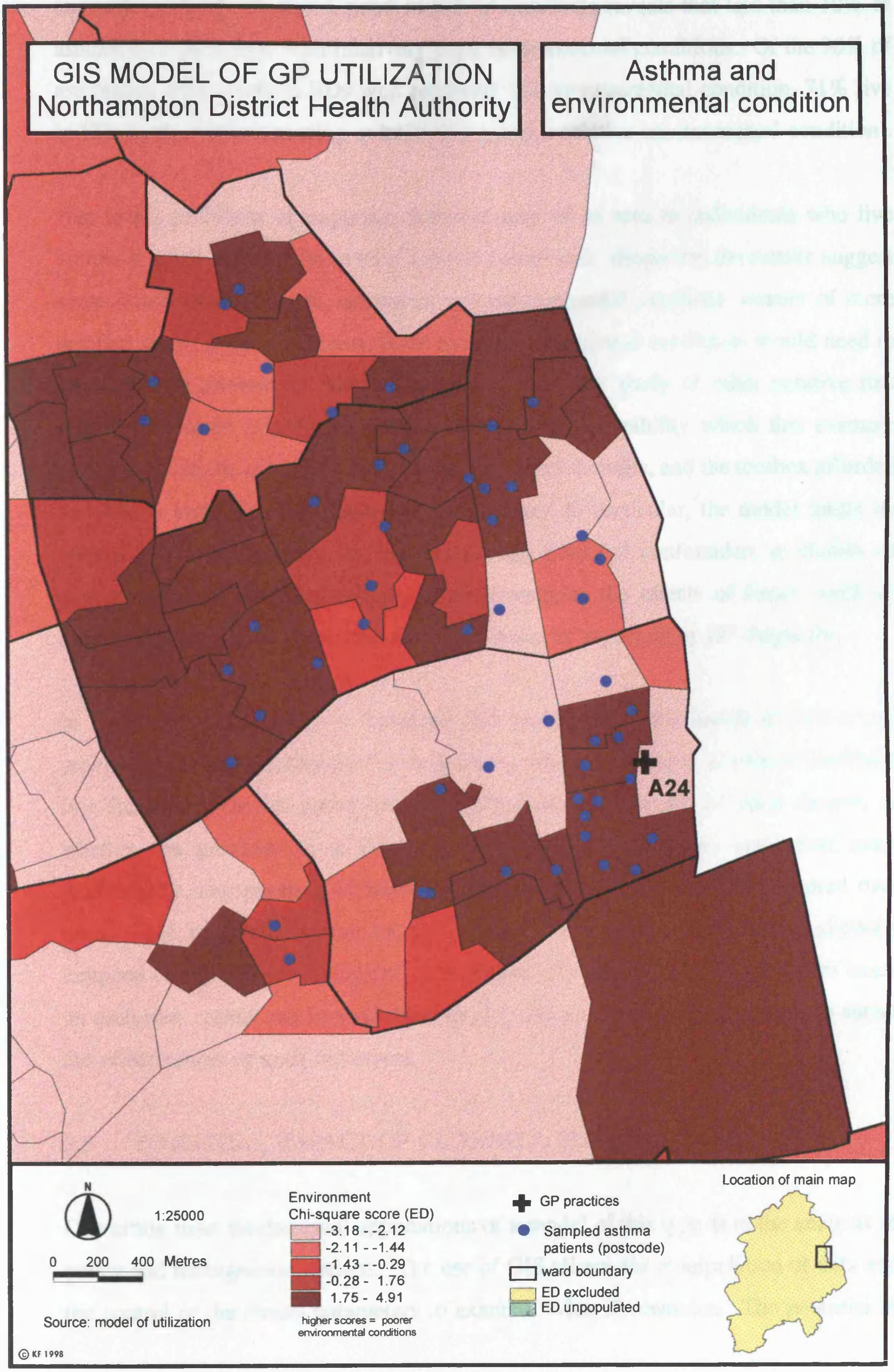
To achieve this, the model outcomes need to be combined with other datasets, such as the patient lists maintained by FHSAs, and/or patient records. Point-in-polygon techniques might be employed to analyse relationships between patients and surgeries. Complete patient lists are not publicly available and such analyses cannot be performed here. However, an example analysis is possible by using the postcode data obtained as part of the patient survey.

GIS offer a toolbox capable of supporting spatial analysis of point-based patient data in relation to areal census data. For instance, patients with particular characteristics (perhaps disaggregated by age, social class etc) and condition can be selected from the patient data and then analysed in comparison with the spatial distribution of other factors, possibly to investigate potential causal links.

Section 4.2.1 illustrated the probable increase in prevalence of asthma and provided a rationale for sampling asthmatics as part of the patient survey. It also identified possible explanations for the increase, suggesting that it was likely to be a result largely of cultural and lifestyle factors rather than airborne pollutants. This being the case, aspects of the indoor environment, such as environmental tobacco smoke, fumes, chemicals and allergens, house dust, mite allergen, dampness and exposure to pets may be implicated. These characteristics are not directly measurable via the census but other housing characteristics provide proxies for these risk factors. The composite environment score, for example, is derived from indicators which measure house ownership, housing standard and overcrowding.

Map 9.5 illustrates the environment score on the eastern side of Northampton Borough, in the EDs of Thorplands, Lumbertubs and Billing. The score varies considerably, but EDs in this part of Northampton Borough show, predominantly, high scores, indicating relatively poor environmental conditions. A sample of patients on the patient list of surgery A24 were questioned as part of the patient survey. The location of returns from asthmatic patients are plotted on Map 9.5. Whilst it is acknowledged that this analysis only illustrates a proportion of asthmatic patients on the practice list it clearly illustrates the spatial distribution of asthma in relation to

Map 9.5 Asthma and environmental condition



environmental condition. A point-in-polygon analysis reveals that less than 10% of asthmatics live in EDs with relatively good environmental conditions. Of the 90% of asthmatics who reside in EDs with relatively low environmental condition, 71% live in EDs in the highest scoring quintile (the poorest relative environmental condition).

Due to the problems of imputing characteristics of an area to individuals who live within, it is not appropriate to infer a direct causal link. However, the results suggest some relationship between asthmatics and environmental condition worthy of more detailed study: at the very least, these social environmental conditions would need to be taken into account as potential confounders in any study of other putative risk factors. Of more importance here, however, is the possibility which this example shows of using the model in combination with other datasets, and the toolbox afforded by GIS, to assist epidemiological investigations. In particular, the model might be helpful in either screening for, or quantifying, potential confounders in studies of environmental health relationships, or to investigate the effects of factors such as accessibility and socio-economic factors on rates of reporting or GP diagnosis.

In these ways, the model is therefore able to inform public health decisions and provides an additional tool useful in deciding whether variation in patient condition is a function of health status, material affluence, environment or other factors, or whether the presence of a GP surgery itself leads to higher utilization rates. Additionally, the targeting of health promotion initiatives could be monitored over time. Each new census provides the opportunity to update the database allowing temporal change to be investigated. The degree of variation between outcomes based on each new census can be evaluated, as can change based on patient data, to assess the effectiveness of such initiatives.

9.5 POTENTIAL IMPACT OF CLOSING A SURGERY

One of the most fundamental applications of a model of this type is in the analysis of policy and management options. The use of GIS allows the manipulation of data and the control of the model parameters to examine 'what if' scenarios. The potential of investigating outcomes through modelling, rather than through trial and error, has clear benefits. In terms of health care planning, the ability to be able to determine the effect of changes in surgery provision will greatly inform resource managers.

This section presents the results of an illustrative analysis to determine the effect of closure of a surgery. In particular it is important to determine the effect closure has on the spatial quality of provision and the consequence in relation to disadvantaged demand exhibited by the local population.

Since the scenario is hypothetical the decision as to which surgery to close is arbitrary. The procedure followed would, nevertheless, be the same whichever surgery closure (or group of closures) is modelled. It was decided to model the closure of surgery B2, a group practice in the town of Daventry with eight partners and average daily weighted surgery hours of 5.67. The practice has a relatively small catchment of 3.2km, covering the four wards of Daventry. The choice of this surgery is, perhaps, extreme since it is unlikely that a loss of eight GPs would occur. However, it provides a suitable illustration of the modelling procedure.

The loss of surgery B2 would result in one remaining practice in Daventry to cater for local needs: practice B1 which has six partners, an average daily weighted surgery hours of 4.66 and a catchment area of 6.4km. However, it is worth noting that several other practices in Northampton have catchment areas which extend to Daventry, and these are thus included in the composite provision score.

To model the closure of surgery B2 the procedure for calculating the provision score was followed (Section 6.7). The following steps were applied:

- choose the surgery closure to be modelled (surgery B2)
- alter the average weighted surgery hours for B2 from 5.67 to 0 (to model no provision from this surgery location)
- determine the affected EDs within the catchment area of surgery B2
- recalculate distance decay scores for each ED to those GPs defining it in its catchment

- for each ED, aggregate the adjusted distance decay scores between the ED and all GPs defining it in its catchment
- recalculate the composite provision chi-square score
- recalculate outcome scores based on recalculated provision score

Any recalculated distance decay score affects the ED directly but also has a knock-on effect on all other scores in the case study area due to the relative nature of the chi-square calculation. For each ED, the calculation of provision takes the form:

$$(O_1-E_1)^2/E_1$$

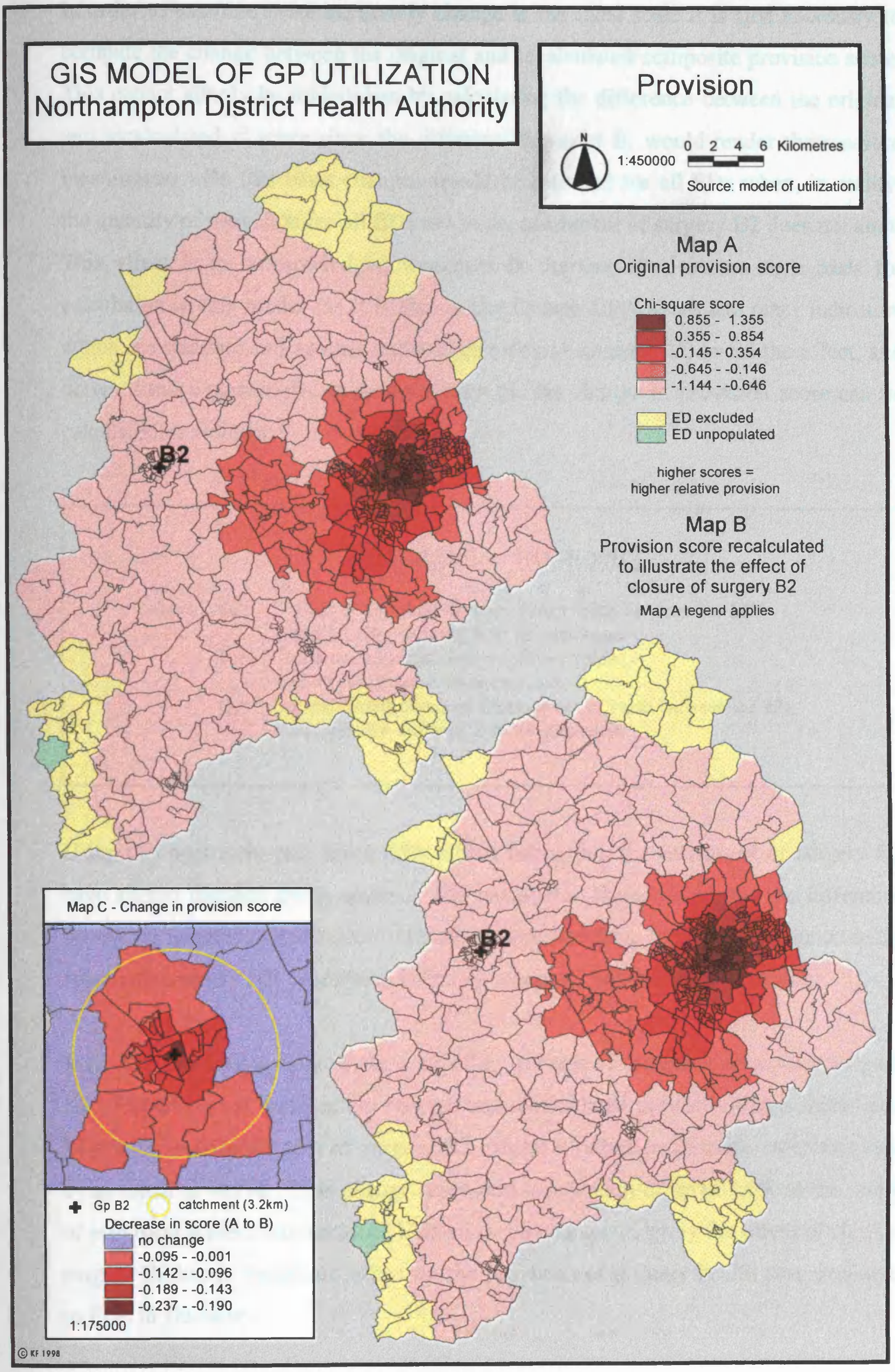
where O_1= observed distance decay value between the ED and all GPs defining it in its catchment
E_1= expected distance decay value ($\bar{x}$ of all distance decay values)

A change in the observed distance decay value, for an affected ED, alters its composite provision score. Furthermore, since $\bar{x}$ of all distance decay values is altered, E_1 also changes. This reflects the circumstance that the provision score is relative to the NDHA area as a whole, so changes in any one area can affect scores across the case study area[3].

The effect of closing surgery B2 on the composite provision score therefore needs to be viewed at the regional scale as well as the local scale. The regional effects of a change in the provision score, arising from the closure of surgery B2, can be seen to be small when comparing Maps 9.6a and 9.6b. The pattern of provision is, broadly, unaltered and most EDs remain in the same quintile.

3 This is a noted drawback of such methods. For example, the Jarman UPA score would be similarly affected by a change in ward values since the UPA calculation involves deriving average values for all wards in England and Wales. This average would be affected by any change in one or more wards leading to some change in all wards.

Map 9.6 Closure of B2: Provision score



In order to examine more accurately change at the local scale it is first necessary to compute the change between the original and recalculated composite provision score. This cannot simply be undertaken by calculating the difference between the original and recalculated x^2 score since the different values of E_1 would render the measure meaningless. On this basis changes would be reported for all EDs when, in reality, the quantity of provision for all EDs not in the catchment of surgery B2 does not alter. This effect is an acknowledged weakness in the use of x^2 scores as a basis for calculation in this model (as it is also in the Jarman UPA score and other indicators which are standardised against regional or national scores). To avoid the effect, and derive a more meaningful measure of change, the change in provision score can be calculated as follows:

$$[(O_2-E_1)^2/E_1] - [(O_1-E_1)^2/E_1]$$

where O_1= original observed distance decay value between the ED and all GPs defining it in its catchment

E_1= original expected distance decay value ($\bar{x}$ of all distance decay values)

O_2= recalculated observed distance decay value between the ED and all GPs defining it in its catchment

Using this approach, only those EDs which fall within the catchment of surgery B2 have altered distance decay scores. The calculation therefore returns the difference between original and recalculated provision scores for those EDs whose distance decay score has altered. All unaffected EDs will return 0, indicative of no change.

Map 9.6c provides a much more compelling picture of the effect of closing surgery B2. The difference between the original and recalculated provision scores shows that EDs in the catchment area of surgery B2 exhibit a reduction in score, in some cases by as much as -0.190. This change represents a reduction of up to 7.6% of the range of provision scores. Surrounding EDs show no change. Clearly the effect of closing surgery B2 has a significant effect on the provision of primary health care available to EDs in Daventry.

Map 9.7 illustrates the change in provision scores in terms of the change in relative ranked position. The regional change in provision is more marked when examining change in ranked position, compared to the change in score on Map 9.6. All EDs outside of the catchment area of surgery B2 either display no change in ranked position or an increase (of up to 22 places). This is expected since the reduction in provision score for EDs in the catchment area of surgery B2 results in a reduction of relative ranked position (of up to 72 places). This being the case, the ranked positions of other EDs in the case study tend to increase in compensation.

The change in ranked position provides a clear impression of the effect of closing surgery B2 both locally and regionally. However, it should be remembered that the use of relative position is not, in itself, a reliable method of illustrating change. For every ED which decreases in rank, one or more EDs will increase (depending on the magnitude of the ranked change) and vice versa. Clearly, one ED will always be ranked highest and one lowest, regardless of any changes in provision. Indeed, an increase in provision in one location may result in an ED elsewhere being re-ranked lowest even though the actual level of provision remains unaltered. The use of ranked change is therefore suitable for illustrative purposes but not for health care planning purposes[4].

Whilst it is valuable to determine the change in patterns of provision resulting from surgery closure, the outcomes in relation to realized demand are, perhaps, more important. Indeed, closure of a surgery may not have a significant impact if low levels of disadvantaged demand are in evidence and where an over-supply previously existed. Map 9.8 illustrates the changes in realized demand arising from changes in provision due to the closure of surgery B2. The recalculated realized demand score (Map 9.8b) does not differ markedly from the original score (Map 9.8a) with most EDs remaining in the same quintile category. Map 9.8c shows the calculation of change in realized demand between the original and recalculated scores (using the same method as noted previously).

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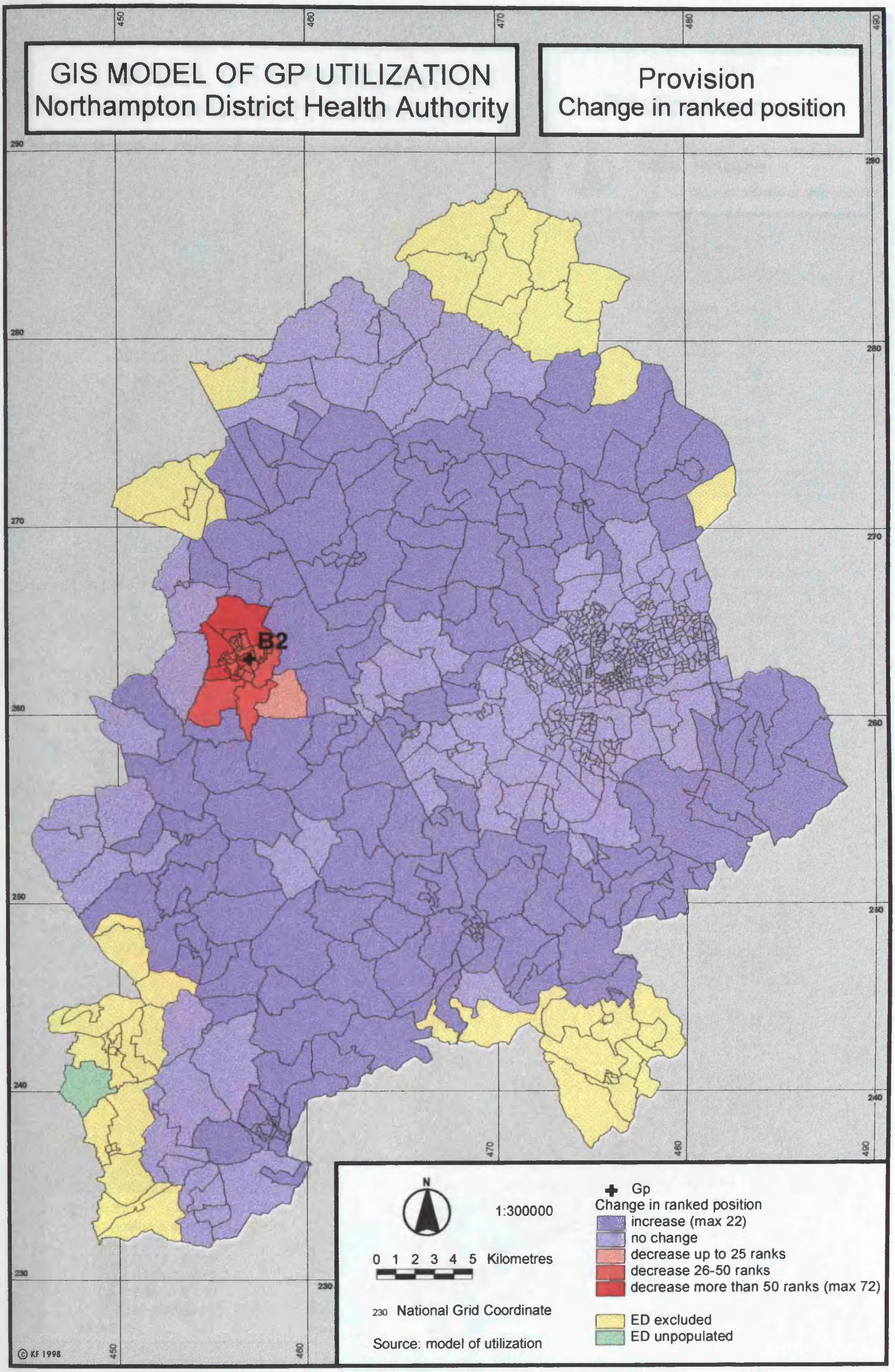
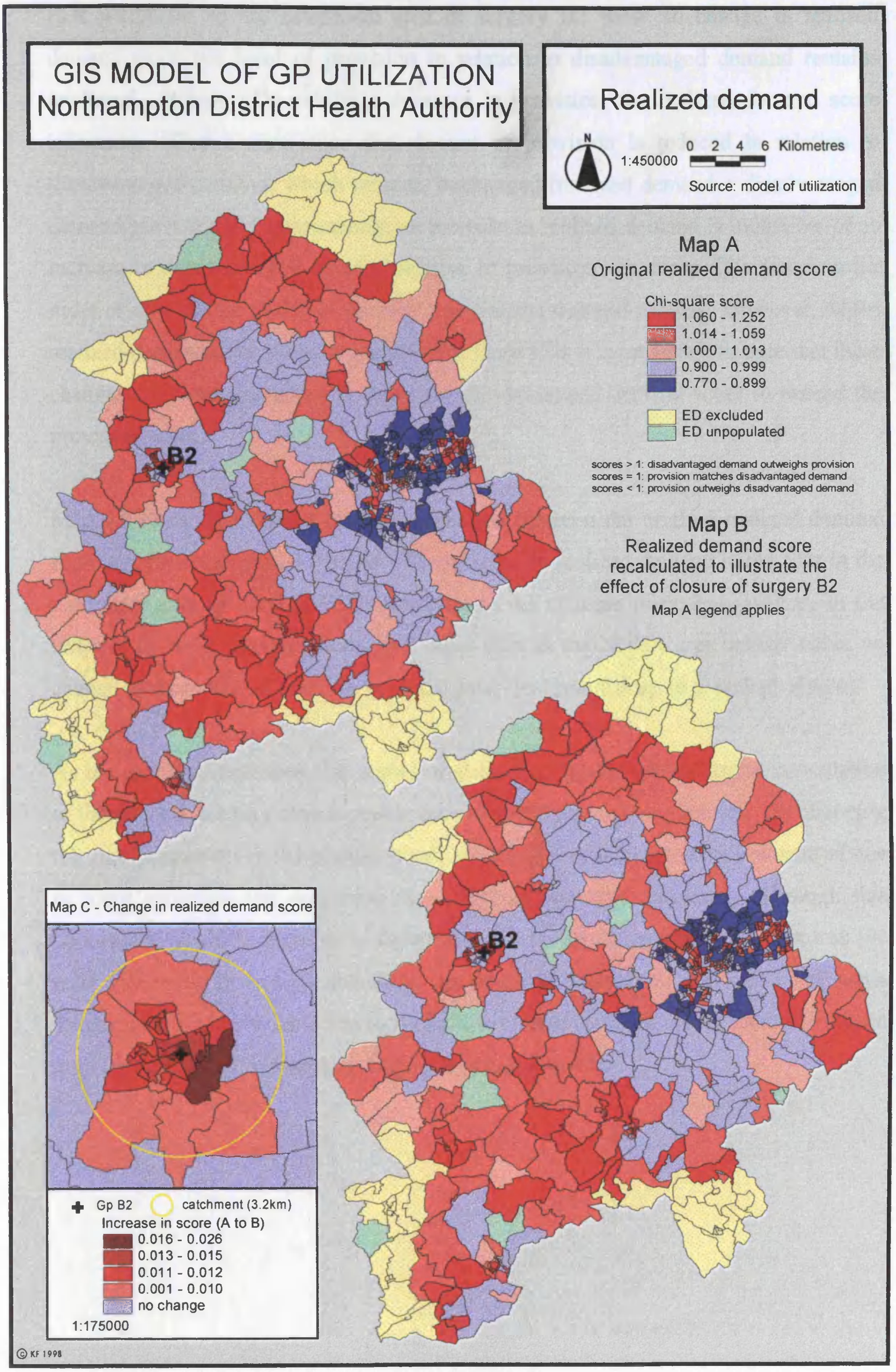
4 Whilst there are clear reasons why the use of relative ranked position is not appropriate for planning purposes such measures are currently in use (for example DoE, 1995).

Map 9.7 Closure of B2: Provision rank



Map 9.8 Closure of B2: Realized demand score

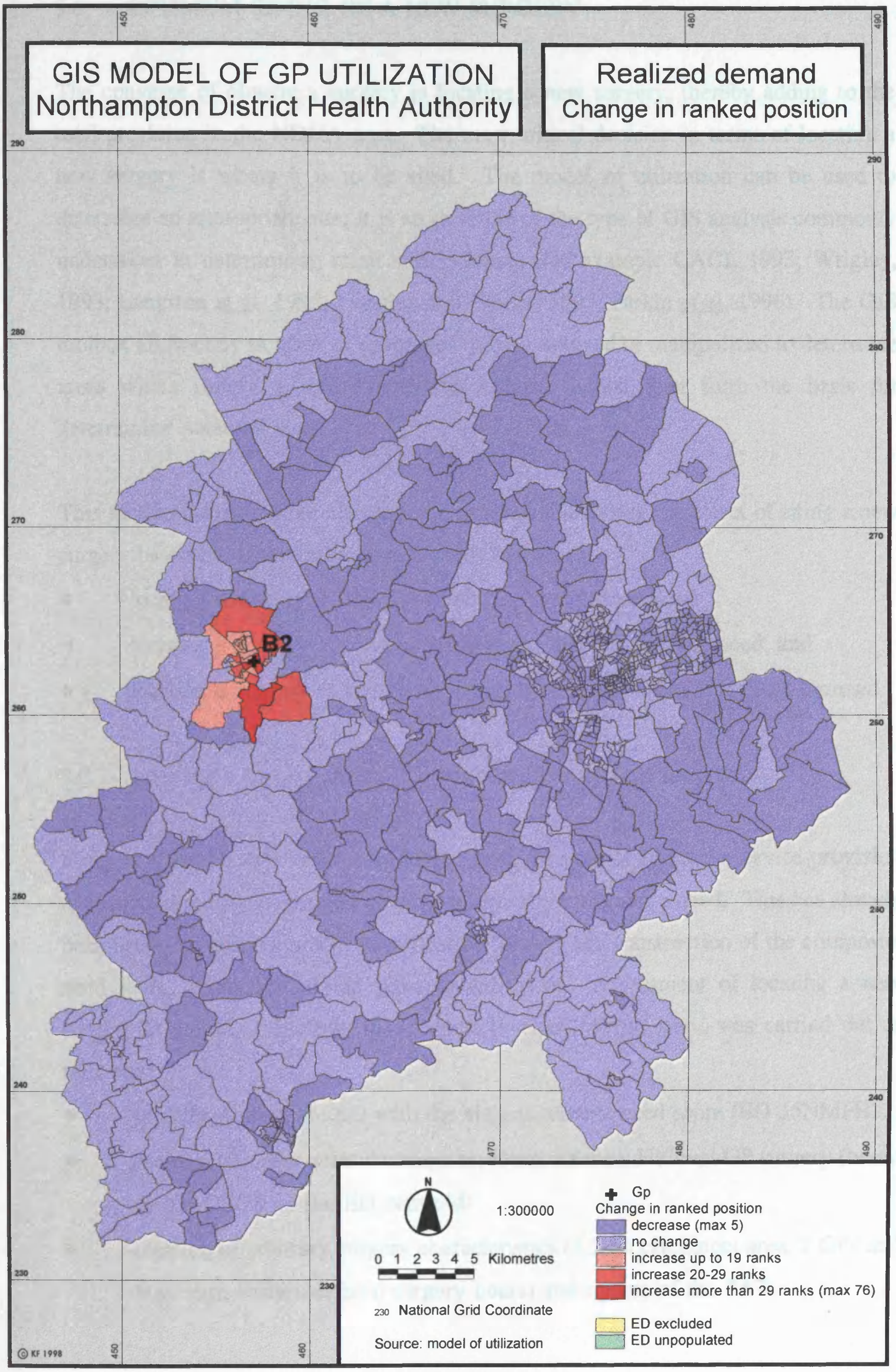


EDs peripheral to the catchment area of surgery B2 show no change in realized demand since the level of provision in relation to disadvantaged demand remains unaltered. Where EDs exhibit a decrease in provision, the realized demand score increases. This occurs since the amount of provision is reduced in relation to disadvantaged demand, which remains unchanged (realized demand = disadvantaged demand/provision). Consequently, an increase in realized demand is indicative of an increase in disadvantaged demand relative to provision. In some EDs this is in the order of up to 0.026 (9.0% of the range of realized demand scores). However, whilst realized demand does show an increase for these EDs it is important to note that these changes are never sufficient to cause the disadvantaged demand score to exceed the provision score.

Map 9.9 shows the change in ranked position between the original realized demand score and the recalculated version. The increase in realized demand in the EDs in the catchment area of surgery B2 is mirrored by an increase in ranked position, in the order of up to 76 ranked places. All other EDs in the NDHA area exhibit either no change in their ranked position or a marginal decrease (of up to 5 ranked places).

As the example illustrates, the model of utilization can be used to assist examination of the effect of surgery closure and is thus of value to resource planners. By changing relevant parameters in the provision sub-model, it is possible to model closure of one or more surgeries and determine the effect on outcome measures. Through this approach it would be possible to determine which surgery closure would result in the least difference in overall and local provision in relation to demand. The same procedure can also be followed to model the effects of losing one or more GPs from a group practice or, perhaps, enlarging a group practice.

Map 9.9 Closure of B2: Realized demand rank



9.6 OPTIMUM SITING OF A NEW SURGERY

The converse of closing a surgery is locating a new surgery, thereby adding to the total provision in the NDHA area. The most critical decision in terms of locating a new surgery is where it is to be sited. The model of utilization can be used to determine an appropriate site; it is an example of the type of GIS analysis commonly undertaken in determining retail site locations (for example CACI, 1993; Wrigley, 1993; Langston et al, 1995; Longley and Clarke, 1995; Birkin et al, 1996). The GIS toolbox allows any number of coverages to be overlayed or manipulated to determine areas which satisfy a set of selection criteria, which then form the basis for determining potential sites.

This section presents three alternative examples, illustrating the effect of siting a new surgery based on different locational rules, namely:

- locating a surgery in the ED exhibiting the greatest need;
- locating a surgery at a site exhibiting the greatest average need; and
- locating a surgery at a site exhibiting the greatest average realized demand.

9.6.1 Locating a surgery in the ED exhibiting the greatest need

In terms of health care location and allocation, the goal of equitable service provision can be achieved by overlaying coverages indicative of service need. This has already been undertaken in the model of utilization through the construction of the composite need score, a function of ten separate indicators. Assessment of locating a new surgery in the ED exhibiting the greatest level of relative need was carried out as follows:

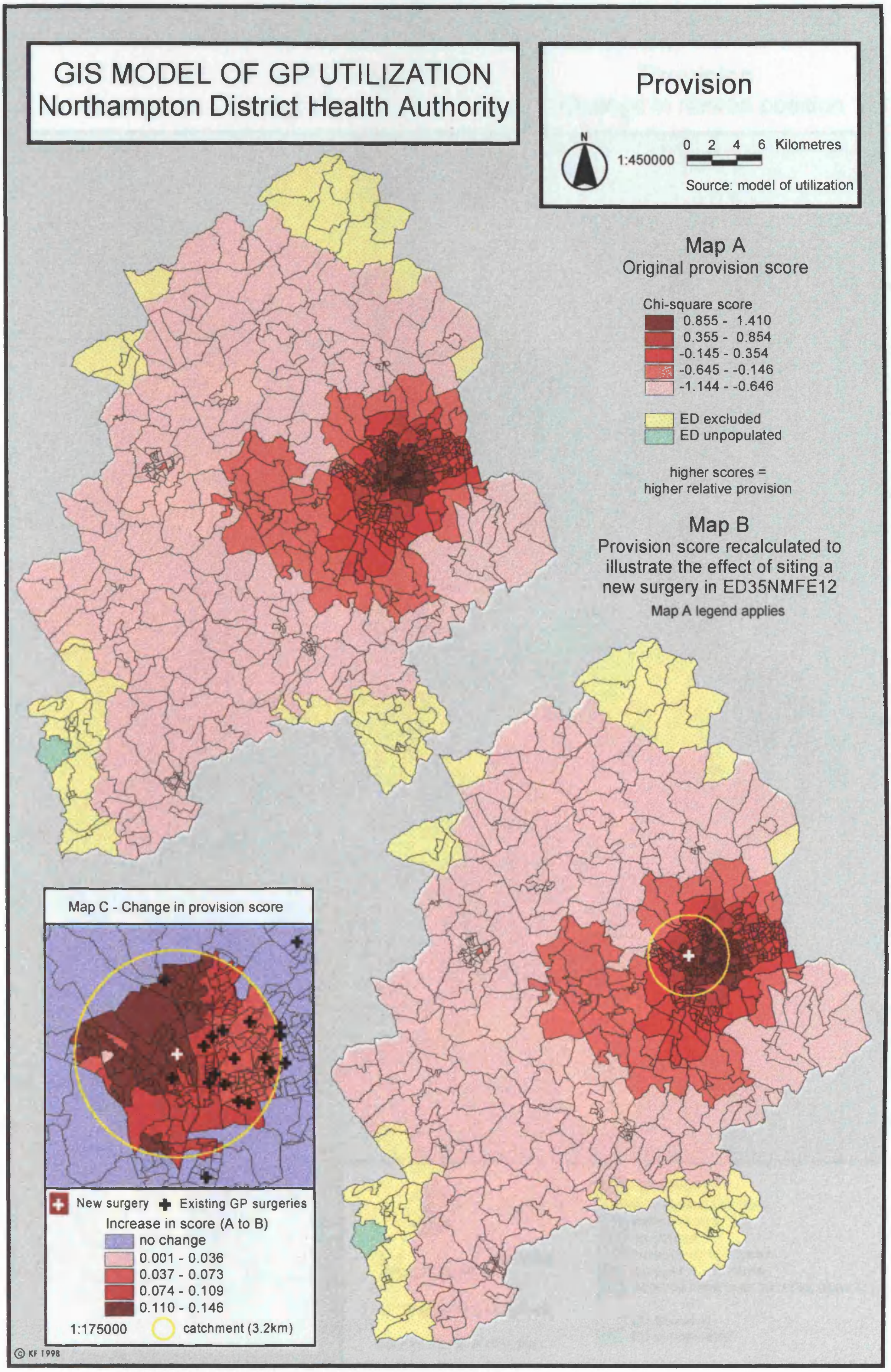
- identification of the ED with the highest relative need score (ED 35NMFE12)
- creation of a new point coverage representing the additional GP surgery (based on the OSGR of the ED centroid)
- creation of arbitrary surgery characteristics (3.2km catchment area, 2 GPs and 6 average daily weighted surgery hours) and update of the PAT.

- identification of the EDs within the catchment area of the new surgery and addition of new provision
- recalculation of distance decay score for each ED to those GPs defining it in its catchment (incorporating new surgery)
- aggregation of the total distance decay scores per ED
- recalculation of the composite provision chi-square score
- recalculation of the outcome scores based on the adjusted provision score
- calculation of change in provision score (and outcomes) based on the method outlined in Section 9.5.

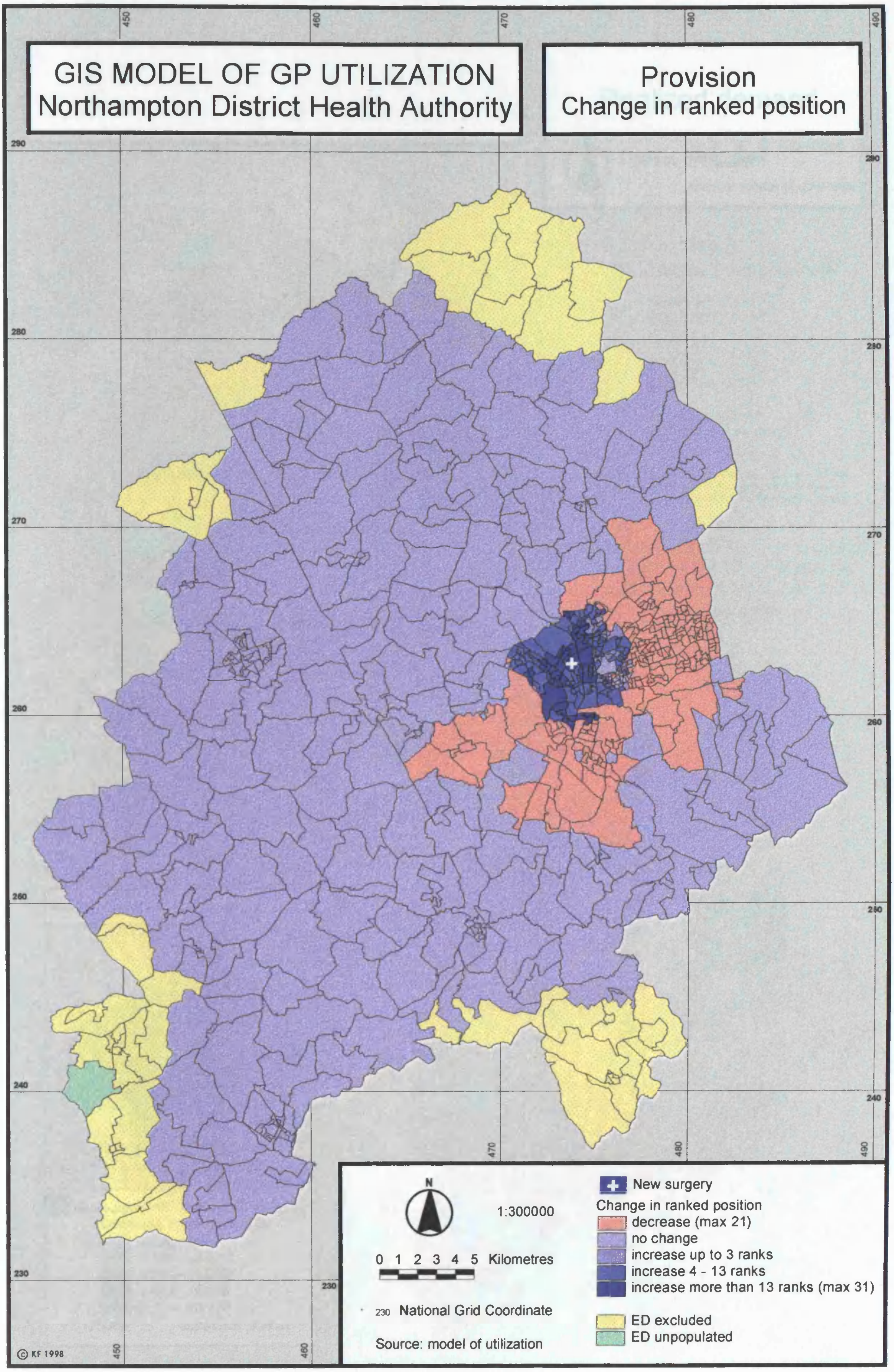
Under these locational rules, the new surgery would be located in Dallington and Kings Heath ward, close to the concentration of provision already present in Northampton. Map 9.10b shows the location of the new surgery and its catchment area. It also illustrates the recalculated provision score which shows little change from the original score (Map 9.10a) with most EDs being categorised in the same quintile. Map 9.10c shows the change in provision score with EDs in the catchment area of the new surgery exhibiting an increase in provision score of up to 0.146 (5.7% of the range of provision scores). The change in provision would appear to benefit the EDs to the north and west of the new surgery, those where no provision currently exists. The pattern of ranked provision scores remains broadly unaltered for the majority of the NDHA area (Map 9.11). However, EDs in the catchment area of the new surgery show an increase in ranked position (of up to 31 ranked places), countered by a decrease in those EDs to the east and south of the catchment area.

In order to discern the benefit of increased provision in this area, realized demand can be recalculated. Maps 9.12a and 9.12b show the effect on realized demand of siting a surgery in ED 35NMFE12. There is very little difference in the quintile categorisation of EDs although some decrease in score can be seen in the catchment area of the new surgery. This is emphasised when examining the change in realized demand score (Map 9.12c). A decrease in score of the order of up to -0.013 (2.6% of the range of realized demand scores) is evident, indicative of the increased level

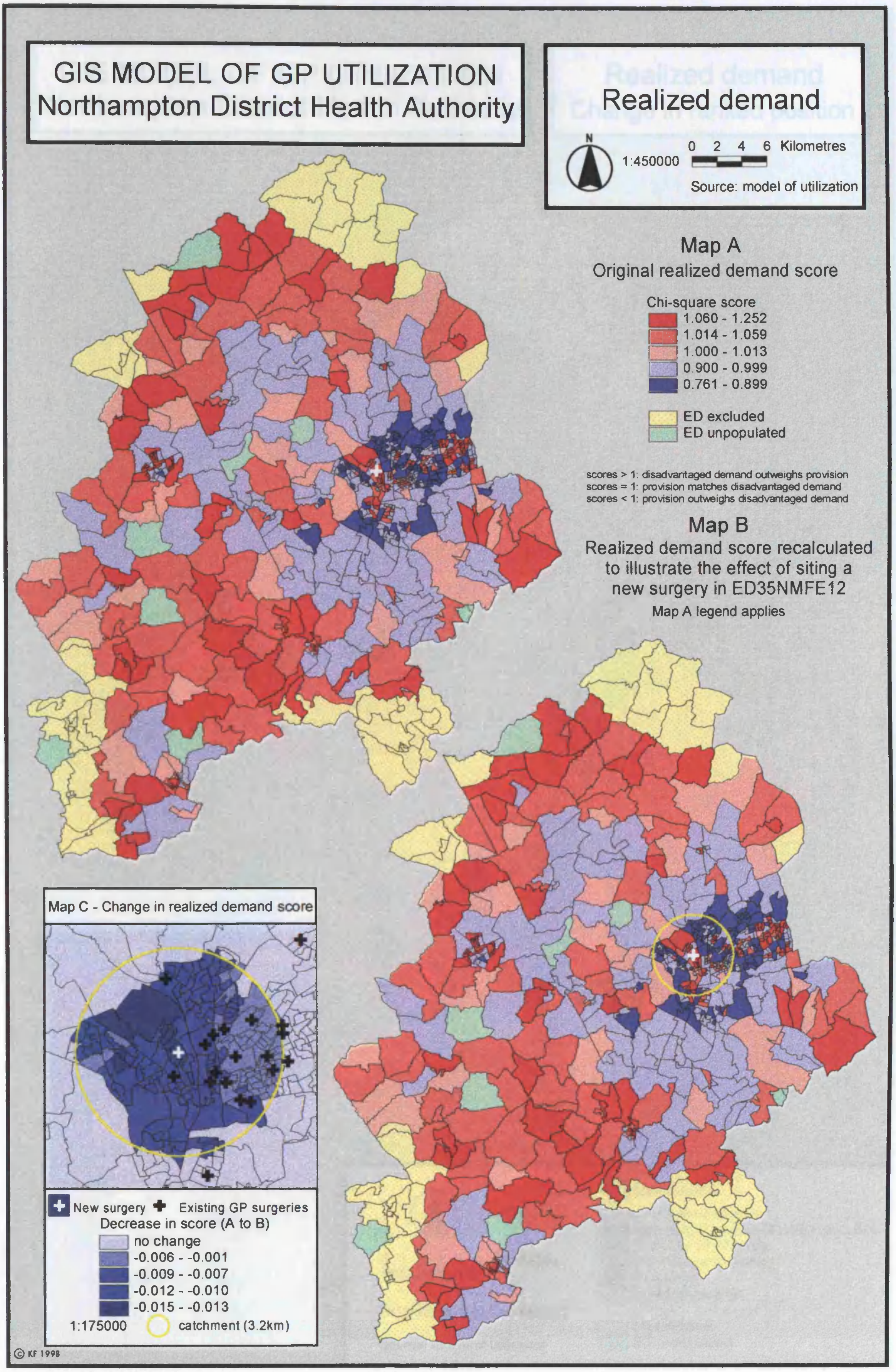
Map 9.10 Siting a new surgery (ED with greatest need): Provision score



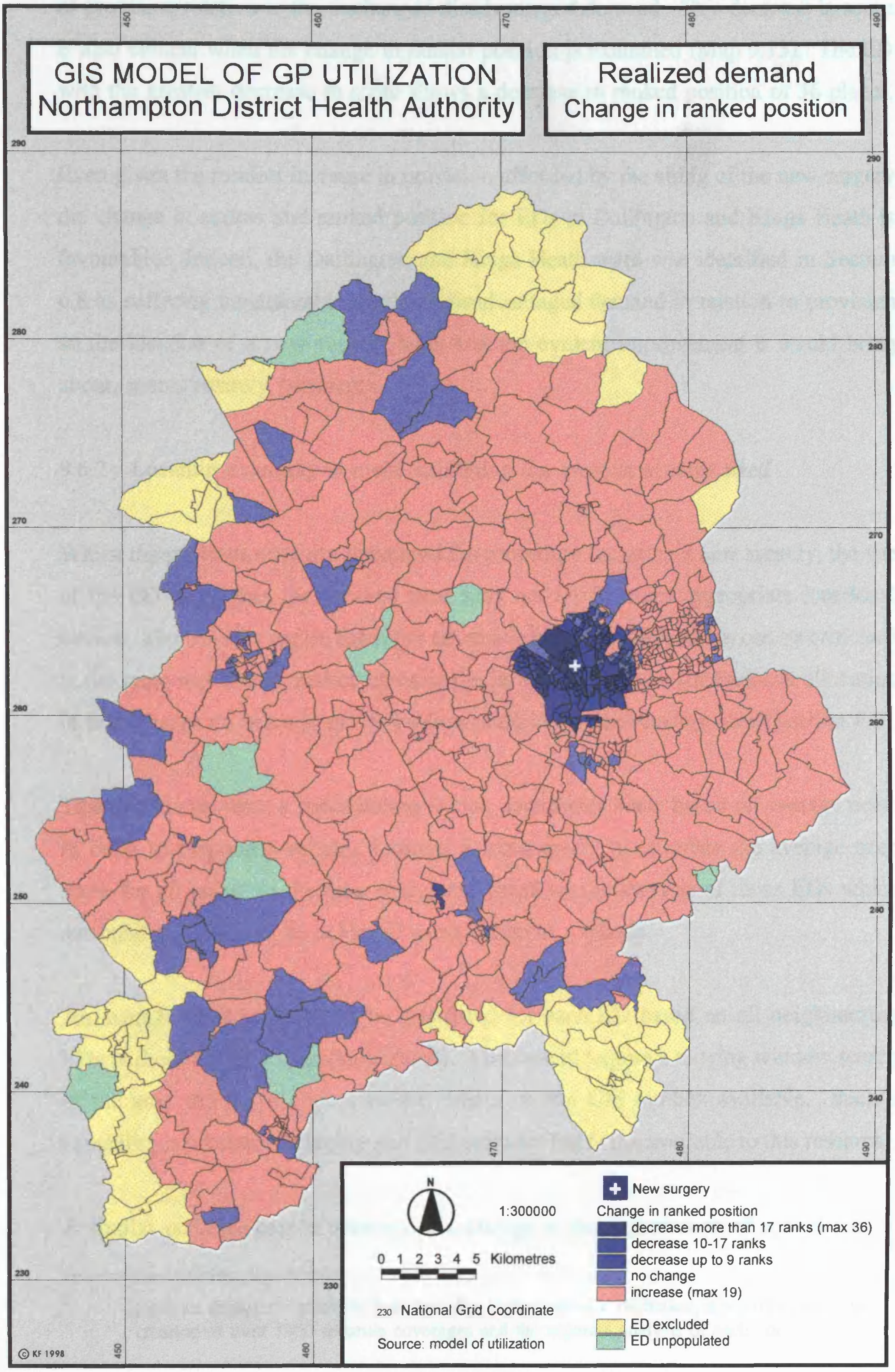
Map 9.11 Siting a new surgery (ED with greatest need): Provision rank



Map 9.12 Siting a new surgery (ED with greatest need): Realized demand score



Map 9.13 Siting a new surgery (ED with greatest need): Realized demand rank



of provision relative to the unchanged disadvantaged demand. This decrease in score is also evident when the change in ranked position is examined (Map 9.13). The ED with the greatest decrease in score shows a decrease in ranked position of 36 places.

Even given the modest increase in provision afforded by the siting of the new surgery the change in scores and ranked position for EDs in Dallington and Kings Heath is favourable. Indeed, the Dallington and Kings Heath ward was identified in Section 6.8 as suffering considerable levels of disadvantaged demand in relation to provision so the location of a new surgery here, and the evident improvement it would bring about, seems entirely pertinent.

9.6.2 Locating a surgery at a site exhibiting the greatest average need

Whilst the previous scenario illustrated the procedure for siting a new surgery, the use of the ED displaying the greatest need may not be the most appropriate locational choice. The use of a single ED score on which to determine location can be criticised in the same way as the method of using the Jarman UPA score for financial allocation in that it takes no account of the level of need in the surrounding area (Section 9.3).

This Section presents a methodology which determines a site based on average need. In order to pinpoint a suitable location it is necessary to calculate the average need score for all points in the case study area based on the average of those EDs which surround it. This can be achieved using different methods.

An average need score could be calculated for each ED based on all neighbouring EDs or those within a specified distance. This would require a moving window search of the area and is, to a great extent, reliant on the GIS toolbox available. Such a capability is available in higher-end GIS software but is not available to this research[5].

A similar outcome can be achieved if a change in the organisation of spatial data is

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5 Such an analysis is possible here but, due to the software limitation, it would require the creation of over 1400 separate coverages and the separate analysis of each one.

implemented. The model of utilization has, throughout this research, been developed and maintained using a vector data model. Consequently, coverages have been created to represent either point, line (arc) or area (polygon) phenomena. Conversion of appropriate coverages to a raster data model allows the data to be modelled as a continuous variable. Continuous variables are represented in GIS as surfaces where the value for each cell is the value for a point at the centre of the cell, and the value of other locations can be interpolated from the cell centre and the centres of neighbouring cells. The surface created is therefore a grid representing magnitude and can be used for neighbourhood analysis in a similar way as the moving window approach.

The approach is therefore twofold. Firstly, a grid is created using a surface interpolator algorithm to create a continuous surface from input point values. Secondly, a neighbourhood analysis calculation can be applied to the grid.

To create a grid of the need score the following procedure was implemented:

- The PAT of ED centroid coverage NDHAEDC was updated to include need scores.

- Using Arc/Info Spatial Analyst, a grid was calculated based on the point coverage NDHAEDC (where each ED is represented by a point placed at its geometrical centre). Depending on the phenomena the values represent, and on how the sample points are distributed, different surface interpolator algorithms produce better surface estimates. An Inverse Distance Weighted (IDW) method of surface calculation was selected here. This algorithm assumes that each input point has a local influence that diminishes with distance. It consequently weights the points closer to the processing cell greater than those farther away. Such a method is more commonly used in creating surfaces of population characteristics than other interpolation algorithms, such as spline interpolation (a general purpose interpolator which fits a minimum curvature surface through the input points - more appropriate for gently varying surfaces) or Kriging (a method of interpolation that assumes the distance or direction between input points shows spatial correlation that helps describe the surface).

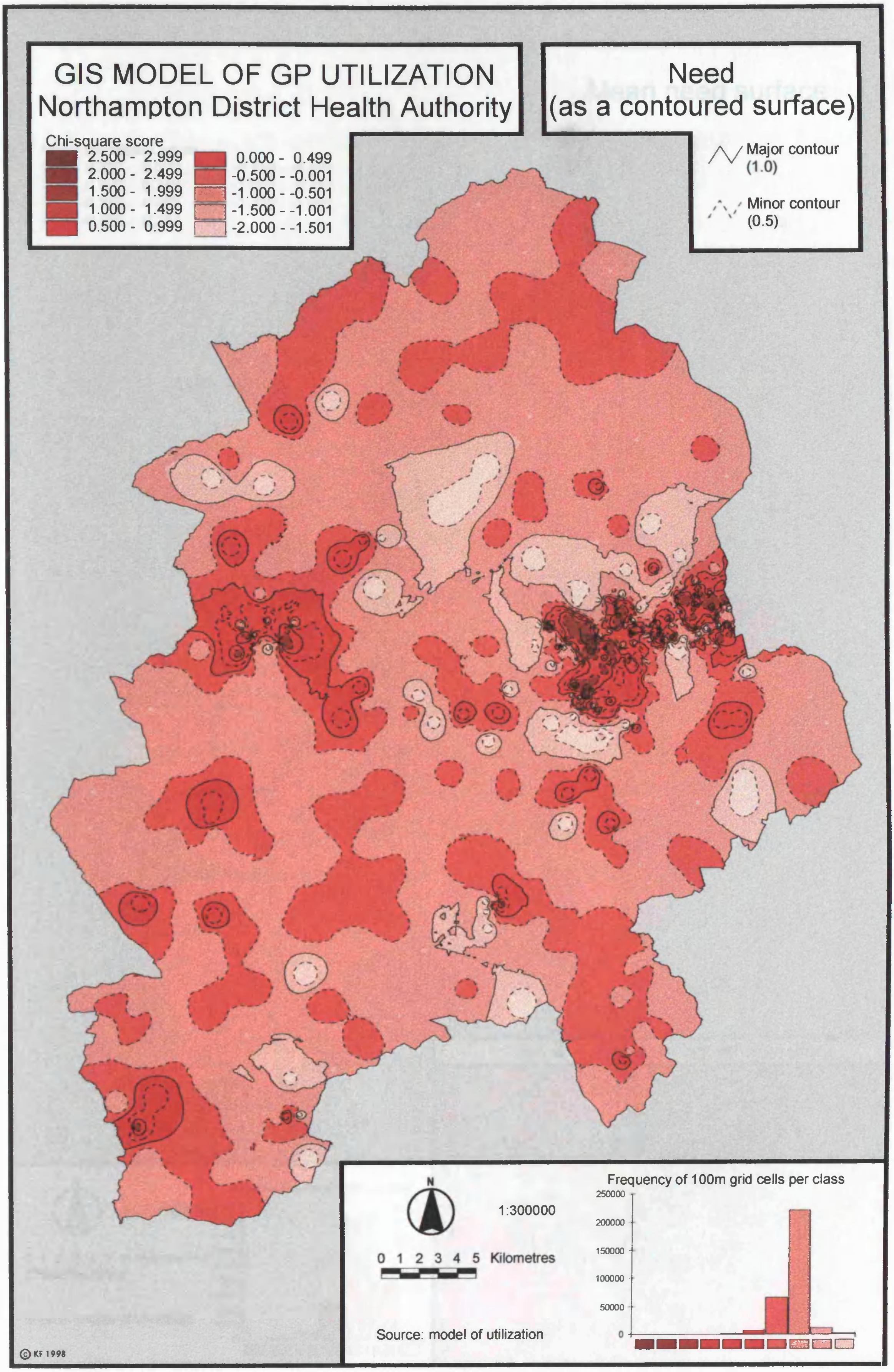
The IDW surface interpolator was used to calculate cell values, at 100m resolution (the resolution of vector data used in the model), using the nearest neighbours of each input point to interpolate cell values.

- Map 9.14 shows the resulting grid, NEED, as a contoured surface. The surface is the raster equivalent of the vector based need maps used elsewhere, and illustrates clearly the localised distribution of high need chi-square scores.

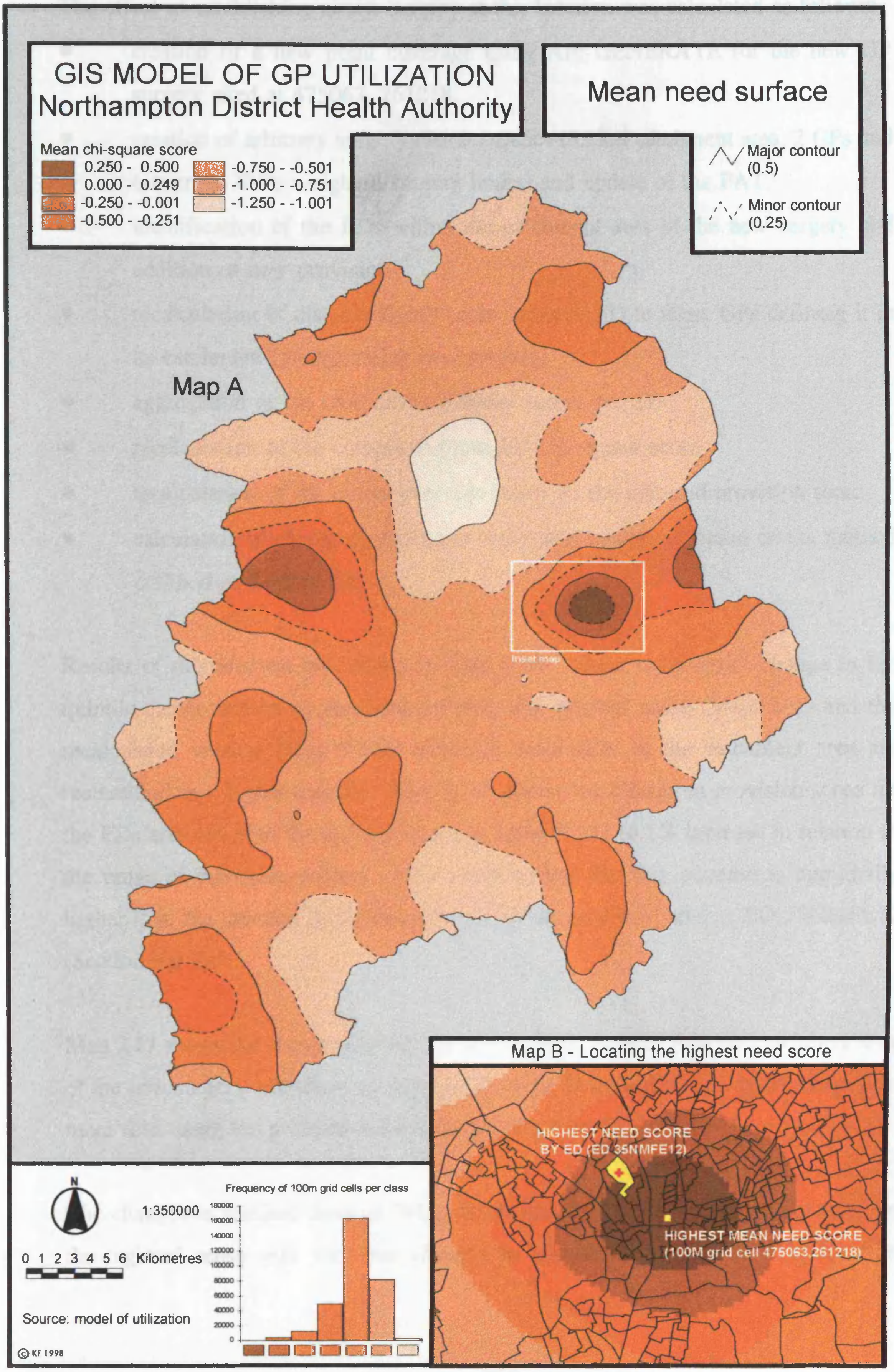
- The second stage of analysis involves the application of neighbourhood analysis functions to the NEED grid coverage. For each cell in the input grid, the function computes a statistic based on the value of the processing cell and the values of cells within a specified neighbourhood. The mean of all cells in a 3.2km radius of each processing cell were calculated (since the GP surgery characteristics to be added are the same as those in Section 9.6.1). A mean need surface was thus created (Map 9.15).

- The preferred location of a new surgery can be determined on the basis of this map - centred in the area with the highest mean need score. Map 9.15b illustrates the location at 475063, 261218. For comparative purposes, an ED overlay illustrates the location of the ED with the highest need score (used to locate the surgery in Section 9.6.1). The highest mean need score is more centrally located in relation to Northampton. The previous analysis showed Dallington and Kings Heath to have EDs with high need scores but its mean scores are much lower. There is therefore a clear benefit in using an average score to locate a new surgery rather than relying on the score exhibited in one ED.

Map 9.14 Siting a new surgery (highest mean ED need): Need surface



Map 9.15 Siting a new surgery (highest mean ED need): Mean need surface



The effect of establishing a new surgery at this location was calculated as follows:

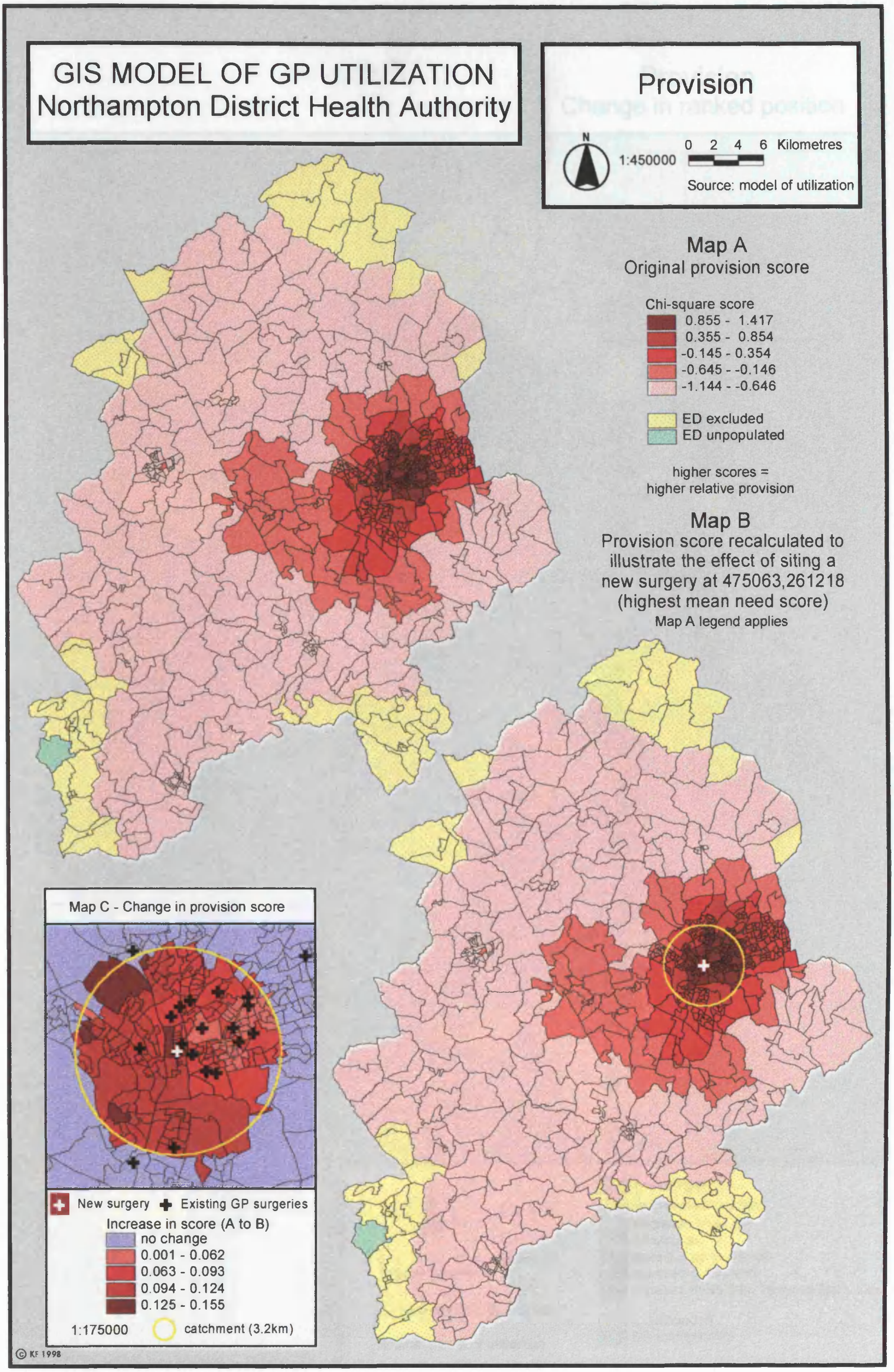
- creation of a new point coverage using Arc GENERATE for the new GP surgery sited at 475063, 261218.
- creation of arbitrary surgery characteristics (3.2km catchment area, 2 GPs and 6 average daily weighted surgery hours) and update of the PAT.
- identification of the EDs within the catchment area of the new surgery and addition of new provision
- recalculation of distance decay score for each ED to those GPs defining it in its catchment (incorporating new surgery)
- aggregation of the total distance decay scores per ED
- recalculation of the composite provision chi-square score
- recalculation of the outcome scores based on the adjusted provision score
- calculation of change in provision score (and outcomes) based on the method outlined in Section 9.5.

Results of this analysis are shown in Map 9.16. There is no major change in the quintile categorisation of provision between the original score (Map9.16a) and the recalculated version (Map 9.16b) although some EDs in the catchment area are reclassified in a higher quintile. Map 9.16c shows the change in provision score for the EDs affected with the greatest increase being 0.155 (6.1% increase in relation to the range of provision scores). It is worth noting that this increase is marginally higher than the increase achieved when a new surgery was sited at ED 35NMFE12 (Section 9.6.1).

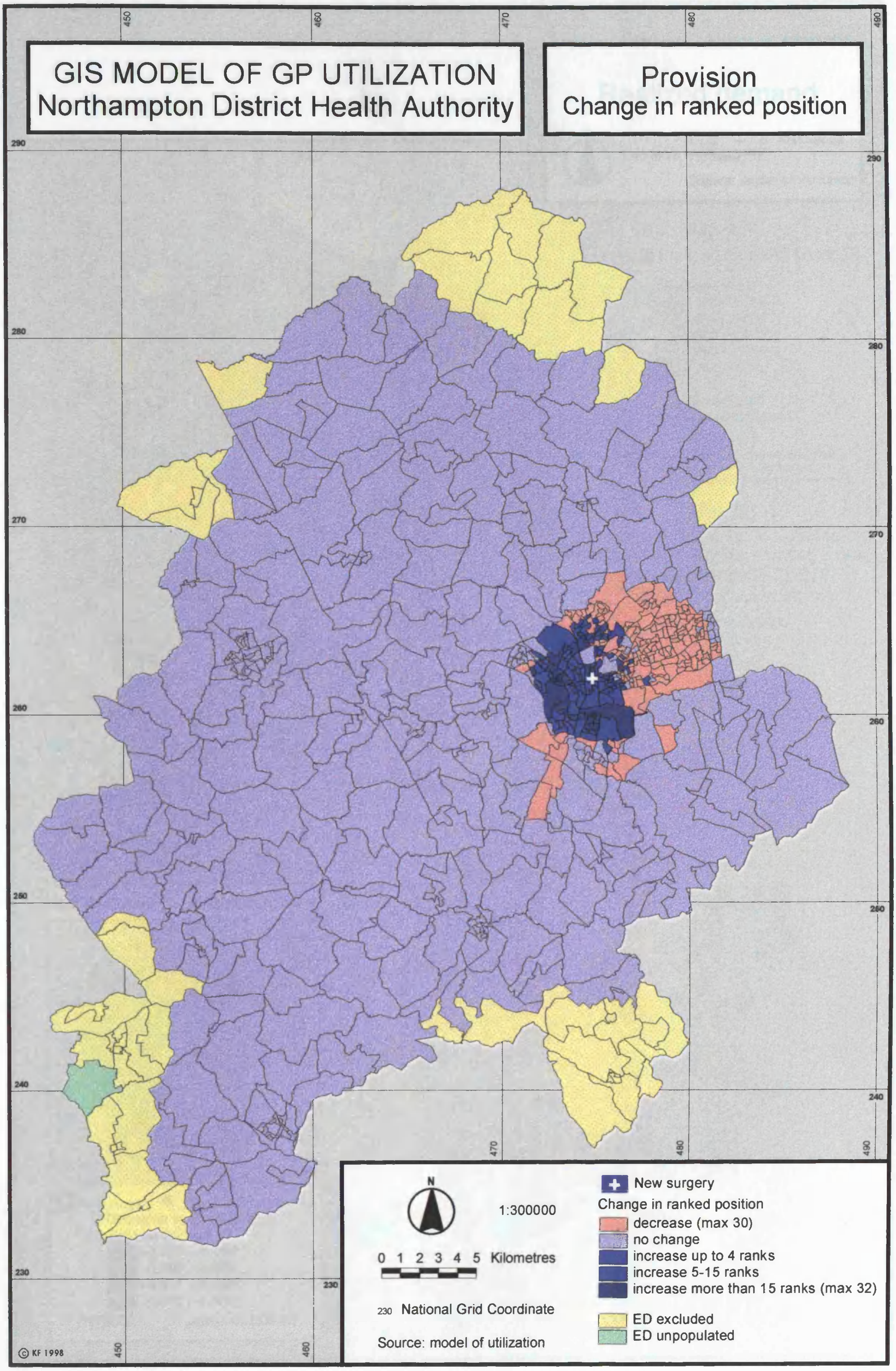
Map 9.17 shows the change in ranked provision with those EDs in the catchment area of the new surgery exhibiting an increase of up to 32 ranked places, again marginally more than using the previous method of surgery location.

The changes in realized demand (Maps 9.18a and 9.18b) are also relatively small in the regional sense with very few changes in quintile categorisation. The level of

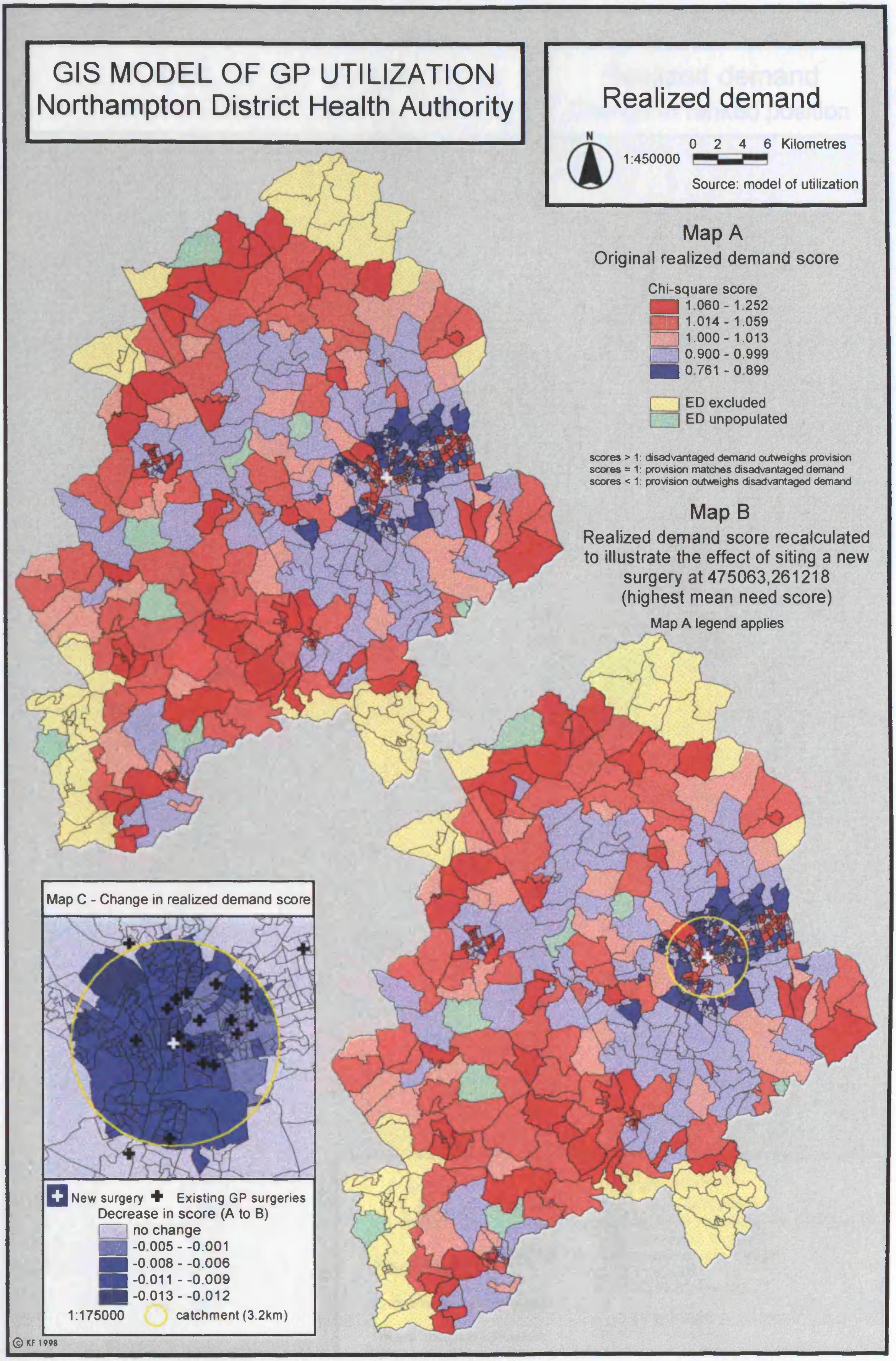
Map 9.16 Siting a new surgery (highest mean ED need): Provision score



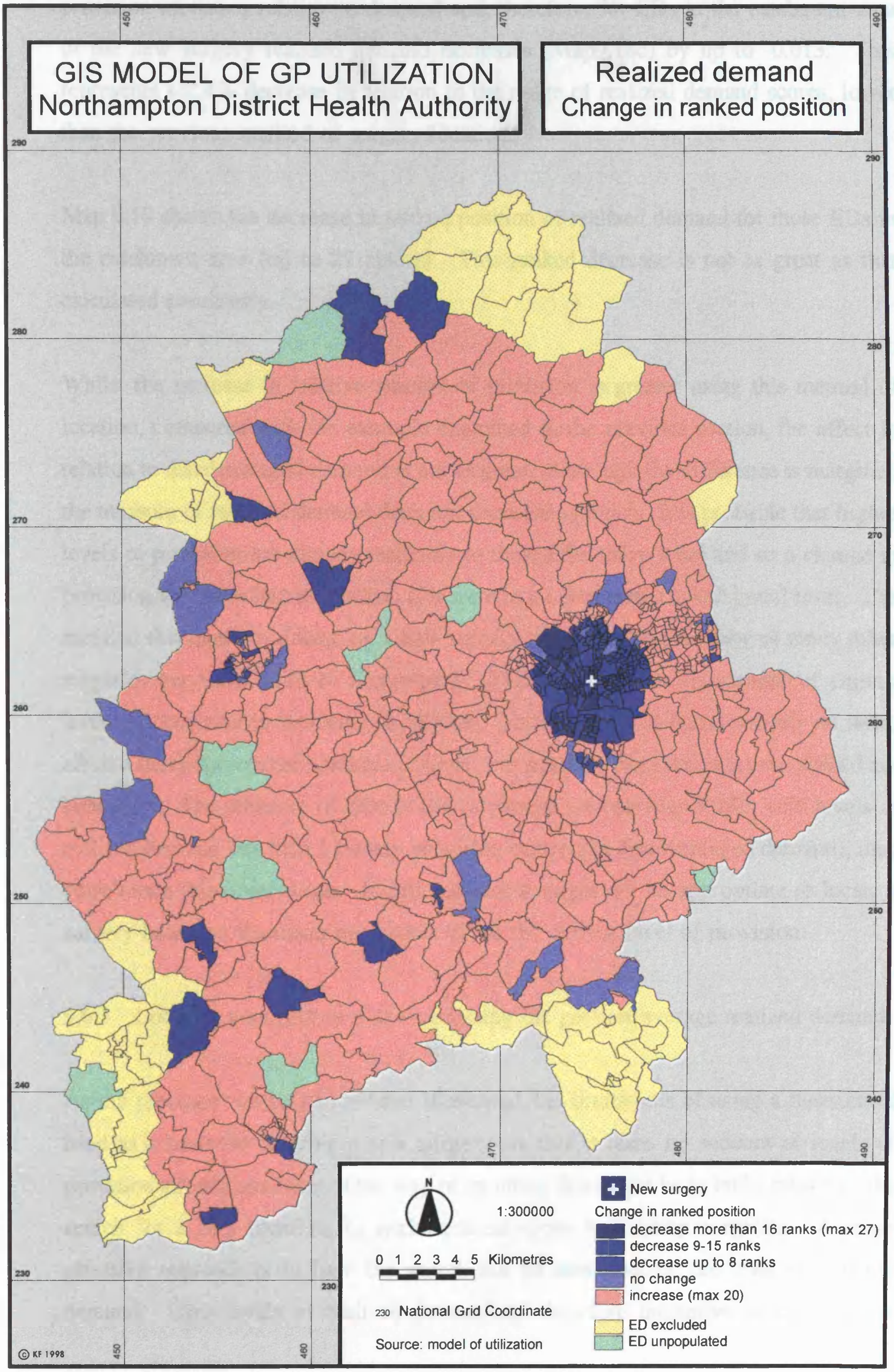
Map 9.17 Siting a new surgery (highest mean ED need): Provision rank



Map 9.18 Siting a new surgery (highest mean ED need): Realized demand score



Map 9.19 Siting a new surgery (highest mean ED need): Realized demand rank



provision increases relative to demand and, therefore, for EDs in the catchment area of the new surgery realized demand decreases (Map9.18c) by up to -0.013. This represents a 2.4% decrease in relation to the range of realized demand scores, lower than the previous method of surgery location.

Map 9.19 shows the decrease in ranked position of realized demand for those EDs in the catchment area (up to 27 places). This ranked decrease is not as great as that calculated previously.

Whilst the increase in relative amount of provision is greater using this method of location, compared with the example examined in the previous section, the effect in relation to disadvantaged demand is not as great. Although the difference is marginal, the measure of realized demand does not decrease as much. It is probable that higher levels of provision are already available to these EDs (Map 9.6c) and so a change in provision will have less effect than if it were in an area with a lower initial level. The fact that this method of locating a new surgery places it in the vicinity of many other surgeries may also point to a drawback. The method takes no account of current levels of provision in its locational choice. Since location is based entirely on need, albeit a more appropriate measure of need, it is possible that current levels of need are being met. The presence of EDs in the catchment area on Map 9.18b, with levels of realized demand less than 1 (where provision outweighs disadvantaged demand), may corroborate this observation. In this instance it might not be appropriate to locate a surgery based on the mean need score given the current level of provision.

9.6.3 Locating a surgery at a site exhibiting the greatest average realized demand

As the previous two scenarios have illustrated, the limitations of using a measure of need as a basis for locating a new surgery are that it takes no account of levels of provision already available. One way of avoiding this might be to build rules into the search for a new location, to exclude areas close to existing surgeries. A more effective approach is to base the search not on need, but on the level of realized demand. High levels of realized demand are therefore indicative of areas where disadvantaged demand is greater, relative to provision, implying a lower level of available provision for the local population.

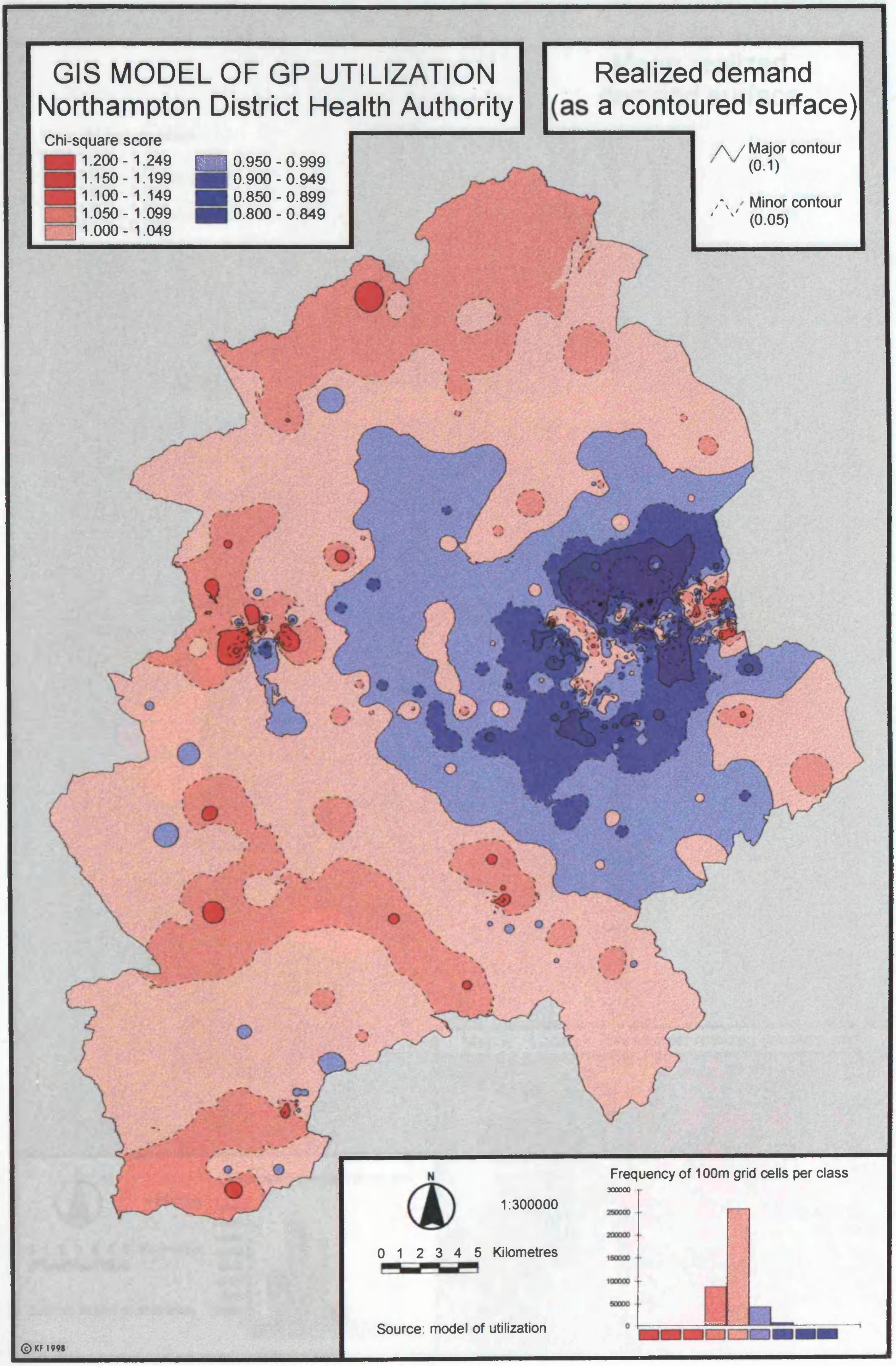
Using GIS query techniques it is possible to identify the ED with the highest realized demand score. However, as the previous two analyses have shown, the use of a single ED score is not the most appropriate method on which to base location. It is more appropriate to apply the method defined in Section 9.6.2, first converting the vector based measure of realized demand to a grid coverage and subsequently calculating the highest mean realized demand cell. The surgery location can then be based on the cell which displays the highest mean realized demand score.

The procedure outlined in Section 9.6.2 was applied to the ED measure of realized demand to create a new grid coverage of realized demand, REALDEM. Map 9.20 shows realized demand as a continuous surface, again at 100m cell resolution and calculated using an IDW surface interpolator algorithm[6]. Using this grid coverage, a neighbourhood analysis was then implemented to calculate the mean cell value based on the value of all cells within a radius of 3.2km (the catchment area of the proposed new surgery). In the same way as before, this allows the identification of a cell which has the highest mean value and, based on the extent of the neighbourhood defined in the analysis, the cell where surgery location may be optimally located.

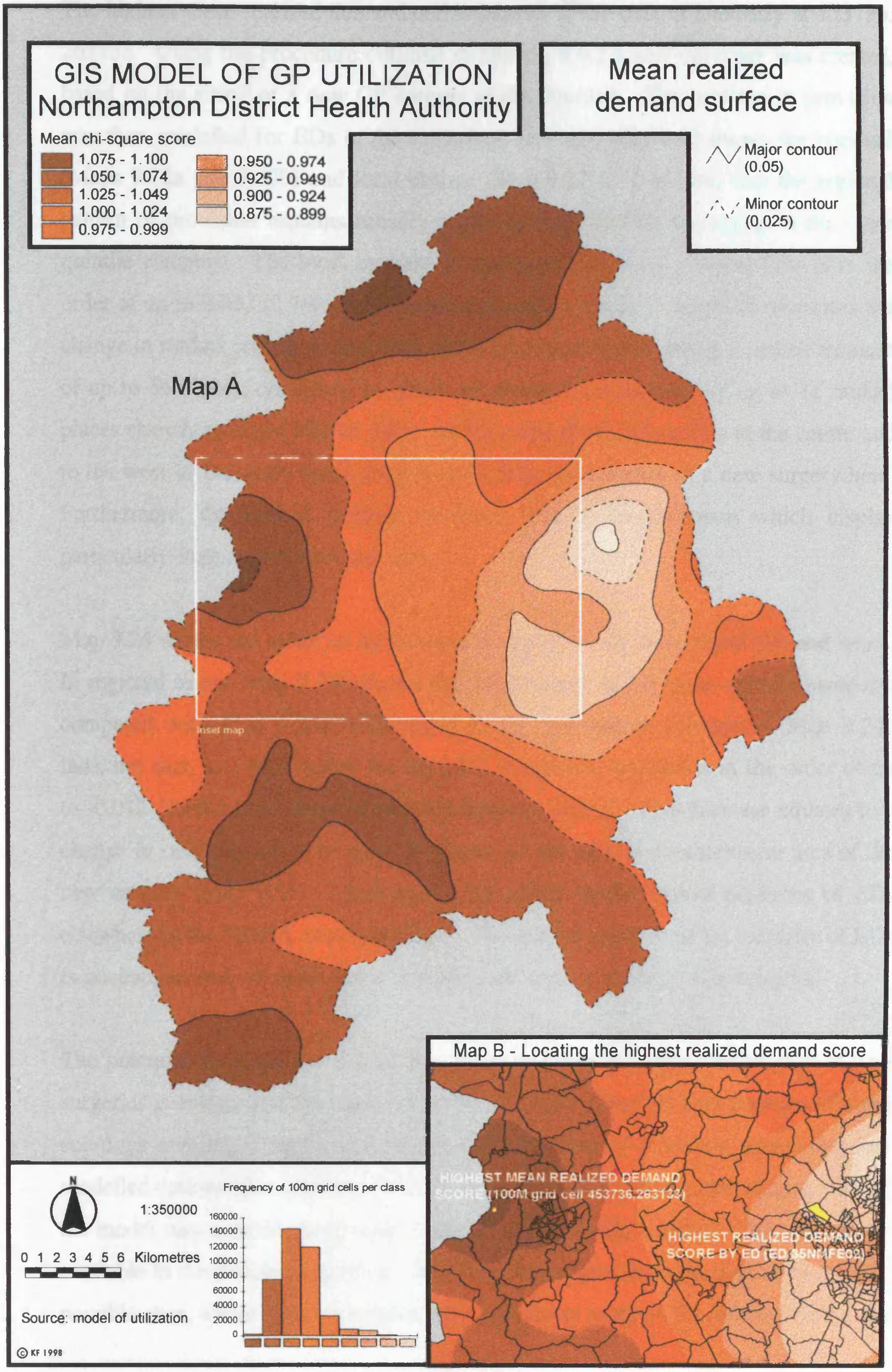
The resulting grid coverage of mean realized demand is illustrated in Map 9.21. The effect of Northampton-centric provision is clear with mean realized demand in the Northampton area being relatively low (with mean scores all below 1, indicative of high provision scores relative to disadvantaged demand scores). This is despite some Northampton EDs being amongst the highest realized demand scores (see Map 9.18a). Indeed, there is a dramatic difference between the ED with the highest realized demand score and the cell with the highest mean realized demand score as Map 9.21b illustrates.

6 The EDs excluded due to the effect of cross-boundary flow are, likewise, excluded from the calculation of mean realized demand.

Map 9.20 Siting a new surgery (highest mean ED realized demand): Realized demand surface



Map 9.21 Siting a new surgery (highest mean ED realized demand): Mean realized demand surface

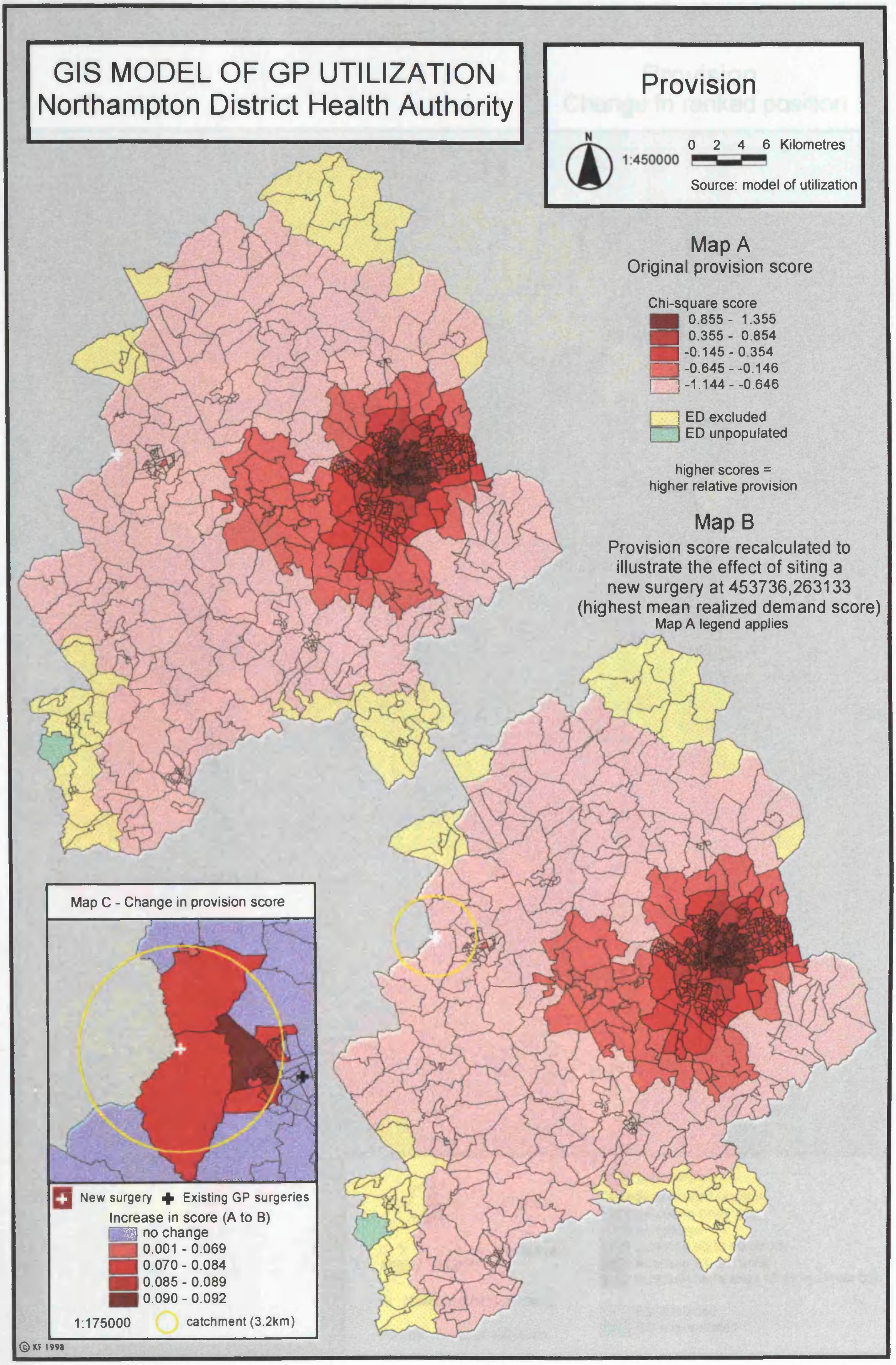


The highest mean realized demand cell is located to the west of Daventry at 453736, 263133. Using the procedure outlined in Section 9.6.2 a new coverage was created, based on the siting of a new GP surgery at this location. The increase in provision was then modelled for EDs in the catchment area and Map 9.22 shows the regional (Maps 9.22a and 9.22b) and local change (Map 9.22c). It is clear that the regional pattern of provision remains broadly unaltered with all EDs remaining in the same quintile category. The local increase in provision scores for affected EDs is in the order of up to 0.092 (3.7% of the range of provision scores). Map 9.23 illustrates the change in ranked provision with EDs in the catchment area showing a ranked increase of up to 56 places, countered by either no change or a decrease of up to 11 ranked places elsewhere in the NDHA area. As the maps show, urban EDs in the centre and to the west of Daventry particularly benefit from the location of a new surgery here. Furthermore, the ranked position of those EDs in Northampton which display particularly high scores does not alter.

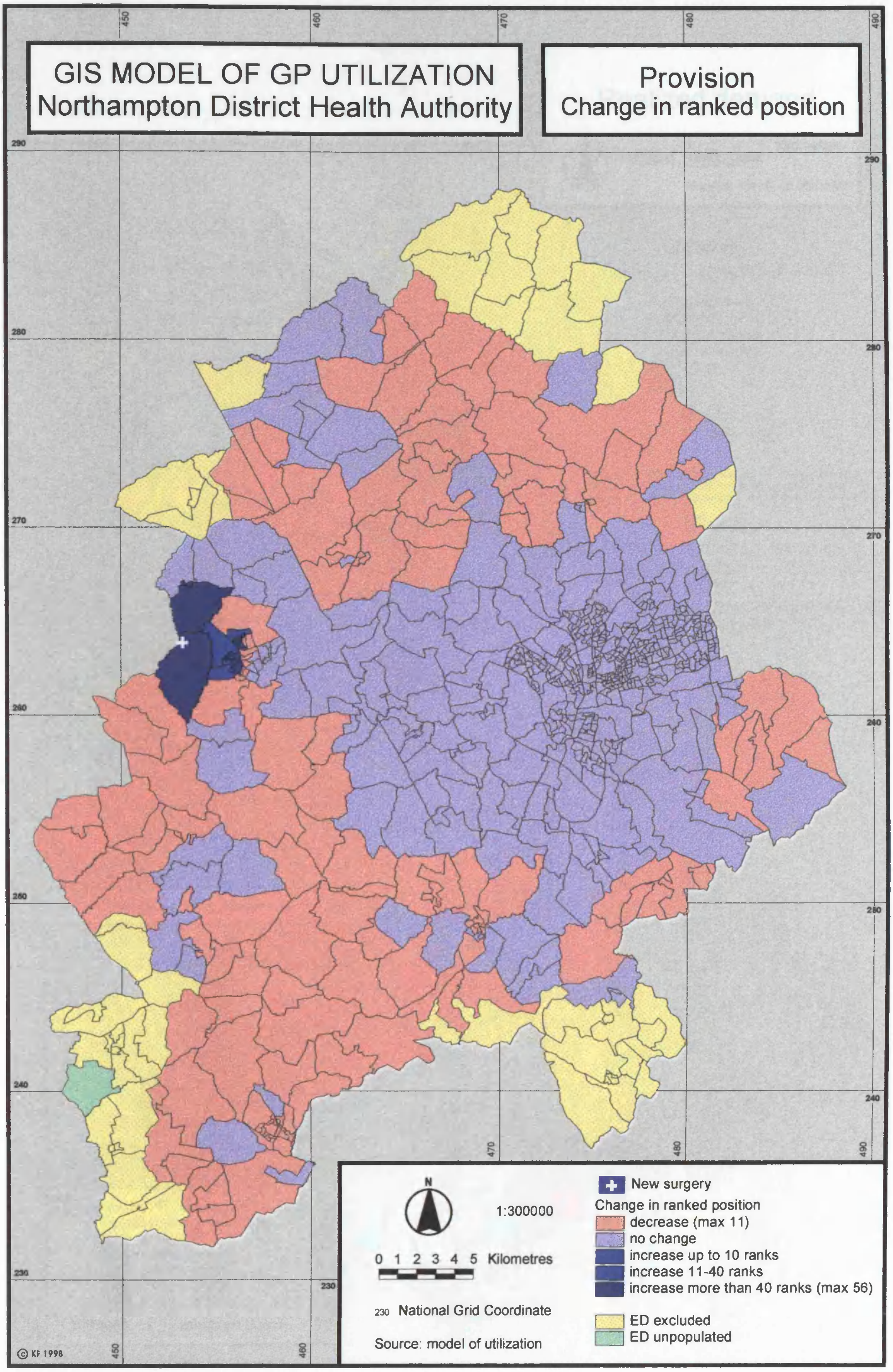
Map 9.24 shows the effect of an increase in provision on the realized demand score. In regional terms, Map 9.24b shows that EDs remain in the same quintile category, compared with Map 9.24a, subsequent to the increase in provision. Map 9.24c indicates that, at a local scale, the decrease in realized demand is in the order of up to -0.012 (2.4% of the range of realized demand scores). This decrease equates to a change in ranked position of up to 29 places for the EDs in the catchment area of the new surgery (Map 9.25). Once again, the effect on the ranked positions of EDs elsewhere in the NDHA area is minimal. The ranked position of the majority of EDs is unchanged and, of those where a ranked increase is evident, it is marginal.

The potential for using the model of utilization for determining the location of new surgeries is evident and the three alternative methods presented here provide different solutions and affect outcome scores in different ways. However, translating any modelled optimum location into practice is subject to many further influences. Whilst the model may suggest an optimum location, for example, a suitable site may not be available in the location identified. An alternative approach might thus be to identify possible sites, where land is available, then model and compare the effects of different

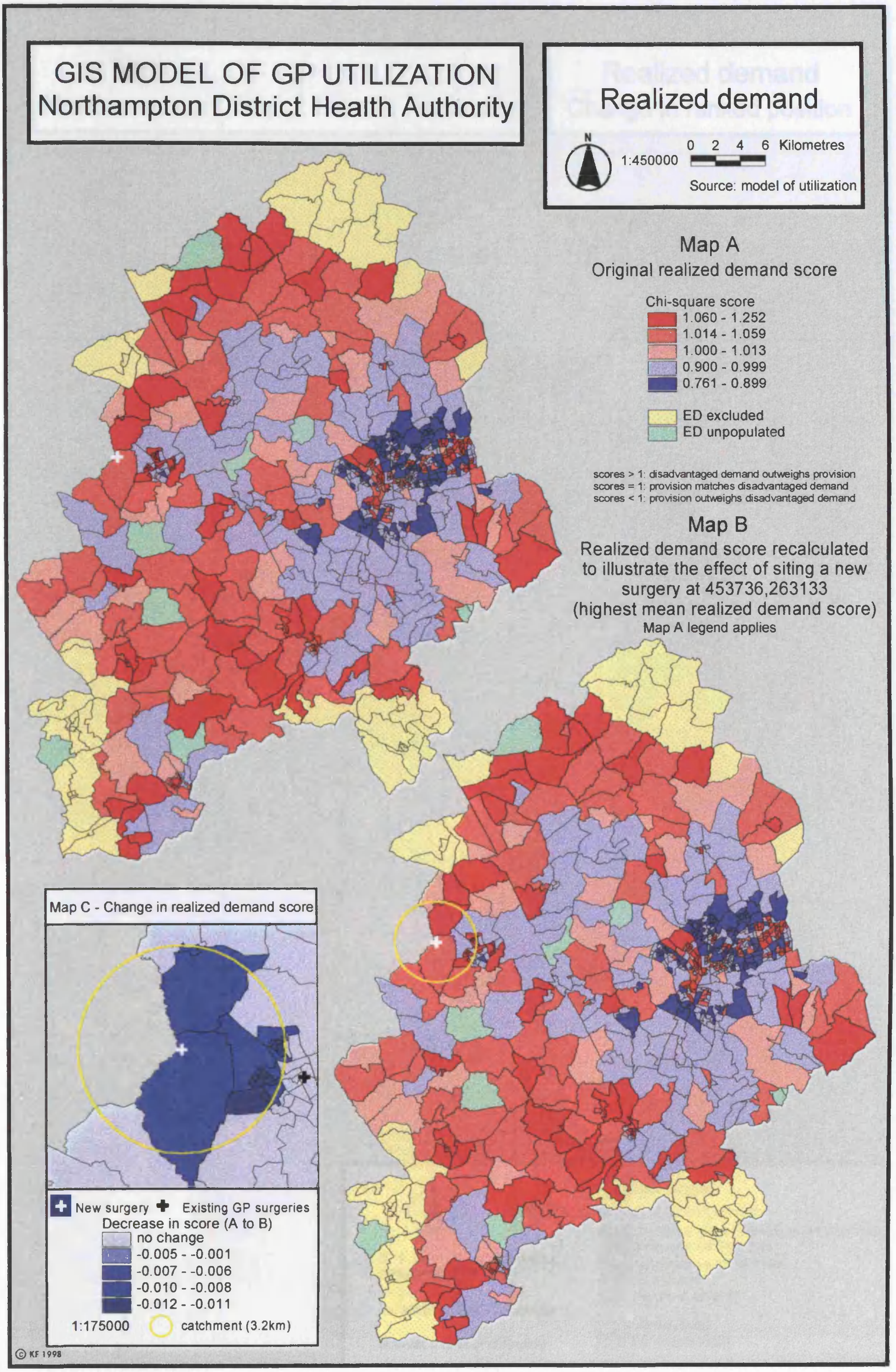
Map 9.22 Siting a new surgery (highest mean ED realized demand): Provision score



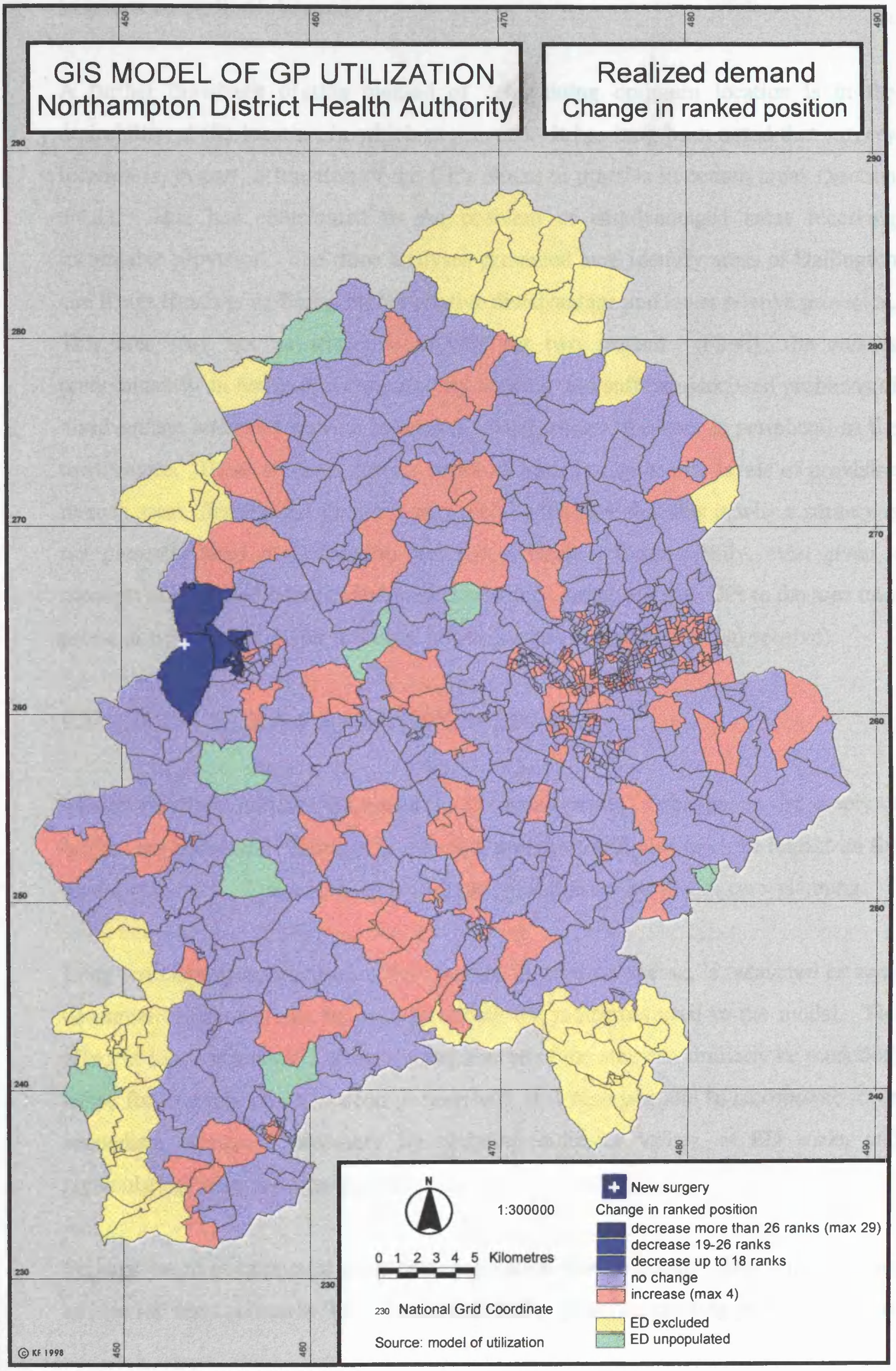
Map 9.23 Siting a new surgery (highest mean ED realized demand): Provision rank



Map 9.24 Siting a new surgery (highest mean ED realized demand): Realized demand score



Map 9.25 Siting a new surgery (highest mean ED realized demand): Realized demand rank



locations on realized demand.

A further drawback of this method of determining optimum location is in the desirability of the location in which to practice. It has long been noted that surgery location is, in part, a function of the GP's desire to practise in certain areas (Section 3.4.1). This has contributed to the problem of disadvantaged areas receiving inequitable provision. The three analyses presented here identify areas of Dallington and Kings Heath as suffering higher relative disadvantage and lower relative provision. This area may not be attractive to GPs for two reasons. Firstly, the area is predominantly an estate of local authority housing and suffers associated problems of disadvantage and poor service provision. Furthermore, the area is peripheral to the town centre. These are both factors noted as contributing to low levels of provision in such areas (Section 3.4.1) and it may well be the case that this is why a surgery is not presently sited in Dallington and Kings Heath. Consequently, even given a scenario of modelled benefits and land availability, attracting new GPs to the area may prove difficult (even given the extra allocation payments they would receive).

9.7 IMPACT OF A POPULATION INCREASE

The previous two sections discussed the potential effects of changes in the supply of health care provision. Changes in demand, however, will also have an impact on the model outcomes. These may equally have implications for health care planning.

Long-term demographic change, for instance population ageing, is measured by each decennial census and can be used to update the indicators used in the model. The effect of long-term natural growth in population of the area can similarly be modelled, based for example on population projections. It is also possible to incorporate more immediate change if necessary by updating indicator values, at ED scale, and recalculating the composite scores.

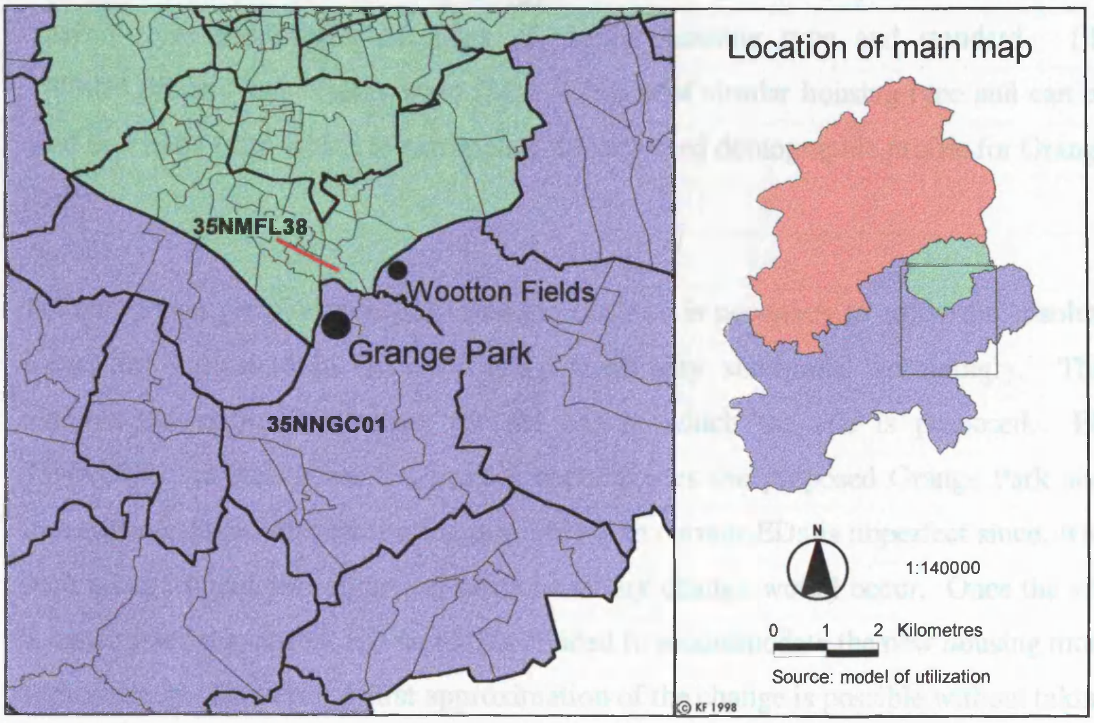
Perhaps the most important short-term population change occurs when a large influx of new residents substantially increases the local population, creating pressure on local resources. Typical examples of this change can be seen in new peripheral housing developments where, previously, very little or no demand for health care existed. In health care planning terms it is beneficial to be able to model the potential effects of such an increase in the local population in order to be able to identify potential demands and assess the extent to which current provision meets such demand. The model of utilization provides this capability.

Northamptonshire has experienced considerable growth in recent years in accordance with the County Structure Plan Policy RES1 requirement which requires the provision of 57500 new homes prior to 2006 (NCC, 1989; 1990). As part of the overall Structure Plan each district has been allocated a target of new homes to be built in the period 1988-2006 and Local Plans identify the approximate siting of these new developments. These planning documents can be used, in conjunction with the model of utilization, to predict changes in demand for health care as a result of increased housing provision and the inherent increase in population.

A total of 6200 new homes have been allocated to South Northamptonshire district as part of the overall allocation determined in the Structure Plan (SNC, 1993; 1997). The Local Plan identifies proposed sites for new development and includes a requirement that 1000 of the allocated provision should be sited as part of the expected growth of Northampton. These new homes are to be built on two sites bordering Northampton Borough. A provision of 200 new homes is to be incorporated in an extension to the Wootton Fields development to the south-east of Northampton (Map 9.26). This area has already experienced considerable growth with no increase in services commensurate with large scale residential development.

Map 9.26 also indicates the location of a much larger new development of 800 homes to be constructed on a previous greenfield site referred to as Grange Park. This site is in an area of land delimited by Wootton, Quinton, the Quinton Road, A508 and M1 motorway near junction 15.

Map 9.26 Proposed sites of new residential development (after SNC, 1993; 1997)



The proposals for new residential developments at these sites are outlined in policies RH1 and WFH1 of the South Northamptonshire Local Plan[7] (SNC, 1993; 1997). Construction at the sites is not due to commence until late 1998 and provides an opportunity to predict potential changes in demand for health care from the model of utilization. In this example only the development at Grange Park is considered. Clearly a more complete analysis would be possible incorporating also changes at Wootton Fields and other sites.

In order to model the impacts of population increase at Grange Park it is necessary to build a demographic profile of the expected population. The proposed housing

7 The original Local Plan requirement was for 1000 homes to be built at Grange Park and no further development at Wootton Fields (SNC, 1993) although a modification in 1997 altered provision (SNC, 1997). It should be noted that at the time of writing the Wootton Fields extension site is the subject of substantial public objection and it is possible that plans for the original allocation of 1000 homes at Grange Park may be reviewed.

type, medium density privately owned and rented accommodation, provides an indicator which can be used. The profile of the Grange Park population is therefore derived from the profile of areas of similar housing type and standard. ED 35NMFL38, in Nene Valley ward (Map 9.26), is of similar housing type and can be used as a basis from which to extrapolate the expected demographic profile for Grange Park.

To incorporate population change into the model it is necessary to adjust the absolute values for indicators in the need and accessibility sub-model accordingly. This requires the change of values for the ED in which the site is proposed. ED 35NNGC01, in Roade ward, currently encompasses the proposed Grange Park site. It is acknowledged that attributing new values to current EDs is imperfect since, with such a large population increase, some boundary change would occur. Once the site is constructed the current ED would be divided to accommodate the new housing more appropriately. However, a first approximation of the change is possible without taking account of these boundary adjustments.

ED 35NMFL38 contains 211 households with 578 residents, a rate of 2.74 people per house. Projecting these figures for a housing provision of 800 gives an expected population number of 2192 at Grange Park. Table 9.1 illustrates the calculation of a new demographic profile for ED 35NNGC01, based on ED 35NMFL38 and the expected total population number.

Once these new absolute values are calculated they can be incorporated into the database and the chi-square score for each indicator recalculated. The need and accessibility sub-models are then determined on the basis of the recalculated chi-square values. Finally, outcomes are derived, based on the new need and accessibility scores.

Table 9.1 Calculating new absolute values for ED35NNGC01

A	B	C	D	E	F
N1	36	6.3	137	6	143
N2	95	16.4	360	15	375
N3	116	20.1	440	18	458
N4	48	8.3	182	5	187
N5	1	0.5	4	2	6
N6	1	1.7	4	0	4
N7	12	2.1	46	4	50
N8	16	2.8	61	2	63
N9	9	22.5	34	0	34
N10	9	4.3	34	0	34
A1	variable remains unchanged (lack of public transport)				
A2	20	9.5	76	9	85
A3	106	18.3	402	26	428
A4	20	3.5	76	6	82
A5	1	0.5	4	2	6
A6	23	65.7	87	7	94
A7	16	2.8	61	2	63
A8	9	22.5	34	0	34

where:
A= Indicator
B= Absolute value of persons or households in ED35NMFL38
C= Proportion of ED35NMFL38 total persons or households (%)
D= Projected absolute value based on Grange Park population or household total
E= Current absolute value in ED35NNGC01
F= Calculated new absolute value for ED35NNGC01 (D+E)

In interpreting the outcomes, it must be remembered that the magnitude of change in scores and ranks between the original and recalculated measures will be greater than those exhibited in previous sections where only provision was changed. Sections 9.5 and 9.6 made changes to the singular provision score, based on the change of the distance decay score in those EDs affected. The changes made to the need and accessibility model involve the recalculation of chi-square scores for each of the indicators (10 indicators of need and 8 indicators of accessibility). Since the levels of $E1_j$ and $E2_j$ will alter (refer to Appendix Five) every ED will show a small change in score. However, since more than one score is used to calculate need and accessibility, small changes in each indicator may manifest as larger changes when all indicators are combined.

Maps 9.27 to 9.31 illustrate the modelled effect of the population increase at Grange Park. Table 9.2 shows the scores for ED 35NNGC01. In evaluating the effect it is first necessary to state that the projected demographic profile, based on ED 35NMFL38, is expected to be reasonably affluent and not suffering any significant disadvantage. In this respect, despite a significant increase in population, the ED may be expected to show lower relative levels of need and greater potential accessibility, than currently exhibited, in comparison with other EDs in the NDHA area. However, it should be noted that the levels of need or accessibility exhibited by the current population are not, in reality, changed - the scores for ED 35NNGC01 are merely diluted as an effect of increasing the population. In this sense, the following discussion also examines the score calculated for the increased population, separate from that of the existing population.

Table 9.2 Outcome scores for ED 35NNGC01

	Original score (existing population only)	Score recalculated for additional population only	Score recalculated for existing and additional population combined
Need	-0.6644	-1.6474	-1.9230
Accessibility	-0.0175	-1.1876	-1.1301
Disadvantaged demand	-0.3410	-1.4175	-1.5266
Utilization	-0.7485	-3.0349	-3.1197
Realized demand	0.9856	0.8758	0.8646

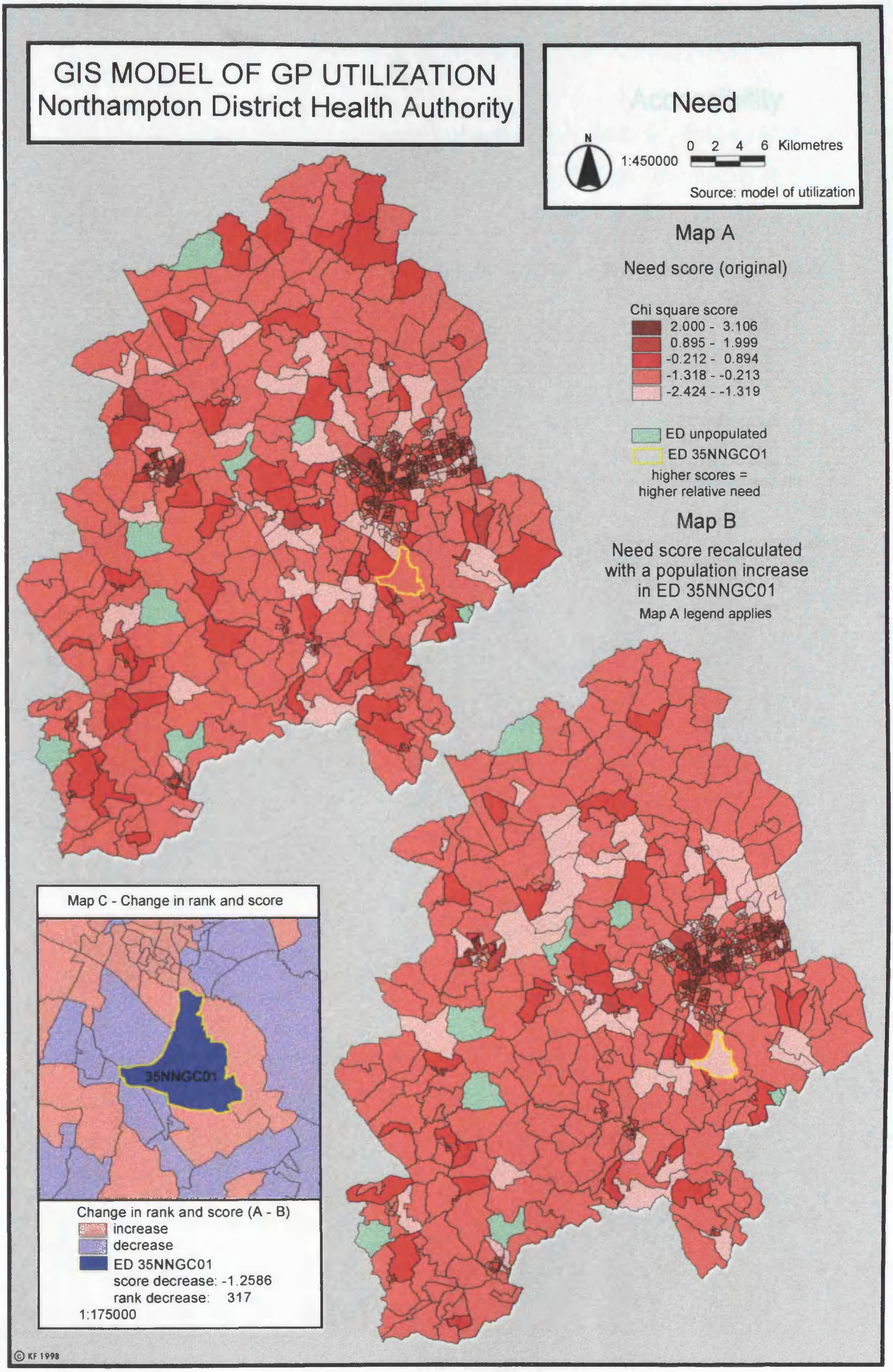
Map 9.27 illustrates change in need based on both the existing and additional population in ED 35NNGC01. The overall pattern of need across the NDHA area has not altered a great deal with most EDs remaining in the same quintile category. Map 9.27c shows the extent of both score and ranked change for ED 35NNGC01. A reduction in need score of -1.26 represents a 22.8% decrease relative to the range of need scores for the area as a whole. This is a considerable reduction in relative need, mirrored by a ranked decrease of 317 places. Some change in scores and rankings is inevitable for all EDs and, unlike the analyses in Sections 9.5 and 9.6, change in both score and rank can be both positive and negative. Given this outcome, it is fair to say that the projected health status, social and material disadvantage and environmental condition does not in itself indicate an increased need for health care.

However, when need for the existing and additional populations are calculated separately the reason for the combined decrease in score is clear. The need score for the existing population is -0.66, compared with -1.65 for the additional population on its own (Table 9.2). The existing population has a higher relative need than the additional population.

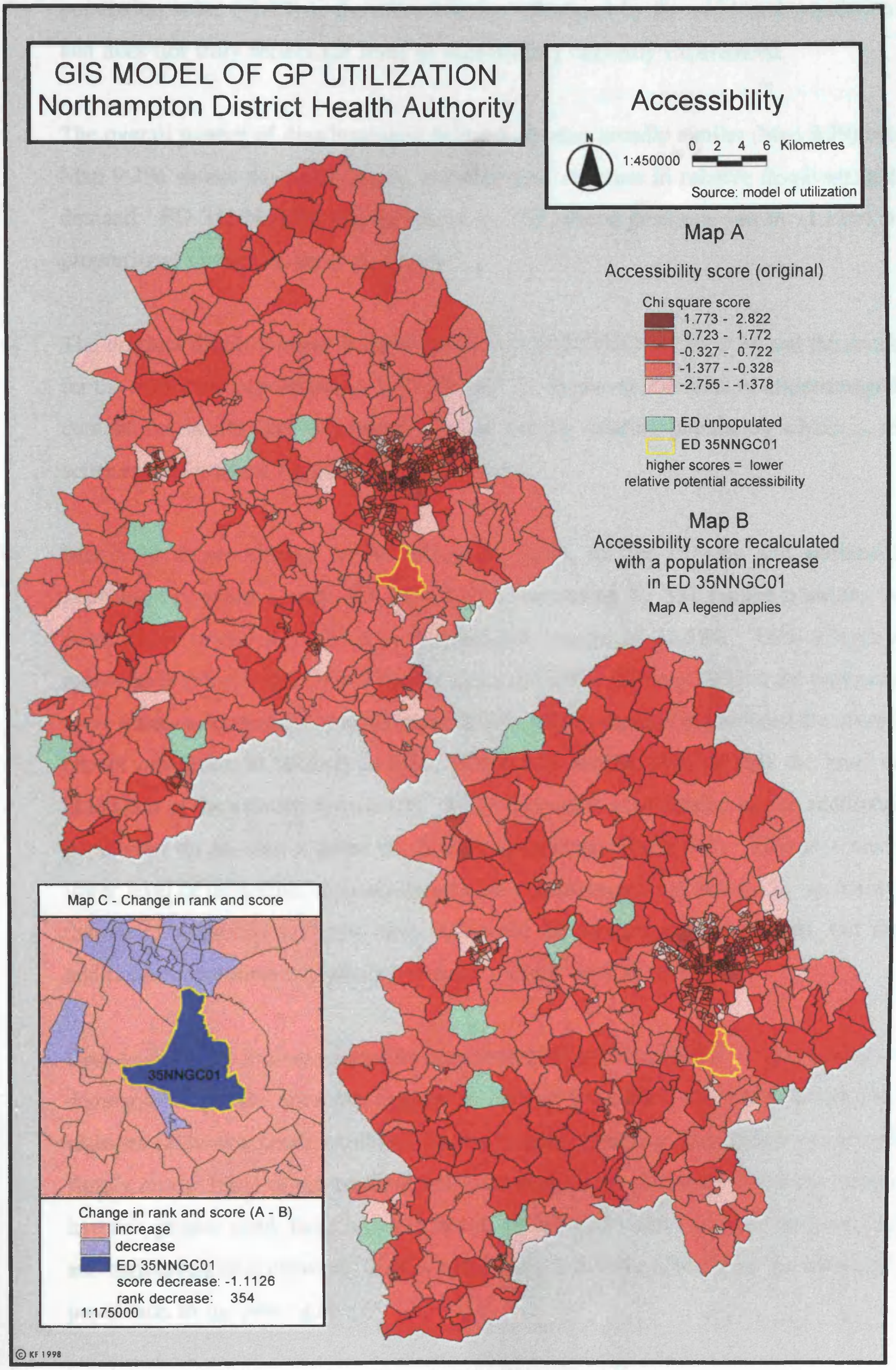
Significant difficulties in terms of accessibility are not expected nor modelled, for the projected population increase, combined with the existing population, at ED 35NNGC01 (Map 9.28). At a local scale, the change between the original and recalculated accessibility score is -1.1126, a decrease of 20% relative to the range of accessibility scores. This is mirrored by a reduction in rank of 354 places. The regional pattern of accessibility shows that some EDs are re-classified in the next highest quintile so the effect of change on regional accessibility is more pronounced than the effect on need.

When calculated separately, the existing population in ED 35NNGC01 exhibits an accessibility score of -0.018 (Table 9.2). This compares with a score of -1.19 for the additional population on its own. Whilst the existing population do not experience high levels of poor accessibility (indicated by a more positive score) they, nevertheless, have poorer levels than the additional population. The combined

Map 9.27 Increase in population: Need



Map 9.28 Increase in population: Accessibility



population score (-1.13) is therefore heavily influenced by the additional population and does not truly reflect the level of accessibility currently experienced.

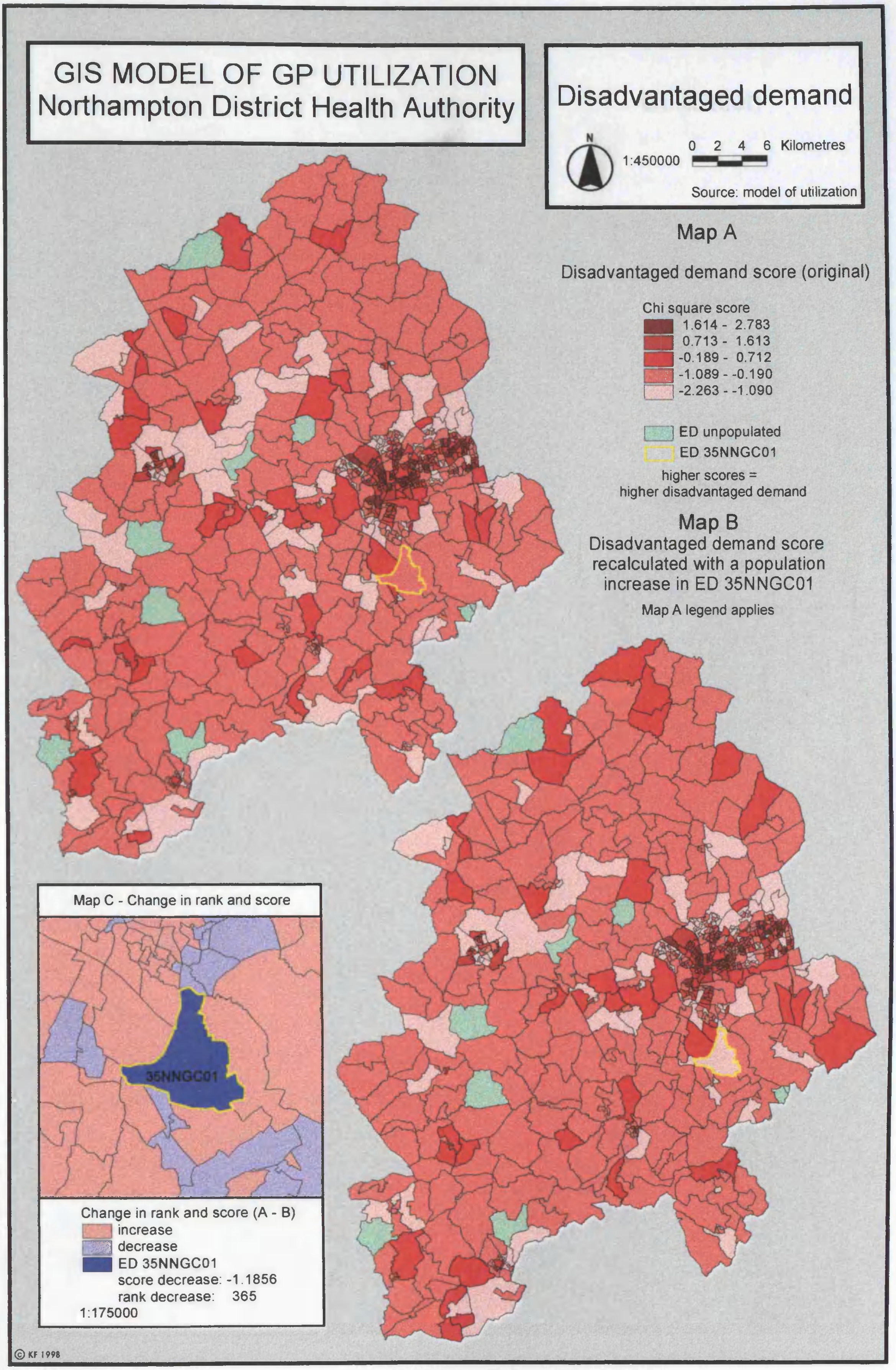
The overall pattern of disadvantaged demand remains broadly similar (Map 9.29) but Map 9.29c shows the much larger, but expected, decrease in relative disadvantaged demand. ED 35NNGC01 has decreased by 365 ranked positions and by -1.1856, a proportional change in score of 23.4%.

The original disadvantaged demand score for ED 35NNGC01 is -0.34 and the score for the additional population is -1.42 (Table 9.2). However, the level of disadvantaged demand for health care is relatively higher for the existing population which is, to some extent, masked by the recalculated score.

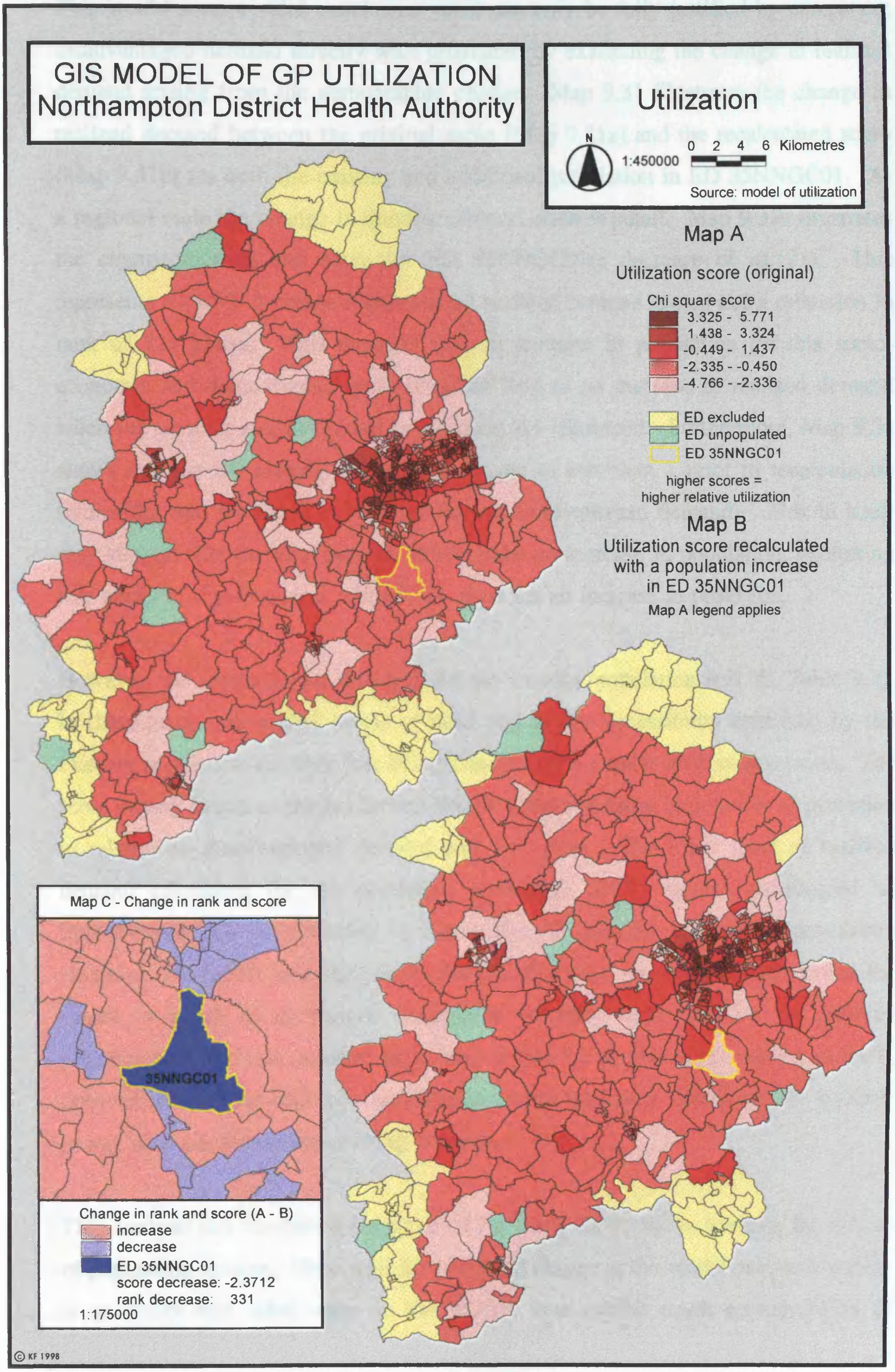
Map 9.30 shows change in the utilization score, for the existing and additional population combined, with ED 35NNGC01 decreasing by 331 ranked positions (a reduction in score of -2.3712, a proportional change of 22.5%). This reflects a reduction in the extent to which people make use of GP services. Whilst the provision score remains constant, the reduction in disadvantaged demand has reduced the overall rate of utilization in relation to other EDs in the NDHA area, diluting the level of utilization of the existing population. When utilization is calculated for the additional population on its own a score of -3.03 is determined (Table 9.2). This is a much lower level of utilization than exhibited by the existing population (-0.75). In reality, therefore, utilization will not have decreased for the existing population, but the additional population is predicted to have a lower relative level.

Despite the large increase in population modelled at ED 35NNGC01, the combined demographic profile does not suggest an area of immediate concern to health care planners (although needs exhibited by the existing population should not be ignored simply on the basis of the recalculated combined score). Indeed, other areas remain in much greater need, have lower levels of accessibility, high disadvantaged demand and high levels of utilization. This is particularly true when considering the additional population in its own right.

Map 9.29 Increase in population: Disadvantaged demand



Map 9.30 Increase in population: Utilization

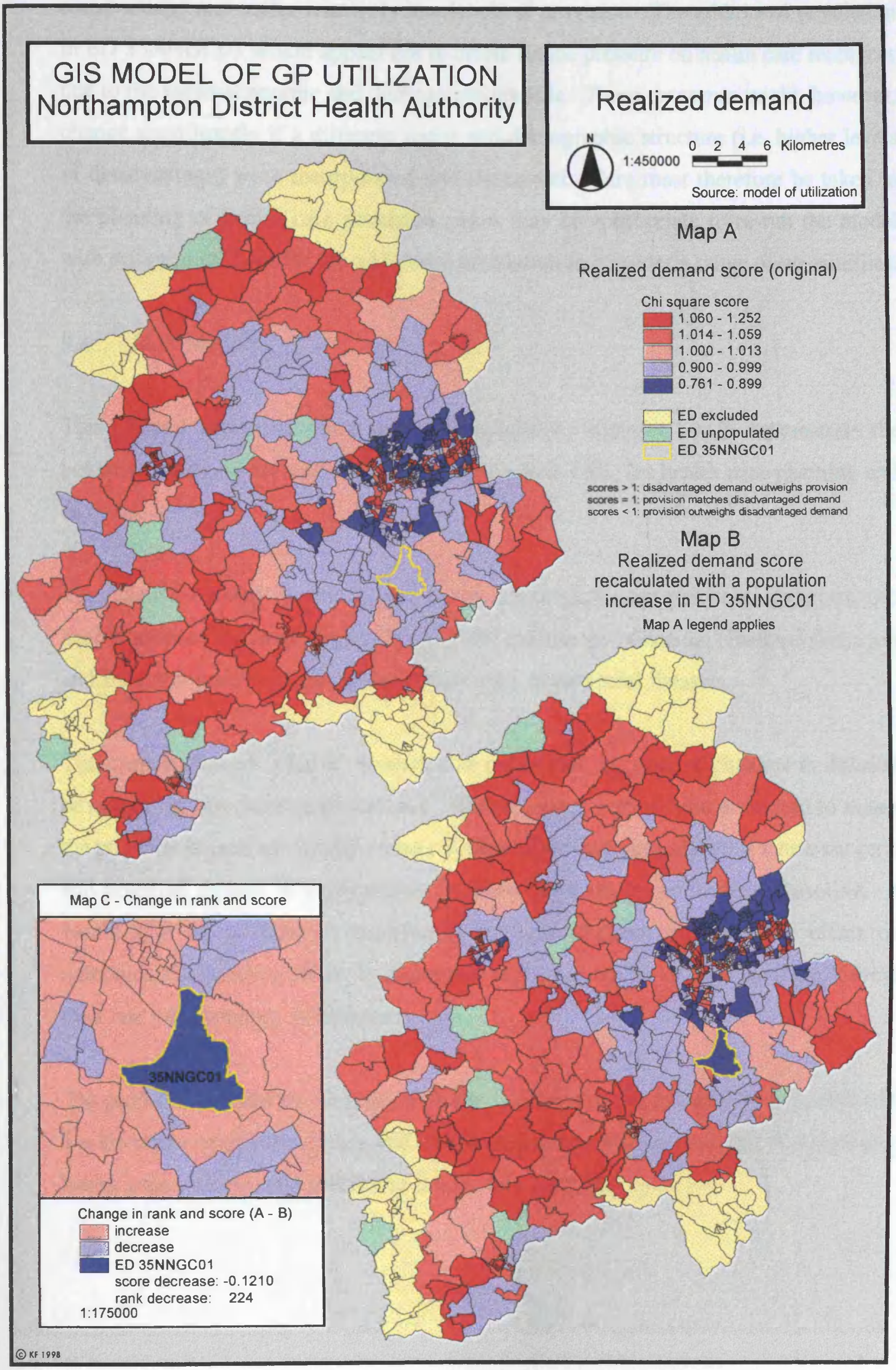


This would seem a valid conclusion yet it can only be fully justified by comparing disadvantaged demand directly with provision: by examining the change in realized demand arising from the demographic change. Map 9.31 illustrates the change in realized demand between the original score (Map 9.31a) and the recalculated score (Map 9.31b) for both the existing and additional population in ED 35NNGC01. At a regional scale the change in quintile categorisation is small. Map 9.31c illustrates the change in rank and score for ED 35NNGC01(a decrease of -0.121). This represents a 24.6% decrease relative to all realized demand scores and a reduction in rank of 224 places. This suggests that an increase in population (of this socio-economic and demographic type) does not lead to an increase in realized demand when the existing and additional populations are combined. Furthermore, Map 9.3a shows that the ED already maintained a score of less than 1 prior to recalculation (indicating that provision is high relative to disadvantaged demand). This in itself may suggest that the area may be able to take an increase in population, exhibiting low levels of disadvantage, without the need for an increase in provision.

However, the realized demand score for the existing population is 0.99 (Table 9.2). In these terms, the higher levels of need and poorer accessibility exhibited by the existing population are only just being matched by a similar level of provision. The score is very much on the borderline between one reflecting high levels of provision in relation to disadvantaged demand and vice versa. The lower level of realized demand calculated for the combined population (0.87) seems to suggest an improvement (i.e. a reduction in disadvantaged demand relative to provision). However, the realized demand score for the additional population (0.88) masks the extent to which disadvantaged demand is currently being met for the existing population. What this measure does show is that the additional population, in itself, does not exert undue additional pressure on current resources. However, this does not in any way ameliorate the existing situation.

This analysis has illustrated the potential for using the model to evaluate the effects of population change. Even with the projected change in the model parameters there is no doubt that other areas in the NDHA area exhibit much greater levels of

Map 9.31 Increase in population: Realized demand



disadvantage and suffer relatively low levels of provision. The additional population in ED 35NNGC01 would appear not to create undue pressure on health care resources due to the socio-economic and demographic profile. These outcomes might, however, change significantly if a different social and demographic structure (i.e. higher levels of disadvantage) were incorporated into the model. Care must therefore be taken in the planning of health care provision and it may be appropriate to re-run the model with different profiles for the additional population to consider a range of possibilities.

9.8 SUMMARY

This Chapter has presented a range of exploratory analyses which demonstrate the potential utility of the model, in combination with GIS, for health care planning and analysis.

The extent to which the model can be manipulated, to suit particular purposes, has been illustrated by examining individual GP catchments, financial resource allocation and the combination of model outcomes with other useful datasets.

The examination of 'what if' scenarios to model the outcome of changes in demand or supply has also been implemented. Whilst scenarios have been presented to assess the potential impact of closing a surgery, alternative optimum sitings of a new surgery, and potential impact of a population increase these are by no means exhaustive. It would also be possible to incorporate multiple changes to assess the effect on outcomes, for instance, multiple changes in service provision or the modelling of more than one new housing development.

The model of utilization, coupled with the GIS framework, is therefore supportive of a wide range of display, query and data manipulation analyses capable of supporting health care analysis and informing health care planning.

10 CONCLUSIONS

10.1 INTRODUCTION

This research has emanated from the geographical concerns raised by organisational change in the NHS (Section 1.2), namely the ongoing debate relating to health and health care inequalities. The principal aim of the research has been to develop, create and apply a model of health care utilization capable of assisting improved health care planning and analysis. In so doing it has contributed to the current resurgence in medical geography identified in Section 1.3.

An applied approach to geographical research has been taken (Section 1.3.1). This has enabled development and application of a model which has a viable practical purpose. The underlying empirical-scientific methods of positivism have previously been noted as having a vital role in modelling the relationships between health inequalities and the location and allocation of health care (Section 1.3.1). In these terms, such methods have also been central to this research and their value as part of an applied approach is clear.

GIS has been pivotal to the research and has supported construction and application of the model, facilitated a wide range of analyses, and enabled the applied approach taken.

In concluding the research it is worthwhile reflecting on the original research aims outlined in Section 1.4. These were:

- *to design a flexible, portable, predictive model of health care utilization for GP services.*

  Flexibility of the model of utilization is explicit. The wide variety of component indicators can be manipulated to provide a range of alternative outcomes, at different scales (Section 6.8). Furthermore, testing of the model illustrated how model components may be simplified (Chapter Seven) or interchanged with other data sets or methods (Chapter Eight). The model is portable to other areas due to the use of routine sources of data. The predictive capabilities of the model are also clear. In particular the application of GIS techniques in assessing alternative scenarios in health care planning and analysis has been extensively demonstrated (Chapter Eight).

- *to validate the conceptual components of the model through a survey of patient utilization.*

  The patient survey (Chapters Four and Five) provided a valuable data set to validate much of the conceptual discussion of utilization in Chapter Three. It provided a means by which the relevance of many of the indicators of need and accessibility could be determined, prior to their selection and measurement in Chapter Six.

- *to construct the model within a GIS framework to provide a powerful analytical system.*

  The use of GIS has been of undoubted benefit to the research. It has provided a coherent framework within which the model has been developed. Furthermore it has enabled a wide range of data manipulation techniques to be undertaken during construction of the model (Chapter Six) and, fundamentally, supported the critical application of the model for alternative scenarios in Chapter Eight.

- *to derive a number of useful model outcomes.*

  The model can be manipulated in different ways to provide alternative outcomes, thus adding to its flexibility. The component indicators of health status, social and economic disadvantage and environment can be combined to create a measure of need for health care (Section 6.5). Indicators of transport availability, personal mobility and service awareness can be combined to determine the extent of accessibility to health care (Section 6.6). Provision of health care has been calculated to incorporate spatial availability and temporal availability of GPs, and the effects of cross-boundary patient flow and distance-decay (Section 6.7). Furthermore, need and accessibility can be subsequently combined to create a measure of disadvantaged demand, showing the extent to which people are impaired in their exigency for health care; need, accessibility and provision combine to create a measure of utilization showing the extent to which people use GP services; and disadvantaged demand and provision can be used to calculate realized demand, showing the extent to which people in disadvantaged areas are able to satisfy their demand by local provision (Section 6.8).

- *to test the sensitivity of the model for conceptual and technical robustness.*
  The model has been rigorously tested through the use of a range of analyses (Chapters Seven and Eight). In general, the model is robust and remains stable both in statistical terms and when comparing the effects of removal of indicators on outcome measures. Nevertheless, the inter-correlation analyses show that there is no gross redundancy in the data and the model is, thus, conceptually sound.

- *to investigate the potential for simplifying the model or making use of alternative data.*
  Simplification of the model was explored as part of the analyses in Chapter Seven. Prudent simplification does not generally affect the outcome measures of utilization, disadvantaged demand or realized demand. However, where possible, the full model should be implemented since some indicators may be more important in explaining variation in other areas. The potential for using other sources of data, within the model, was examined in Chapter Eight. A comparison with other, widely used indices, gave some confidence to the design of the disadvantaged demand component of the model. In this sense it may be possible to substitute the disadvantaged demand component with one of these other indices to reduce the data demands of the model. However, the added complexity of the disadvantaged demand measure may also be seen as part of its strength. As noted in Chapter Eight, the use of a wide range of indicators is likely to make the index more robust, and less sensitive to extreme variations in a single indicator.

- *to illustrate and critically evaluate the application of the model through a series of 'what if' scenarios.*

  The application of the model to health care planning and analysis was clearly demonstrated in Chapter Nine. The model, in conjunction with the capabilities afforded by GIS, can be used to examine individual GP catchment areas (Section 9.2), alternative methods of financial allocation (Section 9.3) and is capable of being combined with other data sets to provide further analytical capabilities (Section 9.4). The predictive capabilities of the model were also extensively demonstrated in Sections 9.5-9.7. In these analyses, the potential impact of surgery closure, optimum siting of a new surgery and impact of a population increase were modelled.

- *to evaluate the potential for applying the model of GP utilization as a decision support tool in comparison with current methods of health care planning and analysis.*

  The potential application of this research has been demonstrated throughout, but was particularly manifest in Chapter Nine. The model, within a GIS framework, has clear benefits over other methods of examining inequalities in health and health care. It provides a valuable tool for health care planning and analysis.

The remainder of this Chapter explores some of the emerging issues from this research. It discusses the extent to which the model of utilization offers more than is currently available using other methods. It also provides a critique of limitations imposed by the use of relative scores, data availability and scale of analysis. These allow a consideration of the direction of possible future research in this area of geographical study.

10.2 THE UTILITY OF THE MODEL OF UTILIZATION

As this research has emphasised, recent organisational changes in the NHS have placed issues of resource allocation firmly on the political agenda. This has led to an increase in accountability for Health Authorities, who are keen to ensure that their area can provide the resources its population base requires. Fundamental to this is the need of resource planners to be able to identify inequalities within their boundaries, in order both to ensure effective provision and, possibly, to win government or European Union (EU) deprivation relief grants.

The use of indices to identify and quantify areas suffering high levels of relative disadvantage has, thus, been a vital tool for resource planners both in health care and local authorities more generally. This research has drawn upon a range of such indices both specific to health care (Jarman UPA score), and more generally (Townsend Index; Index of local conditions; Young Persons' Support Index). In so doing it has provided an opportunity to compare the model of utilization against these indices. Crucial to this discussion is the fundamental principle that this research has been based on developing a model which has capabilities beyond those currently offered by other indices.

The indices discussed throughout this research all have a common goal: to define and measure indicators for improving the targeting of resources on particular societal groups within the population. In this sense the model of utilization follows the same principle, although all reach their objectives following different routes; the nature and number of indicators used to calculate disadvantage vary amongst different indices as do methods of manipulation and aggregation. Notwithstanding the differences in conceptualisation and construction, the identification of disadvantaged areas remains broadly similar regardless of the index used, as Chapter Eight illustrated (supporting earlier work by Carstairs and Morris, 1991). However, those indices which are more specific (such as the Young Persons' Support Index) tend to be the ones which show the least comparability, a function of their use of specific - rather than more generic - indicators. The measure of disadvantaged demand was validated as part of the comparison with alternative indices (Chapter Eight). In this sense, it is able to predict disadvantaged areas in broadly the same way as alternative indices, albeit with its emphasis on inequalities in need for health care and obstacles to accessibility.

However, current methods of determining spatial inequalities take no account of the relationship between levels of disadvantage and provision. Whether an area has been identified as disadvantaged using the Jarman UPA score, the Townsend Index, or any number of other methods, the outcome is limited to simply identifying those areas at a relative disadvantage to others in terms of the phenomena measured. The indices are unable to examine the extent to which areas of disadvantage are already being addressed through more equitable provision of resources. It is on this basis that the model of utilization significantly extends the capabilities offered by such indices. In particular, it provides alternative methods of comparing the spatial extent of disadvantage with the location and allocation of health care: the utilization score measures the extent of use of services; and the realized demand score measures the levels of disadvantage (defined by the disadvantaged demand score) against the provision score. In this way it is possible to identify those areas which may be relatively disadvantaged in both their need for health care and their accessibility, but which also have a relatively high provision score. Whilst this measure cannot be used as a basis to determine absolute levels of provision in relation to disadvantaged demand, it certainly offers a measure not available using other indices. Both the utilization and realized demand scores thus reveal much more about the relationship between disadvantaged societal groups and the location and allocation of resources, in a single framework, than otherwise available.

The decision to measure physical accessibility as part of provision, rather than demand, is a departure from previous methods (for instance Knox, 1978). The obstacle created by distance between the service and user is more appropriately addressed as part of the provider characteristics. A potential improvement in physical accessibility can thus be derived for a whole area through modelling a new pattern of provision. In these terms, it is possible to ascertain how re-allocation can benefit the greatest number of EDs, or those in most need, and to what extent.

Chapter Seven revealed that one of the strengths of the model is that it is based on a wide range of factors. It is therefore not as prone as alternative indices to the possible effects of one or two indicators exhibiting anomalous levels of disadvantage. The multiple regression analyses did, however, suggest that the sub-models measuring need and accessibility can be simplified. Whilst the principle of including all indicators to determine outcome measures remains, since indicators were selected on a legitimate and justifiable basis, the analyses determined the extent to which individual indicators account for variability in the composite sub-model scores.

Analysis of the need sub-model revealed that it is possible to measure need with fewer indicators and achieve a reasonably accurate prediction which correlates with the full model score. The inclusion of indicators N8, N10 and N9 explains 88% of the full model variance and the inclusion of each indicator is statistically significant. The stepwise addition of the remaining seven indicators gradually improves the correlation coefficient but improvements to the correlation coefficient are not statistically significant. In these terms, need can be determined by measuring the three indicators reflecting environmental conditions. Multiple regression analysis of the accessibility sub-model revealed that it could also be simplified to three statistically significant variables, namely A7, A2 and A8. Together, these indicators explain 90% of the variance of the full model score. Each stepwise addition of the remaining five indicators shows no statistically significant improvement in the correlation coefficient. The accessibility sub-model may therefore be measured by using the ethnicity, private transport and educational attainment indicators.

Whilst the results of these analyses suggest that the need and accessibility sub-models may be simplified to three indicators each, omission of the other indicators on this basis should be considered with care. The indicators may differ considerably from the results obtained for the case study area used here, possibly having a greater impact elsewhere. In particular, the analyses suggest that it is possible to achieve a reasonably accurate model outcome which takes no account of age, gender, social class or employment status. The pedigree of the use of these indicators in measuring disadvantage is considerable and they have been extensively used in alternative indices (Chapters Two and Three). Given their similar use elsewhere, it would be prudent to treat their omission with caution until further studies are undertaken to validate the results reported here.

A further feature of the model of utilization is that it would be possible to adapt the indicators to measure the extent of different types of disadvantage, compared with provision of a different service type. The explicit aim of the research has been to examine the nature of inequalities in terms of health and health care. However, different inequalities could equally be modelled. For instance, the Young Persons' Support Index (used in Chapter Eight in the comparison analyses) measures the spatial extent of need for family and child support services. This measure could be used in the same way as disadvantaged demand. Furthermore, if provision of these services was also modelled, using similar techniques as those used to model provision of health care, then measures of utilization or realized demand could similarly be determined. In this sense the model of utilization may offer wider capabilities and could, with adjustment, be used to examine a wide range of inequalities in disadvantage in relation to specific service provision (for instance education, social services, nursery provision etc).

In terms of level of analysis, this research has highlighted the benefit of deriving measurements at ED level, rather than the more aggregated levels currently used in health care planning. Wards, for instance, are not the most appropriate level of aggregation on which to base decisions of health care location since they mask a great deal of potentially useful information. As this study has illustrated, large intra-ward variations in socio-economic and demographic structure occur which are not addressed at ward level. Part of the rationale for using the NDHA area as a case study was the variation in population structure resulting from recent demographic change (Section 4.2). Clearly, in an area which is subject to large-scale, and perhaps rapid, change it becomes even more important to monitor variation at the local level. In terms of this research, measures such as realized demand offer a means of examining the effects of local population change and the extent to which provision is able to meet new or changing demand.

The effect of long-term population ageing is also pertinent to acknowledge here since it has direct implications for health care planning. Changes in the population structure will have direct effects on levels of ill-health, patient demand and the ability of people to access health care, again at the local level. The model of utilization already incorporates indicators of age to measure need for health care and obstacles to accessibility. In these terms, it can be used to help assess the effects of population ageing and the changes in provision which might be required. Again, the ability to examine the impact of change at the local level is crucial to ensure that provision can be adjusted appropriately.

10.2.1 Utility of the model in methodological and conceptual terms

This research concurs strongly with Goodchild's (in Pickles (ed), 1995) belief that, within certain limits, there is an opportunity to utilize the power of GIS technology. GIS has, in this sense, been used to facilitate empirical analysis and has provided the capabilities to derive insights which are not otherwise available. It has thus enabled significant advances to be made in modelling utilization.

Amongst the growing GIS community there is certainly a belief that there is a valuable place for the technology within geographical research. Studies which merge empirical investigation with GIS are therefore bringing together new groupings of ideas and developing an applied quantitative geography of use in its own right (Taylor and Gregory, in Pickles (ed), 1995). In so doing, this research has made a valuable and timely contribution to the implementation of GIS technology in modelling, and the development of applied approaches to tackling ongoing real-world problems.

In conceptual terms this research has also contributed to an improved understanding of utilization and the many factors which contribute to patterns of health care utilization at the local level. In particular, it has shown how concepts of need, accessibility and provision can be brought together within a single conceptual framework to provide different assessments of utilization, from different perspectives. In doing so, however, the research highlights a number of important issues and continuing gaps in knowledge.

One important issue is that utilization cannot be assessed in terms of a single measure, but needs to be evaluated in relation to different concepts, depending upon the interests of those concerned. In the model developed here, for example, three different measures of 'demand' were identified. 'Expressed demand' was measured as need - accessibility, and can be used to identify the extent to which both the need for health care and the capability to access services creates an expressed requirement for health care. It thus provides a measure of the pressure on health services. 'Disadvantaged demand' was computed as need+accessibility and helps to target areas where people have high levels of need, coupled with poor levels of accessibility. It thus gives a measure of the latent demand, which needs to be met either by improving access or by providing improved local services. The extent to which this latent demand is being catered for is measured by 'realized demand' (disadvantaged demand/provision). As the model emphasises, a multi-perspective approach to health care assessment is essential if the varied needs of health care users are to be met.

At the same time, it must be recognised that the concept of need, and how to measure it, are as yet only poorly developed. In developing the model presented here, attention has been focused on measures of what has been termed comparative need, largely because this is relatively easily measured at the aggregate scale. More important from the perspective of the health care user, however, is 'felt need', for it is this which determines to a great extent the behaviour of users and their level of satisfaction with the health care service. This is a much less well-defined concept. It clearly depends fundamentally upon socio-psychological and perceptual factors, which reflect a complex interplay of both personal and cultural influences. More research is undoubtedly required to define these influences, to demonstrate how they operate and to develop appropriate methods of assessment. Recognition of the importance of felt need also suggests the need for a more inclusive approach to health service planning, which involves the wide range of stakeholders in the process of prioritising health care issues, identifying and choosing interventions and assessing performance of the health care system. Whilst models such as the one developed here can help to inform this process, they clearly provide only one part of the armoury of tools which will be needed to ensure active stakeholder participation. For this purpose, there is a need to link the largely positivist approach taken in this research to more behaviourlist approaches.

It is thus clear that the model of utilization reported here contributes much to the development and application of methods of determining demand, based on need and accessibility, and examining its relationship with health care location and allocation. There are also, however, limitations which impact upon the research. These can be both conceptual, as discussed above, or practical. It is the emerging practical issues to which attention now turns.

10.3 LIMITATIONS OF 'RELATIVE' SCORES

As noted in Chapters One and Two, the application of models and indices has a considerable pedigree in human geography. These methods have been extensively used to determine spatial patterns of phenomena, such as deprivation, but they all suffer broadly the same limitation: scores are derived in relative terms (i.e. every score is 'relative' to every other score). Indices do not, therefore, measure phenomena in absolute terms. The Jarman UPA score, for instance, calculates underprivileged scores at ward level relative to an average score for England and Wales. Consequently, any change in value for an indicator in an individual ward will manifest as a small change in the England and Wales average: thus every ward score in England and Wales will be adjusted, if only by a small amount. This may lead to false interpretation since change in a ward score may not be a function of absolute change in contributory factors internally, but due to a change in the population structure or other factors elsewhere.

A further limitation is also discernable for some indices. The Townsend Index, for instance, is normally calculated on a regional, rather than national, basis. Consequently, change to a score within the region has a knock-on effect on every other score in the same region but does not impact on adjacent regions not included in the calculation. In these terms, this type of index does not take account of zonal interdependencies. This is a limitation which affects all indices calculated at a regional, or subregional, level.

The model of utilization also suffers these limitations since scores are calculated in relative terms for the case study area. The problem was highlighted in the analyses in Chapter Nine: any alteration in either levels of provision (Sections 9.5 and 9.6) or demand (Section 9.7) results in small changes to every score in the case study area. To counter this difficulty, a method of calculating change was outlined in Section 9.5 designed to ensure that values of indicators for EDs elsewhere in the case study area do not change. The calculation of change in this way is certainly an improvement on other indices, but it is also acknowledged as being imperfect. Using this approach, the measurement of change can only be calculated relative to the previous ED score - it does not represent absolute change. In this sense, the derivation of relative scores does not adequately support the assessment of change and, despite the developments made here, it remains a fundamental limitation of any such method.

What is possibly required to address this limitation is a set of performance indicators, based on absolute values, which can be used to compare with the outcomes of the model of utilization, and other, indices. The derivation and use of performance indicators is gradually emerging in geographical research, methods are still very much at a conceptual stage and are severely hindered by data availability. For instance, Clarke and Wilson (1994) have proposed a set of model-based performance indicators. They suggest that performance indicators should be based on defining residence-based factors which relate to individuals and households, and facility-based factors which relate to the efficiency and effectiveness of organisations which serve residences (Table 10.1).

These indicators could potentially be used as a basis for examining other phenomena, such as inequality in health care needs. However, the indicators proposed by Clarke and Wilson (1994) are too broad and poorly defined to be of value in the form proposed. Indeed, like many so-called indicators they are not readily measurable, and cannot really be considered as true indicators, but instead are merely general 'issues' or 'concepts' for which indicators might be developed. They also suffer from a lack of data availability; none can be assessed on the basis of routinely available sources. Indeed, it is because these type of performance indicators are too broad and not readily measurable that studies such as the one reported here remain valid.

Table 10.1 Sets of possible performance indicators (after Clarke and Wilson, 1994)

Residence-based:
Household incomes
Quality of housing and residential environment
Work opportunities
Take-up of marketed goods and services
Take-up of public goods and services
Transport (generalized costs)
Organization-based:
Efficiency of production
Role in the pattern of provision
Role in the labour market

Alternatives to the development of performance indicators are possible to limit the effects of the problem of using relative scores. The model of utilization, and other widely used indices, calculate their measures relative to a regional average. Clearly, this places an emphasis on local conditions which will have an impact in determining the regional average. However, if calculations are based on national, rather than local, conditions then change in any one area will have less of an effect on other areas. Jarman's UPA score takes this approach by comparing indicators to the average level for England and Wales. With adaptation, the model of utilization could be calculated in this way. It may therefore offer a means of analysing change with minimal effect on those areas where change does not occur.

A further alternative may be to develop more specific models of utilization (probably at the individual level) which can quantify or rank need for health care more directly. One example is the World Health Organisation (WHO) measure of Disease Affected Life Years (DALY) as an absolute measure of need. If the effect of access to health services on DALYs could be modelled (i.e. a measure of avoidable DALY if people had access to health care), then an absolute measure of health service supply or performance could be obtained.

The use of record linkage techniques might also be used in a similar way. Record linkage is the combination of routine data collection and other information brought together so that the cumulative life history of individuals can be traced. The use of record linkage for individuals is possible through the use of a personal identification number system, used as a key code in all files to assist computerised linking. This system is used in the Nordic countries where high-quality health and population data can be linked by means of a unique personal identifier (Pukkala, 1996). Clearly, where such data exists, more specific models of utilization could be developed to calculate absolute measures.

What is clear, however, is that research efforts must begin to focus on the creation of indicators which can allow the measurement of inequalities in absolute terms. As noted, this may have much more to do with the availability of data, and at a suitable level of spatial disaggregation, than the development of new models. In this sense, the issues of data availability and scale of analysis are inextricably linked to future developments of model-based indices, whether relative or absolute.

10.4 DATA AVAILABILITY AND SCALE OF ANALYSIS

Indicators of social difference, or inequality, can be conceptually defined at several levels: the individual, the family or household, the neighbourhood, the local community, and larger regional or national levels. Each level offers different opportunities for analysis and interpretation. However, the level which is actually used is heavily dependent upon data availability and it is this which continues to constrain research to a large extent. In terms of examining inequalities, information derived from censuses of population remains one of the most important sources of data. The drawback of this is that such large data sets are only made available at an aggregate level. It therefore remains problematic to examine differences in the population at anything other than the ED level as a minimum level of aggregation. This, therefore, leads to the examination of differences based on alternative taxonomies of aggregated populations and consequent problems of confounding.

Additionally, research is subsequently constrained to data available at the chosen level of analysis. In this research, for example, the ED level was chosen as an appropriate level of analysis due to the availability of a wide range of variables from the census which could be used to model components of utilization. However, limitations were enforced by choosing this level of analysis. In measuring need for health care, for instance, it may have been more appropriate to incorporate the standardised mortality ratio (SMR) as an indicator. However, this is unavailable at ED level, although it is available at a more aggregated district level. This presents the classic problem of 'ecological fallacy' discussed elsewhere (Section 6.2; Openshaw, 1984); it would be erroneous to infer that individuals, or smaller levels of disaggregation, exhibit the same level of SMR as exhibited at an aggregated level. Consequently this potentially valuable information cannot be incorporated.

Further, useful, indicators are also unavailable at the small area scale of analysis. In terms of examining deprivation, for instance, a measure of Gross Domestic Product (GDP) would be of immediate benefit as an indicator of household income yet this is not routinely collected or reported at ED level. Instead, social class (or, alternatively Socio-Economic Group), must be used as a proxy measure of relative affluence. As this research also illustrated, routine data reflecting levels of education at the small area level is limited to attainment of diplomas or degrees. This is clearly a less appropriate and sensitive measure of education than indicators such as examination performance at school, or reading age. Attempts at deriving small area estimates for income have been made (e.g. Birkin and Clarke, 1989), yet the focus was to show how microsimulation modelling could be used to construct small area estimates. Whilst estimation of unavailable data is useful research in itself, rather than pursuing ever more complex procedures for estimation, it may be of more benefit to pursue methods of collecting such information or deriving appropriate alternatives.

10.4.1 Boundary issues and aggregate versus individual level data

GIS conventionally handles population based information within traditional cartographic boundaries. This usually leads to the association of census data with arbitrarily defined boundaries within which the data were collected and reported. Census boundaries are not necessarily spatially coincident with other data sets. This may create problems in representing the relationship between one data-set and another. Furthermore, the relationship between the boundaries and the underlying characteristics of the population cannot be determined. When GIS is used to calculate concepts such as distance decay, connectivity or adjacency of population, the representations of population used are, at best, an approximation of the underlying structure.

In addition to the boundary limitations imposed through the use of UK census data other, widely acknowledged, problems also exist which have fundamental effects on research such as that reported here. These are discussed in depth by Openshaw (1995). In summary, the problems identified are:

- boundary changes between censuses make temporal change difficult to model;
- changes in question definition in each census lead to problems of comparability between censuses;
- incomplete responses (especially from disadvantaged social groups) weakens the data in crucial areas;
- a ten-year gap between censuses results in rapid out-dating of information;
- weak linkage between the census and other key data sets (from social security, tax, crime, morbidity and mortality databases) reduces its utility;
- continued use of 10% sample coding for key socio-economic variables is no longer appropriate and creates possible difficulties when used in conjunction with 100% coded variables;
- randomizing data to preserve confidentiality may degrade the value of Small Area Statistics; and
- lateness of availability means data may be several years out of date when it is finally released.

In attempting to overcome difficulties arising from the use of census data and associated boundaries, alternatives have been developed. Examples include the redefinition of polygon boundaries based on the distribution of households (Higgs and Wright, 1991), the creation of a population surface based on the actual population distributions (Bracken, 1991; Martin, 1991; 1995) and the definition of alternative small-areas resulting from research in geodemographics (for example Brown et al, 1991; Batey and Brown, 1994) or residential lifestyle classifications (for example Openshaw, 1991; 1994a; 1994b). These methods attempt to redefine boundaries according to the distribution and characteristics of residential properties and the local population. In so doing, a more accurate distribution of the population can be visualised although the means of attributing census data collected using one spatial framework to newly defined boundaries is not a solution to the problem.

These examples emphasise that no attempt at geographical referencing aggregate level data can provide a totally accurate representation of a population. All boundaries, however defined, have an effect on the outcome and the aggregate nature of population data makes it impossible to resolve such issues.

The UK postcode may help to resolve the problem of aggregation and boundaries, by providing smaller spatial units. Unit postcodes define areas which contain, on average, 14 households. The geographical extent of unit postcode areas depends upon the location (urban or rural), the use of the buildings (commercial or residential), and the housing style (private houses or apartment blocks). The unit postcode, therefore, takes into account much more the spatial variation which exists (albeit in terms of property rather than population) in comparison to the census ED and provides a smaller area of study. As such it provides a useful area of analysis and since many health events, and other data, are now routinely postcoded there is considerable potential for its future use.

There are, however, drawbacks to using aggregated data at the postcode level. Firstly, the only way current routine sources of population data can be used in conjunction with postcoded data is by linking postcodes to EDs. The added value of using unit postcodes for analysis is therefore offset by the reliance on census based population data, not available at postcode level, and the need to combine data at the ED level.

Secondly, as noted, unit postcode areas are defined based on the characteristics of location, building use and housing style. These characteristics vary considerably, resulting in marked variations in the size of unit postcode areas and the consequent difficulties of accurate comparison. Furthermore, as with the census boundaries, changes to postcode areas over time present problems of analysing temporal change. Fundamentally, although the unit postcode area is smaller than a census ED, problems of using aggregate data still remain (Raper et al, 1992)

Whichever method of defining boundaries is followed, based on census or postcode geography, they are all equally vulnerable to the problems associated with representing aggregate data in an arbitrarily defined area. In these terms, the development of disaggregate data, at the individual level, may offer a means of addressing the limitations of aggregate data and associated boundary problems.

Moves towards data collection at the individual level have been ongoing in the United States. For instance street network information is used to encode addresses and information about specific streets or blocks which can subsequently be used to describe the spatial pattern of census data. The DIME (Dual Independent Map Encoding) system has, since 1970, provided a mechanism whereby census enumeration can change dependent upon user requirements. For instance, DIME could be used in conjunction with household address information in order to create an enumeration area which is more socially homogenous. Thus the aggregate data subsequently made available in the United States more appropriately reflects spatial variation than the census does in a UK context. The DIME system was replaced, in 1990, by the TIGER (Topologically Integrated Geographical Coding and Referencing) system. This extended the principles used in DIME to include street level information and additional levels of areal definition (including methods of political aggregation). In particular, TIGER is used as a system for georeferencing addresses as well as a sampling frame for population censuses. Additionally, US freedom of information legislation has ensured that TIGER data is widely available and, coupled with the alternative locational devices used to code items of information, this gives it a wide applicability.

Such information is becoming available in the UK via the Ordnance Survey's Address Point system. In Address Point, every postal address in Britain has been coded with a unique reference along with an OSGR at 1 metre resolution. This may provide a valuable method of using georeferenced address-based information at a level which is both more detailed and geographically accurate than the similar TIGER product available in the United States.

Whilst DIME, TIGER and Address Point are examples of the sorts of data and tools which facilitate individual level analysis, difficulties still remain. Issues of confidentiality are likely to ensure that data continue to be made available only in aggregate form. It is generally accepted that any demographic or medical data which would permit the identification of an individual are confidential. For medical data, the same standards of confidentiality as apply to the doctor-patient relationship are maintained. Additionally, the modifiable areal unit problem, discussed in Section 6.3.1, which affects inference from aggregated areas to EDs, would be equally true for analysis of aggregated individual level data.

Furthermore, if data are collated at an individual level, the question of which postal address (or other individual level spatial identifier) to use for locational purposes is important. Current census data, for instance, is based on residential location. However, a large part of an individual's time is spent elsewhere, for instance at work or following recreational pursuits. The extent to which a person's home residence affects notions of accessibility may, therefore, not be as appropriate as the location where they spend most of their day. In this sense, different locations will place them in a different spatial relationship with points of service provision, altering their access opportunity.

It is thus clear from this discussion that disaggregate data offers benefits over aggregate data but its use is not without difficulties. Information collated at an individual level, and referenced by a point-based spatial identifier, cannot be taken as a panacea for the problems associated with aggregate data.

10.5 IMPLICATIONS OF THE 1997 ORGANISATIONAL CHANGES

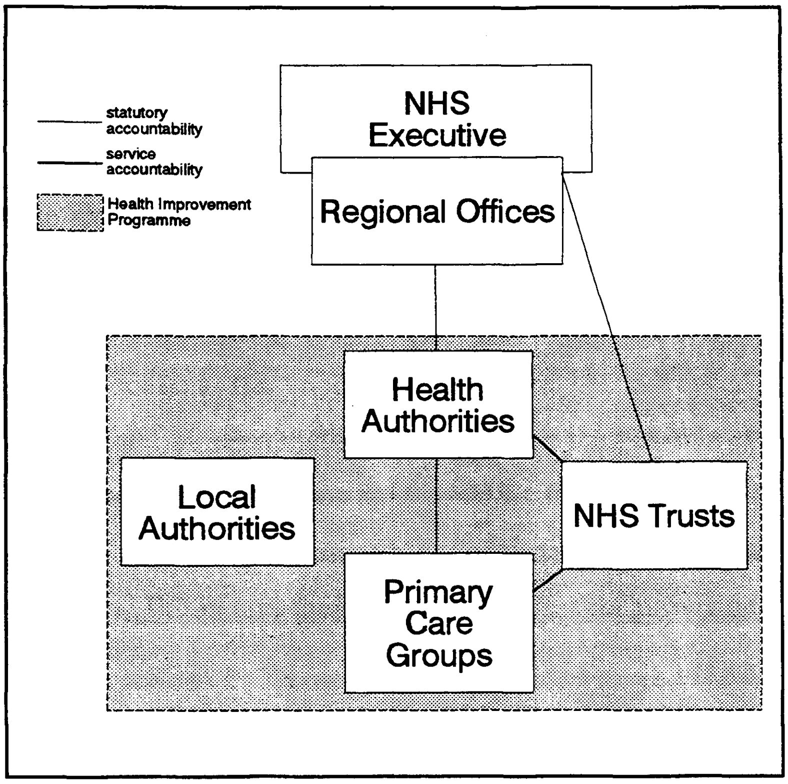
This research has been undertaken during a period of considerable organisational change in primary care services in the NHS. Changes brought about in 1991 radically altered the structure of the NHS introducing contractualism and the setting-up of an internal market. It is the impact of these changes on primary health care provision which provided part of the impetus for this research. Further organisational changes, post-1991, have altered the administrative areas and merged DHAs and FHSAa into unitary Health Authorities. These changes have altered the administrative framework but they still operate within the 1991 structures (Figure 1.3).

Of more recent interest are the potential impacts arising from the election of a new British Government in May 1997 and the radical alterations put forward in New Labour's 1997 White Paper *'The new NHS: modern • dependable'*. The prime aim of the White Paper is to replace the internal market with integrated care, 'combining efficiency and quality with a fundamental belief in fairness and partnership' (DoH, 1997 p1). The White Paper criticises the previous organisational structure of the NHS suggesting that it prevented the health service from properly focusing on the needs of patients and wasted resources administering competition. Instead, they explicitly place the needs of patients as central to the new system and reiterate the historic principles of the NHS:

> "that if you are ill or injured there will be a national health service there to help; and access to it will be based on need and need alone - not on your ability to pay, or on who your GP happens to be or on where you live"
> (DoH, 1997 p3)

In applying these principles the White Paper suggests wholesale changes to the NHS. In particular, it pledges that the NHS will be renewed as a genuinely national service providing high quality, prompt and accessible services across the country. The delivery of health care against new national standards will be on the basis of local responsibility and implemented at this level by those who are best placed to determine patient needs. Replacing the internal market with integrated care will involve the creation of Health Improvement Programmes, led by Health Authorities, jointly agreed by all who are charged with planning or providing health care, namely NHS Trusts, Primary Care Groups, other primary care professionals and local authorities (Figure 10.1).

Figure 10.1 The New NHS (1997)
(after DoH, 1997 p20)



Changes to the structure and operation of the NHS are proposed across the service but are particularly evident at the primary care level with the introduction of Primary Care Groups (PCG). These comprise all GPs in an area, together with community nurses, who will take responsibility for commissioning services for the local community. PCGs are designed to typically serve 100,000 patients and are to be based around local communities rather than being delimited by arbitrary authority boundaries. The new PCGs will replace existing commissioning and fundholding arrangements, such as Multifunds and Total Purchasing Projects (see Figure 1.3), and be accountable to Health Authorities. However, they will have freedom to make decisions about how they deploy their resources within the framework of the Health Improvement

Programme.

The key principle of this change, towards a more integrated approach, is that primary health care provision will increasingly be based on an assessment of local needs and access opportunity. In conceptual terms at least, these proposals seem to offer a means by which the inequalities manifest in health and health care can be addressed. Furthermore, in executing the proposals, the White Paper views Information Technology as crucial to both the process of change and to future decision-making as part of improved health care planning at a local level.

It is clear that the alterations proposed will create a fundamental requirement for new and more effective methods of examining the needs of local populations, their access opportunity and their relationship with current and future health care location and allocation. In this context, the model created here has advanced techniques of modelling utilization and offers a method of examining the possible effects of change brought about by imminent alterations to the NHS. It has a particular utility at the primary care level, in improving the assessment of need and access locally, which will be of value to the new PCGs and their local level remit for provision.

The practical value of this research to health care planning and analysis, in the fast changing world of public health care provision, is clear and it is thus a timely addition to the armoury of health and health care planners.

APPENDIX 1

Survey details

i. Patient questionnaire

PRIMARY HEALTH CARE UTILIZATION SURVEY	

PLEASE ANSWER THE FOLLOWING QUESTIONS BY TICKING THE APPROPRIATE RESPONSE OR FILLING IN THE GAPS. *Thankyou*

SECTION A	Background information

1. Have you been diagnosed as having Asthma?

Yes	
No	

2. Have you been diagnosed as having Diabetes?

Yes	
No	

3. What is your Postcode?

4. What is your age?

16 to 44	
45 to 64	
65 to 79	
80 or over	

5. What is your sex?

Male	
Female	

6. What is your usual occupation?

7. Are you currently employed?

Yes	
No	

8. What is your ethnic origin?

White	
Caribbean	
African	
Indian	
Pakistani	
Chinese	
Bangladeshi	
Other (please state)	

SECTION B	Visiting your doctor

10. How often, on average, do you visit your doctor?

Once a week	
Once a fortnight	
Once a month	
Once/twice a year	
Other (please state)	

27. Do you seek regular consultations with your doctor?

Yes	
No	

15. How far away is the surgery from your home?

Less than 1 mile	
1 to 3 miles	
4 to 5 miles	
More than 5 miles	

28. Do you depend on home visits from your doctor or District Nurse?

Regularly	
Occasionally	
Never	

29. What is the usual reason for you to visit your doctor?

Regular visit	
Physically ill	
'Feel' unwell	
Advice	
Other (please state)	

SECTION C	Getting to your doctors

11. Do you hold a current driving licence?

Yes	
No	

12. Do you own a car?

Yes	
No	

13. Do you have easy access to a car?

All of time	
Sometimes	
Never	

14. By what method do you usually travel to your doctors?

Car	
Walk	
Public transport	
Friend's car	
Other (please state)	

16. How long, on average, does the journey take?

Less than 5 mins	
5 to 10 mins	
11 to 30 mins	
Over 30 mins	

SECTION D[1]	The doctor's surgery

19. How satisfied are you with the surgery hours?

Very satisfied	
Acceptable	
Not satisfied	

20. How long, on average, do you wait between making an appointment and seeing a doctor? (apart from routine visits made in advance)

Same day	
Day after	
2 or 3 days	
Over 3 days	

21. How satisfied are you with this waiting time?

Very satisfied	
Acceptable	
Not satisfied	

22. When you arrive at your doctor's surgery how long, on average, do you have to wait between your stated appointment time and seeing your doctor?

Appointment kept	
0 to 5 mins	
6 to 10 mins	
11 to 30 mins	
Over 30 mins	

23. How satisfied are you with this waiting time?

Very satisfied	
Acceptable	
Not satisfied	

25. Do you find your doctor easy to approach?

Very easy	
O.K.	
Difficult	

24. Are there any other difficulties you encounter when arranging to see a doctor?

(Please state)

1 Whilst these questions formed part of the survey, they were not subsequently used as part of this research.

SECTION E	Obstacles in getting to your Doctor

30. Does the transport method you use affect your ability to get to your doctor's surgery?

Yes, alot	
Yes, a bit	
Not at all	

31. Does the time taken to get to the surgery affect your ability to see your doctor?

Yes, alot	
Yes, a bit	
Not at all	

32. Does the cost of the journey affect your ability to see your doctor?

Yes, alot	
Yes, a bit	
Not at all	

33. Do overall time constraints affect your ability to see your doctor?

Yes, alot	
Yes, a bit	
Not at all	

34. Does time off work or loss of earnings affect your ability to see your doctor?

Yes, alot	
Yes, a bit	
Not at all	

35. Do family commitments affect your ability to see your doctor?

Yes, alot	
Yes, a bit	
Not at all	

36. Does the location of the surgery affect your ability to see your doctor?

Yes, alot	
Yes, a bit	
Not at all	

37. Generally speaking, please state how accessible you find it to see your doctor?

Very accessible	
Fairly accessible	
Acceptable	
Inaccessible	
Very inaccessible	

ii. Patient letter of introduction

Northampton Health Authority

Our Ref:

Department of
Public Health Medicine
District Headquarters
Highfield
Cliftonville Road
Northampton NN1 5DN

When telephoning please ask for:

Date as postmark

Dear Sir/Madam,

You have been selected, at random, by your doctor to receive the enclosed questionnaire which is part of research being undertaken into the use of primary health care services. It is being distributed to a sample of people who have been diagnosed as having asthma or diabetes and will be used to assess the use of services and any difficulties you experience.

You will notice that the questionnaire requires you to supply your postcode which will be used for computer analysis purposes. Please be assured that this is a completely anonymous questionnaire and it is impossible to identify a person or a single property from a postcode.

Please could you take a few minutes to complete the questionnaire and return it in the prepaid envelope provided no later than Monday 22nd February 1993. All information supplied will be treated in the strictest confidence and no further correspondence will be sent to you.

Thankyou for your cooperation.

Yours sincerely

Mr. K. Field
<u>Research Assistant</u>

iii. Initial letter to GP practices

Northampton Health Authority

Our Ref:

Department of
Public Health Medicine
District Headquarters
Highfield
Cliftonville Road
Northampton NN1 5DN

When telephoning please ask for:

Dear

I am at present investigating issues concerning utilization of primary health care facilities within the Northampton District Health Authority area as part of my Ph.D research registered at Leicester University.

It is a study being undertaken with the consent of Dr. J. Cordingley of the District Health Authority with the aim of providing a model of utilization to GP services using a Geographical Information System (GIS). The intent is to develop a method of modelling utilization, from which outcome measures can be derived, to assist health care planning and analysis and to assess the suitability of GIS in studying these issues.

I am writing to ask for your support in this study. I realise that workloads are extremely heavy but I hope that you will find time to help in my research, which should not prove too time-consuming. Attached are details of the study and a short questionnaire is included which I would ask you to return, if possible, before Friday 2nd October, 1992.

I look forward to hearing from you.

Yours sincerely,

Mr. K. Field
Research Assistant

RESEARCH DETAILS

1.) The GIS will hold information relating to GP practices, route networks and the demographic nature of the population to analyse utilization for the population served. Utilization of primary care services is to be investigated for certain groups of the population, namely those who are receiving some form of health care in relation to a diabetic or asthmatic condition. This will be undertaken in the form of a sample survey and will aim to provide information from the patient's viewpoint on their utilization of services and any hindrance in their accessibility.

2.) Firstly, I require GPs to complete a short questionnaire to gain information on the number of people they treat for asthma or diabetes. From this I can decide on the size of survey necessary for the research.

3.) In order that the patient information remains completely anonymous I shall then distribute a number of patient questionnaires to GPs who shall, in turn, distribute them to the patients. This will only require the addition of the patient address to pre-paid envelopes.

4.) The completed patient questionnaires will then be sent directly to me in preparation for analysis. Due to the geographical nature of the study, although names and addresses are not required, the postcode of the patient's address will be necessary in order to locate data within the GIS and allow analysis of the questionnaire response in relation to the other data-sets. The postcode is of sufficient scale to maintain anonymity of patient information since it is not unique to individual properties.

5.) I enclose a copy of the patient questionnaire for your inspection.

GP QUESTIONNAIRE

INFORMATION SUPPLIED WILL BE TREATED IN THE STRICTEST CONFIDENCE AND WILL BE USED SOLELY FOR THE PURPOSE OF THE RESEARCH PREVIOUSLY OUTLINED.

1. Do you offer a clinic for asthmatics? YES/NO
   If YES, how often? ....

2. Do you offer a clinic for diabetics? YES/NO
   If YES, how often? ....

3. How many patients are currently being treated for Asthma? ....

4. How many patients are currently being treated for Diabetes? ....

5. If it is possible, could you provide a list of individual postcodes only for the patients who you treat for Diabetes and another, separate, list for those you treat for Asthma.

Please return in the envelope provided, if possible, before Friday 2nd October

Thankyou.

iv. Letter to recruited GPs

Northampton Health Authority

Our Ref:

When telephoning please ask for:

Department of
Public Health Medicine
District Headquarters
Highfield
Cliftonville Road
Northampton NN1 5DN

Date as postmark

Dear Dr ,

I am writing to you as the first named partner on the FHSA Practice list regarding the research being undertaken into utilization of health care services. Thankyou for agreeing to take part in the research. The preliminary work for the survey has been completed and it is now at the stage of distribution to patients.

Please find enclosed a number of sealed envelopes which contain the following:

A letter of introduction
A questionnaire
A prepaid envelope

It has been decided to use a 20% sample for asthmatic patients and a 40% sample for diabetics in order to provide meaningful data for statistical analysis. Therefore, could you please select **n** asthmatics and **n** diabetics from your patient lists, based on the following systematic sampling guidelines, and distribute the prepaid envelopes to them no later than Friday 5th February 1993.

Sampling guidelines:

- The patient list for each condition should be used but all patients under the age of 16 excluded.
- For asthma patients, every 5th patient on the patient list should be surveyed.
- For diabetic patients, every 3rd and 5th patient on the patient list should be surveyed.
- Each survey pack should then be addressed accordingly and sent to the patient by post.
- Completed questionnaires are returned directly to avoid further administrative work by yourselves.

Thankyou again for your cooperation.

Yours sincerely

Mr. K. Field
Research Assistant

v. Patient survey distribution and response summary

The following table presents a breakdown of the patient survey details. Practice codes are used instead of GP names for reasons of confidentiality.

Practice		Asthma			Diabetes			Spoiled Returns
		Total	20% sent	Returns	Total	40% sent	Returns	
M1 (PILOT)		302	60	43	147	59	48	2
A2		257	51	26	119	48	32	6
A4	*	210	42	21	46	18	14	3
A15	*	130	26	14	23	9	7	0
A16	*	239	48	31	99	40	24	7
A17		191	38	19	90	36	25	2
A22	*	202	40	25	56	22	17	4
A24		650	130	52	98	39	25	8
A26		766	153	63	169	68	41	28
A28	*	421	(84)	x	163	(65)	x	x
B1		347	69	47	91	36	18	5
C1	*	407	81	50	115	46	31	9
P3		35	7	4	25	10	6	4
Total (excluding pilot practice)		4155	685	352	1244	372	240	76

* denotes supply of Postcode list
(84) denotes GP failed to distribute (Practice A28)
x denotes no questionnaires returned

Summary:
1206 questionnaires distributed to GPs
1057 questionnaires distributed to patients:
Total returns: 668 (63.2% overall response)
Total usable returns: 592 (56%)

APPENDIX 2

Survey results

i. Summary of frequency of response

The following results are a summary of the response to each question in the patient survey, appropriate to this research. The asthmatic and diabetic cohort are combined giving 592 questionnaire responses.

Q1: Asthmatic diagnosis

Response	Frequency	Percent
Yes	374	63.2
No	218	36.8

Q2: Diabetic diagnosis

Response	Frequency	Percent
Yes	240	40.5
No	352	59.5

Q4: Age

Response	Frequency	Percent
< 16	58	9.8
16-44	197	33.3
45-64	170	28.7
65-79	143	24.2
80 or over	24	4.1

Q5: Sex

Response	Frequency	Percent
Male	276	46.6
Female	316	53.4

Q6: Social class

Response	Frequency	Percent
Class I	154	26.0
Class II	23	3.9
Class IIIN	69	11.7
Class IIIM	88	14.9
Class IV	39	6.6
Class V	55	9.3
H'wife/husband	11	1.9
Student	92	15.5
Retired/other	26	4.4
Missing	35	5.9

Q7: Employment status

Response	Frequency	Percent
Employed	240	40.5
Unemployed	345	58.3
Missing	7	1.2

Q8: Ethnicity

Response	Frequency	Percent
White	576	97.3
Black (C'bean)	6	1.0
Black (African)	0	0
Indian	4	.7
Pakistani	0	0
Chinese	0	0
Bangladeshi	1	.2
Other	3	.5
Missing	2	.3

Q10: Frequency of consultation

Response	Frequency	Percent
Once a fortnight	14	2.4
Once a month	136	23.0
3-12 per year	331	55.9
1 or 2 per year	41	6.9
When necessary	62	10.5
Missing	8	1.4

Q11: Driving licence ownership

Response	Frequency	Percent
Yes	350	59.1
No	236	39.9
Missing	6	1.0

Q12: Car ownership

Response	Frequency	Percent
Yes	292	49.3
No	173	29.2
Missing	127	21.5

Q13: Access to a car

Response	Frequency	Percent
Always	268	45.3
Sometimes	115	19.4
Never	91	15.4
Missing	118	19.9

Q14: Method of transport

Response	Frequency	Percent
Car	356	60.1
Walk	156	26.4
Public transport	53	9.0
Friend's car	23	3.9
Other	3	.5
Missing	1	.2

Q15: Proximity of surgery (distance)

Response	Frequency	Percent
< 1 mile	190	32.1
1-3 miles	296	50.0
4-5 miles	84	14.2
> 5 miles	18	3.0
Missing	4	.7

Q16: Proximity of surgery (time)

Response	Frequency	Percent
< 5 mins	131	22.1
5-10 mins	278	47.0
11-30 mins	167	28.2
> 30 mins	15	2.5
Missing	1	.2

Q27: Regular consultations sought

Response	Frequency	Percent
Yes	233	39.4
No	349	59.0
Missing	10	1.7

Q28: Home visit dependence

Response	Frequency	Percent
Regularly	10	1.7
Occasionally	180	30.4
Never	400	67.6
Missing	2	.3

Q29: Usual reason for arranging consultation

Response	Frequency	Percent
Regular visit	188	31.8
Physically ill	189	31.9
'Feel' unwell	190	32.1
Advice	2	.3
Other	15	2.6
Missing	8	1.4

Q30: Transport method affecting accessibility

Response	Frequency	Percent
Yes, a lot	58	9.8
Yes, a bit	81	13.7
Not at all	449	75.8
Missing	4	.7

Q31: Journey time affecting accessibility

Response	Frequency	Percent
Yes, a lot	15	2.5
Yes, a bit	59	10.0
Not at all	517	87.3
Missing	1	.2

Q32: Cost of journey affecting accessibility

Response	Frequency	Percent
Yes, a lot	4	.7
Yes, a bit	41	6.9
Not at all	545	92.1
Missing	2	.3

Q33: Time constraints affecting accessibility

Response	Frequency	Percent
Yes, a lot	30	5.1
Yes, a bit	126	21.3
Not at all	429	72.5
Missing	7	1.2

Q34: Work commitments affecting accessibility

Response	Frequency	Percent
Yes, a lot	28	4.7
Yes, a bit	76	12.8
Not at all	454	76.7
Missing	34	5.7

Q35: Family commitments affecting accessibility

Response	Frequency	Percent
Yes, a lot	6	1.0
Yes, a bit	44	7.4
Not at all	537	90.7
Missing	5	.8

Q36: Surgery location affecting accessibility

Response	Frequency	Percent
Yes, a lot	10	1.7
Yes, a bit	51	8.6
Not at all	529	89.4
Missing	2	.3

Q37: Overall accessibility

Response	Frequency	Percent
Very accessible	348	58.8
Fairly accessible	144	24.3
Acceptable	92	15.5
Inaccessible	6	1.0
Very inaccessible	2	.3

ii. Comparison of survey with host population

The following table indicates the results of x^2 tests for goodness-of-fit between the survey and host population. The tests are determined at a 95% confidence interval.

Variable	x^2 value	DF	Significance (p-value)
Age	171.20	4	0.00
Sex	1.49	1	0.22
Social class	277.98	6	0.00
Employment	2575.47	1	0.00
Ethnicity	6.65	7	0.47
Car availability	344.82	1	0.00

iii. Comparison of asthmatic and diabetic response

The following table indicates the results of x^2 tests for difference (of two independent samples) between frequency of responses for asthmatics and diabetics. The tests are determined at a 95% confidence interval.

Variable	x^2 value	DF	Significance (p-value)
Q10: Frequency of consultation	3.99	7	0.78
Q29: Usual reason for arranging consultation	46.82	6	0.00
Q28: Home visit dependence	7.29	3	0.06
Q14: Method of transport	11.42	5	0.04
Q37: Overall accessibility	4.80	4	0.31
Q13: Access to a car	3.98	3	0.27
Q31: Journey time obstacle	2.28	3	0.52
Q32: Cost of journey obstacle	2.30	3	0.51

iv. Survey analysis tabulated results

The following tables indicate the results of x^2 tests for difference between survey variables. The tests are determined at a 95% confidence interval. The proportion of cells with an expected frequency of less than 5 is also indicated. A value of above 20% invalidates the test although the original categories were defined on a legitimate and justifiable basis and collapsing the categories further would mask variation.

Variable 1	Variable 2	x^2 value	DF	Significance (p-value)	% of cells with E<5
Q4: Age	Q10: Frequency of consultation	28.87	16	0.03	32%
	Q27: Regularity of consultation	37.99	4	0.00	0%
	Q28: Home visit dependence	60.45	8	0.00	33%
	Q11: Driving licence ownership	33.22	3	0.00	0%
	Q12: Car ownership	32.96	3	0.00	0%
	Q13: Access to a car	24.07	8	0.002	13%
	Q14: Method of transport	39.37	16	0.001	32%
	Q30: Transport method obstacle	8.12	8	0.42	13%
	Q31: Journey time obstacle	4.68	8	0.79	33%
	Q32: Cost of journey obstacle	9.62	8	0.29	47%
	Q33: Time constraints obstacle	69.87	8	0.00	13%
	Q34: Work commitments obstacle	63.64	8	0.00	20%
	Q35: Family commitments obstacle	28.22	8	0.00	47%
	Q36: Surgery location obstacle	4.28	8	0.83	47%

Variable 1	Variable 2	x^2 value	DF	Significance (p-value)	% of cells with E<5
Q5: Sex	Q10: Frequency of consultation	8.20	4	0.84	0%
	Q27: Regularity of consultation	1.07	1	0.30	0%
	Q28: Home visit dependence	0.25	2	0.88	17%
	Q11: Driving licence ownership	49.79	1	0.00	0%
	Q12: Car ownership	15.43	1	0.00	0%
	Q13: Access to a car	12.96	2	0.002	0%
	Q14: Method of transport	8.02	4	0.09	20%
	Q30: Transport method obstacle	15.04	2	0.001	0%
	Q31: Journey time obstacle	8.15	2	0.02	0%
	Q32: Cost of journey obstacle	3.94	2	0.14	33%
	Q33: Time constraints obstacle	7.60	2	0.02	0%
	Q34: Work commitments obstacle	0.51	2	0.78	0%
	Q35: Family commitments obstacle	13.04	2	0.001	33%
	Q36: Surgery location obstacle	10.4	2	0.006	17%

Variable 1	Variable 2	x^2 value	DF	Significance (p-value)	% of cells with E<5
Q6: Social class	Q10: Frequency of consultation	41.71	32	0.12	44%
	Q27: Regularity of consultation	36.50	8	0.00	6%
	Q28: Home visit dependence	48.92	16	0.00	37%
	Q11: Driving licence ownership	102.13	8	0.00	6%
	Q12: Car ownership	86.34	8	0.00	11%
	Q13: Access to a car	81.34	16	0.00	22%
	Q14: Method of transport	89.42	32	0.00	51%
	Q30: Transport method obstacle	25.72	16	0.06	26%
	Q31: Journey time obstacle	15.90	16	0.46	48%
	Q32: Cost of journey obstacle	30.78	16	0.01	56%
	Q33: Time constraints obstacle	42.99	16	0.00	30%
	Q34: Work commitments obstacle	89.32	16	0.00	41%
	Q35: Family commitments obstacle	10.40	16	0.85	52%
	Q36: Surgery location obstacle	13.60	16	0.63	52%

Variable 1	Variable 2	x^2 value	DF	Significance (p-value)	% of cells with E<5
Q7: Employment	Q10: Frequency of consultation	25.31	4	0.00	0%
	Q27: Regularity of consultation	17.18	1	0.00	0%
	Q28: Home visit dependence	32.67	2	0.00	17%
	Q11: Driving licence ownership	55.59	1	0.00	0%
	Q12: Car ownership	45.46	1	0.00	0%
	Q13: Access to a car	34.04	2	0.00	0%
	Q14: Method of transport	29.64	4	0.00	20%
	Q30: Transport method obstacle	15.48	2	0.00	0%
	Q31: Journey time obstacle	6.77	2	0.03	0%
	Q32: Cost of journey obstacle	13.33	2	0.001	0%
	Q33: Time constraints obstacle	41.24	2	0.00	0%
	Q34: Work commitments obstacle	94.49	2	0.00	0%
	Q35: Family commitments obstacle	1.99	2	0.37	33%
	Q36: Surgery location obstacle	4.88	2	0.09	17%

Variable 1	Variable 2	x^2 value	DF	Significance (p-value)	% of cells with E<5
Q8: Ethnicity	Q10: Frequency of consultation	17.27	16	0.37	80%
	Q27: Regularity of consultation	7.32	4	0.12	80%
	Q28: Home visit dependence	2.61	8	0.96	80%
	Q11: Driving licence ownership	2.45	4	0.65	80%
	Q12: Car ownership	2.28	4	0.68	80%
	Q13: Access to a car	6.22	8	0.62	80%
	Q14: Method of transport	43.01	16	0.00	84%
	Q30: Transport method obstacle	11.86	8	0.16	80%
	Q31: Journey time obstacle	44.49	8	0.00	73%
	Q32: Cost of journey obstacle	147.69	8	0.00	80%
	Q33: Time constraints obstacle	26.24	8	0.001	80%
	Q34: Work commitments obstacle	7.85	8	0.45	80%
	Q35: Family commitments obstacle	3.92	8	0.86	73%
	Q36: Surgery location obstacle	60.33	8	0.00	73%

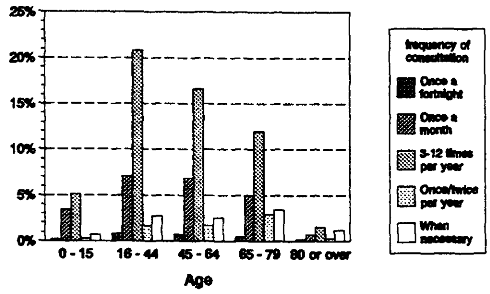
Variable 1	Variable 2	x^2 value	DF	Significance (p-value)	% of cells with E<5
Q15: Proximity (distance)	Q10: Frequency of consultation	19.21	12	0.08	30%
	Q27: Regularity of consultation	7.70	3	0.05	0%
	Q28: Home visit dependence	13.46	6	0.04	25%
	Q11: Driving licence ownership	11.13	3	0.01	0%
	Q12: Car ownership	4.96	3	0.17	0%
	Q13: Access to a car	18.73	6	0.005	17%
	Q14: Method of transport	211.04	12	0.00	40%
	Q30: Transport method obstacle	31.37	6	0.00	17%
	Q31: Journey time obstacle	9.91	6	0.13	33%
	Q32: Cost of journey obstacle	13.32	6	0.04	42%
	Q33: Time constraints obstacle	16.17	6	0.01	25%
	Q34: Work commitments obstacle	3.67	6	0.72	25%
	Q35: Family commitments obstacle	5.89	6	0.44	42%
	Q36: Surgery location obstacle	24.90	6	0.00	33%

Variable 1	Variable 2	x^2 value	DF	Significance (p-value)	% of cells with E<5
Q16: Proximity (time)	Q10: Frequency of consultation	19.32	12	0.08	30%
	Q27: Regularity of consultation	8.29	3	0.04	0%
	Q28: Home visit dependence	34.24	6	0.00	42%
	Q11: Driving licence ownership	17.31	3	0.00	0%
	Q12: Car ownership	32.60	3	0.00	13%
	Q13: Access to a car	80.27	6	0.00	17%
	Q14: Method of transport	117.91	12	0.00	35%
	Q30: Transport method obstacle	36.55	6	0.00	17%
	Q31: Journey time obstacle	36.09	6	0.00	33%
	Q32: Cost of journey obstacle	37.04	6	0.00	42%
	Q33: Time constraints obstacle	4.48	6	0.61	17%
	Q34: Work commitments obstacle	5.52	6	0.48	17%
	Q35: Family commitments obstacle	2.81	6	0.83	42%
	Q36: Surgery location obstacle	45.39	6	0.00	42%

iv. Survey analysis graphical results

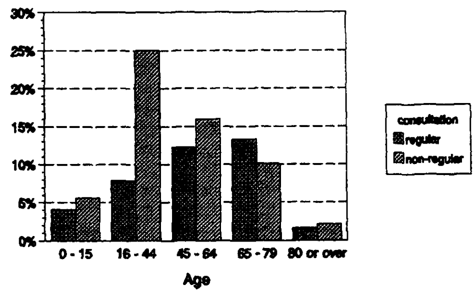
Influence of age on utilization behaviour

a) frequency of consultation by age



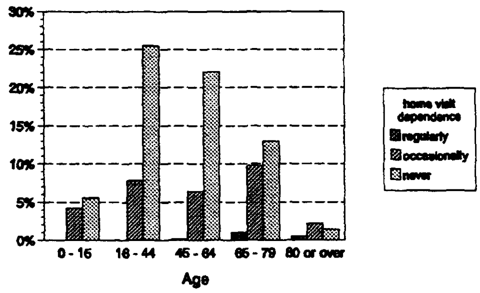
Missing observations: 9
Source: Patient survey 1993

b) regularity of consultation by age



Missing observations: 10
Source: Patient survey 1993

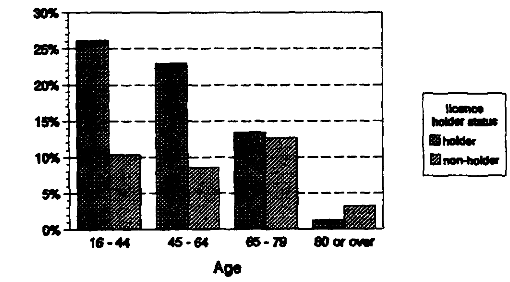
c) home visit dependence by age



Missing observations: 2
Source: Patient survey 1993

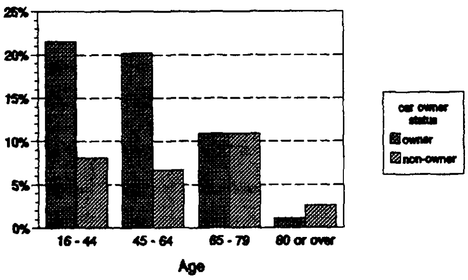
Influence of age on mobility characteristics

a) driving licence ownership by age



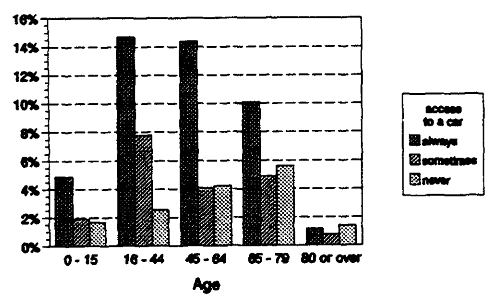
Missing observations: 6
Under 16s excluded from analysis
Source: Patient survey 1993

b) car ownership by age



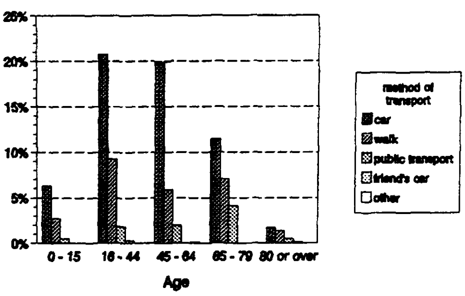
Missing observations: 96
Under 16s excluded from analysis
Source: Patient survey 1993

c) access to a car by age



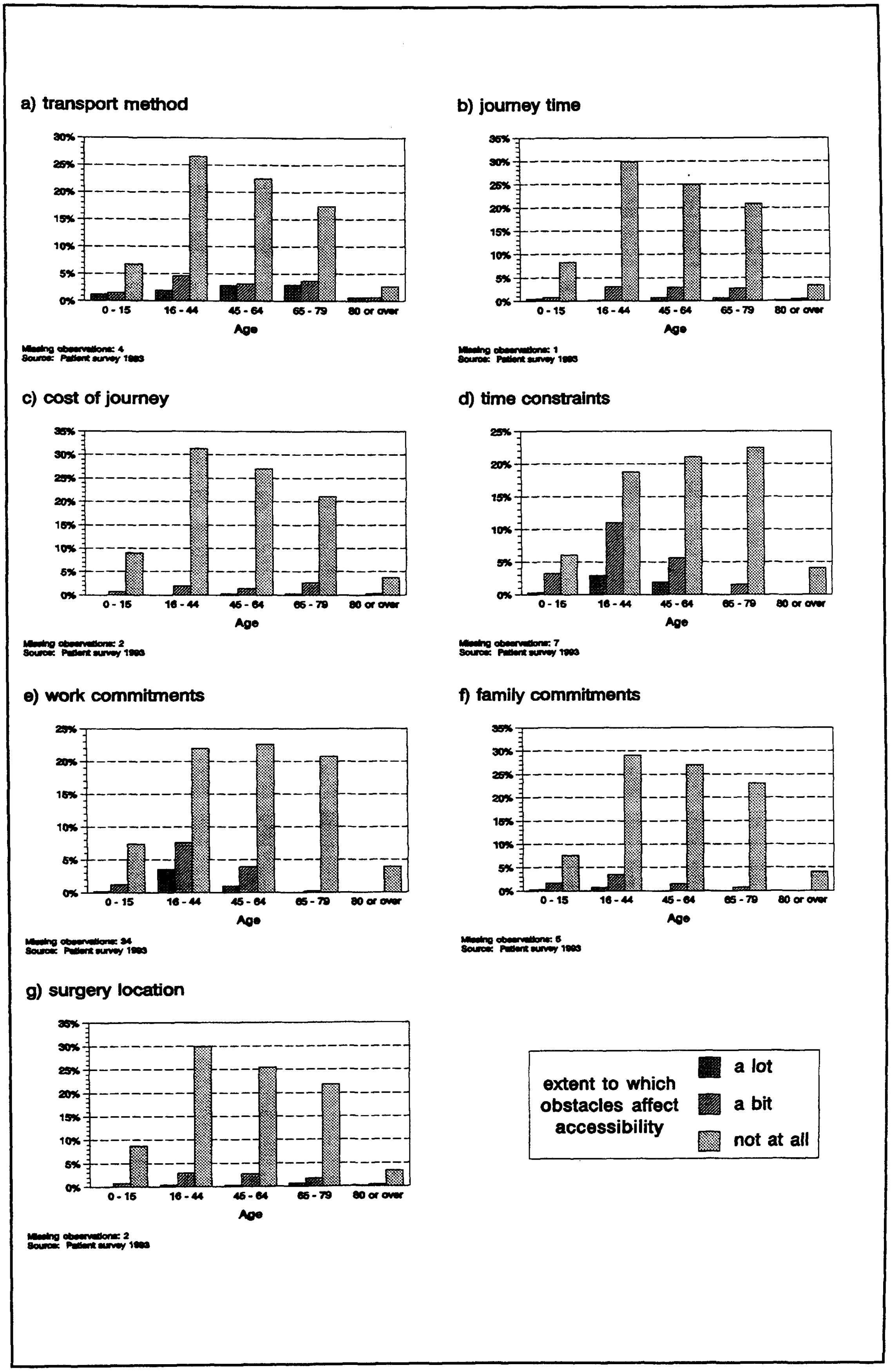
Missing observations: 118
Source: Patient survey 1993

d) method of transport by age

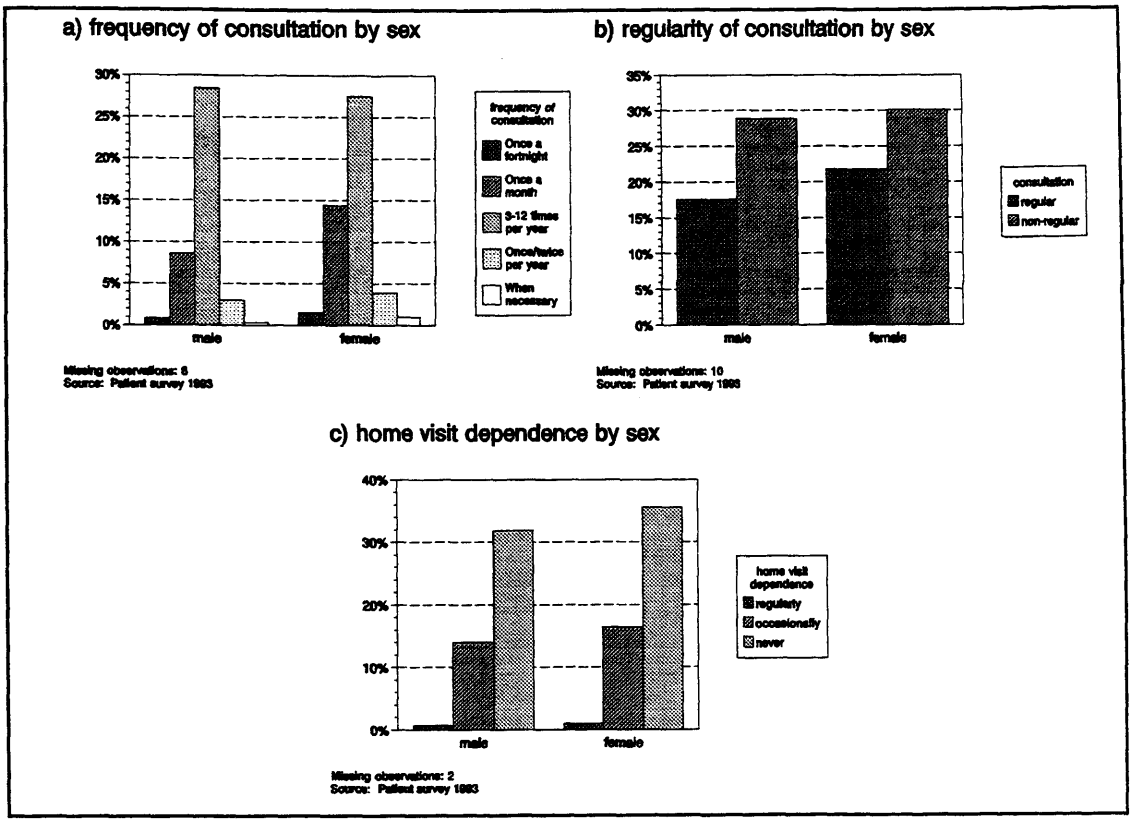


Missing observations: 1
Source: Patient survey 1993

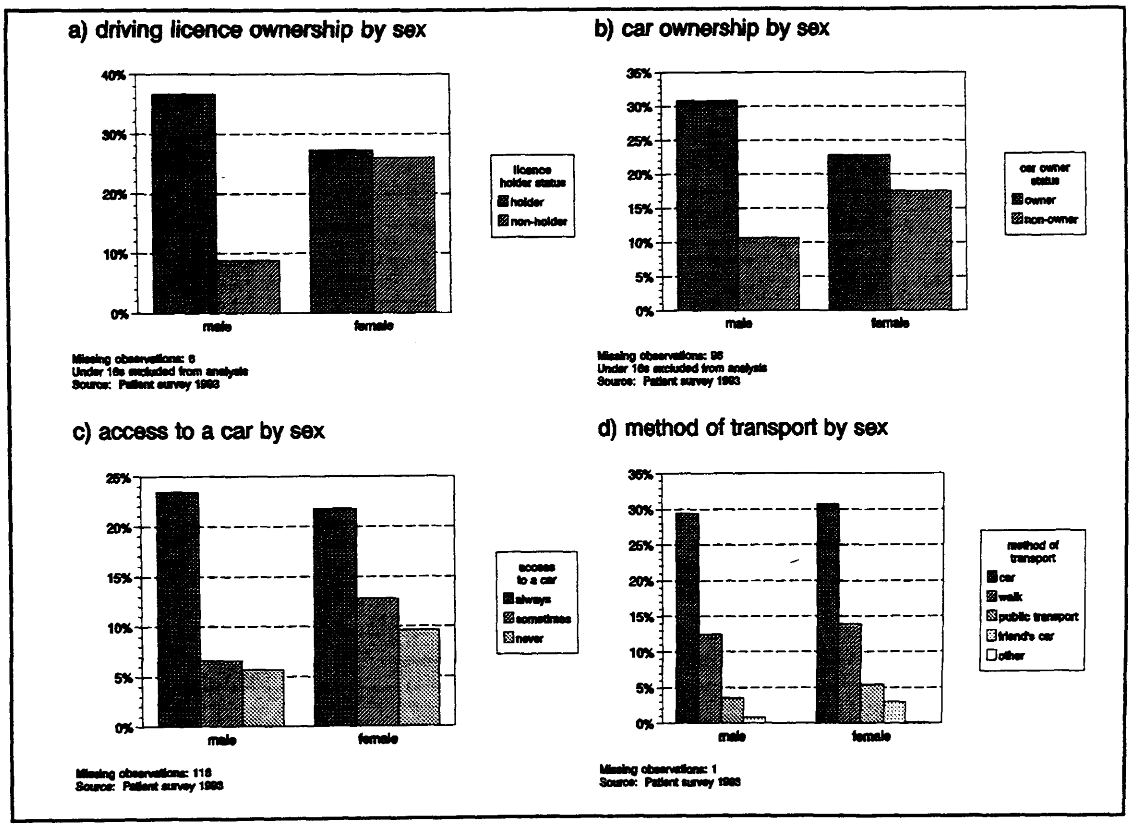
Influence of age on obstacles to accessibility



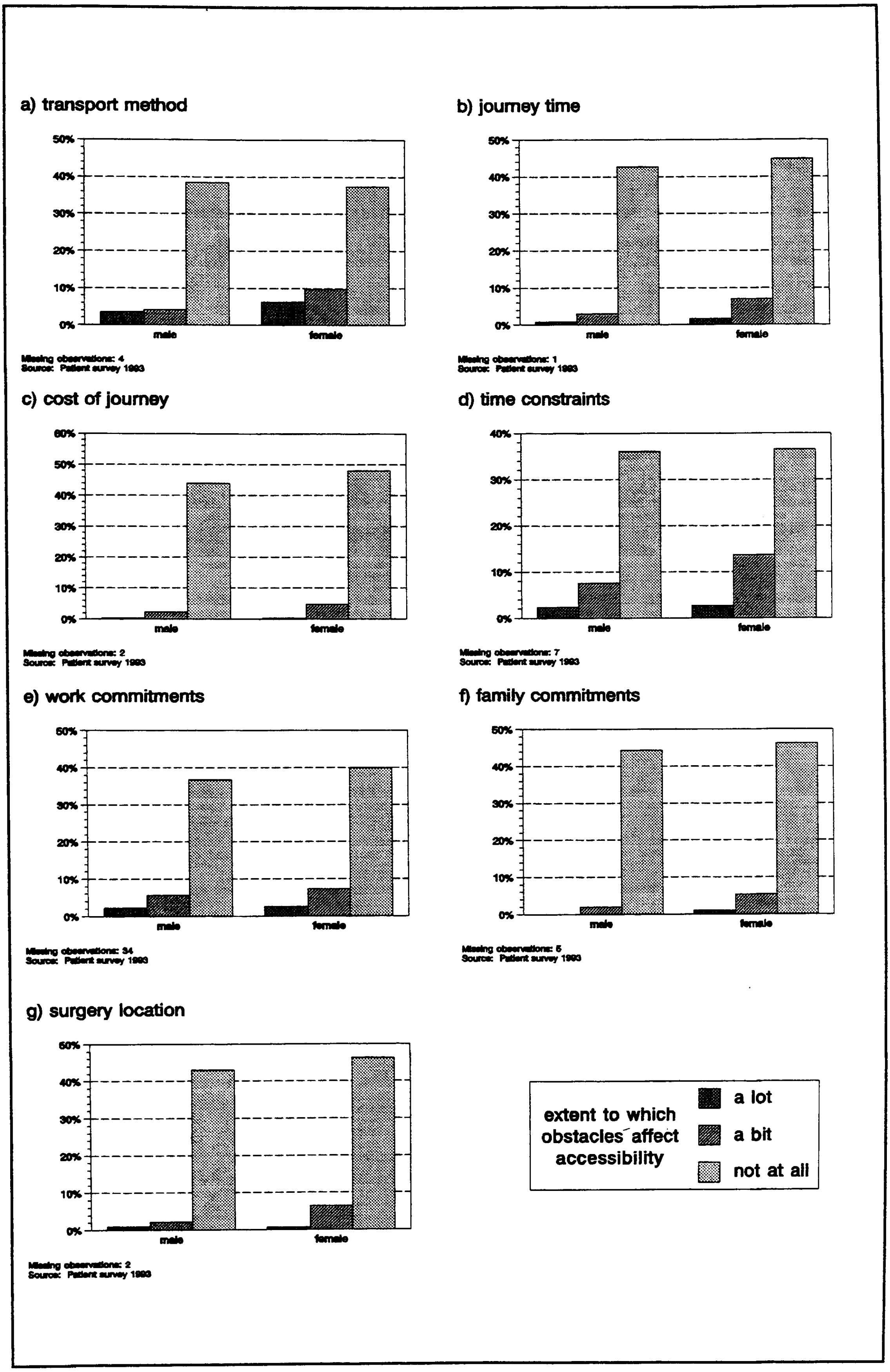
Influence of gender on utilization behaviour



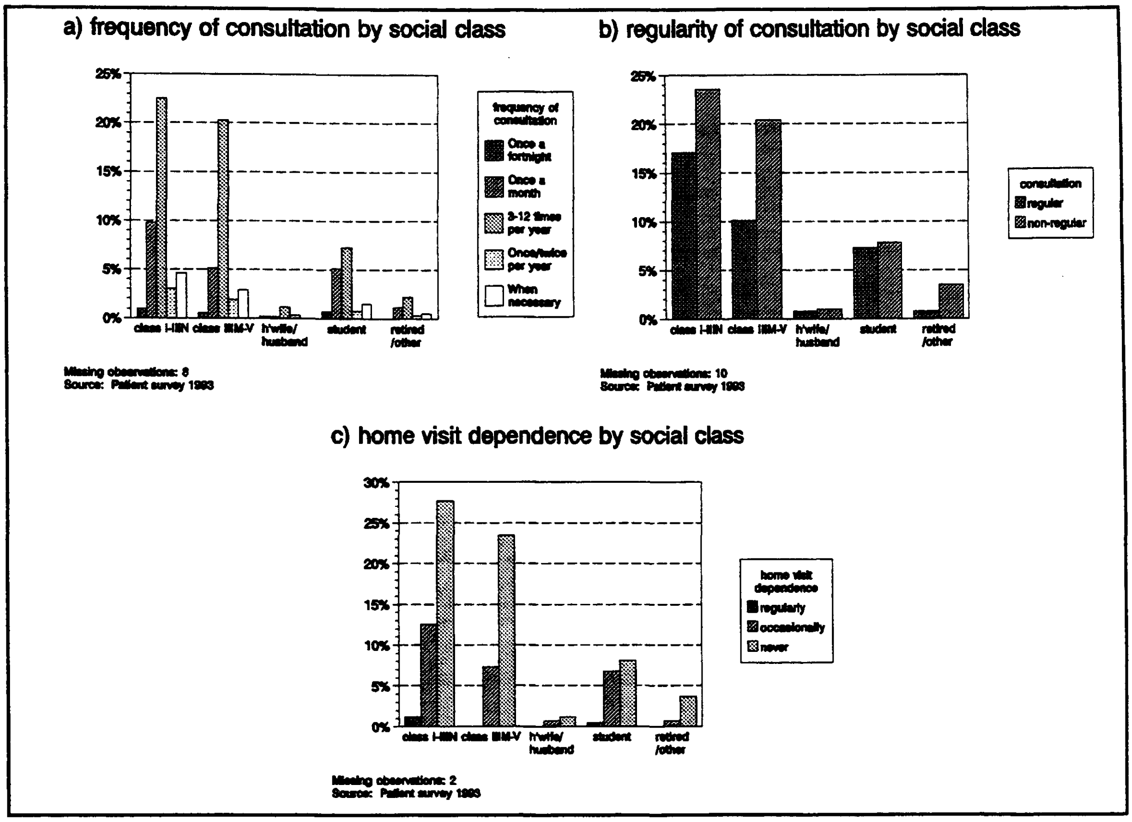
Influence of gender on mobility characteristics



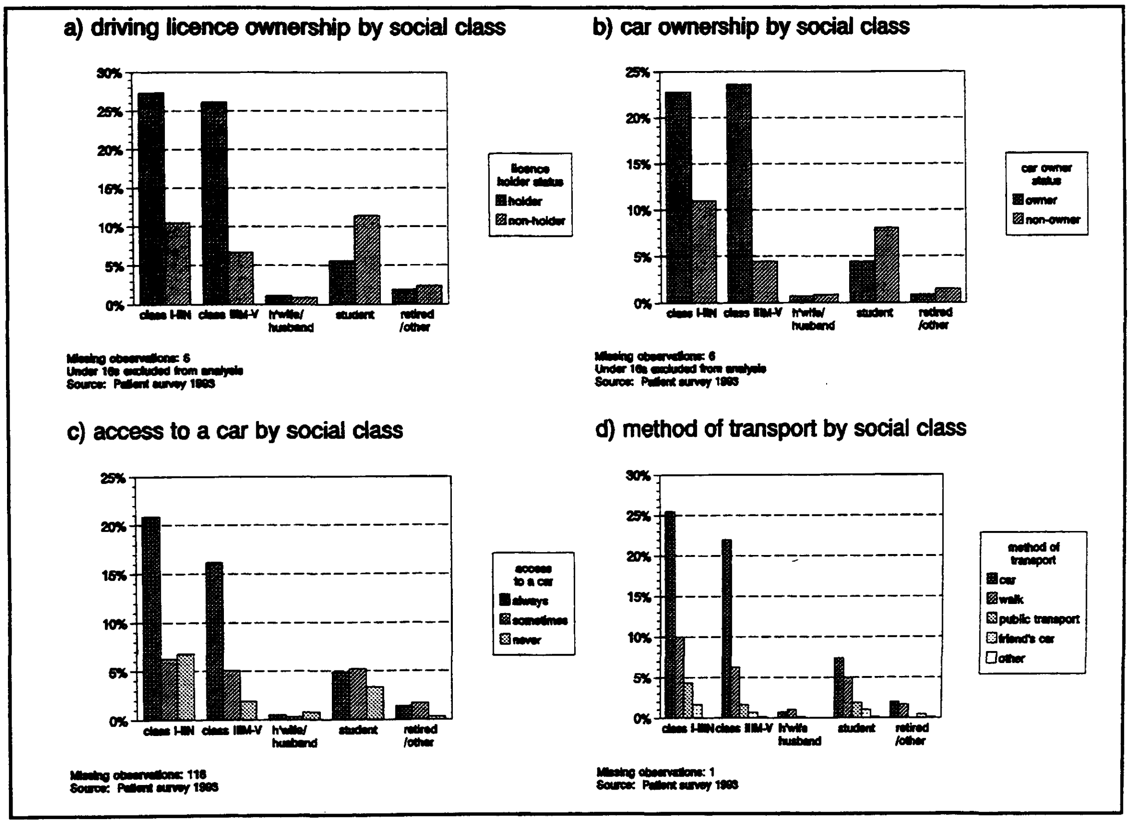
Influence of gender on obstacles to accessibility



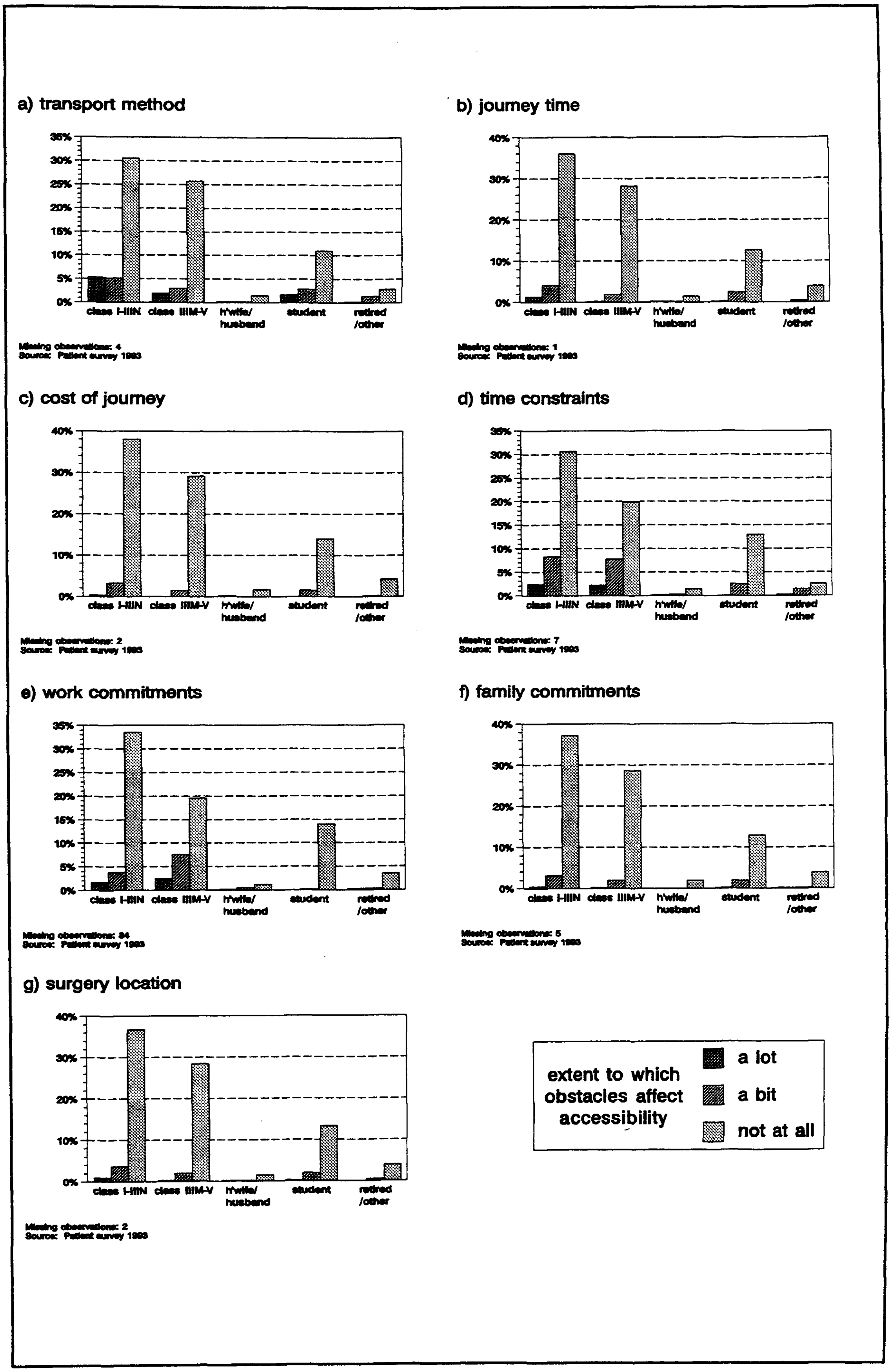
Influence of social class on utilization behaviour



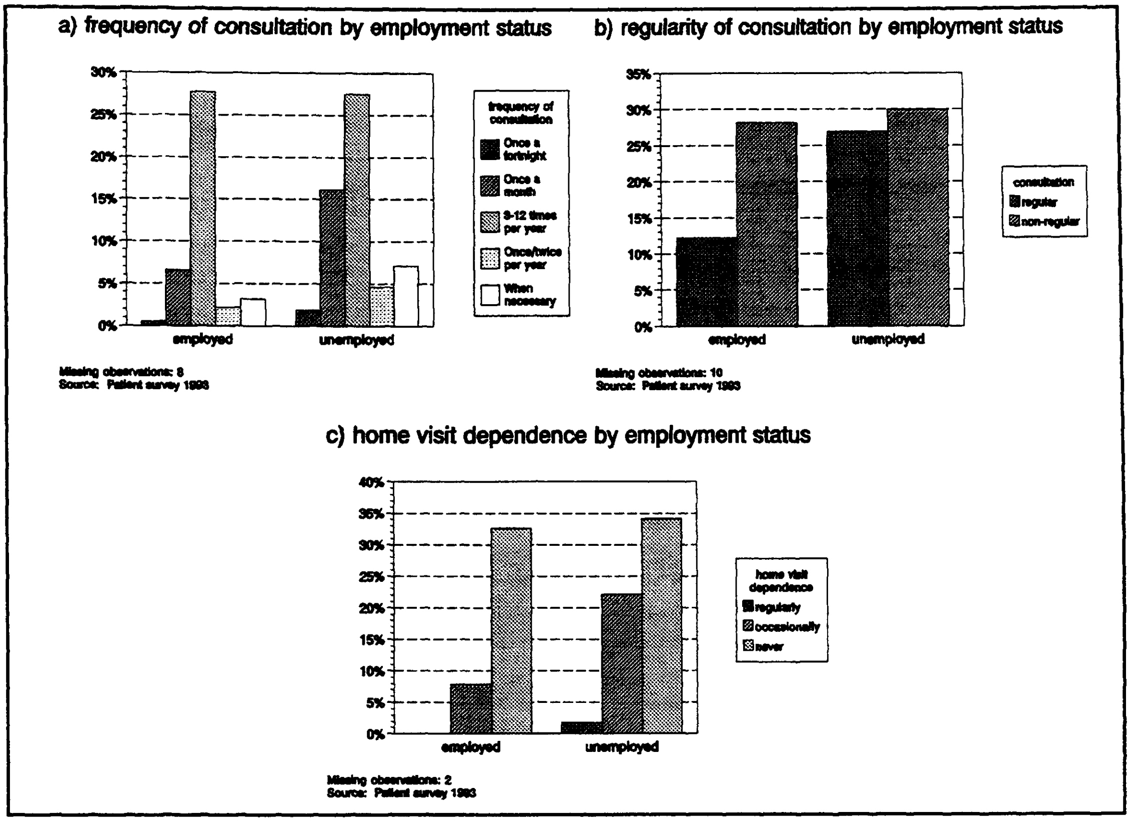
Influence of social class on mobility characteristics



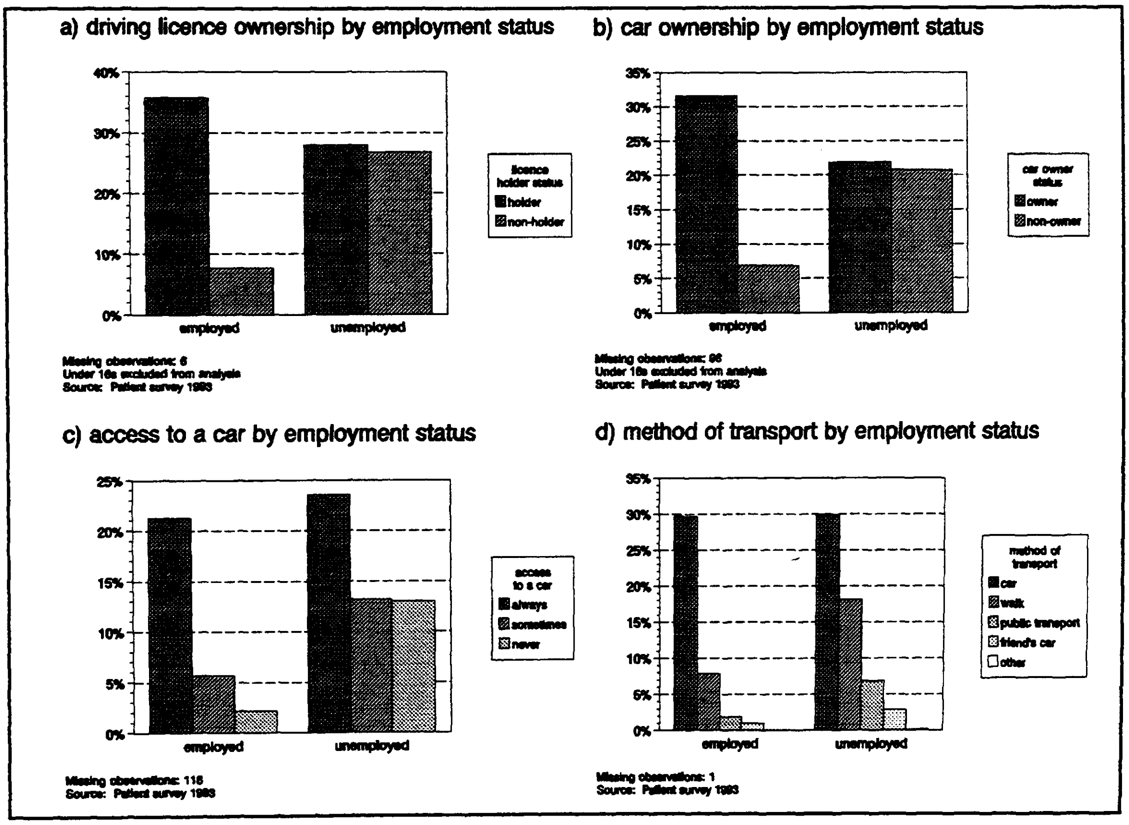
Influence of social class on obstacles to accessibility



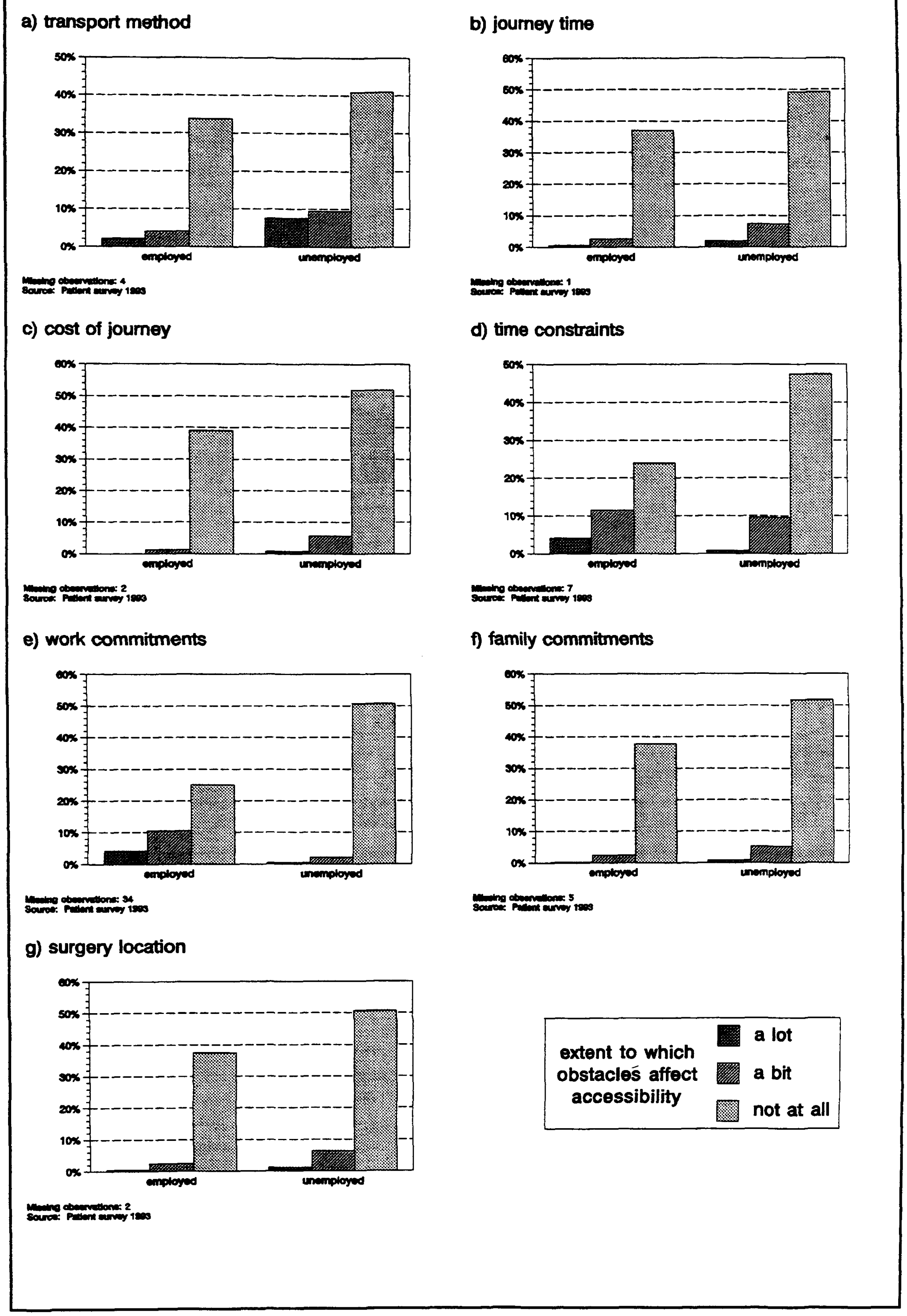
Influence of employment on utilization behaviour



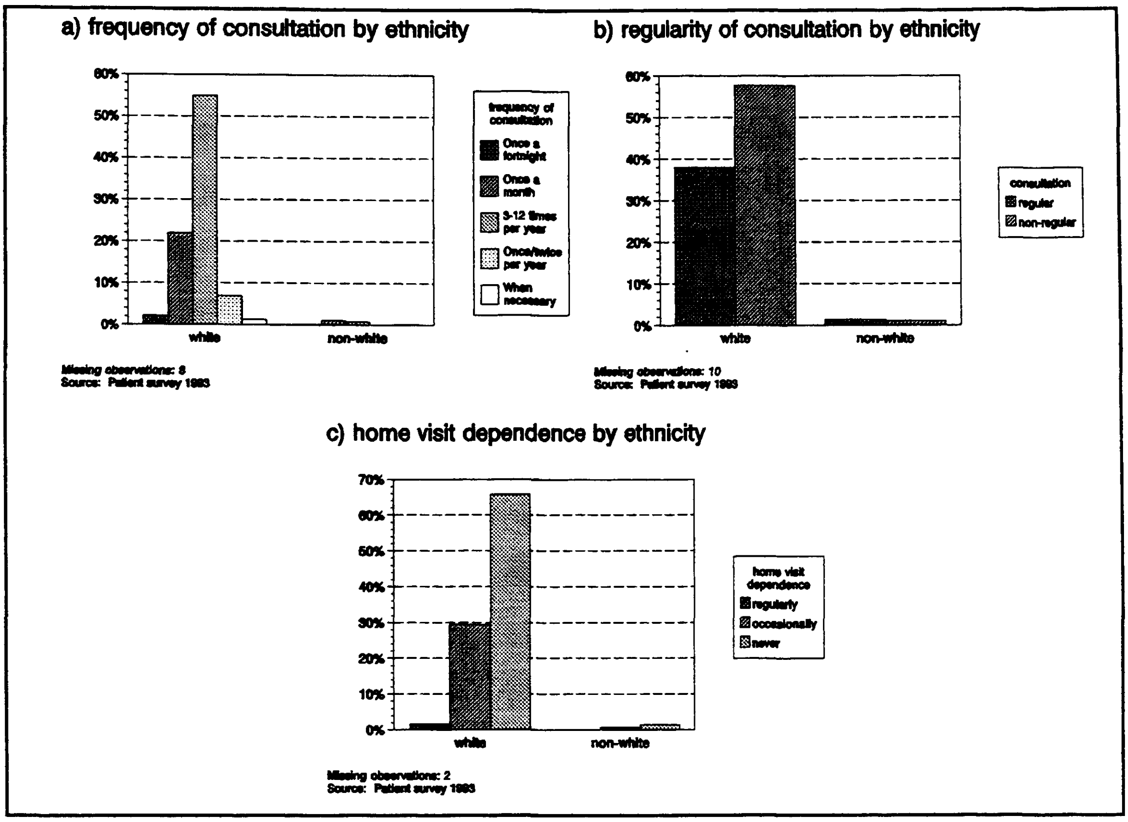
Influence of employment on mobility characteristics



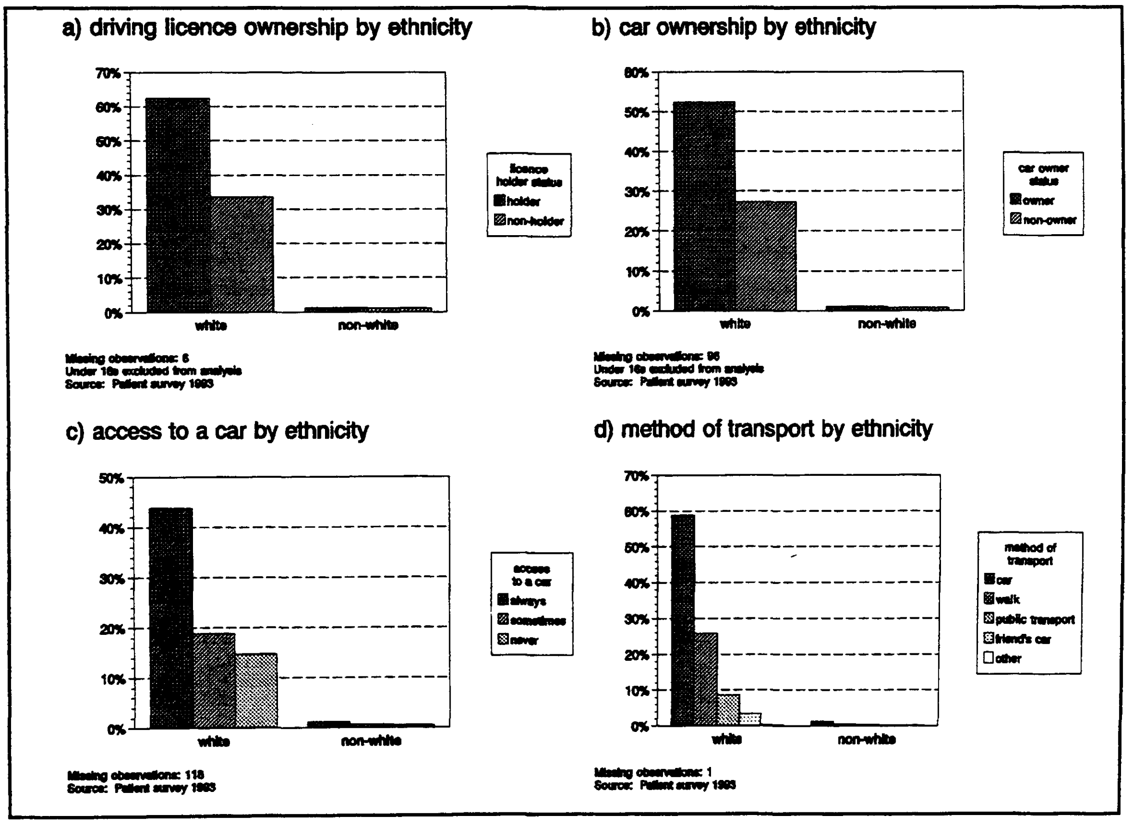
Influence of employment status on obstacles to accessibility



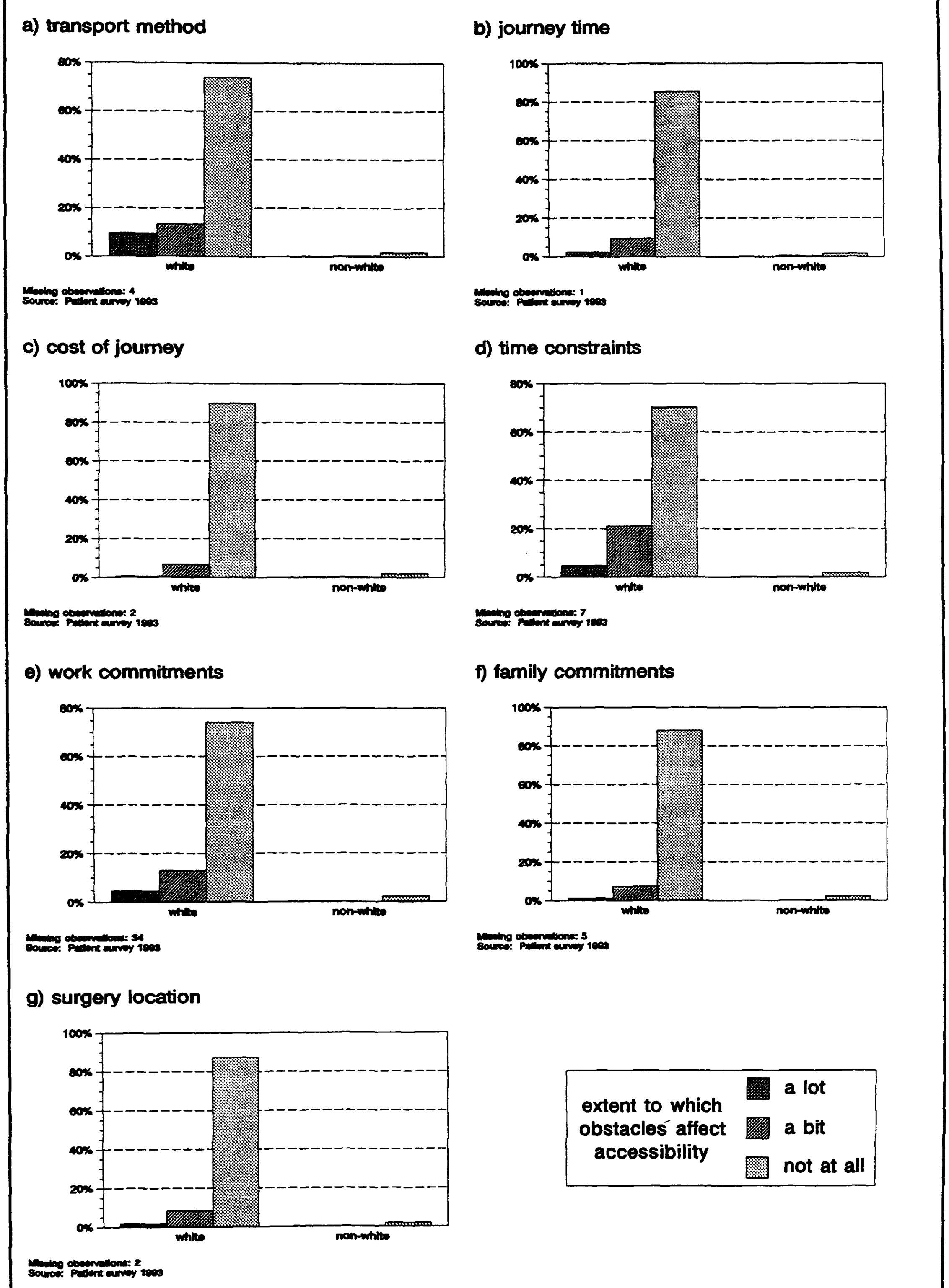
Influence of ethnicity on utilization behaviour



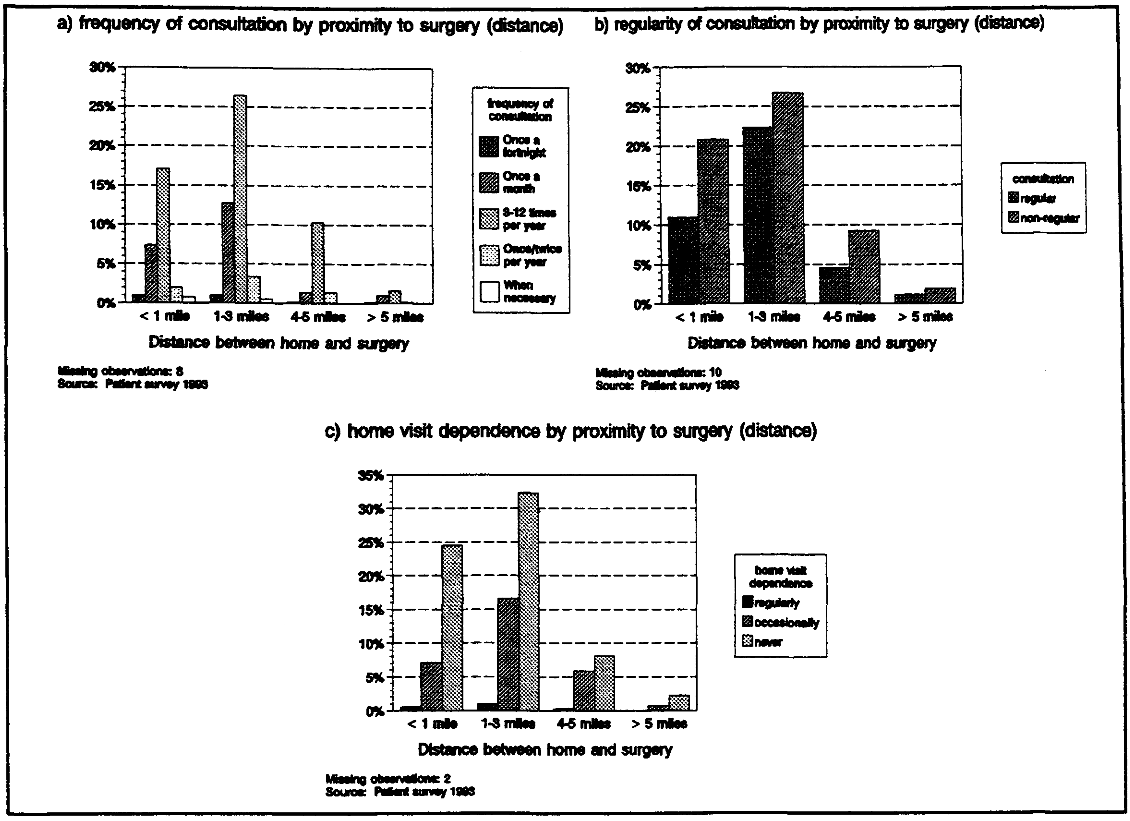
Influence of ethnicity on mobility characteristics



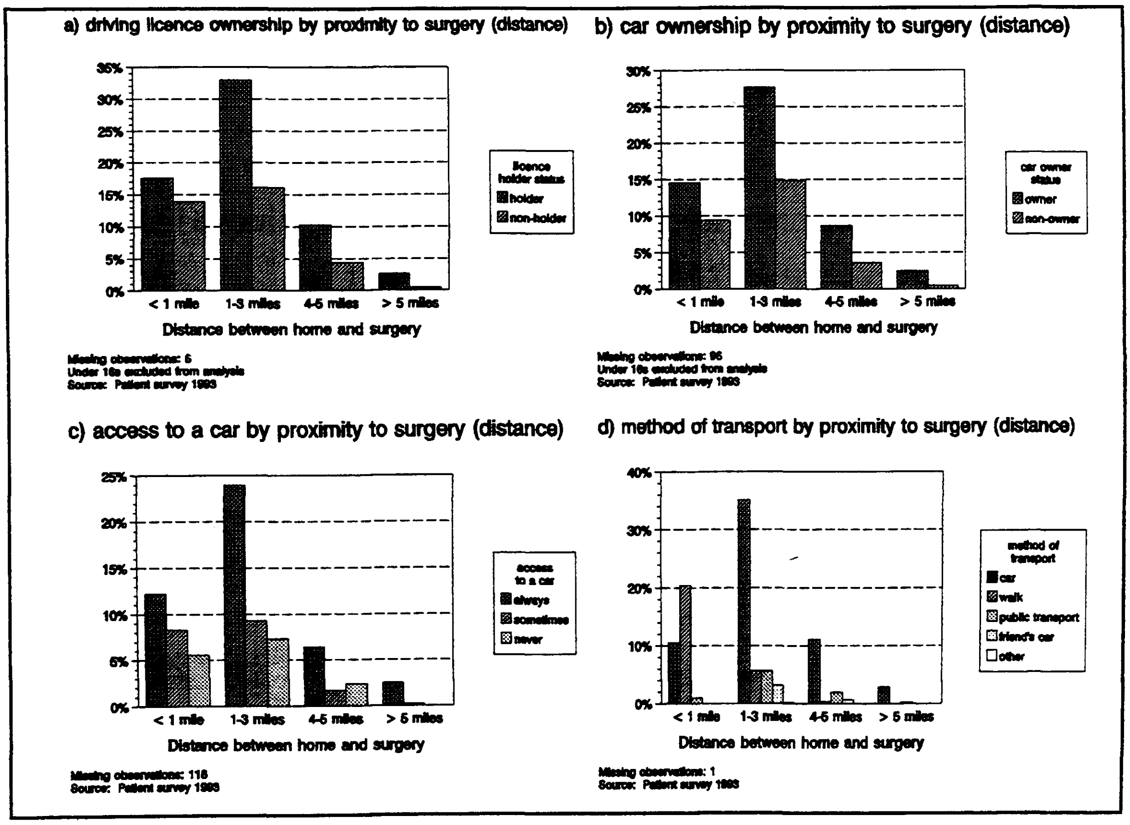
Influence of ethnicity on obstacles to accessibility



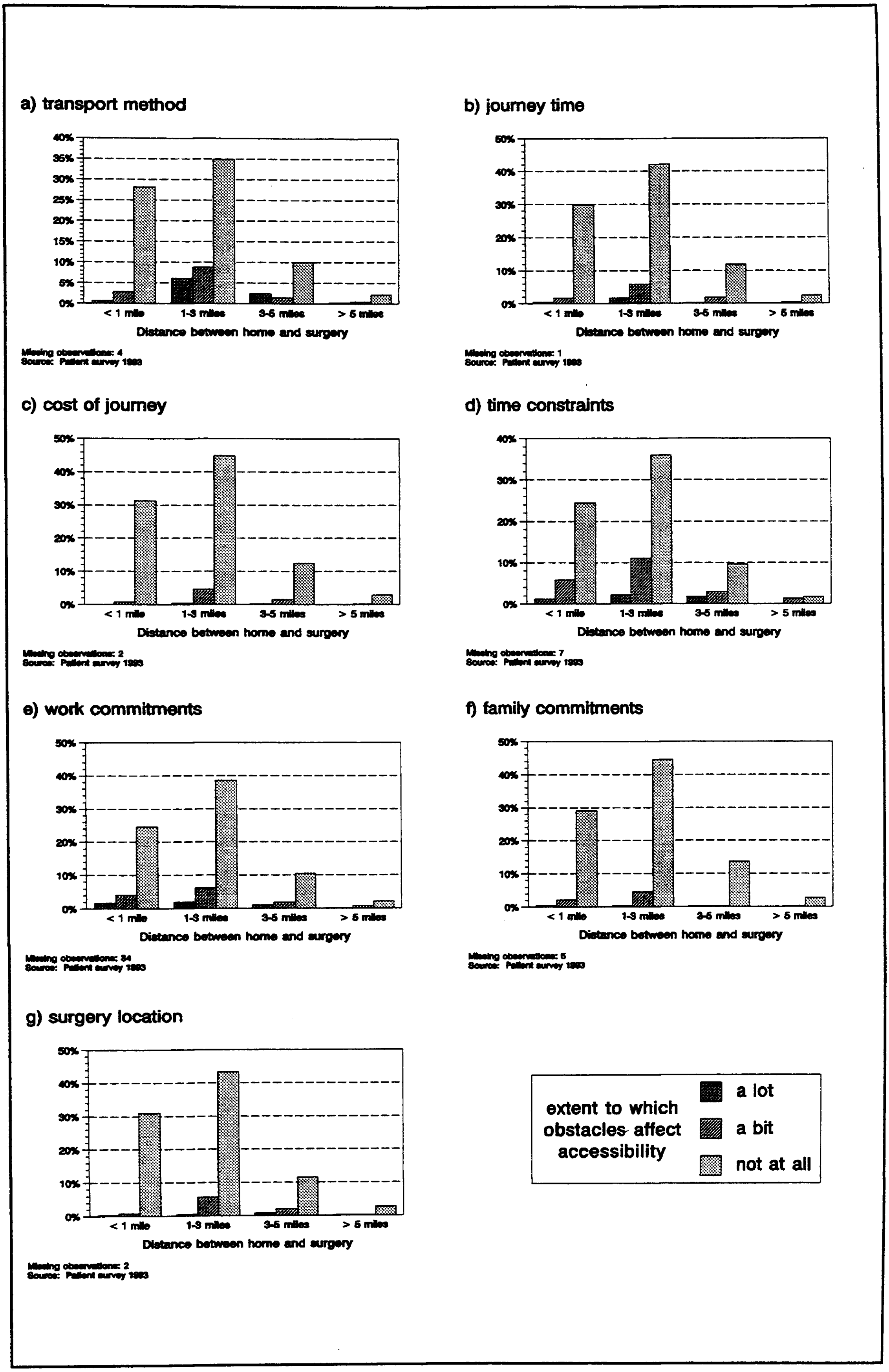
Influence of proximity to surgery (distance) on utilization behaviour



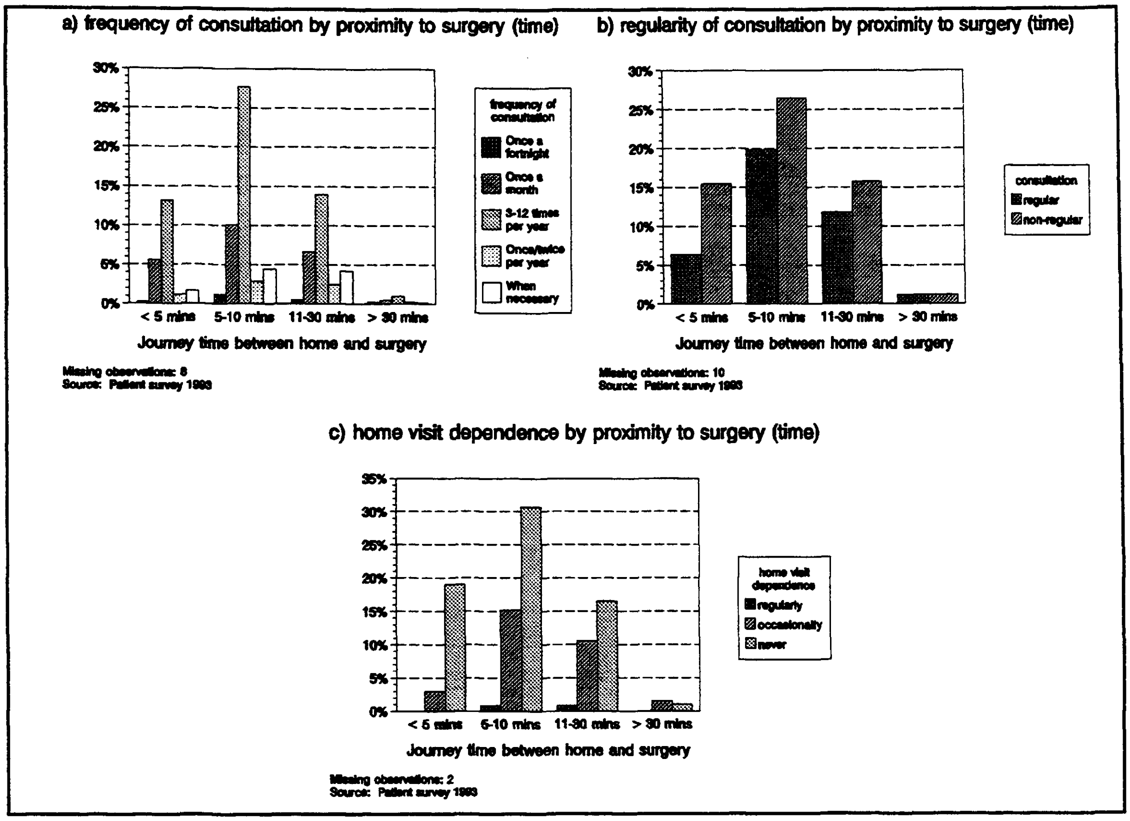
Influence of proximity to surgery (distance) on mobility characteristics



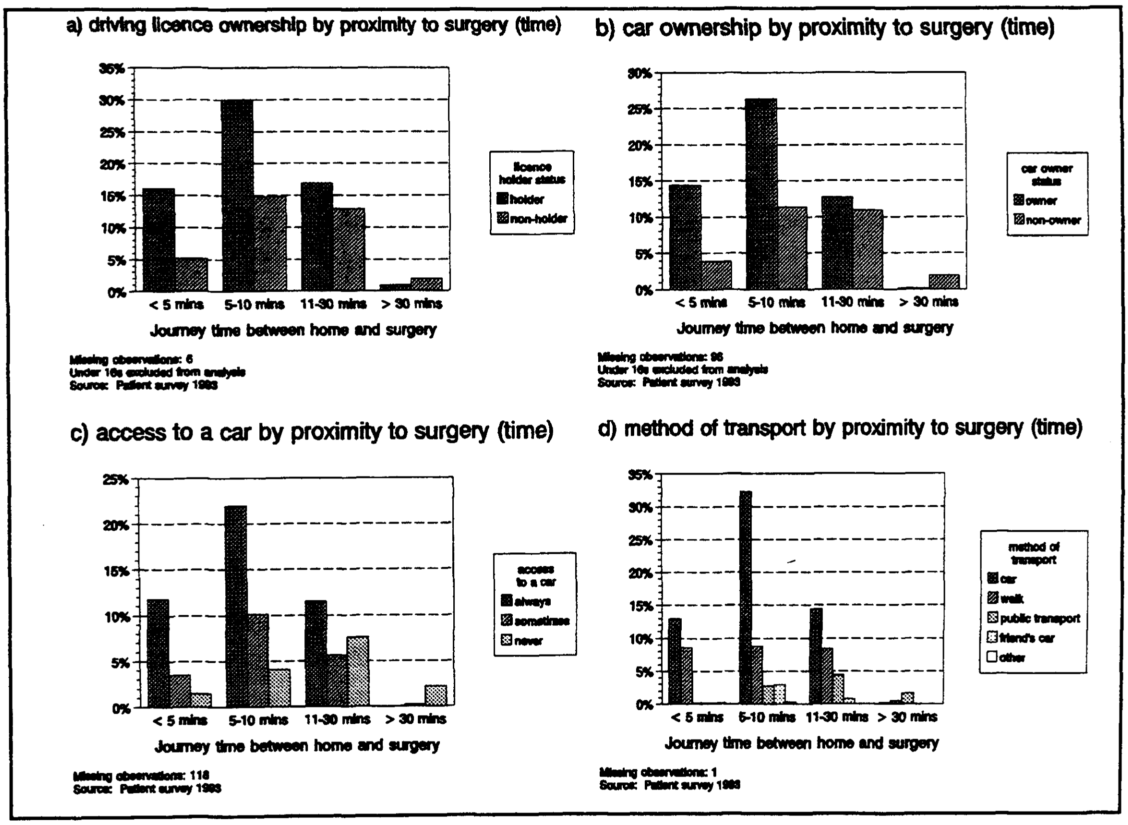
Influence of proximity to surgery (distance) on obstacles to accessibility



Influence of proximity to surgery (time) on utilization behaviour

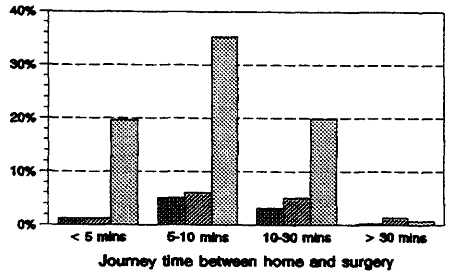


Influence of proximity to surgery (time) on mobility characteristics



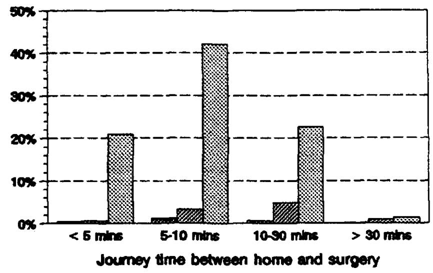
Influence of proximity to surgery (time) on obstacles to accessibility

a) transport method



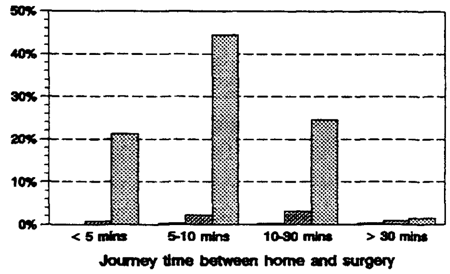
Missing observations: 4
Source: Patient survey 1993

b) journey time



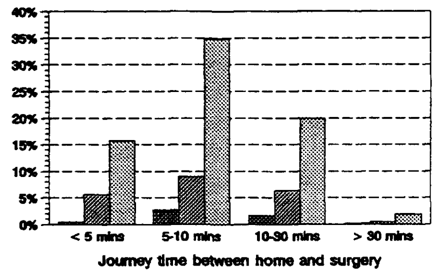
Missing observations: 1
Source: Patient survey 1993

c) cost of journey



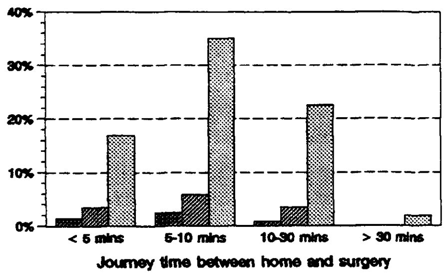
Missing observations: 2
Source: Patient survey 1993

d) time constraints



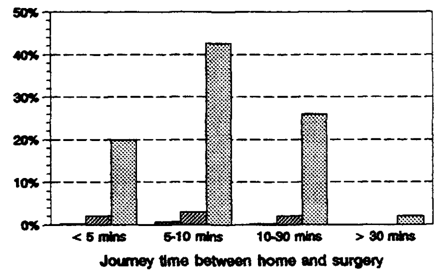
Missing observations: 7
Source: Patient survey 1993

e) work commitments



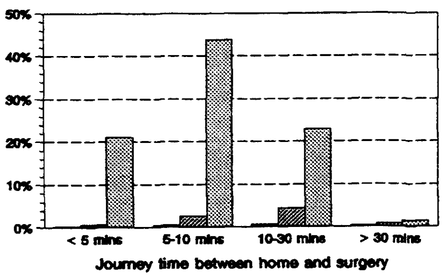
Missing observations: 34
Source: Patient survey 1993

f) family commitments

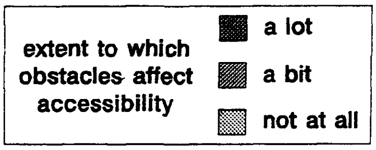


Missing observations: 5
Source: Patient survey 1993

g) surgery location



Missing observations: 2
Source: Patient survey 1993



APPENDIX 3

Generic data manipulation

i. Boundary data

The spatial data relating to the ED boundaries for the NDHA area is represented by a polygon coverage. ED boundary data was made available by the NDHA, in a digital format, for an area larger than the County of Northamptonshire. The coverage was created as follows:

- Import Northamptonshire boundary data file into Arc/Info
- BUILD coverage topology
- Extract EDs which fall within NDHA area to create coverage NDHAED
- Add attribute information to the PAT

A coverage of ED centroids (NDHAEDC), represented as points, was subsequently created to be used in further analyses. This coverage indicated the geometric centre of each ED with attribute data being maintained.

Spatial data coverages for NDHA ward, district and boundary scales of analysis were created from the ED coverage. The polygon coverages were created as follows:

- DISSOLVE the ED coverage based on ward, district or boundary attributes in the PAT to create a ward data file (NDHAW), district data file (NDHAD) and outline data file (NDHAO).
- Attributes relating to ward and district codes were maintained in new PATs.

ii 1991 Census of population

The spatial data coverages each have an associated attribute table. These attribute tables contain 'items' which are used to perform relational 'joins' to other attribute tables. In this way, attribute information is maintained in separate attribute tables representing particular themes of information which can be joined to each other as and when required. This allows a clearly structured database to be maintained. Arc/Info maintains attribute data in dBase (.DBF) format and allows relational joins based on common 'items' being present in each attribute table. Consequently, attribute data can be joined to spatial data for subsequent visualisation and analysis.

The data derived from the 1991 census of population did not require any specific GIS operations. The only requirement of its collection was that it should be extracted in a format which Arc/Info can read. Data was extracted from CD-ROM in Microsoft EXCEL (.XLS) format and subsequently exported in dBase (.DBF) format for use in Arc/Info. The maintenance of ED codes as item names ensured compatability with boundary data.

iii. Topographic data sets

The road network is represented by an arc spatial coverage containing linear information relating to the roads within the NDHA area, including distance of each arc (in metres), road order and average driving speeds (to allow estimation of travel time per arc length). The road network was derived from the Bartholomews 1:250000 digital dataset of Great Britain (Arc/Info generate format). Information relating to the average driving speeds for given conditions and road types was based on those used in the commercially available routing software "Autoroute". The coverage was created as follows:

- Extract Bartholomews digital data set for National Grid 100km tile SP
- Generate Arc/Info coverages for spatial features in data set
- Use the RD data and BUILD arc coverage topology to create the coverage ROADS.
- CLIP only the roads within the area covered by NDHA
- Attribute data in the original data set is preserved. Driving speeds are added as items to the Arc Attribute Table (AAT).

The urban data set is derived from the same source at 1:250000 and the coverage is created as follows:

- Extract Bartholomews digital data set for National Grid 100km tile SP
- Generate Arc/Info coverages for spatial features in data set
- Use the UB data and BUILD polygon coverage topology to create the coverage URBAN.
- CLIP only the urban areas within the area covered by NDHA
- Attribute data in the original data set is preserved.

iv. Postcode data

Postcode data is used to provide a spatial reference for GPs and patients (from the patient survey). The GP spatial data is in the form of a point coverage representing the locations of all 50 GP surgeries in the NDHA area, based on the postcode of each surgery. The postcodes were manipulated using 'GB Profiler' software to derive the associated OSGR (accurate to 100m). The coverage was created as follows:

- Input GP postcodes to text file
- Import file into GB Profiler
    - Create ARC generate file of x, y coordinates
    - Create text file of spatial attributes associated with postcode
- BUILD GP point coverage (GP) in Arc/Info using ARC generate file
- JOIN spatial attribute text file to GP
- Add attribute data relating to practice characteristics derived from FHSA register and GP survey.

The patient spatial data is in the form of a point coverage representing the locations of the 592 patients who responded to the survey, based on the surgery postcode. The coverage was created as follows:

- Export patient postcodes from survey coded SPSS data to text file
- Import file into GB Profiler
    - Create ARC generate file of x, y coordinates
    - Create text file of spatial attributes associated with postcode
- BUILD patient point coverage (PT) in Arc/Info using ARC generate file
- JOIN spatial attribute text file to PT
- Add attribute data relating to patient characteristics derived from the patient survey.

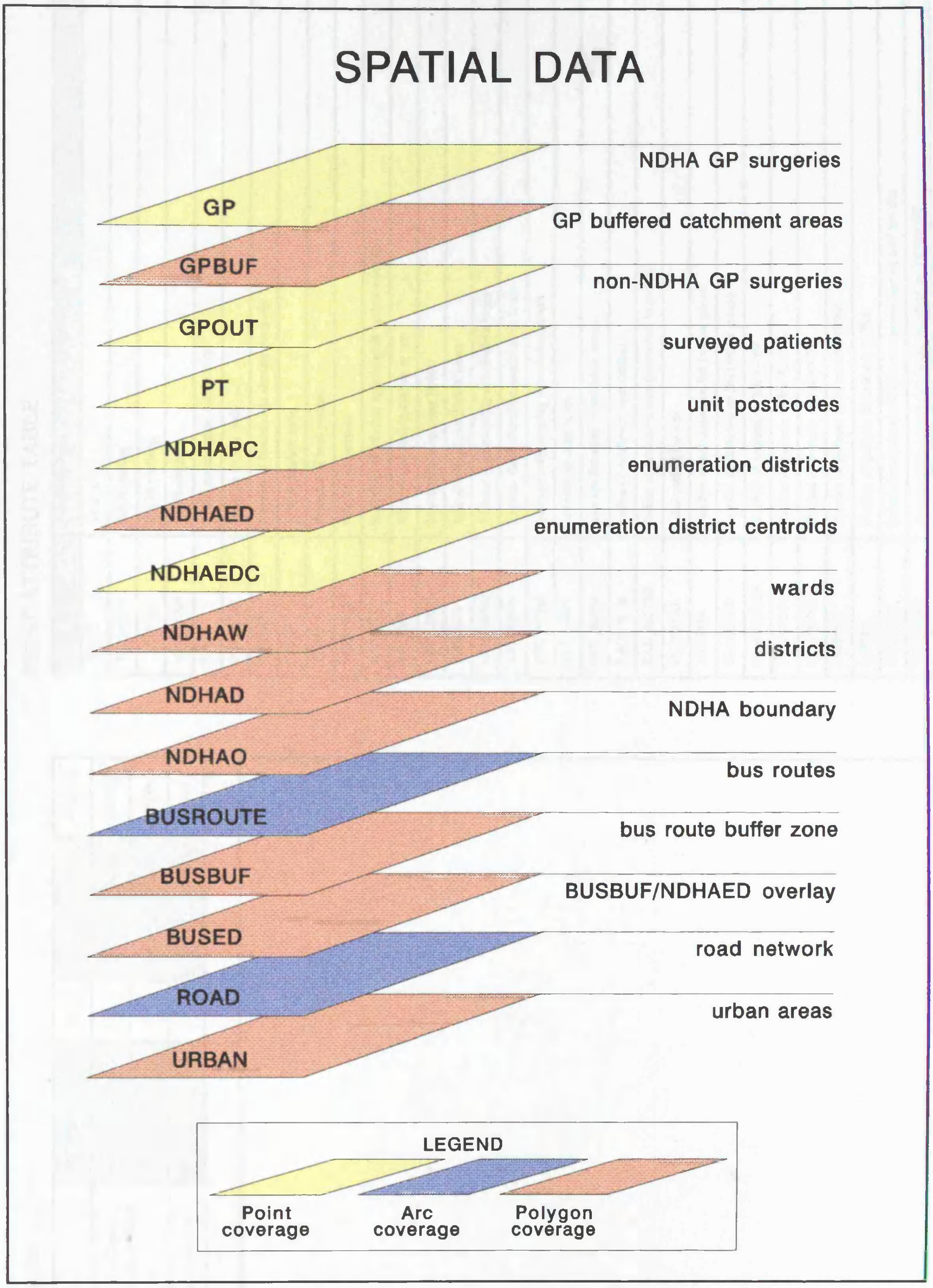
A spatial data set, in the form of a point coverage, representing the locations of all postcodes in the NDHA area was also created as follows:

- Create a text file of all postcodes in the NDHA area
- Import file into GB Profiler
    - Create ARC generate file of x, y coordinates
    - Create text file of spatial attributes associated with postcode
- BUILD postcode point coverage (NDHAPC) in Arc/Info using ARC generate file
- JOIN spatial attribute text file to NDHAPC
- Add attribute data derived from 'GB Profiler'.

APPENDIX 4

Database details

i. SPATIAL DATA



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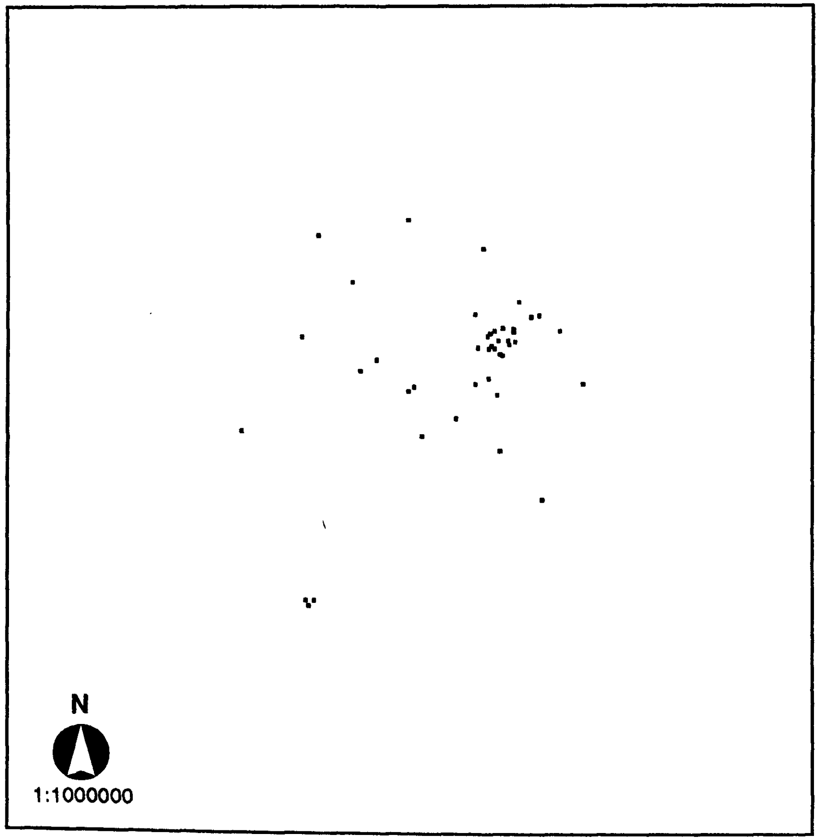
NDHA GP surgeries

COVERAGE	GP	POINTS		50	EXTENT	Xmin	451815.0
CONTENTS	A point coverage representing NDHA GPs	ARCS	Segments	0		Xmax	483759.0
			Nodes	0		Ymin	237006.0
ORIGIN	Surgery Postcode	POLYGONS		0		Ymax	273105.0

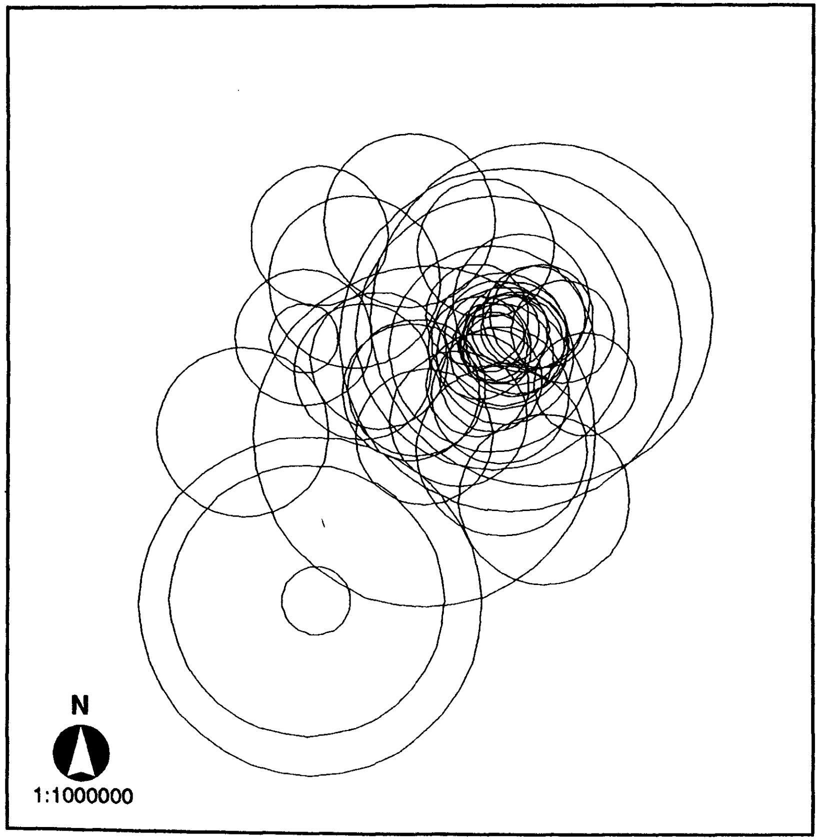


POINT ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
GP_ID	Internal ID
X_COORD	OSGR easting
Y_COORD	OSGR northing
POSTCODE	GP Postcode
ED	OPCS enumeration district code
CLUSTER	Lifestyle cluster code
HHOLD	Number of households sharing postcode
CODE	NDHA practice code
NAME	Surname of lead partner
PARTNERS	Number of partners
APPOINT	Indication of whether appointment system operates
SURVEY	Whether included in survey or not
SUR_OPEN	Average daily opening hours
SUR_HRS	Average daily consultation hours
MOR_SURG	Average daily morning consultation hours
AFT_SURG	Average daily afternoon consultation hours
EVE_SURG	Average daily evening consultation hours
SAT_OPEN	Saturday opening hours
SAT_SURG	Average Saturday consultation hours
RADIUS_M	Radius of catchment area (miles)
RAD_METRE	Radius of catchment area (converted to metres)
PL_TOTAL	Total patient list size
ASTHMA	Number of asthmatics on list (where given)
DIABETES	Number of diabetics on list (where given)
PL_64UNDER	Number of patients on list =< 64
PL_65TO74	Number of patients on list 65 to 74
PL_75OVER	Number of patients on list => 75
LISTOUT	Number of patients from outside NDHA
LISTIN	Number of patients from inside NDHA
PERCOUT	Patients from outside NDHA as a percentage of total list size
WTSURHR	Average daily consultation hours weighted by PERCOUT

GP buffered catchment areas

COVERAGE	GPBUF	POINTS		49	EXTENT	Xmin	442112.0
CONTENTS	A polygon coverage representing GP catchment areas	ARCS	Segments	3347		Xmax	495719.0
			Nodes	910		Ymin	221006.0
ORIGIN	GP coverage	POLYGONS		862		Ymax	281105.0

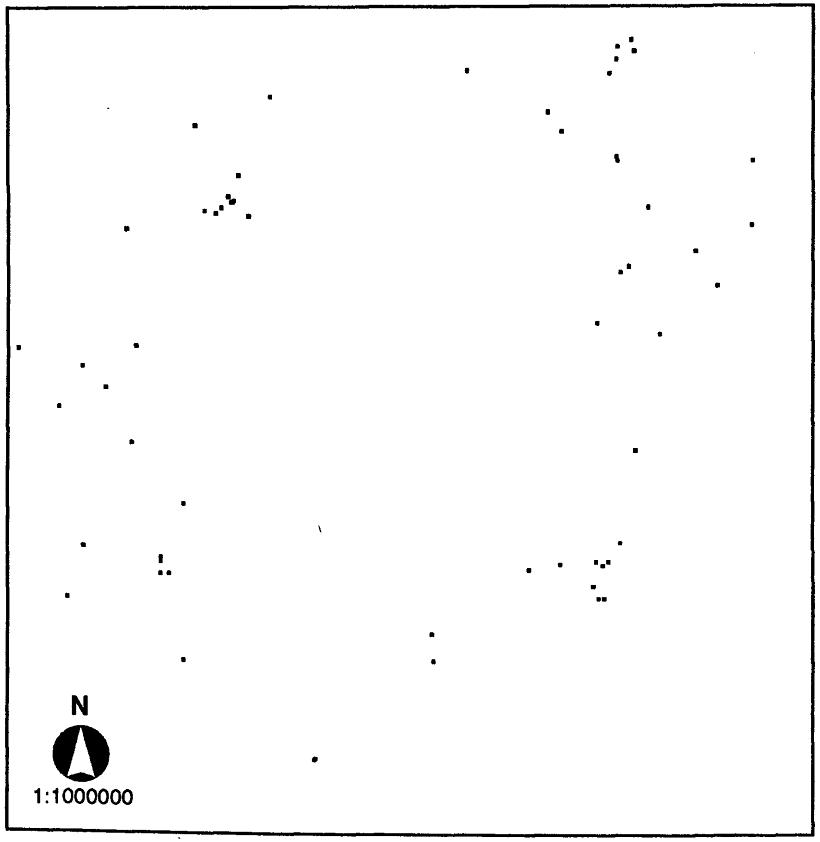


POLYGON ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
AREA	Area of polygon
PERIMETER	Perimeter distance of polygon
GPBUF_ID	Internal ID
SURG	Total number of surgeries
GPS	Total number of GPs
HOURS	Total number of consultation hours

Non-NDHA GP surgeries

COVERAGE	GPOUT	POINTS		76	EXTENT	Xmin	430974.0
CONTENTS	A point coverage of non-NDHA GPs	ARCS	Segments	0		Xmax	499704.0
			Nodes	0		Ymin	222543.0
ORIGIN	Surgery Postcode	POLYGONS		0		Ymax	289639.0



POINT ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
GPOUT_ID	Internal ID
X_COORD	OSGR easting
Y_COORD	OSGR northing
POSTCODE	GP Postcode
DHA	District Health Authority provider

Surveyed patients

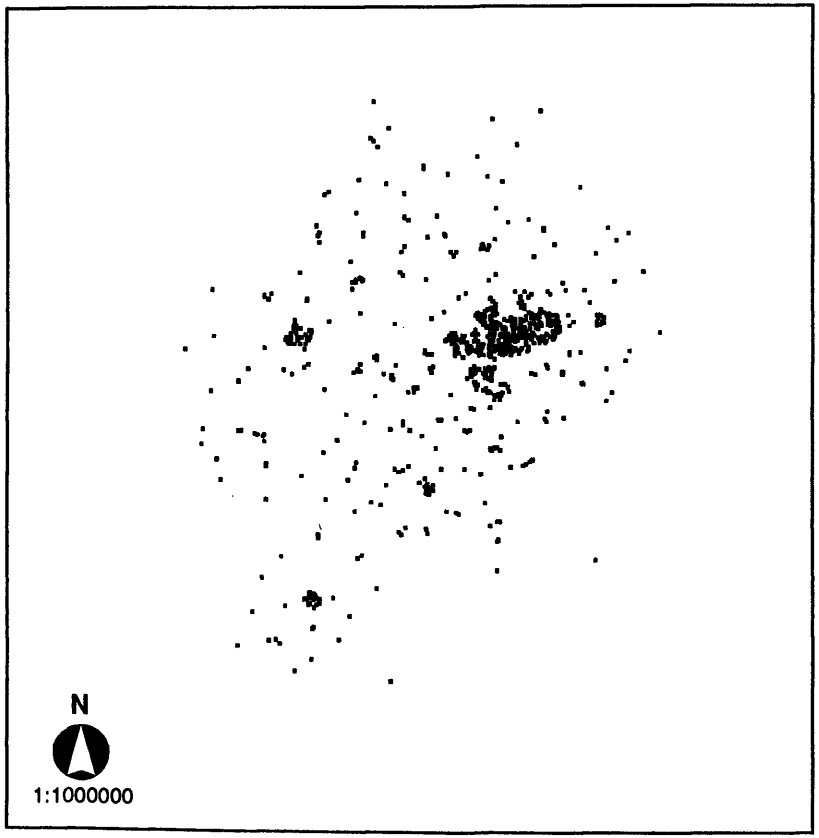
COVERAGE	PT	POINTS		576	EXTENT	Xmin	453709.0
CONTENTS	A point coverage of the surveyed patients	ARCS	Segments	0		Xmax	482392.0
			Nodes	0		Ymin	234865.0
ORIGIN	Patient Postcode	POLYGONS		0		Ymax	273160.0

POINT ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
PT_ID	Internal ID	Q26	Coded reponse to question
X_COORD	OSGR easting	Q27	Coded reponse to question
Y_COORD	OSGR northing	Q28	Coded reponse to question
POSTCODE	Patient Postcode	Q29	Coded reponse to question
ED	OPCS enumeration district code	Q30	Coded reponse to question
CLUSTER	Lifestyle cluster code	Q31	Coded reponse to question
HHOLD	Households sharing postcode	Q32	Coded reponse to question
GP	NDHA practice code of GP	Q33	Coded reponse to question
ASTHMA	Whether diagnosed as asthmatic	Q34	Coded reponse to question
DIABETES	Whether diagnosed as diabetic	Q35	Coded reponse to question
AGE	Age of patient	Q36	Coded reponse to question
SEX	Sex of patient	Q37	Coded reponse to question
SOC_CLASS	Social class of patient		
EMPLOYED	Employment status of patient		
ETHNICITY	Ethnic origin of patient		
Q9	Coded response to question		
Q10	Coded response to question		
Q11	Coded response to question		
Q12	Coded response to question		
Q13	Coded response to question		
Q14	Coded response to question		
Q15	Coded response to question		
Q16	Coded response to question		
Q17	Coded response to question		
Q18	Coded response to question		
Q19	Coded response to question		
Q20	Coded response to question		
Q21	Coded response to question		
Q22	Coded response to question		
Q23	Coded response to question		
Q25	Coded response to question		

Unit Postcodes

COVERAGE	NDHAPC	POINTS		7203	EXTENT	Xmin	446526.0
CONTENTS	A point coverage representing unit postcodes in NDHA	ARCS	Segments	0		Xmax	490964.0
			Nodes	0		Ymin	229721.0
ORIGIN	CPD file	POLYGONS		0		Ymax	284064.0

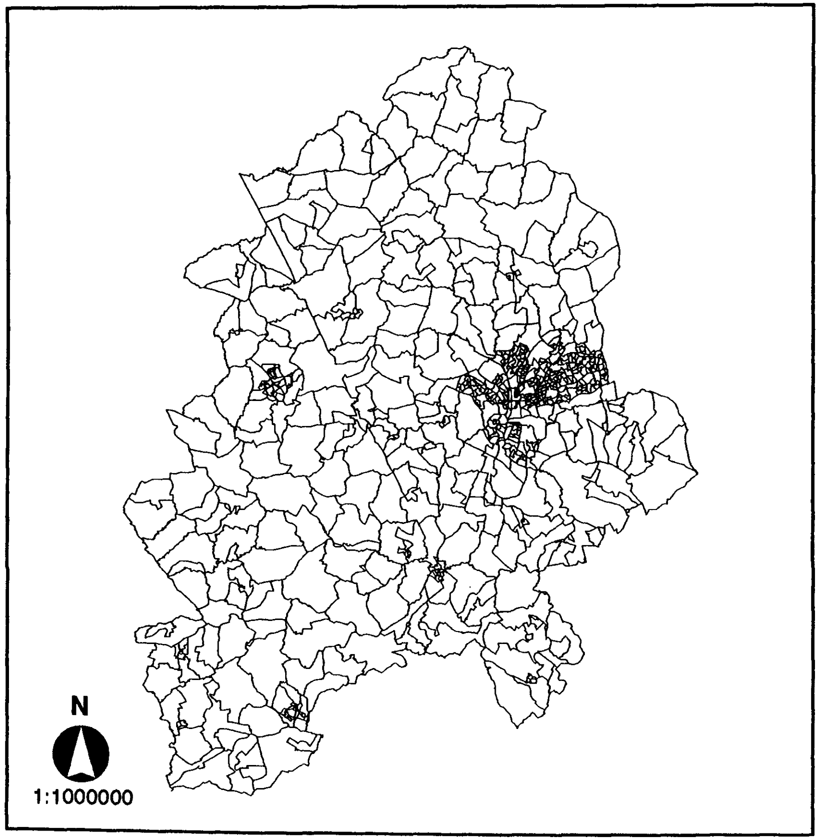


POINT ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
NDHAPC_ID	Internal ID
X_COORD	OSGR easting
Y_COORD	OSGR northing
POSTCODE	Postcode
ED	OPCS enumeration district code
CLUSTER	Lifestyle cluster code
HHOLD	Number of households sharing postcode

Enumeration districts

COVERAGE	NDHAED	POINTS		700	EXTENT	Xmin	445754.0
CONTENTS	A polygon coverage representing NDHA enumeration districts	ARCS	Segments	12099		Xmax	488613.0
			Nodes	1668		Ymin	231296.0
ORIGIN	CACI digital data	POLYGONS		701		Ymax	287128.0

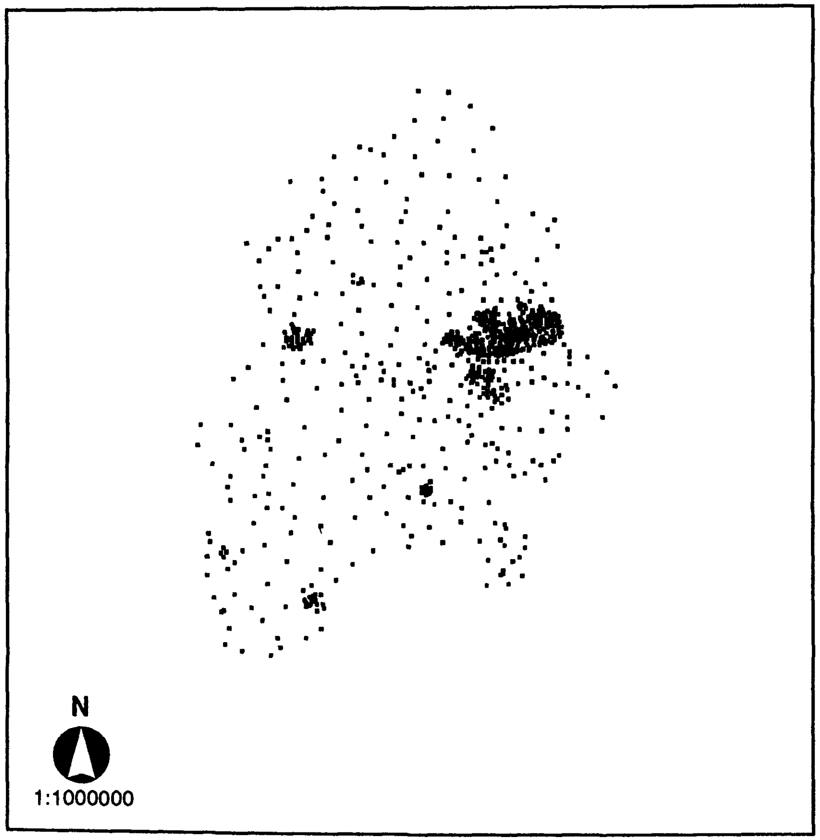


POLYGON ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
AREA	Area of polygon
PERIMETER	Perimeter distance of polygon
NDHAED_ID	Internal ID
DISTRICT	OPCS district code
WARD	OPCS ward code
ED	OPCS enumeration district code

Enumeration district centroids

COVERAGE	NDHAEDC	POINTS		700	EXTENT	Xmin	445754.0
CONTENTS	A point coverage representing ED centroids	ARCS	Segments	12099		Xmax	488613.0
			Nodes	1668		Ymin	231296.0
ORIGIN	NDHAED coverage	POLYGONS		701		Ymax	287128.0

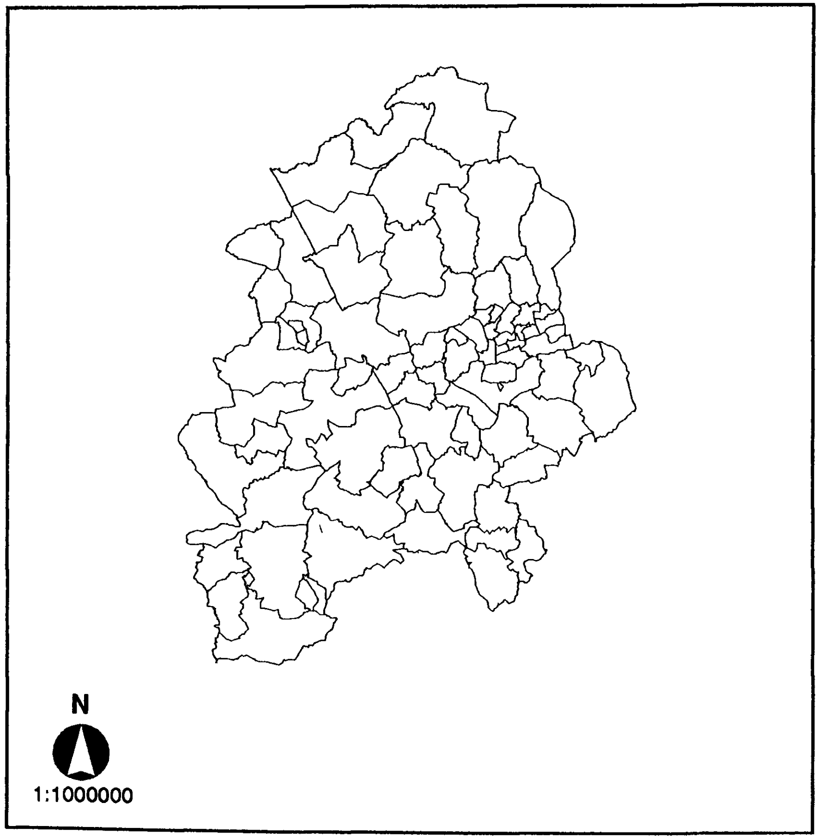


POINT ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
NDHAEDC_ID	Internal ID
GP_	Internal ID of nearest point in GP coverage (point to point)
ED	OPCS enumeration district code
GP_DIST	Distance to GP_ (point to point)
NODE_	Internal ID of nearest node in ROAD coverage
NODE_DIST	Distance to NODE_
GPNODE_	Internal ID of nearest node to GP_ in ROAD coverage
GPNODE_DIS	Distance between GP_ and GPNODE_
ROAD_	Internal ID of nearest arc in ROAD coverage
DISTANCE	Distance to ROAD_
NDHAPC_	Internal ID of nearest point in NDHAPC coverage
NODENODE	Distance from NODE_ to GPNODE_
TOTDIST	Total distance between ED centroid and nearest GP surgery by road

Wards

COVERAGE	NDHAW	POINTS		0	EXTENT	Xmin	445754.0
CONTENTS	A polygon coverage representing NDHA wards	ARCS	Segments	5841		Xmax	488613.0
			Nodes	1005		Ymin	231296.0
ORIGIN	NDHAED coverage	POLYGONS		80		Ymax	287128.0

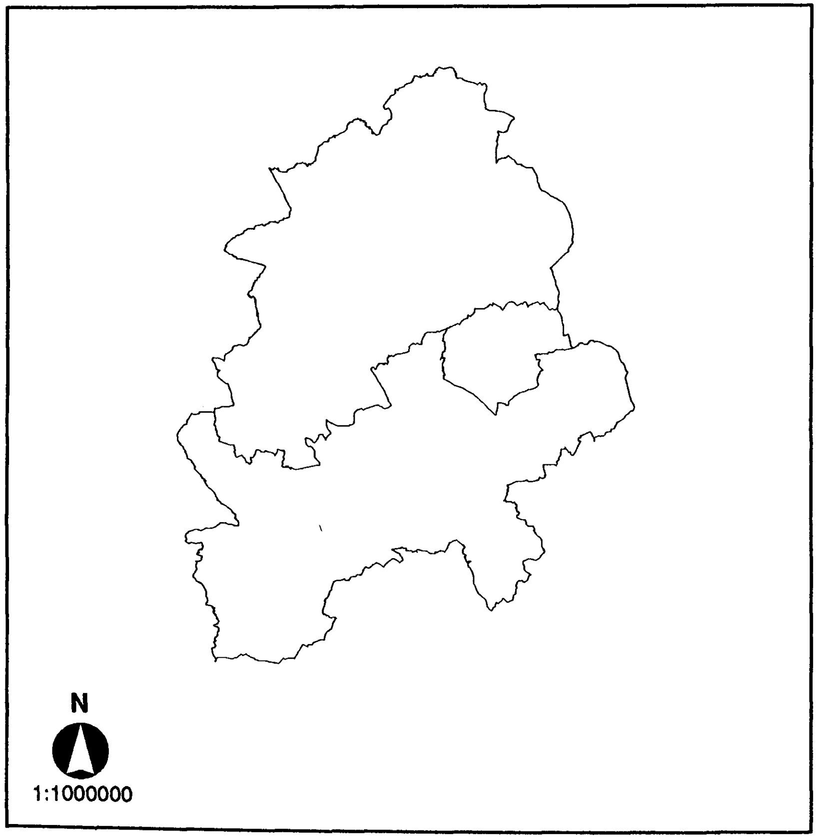


POLYGON ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
AREA	Area of polygon
PERIMETER	Perimeter distance of polygon
NDHAW_ID	Internal ID
DISTRICT	OPCS district code
WARD	OPCS ward code

Districts

COVERAGE	NDHAD	POINTS		0	EXTENT	Xmin	445754.0
CONTENTS	A polygon coverage representing NDHA districts	ARCS	Segments	2229		Xmax	488613.0
			Nodes	455		Ymin	231296.0
ORIGIN	NDHAED coverage	POLYGONS		4		Ymax	287128.0

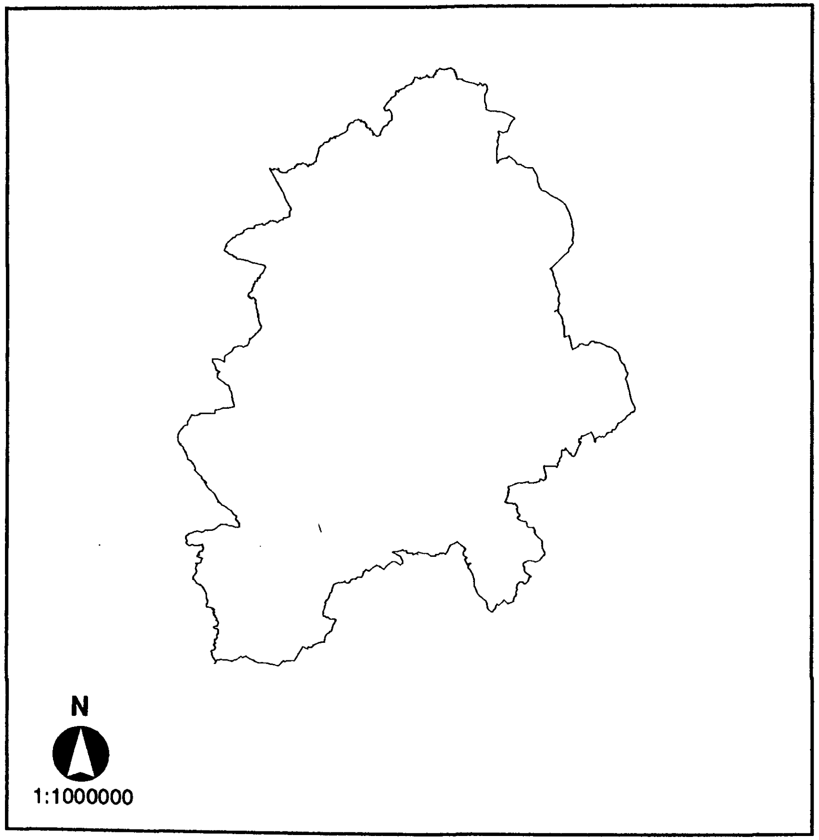


POLYGON ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
AREA	Area of polygon
PERIMETER	Perimeter distance of polygon
NDHAD_ID	Internal ID
DISTRICT	OPCS district code

NDHA boundary

COVERAGE	NDHAO	POINTS		0	EXTENT	Xmin	445754.0
CONTENTS	A polygon coverage representing the NDHA boundary	ARCS	Segments	1574		Xmax	488613.0
			Nodes	4		Ymin	231296.0
ORIGIN	NDHAED coverage	POLYGONS		2		Ymax	287128.0

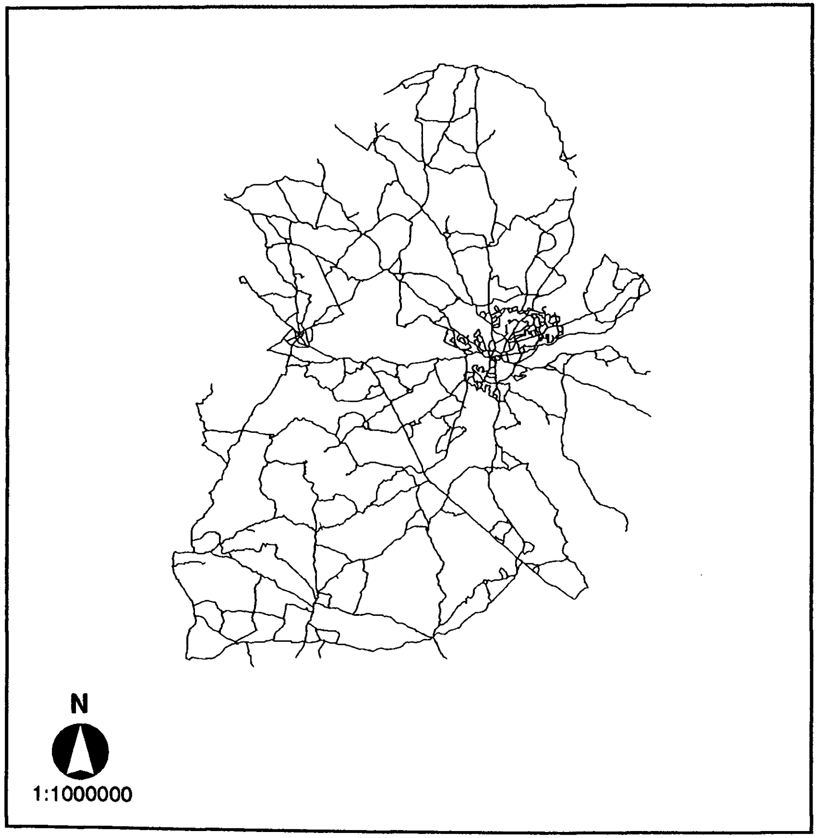


POLYGON ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
AREA	Area of polygon
PERIMETER	Perimeter distance of polygon
NDHAO_ID	Internal ID
DISTRICT	OPCS district code

Bus routes

COVERAGE	BUSROUTE	POINTS		0	EXTENT	Xmin	445311.0
CONTENTS	An arc coverage representing bus routes	ARCS	Segments	6232		Xmax	490000.0
			Nodes	0		Ymin	231000.0
ORIGIN	Manually digitized	POLYGONS		0		Ymax	287378.0



ARC ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
F_NODE	From node
T_NODE	To node
LENGTH	Length of arc
BUSROUTE_ID	Internal ID
FREQUENCY	Frequency of service

Bus route buffer zone

COVERAGE	BUSBUF	POINTS		111	EXTENT	Xmin	444811.0
CONTENTS	A polygon coverage representing 500m buffer zone	ARCS	Segments	7782		Xmax	490500.0
			Nodes	116		Ymin	230500.0
ORIGIN	BUSROUTE	POLYGONS		112		Ymax	287874.0

POLYGON ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
AREA	Area of polygon
PERIMETER	Perimeter distance of polygon
BUSBUF_ID	Internal ID
INSIDE	Code indicating buffer polygon

BUSBUF/NDHAED overlay

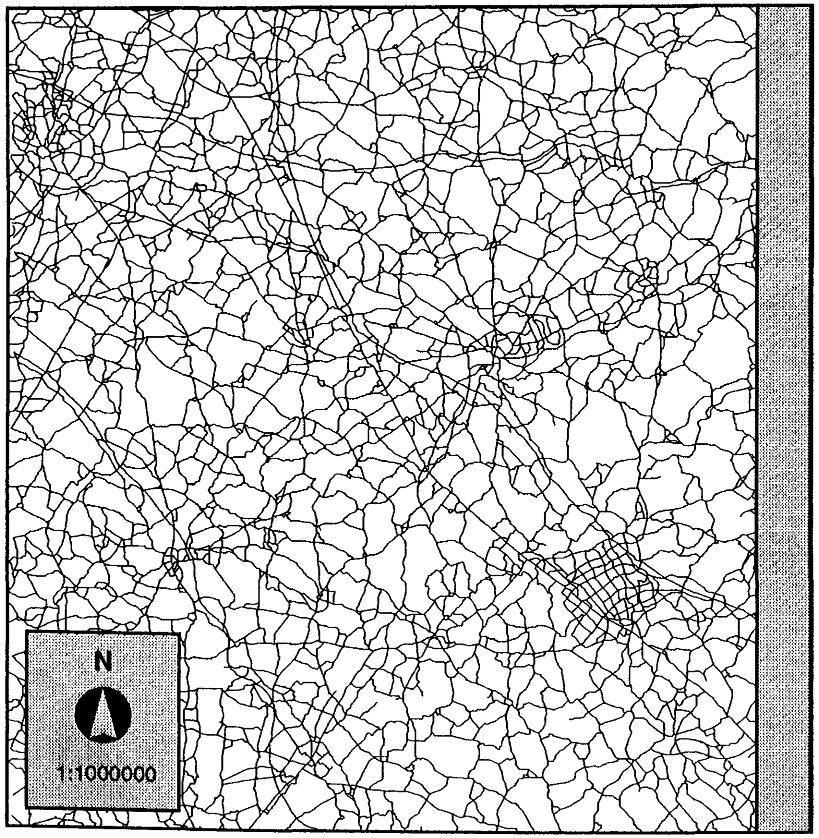
COVERAGE	BUSED	POINTS		1534	EXTENT	Xmin	444811.0
CONTENTS	A polygon coverage representing overlay operation	ARCS	Segments	21359		Xmax	490500.0
			Nodes	2608		Ymin	230500.0
ORIGIN	BUSBUF/NDHAED	POLYGONS		1535		Ymax	287874.0

POLYGON ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
AREA	Area of polygon
PERIMETER	Perimeter distance of polygon
BUSED_ID	Internal ID
BUSBUF_ID	Internal ID of coverage BUSBUF
INSIDE	Code indicating buffer polygon
NDHAED_ID	Internal ID of NDHAED
DISTRICT	OPCS district code
WARD	OPCS ward code
ED	OPCS enumeration district code

Road network

COVERAGE	ROAD	POINTS		0	EXTENT	Xmin	445944.0
CONTENTS	An arc coverage representing road network	ARCS	Segments	8116		Xmax	488459.0
			Nodes	1056		Ymin	231330.0
ORIGIN	Bartholomews data	POLYGONS		0		Ymax	287095.0

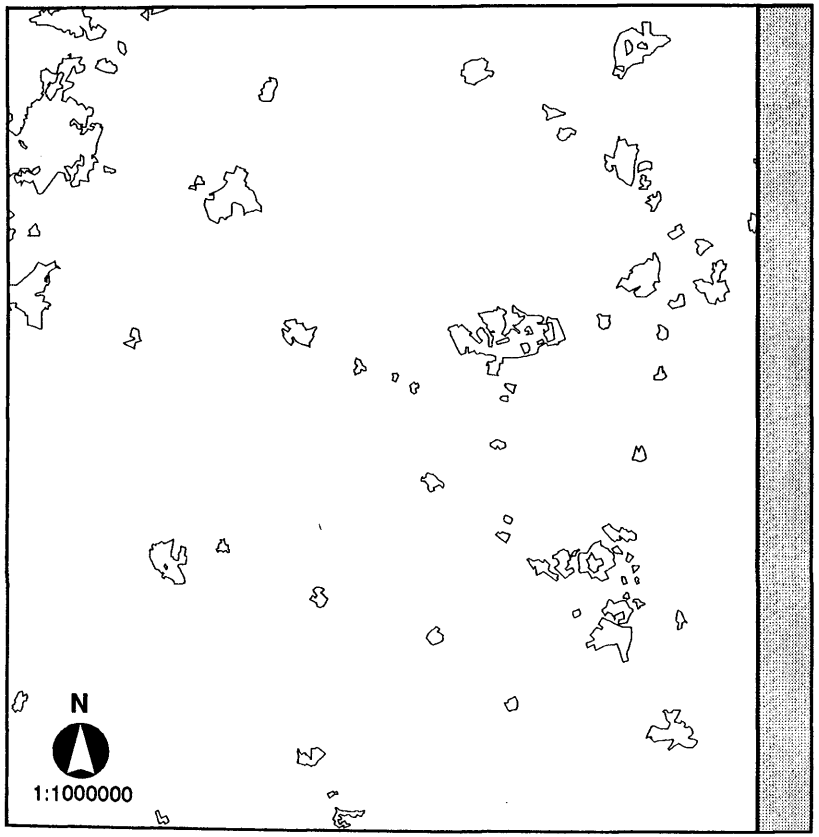


ARC ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
F_NODE	From node
T_NODE	To node
LENGTH	Length of arc
ROAD_ID	Internal ID
ROADCODE	Code indicating road classification

Urban areas

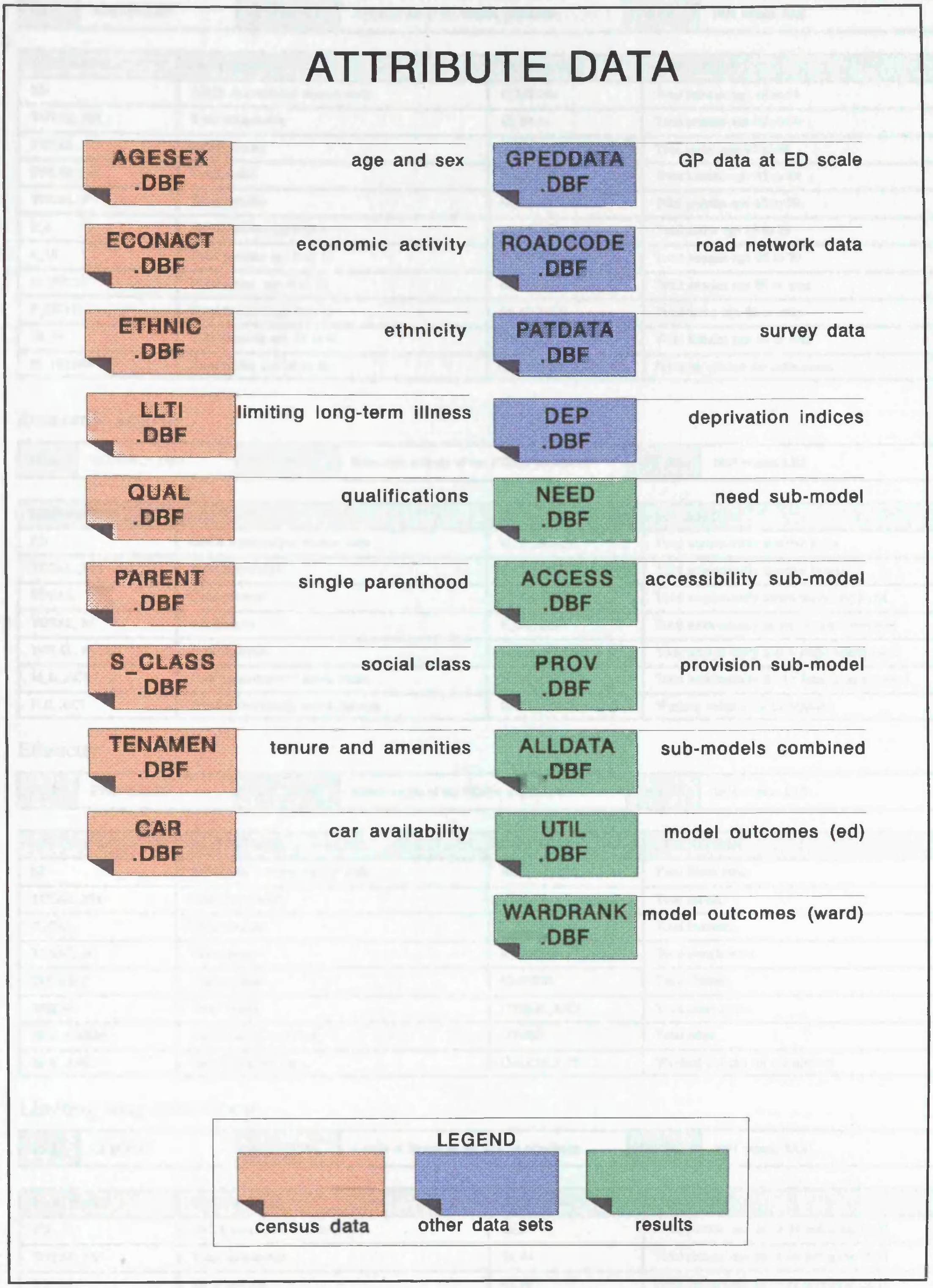
COVERAGE	URBAN	POINTS		21	EXTENT	Xmin	445754.0
CONTENTS	A polygon coverage representing urban areas	ARCS	Segments	2227		Xmax	488613.0
			Nodes	32		Ymin	231296.0
ORIGIN	Bartholomews data	POLYGONS		22		Ymax	287128.0



POLYGON ATTRIBUTE TABLE

ITEM NAME	DESCRIPTION
AREA	Area of polygon
PERIMETER	Perimeter distance of polygon
URBAN_ID	Internal ID
CODE	Urban area code
COMMENT	Annotation of place name

ii. ATTRIBUTE DATA



Age and sex

FILE	AGESEX.DBF	CONTENTS	Age and sex of the NDHA population	ORIGIN	1991 census SAS

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	F_16TO44	Total females age 16 to 44
TOTAL_HH	Total households	45_64	Total persons age 45 to 64
TOTAL	Total persons	M_45TO64	Total males age 45 to 64
TOTAL_M	Total males	F_45TO64	Total females age 45 to 64
TOTAL_F	Total females	65_79	Total persons age 65 to 79
0_4	Total persons age 0 to 4	M_65TO79	Total males age 65 to 79
0_15	Total persons age 0 to 15	F_65TO79	Total females age 65 to 79
M_0TO15	Total males age 0 to 15	80OVER	Total persons age 80 or over
F_0TO15	Total females age 0 to 15	M_80OVER	Total males age 80 or over
16_44	Total persons age 16 to 44	F_80OVER	Total females age 80 or over
M_16TO44	Total males age 16 to 44	CALCULATE	Working column for calculations

Economic activity

FILE	ECONACT.DBF	CONTENTS	Economic activity of the NDHA population	ORIGIN	1991 census LBS

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	M_E_INACT	Total economically inactive males
TOTAL_HH	Total households	F_E_INACT	Total economically inactive females
TOTAL	Total persons	M_EA_EMP	Total economically active males employed
TOTAL_M	Total males	F_EA_EMP	Total economically active females employed
TOTAL_F	Total females	M_EA_UNEMP	Total economically active males unemployed
M_E_ACT	Total economically active males	F_EA_UNEMP	Total economically active females unemployed
F_E_ACT	Total economically active females	CALCULATE	Working column for calculations

Ethnicity

FILE	ETHNIC.DBF	CONTENTS	Ethnic origin of the NDHA population	ORIGIN	1991 census SAS

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	BLK_OTHER	Total Black other
TOTAL_HH	Total households	INDIAN	Total Indian
TOTAL	Total persons	P_STANI	Total Pakistani
TOTAL_M	Total males	B_DESHI	Total Bangladeshi
TOTAL_F	Total females	CHINESE	Total Chinese
WHITE	Total White	OTHER_ASIA	Total other Asian
BLK_CARIB	Total Black Caribbean	OTHER	Total other
BLK_AFR	Total Black African	CALCULATE	Working column for calculations

Limiting long-term illness

FILE	LLTI.DBF	CONTENTS	Levels of illness in the NDHA population	ORIGIN	1991 census SAS

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	16_29	Total persons age 16 to 29 indicating LLTI
TOTAL_HH	Total households	30_44	Total persons age 30 to 44 indicating LLTI
TOTAL	Total persons	45_59	Total persons age 45 to 59 indicating LLTI
TOTAL_M	Total males	60_64	Total persons age 60 to 64 indicating LLTI
TOTAL_F	Total females	65_74	Total persons age 65 to 74 indicating LLTI
TOTAL_P	Total persons indicating LLTI	75OVER	Total persons age 70 or over indicating LLTI
0_15	Total persons age 0 to 15 indicating LLTI	CALCULATE	Working column for calculations

Qualifications

FILE	QUAL.DBF	CONTENTS	Qualification status of the NDHA population	ORIGIN	1991 census LBS

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	QUAL	Total persons with higher qualifications
TOTAL_HH	Total households	HIGHER	Total persons with higher degree qualification
TOTAL	Total persons	DEGREE	Total persons with degree qualification
TOTAL_M	Total males	DIPLOMA	Total persons with diploma qualification
TOTAL_F	Total females	CALCULATE	Working column for calculations
P18_OVER	Total persons age 18 or over		

Single parenthood

FILE	PARENT.DBF	CONTENTS	Parental status of the NDHA population	ORIGIN	1991 census SAS

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	1PARENT	Total 1 parent households
TOTAL_HH	Total households	CALCULATE	Working column for calculations

Social Class

FILE	S_CLASS.DBF	CONTENTS	Occupational Class of the NDHA population	ORIGIN	1991 census LBS

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	PP_IIIM	Total people occupational class IIIM
TOTAL_HH	Total households	HH_IV	Total households occupational class IV
TOTAL	Total persons	PP_IV	Total people occupational class IV
TOTAL_M	Total males	HH_V	Total households occupational class v
TOTAL_F	Total females	PP_V	Total people occupational class v
HH_I	Total households occupational class I	HH_O_ACT	Total households other active
PP_I	Total people occupational class I	PP_O_ACT	Total people other active
HH_II	Total households occupational class II	HH_RETIRED	Total households inactive (retired)
PP_II	Total people occupational class II	PP_RETIRED	Total people inactive (retired)
HH_IIIN	Total households occupational class IIIN	HH_O_INACT	Total households other inactive
PP_IIIN	Total people occupational class IIIN	PP_O_INACT	Total people other inactive
HH_IIIM	Total households occupational class IIIM	CALCULATE	Working column for calculations

Tenure and amenities

FILE	TENAMEN.DBF	CONTENTS	Housing tenure and amenities in NDHA area	ORIGIN	1991 census SAS

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	PP_PERM	Total persons in households all permanent
TOTAL_HH	Total households	PP_OWNOCC	Total persons in households owner occupied and buying
TOTAL	Total persons	PP_RENTPR	Total persons in households rented privately
TOTAL_M	Total males	PP_OTHRENT	Total persons in households other rented (HA/LA)
TOTAL_F	Total females	PP_NONPERM	Total persons in households non-permanent
HH_PERM	Total households all permanent	PP_NOHEAT	Total persons in households no central heating
HH_OWNOCC	Total households owner occupied and buying	PP_LACKING	Total persons in households lacking or sharing use of bath/shower and/or inside WC
HH_RENTPR	Total households rented privately	HHOVER1PPR	Total households with over 1 person per room
HH_OTHRENT	Total households other rented (HA/LA)	PPOVER1PPR	Total persons in households with over 1 person per room
HH_NONPERM	Total households non-permanent	LARENTED	Total households rented from Local Authority
HH_NOHEAT	Total households no central heating	CALCULATE	Working column for calculations
HH_LACKING	Total households lacking or sharing use of bath/shower and/or inside WC		

Car availability

FILE	CAR.DBF	CONTENTS	Car availability for the NDHA population	ORIGIN	1991 census SAS

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	HH_NOCAR	Total households no car
TOTAL_HH	Total households	HH_1CAR	Total households 1 car
TOTAL	Total persons	HH_2CAR	Total households 2 cars
TOTAL_M	Total males	HH_3PLUS	Total households 3 or more cars
TOTAL_F	Total females	CALCULATE	Working column for calculations

GP data

FILE	GPEDDATA.DBF	CONTENTS	GP data calculated for enumeration districts	ORIGIN	NDHA/Northants FHSA

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	T_PART	Total GPs available to ED
NDHAED_ID	Internal ID of coverage NDHAED	T_WTSUR	Total consultation hours available to ED (weighted for cross-boundary flow)
TOTAL	Total persons	KNOXSURG	Distance decay function applied to T_WTSUR
T_SURGER	Total surgeries available to ED	NEARGPOUT	Code for EDs whose nearest GP is outside NDHA

Road network data

FILE	ROADCODE.DBF	CONTENTS	Classified road types and average speeds	ORIGIN	Bartholomews data

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ROADCODE	Code identifying road classification	SLOW	Average driving speed in slow traffic
TYPE	Description of road classification	URBAN	Average driving speed in urban area
NORMAL	Average driving speed	SLOW_URBAN	Average driving speed in slow urban area

Survey data

FILE	PATDATA.DBF	CONTENTS	Coded response from patient survey	ORIGIN	Patient survey

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
GP	NDHA practice code of GP	Q19	Coded response to question
POSTCODE	Patient Postcode	Q20	Coded response to question
ASTHMA	Whether diagnosed as asthmatic	Q21	Coded response to question
DIABETES	Whether diagnosed as diabetic	Q22	Coded response to question
AGE	Age of patient	Q23	Coded response to question
SEX	Sex of patient	Q25	Coded response to question
SOC_CLASS	Social class of patient	Q26	Coded response to question
EMPLOYED	Employment status of patient	Q27	Coded response to question
ETHNICITY	Ethnic origin of patient	Q28	Coded response to question
Q9	Coded response to question	Q29	Coded response to question
Q10	Coded response to question	Q30	Coded response to question
Q11	Coded response to question	Q31	Coded response to question
Q12	Coded response to question	Q32	Coded response to question
Q13	Coded response to question	Q33	Coded response to question
Q14	Coded response to question	Q34	Coded response to question
Q15	Coded response to question	Q35	Coded response to question
Q16	Coded response to question	Q36	Coded response to question
Q17	Coded response to question	Q37	Coded response to question
Q18	Coded response to question		

Deprivation indices

FILE	DEP.DBF	CONTENTS	Deprivation indices for NDHA area (wards)	ORIGIN	Calculated from census data

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
WARD	OPCS ward code	ILC	Index of Local Conditions
JARMAN	Jarman UPA 8 score	YPSI	Young Persons Support Index
TOWNSEND	Townsend Deprivation Index score		

Note: The following database files contain results only. They do not contain data used during calculation steps.

Need sub-model

FILE	NEED.DBF	CONTENTS	Measures of need	ORIGIN	Calculated from database

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	N8	Calculated x^2 value for indicator N8
N1	Calculated x^2 value for indicator N1	N9	Calculated x^2 value for indicator N9
N2	Calculated x^2 value for indicator N2	N10	Calculated x^2 value for indicator N10
N3	Calculated x^2 value for indicator N3	HEALTH	Composite score for health status
N4	Calculated x^2 value for indicator N4	SOCECON	Composite score for social and economic disadvantage
N5	Calculated x^2 value for indicator N5	ENV	Composite score for environment
N6	Calculated x^2 value for indicator N6	NEED	Overall composite score for need
N7	Calculated x^2 value for indicator N7		

Accessibility sub-model

FILE	ACCESS.DBF	CONTENTS	Measures of accessibility	ORIGIN	Calculated from database

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	A7	Calculated x^2 value for indicator A7
A1	Calculated x^2 value for indicator A1	A8	Calculated x^2 value for indicator A8
A2	Calculated x^2 value for indicator A2	TRANSP	Composite score for transport availability
A3	Calculated x^2 value for indicator A3	PERMOB	Composite score for personal mobility
A4	Calculated x^2 value for indicator A4	AWARE	Composite score for service awareness
A5	Calculated x^2 value for indicator A5	ACCESS	Overall composite score for accessibility
A6	Calculated x^2 value for indicator A6		

Provision sub-model

FILE	PROV.DBF	CONTENTS	Measure of provision	ORIGIN	Calculated from database

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	PROVIS	Overall calculated score for provision

Sub-model data combined

FILE	ALLDATA.DBF	CONTENTS	Combined results from all three sub-models	ORIGIN	NEED.DBF/ACCESS.DBF/PROV.DBF

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	NEED	Overall composite score for need
N1	Calculated x^2 value for indicator N1	A1	Calculated x^2 value for indicator A1
N2	Calculated x^2 value for indicator N2	A2	Calculated x^2 value for indicator A2
N3	Calculated x^2 value for indicator N3	A3	Calculated x^2 value for indicator A3
N4	Calculated x^2 value for indicator N4	A4	Calculated x^2 value for indicator A4
N5	Calculated x^2 value for indicator N5	A5	Calculated x^2 value for indicator A5
N6	Calculated x^2 value for indicator N6	A6	Calculated x^2 value for indicator A6
N7	Calculated x^2 value for indicator N7	A7	Calculated x^2 value for indicator A7
N8	Calculated x^2 value for indicator N8	A8	Calculated x^2 value for indicator A8
N9	Calculated x^2 value for indicator N9	TRANSP	Composite score for transport availability
N10	Calculated x^2 value for indicator N10	PERMOB	Composite score for personal mobility
HEALTH	Composite score for health status	AWARE	Composite score for service awareness
SOCECON	Composite score for social and economic disadvantage	ACCESS	Overall composite score for accessibility
ENV	Composite score for environment	PROVIS	Overall calculated score for provision

Model outcomes (enumeration district)

FILE	UTIL.DBF	CONTENTS	Calculated outcomes	ORIGIN	ALLDATA.DBF

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	DEMAND	Calculated scores for disadvantaged demand
NEED	Overall composite score for need	DRANK	Ranked disadvantaged demand scores
NRANK	Ranked NEED scores	GPU	Calculated scores for GP utilization
ACCESS	Overall composite score for accessibility	URANK	Ranked GPU scores
ARANK	Ranked ACCESSIBILITY scores	REALIZE	Calculated scores for realized demand
PROVIS	Overall calculated score for provision	RRANK	Ranked REALIZE scores
PRANK	Ranked PROVISION scores		

Model outcomes (ward)

FILE	WARDRANK.DBF	CONTENTS	Calculated outcomes (ward averages)	ORIGIN	ALLDATA.DBF

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
WARD	OPCS ward code	AWARE	Composite score for service awareness
HEALTH	Composite score for health status	A_RANK	Ranked AWARE scores
H_RANK	Ranked HEALTH scores	ACCESS	Overall composite score for accessibility
SOCECON	Composite score for social and economic disadvantage	ARANK	Ranked ACCESSIBILITY scores
S_RANK	Ranked SOCECON scores	PROVIS	Overall calculated score for provision
ENV	Composite score for environment	PRANK	Ranked PROVISION scores
E_RANK	Ranked ENV scores	DEMAND	Calculated scores for disadvantaged demand demand
NEED	Overall composite score for need	DRANK	Ranked disadvantaged demand scores
N_RANK	Ranked NEED scores	GPU	Calculated scores for GP utilization
TRANSP	Composite score for transport availability	URANK	Ranked GPU scores
T_RANK	Ranked TRANSP scores	REALIZE	Calculated scores for realized demand
PERMOB	Composite score for personal mobility	RRANK	Ranked REALIZE scores
P_RANK	Ranked PERMOB scores		

APPENDIX 5

Manipulation of indicators

i. Discussion

The calculation of a signed chi-square value is based on absolute values of data. Observed values (O) are those exhibited in each ED and the expected values (E) are those expected for the NDHA area as a whole (where possible the value expressed as a proportion of the total, otherwise, a mean expected value in relation to the total).

This appendix presents an example of the calculation of the signed chi-square value and subsequent transformation based on one of the age indicators from the need sub-model (N2). This variable measures the proportion of people in each ED who have a greater potential need for health care based on their age (total males and females age 65 or over as a proportion of the overall population).

The calculation is made for a small selection of EDs for illustrative purposes only. Note that this selection is examined independently and does not reflect the values of all EDs in the NDHA area:

ED	TOTAL	65TO79	80OVER	% 65+
35NJFA01	491	54	4	11.81
35NJFA02	534	38	6	8.24
35NJFA03	515	20	1	4.08
35NJFA04	411	103	14	28.47
35NJFA05	496	54	19	14.72
35NJFA06	391	84	18	26.09
35NJFA07	447	100	8	24.16
35NJFB01	462	37	11	10.39
35NJFB02	535	92	49	26.36
35NJFB03	523	93	44	26.20

Definitions are as follows:

ED:	Enumeration District code
TOTAL:	Total number of males and females
65TO79:	Total number of males and females age 65 to 79
80OVER:	Total number of males and females age 80 or over
% 65+:	Percentage of males and females age 65 or over as a proportion of the ED total population

ii. Calculation

The method used here follows similar use by DoE (1995; 1991 Deprivation Index)

Calculation of the signed chi-square value is based on the following formula:

$$((O1_j - E1_j)^2 / E1_j) + ((O2_j - E2_j)^2 / E2_j)$$

where:

$_j$	=	area for which the chi-square value is determined
$O1_j$	=	Observed1 (age 65 or over in place $_j$)
$O2_j$	=	Observed2 (age under 65 in place $_j$)
$E1_j$	=	Expected1 (R1*total persons in place $_j$)
$E2_j$	=	Expected2 (R2*total persons in place $_j$)
R1	=	Average rate for persons age 65 or over (i.e. total persons age 65 or over in all EDs/total persons in all EDs = 849/4805 = 0.17669)
R2	=	Average rate for persons age under 65 (i.e. total persons age under 65 in all EDs/total persons in all EDs = 3956/4805 = 0.82331)

The calculation is demonstrated for two of the EDs (35NJFA01 and 35NJFA03):

35NJFA01:	$E1_j$	= (0.17669*491) = 86.755
	$E2_j$	= (0.82331*491) = 404.245
	Chi-square	= $(((58-86.755)^2)/86.755) + (((433-404.245)^2)/404.245)$
		= 11.576
35NJFA03:	$E1_j$	= (0.17669*515) = 90.995
	$E2_j$	= (0.82331*515) = 424.005
	Chi-square	= $(((21-90.995)^2)/90.995) + (((494-424.005)^2)/424.005)$
		= 65.397

Note: expected values are replaced by mean values where necessary.

Transformation of the chi-square value completes calculation of the score. The calculation of the logarithmic value reduces skewness and the effect of the absolute values of data which are not comparable with other variables in their raw state. The procedure is as follows:

- Remove the negative sign
- Add 1.0 (this avoids negative values for those which are less than 1.0)
- Calculate the log
- Replace the negative sign where the outcome of $O1_j$-$E1_j$ is negative (therefore all EDs with rates below the total area average illustrated as negative values)

Transformation for the sample EDs (TLV = Transformed Log Value to 3 decimal places):

ED	TOTAL	65TO79	80OVER	% 65+	TLV
35NJFA01	491	54	4	11.81	-1.100
35NJFA02	534	38	6	8.24	-1.527
35NJFA03	515	20	1	4.08	-1.822
35NJFA04	411	103	14	28.47	1.531
35NJFA05	496	54	19	14.72	-0.599
35NJFA06	391	84	18	26.09	1.302
35NJFA07	447	100	8	24.16	1.145
35NJFB01	462	37	11	10.39	-1.251
35NJFB02	535	92	49	26.36	1.459
35NJFB03	523	93	44	26.20	1.434

iii. EXCEL calculations

The following table and workings represent the calculation using Microsoft EXCEL:

	A	B	C	D	E	F	G	H	I	J
1	ED	TOT	65OVER	%_65+	E1j	E2j	CHI	NEGPOS	LOG	ADDNEG
2	35NJFA01	491	58	11.813	86.755	404.245	11.576	11.576	1.100	-1.100
3	35NJFA02	534	44	8.240	94.353	439.647	32.639	32.639	1.527	-1.527
4	35NJFA03	515	21	4.078	90.996	424.004	65.397	65.397	1.822	-1.822
5	35NJFA04	411	117	28.467	72.620	338.380	32.942	32.942	1.531	1.531
6	35NJFA05	496	73	14.718	87.639	408.361	2.970	2.970	0.599	-0.599
7	35NJFA06	391	102	26.087	69.086	321.914	19.046	19.046	1.302	1.302
8	35NJFA07	447	108	24.161	78.981	368.019	12.950	12.950	1.145	1.145
9	35NJFB01	462	48	10.390	81.631	380.369	16.829	16.829	1.251	-1.251
10	35NJFB02	535	141	26.355	94.530	440.470	27.747	27.747	1.459	1.459
11	35NJFB03	523	137	26.195	92.409	430.591	26.134	26.134	1.434	1.434

The signed chi-square values are calculated as follows. This represents the typical process which is undertaken within the software to calculate the final value for each variable in the model. Formulas are presented for row 2 of the above table, formulas for other rows would require alteration with the relevant row number being inserted where the number '2' exists. Note that some manipulation of census data is required prior to this to obtain values of all persons age 65 or over:

%_65+	D = (C2/B2)*100
E1j	E = ((SUM(SUMC)/SUM(SUMB))*B2
E2j	F = (SUM(SUMB)-(SUM(SUMC))/SUM(SUMB))*B2
CHI	G = ((SUMSQ(C2)-E2))/E2)+((SUMSQ((B2-C2)-F2))/F2)
NEGPOS	H = IF(SIGN(G2)=-1,G2*-1,G2)
LOG	I = LOG10(H2+1)
ADDNEG	J = IF(SIGN(C2)-E2)=-1,I2*-1,I2)

APPENDIX 6

Tabulated results

i. **Indicator chi-square scores**

The matrix of results, on the following pages, illustrates the calculated indicator scores and the component scores determined for the three sub-models.

LEGEND

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	NEED	Overall composite score for need
N1	Calculated x^2 value for indicator N1	A1	Calculated x^2 value for indicator A1
N2	Calculated x^2 value for indicator N2	A2	Calculated x^2 value for indicator A2
N3	Calculated x^2 value for indicator N3	A3	Calculated x^2 value for indicator A3
N4	Calculated x^2 value for indicator N4	A4	Calculated x^2 value for indicator A4
N5	Calculated x^2 value for indicator N5	A5	Calculated x^2 value for indicator A5
N6	Calculated x^2 value for indicator N6	A6	Calculated x^2 value for indicator A6
N7	Calculated x^2 value for indicator N7	A7	Calculated x^2 value for indicator A7
N8	Calculated x^2 value for indicator N8	A8	Calculated x^2 value for indicator A8
N9	Calculated x^2 value for indicator N9	TRANSP	Composite score for transport availability
N10	Calculated x^2 value for indicator N10	PERMOB	Composite score for personal mobility
HEALTH	Composite score for health status	AWARE	Composite score for service awareness
SOCECON	Composite score for social and economic disadvantage	ACCESS	Overall composite score for accessibility
ENV	Composite score for environment	PROVIS	Overall calculated score for provision

Note: Blank cells indicate no data available (unpopulated enumeration district).
Values of 99 in the PROVIS column indicate excluded EDs

ID	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	HEALTH	SOCECON	ENV	NEED	A1	A2	A3	A4	A5	A6	A7	A8	TRANSP	PERMOB	AWARE	ACCESS	PROVIS
35NJFA01	0.3124	-0.4742	0.2388	-0.0265	0.7060	-0.1066	0.0093	2.1655	-0.4450	-0.0101	0.0516	0.6067	1.7304	0.7919	-0.5275	0.8379	-0.3703	-1.0000	0.7060	-0.0929	-0.8827	-0.2663	0.6604	-0.7572	-1.1490	-0.4336	-0.9401
35NJFA02	-0.6307	-1.1983	-0.0311	-0.1066	-0.6066	0.0084	0.4609	-1.6146	-0.4264	-0.6138	-1.8687	-0.1162	-2.6548	-1.3908	0.5935	-1.0196	-0.7306	-0.9249	-0.6066	-0.1369	-1.3113	-0.5621	-0.8099	-2.3978	-1.8734	-1.9411	-0.8717
35NJFA03	1.0685	-1.6358	0.4453	-0.5077	1.0361	0.2703	0.9489	1.9772	-0.3958	-0.5783	-0.8295	2.2633	1.0053	0.9288	0.5935	0.9609	0.4753	-1.2041	1.0361	-0.9344	-0.9599	-0.6468	0.9131	-0.8271	-1.5065	-0.4535	-0.9872
35NJFA04	0.0054	1.8586	-1.2987	1.9121	-0.2002	0.7758	-0.3947	1.9660	-0.3985	-0.3299	2.4774	0.1609	1.2378	1.0922	0.5935	1.2541	-1.0364	0.0248	-0.2002	-0.7679	-1.1914	-0.5837	1.1682	-1.9687	-1.7761	-0.7956	-0.9774
35NJFA05	-0.8147	0.0799	-0.6521	0.9404	0.0182	0.0211	0.2298	2.3996	1.7641	0.1382	-0.4465	0.2679	4.2918	1.4083	-0.5275	1.6310	-0.1006	0.2164	0.0182	-1.0669	-0.8221	-0.7916	1.3504	-0.9328	-1.6137	-0.3649	-0.8864
35NJFA06	-0.9841	1.0836	-0.9930	0.7709	-0.5434	-0.3772	0.8610	2.3284	-0.4043	-0.5868	0.6873	-0.0596	1.3373	0.6727	-0.5275	1.7712	-1.3319	0.6446	-0.5434	-1.2407	-1.1694	-0.7690	1.4724	-2.5714	-1.9374	-0.8764	-0.8717
35NJFA07	0.7676	1.5929	-0.8789	0.7120	0.7855	-0.4143	-0.1838	2.3438	-0.4028	0.1816	2.1937	0.1874	2.1225	1.3184	-0.5275	1.8506	-0.2677	-0.5863	0.7855	-0.4931	-1.2300	-0.6611	1.5414	-0.5616	-1.8911	-0.3153	-0.8782
35NJFB01	0.1775	-0.7813	0.4611	0.4298	1.2548	0.0486	0.9600	1.5797	-0.4043	0.0061	0.2871	2.2843	1.1606	1.2267	0.5935	1.4999	0.2442	-0.2992	1.2548	-0.8612	-0.9646	-0.0001	1.3821	0.3386	-0.9647	0.2934	-0.8600
35NJFB02	-0.7200	1.8382	-0.5306	1.9811	-0.8470	0.0065	0.0252	-1.3758	1.6085	-0.6846	2.5687	-0.6163	-0.4519	0.2858	-0.5275	1.5748	-1.4404	1.7958	-0.8470	-0.1510	-0.3264	-0.8069	1.3016	-0.4428	-1.1323	-0.0281	-0.8424
35NJFB03	-0.3403	1.8153	-1.0981	0.2237	-0.1403	-0.1319	-0.0068	-1.4606	-0.0956	0.1224	0.8006	-0.2790	-1.4238	-0.4175	-0.5275	-0.0025	-0.8909	1.8722	-0.1403	-0.7294	-1.2118	-0.0671	-0.0706	-0.0684	-1.2689	-0.6920	-0.5476
35NJFB04	-1.0149	1.7082	-0.6906	0.3298	-0.7793	-0.2518	0.0178	-0.8704	-0.2008	-0.5038	0.3326	-1.0135	-1.5750	-0.7797	0.5935	0.0060	-1.1563	1.7573	-0.7793	-0.9709	-1.3142	-0.5053	0.0824	-1.1492	-1.8195	-1.1559	-0.8433
35NJFB05	-1.2214	0.8596	-0.3241	0.6068	-0.6322	0.6549	0.9331	-1.6323	-0.4476	-0.6392	-0.0791	0.9558	-2.7190	-0.6076	-0.5275	-0.9238	-1.1690	-0.1184	-0.6322	-1.1971	-0.9696	-0.4707	-0.7851	-3.0367	-1.4402	-1.8718	-0.6995
35NJFB06	-0.6448	-0.5816	-0.0196	-0.3671	-0.7687	-0.2728	0.6966	-1.7819	-0.4904	-0.6901	-1.8128	-0.3428	-2.9624	-1.5549	-0.5275	-1.5608	-0.4997	-1.0667	-0.7687	-0.8179	-1.2276	-0.6126	-1.4265	-3.1730	-1.8401	-2.4266	-0.7216
35NJFC01	-0.8201	0.4516	-0.4936	-0.5509	-0.6546	0.3679	-0.3475	-0.7703	0.4401	-0.0626	-1.4130	-0.6342	-0.3930	-0.6957	1.1565	-1.0994	-1.2540	0.0418	-0.6546	0.5398	-1.2933	0.6984	-0.8061	-1.3270	-0.5949	-1.0323	-1.0037
35NJFC02	-0.4092	-0.4835	-0.1460	-0.0661	-0.2840	-0.0938	0.0953	-0.8070	-0.0698	-0.1222	-1.1049	-0.2726	-0.9990	-0.7000	1.4079	-0.9452	0.1494	-0.4932	-0.2840	-0.0016	-0.2828	-0.2619	-0.6393	-0.6304	-0.5346	-0.7446	-1.0326
35NJFC03	-0.0446	1.1297	-0.9570	0.0474	-0.4575	-0.2675	0.0094	-0.5864	-0.2404	-0.3760	0.1755	-0.7156	-1.2028	-0.5956	0.9250	-0.3974	-0.5068	0.7955	-0.4575	-0.2453	-0.9433	0.4433	-0.2255	-0.4141	-0.5000	-0.4663	-0.9089
35NJFC04	-0.5362	1.0050	-0.4404	0.6000	-0.1460	0.0060	-0.0598	-0.3015	0.3736	-0.4292	0.6284	-0.1998	-0.3571	-0.0285	0.8060	-0.6192	-0.3917	0.1417	-0.1460	0.4467	-1.0566	0.0770	-0.4341	0.0507	-0.9798	-0.6942	-0.7129
35NJFC05	-0.1126	0.2188	-0.3075	-0.0766	-0.6074	-0.2144	-0.8816	-1.0155	-0.2061	-0.3314	-0.2779	-1.7033	-1.6550	-1.1566	1.4079	-1.3373	-0.8738	0.0047	-0.6074	0.6465	-0.9164	0.2388	-0.9604	-0.8300	-0.6776	-1.0365	-1.0799
35NJFC06	-0.0673	0.1627	-0.8391	-0.6615	-0.2930	-0.4084	-0.5786	-0.8072	-0.3749	-0.5506	-1.4052	-1.2800	-1.7327	-1.3555	0.5637	-1.0665	0.0007	-0.4479	-0.2930	1.2428	-1.1097	0.5517	-0.8548	0.5026	-0.5580	-0.5807	-0.9882
35NJFC07	0.4576	-0.3830	-0.3278	0.0111	-0.7104	0.0000	-0.1946	-1.3127	-0.2646	-0.4087	-0.2421	-0.9052	-1.9860	-1.0243	0.7351	-1.3378	0.2599	0.1124	-0.7104	0.6401	-0.9545	0.6541	-1.0683	0.3020	-0.3004	-0.6089	-0.8542
35NJFD01	0.5092	-1.3896	0.2245	-0.5863	-0.4753	-0.0428	0.2179	-1.0420	-0.0043	-0.4876	-1.2422	-0.3002	-1.5339	-0.9219	0.9835	-1.3688	0.7655	-0.9350	-0.4753	-0.8528	-1.0538	-0.2478	-1.0628	-1.4974	-1.3016	-1.5556	99.0000
35NJFD02	-0.6597	-0.0754	-0.6344	-0.0388	-0.5042	0.1277	-0.9065	-1.6277	-0.3350	-0.2071	-1.4083	-1.2830	-2.0698	-1.4697	0.6046	-1.4960	-0.0164	-0.4075	-0.5042	0.5527	-1.1012	1.2334	-1.2359	-0.3754	0.1322	-0.6457	99.0000
35NJFD03	-0.1355	-1.0584	-0.7180	-1.2344	0.0505	-0.1706	-0.1800	-1.1539	-0.1156	-0.6267	-3.1463	-0.3001	-1.8962	-1.5187	0.5935	-1.5926	-0.1194	-0.9747	0.0505	0.8041	-1.3787	0.4735	-1.3084	-0.2395	-0.9052	-1.1667	99.0000
35NJFE01	-0.1748	-0.2766	-0.5806	-0.6229	-0.1832	0.2000	-0.0660	-0.8417	-0.1584	-0.2601	-1.6549	-0.0692	-1.2602	-0.8569	0.6203	-0.8927	-0.2061	-0.3921	-0.1832	0.5162	-0.8273	0.3676	-0.7090	-0.2652	-0.4597	-0.6607	-0.4522
35NJFE02	-0.6957	1.4276	-0.4307	0.4322	-0.3815	0.0670	0.0488	0.0000	0.7122	-0.5833	0.7433	-0.2657	0.1289	0.1402	0.1983	-0.7485	-1.2373	0.4373	-0.3815	0.5518	-1.2742	0.5272	-0.6254	-0.6297	-0.7470	-0.8436	-0.6124
35NJFE03	-1.0060	1.1254	-0.8167	-0.0686	-0.6117	0.0770	0.5596	-1.2814	-0.2147	-0.3407	-0.8848	0.0248	-1.8368	-0.8252	-0.0812	-0.9347	-1.1659	0.0476	-0.6117	-0.5434	-0.9431	0.7004	-0.8211	-2.2634	-0.2427	-1.0978	-0.1139
35NJFE04	-0.9712	0.3443	-0.2656	-1.0050	-0.8174	-0.4540	-1.1536	-1.6290	-0.0760	-0.5903	-1.8976	-2.4250	-2.2953	-2.0478	-0.2700	-1.5617	-0.7911	-0.3549	-0.8174	1.4216	-1.2611	1.0337	-1.3938	-0.5318	-0.2174	-0.9386	0.5234
35NJFF01	-1.0185	-0.2747	-0.0236	-0.9699	-0.0135	-0.2505	-0.6093	-1.3270	-0.2382	-0.3703	-2.2867	-0.8723	-1.9335	-1.5069	0.9784	-1.3114	-1.1719	-0.2058	-0.0135	0.5694	-0.0140	0.6303	-1.0137	-0.8218	0.6163	-0.4042	-0.6401
35NJFF02	-1.1208	1.0737	-0.6638	0.8132	-0.8226	0.0574	-0.5122	-1.5839	0.6913	-0.5920	0.1023	-1.2774	-1.4846	-0.8951	-0.0079	-1.3278	-1.2153	0.5224	-0.8226	1.1820	-1.2310	0.3475	-1.1562	-0.3335	-0.9835	-1.1032	-0.5563
35NJFF03	-0.4194	-0.0410	-0.2064	-0.4876	-0.2621	-0.2838	0.5831	-1.1040	-0.2546	-0.3954	-1.1544	0.0472	-1.7540	-0.8576	0.9084	-1.0807	-0.4803	-0.0012	-0.2621	-0.2434	-0.7765	0.6541	-0.8221	-0.9770	-0.1224	-0.7165	-0.7440
35NJFF04																											-0.6966
35NJFF05	-0.0341	0.2151	0.0220	-0.2726	-0.2894	-0.2049	-0.8533	-1.2120	0.6931	-0.3066	-0.0695	-1.3466	-0.8246	-0.7411	0.4134	-0.7446	-0.4556	0.5559	-0.2894	1.0218	-0.7639	0.6977	-0.5940	0.8337	-0.0662	-0.1217	-0.6563
35NJFF06	-0.3546	0.2393	-0.0379	-0.1352	-0.2243	-0.2757	-0.8014	-1.0066	0.9858	-0.3844	-0.2894	-1.3014	-0.5062	-0.6743	1.2109	-1.2636	-0.0145	0.3666	-0.2243	0.8841	-0.9492	1.0698	-0.9332	1.0119	0.1206	-0.1533	-0.5246
35NJFF07	-0.0203	-0.1163	0.0365	-1.0787	-0.6760	-0.2757	-0.8132	-1.0889	-0.2606	-0.3899	-1.1788	-1.7639	-1.7294	-1.4591	0.8859	-1.3992	-0.6012	-0.0518	-0.6760	1.0633	-0.8499	0.7473	-1.1021	-0.2447	0.0974	-0.5635	-0.8882
35NJFG01	0.0661	-1.2631	0.0480	-0.7768	-0.5596	-0.1474	0.1636	-1.1266	-0.4057	-0.3434	-1.9259	-0.6434	-1.8767	-1.2878	0.7566	-1.4156	0.2742	-0.9984	-0.5596	0.1621	-1.1320	1.0337	-1.1332	-1.1217	-0.0983	-0.8962	-1.0990
35NJFG02	-0.1165	0.6541	-0.4790	1.1073	0.2092	-0.3641	0.3222	1.7318	-0.3626	0.3218	1.1659	0.1673	1.6911	0.9109	0.3957	0.1097	-0.7522	-0.4942	0.2092	-1.0613	-1.1478	-0.0007	0.1456	-2.0986	-1.1485	-1.0261	-0.9970
35NJFG03	-0.1650	0.6136	-0.4359	1.0047	-0.2102	-0.2591	0.0292	-1.2378	0.9877	1.1276	0.1073	-0.4401	0.8776	0.4001	0.4079	-0.5618	-0.0037	-0.2626	-0.2102	-0.7644	-0.0493	-0.1747	-0.4270	-1.2408	-0.2240	-0.6367	-1.0944
35NJFG04	-0.7980	0.0800	-0.8880	0.5291	-0.0668	0.0084	-0.7096	-0.9569	-0.1193	-0.6299	-0.0769	-0.7679	-1.7061	-0.8439	0.5935	-0.6352	-0.8400	-0.1689	-0.0668	1.0311	-1.0038	1.0609	-0.4756	-0.0446	0.0671	-0.2204	-1.0970
35NJFH01	0.3226	-0.6199	0.3499	0.0373	-0.1096	-0.2605	-0.6192	-0.7474	1.0112	-0.3346	-0.1091	-0.9783	-0.0707	-0.3769	0.6489	-1.0493	0.1917	-0.5402	-0.1096	1.0062	-0.9992	0.9962	-0.8277	0.5471	-0.0030	-0.2786	-0.9801
35NJFH02	0.0076	-0.0034	0.3136	-0.4408	-0.3103	-0.0963	0.3472	0.0002	-0.0649	-0.1469	-0.1231	-0.0594	-0.2315	-0.1277	1.3991	-0.1807	-0.1713	-0.2049	-0.3103	-0.2481	-0.5633	-0.2619	0.0247	-0.9346	-0.8152	-0.6289	99.0000
35NJFH03	-0.1612	-0.7300	0.0728	-0.5659	-0.3729	-0.2326	0.6432	-1.0246	-0.2147	-0.3407	-1.3845	0.0376	-1.5800	-0.8603	1.1376	-1.0707	-0.6466	-0.6209	-0.3729	-0.0444	0.0019	-0.1124	-0.7836	-1.6849	-0.1105	-0.8693	-0.9386
35NJFH04	-0.0943	-0.1948	-0.1289	-0.7984	-0.1084	-0.3147	-0.3429	-0.6049	-0.2723	-0.4190	-1.2162	-0.7860	-1.2962	-0.9916	0.9431	-1.2210	0.7266	-0.2203	-0.1084	0.7753	-1.1113	-0.3634	-0.9397	1.1722	-1.4647	-0.9092	-0.9254
35NJFH05	-0.7012	0.6706	-0.0047	-0.4976	-0.5944	-0.4485	-0.4028	-0.9594	0.0351	-0.3746	-0.6328	-1.4457	-1.2079	-1.0477	0.7674	-0.6138	-0.4403	-0.2371	-0.5944	0.8013	-1.2011	0.0633	-0.3472	-0.4705	-1.1378	-0.8601	-0.9314
35NJFH06	-0.1281	-0.7121	-0.0103	-1.0287	-0.4293	0.2407	-0.6133	-1.6686	-0.4043	1.2916	-1.8792	-1.0019	-0.7813	-1.0642	1.1903	-1.2622	0.7719	-0.7838	-0.4293	1.0237	-1.3146	-0.0665	-0.9434	0.5826	-1.3711	-1.0116	-0.9467
35NJFH07	0.9530	-1.6074	1.3374	-1.3436	-0.0106	-0.6002	-0.7450	-1.7204	-0.4614	-0.1913	-0.6697	-1.2538	-2.3631	-1.3706	0.5935	-1.7622	1.1861	-1.0684	-0.0106	1.2852	-1.3373	-0.0419	-1.4560	1.3723	-1.3792	-0.0745	-0.7841
35NJFH08	0.6958	-1.6281	1.0604	-1.3958	-0.0329	-0.4540	-0.2232	-1.6226	-0.3883	-0.5673	-1.2777	-0.7101	-2.5782	-1.4166	0.8821	-1.7394	1.3194	-0.9741	-0.0329	0.9661	-1.2580	0.4206	-1.3988	1.2775	-0.9354	-0.7978	-0.7129
35NJFH09	-0.0688	2.0073	-0.9573	1.2380	-0.6841	-0.4647	0.0219	1.5936	0.2377	0.0424	2.2214	-1.1269	1.8737	0.8043	-0.6276	0.9863	-0.8979	2.0471	-0.6841	0.0762	-1.0219	-0.7281	0.7895	0.4413	-1.7499	-0.3699	-0.6910
35NJFH10	-0.3410	0.7541	-0.2169	0.0965	-0.6787	-0.0634	-0.4603	-1.8440	0.7038	-0.3407	0.2817	-1.2024	-1.2809	-0.7548	0.0001	-1.0327	-0.9658	-0.3166	-0.6787	0.2472	-0.4794	-0.1003	-0.6884	-1.7129	-0.5797	-1.1673	-0.7896
35NJFH11	1.6395	-1.3841	0.7689	-0.9024	-0.1220	-0.0052	0.0602	-1.4229	0.5448	-0.4387	0.1219	-0.0670	-1.3168	-0.4308	0.5935	-1.5840	1.4963	-1.1024	-0.1220	0.1466	-1.2699	0.1536	-1.3009	0.4185	-1.1163	-1.1040	-0.6692
35NJFJ01																											-0.9882
35NJFJ02	-0.5327	-0.6204	-0.3318	-0.2967	-0.4047	-0.2418	-0.8219	-0.8372	-0.2256	-0.0214	-1.7816	-1.4684	-1.0842	-1.2863	0.8431	-1.1791	-0.7600	-0.3112	-0.4047	1.0893	-0.9683	-0.0004	-0.9032	-0.3686	-0.9687	-1.0276	-1.0319
35NJFJ03	-0.1100	0.0000	-0.3139	-0.0702	-0.2001	0.1736	0.0000	-1.0905	-0.1193	-0.6299	-0.4941	-0.0266	-1.8397	-0.7456	0.9168	-1.0224	-0.0267	0.0921	-0.2001	0.0709	-1.2367	0.7056	-0.7704	-0.0638	-0.6312	-0.6668	-1.0562
35NJFJ04	-0.3153	0.4309	-0.7246	-0.3002	-0.2347	-0.5146	0.8395	0.4110	-0.4857	-0.4878	-0.9092	0.0902	-0.5625	-0.3847	-0.0612	-0.4289	-0.1514	-0.2020	-0.2347	-1.0593	-1.4271	-0.0050	-0.3811	-1.6474	-1.4321	-1.3185	-1.0375
35NJFK01	-0.1282	1.0637	-0.1036	-0.6992	-0.2654	-0.2049	-0.8533	-0.4010	-0.1780	-0.2886	0.1327	-1.3236	-0.8876	-0.6972	0.4994	-0.4625	-0.9117	1.2804	-0.2654	0.7602	-0.8879	0.8949	-0.3376	0.8635	0.0070	0.0606	99.0000
35NJFK02	0.0018	0.0006	-0.3145	-0.0114	-0.4631	0.0250	-0.3718	0.0069	-0.2424	-0.3788	-0.3235	-0.8099	-0.6143	-0.5558	1.0597	-0.9229	-0.9527	-0.4267	-0.4631	0.3852	-1.0180	0.3311	-0.6652	-1.4573	-0.6869	-1.0404	99.0000
35NJFK03	-0.8441	0.8347	-0.1609	-0.1490	-0.0739	-0.3368	-0.0861	-0.1983	-0.0004	0.9976	-0.3193	-0.4986	0.7989	0.0203	0.2593	-0.4350	-0.9869	1.3962	-0.0739	0.1710	-0.7650	0.0006	-0.3447	0.5084	-0.7646	-0.4280	99.0000
35NJFK04	-0.5887	0.0569	-0.0387	-0.6176	-0.5272	-0.0428	-0.5840	-0.9600	0.1982	-0.2169	-1.1861	-1.1540	-0.9786	-1.0074	1.0322	-1.0418	-0.0634	0.9679	-0.5272	1.2621	-0.9973	1.2894	-0.7722	1.6394	0.2921	0.1698	99.0000
35NJFK05	-0.2899	1.7684	-0.9069	-0.0331	-0.3882	-0.1431	-0.0636	-0.9764	1.0360	0.1391	0.5395	-0.5949	0.1987	0.0026	0.5459	-0.6968	-0.9547	2.0279	-0.3882	0.2687	-0.7217	-0.3829	-0.5265	0.9637	-1.1046	-0.5771	99.0000
35NJFK06	-0.1189	-0.8389	0.0522	-0.4593	-0.1960	-0.2591	-0.7538	-1.1065	-0.2320	0.5158	-1.3648	-1.2089	-0.8227	-1.0184	1.2000	-1.3183	-0.0951	-0.2321	-0.1960	0.9311	-1.0044	0.5655	-0.9909	0.4079	-0.4389	-0.6129	99.0000
35NJFK07	-0.6969	-0.2190	0.2420	0.0001	0.5974	0.6976	-0.5433	0.1767	-0.1780	0.3527	-0.6738	0.7516	0.3514	0.1992	1.0006	-0.4625	-0.1202	0.0594	0.5974	0.4817	-0.8741	0.1304	-0.2723	1.0183	-0.7437	-0.2534	99.0000
35NJFL01	-0.2704	-0.4268	0.0282	-0.1182	-0.3737	-0.1318	-0.2649	-0.9542	1.0820	-0.1791	-0.7872	-0.7604	-0.0613	-0.4674	1.1243	-1.0012	0.0470	-0.4279	-0.3737	0.4482	-0.7150	0.0206	-0.7249	-0.3064	-0.6944	-0.7863	-0.9794
35NJFL02	0.0116	-0.1728	-0.3601	-0.5795	-0.2589	-0.2838	0.0409	-1.3727	-0.2506	0.4382	-1.0908	-0.5018	-1.1851	-0.8350	0.6082	-1.3762	0.0018	-0.2044	-0.2589	0.1710	-1.0535	0.5032	-1.1182	-0.2905	-0.5503	-0.9069	-1.0312
35NJFL03	-0.2017	0.1670	-0.1229	0.2676	-0.1565	-0.3707	0.6549	0.9237	0.6000	0.1329	0.1000	0.1277	1.6566	0.6198	0.6465	-0.2232	-0.2163	-0.0349	-0.1565	-0.2979	-1.2069	-0.0748	-0.1101	-0.7056	-1.2817	-0.8723	-1.0398
35NJFL04	0.7087	-0.3216	0.0473	-0.1576	-0.0903	-0.2917	-0.6423	-1.0957	-0.2626	-0.4060	0.2769	-1.0243	-1.7643	-0.8603	0.0695	-1.1474	-0.0065	-0.0221	-0.0903	1.0371	-1.0761	-0.0026	-0.9892	0.8182	-1.0786	-0.8044	-0.9720
35NJFL05	-1.0100	0.6136	-0.6442	0.4071	-0.9317	-0.1163	-1.1839	-0.5654	-0.4043	-0.5868	-0.6335	-2.2319	-1.5565	-1.4212	0.8030	-0.7983	-0.0824	0.0009	-0.9317	1.1979	-1.1298	-0.2430	-0.6884	0.1747	-1.3728	-0.9389	-0.9734
35NJFL06	-1.0675	-0.1704	-0.6186	-0.4064	-0.2710	0.1009	-0.1735	-1.5950	0.4955	-0.5429	-2.2829	-0.3436	-1.6424	-1.2327	0.9084	-1.2348	-0.8502	0.2079	-0.2710	0.8948	-1.0150	0.9925	-0.9562	-0.0185	-0.0225	-0.4940	-0.9630
35NJFL07	-0.5451	1.0698	-0.5484	-0.8850	-0.2258	-0.4023	-0.5473	-1.0942	-0.0205	-0.5232	-0.9097	-1.1754	-1.6379	-1.1652	1.0692	-1.2543	-0.8611	0.8890	-0.2258	0.3807	-1.2581	0.1695	-0.9522	0.1828	-1.0888	-0.9747	-0.8758
35NJFM01	-0.6552	-0.6913	-0.1236	-0.7354	-0.7731	-0.1706	1.0986	-1.4161	-0.4460	-0.1774	-2.2065	0.1549	-2.0385	-1.1792	-0.0556	-1.1574	-0.5589	-0.1889	-0.7731	-1.0869	-1.2972	-0.4526	-1.0142	-2.6078	-1.7499	-2.0340	-0.9432
35NJFM02	1.2204	-0.9878	0.5255	0.2175	1.1516	0.9238	0.7162	1.9483	-0.0555	-0.3133	0.9756	2.7916	1.5795	1.7009	-0.5275	0.9703	0.9217	-0.9752	1.1516	-1.0327	-0.9176	-0.7572	0.7756	0.0654	-1.6747	-0.4332	-0.8913
35NJFM03	-0.1223	-1.5790	0.0876	-0.3036	-0.4099	-0.2657	0.0875	-1.0803	-0.4552	-0.1997	-1.9073	-0.5881	-1.7352	-1.2513	-0.5275	-1.4666	1.1134	-1.1233	-0.4099	-0.2401	-0.8750	0.0173	-1.3446	-0.6599	-0.8577	-1.2661	-0.8750
35NJFM04	0.6434	-1.1326	0.4745	0.0000	1.0720	0.3014	0.8733	2.0110	-0.0539	0.2297	-0.0147	2.2467	2.1888	1.4742	-0.5275	0.8162	0.8472	-1.1859	1.0720	-0.9152	-0.1885	-0.4545	0.4675	-0.1819	-0.8430	-0.1332	-0.9577
35NJFM05	-0.1059	-0.0022	0.1254	0.0038	0.3644	-0.4374	0.0674	1.8320	-0.4014	0.4444	0.0211	-0.0056	1.8750	0.6284	-0.5275	0.3729	0.7940	-0.7724	0.3644	-0.2282	-1.0081	-0.0053	0.2558	0.1578	-1.0134	-0.3394	-0.8758
35NJFM06	0.7488	-1.6065	0.9690	-0.0093	1.3064	0.4931	1.0000	2.0585	-0.3927	1.3240	0.1020	2.7995	2.9898	1.9553	-0.5275	0.1965	1.2480	-0.9920	1.3064	-0.9708	1.1310	-0.7150	0.1024	0.5916	0.4160	0.4071	-0.8840

EQ	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	HEALTH	SOCECON	ENV	NEED	A1	A2	A3	A4	A5	A6	A7	A8	TRANSP	PERMOB	AWARE	ACCESS	PROVIS
35NJFM07	-0.0874	-1.5268	1.0161	-1.4798	-0.2302	-0.2231	0.0651	-1.6956	-0.4498	-0.1858	-2.0779	-0.3682	-2.3302	-1.4189	0.5935	-1.4663	0.5679	-0.8883	-0.2302	-0.1296	-0.5594	-0.0284	-1.1977	-0.6801	-0.5878	-1.0628	-0.8774
35NJFM08	0.5983	-0.3424	-0.0345	-0.4316	1.0426	1.0293	0.3194	1.8706	-0.4411	1.0696	-0.2102	2.3912	2.4690	1.5742	-0.3796	0.7446	1.3895	1.0688	1.0426	-0.6775	-0.0245	-0.6236	0.5966	2.8433	-0.6481	0.6661	-0.9867
35NJFM09	0.8773	-1.4624	0.4663	-0.0997	1.1223	-0.0007	0.0623	1.9510	-0.4196	0.9799	-0.2185	1.1939	2.5113	1.1771	-0.5275	0.3664	1.7265	-0.8164	1.1223	-0.8947	-0.3441	-0.8235	0.2676	1.1377	-1.1676	-0.1656	-0.9547
35NJFM10	0.6756	-1.8492	1.8060	-1.3730	-0.6960	-0.4903	1.1002	-1.7312	-0.4701	0.6362	-0.9407	0.0139	-1.5661	-0.7626	-0.5275	-1.2874	0.1265	-1.2633	-0.5960	-0.6995	-1.2308	-0.7275	-1.1686	-2.6333	-1.9563	-2.2318	-0.9601
35NJFM11	1.4057	-1.9024	1.2831	-1.5260	-0.4813	-0.2518	0.7150	-1.8145	-0.5153	-0.5380	-0.7596	-0.0191	-2.8678	-1.1519	-0.5275	-1.5302	0.8106	-1.2909	-0.4813	-0.3405	-1.1105	-0.1696	-1.3999	-1.3021	-1.2601	-1.8655	-0.7477
35NJFM12	0.2674	-1.7066	1.5063	-1.3287	-0.5960	-0.0001	0.9168	-1.7504	-0.1650	-0.6676	-1.2646	0.3207	-2.5830	-1.0703	-0.5276	-1.7505	-0.2183	-1.2864	-0.5960	-0.4633	-0.8030	-0.0011	-1.5915	-2.5440	-0.8041	-1.8338	-0.8692
35NJFN01	-0.3297	0.4242	-0.3496	-0.6316	-0.6641	0.1579	-0.9532	-0.7852	-0.0064	-0.4941	-0.8867	-1.4594	-1.2857	-1.1300	1.1707	-1.4242	-0.6937	-0.3473	-0.6641	1.1978	-1.1981	0.8400	-1.0869	-0.5172	-0.3581	-0.8518	-0.8913
35NJFN02	-0.6199	0.0217	-0.0075	-0.2166	-0.2959	-0.2237	0.0134	-0.8217	0.1418	-0.3056	-0.8223	-0.5062	-0.9855	-0.7029	0.2509	-0.6659	-0.2688	0.2459	-0.2959	0.3179	-0.9269	0.1346	-0.5467	0.0011	-0.7923	-0.6692	-0.9432
35NJFN03	-0.0041	-0.0588	0.0024	-0.6767	-0.3858	0.0170	0.0909	-1.2355	0.0752	-0.0149	-0.9372	-0.2779	-1.1752	-0.7187	0.8531	-1.0921	0.0499	-0.1507	-0.3858	-0.7100	-0.6267	0.2792	-0.8392	-1.1966	-0.3476	-0.6925	-0.6421
35NJFN04	-0.1735	0.0015	-0.1692	-0.4050	-0.4169	-0.2505	-0.0322	-0.7738	0.5432	-0.3618	-0.7462	-0.6996	-0.5922	-0.6172	0.7396	-1.1966	-0.0035	-0.0597	-0.4169	0.1433	-0.6705	0.1348	-0.9449	-0.3368	-0.5359	-0.6246	-1.0398
35NJFN05																											-1.0049
35NJFP01	-0.3949	-0.9195	0.1018	-0.3144	-0.3524	-0.0194	-0.1069	-1.3781	-0.3367	-0.0045	-1.6271	-0.4787	-1.7193	-1.1144	0.7906	-1.4014	-0.4062	-0.4602	-0.3524	0.1561	-1.1340	-0.0227	-1.1164	-1.0647	-1.1567	-1.4027	-0.6976
35NJFP02	-0.4419	-0.7009	-0.0029	-0.6267	-0.6931	0.0008	-1.0464	-1.2366	-0.2667	-0.3961	-1.9744	-1.7377	-1.8914	-1.7033	1.2687	-1.4272	0.5143	-0.4293	-0.6931	1.0695	-0.9194	0.3311	-1.0767	0.4614	-0.5883	-0.7172	-0.6512
35NJFP03																											-0.6360
35NJFP04	-1.0253	0.2751	-0.4762	-0.5695	-0.3391	-0.2144	-0.0040	-0.8943	0.1077	-0.3261	-1.7959	-0.5575	-1.1117	-1.0054	0.9103	-1.0129	-0.9905	-0.1717	-0.3391	0.0150	-0.9079	-0.0004	-0.7629	-1.4863	-0.9083	-1.2072	-0.6712
35NJFP05	-0.0538	0.2612	-0.0066	0.3786	-0.2173	-0.2675	-0.0211	0.7364	-0.2424	0.7666	0.5706	-0.5059	1.2808	0.4009	1.3060	-0.8238	-0.3370	-0.1549	-0.2173	0.1259	-1.0345	-0.1669	-0.5471	-0.5632	-1.2014	-1.0201	-0.4976
35NJFP06	-0.7630	1.0631	-0.6874	-1.1306	-0.7349	-0.4023	0.0239	-0.7146	0.5098	-0.2637	-0.5079	-1.1133	-0.4684	-0.6542	0.7601	-0.3466	-0.6771	0.2717	-0.7349	0.5687	-1.1638	0.0012	-0.2018	-0.5716	-1.1526	-0.6202	-0.4774
35NJFP07	-0.9294	0.8709	-0.1265	0.0660	-0.9377	-0.4202	-0.7397	-1.4816	-0.0631	0.0012	-0.0990	-2.0976	-1.5635	-1.2451	-0.3907	-1.1739	-1.0668	0.4568	-0.9377	1.2998	-1.1976	1.0698	-1.0721	-0.2879	-0.1377	-0.6719	-0.4933
35NJFQ01	-0.6236	0.0164	-0.0049	0.5024	-0.2470	-0.3366	0.1872	-0.9949	-0.3110	0.0015	-0.1077	-0.3984	-1.3044	-0.5839	0.9786	-1.1700	-0.9804	-0.0076	-0.2470	0.3168	-1.1601	0.6135	-0.8909	-0.9181	-0.5366	-0.9433	-1.0871
35NJFQ02	0.2230	-0.9925	0.0553	-0.0107	-0.4895	-0.1653	-0.2692	-1.1217	1.6910	-0.2601	-0.7249	-0.9640	0.3092	-0.3995	0.9904	-0.9811	-0.0094	-0.2060	-0.4895	0.6465	-0.8378	0.6178	-0.7248	-0.0594	-0.3198	-0.5372	-1.0831
35NJFQ03	-0.4598	-0.1872	-0.1381	-0.4742	0.1057	0.0008	-0.6742	-0.4753	0.9454	-0.0665	-1.2391	-0.7677	0.3036	-0.4645	1.0174	-0.9312	-0.6235	-0.4401	0.1057	0.4005	-0.6341	-0.0613	-0.6779	-0.7574	-0.8954	-0.9760	-1.0618
35NJFQ04	-0.1696	0.0253	0.0024	-0.0280	-0.4091	-0.1203	-0.4298	-1.0076	-0.1191	-0.2008	-0.1699	-0.9592	-1.3275	-0.8047	1.1273	-0.9747	-0.0045	0.1274	-0.4091	0.1091	-0.0480	-0.2886	-0.7014	-0.1771	-0.3366	-0.5833	-1.0630
35NJFQ05	0.0237	-0.6423	-0.0063	-0.2937	-0.2067	-0.1952	-0.8304	-1.1443	-0.1634	-0.2674	-0.9176	-1.2343	-1.5761	-1.1659	0.6905	-0.8493	0.9167	0.0787	-0.2067	0.5659	0.0590	-0.0035	-0.6491	1.3726	0.0655	0.0484	-1.0718
35NJFQ06	-0.8334	0.0866	-0.8606	-0.2412	-0.0029	-0.1163	-0.5663	-0.8143	-0.0726	-0.3407	-1.6494	-0.6955	-1.2275	-1.0500	0.8670	-1.2517	-0.2424	-0.0001	-0.0029	0.9035	-1.3287	1.0207	-0.9776	0.5591	-0.3060	-0.5023	-0.8809
35NJFQ07	0.0221	0.7801	-0.5042	-0.5444	0.0306	-0.1203	1.2064	-0.4040	-0.1353	0.0662	-0.2464	1.1167	-0.4731	0.1529	0.1231	-0.5972	-0.8419	-0.3550	0.0306	-1.0611	-0.6651	0.0784	-0.5036	-2.2274	-0.5867	-1.1020	-0.9432
35NJFR01	0.2901	-1.6659	1.3010	-1.3693	-0.1574	-0.4202	-0.2146	-1.8202	-0.0623	-0.5654	-1.4441	-0.7922	-2.2379	-1.3711	-0.1399	-1.6513	0.0477	-1.0666	-0.1574	0.8013	-0.2521	0.1389	-1.4548	-0.3950	-0.1132	-0.6828	-0.9493
35NJFR02	0.0002	-0.8405	-0.2903	1.1204	0.6929	-0.0017	0.0964	1.9974	-0.4527	-0.6453	-0.0102	0.9876	0.8994	0.6265	-0.5275	0.0000	0.7489	-0.9076	0.6929	-0.2016	-1.3739	-0.5782	-0.0666	0.6327	-1.9521	-0.6772	-0.7206
35NJFR03	0.6376	-1.1637	0.1640	-0.6180	0.7519	0.0055	0.1672	1.1268	-0.4099	1.0106	-0.8001	0.9246	1.7275	0.6840	-0.5275	0.0491	0.6268	-1.2242	0.7519	-0.7668	-0.6361	-0.5109	-0.0259	-0.6323	-1.3470	-0.6445	-0.7486
35NJFR04	0.0067	-1.6398	0.4989	-1.3688	-0.3199	0.6336	0.0245	-1.6453	-0.4305	-0.1465	-2.7228	0.3382	-2.2223	-1.3087	-0.5275	-1.7228	1.3571	-1.2851	-0.3199	0.0533	-1.1903	-0.3753	-1.5674	-0.1946	-1.5656	-1.6152	-0.7606
35NJFR05	1.2561	-1.5872	0.4401	-0.1953	1.3923	0.8924	1.4529	2.2420	-0.3869	0.0217	-0.0683	3.7378	1.9769	1.6549	-0.5275	1.0654	0.9492	-1.0682	1.3923	-1.3962	-0.6893	-0.6002	0.8757	-0.1229	-1.4895	-0.3371	-0.7431
35NJFR06	0.7349	-0.7719	0.0137	1.1485	1.4526	0.0211	1.1092	2.5359	-0.3893	1.2159	1.1252	2.5829	3.3635	2.2634	-0.5275	1.7934	1.2592	-0.4184	1.4526	-1.2626	-0.6323	-0.8910	1.4917	1.0308	-1.7133	0.1469	-0.7291
35NJFR07	1.1019	-1.4336	0.3695	-0.1969	1.2703	0.6030	0.3958	2.5187	-0.0706	1.1735	-0.1721	2.2891	3.6194	1.9199	-0.5275	1.3307	1.1144	-0.9529	1.2703	-0.6335	-0.9739	-0.7604	1.0691	0.7963	-1.7543	-0.1330	-0.7206
35NJFR08	0.6980	-1.5970	1.0994	-0.1808	0.9471	1.4627	0.9651	2.3773	-0.0324	0.7984	0.3096	3.3749	3.1433	2.2501	-0.1059	0.8420	1.1404	-1.1966	0.9471	-1.3309	0.1614	-0.5489	0.7189	-0.4400	-0.3875	0.0557	-0.6771
35NJFS01	-0.2439	0.4290	-0.4538	-0.5590	0.1796	0.2344	0.1279	-1.1217	0.2569	0.0273	-0.8277	0.5419	-0.8376	-0.3055	0.9652	-0.6892	0.0154	0.0509	0.1796	0.4336	-0.8060	0.3676	-0.4740	0.6793	-0.4384	-0.2864	-0.9904
35NJFS02	-0.4494	0.4902	-0.4531	0.2376	-0.4610	0.0084	-1.0613	0.5380	0.0302	-0.3821	-0.1748	-1.5139	0.1661	-0.4663	0.8492	-0.3576	-0.0604	0.8527	-0.4610	1.5737	-1.3500	1.4292	-0.2007	1.8650	0.0792	0.4105	99.0000
35NJFS03	-0.0008	0.3812	-0.6661	0.0276	-0.2930	-0.4318	0.1972	-0.6035	-0.3764	-0.5524	-0.2579	-0.6276	-1.5323	-0.7511	0.0003	-1.2813	0.0862	0.2872	-0.2930	-0.2979	-1.3066	0.7639	-1.0973	-0.2175	-0.6426	-0.8743	-1.0403
35NJFS04	-0.6143	-0.1582	-0.5512	0.0042	-0.5977	-0.3221	-0.7410	-1.3485	-0.2985	-0.4535	-1.3195	-1.6608	-2.1005	-1.5938	0.8492	-1.2873	-0.6600	-0.2630	-0.5977	1.1287	-0.8091	1.1034	-1.0096	-0.3920	0.2943	-0.4557	-1.0375
35NJFS05	-0.5529	0.2095	-0.3520	0.3086	-0.6750	0.3859	-0.3359	-1.0689	-0.2445	0.1058	-0.3868	-0.6281	-1.2276	-0.7153	0.6781	-1.1702	-0.1733	-0.0062	-0.6750	0.2580	-1.0611	0.1084	-0.9298	-0.5965	-0.9527	-1.0904	-0.9890
35NJFS06	-0.4790	1.1049	-0.5428	-0.1476	-0.8181	-0.3836	-0.9243	-0.1092	-0.3317	-0.4962	-0.0645	-2.1260	-0.9371	-1.0372	0.6465	-1.0426	-0.3308	1.1314	-0.8181	0.6117	-1.2281	0.0005	-0.8232	0.5942	-1.2276	-0.8769	-0.9838
35NJFT01	-0.1235	-0.1615	0.6642	-0.0053	-0.0973	-0.4143	-0.0227	-1.6599	-0.4066	-0.3487	0.2639	-0.5343	-2.4171	-0.9178	0.4994	-1.1666	-0.6993	-0.3733	-0.0973	-0.0423	-1.1265	0.5349	-0.9602	-1.2122	-0.5916	-1.0740	-0.9458
35NJFT02	-1.1070	1.0600	-0.7980	-0.1790	-0.7565	-0.0003	-0.6026	-0.7619	0.3441	-0.4415	-1.0240	-1.3584	-0.8592	-0.9952	0.9253	-0.4795	-1.0060	-0.0942	-0.7565	0.5497	-1.1127	-0.6493	-0.3090	-1.3060	-1.7620	-1.3620	-0.7992
35NJFT03	0.7469	-0.8903	0.4672	-1.2865	-0.3272	-0.2376	-0.6030	-1.7541	0.2013	-0.6661	-0.9527	-1.1678	-2.2189	-1.3671	-0.5275	-1.2984	1.0035	-0.5279	-0.3272	0.6721	-1.3326	0.8989	-1.1962	1.0205	-0.3337	-0.5106	-0.8036
35NJFT04	0.0215	0.8754	-0.7921	0.0050	-0.4064	-0.4953	0.9024	1.3395	-0.1340	0.4996	0.1098	0.0017	1.7051	0.5964	-0.5146	0.2498	-0.0691	-0.1744	-0.4064	-0.8909	-1.3219	-0.0116	0.1496	-1.5398	-1.3336	-0.9769	-0.7366
35NJFT05	0.8646	0.0051	0.6728	0.0083	-0.2111	-0.5002	-0.2231	-0.1098	-0.4774	-0.6747	1.5508	-0.9344	-1.2619	-0.3444	-0.5275	-0.6953	0.4468	0.3029	-0.2111	-0.1692	-1.2164	-0.9072	-0.5865	0.3794	-2.1226	-1.2597	-0.7939
35NJFT06	-0.1361	-0.4558	-0.7630	-0.8277	0.0000	0.0068	-0.9543	-1.8344	-0.0211	-0.1502	-2.1826	-0.9485	-2.0067	-1.5304	-0.5275	-1.7933	0.2584	-0.3940	0.0000	1.4242	-1.5303	1.0455	-1.6287	1.2886	-0.4848	-0.7346	-0.8080
35NJFT07	-0.6764	1.5836	-0.4870	1.1912	-0.7441	-0.0036	0.6148	1.6605	-0.3656	0.0568	1.7124	-0.1331	1.3517	0.8343	0.2038	1.1159	-1.2657	1.4803	-0.7441	-0.6726	-1.1376	0.0006	0.9973	-1.2021	-1.1371	-0.3704	-0.9270
35NJFT08	-0.2632	-0.0789	-0.4058	0.0823	-0.4406	-0.2505	-0.9510	-0.8233	-0.2320	-0.3646	-0.6658	-1.6420	-1.4199	-1.1870	0.9591	-1.0662	-0.6266	0.0719	-0.4406	1.2129	-0.3614	0.5656	-0.8029	0.2177	0.1841	-0.2560	-0.9660
35NJFU01	-0.7649	-0.7947	-0.3693	-1.2738	-0.3551	-0.0016	-0.7386	-1.3928	-0.2856	-0.4366	-3.2027	-1.0952	-2.1160	-1.8707	0.8629	-1.2661	-0.9171	-0.7676	-0.3551	1.1287	-1.1246	1.2002	-0.9893	-0.9110	0.0756	-0.8846	-0.3424
35NJFU02	-0.5036	-0.7080	-0.0076	-0.7868	-0.6630	-0.3836	-0.4706	-0.8708	-0.0049	0.1581	-2.0059	-1.5074	-0.7176	-1.2431	-0.1202	-1.0442	-0.1767	-0.2112	-0.6530	0.8510	-0.6780	0.5349	-0.9241	-0.1899	-0.1431	-0.5811	-0.2057
35NJFU03	-0.8830	1.1104	-0.8814	0.1983	-0.7633	-0.5146	-0.7931	-1.7040	-0.4881	-0.4916	-0.4557	-2.0710	-2.6839	-1.6989	-0.2841	-1.4991	-0.7974	0.8883	-0.7633	0.9603	-1.1988	0.4916	-1.3326	0.2879	-0.7072	-0.9479	-0.0036
35NJFU04	-0.5652	1.9556	-0.9996	1.7415	-0.3356	-0.5050	-0.9541	2.0050	0.6764	0.0000	2.1323	-1.7947	2.6804	0.8283	-0.4482	1.4778	-1.0298	0.9363	-0.3356	0.9262	-0.8636	-0.0206	1.2274	0.4971	-0.8841	0.2959	0.6799
35NJFU05	-1.1761	0.3646	-0.9903	-0.2595	-0.8052	-0.1706	-0.1962	-1.4299	0.2276	-0.4432	-2.0601	-1.1710	-1.6456	-1.4639	-0.5276	-0.7628	-1.1686	0.7176	-0.8052	-0.0416	-1.0199	0.2235	-0.7320	-1.2978	-0.7964	-1.0887	0.2022
35NJFU06	-1.1655	0.5989	-1.0606	0.6193	-0.7591	-0.1241	0.3793	-1.6788	-0.1175	-0.6283	-1.0079	-0.5039	-2.4246	-1.2281	-0.5197	-0.7221	-0.9656	0.2714	-0.7591	-0.5637	-1.2453	-0.2663	-0.6958	-2.0170	-1.5116	-1.6080	0.7624
35NJFW01	-0.7857	0.5130	-0.5614	0.0111	-0.7493	0.0000	-0.3307	-0.0808	-0.2949	0.0116	-0.8230	-1.0800	-0.3642	-0.6872	1.1346	-0.6087	-0.4556	0.3907	-0.7493	0.3716	-0.9546	1.0302	-0.3821	-0.4427	0.0757	-0.2639	-0.9386
35NJFW02	-0.6026	-0.0163	-0.0053	-0.0629	-0.1651	-0.1706	-0.7980	1.3408	0.8862	-0.3870	-0.6871	-1.1237	1.8390	0.0667	-0.4671	-0.6911	0.0571	-0.1947	-0.1551	0.5269	-1.0111	0.0443	-0.6620	0.2342	-0.9668	-0.7559	-0.9363
35NJFW03	-0.3986	0.4096	-0.3251	-0.1233	0.0054	-0.2237	-0.3129	-1.1332	-0.2103	-0.3346	-0.4374	-0.6312	-1.6780	-0.8458	0.3044	-1.0910	-0.1341	0.4187	0.0054	0.8819	-0.9290	-0.1414	-0.9098	1.1719	-1.0704	-0.6970	-0.9992
35NJFW04	-0.7260	0.1672	-0.9670	-0.5637	-0.1738	-0.3641	-0.8729	0.0007	0.1814	-0.5151	-2.0895	-1.4108	-0.3330	-1.1036	0.0471	-0.9095	-0.5535	-0.3473	-0.1738	1.3660	-0.9380	0.6135	-0.7851	0.2914	-0.3225	-0.4810	-0.8160
35NJFW05	-0.1902	-0.4630	0.2058	-0.4003	-0.5899	-0.2418	-0.9328	-0.7042	-0.2058	-0.3283	-0.8477	-1.7646	-1.2383	-1.2129	0.1111	-1.0802	0.1161	0.0117	-0.5899	1.3218	-0.6262	-0.0004	-0.9263	0.6597	-0.6266	-0.5610	99.0000
35NJFW06	-0.9811	0.0122	-0.1491	-0.7744	-0.1167	-0.2418	0.2952	-1.2760	0.0637	-0.3407	-1.8914	-0.0633	-1.5330	-1.0050	-0.0282	-1.2359	-0.5931	-0.3200	-0.1167	-0.0470	-0.9721	-0.2390	-1.0789	-1.0768	-1.2111	-1.4142	-0.2772
35NJFW07	-1.0585	0.2227	-0.4501	-0.1490	-0.2109	-0.1163	0.0039	-1.5678	-0.4028	-0.5861	-1.4349	-0.3233	-2.5557	-1.3184	0.3382	-1.4424	-0.3346	-0.4067	-0.2109	-0.2821	-1.0779	0.0076	-1.2109	-1.2343	-1.0704	-1.4492	-0.2104
35NJFX01	-0.6440	-0.1946	-0.2440	-1.0258	-0.5806	-0.3147	-0.7127	-1.1898	-0.2912	-0.4439	-2.1084	-1.6080	-1.9249	-1.7047	0.0906	-1.0198	0.1602	-0.2203	-0.5806	0.1162	-1.1113	0.2792	-0.8756	-0.5245	-0.8321	-0.9849	-0.8517
35NJFX02	-0.3982	0.4081	-0.5937	-0.0810	-0.4236	-0.0038	-0.9460	-0.1175	-0.3039	-0.1470	-0.6648	-1.3734	-0.5684	-0.8135	0.8840	-0.9282	-0.7430	0.0346	-0.4236	1.0133	-0.9959	0.3621	-0.6926	-0.1167	-0.6338	-0.6929	-0.8046
35NJFX03	0.4939	-0.2123	0.2184	-0.0072	-0.3610	-0.1203	1.0785	-0.9187	-0.0966	0.7986	0.4928	0.6072	-0.2167	0.2534	1.1972	-0.5492	-0.0628	-0.5989	-0.3610	-0.7644	-0.6651	0.6899	-0.3222	-1.7769	0.0248	-0.5929	-0.6840
35NJFX04	-0.7260	-1.0567	0.0313	-0.9216	-0.6530	-0.3641	-0.8729	-0.5728	-0.3249	-0.4876	-2.8730	-1.8900	-1.3863	-1.7600	1.1536	-1.3743	-0.1306	-0.5900	-0.6530	1.1000	-1.1981	1.3159	-1.0467	-0.2736	0.1178	-0.5324	-0.7778
35NJFX05	-0.4217	-0.0297	0.0000	-0.2295	-0.5398	-0.3147	-0.1145	-0.2285	-0.2762	-0.4241	-0.6809	-0.9690	-0.9288	-0.8028	0.9305	-1.2805	-0.4677	0.0037	-0.5398	0.7654	-1.0512	0.3167	-0.9931	-0.2384	-0.7345	-0.9234	-0.8467
35NJFX06	-1.2370	-0.0010	0.0256	-0.7197	-0.6677	0.1743	-1.0158	-1.5246	-0.3300	-0.4941	-1.9321	-1.6090	-2.3497	-1.7689	0.7689	-1.2906	-0.2527	-0.0775	-0.6677	1.2895	-1.1892	1.0680	-1.0242	0.2916	-0.1212	-0.4998	-0.8509
35NJFY01	-0.1459	-0.1336	0.0001	0.4323	-0.5325	-0.1853	0.1622	-1.1795	0.1899	-0.2817	0.1629	-0.5556	-1.2714	-0.5708	1.3147	-0.6437	-0.4119	0.2803	-0.5325	-0.2956	-0.8575	0.7679	-0.3891	-0.9597	-0.0896	-0.4793	-0.8609
35NJFY02	-0.0016	-0.0358	0.0000	-0.6350	-0.3953	-0.1318	-0.0369	-0.9870	-0.1191	-0.2008	-0.6724	-0.5630	-1.3069	-0.7914	-0.5067	-1.1328	0.2139	-0.1650	-0.3953	0.4817	-0.7013	0.2759	-1.0512	0.1353	-0.4264	-0.7045	-0.8534
35NJFY03	-0.3546	-0.0446	0.1277	-0.3176	-0.1623	0.1277	-0.9857	-1.1667	0.5793	-0.5089	-0.5890	-1.0203	-1.0963	-0.8528	0.7219	-0.9412	0.4522	-0.2895	-0.1623	0.8799	-1.2197	0.8169	-0.7260	0.8803	-0.4028	-0.3438	-0.8484
35NJFY04	0.0328	-0.2068	0.2921	-0.2974	-0.0235	0.1613	0.2118	-0.1549	0.2343	-0.6514	-0.1793	0.3494	-0.5720	-0.1190	-0.0160	-0.8940	0.0591	-0.1065	-0.0235	-0.1368	-1.3292	0.6256	-0.7797	-0.2097	-0.5036	-0.6941	-0.8484
35NJFY05	-0.9544	0.1351	-0.1694	0.6315	0.1584	-0.2328	-0.9215	-1.2706	-0.2103	-0.3346	-0.3572	-0.9959	-1.8164	-1.0264	1.0660	-0.9802	-0.0251	0.3221	0.1584	1.0940	-0.9569	0.1834	-0.7142	1.6494	-0.7736	-0.3565	-0.7966
35NJFY06	-0.0633	0.7133	-0.6143	0.3235	-0.1002	-0.0146	-0.7417	0.0652	1.9763	-0.4765	0.3592	-0.8565	1.5560	0.3226	0.3857	-0.8105	-0.0173	0.2478	-0.1002	0.9673	-1.1144	0.7343	-0.6550	1.0976	-0.3901	-0.2432	-0.8071
35NJFZ01	0.0104	0.6102	-0.2072	0.9697	-0.2269	0.0486	0.0096	1.2734	-0.4057	0.1724	1.3931	-0.1687	1.0401	0.6362	-0.4962	-0.1090	0.6485	0.5666	-0.2269	0.0480	-1.2933	-0.0565	-0.1593	1.0362	-1.3498	-0.4955	-0.5279

ED	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	HEALTH	SOCECON	ENV	NEED	A1	A2	A3	A4	A5	A6	A7	A8	TRANSP	PERMOB	AWARE	ACCESS	PROVIS
35NJFZ02	-0.7948	-1.4089	0.4848	-1.0651	0.4113	-0.4540	-0.0667	-1.6275	-0.3898	-0.0678	-2.7840	-0.0984	-2.0861	-1.4238	0.6106	-1.3788	0.7122	-1.1023	0.4113	0.8721	-1.2128	0.4138	-1.1202	0.6933	-0.7990	-0.7363	-0.4313
35NJFZ03	0.2388	-0.9206	-0.0229	-0.5691	0.3210	-0.1066	1.0198	1.5116	-0.3764	0.7662	-1.2759	1.2322	1.9013	0.7265	0.7864	-0.8648	0.6422	-0.9307	0.3210	-1.2169	-0.8827	0.0466	-0.6501	-1.2643	-0.8361	-1.0642	-0.8306
35NJFZ04	-0.0981	-0.6678	-0.2522	-0.5249	-0.7592	-0.0656	-0.2215	0.7828	-0.3749	-0.2846	-1.5428	-1.0663	0.1231	-0.7001	-0.0614	-0.6919	0.6556	-0.8782	-0.7592	0.6732	-1.1909	-0.0399	-0.6126	-0.3086	-1.2308	-0.9988	-0.5820
35NJFZ05	-0.1756	1.4762	-0.8328	0.2337	-0.6920	-0.4023	-0.8327	0.6756	0.3792	-0.3461	0.7016	-1.9270	0.7097	-0.2307	1.1945	0.6191	-1.0213	0.8717	-0.6920	0.8956	-0.9076	-0.0399	0.6939	0.0539	-0.9476	-0.1133	-0.6840
35NJGA01	-0.9143	0.5998	-0.2404	-0.9716	-0.3244	-0.3221	-0.1371	-1.0039	-0.2743	-0.4218	-1.5267	-0.7836	-1.6998	-1.2095	1.1108	-1.2298	-0.4792	1.3366	-0.3244	0.0464	-0.7201	0.7754	-0.9247	0.6794	0.0563	-0.2899	99.0000
35NJGA02	0.3957	0.3938	-0.2685	0.7179	-0.2840	-0.0963	-0.5703	-0.8070	0.8628	-0.1322	1.2387	-0.9506	-0.2864	-0.1027	1.0770	-0.4538	0.2265	0.8307	-0.2840	0.0000	-0.5999	-0.1678	-0.2548	0.7732	-0.7677	-0.3180	-1.0904
35NJGA03	-0.3890	-0.4216	-0.3146	-0.6347	-0.0281	-0.2591	0.0285	0.7364	1.4093	-0.0422	-1.9597	-0.2607	2.1036	0.1243	0.8964	-0.3740	-0.0783	0.2738	-0.0281	0.4196	-0.8276	0.8437	-0.2090	0.5870	0.0162	0.0504	-1.1443
35NJGA04	0.0259	-1.0698	-0.1841	-0.4484	-0.0114	-0.0656	-0.3240	-1.0716	0.1123	-0.0463	-1.6964	-0.4210	-1.0055	-0.8996	-0.6275	-1.3868	0.5476	-0.8749	-0.0114	0.5947	-1.1353	0.2372	-1.2751	0.2560	-0.8981	-1.0226	-1.0898
35NJGA05	-0.0334	0.9744	-0.1970	-1.0292	0.1878	-0.3147	-0.4793	-1.2860	-0.2508	-0.3899	-0.2852	-0.6062	-1.9065	-0.9089	0.2705	-1.3211	-0.0185	1.7492	0.1878	0.5110	-1.0403	0.6652	-1.1142	2.4295	-0.3751	-0.1373	-1.0878
35NJGB01	0.0092	-0.4272	-0.4930	-0.0692	0.6490	-0.1066	0.4540	1.8138	-0.4014	0.0070	-0.9812	0.9934	1.4192	0.5589	0.2593	-0.1577	0.6039	-0.7782	0.6490	-0.9556	-1.3184	-0.3922	-0.1035	-0.2819	-1.7106	-0.9775	-1.0277
35NJGB02	0.4992	0.3121	0.0013	-0.1174	-0.1643	-0.1552	0.5243	1.2683	-0.4640	-0.4498	0.6962	0.2148	0.3645	0.3636	-0.6275	-0.0618	-0.0027	-0.0630	-0.1543	-0.9678	-1.1902	-0.8436	-0.1222	-1.1778	-2.0337	-1.3724	-1.0214
35NJGB03	0.6742	1.1101	0.1135	0.9452	-0.8000	-0.4318	0.9324	-0.2122	0.5562	-0.6469	2.8430	-0.2994	-0.3029	0.5100	-0.6275	0.6379	-0.6417	1.3951	-0.8000	-0.5684	-0.5268	0.5690	0.3994	-0.6150	0.0432	0.0676	-1.0284
35NJGB04	0.1457	-1.4235	1.2606	-1.6182	-0.9744	0.2703	0.7073	-1.8382	0.0206	-0.3992	-1.5334	0.0032	-2.0149	-1.0539	1.1707	-1.6563	-0.2873	-0.9741	-0.9744	-0.3765	-1.3000	0.2631	-1.2009	-2.6123	-1.0469	-1.7770	-1.0598
35NJGB05	0.0044	0.7653	-0.4251	0.0614	-0.6066	-0.3838	0.5512	-1.5950	-0.0363	-0.2757	0.3960	-0.4390	-1.9060	-0.6827	0.7373	-0.8303	-0.1560	0.6138	-0.6066	-0.8626	-1.1768	-0.0399	-0.6285	-1.1014	-1.2165	-1.1989	-0.9970
35NJGC01																											-1.1443
35NJGC02	-0.9828	-0.6054	-0.4621	0.0726	-0.4603	-0.0146	-0.0719	-0.1400	0.6536	0.0001	-1.9677	-0.6468	0.6137	-0.6030	1.0613	-1.2356	-0.8242	-0.6479	-0.4603	0.1116	-0.9833	0.2372	-0.9370	-1.7209	-0.7461	-1.2718	99.0000
35NJGC03	0.6015	-0.0147	-0.0341	-0.6282	-0.2748	-0.0963	-0.6438	-0.1516	-0.0769	0.3469	-0.1755	-0.9149	0.1194	-0.3090	1.0306	-0.4145	0.1562	0.4127	-0.2748	0.0000	-0.6727	-0.0634	-0.2268	0.2941	-0.6361	-0.3578	-1.1068
35NJGC04	0.6555	-0.0677	-0.4686	-0.2149	-0.2164	-0.0709	-0.4628	-0.6780	-0.0610	-0.0906	-0.0867	-0.7391	-0.8196	-0.6410	1.3914	-0.8086	0.1879	-0.0903	-0.2164	0.1091	-0.4791	0.9138	-0.5226	-0.0087	0.4347	-0.0461	-1.0878
35NJGC05	-0.6589	0.8551	-1.0651	0.0274	-0.6562	-0.2767	-0.8038	1.0606	0.0378	-0.0422	-0.9396	-1.7357	1.0762	-0.4297	1.1608	-0.3261	-0.5552	-0.1630	-0.6562	0.7099	-1.0377	0.3958	-0.1328	-0.6656	-0.6519	-0.5587	-1.1042
35NJGC06	-0.6398	0.2821	-0.4857	-0.5789	-0.6904	0.0000	-0.1176	-1.7338	-0.4602	-0.6544	-1.4223	-0.8080	-2.8494	-1.5744	0.0624	-1.4793	-0.2388	0.2294	-0.6904	0.5358	-1.3862	0.5863	-1.2802	-0.1640	-0.7989	-1.0806	-0.9838
35NMFA01	-0.2529	-0.6734	0.0101	-0.4869	-0.5062	-0.1008	-1.1628	-1.4911	0.0629	0.4823	-1.4031	-1.7688	-0.9259	-1.2490	-0.6275	-0.7044	0.2475	-0.2275	-0.5052	1.2228	-0.0460	0.3837	-0.6814	0.7374	0.3387	0.0130	1.2861
35NMFA02	-0.9504	1.2869	-0.2095	-0.0626	0.0183	-0.0707	-0.9187	-1.0367	-0.3794	-0.2933	0.0644	-0.9711	-1.7094	-0.8774	-0.6275	-0.2984	-0.6259	1.4038	0.0183	0.8605	-1.1646	0.4821	-0.3282	1.7568	-0.6824	-0.0661	1.2711
35NMFA03	-0.6300	1.7260	-0.0384	-0.1330	-0.6616	0.0268	-1.1829	-1.4373	0.4223	-0.6727	0.9246	-1.8177	-1.5877	-0.9040	-0.6275	-0.2616	-1.1513	1.9619	-0.6616	1.2460	0.0760	0.4821	-0.2874	1.3950	0.5581	0.4641	1.1686
35NMFA04	0.2076	-0.6456	0.5537	0.3542	0.1323	0.3340	0.0202	-1.6409	2.5662	1.9087	0.2698	0.4665	2.6540	1.1810	-0.6275	1.3328	-0.1518	-0.4739	0.1323	-0.4011	2.1166	1.0472	1.0910	-0.8946	3.1638	1.9038	1.2418
35NMFA05	-0.0598	-1.0049	0.8190	-0.3186	-0.3446	0.9888	0.4958	-1.6566	2.1961	0.7561	-0.5841	1.1401	1.2956	0.6709	-0.6275	1.2573	-0.9197	0.1264	-0.3445	-0.8377	0.7950	0.7639	1.0253	-1.9755	1.5589	0.7992	1.2711
35NMFA06	-0.0556	0.6873	-0.1187	0.1459	-0.3445	0.6030	-0.8241	-1.6105	0.8668	0.0868	0.8598	-0.5656	-0.6571	-0.1929	-0.6275	0.2125	-0.9374	1.0639	-0.3445	1.1029	1.0831	0.7311	0.1163	0.8849	1.8142	1.1865	1.2963
35NMFA07	0.0000	0.6282	0.4032	-0.0234	0.0263	-0.4699	-0.4966	-1.7125	2.2791	1.3909	1.0080	-0.9402	1.9675	0.6911	-0.6275	1.1965	-0.8684	1.7793	0.0263	0.6190	2.3836	0.3163	0.9724	1.4562	2.6989	2.1997	1.3417
35NMFA08	-0.8719	0.6709	0.4661	0.5866	0.0019	-0.0247	-0.0011	-1.6299	0.4287	0.2197	0.8507	-0.0239	-0.9835	-0.1231	-0.6275	1.4402	-1.3498	0.8271	0.0019	-0.3898	1.4147	-0.1713	1.1914	-0.9106	1.2434	0.9898	1.3331
35NMFA09	0.0755	-0.5169	0.7385	0.0961	0.1607	0.5800	0.0161	-1.6081	-0.0107	-0.5047	0.3942	0.7468	-2.0235	-0.3270	-0.6275	0.7208	-0.4063	-0.6514	0.1507	-0.4931	1.9435	-0.7690	0.5585	-1.3991	1.1745	0.6167	1.2346
35NMFA10	-0.4612	0.8711	0.9161	0.7201	-0.4871	0.9398	-0.0337	-1.6964	1.5144	-0.0027	1.6461	0.4190	-0.1947	0.5396	-0.6275	1.3658	-0.9514	1.0601	-0.4871	-0.0423	1.6560	0.3475	1.1197	-0.4007	2.0035	1.4614	1.2407
35NMFA11	-0.7100	1.7318	0.2548	1.1998	-0.0760	0.1743	0.6062	-1.6496	0.3919	0.1815	2.4764	0.7055	-1.0752	0.4959	-0.6275	1.8495	-1.5803	1.5379	-0.0760	-0.9949	0.0279	0.1568	1.3665	-1.1123	0.1847	0.4975	1.2894
35NMFA12	0.0547	-0.2630	0.5318	-0.1254	-0.2794	0.8465	1.0700	-1.6732	0.0421	0.9887	0.1961	1.6371	-0.6424	0.3811	-0.6275	0.8636	-0.5860	-0.3518	-0.2794	-1.0461	2.6835	0.4110	0.6828	-2.2633	3.0945	1.3228	1.3089
35NMFA13	-0.3476	-0.2873	0.8193	0.6198	-0.0090	0.4340	-0.5920	-1.6764	1.0394	1.2794	0.6040	-0.1670	0.6414	0.3691	-0.6275	1.0569	-0.8649	-0.6128	-0.0090	0.5687	2.9874	0.8268	0.8509	-0.9180	3.8142	2.1031	1.3031
35NMFA14	-0.0079	1.1692	0.0781	0.9226	-0.0006	0.4782	0.3117	-1.5965	1.7842	0.0060	2.1620	0.7893	0.1937	0.6692	-0.6275	1.3812	-1.1805	0.8061	-0.0006	-0.2354	1.2316	-0.4545	1.1331	-0.8104	0.7771	0.8025	1.3120
35NMFA15	-0.0309	1.3041	0.1212	-0.2286	-0.0760	-0.4143	-0.4260	-1.6242	1.1640	-0.0939	1.1658	-0.9153	-0.5641	-0.2017	-0.6275	1.0145	-0.8468	1.7693	-0.0760	0.1561	1.4880	0.3122	0.8140	1.0036	1.8002	1.6580	1.2081
35NMFB08	0.1528	-1.2824	0.2355	-0.7376	0.1078	-0.2676	0.0079	-1.2972	-0.2213	-0.0170	-1.6317	-0.1520	-1.5355	-0.9704	-0.6275	-1.2158	0.8212	-0.8606	0.1078	-0.1335	0.6227	-0.2390	-1.1263	-0.0553	0.2837	-0.4351	0.0398
35NMFB09	-1.0762	1.1570	-0.7421	-0.4619	-0.6339	-0.2084	-1.2946	-1.7700	-0.1831	-0.6618	-1.1432	-2.1369	-2.6349	-1.8764	-0.6275	-0.8303	-0.6349	0.3911	-0.6339	1.3827	-1.0274	0.9041	-0.7909	0.6050	-0.1233	-0.3059	0.1848
35NMFB10	0.8094	-1.7075	1.3964	-1.1285	-0.0973	0.0119	-0.9230	-1.6599	-0.4127	-0.3666	-0.6312	-1.0084	-2.4292	-1.3037	-0.6275	-1.5729	0.9621	-1.2601	-0.0973	1.3010	-0.0007	-0.2194	-1.4370	0.9057	-0.2201	-0.6021	0.0549
35NMFB11	1.1272	1.7239	-0.8580	1.5763	1.2398	-0.1241	0.1740	2.6333	-0.4318	0.0969	3.5684	1.2897	2.2984	2.0881	-0.6275	2.0198	1.4626	0.6775	1.2398	-0.7382	-0.4376	-0.6162	1.6887	2.6417	-1.0638	0.9779	0.1201
35NMFB12	-0.3147	-0.8630	0.0703	-0.7875	-0.4617	0.0109	-0.0037	-1.0690	-0.5420	0.0187	-1.8949	-0.4446	-1.6123	-1.1593	-0.6275	-1.1001	0.0853	-0.6793	-0.4617	0.4642	-0.4310	0.1073	-1.0257	-0.5916	-0.3237	-0.8226	0.2067
35NMFB13	1.3366	-1.8191	0.8945	-1.2806	1.7010	-0.0001	0.0205	1.4036	-0.4291	0.9497	-0.8687	1.7214	1.9242	0.9980	-0.6275	-0.2342	1.6229	-1.1723	1.7010	-0.3561	1.0512	-0.7021	-0.2723	1.7956	0.3491	0.4873	0.1689
35NMFB14	1.4463	-1.3948	0.0004	-0.0362	1.3872	0.7832	-0.0082	2.2053	-0.4652	1.9980	0.0177	2.1622	3.7381	1.9712	-0.6275	1.4566	1.9025	-1.1606	1.3872	-1.0809	1.3809	-0.1362	1.1987	1.0592	1.2447	1.4863	0.1489
35NMFB15	0.9954	-0.4921	-0.0584	0.6541	1.0638	0.0005	0.2378	2.4021	-0.4346	0.9326	1.0890	1.3019	2.9002	1.6730	-0.6275	1.3077	1.5231	-0.5993	1.0638	-0.2529	0.7487	-0.2891	1.0691	1.7347	0.4596	1.1980	0.1305
35NMFB16	0.9141	0.4402	0.0482	1.4659	1.5271	0.1724	0.4941	2.7048	-0.3272	0.7646	2.6694	2.1936	3.1421	2.4957	-0.6275	1.9344	1.4486	0.3479	1.5271	-1.0733	0.0000	-0.7143	1.6144	2.2603	-0.7143	1.0126	0.0875
35NMFB17	0.6057	-1.4260	0.6694	-1.4930	1.0276	-0.2231	0.0372	-1.6763	-0.4224	-0.1297	-1.4459	0.6417	-2.2274	-0.8229	-0.6275	-1.5286	1.5547	0.4141	1.0276	0.5446	0.9828	-0.0738	-1.3985	3.5410	0.9090	0.6405	0.0820
35NMFB18	0.0015	-1.6286	0.8480	-0.8316	-0.3262	-0.4699	-0.1351	-1.6202	-0.3869	-0.5654	-1.6107	-0.9302	-2.5726	-1.5702	-0.6275	-1.6950	0.7790	-0.9540	-0.3252	0.6452	0.9366	0.8256	-1.5432	0.1460	1.7622	0.1458	0.3532
35NMFB19	-0.0961	-1.5610	1.4378	-0.5585	0.4418	-0.4430	0.0379	-1.3868	-0.4437	0.7286	-0.7768	0.0387	-1.1016	-0.5491	-0.6275	-1.4266	-0.0030	-1.1914	0.4418	0.3627	-0.0036	-0.0026	-1.3097	-0.3899	-0.0062	-0.7564	0.1295
35NMFB20	1.0897	-0.8216	0.2989	0.2359	1.1797	0.1527	1.2064	2.3923	-0.2970	0.9639	0.8029	2.5388	3.0492	2.0634	-0.6275	1.5643	1.6532	-0.0207	1.1797	-1.4602	1.6943	-0.5637	1.2924	1.3520	1.1406	1.5545	0.1348
35NMFC01	-0.4698	-1.8195	0.3342	-1.4369	-0.3925	0.5676	0.1685	-1.7165	-0.4463	-0.0112	-3.3920	0.3536	-2.1740	-1.4546	-0.6275	-1.6231	1.3821	-1.1938	-0.3925	0.3521	-0.2817	-0.1495	-1.4807	0.1579	-0.4312	-0.9165	0.7486
35NMFC02	0.7441	-1.2100	1.0657	-1.6349	-0.6446	-0.6330	1.0752	-1.7065	-0.4411	-0.4088	-1.0361	-0.1023	-2.5664	-1.1460	-0.6275	-1.4685	0.9275	0.7061	-0.6445	-0.8113	-0.7831	-0.0003	-1.3462	0.1778	-0.7834	-1.0204	0.7605
35NMFC03	-0.2157	-1.5132	0.6509	-0.8131	-0.4339	0.1735	1.3293	-1.6710	-0.4169	-0.3644	-1.8911	1.0689	-2.4623	-0.9339	-0.6275	-1.4958	1.1582	-0.7181	-0.4339	-1.3310	0.1734	-0.4341	-1.3699	-1.3248	-0.2607	-1.1465	0.7633
35NMFC04	0.0957	-1.6163	0.9377	-1.2643	-0.1175	0.1613	1.2169	-1.7980	-0.4552	0.4806	-1.6472	1.2597	-0.7726	-0.2994	-0.6275	-0.8745	0.7585	-1.0717	-0.1175	-0.7664	0.2177	-0.6379	-0.8294	-1.1971	-0.4202	-0.9241	0.7879
35NMFC05	0.2122	-1.5998	0.6200	-1.1113	-0.0402	-0.2518	-0.7310	-0.9131	-0.4652	-0.0328	-1.8779	-1.0230	-1.4109	-1.2808	-0.6275	-1.1373	1.1379	-1.0537	-0.0402	1.1123	-1.1093	-0.2301	-1.0580	1.1563	-1.3394	-0.9096	0.7823
35NMFC06	-0.9776	2.0180	-1.4450	1.4253	-0.2998	0.3340	-0.5108	0.7480	-0.0974	-0.0001	1.0208	-0.4766	0.6505	0.3132	-0.6275	1.4017	-1.2840	2.0473	-0.2998	0.2289	-1.2168	-0.4739	1.1509	0.6924	-1.6907	-0.0968	0.9238
35NMFC07	-0.8966	1.9836	-0.3924	1.5666	-0.3589	-0.4260	-0.2523	2.0927	-0.4398	-0.1682	2.2531	-1.0372	1.4767	0.7098	-0.6275	1.7346	-1.2698	0.6498	-0.3589	-0.6978	-0.9065	-0.8025	1.4405	-1.6767	-1.7090	-0.6534	0.9615
35NMFC08	-0.9740	-0.3080	-0.2435	-0.0240	0.1909	0.1736	0.6474	0.1887	-0.4615	-0.4454	-1.5495	0.9118	-0.7182	-0.3228	-0.6275	-0.6398	-0.6942	-1.1685	0.1909	-0.6902	-1.1424	-0.4341	-0.6252	-2.3620	-1.5765	-1.6914	0.9057
35NMFC09	-0.6252	-1.8841	0.1910	-1.2979	-0.2892	-0.2861	-0.3870	-1.7394	0.0026	-0.6598	-3.5962	-0.9623	-2.3966	-2.0184	-0.6275	-1.6610	0.3195	-1.3657	-0.2892	0.7991	0.4127	0.1572	-1.5136	-0.5363	0.5699	-0.6059	0.9025
35NMFC10	-0.2476	1.1686	-0.6356	1.5022	0.7123	0.6360	0.3632	2.1399	0.2694	-0.1774	1.7877	1.7116	2.2319	1.7614	-0.6275	1.3006	-0.9947	-0.0112	0.7123	-0.3561	-0.3686	-0.6456	1.0629	-0.6497	-0.9142	-0.0881	0.9262
35NMFC11	-0.7699	2.1252	-1.2361	1.8138	-0.6952	-0.0428	0.6618	-0.9327	-0.0777	-0.1020	1.9320	-0.0762	-1.1124	0.0870	-0.6275	1.4288	-1.6142	1.6578	-0.6952	-0.8947	-0.4687	-0.8986	1.1745	-1.5463	-1.3653	-0.4820	0.9409
35NMFD01	0.5395	1.0654	-0.0597	0.9226	0.3972	0.9899	1.2598	1.2994	1.1072	0.3883	2.3998	2.6446	2.7729	2.4031	-0.6275	1.7670	-0.2701	0.9564	0.3972	-1.3431	-0.8293	-0.2691	1.4687	-0.2596	-1.1184	0.1103	1.1042
35NMFD02	-0.6673	1.0736	0.6463	0.7260	-0.6019	0.3654	-0.2078	0.4060	2.1040	1.2333	1.6786	-0.4243	3.7433	1.5260	-0.6275	1.9123	-1.6576	0.9462	-0.6019	0.0256	1.7180	-0.0666	1.6951	-1.2876	1.8615	1.3064	1.1190
35NMFD03	0.2419	0.0289	1.0676	0.0860	-0.1961	0.3679	-0.0053	-1.6810	1.0689	-0.0047	1.4143	0.1676	-0.6168	0.2038	-0.6275	1.3665	-0.6170	0.1233	-0.1951	-0.3409	0.0000	-0.8131	1.1203	-1.0297	-0.8131	-0.1038	1.1087
35NMFD04	0.6519	-0.3632	0.4118	0.0766	0.0334	0.0574	1.0975	-1.6555	1.3164	1.2879	0.7771	1.1883	0.8478	0.9063	-0.6275	1.4288	-1.0445	-1.1331	0.0334	-1.0505	0.7517	-0.0001	1.1746	-2.1947	0.7516	0.4144	1.1145
35NMFD05	-0.0816	1.1021	0.4922	0.7872	-0.0185	0.9888	0.5354	-1.4975	2.1147	1.3597	2.2999	1.6057	1.9759	1.7355	-0.6275	1.5609	-0.7100	-0.2958	-0.0185	-0.6670	1.1004	-0.0084	1.3677	-1.6913	1.0920	0.8070	1.1254
35NMFD06	-0.6819	1.9984	-1.0903	1.7674	-0.2533	-0.0103	-0.9845	2.3978	1.4421	0.6417	1.9936	-1.2481	4.4714	1.5728	-0.6275	2.2881	-1.2631	1.7174	-0.2533	0.9311	0.8600	0.0050	1.9221	1.1321	0.8850	1.6766	1.1664
35NMFD07	0.9485	-0.5998	0.9783	0.9207	0.1973	0.0486	0.1856	-1.0063	0.6261	0.3364	2.2479	0.4316	-0.0468	0.8905	-0.6275	1.2987	-0.5388	-0.7912	0.1973	-0.2282	1.0025	-0.4739	1.0598	-1.3607	0.5286	0.4539	1.0891
35NMFD08	-0.3645	-0.2332	1.1942	-0.0085	-0.2989	0.3854	-0.0262	-1.5958	1.5558	-0.6598	0.5880	0.0604	-0.6988	-0.0658	-0.6275	1.7373	-1.5743	-0.5964	-0.2989	0.1724	1.4570	0.6659	1.4429	-2.2971	2.1229	1.2086	1.0959
35NMFD09	0.9494	-0.3089	0.3930	0.1913	-0.3637	0.2128	1.1168	-1.6873	0.6946	1.6489	1.1239	0.9657	0.5562	0.7893	-0.6275	1.4469	0.6531	-0.1697	-0.3637	-1.3985	2.6659	-0.3333	1.1902	-1.3778	2.3526	1.4270	0.8782
35NMFD10	-0.4432	2.0158	-0.3518	1.6379	-0.2742	0.8513	0.6683	0.6266	0.0403	0.1342	2.8587	1.2454	0.8011	1.3988	-0.2447	1.9725	-1.3498	1.5150	-0.2742	-0.2979	0.0735	-0.2194	1.6843	-0.4089	-0.1459	0.8676	0.8019
35NMFD11	-0.1563	2.2709	-0.2708	1.8016	-0.0821	-0.0038	-0.6750	2.0312	0.0629	-0.0912	3.6463	-1.3609	2.0029	1.1253	-0.6275	2.1916	-1.3902	1.9608	-0.6821	-0.6343	0.1863	-0.7672	1.6380	-0.7258	-0.5709	0.4521	0.8262
35NMFD12	-0.0001	1.0763	0.4475	0.7808	-0.3272	-0.1397	-0.0169	0.7423	0.5041	0.8116	2.2835	-0.4838	2.0579	1.0956	-0.6275	1.7690	-0.6421	0.6890	-0.3272	-1.0284	1.6500	-0.4545	1.4706	-1.3067	1.1955	1.0063	0.8517
35NMFD13	0.6186	0.6627	0.1509	0.6949	0.4629	0.0574	-0.0262	1.9050	0.6024	-0.4040	2.3171	0.4941	2.1034	1.4451	-0.6275	1.6239	-0.8285	-0.0581	0.4629	-0.2354	1.7526	-0.4739	1.3441	-0.6571	1.2787	1.1471	0.8750
35NMFD14	-0.7900	1.3576	0.7048	1.6129	-0.2633	1.0878	0.0379	2.7570	-0.4113	-0.1076	2.7853	0.8724	2.2382	1.7332	-0.6275	2.3577	-1.6903	1.2665	-0.2633	-0.4663	0.8907	-0.3534	1.9828	-1.1434	0.5373	0.9741	0.8228

ED	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	HEALTH	SOCECON	ENV	NEED	A1	A2	A3	A4	A5	A6	A7	A8	TRANSP	PERMOB	AWARE	ACCESS	PROVIS
35NMFD15	-0.4159	0.4519	-0.3312	1.7710	1.4768	1.3203	0.0114	2.8444	0.0421	0.0003	1.4768	2.8085	2.8868	2.2674	-0.5275	2.4974	-1.0662	0.3650	1.4768	-0.9836	2.0340	-0.7326	2.1042	-0.2080	1.3014	1.6508	1.0021
35NMFD16	-1.1646	2.5176	-1.3469	2.4070	-0.5401	0.6919	0.0058	2.9212	0.2518	-0.1913	2.4131	0.1576	2.9815	1.6496	-0.5275	2.6906	-1.8130	1.8487	-0.5401	-0.6653	0.1789	-0.7326	2.1852	-1.1697	-0.5537	0.5233	1.0634
35NMFD17	-1.1286	2.1235	-1.2482	2.1762	-0.4913	1.2702	0.1421	2.8717	-0.4345	-0.3968	1.9219	0.9210	2.0404	1.4676	-0.5275	2.6216	-1.6994	1.6207	-0.4913	-1.2508	1.3483	-0.5305	2.1264	-1.8208	0.8178	1.0164	1.0312
35NMFD18	-0.3036	1.9146	-0.9551	1.9766	0.1237	0.3606	0.0103	2.7169	-0.3824	0.5165	2.6316	0.4946	2.8490	1.7724	-0.5275	2.4666	-1.1469	1.3538	0.1237	-1.0611	0.9224	-0.6007	2.0773	-0.7304	0.3217	1.0169	0.8977
35NMFD19	-0.4182	0.0126	0.0001	0.0427	0.4049	0.4962	0.5123	1.7718	-0.2912	0.0152	-0.3629	1.4134	1.4956	0.8789	-0.5275	1.7781	-0.7494	-0.5367	0.4049	-0.6200	0.5249	-0.1124	1.4784	-1.4012	0.4126	0.5952	0.8517
35NMFE01	0.8336	0.0040	-0.3790	1.2740	1.2691	0.2286	0.1633	2.3336	-0.3163	0.0003	1.7326	1.8610	2.0176	1.8593	0.9644	1.4894	0.4513	-0.4839	1.2691	-0.5678	0.1423	-0.6493	1.4212	0.6687	-0.5070	0.6243	0.2724
35NMFE02	0.5379	0.7837	0.5686	1.4991	1.6746	0.3176	1.0831	2.6739	-0.4398	0.5379	3.3893	3.0761	2.7720	2.7964	-0.4018	1.7175	0.2769	0.6584	1.6746	-1.0169	1.2747	-0.0138	1.4420	1.5939	1.2609	1.7499	-0.1964
35NMFE03	0.0777	-0.0466	0.4761	0.7766	1.6516	-0.1008	0.0879	2.3481	-0.4291	0.3413	1.2858	1.6387	2.2603	1.6211	-0.5275	1.7208	-0.0141	-0.5741	1.6516	0.0000	-0.1446	-0.8720	1.4286	1.0634	-1.0166	0.4719	0.8462
35NMFE04	0.0000	1.9816	-0.2650	-0.0013	-0.3594	0.4196	-0.7724	2.0871	-0.4798	-0.4776	1.6952	-0.7122	1.1298	0.5630	-0.5275	1.5332	-0.9626	2.2680	-0.3594	0.4812	-0.8353	-0.5219	1.2653	1.4273	-1.4572	0.2609	0.7761
35NMFE05	0.9997	-1.1640	0.5879	0.0130	1.8069	0.7440	1.3631	2.2317	-0.4498	0.7108	0.4466	3.9140	2.4937	2.2476	-0.5275	1.8666	0.6230	-1.2192	1.8069	-1.6546	-0.3165	-0.9072	1.5554	-0.4439	-1.2227	0.0554	0.7459
35NMFE06	0.6006	1.5731	-0.2332	1.2167	1.2134	0.4033	0.5636	2.4288	-0.0622	0.2060	3.1564	2.1603	2.5716	2.3731	-0.5275	2.0247	-0.2656	1.9782	1.2134	-1.2716	-0.2011	-0.8025	1.6929	1.6544	-1.0036	0.7593	0.5410
35NMFE07	1.2297	0.3126	0.5252	1.5627	1.6712	0.4033	-0.5869	2.7591	-0.4224	0.0000	3.6301	1.4876	2.3367	2.1823	-0.5275	2.2217	0.0163	-0.2243	1.6712	-0.7644	0.4036	-0.7326	1.8643	0.6988	-0.3290	0.9424	0.7796
35NMFE08	0.9368	-0.0274	0.1824	1.1941	1.3106	0.8924	0.0083	2.4606	-0.4306	0.7745	2.2749	2.2113	2.8046	2.2407	-0.5275	2.0332	-0.1063	-0.7782	1.3106	-0.5686	-0.5697	-0.8026	1.7003	-0.1426	-1.3722	0.1284	0.6703
35NMFE09	-0.1266	1.9796	-0.8342	1.2714	0.5195	1.0056	-0.0957	2.3888	-0.4305	-0.1466	2.2913	1.4293	1.8116	1.6531	-0.5275	1.9250	-1.0839	-0.3989	0.5195	-1.0264	-0.7296	-0.8336	1.6062	-1.9896	-1.5632	-0.4759	0.7169
35NMFE10	0.1609	0.2064	0.1016	0.9600	0.9939	0.0405	0.1466	2.4368	0.0272	0.3413	1.4279	1.1809	2.8063	1.6857	-0.5275	1.9694	-0.2073	-0.4220	0.9939	-1.2650	0.4883	-0.6466	1.6449	-0.9004	-0.1583	0.5182	0.7957
35NMFE11	0.9783	0.3946	0.0034	1.1592	1.6896	0.0032	0.9699	2.6071	-0.4331	1.3222	2.5354	2.8627	3.4862	2.6868	-0.5275	2.2201	1.3269	-0.6409	1.6896	-1.5395	1.7264	-0.8235	1.8629	0.8381	0.9029	1.5924	0.9734
35NMFE12	1.0232	1.2865	-0.5033	1.2127	1.4116	0.5707	0.4110	2.4911	0.5946	1.5737	3.0191	2.3933	4.6594	3.1057	-0.5275	2.1969	0.8579	-0.4905	1.4116	-0.9340	0.6784	-0.6316	1.8419	0.8450	0.0468	1.1556	0.8382
35NMFE13	-0.6529	2.1762	-1.2067	1.6126	-0.0747	0.4400	-0.0867	2.1052	-0.4424	0.0713	1.8302	0.2786	1.7341	1.1286	-0.5275	1.9114	-1.3196	0.9166	-0.0747	-0.6956	0.6969	-0.2430	1.6943	-1.0733	0.4539	0.7568	0.8271
35NMFE14	-0.2663	1.6684	-0.6368	1.0802	-0.1066	0.2285	0.8281	2.1839	-0.4627	1.0241	1.8365	0.9460	2.7663	1.6926	-0.5275	1.7480	-0.6603	0.4246	-0.1086	-1.1266	1.8655	-0.3763	1.4622	-1.4609	1.4902	1.1060	0.8476
35NMFE15	1.1814	0.4361	-0.3132	1.1711	1.3316	0.6860	0.0650	2.4407	0.5868	1.1803	2.4744	2.0846	4.2078	2.7161	-0.5275	2.0450	1.3849	-0.1636	1.3316	-1.2368	2.2180	-0.7160	1.7106	1.3261	1.5030	1.9383	0.9749
35NMFE16	0.2508	1.9733	-0.9698	0.2467	-0.3036	0.8569	0.2467	0.0381	0.0018	0.8279	1.5030	0.8000	0.8678	0.9317	-0.5275	1.0111	-0.5802	2.1281	-0.3036	-0.4413	-0.7674	0.1276	0.8111	0.8010	-0.6399	0.2859	0.7496
35NMFE17	1.1907	0.0316	0.0008	0.4270	1.4583	-0.2008	-0.0086	1.5745	0.0034	1.1288	1.8501	1.2468	2.7067	1.7304	-0.5275	1.8290	0.8266	0.0051	1.4583	-0.9405	1.9023	-0.8272	1.5227	1.3475	1.0761	1.6358	0.8791
35NMFE18	0.6689	0.1846	1.1044	0.4799	1.4988	0.1009	-0.1492	1.9600	0.6829	0.0017	2.4378	1.4505	2.6346	1.9712	-0.5275	1.6957	-0.2926	0.4786	1.4988	0.2126	0.9742	-0.2194	1.4087	1.8976	0.7548	1.5551	0.8953
35NMFE19	-0.1707	0.0381	-0.4661	0.7363	-0.7327	0.2703	-0.0427	-1.6591	0.0302	-0.0006	0.1366	-0.5051	-1.6295	-0.6774	-0.5275	0.3802	-0.7244	-0.2526	-0.7327	-0.0960	1.0448	-0.3753	0.2622	-1.8046	0.6696	0.0147	0.8348
35NMFE20	0.9331	-1.0309	0.1427	0.0639	0.8451	1.2130	1.3373	-1.5690	-0.0866	1.4676	0.1289	3.3954	-0.1681	1.1013	-0.5275	1.1558	0.6097	-0.3871	0.8451	-1.2371	2.5634	-0.7856	0.9370	-0.1694	1.7778	1.3161	0.8584
35NMFE21	0.4624	-0.6319	0.9697	-0.1257	-0.0040	0.5178	0.0726	0.0208	1.4486	1.4856	0.6645	0.5864	2.9560	1.3466	-0.5275	2.0281	-0.5339	-0.3911	-0.0040	-0.6978	1.9737	-0.1003	1.6959	-1.6269	1.8734	1.3780	0.7633
35NMFF01	0.1501	-0.1314	0.0071	-0.4432	-0.3149	0.0405	1.0914	-1.4920	2.1621	1.4427	-0.4174	0.8170	2.1128	0.8723	-0.2197	1.2213	-0.7586	0.0334	-0.3149	-1.3040	0.1733	-0.4927	1.0340	-2.3441	-0.3194	-0.2287	0.6936
35NMFF02	-0.0510	0.4884	-0.3311	0.4503	-0.2697	0.5868	-0.0030	-1.7319	-0.4539	0.0471	0.5566	0.3141	-2.1387	-0.4691	-0.5275	0.3286	-0.9223	0.0532	-0.2697	-0.1510	0.3658	-0.3954	0.2173	-1.2698	-0.0398	-0.2336	0.6731
35NMFF03	-0.0079	-0.2547	0.6601	-0.2574	-0.1734	-0.0428	-0.1321	-1.6018	0.0912	0.4986	0.1401	-0.3483	-1.0118	-0.4183	-0.5275	0.8037	-1.1805	0.0465	-0.1734	0.1430	0.1494	0.2023	0.6306	-1.1644	0.3517	0.2001	0.6869
35NMFF04	0.8631	-0.7966	0.1530	-0.0627	-0.2302	0.0000	0.8665	-1.7166	1.3664	-0.1746	0.1568	0.4363	-0.6247	0.0097	-0.5275	0.5943	0.4881	-0.0061	-0.2302	-0.5578	-0.0387	-0.7397	0.4495	-0.3060	-0.7784	-0.2415	0.6859
35NMFF05	-0.8861	1.5147	-0.7276	0.9863	-0.1415	-0.4023	-0.0021	-1.6128	0.4628	-0.5562	0.8973	-0.5459	-1.7062	-0.5264	-0.5275	0.0105	-0.5909	0.5918	-0.1415	-0.3551	-0.9784	-0.6466	-0.0594	-0.4957	-1.6250	-0.9661	0.4888
35NMFF06	0.9076	0.9536	-0.3107	0.0876	0.0041	0.1992	-0.1769	-0.7697	1.3364	0.4769	1.6381	0.0264	1.0426	0.7659	-0.5275	1.5340	0.0126	0.0174	0.0041	0.0146	1.0122	0.0601	1.2660	0.0488	1.0723	1.1813	0.6093
35NMFF07	-0.0003	0.9892	0.0000	1.0522	0.0025	0.3679	-0.0046	-1.1198	0.8927	0.1111	2.0411	0.3659	-0.1160	0.5936	-0.5275	1.4111	-0.8028	0.2348	0.0026	-0.6978	0.8393	-0.6002	1.1591	-1.2636	0.2381	0.3827	0.6810
35NMFF08	1.7381	-1.0087	-0.0125	-0.1598	1.4505	0.4781	-0.4331	2.2808	0.0318	1.5316	0.5581	1.4966	3.8442	1.9194	-0.5275	1.9809	1.6764	-0.9381	1.4505	-1.0322	0.5267	-0.6002	1.6549	1.1656	-0.0736	1.0796	0.6062
35NMFF09	0.1737	0.4593	-0.4006	1.2248	1.3709	-0.0076	-0.7638	2.1774	0.0016	0.2045	1.4573	0.5786	2.3834	1.3620	-0.5275	1.6818	0.8934	-0.5692	1.3709	-0.6277	0.0032	-0.8026	1.3946	1.0674	-0.7993	0.5646	0.6114
35NMFF10	-0.0261	1.2162	-0.6530	0.7068	0.1272	-0.5002	0.5620	1.3546	-0.4738	0.9585	1.2419	0.1890	1.8393	0.9868	-0.5275	1.2358	0.0867	0.3207	0.1272	-1.2378	0.0034	-0.8986	1.0066	-0.7032	-0.8952	-0.1201	0.6061
35NMFF11	-0.8583	1.6506	-1.0002	1.1118	-0.3445	-0.4699	0.1426	-1.6788	-0.4346	-0.0033	0.9041	-0.6718	-2.1166	-0.7034	-0.3038	-0.6085	-0.2425	0.1447	-0.3446	-0.2821	0.6103	0.1823	-0.5689	-0.7244	0.7926	-0.0693	0.5617
35NMFF12	-0.0447	1.6247	-0.8791	0.0001	-0.0482	-0.1629	-0.7040	1.0388	-0.4305	0.9454	0.7010	-0.9161	1.5537	0.3881	-0.5275	1.4804	0.2962	-0.3746	-0.0482	-0.0076	-0.1256	-0.5285	1.2194	-0.1340	-0.6541	0.2492	0.6279
35NMFF13	0.6707	1.6171	-0.1617	1.7986	0.4267	-0.4084	1.0667	2.6946	-0.4166	0.3918	3.8247	1.0850	2.6708	2.2081	-0.5275	2.0827	-0.4426	1.0065	0.4267	-1.3966	-0.9170	-0.8131	1.7434	-0.4048	-1.7301	-0.0946	0.6046
35NMFF14	-0.5186	1.5882	-0.6844	0.5951	0.0000	-0.0016	-0.9263	1.7573	-0.3128	0.0010	0.9803	-0.9279	1.4455	0.4176	0.5936	1.4982	-0.2419	0.0029	0.0000	0.5485	-0.0243	-0.0861	1.3806	0.3095	-0.1104	0.7125	0.3878
35NMFG01	-0.1170	1.2636	-0.9994	0.8671	-0.4277	-0.4699	0.0061	-1.4333	0.0034	0.0338	1.0042	-0.8915	-1.3961	-0.5115	-0.5275	0.9070	-0.6079	1.0030	-0.4277	-0.6496	1.0077	0.0076	0.7205	-0.5822	1.0162	0.7223	1.1609
35NMFG02	-0.2754	0.8449	-0.5594	1.0004	1.0118	-0.2304	-0.4072	1.8018	-0.4689	0.4298	1.0106	0.3742	1.7625	0.9649	-0.5275	1.0267	0.7326	-0.1279	1.0118	-0.3659	0.0687	-0.5621	0.8247	1.2606	-0.4934	0.4783	0.8872
35NMFG03	-1.2225	2.2023	-1.4321	1.3347	-0.5668	-0.1163	-0.0141	-1.4606	-0.4602	-0.2107	0.8824	-0.6972	-2.1314	-0.7223	-0.5275	0.1053	-1.4951	1.2927	-0.5668	0.2724	-0.5044	-0.0571	0.0230	-0.4968	-0.5615	-0.3936	0.7043
35NMFG04	-0.0908	-1.3182	0.5081	-0.9846	0.0138	-0.2084	-0.2292	-1.6807	-0.4614	-0.0160	-1.8855	-0.4238	-2.1481	-1.3287	-0.5275	-1.3760	0.5850	-0.7728	0.0138	0.4323	1.3503	0.0633	-1.2657	0.2585	1.4136	0.1366	0.6947
35NMFG05	0.3748	1.7206	-0.3066	0.7992	0.2161	-0.1241	0.7604	0.4642	-0.4677	0.0402	2.5880	0.8524	0.0467	0.9467	-0.5275	1.2862	-0.5095	1.6719	0.2161	-0.9661	-0.1323	-0.9072	1.0604	0.3924	-1.0396	0.1036	1.0249
35NMFG06	-1.3003	2.4554	-1.4734	2.1224	-0.6128	-0.3836	0.4510	-0.8960	-0.4281	-0.3870	1.8041	-0.5464	-1.7121	-0.3016	-0.5275	1.8615	-1.3934	2.4152	-0.6128	-1.3216	-0.2438	-0.4344	1.3769	-0.9126	-0.6782	0.1212	0.7823
35NMFG07	0.0491	1.2236	-0.6617	0.1086	-0.4406	-0.0495	-0.6978	-1.5357	-0.3703	-0.5449	0.7194	-1.1879	-2.4509	-1.0331	-0.5275	-0.1886	0.0677	1.3260	-0.4406	0.4005	-1.0070	-0.0573	-0.2327	1.3536	-1.0643	-0.3101	1.0164
35NMFG08	-0.5326	2.0276	-0.8239	1.3983	0.0008	0.3914	0.7537	0.5293	2.0879	-0.2190	2.0694	1.1459	2.3982	1.6987	-0.5275	1.5263	-0.4859	2.4445	0.0008	-1.4016	0.4004	-0.8561	1.2593	0.5578	-0.4567	0.5413	0.7633
35NMFG09	-1.0402	1.8381	-1.1484	1.4618	-0.0209	-0.4023	0.0140	1.6743	-0.0938	-0.6072	1.1113	-0.4092	0.9733	0.4659	-0.5275	1.6848	-1.3323	1.2618	-0.0209	-0.6978	-0.8377	-0.5837	1.3972	-0.7892	-1.4214	-0.2094	0.6820
35NMFG10	-0.8189	1.6577	-1.1700	0.6271	-0.8849	-0.4318	-0.1906	-1.7126	-0.4437	-0.1746	0.2959	-1.6073	-2.3308	-1.2064	-0.5275	-0.4449	-1.3388	0.9371	-0.8849	-0.1833	-1.1108	-0.0284	-0.4556	-1.4699	-1.1392	-1.1649	0.6652
35NMFG11	-1.0616	1.9082	-1.4818	1.4310	-0.8667	0.4033	-0.1635	-1.6984	-0.4331	-0.3944	0.7958	-0.6269	-2.6239	-0.8513	-0.5275	-0.3863	-1.6724	0.3260	-0.8667	0.1978	0.0886	-0.0284	-0.4047	-2.0153	0.0601	-0.6761	0.6632
35NMFG12	-0.1986	1.3822	-0.8834	-0.2168	-0.6342	0.0162	-0.1844	-1.7006	-0.4359	-0.3992	0.0846	-0.8024	-2.6365	-1.0916	-0.5275	-1.0066	-1.0439	0.2763	-0.6342	0.7229	-1.0940	0.1536	-0.9434	-0.6799	-0.9404	-1.1119	0.6350
35NMFH01	-0.3369	-0.0621	0.1230	0.3934	-0.4698	-0.4486	0.0932	-1.3433	-0.4306	-0.1466	0.1174	-0.8261	-1.9203	-0.8868	-0.5275	0.7602	-0.6417	0.3921	-0.4698	0.1264	0.0413	-0.0419	0.5928	-0.6840	-0.0006	0.1476	0.9692
35NMFH02	-0.9602	1.1480	-0.6659	0.1862	-0.5220	-0.0007	-0.0340	-1.7768	-0.1902	-0.4918	-0.2919	-0.5567	-2.4598	-1.0781	0.1304	-0.2085	-1.2111	-0.1913	-0.5220	0.0093	-0.3504	0.0031	-0.1644	-1.9151	-0.3473	-0.7346	0.7366
35NMFH03	-1.0701	1.9593	-0.9525	1.2600	-0.8230	-0.4202	-0.1384	-1.7468	0.0016	-0.6632	1.1967	-1.3816	-2.4085	-0.9642	-0.6015	1.1450	-1.5595	1.4675	-0.8230	0.0012	-1.1975	0.0163	0.9310	-0.9138	-1.1812	-0.3536	0.6502
35NMFH04	-0.0168	0.2618	0.2130	0.7556	-0.4009	-0.1397	0.8207	-0.8343	-0.4527	0.6973	1.2146	0.2801	-0.5897	0.2005	-0.5275	1.5714	-0.5713	0.7690	-0.4009	-1.0605	-0.6775	-0.1797	1.2985	-1.2537	-0.8572	-0.0928	0.8734
35NMFH05	-0.8141	2.2369	-0.9022	2.0624	-0.0060	-0.0247	-1.0361	-1.5312	1.4849	-0.4182	2.6020	-1.0668	-0.4645	0.1401	-0.5275	1.9384	-1.3767	1.9279	-0.0060	0.4817	0.0701	-0.5837	1.6178	1.0279	-0.5136	0.8091	0.9890
35NMFH06	-0.4600	1.4021	-0.3988	1.1630	0.0063	0.2265	-0.3130	1.3160	0.0060	-0.2062	1.7063	-0.0812	1.1168	0.7714	-0.5275	1.8085	-0.4137	-0.6387	0.0063	-0.7260	-0.0322	-0.6752	1.5048	-1.7731	-0.7074	-0.0446	0.9970
35NMFH07	-0.3796	1.6232	0.0067	1.4910	0.5771	0.0674	0.0921	1.6274	-0.4460	-0.4169	2.7403	0.7266	0.7665	1.1828	-0.5275	1.8844	-1.0063	1.3088	0.5771	-0.1692	-0.6432	-0.2663	1.5709	0.7204	-0.9095	0.5108	1.1455
35NMFH08	-0.1192	0.7392	-0.1421	0.6561	-0.5960	-0.2231	0.0372	-1.4066	-0.1632	-0.0396	1.1340	-0.7819	-1.6084	-0.5133	-0.4455	-0.4261	0.0241	-0.4869	-0.5960	-0.2016	-0.2867	-0.6654	-0.4278	-1.2603	-0.9511	-1.0045	1.0771
35NMFH09	-0.0051	1.4117	-0.4627	-0.5142	-0.6904	-0.2657	-0.8253	-1.6723	1.5667	-0.4410	0.4297	-1.7814	-0.5468	-0.6686	-0.5275	-0.3522	-0.4598	1.7332	-0.6904	0.6251	1.0697	0.4936	-0.3750	1.2091	1.5833	0.9064	1.2040
35NMFH10	0.6673	-1.0179	0.0143	-0.0042	-0.0591	-0.1934	0.5936	-1.7005	0.0193	0.5476	-0.3405	0.3411	-1.1336	-0.3493	-0.5275	-0.0109	0.6476	-0.5768	-0.0591	-0.1296	-0.0873	0.3153	-0.0781	-0.1178	0.2280	0.0455	1.2063
35NMFH11	-0.8821	1.7622	-0.3721	1.2820	-0.6854	-0.3641	-0.7902	0.7672	-0.0725	-0.3407	1.8100	-1.9397	0.3540	-0.0427	-0.5275	1.5819	-1.1335	1.5226	-0.6854	0.4718	-0.0026	-0.6002	1.3077	0.1753	-0.6028	0.3963	1.3213
35NMFH12	0.1501	-0.5750	0.9497	-0.7431	-0.3615	0.3508	0.8514	-1.5861	1.4686	0.4497	-0.2193	0.6407	0.3322	0.2695	-0.5275	0.0227	-0.0006	-0.5353	-0.3615	-1.0490	-0.1892	-0.0944	-0.0468	-1.9466	-0.2836	-0.6529	1.2046
35NMFJ01	-0.5597	0.2341	-0.4705	0.4533	-0.3493	-0.1629	-0.2387	-1.2389	-0.4398	-0.0063	-0.3428	-0.7509	-1.6850	-0.8977	-0.5275	-0.1631	-0.1371	-0.3688	-0.3493	-0.0098	-1.1534	-0.3116	-0.2105	-0.8648	-1.4649	-1.0539	0.8254
35NMFJ02	-1.0057	1.1567	-0.8707	1.3602	-0.7297	-0.4202	0.7796	-1.6796	-0.4237	-0.3771	0.6305	-0.3704	-2.4804	-0.7926	-0.5275	-1.0438	-1.4698	0.5941	-0.7297	-0.6047	-0.6488	-0.5285	-0.9767	-2.2101	-1.1771	-1.6294	0.9081
35NMFJ03	-0.5877	-1.6313	0.5137	-1.2539	-0.3728	-0.2794	0.0324	-1.7717	-0.4846	-0.2645	-2.9592	-0.6198	-2.5207	-1.7866	-0.5275	-1.5176	0.8954	-1.2386	-0.3728	0.3232	-0.9709	0.4107	-1.3869	-0.3926	-0.5602	-1.0728	0.9897
35NMFJ04	0.2779	0.6963	-0.0042	0.8582	1.3526	-0.0656	0.4955	1.8320	-0.4183	0.3815	1.8282	1.7625	1.7952	1.6430	-0.5275	1.5932	0.0135	0.0040	1.3526	-1.2716	0.0392	-0.7916	1.3175	0.0985	-0.7524	0.3072	0.9764
35NMFJ05	-0.1976	0.0996	0.1362	0.9355	0.0821	0.9080	-0.6885	2.2808	-0.4264	0.5868	0.9738	0.3016	2.4412	1.1677	-0.5275	1.6346	-0.1587	-0.3527	0.0821	0.0083	-0.6318	-0.5666	1.3535	-0.4230	-1.0984	0.0218	1.0013
35NMFJ06	-0.6377	2.2805	-0.9052	2.1476	0.2453	0.1743	0.2539	2.7257	-0.0938	-0.1269	2.8852	0.6735	2.5050	1.7608	-0.5275	2.1652	-1.4263	1.6597	0.2453	-1.1005	0.1073	-0.8336	1.8151	-0.6218	-0.7263	0.3890	0.9963
35NMFJ07	1.0833	0.0802	0.0865	1.1273	1.8285	0.6360	-0.0434	2.1602	-0.0992	1.8868	2.3773	2.4211	3.7478	2.6506	-0.5275	1.8582	1.0416	-0.2719	1.8285	-0.0976	0.0001	-0.3753	1.5481	2.5007	-0.3762	1.2116	1.0013
35NMFJ08	1.7676	-1.1601	0.4166	0.1967	2.0634	0.0032	-0.2103	2.5904	-0.4237	1.8218	1.2198	1.8563	3.9885	2.2632	-0.5275	2.0364	1.5699	-0.9454	2.0634	-0.3409	0.6797	-0.6002	1.7031	2.3470	0.0795	1.4781	1.0186
35NMFJ09	1.5259	-0.1714	0.0033	0.1110	1.8697	0.5707	0.0306	2.5454	-0.0956	1.2410	1.4688	2.4710	3.6908	2.4211	-0.5275	2.1310	1.3217	-0.7726	1.8697	-0.7590	0.4873	-0.3700	1.7854	1.6598	0.1173	1.3663	1.0931

ED	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	HEALTH	SOCECON	ENV	NEED	A1	A2	A3	A4	A5	A6	A7	A8	TRANSP	PERMOB	AWARE	ACCESS	PROVIS
35NMFJ10	1.4179	-0.1459	0.0510	0.4788	1.9093	0.0055	0.3467	2.3542	-0.4224	1.3513	1.8018	2.2815	3.2831	2.2987	-0.5275	1.8870	1.3441	-0.4324	1.9093	-1.4187	0.0201	-0.8436	1.5731	1.4023	-0.8234	0.7254	1.1113
35NMFJ11	-0.7343	-0.0702	-0.4413	-0.4044	-0.2376	0.0405	-0.5800	-1.3129	-0.0760	0.0035	-1.6502	-0.7770	-1.3854	-1.1334	-0.5275	-0.6941	-1.1606	-0.9012	-0.2376	0.7847	0.2530	-0.1362	-0.6637	-1.5046	0.1168	-0.6496	1.1374
35NMFJ12	-0.6214	-0.7277	-0.6027	-0.9755	-0.2302	-0.1708	-0.1922	-1.7165	0.0109	-0.0123	-2.9273	-0.5930	-1.7179	-1.5021	-0.5275	-1.3038	-0.9677	-0.3116	-0.2302	0.7676	0.4127	-0.1297	-1.2029	-0.7420	0.2830	-0.6456	1.0746
35NMFJ13	0.2510	-0.9428	0.1065	-0.1148	0.5569	-0.1783	0.4913	-0.3552	-0.4488	0.8861	-0.7001	0.8699	0.0821	0.1423	-0.5275	0.3878	-0.0629	0.0062	0.5569	-0.9861	1.3129	-0.6888	0.2688	-0.4869	0.6241	0.3247	1.0771
35NMFJ14	0.1764	1.6579	-0.3556	1.2641	0.5479	0.0574	0.6312	2.3116	-0.4224	0.1224	2.7328	1.2365	2.0115	1.7659	-0.5275	2.0607	0.0347	0.8867	0.5479	-1.1396	-0.5363	-0.8025	1.7242	0.3297	-1.3388	0.2751	1.2145
35NMFJ15	1.3207	-0.7922	0.0156	-0.0079	2.0535	1.0690	0.0298	2.4591	-0.0884	1.1320	0.5382	3.1523	3.5027	2.3524	-0.5275	2.0958	1.5015	-0.0005	2.0535	-0.7067	1.0283	-0.7198	1.7546	2.8478	0.3065	1.7425	1.1603
35NMFJ16	1.2785	0.1979	-0.1223	0.9098	1.8008	-0.0007	1.1094	2.1660	0.0026	0.6572	2.2639	2.9095	2.8258	2.4777	-0.5275	1.8831	1.0182	0.0645	1.8008	-1.0989	1.7608	-0.4707	1.5697	1.7846	1.2901	1.8761	1.2401
35NMFK01	0.0242	-1.8218	1.3933	-0.4378	0.3522	0.8321	1.5511	1.9168	-0.5142	-0.0027	-0.8421	2.7354	1.3999	1.1679	-0.5275	0.6469	0.4344	-1.3377	0.3522	-1.3297	1.7183	-0.5984	0.4942	-1.8808	1.1199	0.3369	0.7532
35NMFK02	0.5806	-1.4384	0.5210	-0.7452	1.0319	-0.0017	1.3689	1.8774	-0.4437	1.1803	-1.0820	2.3991	2.6140	1.4005	-0.5275	1.3392	1.3231	-1.0795	1.0319	-1.2029	2.3207	-0.8435	1.0965	0.0728	1.4772	1.3060	0.7158
35NMFK03	1.2111	-1.5796	1.1460	-0.2309	1.3432	0.8948	0.7780	2.1255	-0.4602	1.0007	0.5466	3.0160	2.8660	2.0307	-0.5275	1.5114	1.0121	-1.1637	1.3432	-0.9386	2.3458	0.0012	1.2463	0.2530	2.3470	1.8599	0.6908
35NMFK04	1.2455	-1.6688	0.4434	-0.3440	1.8918	0.6742	0.9705	1.9560	-0.4331	1.3222	-0.3239	3.5365	2.8471	2.0469	-0.5275	1.5902	1.6989	-1.1627	1.8918	-1.0306	2.6214	-0.7150	1.3149	1.3874	1.9064	1.9576	0.6582
35NMFK05	1.2676	-0.0286	0.6660	0.2262	0.9154	1.0270	0.3467	1.8383	-0.4501	0.7063	2.1312	2.2891	2.0945	1.9940	-0.5275	1.3020	1.0344	0.0649	0.9154	-0.9511	1.6289	-0.0944	1.0642	1.0636	1.5346	1.6653	0.2712
35NMFK06	1.2739	-1.8521	1.1930	-1.0467	1.7010	0.4196	0.9969	1.9622	-0.4305	1.0914	-0.4420	3.1175	2.6131	1.7997	-0.5275	0.5438	1.8492	-1.2934	1.7010	-1.1384	1.9398	-0.8336	0.4045	1.1184	1.1060	1.0349	0.1566
35NMFK07	1.7958	-1.8555	1.0409	-1.0843	1.6546	0.9949	0.9418	2.2033	-0.4774	1.4843	-0.1131	3.5912	3.2102	2.2389	-0.5275	1.4336	1.8886	-1.2730	1.6546	-1.3624	2.0612	-0.3954	1.1787	0.9077	1.6558	1.6442	0.1610
35NMFK08	-0.3411	-1.7001	1.0866	0.0846	1.1674	-0.2376	0.5529	1.8276	-0.1358	1.5494	-0.9000	1.4827	3.2401	1.3493	-0.5275	1.2831	1.4111	-1.2313	1.1674	-0.8174	2.6890	-0.0419	1.0477	0.5298	2.6471	1.9799	0.6010
35NMFK09	1.4845	-0.6868	0.5420	0.2713	1.7398	1.0409	0.0021	1.9470	-0.4750	1.0891	1.6110	2.7828	2.5611	2.1841	-0.5275	1.9172	1.5143	-0.2822	1.7398	-0.0420	2.5804	0.0000	1.5994	2.9299	2.5804	2.8224	0.6165
35NMFK10	0.5157	-1.3943	1.2025	0.1808	0.3566	1.3203	0.7830	1.6265	-0.0708	0.6723	0.5047	2.4599	2.2280	1.6888	-0.5275	1.9563	-0.4379	-1.0942	0.3566	-1.2880	1.8392	-0.5666	1.6325	-2.4635	1.2726	0.8367	0.6563
35NMFK11	0.9097	-1.8623	0.5107	-1.2186	1.3050	0.2858	1.3110	1.6188	-0.4527	1.4822	-1.6605	2.9018	2.6283	1.4282	-0.5275	0.8165	1.8114	-1.3288	1.3050	-1.3882	2.3248	-0.6089	0.8418	0.4018	1.7157	1.2792	0.5223
35NMFK12	2.0692	-1.6568	0.0070	-0.2600	2.2919	1.1623	0.6955	2.6910	-0.4305	1.9742	0.1594	4.1397	4.2347	2.8313	-0.5275	1.6481	2.3888	-0.5696	2.2919	-1.2591	2.3236	-0.7150	1.3653	2.8630	1.6085	2.2002	0.1745
35NMFK13	0.4990	1.7467	-0.6969	1.6193	0.1778	-0.0932	-0.4815	2.3981	-0.4358	-0.6251	3.1681	-0.3969	1.3372	1.1055	-0.5275	1.4885	0.6838	1.0303	0.1778	0.0034	-0.8458	-0.7916	1.2264	1.8953	-1.6372	0.2684	0.2893
35NMFK14	0.5522	1.1384	-0.1967	0.3283	0.5100	-0.1474	-0.8114	0.4642	-0.4590	-0.6529	1.8222	-0.4498	-0.6477	0.0901	-0.5275	0.3286	-0.0572	0.2757	0.5100	0.1845	-0.5194	-0.2194	0.2173	0.9130	-0.7388	-0.0325	0.2496
35NMFK15	1.6161	-1.6424	0.6499	-0.7710	1.5719	0.4054	0.3693	1.8706	-0.4398	0.3025	-0.1474	2.3456	1.7333	1.3228	-0.5275	1.3289	1.8548	-1.1139	1.5719	-0.7521	1.3413	-0.1579	1.0876	1.5607	1.1634	1.5257	0.1478
35NMFK16	1.1402	-1.7433	0.9454	-0.6648	1.9270	0.0016	0.5619	2.2052	-0.4169	0.6216	-0.3225	2.4905	2.4099	1.5528	-0.5275	1.0264	1.7574	-1.1412	1.9270	-0.6425	1.3559	-0.1579	0.8244	1.9007	1.1979	1.4863	0.2128
35NMFK17	0.5637	-0.4619	0.2749	0.0539	1.4407	-0.0007	-0.2660	2.1645	-0.4476	0.2745	0.4306	1.1740	1.9915	1.1626	-0.5275	1.3592	1.5245	-0.5698	1.4407	0.4476	0.4962	-0.8435	1.1139	2.8430	-0.3473	1.0941	0.0480
35NMFK18	1.1656	-1.1701	0.9740	-0.0668	1.0444	1.1617	1.2845	2.1537	-0.4169	0.1392	0.9227	3.4908	1.8750	2.0192	-0.5275	0.6806	1.5459	-0.2999	1.0444	-1.1485	0.3358	-0.3115	0.5235	1.1419	0.0243	0.5594	0.0444
35NMFK19	1.8920	-1.5459	0.4764	-0.0555	2.1354	0.0016	0.4937	2.5493	-0.4085	0.6519	0.7660	2.6307	2.7927	1.9993	-0.5275	1.3420	2.0423	-1.1892	2.1354	-0.6558	-0.2010	-0.0399	1.0990	2.3337	-0.2409	1.0126	0.0032
35NMFK20	1.6663	-1.7943	1.0400	0.0458	1.6890	0.8821	-0.6736	2.3729	-0.4463	1.1729	0.9578	1.8975	3.0995	1.9051	-0.5275	1.5118	1.8834	-1.2693	1.6890	-0.0428	1.5451	-0.0419	1.2467	2.2603	1.5032	1.9400	0.0688
35NMFK21	1.4881	-1.8664	1.4722	-1.2080	-0.0382	0.0084	0.1143	-1.6881	-0.4291	-0.1437	-0.1141	0.0845	-2.2609	-0.7640	-0.5275	-1.7007	0.5696	-1.2147	-0.0382	0.5392	-0.2015	0.7954	-1.5482	-0.1441	0.6939	-0.5132	0.0480
35NMFK22	-0.0014	-1.8729	0.8290	-1.5839	-0.0668	0.1066	-0.0894	-1.7045	-0.4398	-0.4064	-2.8292	-0.0296	-2.5507	-1.5174	-0.5275	-1.7776	1.0907	-1.3091	-0.0668	0.5446	1.3204	0.8783	-1.8151	0.2594	2.1987	0.3567	0.0336
35NMFK23	1.4758	-1.7858	1.4167	-1.1467	-0.5228	0.0490	0.0324	-1.8314	-0.5262	-0.1502	-0.0402	-0.4414	-2.5078	-0.9931	-0.5275	-1.6246	0.8954	-1.3588	-0.5228	0.5512	-0.2846	-0.0443	-1.4820	-0.4350	-0.3289	-1.0142	0.1242
35NMFK24	-0.0420	-1.0550	-0.6288	-0.5650	-0.5705	0.7395	-0.6568	-1.5709	-0.3578	-0.0220	-2.2908	-0.4876	-1.9507	-1.3855	-0.5275	-1.6350	0.1219	-1.0643	-0.5705	0.9850	0.2356	0.8400	-1.4910	-0.5179	1.0756	-0.3372	0.0503
35NMFL01	1.8563	-1.4913	1.0003	-0.9519	1.7929	1.3095	0.9880	2.5454	0.0318	0.7929	0.4134	4.0904	3.3701	2.5902	-0.5067	0.9924	1.8231	-1.0316	1.7929	-1.0304	1.2647	-0.2430	0.7976	1.5541	1.0217	1.2981	0.7309
35NMFL02	1.3881	1.0965	-0.0732	1.7570	1.2156	0.2126	0.5508	2.7016	-0.1138	1.3149	4.1684	1.9790	3.9027	3.0027	-0.4777	1.8573	0.9779	-0.1631	1.2156	-1.2842	0.0272	-0.8986	1.5538	0.7262	-0.8714	0.5228	0.7861
35NMFL03	1.5730	-1.5936	1.1879	-0.6227	1.9543	-0.1474	0.4494	2.0151	-0.4183	0.1342	0.6446	2.2563	1.7310	1.4903	-0.5275	0.7054	1.7008	-1.2276	1.9543	-0.7953	1.2771	-0.4344	0.5451	1.6322	0.8427	1.1020	0.5541
35NMFL04	1.3031	-1.6897	1.1068	-1.0510	-0.1621	-0.0781	-0.0227	-1.6177	-0.3839	-0.5618	-0.3318	-0.2529	-2.5634	-1.0217	-0.5275	-1.4463	0.7399	-1.1993	-0.1621	0.5865	-0.4388	0.3122	-1.3269	-0.0250	-0.1246	-0.7320	0.3496
35NMFL05	1.3041	-1.1173	0.2872	-1.1676	-0.8643	-0.1552	0.8313	-1.6943	-0.1083	-0.0021	-0.6936	-0.1892	-1.8047	-0.8377	-0.5275	-1.4416	0.7947	-0.8626	-0.8643	-0.1260	1.7228	0.0163	-1.3229	-1.0802	1.7391	-0.0619	0.6179
35NMFL06	-0.4628	1.9257	-0.5631	1.6521	1.0622	0.5707	0.4809	2.5867	1.9852	-0.1969	2.4519	2.1138	4.3750	2.7759	-0.5275	2.0566	-0.2288	2.0312	1.0622	-1.2378	-0.5981	-0.7856	1.7207	1.6270	-1.3837	0.5753	0.6442
35NMFL07	1.0353	-0.1397	0.5854	0.1285	0.4119	0.3854	0.8934	1.7811	0.3341	-0.6089	1.6095	1.6907	1.5063	1.4680	0.5935	0.9439	0.3738	-0.4772	0.4119	-1.0067	-0.3216	-0.5837	0.8983	-0.6972	-0.9063	-0.1779	0.5389
35NMFL08	1.8014	-1.7097	0.7353	-0.2868	1.6516	0.1613	0.8820	2.3271	-0.4278	0.3463	0.6402	2.6949	2.2456	1.7819	0.5935	0.8614	1.9068	-1.1294	1.6516	-0.8421	0.3886	-0.4927	0.8268	1.5869	-0.1041	0.7580	0.6410
35NMFL09	-0.8882	0.7394	-0.6684	-0.3799	-0.4010	-0.4430	-1.0632	-0.8234	-0.0742	-0.3434	-1.1971	-1.9272	-1.2410	-1.3563	0.3634	-1.4108	-0.2990	0.2988	-0.4010	1.3827	-0.0477	1.6821	-1.1802	0.9815	1.6344	0.4726	-0.0820
35NMFL10	-0.0342	0.0090	-0.4566	0.0067	-0.1601	-0.1474	-0.1285	-1.1546	-0.4210	-0.1269	-0.4761	-1.4260	-1.7025	-1.1619	-0.0752	-1.3629	0.1253	-0.0022	-0.1501	1.3987	-1.0625	1.0661	-1.1955	1.3717	0.0036	-0.2530	0.0323
35NMFL11	0.7612	-1.1012	-0.4865	-0.5294	-0.0600	0.0607	-0.0579	-1.2182	-0.1876	-0.3022	-1.3579	-0.0472	-1.7079	-0.9245	1.1736	-1.3166	1.1602	-0.7463	-0.0500	0.7592	-0.8445	0.9349	-0.9946	1.1201	-0.0096	-0.2221	-0.0526
35NMFL12	1.1601	-1.5879	0.9148	-1.1279	-0.2896	0.2265	-0.9667	-1.6775	-0.4210	-0.6072	-0.6209	-1.0298	-2.7067	-1.4004	-0.5275	-1.7616	0.1752	-1.0114	-0.2696	0.9777	-1.1814	-0.0944	-1.6196	-0.1461	-0.2756	-0.9642	0.0381
35NMFL13	0.0065	-0.7794	0.6442	-0.1669	-0.2742	0.0333	-0.6862	-0.8837	-0.4163	-0.6039	-0.2956	-0.9271	-1.9059	-0.0192	0.5935	-1.3001	0.0523	-1.0469	-0.2742	0.9264	0.7038	0.6659	-1.0539	-0.3424	1.3697	0.0723	0.1791
35NMFL14	1.6867	-1.2692	0.8190	-0.1876	0.0334	0.3014	0.5039	1.0940	-0.4065	-0.5920	1.0499	0.8387	0.0935	0.6732	-0.5275	-0.7416	1.2206	-0.0798	0.0334	-0.4806	0.0484	-0.6811	-0.7138	-0.3064	-0.6127	-0.7399	0.4326
35NMFL15	1.1399	-1.4922	1.3069	-1.1640	0.3679	-0.0932	-0.0166	-1.5706	-0.4291	-0.6171	-0.1984	0.2581	-2.8168	-0.8361	-0.5275	-1.3732	0.1646	-1.1069	0.3679	0.4072	-0.3166	0.8471	-1.2633	-0.1672	0.6305	-0.3582	0.2257
35NMFL16	-1.2742	1.2007	-0.6369	-0.0164	-0.6966	-0.1662	-0.3255	-1.7375	-0.4602	-0.6544	-0.7267	-1.1773	-2.6521	-1.5248	-0.5275	-1.5768	-1.2363	0.0425	-0.6966	0.3169	-1.2657	0.8249	-1.4404	-1.5715	-0.4608	-1.3435	0.0923
35NMFL17	-1.0646	2.0499	-1.4169	1.0468	-0.8960	0.0670	-0.7670	-1.2515	-0.1358	-0.6438	0.6252	-1.5960	-2.0311	-1.0627	-0.5275	0.2846	-1.5695	1.6025	-0.8960	0.0991	-1.2207	-0.8131	0.1789	-0.7839	-2.0338	-1.1234	0.1337
35NMFL19	0.1343	1.8099	-0.9722	1.7043	0.4832	0.0032	-0.3162	2.2755	0.0030	-0.4476	2.8763	0.1702	1.8309	1.3361	-0.5275	0.7383	-0.3342	-0.0084	0.4832	-0.0867	-1.0943	-0.3954	0.5737	0.0539	-1.4897	-0.4446	0.0662
35NMFL20	0.0372	-0.1898	-0.0320	-0.4329	-0.4462	-0.2675	0.9208	-1.3412	0.0435	-0.3732	-0.6175	0.2071	-1.6709	-0.6423	0.0007	-1.3318	-0.0422	-0.4306	-0.4462	-0.3409	-1.0197	-0.3789	-1.1686	-1.2699	-1.3986	-1.5936	0.0104
35NMFL21	0.4258	-1.8747	0.6895	-1.4228	-0.4610	-0.5192	-0.4210	-1.6839	-0.4261	-0.3798	-2.1622	-1.4012	-2.4886	-1.8422	0.6299	-1.8064	1.4042	-1.1769	-0.4610	1.0166	0.0566	0.9299	-1.4897	0.7640	0.9865	-0.0656	0.0748
35NMFL22	0.1013	-1.9921	0.6284	-1.5943	-0.3637	-0.5376	-0.9923	-1.7085	-0.4424	-0.6330	-2.8487	-1.7835	-2.7639	-2.2346	-0.5275	-1.7824	1.3922	-1.3390	-0.3637	1.3813	-0.2768	0.9027	-1.6193	1.0706	0.6259	-0.2290	0.1000
35NMFL23	-0.1902	-0.6204	0.4921	0.0188	-0.5943	-0.2418	-0.9328	-1.1332	-0.2068	-0.3283	-0.2997	-1.7689	-1.6673	-1.2203	-0.5275	-1.0910	0.1161	-0.8921	-0.5943	0.8266	-0.9683	0.3004	-1.0177	-0.5437	-0.8679	-0.9787	0.1734
35NMFL24	0.8239	-1.8943	0.8675	-1.2342	-0.8180	-0.6330	-0.3369	-1.7431	-0.4664	-0.6617	-1.4371	-1.6879	-2.8712	-1.8790	-0.3879	-1.8705	1.3270	-1.2931	-0.8180	1.1489	-0.0941	0.8546	-1.6778	0.3647	0.7605	-0.3675	0.1467
35NMFL25	0.7959	-1.5695	1.3136	-1.4074	-0.4161	-0.4015	-1.3413	-1.9233	-0.5946	-0.6646	-0.8674	-2.1599	-3.1825	-1.9973	0.2011	-1.9682	0.3387	-1.3428	-0.4161	1.5797	-0.1480	0.3153	-1.6862	0.1595	0.1673	-0.7196	0.0180
35NMFL26	0.8646	-1.1474	0.5262	-0.1171	-1.0149	-0.0017	-1.0007	-1.7468	-0.1596	-0.4563	0.1263	-2.0173	-2.3627	-1.4284	-0.5275	-1.7099	0.4057	-1.3278	-1.0149	1.3349	0.7465	1.0609	-1.5562	-0.6021	1.8074	-0.0249	0.0604
35NMFL27	1.0522	-1.6827	1.1261	-1.2697	0.1110	-0.0245	-0.0958	0.1662	-0.5337	-0.1675	-0.7741	-0.0093	-0.6350	-0.3750	0.5935	-1.0185	0.6425	-1.2546	0.1110	0.8919	1.4788	0.0031	-0.8089	0.5908	1.4819	0.4842	0.1644
35NMFL28	1.0604	-1.7054	1.3082	-1.0015	-0.5889	-0.2518	-0.9729	-1.7468	-0.1614	-0.6647	-0.3383	-1.8136	-2.5729	-1.5467	-0.5275	-1.7628	1.1634	-1.3671	-0.5889	1.0471	1.3743	0.2838	-1.8020	0.2545	1.6581	0.0917	0.0077
35NMFL29	1.6264	-1.7273	1.6259	-1.5062	0.4982	0.0032	0.1325	-1.6943	-0.4346	-0.6235	0.0188	0.6339	-2.7623	-0.7014	-0.5275	-1.5631	1.1261	-1.2808	0.4982	0.6541	0.5128	0.0163	-1.4285	0.9996	0.5291	-0.1998	0.0032
35NMFL30	0.7810	-1.7002	0.2746	-0.8269	-0.5351	-0.4594	-1.1123	-1.6440	-0.4028	-0.5951	-1.4715	-2.1068	-2.6319	-1.9474	-0.5275	-1.6825	1.3273	-1.2648	-0.5351	1.3660	-0.3959	0.4963	-1.5324	0.8934	0.1004	-0.4927	0.0362
35NMFL31	1.6785	-2.0258	1.7483	-1.5624	-0.0728	-0.3675	-0.3796	-1.8555	-0.5928	-0.4953	-0.1614	-0.8199	-2.9436	-1.2949	-0.5275	-1.9894	0.5644	-1.3358	-0.0728	0.9889	-0.1923	0.1716	-1.7965	0.1446	-0.0207	-0.8735	0.0305
35NMFL32	0.8630	-1.7475	1.3112	-1.4541	-0.3357	-0.3899	-0.7808	-1.5367	-0.3400	-0.5068	-1.0274	-1.5064	-2.3835	-1.5535	-0.5275	-1.6684	0.9073	-1.1575	-0.3357	1.2644	0.4591	1.2471	-1.5201	0.6785	1.7062	0.2627	0.0269
35NMFL33	1.3094	-1.8058	1.8371	-1.3663	-0.2988	0.0119	0.2394	-1.7431	-0.4664	-0.4542	-0.0256	-0.0475	-2.8637	-0.9101	-0.5275	-1.7813	-0.0962	-1.2585	-0.2988	0.0068	-0.1748	0.7654	-1.8270	-1.6467	0.5906	-0.9299	0.0061
35NMFL34	1.1875	-1.8190	1.5715	-1.4032	-0.6165	-0.1066	-1.0706	-1.6902	-0.4306	-0.6187	-0.4632	-1.7957	-2.7394	-1.6275	-0.5275	-1.7601	0.0196	-1.2374	-0.6165	1.5104	-0.0271	1.2440	-1.5999	-0.3239	1.2169	-0.2725	0.0006
35NMFL35	1.4893	-1.8443	1.6627	-1.4486	-0.4054	-0.4751	0.0021	-1.7262	0.0070	-0.6469	-0.1409	-0.6784	-2.3661	-1.1167	-0.5275	-1.7161	0.1126	-1.2393	-0.4054	0.1797	-0.0463	-0.0171	-1.5616	-1.3524	-0.0634	-1.1506	-0.0018
35NMFL36	0.9496	-0.1765	0.6078	-1.2509	0.0370	-0.0001	-0.5320	-1.6532	-0.4057	-0.5886	0.1300	-0.4951	-2.6476	-1.0150	-0.5275	-1.6736	0.7131	1.6132	0.0370	1.2370	0.6760	0.2908	-1.5246	3.6003	0.9668	0.6212	-0.0190
35NMFL37	0.2939	-0.0671	-0.1428	-0.0319	-0.0750	0.0016	0.7344	-0.6696	-0.4043	0.0051	0.0521	0.6610	-1.0688	-0.1229	-0.5275	-0.3009	0.7041	0.0005	-0.0750	-1.0748	-1.1557	-0.6888	-0.3304	-0.4452	-1.8445	-1.1988	0.0166
35NMFL38	-0.2429	0.5805	-0.3591	-0.2195	-0.8759	-0.1783	-0.6664	-1.4899	0.0169	-0.1662	-0.2410	-1.7206	-1.6392	-1.1802	-0.5275	-1.4641	-0.6871	0.0533	-0.8759	0.5947	-0.4610	0.5690	-1.3423	-0.9150	0.1060	-0.8459	-0.0349
35NMFL39	-0.0945	0.3241	-0.5888	-0.0073	-0.3637	-0.1629	-0.4416	0.6347	-0.4424	0.5283	-0.3465	-0.9682	0.7206	-0.1692	-0.4128	-0.6032	0.0307	-0.1697	-0.3637	0.7819	-1.2030	0.4821	-0.5784	0.2802	-0.7209	-0.5796	-0.0466
35NMFM01	-0.4633	-0.3351	-0.6191	-0.3556	-0.7534	-0.4374	-0.6193	-1.6291	0.2991	-0.1549	-1.7731	-1.8101	-1.4849	-1.5416	-0.5275	-1.1069	-1.2380	0.0054	-0.7534	0.3626	-0.6438	-0.0026	-1.0316	-1.6334	-0.6464	-1.2474	-0.3759
35NMFM02	0.9144	-1.7372	1.1023	-1.3561	-0.4058	0.3014	-0.3523	-1.6577	-0.4099	-0.1048	-1.0766	-0.4567	-2.1724	-1.1455	-0.5275	-1.7203	0.5254	-1.2408	-0.4058	0.8391	-1.2323	0.1695	-1.5652	-0.2821	-1.0628	-1.3845	-0.3937
35NMFM03	-0.0006	0.8249	-0.5019	0.6320	-0.7467	-0.0007	-0.2873	-1.1993	-0.4810	-0.6790	0.9544	-1.0347	-2.3593	-0.8927	-0.5275	-0.5649	-0.6595	0.0111	-0.7467	0.4476	-1.0618	0.1679	-0.5600	-0.9475	-0.8939	-0.9638	-0.3783
35NMFM04	-0.7640	-0.4534	-0.0802	-0.7794	-0.4320	-0.4803	0.9261	-1.7375	-0.4602	-0.6544	-2.0770	0.0138	-2.8521	-1.4654	-0.5275	-1.3619	0.0240	-0.9028	-0.4320	-0.6436	-1.2094	-0.0011	-1.2534	-1.9544	-1.2105	-1.7206	-0.3842

ED	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	HEALTH	SOCECON	ENV	NEED	A1	A2	A3	A4	A5	A6	A7	A8	TRANSP	PERMOB	AWARE	ACCESS	PROVIS
36NMFM05	1.2171	-1.8104	1.3294	-1.4408	-0.4964	-0.0634	0.6998	-1.6228	-0.3869	-0.5654	-0.7047	0.1400	-2.5749	-0.9878	-0.6275	-1.6646	0.4815	-1.1836	-0.4964	-0.4200	-0.2702	0.5349	-1.5080	-1.6185	0.2647	-1.0263	-0.3544
36NMFM06	0.1631	-1.8472	1.4994	-1.4871	-0.0290	-0.1783	-0.5110	-1.6818	-0.0974	-0.0001	-1.8718	-0.7183	-1.7793	-1.2606	-0.6275	-1.7499	1.0832	-1.3071	-0.0290	0.7416	-0.2040	0.4821	-1.5910	0.4887	0.2781	-0.5343	-0.4488
36NMFM07	0.9564	-1.7323	1.2692	-1.3353	-0.4127	-0.3605	-0.6541	-1.4694	-0.3003	-0.4558	-0.8520	-1.4173	-2.2265	-1.4273	-0.6275	-1.5374	1.0999	-1.1022	-0.4127	1.3729	-0.1879	0.6135	-1.4061	0.9578	0.4256	-0.2508	-0.3460
36NMFM08	-0.8143	-1.7352	0.7101	-1.2946	-0.0054	-0.0429	0.6320	-1.7630	-0.4786	-0.6761	-3.1339	0.5837	-2.9177	-1.5615	-0.6275	-1.6041	0.8600	-1.2026	-0.0054	-0.3927	-0.5506	-0.3672	-1.4641	-0.9406	-0.9178	-1.4261	-0.3339
36NMFM09	-1.1101	0.1323	-0.5261	-0.1066	-0.8103	-0.1783	0.0481	-1.7376	0.0034	0.0338	-1.6094	-0.9405	-1.7003	-1.2826	-0.6275	-1.1162	-1.1405	-0.6152	-0.8103	0.1621	-0.8297	-0.1696	-1.0397	-2.4039	-0.7993	-1.5205	-0.3207
36NMFM10	-0.5911	-0.4534	-0.7586	-0.5747	-0.6679	-0.1706	1.2936	-1.7204	-0.4501	0.4996	-2.3778	0.4551	-1.6709	-0.9997	-0.6275	-1.2236	-0.7699	-0.0941	-0.6679	-0.9088	-0.0671	-0.7281	-1.1331	-2.4407	-0.7952	-1.5743	-0.2269
36NMFM11	0.0722	-0.4876	-0.0742	-0.2612	-0.7786	-0.4853	0.8198	-1.6936	-0.4476	-0.6392	-0.7708	-0.4441	-2.7803	-1.2675	-0.6275	-1.1711	-0.1161	-0.7002	-0.7786	-0.5384	-1.1293	-0.6519	-1.0874	-2.1333	-1.7812	-1.9676	-0.2116
36NMFM12	-0.6148	0.4701	-1.0300	0.4392	-0.6367	-0.4084	0.2445	-1.5888	-0.0490	-0.0580	-0.7355	-0.6006	-1.6958	-1.0160	-0.6275	-1.1403	-0.8977	-0.9278	-0.6367	0.0397	0.0221	-0.4344	-1.0606	-2.4225	-0.4123	-1.3421	-0.0629
36NMFM13	0.5802	-1.2353	-0.3078	-0.6557	-0.4364	-0.2518	-0.0231	-1.4401	-0.4627	-0.2162	-1.6186	-0.7113	-2.1190	-1.3481	-0.6275	-1.1233	1.2698	-0.6671	-0.4364	0.0614	-0.3296	0.1679	-1.0458	0.2277	-0.1617	-0.5468	-0.0161
36NMFM14	-0.4861	0.1568	-0.4448	0.4213	-0.2940	0.1813	-0.1016	0.3183	-0.4627	-0.6573	-0.3528	-0.2343	-0.8017	-0.4335	-0.6275	0.3714	-0.3260	-1.0175	-0.2940	0.0108	0.2974	-0.4882	0.2545	-1.6267	-0.1908	-0.3748	0.0662
36NMFM15	1.2407	0.0779	0.8604	-0.9363	-0.2843	-0.1706	-0.8076	0.7952	-0.4615	0.0338	1.2427	-1.2624	0.3675	0.0124	-0.6275	-0.1871	0.0853	-0.9801	-0.2843	0.9374	-0.6171	0.1269	-0.2314	-0.2417	-0.4902	-0.4212	0.2317
36NMFM16	-0.8953	1.6708	-0.7468	0.6898	-0.9047	-0.1859	0.6979	1.8882	-0.4552	-0.0200	0.6185	-0.3927	1.4130	0.4947	-0.6275	1.2658	-1.2816	1.9249	-0.9047	-0.8311	-0.9349	-0.4526	1.0327	-1.0925	-1.3875	-0.4505	0.2306
36NMFM17	-0.0457	0.6883	-0.0498	0.9350	0.9149	-0.0001	-0.2383	2.3244	-0.4689	0.2004	1.5278	0.6765	2.0559	1.2928	-0.6275	1.5763	0.9284	-0.0706	0.9149	0.0002	-0.2169	-0.8436	1.3028	1.7729	-1.0604	0.6644	0.6573
36NMFM18	-0.9856	0.0201	-0.8425	0.4472	-0.6904	-0.1629	1.3095	-1.4673	-0.4590	-0.0245	-1.3608	0.4562	-1.9408	-0.8351	-0.6275	-0.2860	-1.1468	-0.5688	-0.6904	-1.4295	-0.8741	-0.8272	-0.3174	-3.8355	-1.7013	-1.9682	0.4843
36NMFN01	-0.0535	-1.4372	0.0281	-1.1931	-0.3225	-0.5375	0.8207	-1.7135	-0.4738	-0.6704	-2.6557	-0.0393	-2.8577	-1.8296	-0.6275	-1.5629	0.5016	-1.1173	-0.3225	-1.0724	-0.0095	-0.0011	-1.4283	-2.0106	-0.0106	-1.2221	-0.0466
36NMFN02	-0.9387	1.9389	-0.8363	0.1438	-0.9799	-0.4751	0.2913	-1.0607	-0.4450	-0.6361	0.3077	-1.1637	-2.1418	-1.0249	-0.6275	0.0103	-1.2916	1.3500	-0.9799	-0.4806	-0.3021	0.0962	-0.0596	-1.4021	-0.2059	-0.4833	0.0175
36NMFN03	-1.1443	1.7738	-1.3136	1.2365	-0.7907	-0.2917	-0.7487	-1.4963	-0.3163	-0.1707	0.5514	-1.8311	-1.9833	-1.1336	-0.6275	0.6811	-1.5404	1.0695	-0.7907	0.0404	-0.5908	0.0038	0.4370	-1.2212	-0.6870	-0.3803	0.3002
36NMFN04	-1.1010	1.6641	-1.2636	1.1372	-0.7448	-0.4318	-0.9877	-1.6902	-0.4318	-0.6203	0.4468	-2.1641	-2.7423	-1.5238	-0.6275	-0.8699	-1.2902	0.7886	-0.7446	0.7417	-1.3065	-0.2663	-0.8254	-0.5045	-1.5728	-1.3262	0.3818
36NMFN05	-1.0988	1.5427	-1.4476	0.2586	-0.8525	-0.4318	0.0311	-1.6839	-0.4278	-0.6164	-0.7451	-1.2632	-2.7271	-1.6130	-0.6275	-0.7876	-1.3874	-0.4569	-0.8526	-0.1592	-0.7023	-0.5621	-0.7638	-2.8560	-1.2644	-1.7231	0.6268
36NMFN06	-0.5436	1.7921	-0.4827	1.1171	-0.6272	0.3679	0.0178	-1.6964	0.6063	-0.6267	1.8829	-0.2415	-1.7168	-0.1820	-0.6275	0.1184	-1.0788	1.1947	-0.6272	-0.4698	-1.1365	0.8558	0.0344	-0.9811	-0.2807	-0.3684	0.4020
36NMFN07	-0.6613	0.1931	-0.3572	0.0957	-0.7759	0.0055	0.2776	-1.7126	-0.4463	-0.6377	-0.7297	-0.4928	-2.7965	-1.2789	-0.6275	-0.3108	-0.6649	-0.1024	-0.7759	-0.0856	-0.0109	-0.0419	-0.3391	-1.6289	-0.0528	-0.6032	0.6227
36NMFN08	-0.9808	1.2134	-0.6596	0.0497	-0.5322	0.5236	0.2952	-1.4852	-0.4488	-0.6407	-0.3773	0.2888	-2.5747	-0.8570	-0.6275	-0.8708	-1.2268	1.2128	-0.5322	0.1978	0.6504	-0.0906	-0.8282	-0.3486	0.5598	-0.2204	0.6731
36NMFN09	-0.7315	1.1895	-0.6616	0.0782	-0.5906	-0.0428	0.7267	-1.6753	-0.4224	-0.3746	-0.1254	0.0933	-2.4723	-0.8244	-0.6275	-0.2200	-1.0805	-0.7767	-0.5906	-0.6526	-0.0686	-0.1713	-0.2600	-3.3004	-0.2399	-1.0751	0.6642
36NMFN10	-1.2074	1.8502	-1.0287	1.5142	-0.5981	-0.3899	-0.0074	-1.5068	-0.4251	-0.3796	1.1283	-0.9954	-2.3115	-0.8202	-0.6275	1.1608	-1.5643	1.2130	-0.5981	-0.5219	-0.0868	-0.6611	0.9413	-1.4713	-0.7479	-0.2711	0.6958
36NMFN11	-1.0338	1.9949	-0.6788	1.5360	-0.9593	-0.3899	1.1449	-1.6860	-0.1047	-0.6171	1.8185	-0.2044	-2.4078	-0.4161	-0.6275	1.6461	-1.5148	1.0849	-0.9593	-1.1186	1.2563	-0.8899	1.3653	-2.5077	0.3664	0.2389	0.6432
36NMFN12	-0.7249	1.2132	-0.8778	0.7142	-0.4385	-0.1163	1.3602	-1.6732	-0.4210	0.1263	0.3247	0.7954	-1.8679	-0.3097	-0.6275	0.2444	-0.6495	0.4080	-0.4385	-1.5340	1.4852	-0.5109	0.1441	-2.2140	0.9743	0.0067	0.6622
36NMFN13	-0.9593	2.1385	-1.3859	1.1842	-0.4742	-0.4318	-0.8421	-1.6902	-0.4318	-0.3920	0.9776	-1.7481	-2.5140	-1.1763	-0.6275	1.3363	-1.3808	1.7889	-0.4742	0.3179	-0.9211	-0.8627	1.0940	0.2618	-1.7838	-0.2820	0.7072
36NMFN14	0.2029	1.5215	-0.4812	0.3886	-0.2835	0.2098	0.8075	-1.5091	-0.0043	-0.4876	1.8318	0.5336	-2.0010	-0.0812	-0.3151	-0.6049	-0.5335	-0.1242	-0.2835	-1.0963	0.5673	-0.1003	-0.5672	-2.0375	0.4670	-0.5595	0.7149
36NMFN15	-0.8140	1.9546	-0.4952	0.3789	-0.0143	-0.1640	-0.7360	-0.2452	-0.0966	-0.1656	1.0243	-0.9043	-0.5074	-0.2145	0.5306	-0.0517	-1.0376	2.1582	-0.0143	0.9351	-0.6037	0.2769	0.0240	2.0415	-0.3278	0.3585	-0.0030
36NMFP01	0.1175	-1.4573	0.6408	-1.0336	-0.1256	-0.4803	-0.0002	-1.6732	-0.4169	-0.3644	-1.7326	-0.6061	-2.4545	-1.4534	-0.6275	-1.5246	1.2837	-1.0340	-0.1256	0.5986	-0.5172	0.0286	-1.3950	0.7227	-0.4886	-0.7611	0.6642
36NMFP02	0.0927	-1.1519	0.2282	-0.1840	-0.5981	-0.4374	-0.7193	-1.6796	0.0334	-0.1326	-1.0150	-1.7638	-1.7787	-1.4313	-0.6275	-1.3811	-0.1476	-1.0658	-0.5981	1.0237	-1.1260	0.1823	-1.2701	-0.7877	-0.9437	-1.3038	0.7642
36NMFP03	-0.1603	1.3980	-0.4264	0.5360	-0.2586	-0.0634	-0.4475	-1.6644	-0.0831	-0.5971	1.3483	-0.7695	-2.3446	-0.7010	-0.6275	-0.3487	-0.9416	0.3864	-0.2586	0.0991	-0.9020	-0.1579	-0.3719	-0.7147	-1.0699	-0.8946	0.6830
36NMFP04	0.7091	-1.8773	0.8230	-1.1234	-0.4913	-0.4953	-0.5601	-1.6984	-0.1120	-0.6235	-1.4686	-1.5467	-2.4339	-1.6940	-0.6275	-1.6759	1.4858	-1.3203	-0.4913	1.1670	-0.0023	1.0337	-1.5266	0.8312	1.0314	-0.0398	0.6849
36NMFP05	0.0120	-1.3671	0.1528	-1.2299	-0.6662	0.0313	0.3256	-1.7512	-0.4961	-0.6955	-2.4222	-0.3093	-2.9418	-1.6693	-0.6275	-1.7653	1.1052	-0.2303	-0.6662	0.1417	0.3496	-0.3275	-1.6218	0.3504	0.0223	-0.7122	0.7449
36NMFP06	-0.6739	-0.0313	-0.3695	-0.3552	-0.3396	0.0119	0.0062	-1.4238	-0.4368	-0.1577	-1.4299	-0.3215	-2.0173	-1.1371	-0.6275	-1.3130	-0.1206	-0.2648	-0.3396	-0.3892	-0.2815	0.3804	-1.2109	-1.1132	0.0989	-0.8343	0.6367
36NMFP07	-0.9914	1.6428	-1.1931	1.3030	-0.6712	0.0405	0.1317	-1.7017	-0.4501	-0.4261	0.7613	-0.4990	-2.5789	-0.8350	-0.6275	-0.1907	-1.5563	0.8980	-0.6712	0.4177	-0.4021	-0.0011	-0.2345	-0.9118	-0.4032	-0.5468	0.7733
36NMFP08	-0.3914	0.4279	-0.4953	-0.0001	-0.6904	0.4196	0.0135	-1.7338	-0.4590	-0.4410	-0.4489	-0.2673	-2.6338	-1.0759	-0.6275	-1.3240	0.0947	0.2609	-0.6904	0.1641	-0.3378	-0.0316	-1.2205	-0.1807	-0.3693	-0.8401	0.7082
36NMFP09	-1.1934	1.5932	-1.3530	1.0219	-0.7786	-0.1241	0.5941	-1.7146	-0.4450	-0.4159	0.0687	-0.3086	-2.5754	-0.9442	-0.6275	-0.8022	-1.5222	-0.1116	-0.7786	-0.9709	-1.0323	-0.7516	-0.7665	-3.3833	-1.7839	-2.1210	0.9025
36NMFP10	-1.3209	1.3978	-0.6581	0.6452	-0.4828	-0.4318	0.3077	-1.6943	-0.1083	-0.1493	0.0640	-0.6069	-1.9519	-0.8369	-0.6275	-0.0168	-1.5450	0.7055	-0.4828	-0.2896	-0.8556	-0.5286	-0.0832	-1.6119	-1.3841	-1.1366	1.0768
36NMFP11	-0.6115	2.0066	-1.0867	1.3763	-0.8154	-0.4260	-0.3803	-1.7216	-0.4627	-0.0292	1.6837	-1.6217	-2.2136	-0.8575	-0.6275	0.9124	-1.6273	1.1514	-0.8154	-1.1339	-0.5137	-0.1579	0.7262	-2.4252	-0.6716	-0.5795	0.9285
36NMFP12	-1.4149	2.3045	-1.3766	1.0544	-0.9173	-0.4640	-0.6228	-1.4436	-0.4627	-0.4476	0.5654	-1.9941	-2.3538	-1.3080	-0.6275	-0.4138	-1.7814	1.9803	-0.9173	0.7165	-0.5709	-0.0148	-0.4286	-0.0219	-0.5657	-0.6126	1.1087
36NMFP13	-1.2214	2.3400	-1.4648	1.8406	-0.5065	-0.4647	-0.2877	1.9839	-0.4822	-0.6804	1.4944	-1.2589	0.8213	0.2277	-0.6275	1.6409	-1.5959	2.1546	-0.5065	-0.2434	-0.7718	-0.6914	1.3590	-0.1912	-1.4632	-0.0999	0.7930
36NMFP14	-0.7283	1.5788	-1.2476	1.5708	-0.9068	0.6194	-0.7446	-1.7319	-0.4565	0.0424	1.1737	-1.0320	-2.1460	-0.7659	-0.6275	-0.8486	-1.2608	0.6071	-0.9068	0.1710	0.0484	-0.1150	-0.8069	-1.3895	-0.0666	-0.7841	0.7291
36NMFP15	-1.0229	1.4982	-0.9992	1.5599	-0.0297	-0.4023	-0.0001	1.7425	-0.3869	-0.5864	1.0340	-0.4321	0.7902	0.3779	-0.6275	1.0654	-1.1362	1.6305	-0.0297	-0.6500	-0.6544	-0.0026	0.8757	-0.1654	-0.6570	0.0630	0.8115
36NMFP16	-0.8794	0.2999	-0.5306	0.7451	0.0392	0.0055	0.0695	1.0315	-0.1193	0.3025	-0.3650	0.1342	1.2147	0.3584	-0.6275	0.1775	-0.7376	-0.6114	0.0392	-0.3658	-0.5136	0.1536	0.0859	-1.5756	-0.3600	-0.5310	0.8027
36NMFP17	-0.3271	-1.7122	0.4720	-1.1873	0.0771	-0.2657	0.7223	-1.6860	-0.4264	0.3512	-2.7546	0.5337	-1.7612	-1.0978	-0.6275	-1.6779	1.5020	-1.2646	0.0771	-0.2238	2.4814	0.5567	-1.5293	0.0907	3.0381	0.7776	0.7291
36NMFQ01	-0.7260	1.4282	-1.1201	-0.1771	-0.4277	-0.1706	-0.8018	-1.7357	-0.1505	-0.4454	-0.5950	-1.4001	-2.3316	-1.3927	-0.6275	-0.8685	0.0003	0.5574	-0.4277	0.3228	-1.3007	-0.1579	-0.8242	0.4528	-1.4586	-1.0282	1.1171
36NMFQ02	0.1360	0.3456	-0.3082	1.3206	-0.0005	0.5236	0.0243	1.7912	1.5346	0.1843	1.4940	0.5474	3.5100	1.7260	-0.6275	1.5692	0.0140	0.0000	-0.0005	-0.6670	1.3113	-0.0026	1.2966	-0.6535	1.3087	1.1393	1.1128
36NMFQ03	0.0043	-0.6082	0.0097	0.4563	1.1952	0.1495	-0.0046	2.5392	-0.4627	0.8403	-0.1379	1.3401	2.9168	1.3845	-0.6275	2.1714	0.9194	-0.6753	1.1952	-0.8749	0.9603	-0.8532	1.8206	0.5644	0.1071	1.1049	0.8929
36NMFQ04	0.9608	-0.2526	-0.3361	0.4587	1.4981	0.7727	0.2566	2.4620	-0.1541	0.9891	0.8308	2.5273	3.2970	2.1491	-0.6275	1.9871	0.8166	-0.9043	1.4981	-0.7487	0.0237	-0.8532	1.6802	0.6617	-0.8295	0.5808	0.8115
36NMFQ05	-0.8398	2.2765	-1.4036	1.8012	-0.6744	-0.0634	0.0112	-1.7243	-0.4539	-0.0186	1.8343	-0.7266	-2.1968	-0.5159	-0.6275	1.3512	-1.0996	2.0157	-0.6744	0.2234	-0.3852	0.0799	1.1070	0.4661	-0.3053	0.5171	1.2446
36NMFQ06	0.0608	-1.0991	0.1284	-0.1308	0.9682	0.0792	1.0140	1.4063	0.0056	1.1434	-1.0207	2.0614	2.5553	1.2837	-0.6275	1.0529	0.8476	-0.6094	0.9682	-0.8656	1.7505	-0.4707	0.8474	0.4419	1.2798	1.1741	1.2651
36NMFQ07	0.2083	1.1018	-0.7917	1.4804	1.0810	0.0000	0.3201	2.1632	-0.1669	0.8074	1.9988	1.4011	2.7937	1.8980	-0.6275	1.7856	-0.1697	-0.3174	1.0810	-0.9709	1.1960	-0.4150	1.4849	-0.3770	0.7810	1.0387	1.1803
36NMFQ08	0.7161	-0.3040	0.6340	-0.2923	1.5760	0.1271	0.5865	2.0953	0.6041	0.9661	0.6628	2.2886	3.5655	2.1146	-0.6275	1.7750	1.2660	-0.1663	1.5760	-0.5478	1.6984	-0.9476	1.4757	2.1269	0.7509	1.6450	1.2122
36NMFQ09	0.9898	-0.0248	0.0196	0.5430	2.0160	0.0162	0.9530	2.2754	-0.0938	1.5419	1.5276	2.9852	3.7235	2.8181	-0.6275	1.7623	1.3392	0.1546	2.0160	-1.2168	0.3772	-0.7021	1.4646	2.2930	-0.3249	1.1431	1.1683
36NMFQ10	-0.0470	1.2283	-0.2220	0.9780	0.5409	0.6924	-0.6218	2.3500	-0.4264	0.7883	1.9373	0.8114	2.7119	1.6598	-0.6275	2.0148	-0.0433	0.8362	0.5408	-0.8364	1.6176	-0.3234	1.6843	0.4973	1.2942	1.8136	1.1845
36NMFQ11	1.4062	-0.0878	-0.2644	0.7977	2.0434	0.6194	-0.1463	2.3544	-0.0795	1.0106	1.8517	2.5165	3.2855	2.3969	-0.6275	2.1406	1.5675	0.1110	2.0434	-0.2627	1.2091	-0.6611	1.7937	3.4592	0.6480	2.0357	1.1679
36NMFQ12	-0.3530	-0.0327	-0.6730	0.2398	0.9113	-0.1934	1.2969	1.7213	-0.1010	0.7883	-0.8189	2.0148	2.4086	1.2697	-0.6275	1.4552	1.0491	-0.4900	0.9113	-1.2293	1.5769	0.3201	1.1974	0.2411	1.8970	1.6075	1.2162
36NMFR01	-0.5029	1.8235	-0.7354	1.4351	-0.4153	0.7395	-0.2406	2.0853	1.5604	1.2682	2.0203	0.0836	4.9139	2.1709	-0.6275	2.1662	-1.3942	0.8648	-0.4153	-0.3037	1.8100	-0.4739	1.8160	-1.2484	1.1361	1.1640	1.1436
36NMFR02	0.6108	0.2770	0.8691	0.8894	-0.2163	-0.0563	0.1334	-1.2584	1.1576	0.8723	2.6463	-0.1392	0.5715	0.8057	-0.6275	1.6131	-0.3988	0.7492	-0.2163	-0.3283	2.3224	-0.4344	1.3348	-0.1942	1.8880	1.5629	1.1305
36NMFR03	0.3471	-0.6693	0.6642	0.6168	0.1448	0.7395	-0.0522	-1.6599	1.7690	1.6494	0.9698	0.8321	1.7565	1.1035	-0.6275	1.7355	-0.5277	0.0005	0.1448	0.0192	2.8113	0.0466	1.4413	-0.3632	2.8579	2.0588	1.3328
36NMFR04	0.5036	-0.8650	1.0068	-0.2721	0.4262	-0.2675	0.0148	-1.3255	2.7606	1.4093	0.3723	0.1735	2.8446	1.0991	-0.6275	1.7264	-0.8582	-0.7242	0.4262	-0.1335	0.5482	-0.2390	1.4334	-1.2897	0.3092	0.5489	1.3341
36NMFR05	-0.0017	0.0523	0.8604	1.1864	-0.0320	-0.4260	0.1428	-1.2310	1.5264	0.1076	2.0974	-0.3152	0.4029	0.5536	-0.6275	1.6760	-0.8577	0.0003	-0.0320	-0.3882	2.2743	-0.1362	1.3896	-1.2776	2.1381	1.4444	1.3295
36NMFR06	-0.0348	0.3870	0.4090	0.5424	0.4267	0.0333	0.2781	-1.6478	2.4158	1.2487	1.3036	0.7381	2.0167	1.2442	-0.6275	1.6791	-0.9057	0.2632	0.4267	-0.7382	2.6070	-0.0419	1.3922	-0.9640	2.5651	1.7402	1.3260
36NMFR07	-0.5487	1.6107	-0.6551	1.5765	-0.0090	-0.0707	0.6598	2.3979	1.0350	0.7063	1.9834	0.6799	4.1392	2.0689	-0.6275	2.2428	-1.2829	1.1179	-0.0090	-1.1301	2.7671	-0.2891	1.8827	-1.3041	2.4680	1.8493	1.1981
36NMFR08	0.0181	-1.0546	0.7804	-0.0881	0.0230	-0.2591	-0.0570	-1.1959	1.0271	0.8387	-0.3462	-0.2931	0.6699	0.0391	-0.6275	1.5092	-0.9851	-0.2365	0.0230	-0.1586	2.1698	-0.0204	1.2444	-1.3572	2.1492	1.3575	1.0937
36NMFR09	0.0229	0.2220	0.4624	1.1407	0.0187	0.9316	-0.8941	-1.4416	0.8930	0.8924	1.8480	0.0562	0.3438	0.5953	-0.6275	1.6597	-0.1862	-0.1043	0.0187	0.2580	2.6914	-0.0104	1.3746	-0.0138	2.6810	2.0243	1.1146
36NMFR10	-0.0017	-0.3326	0.4008	0.6002	0.3277	0.8435	-0.2510	-1.3078	1.6624	1.6721	0.6667	0.9202	2.0267	1.1240	-0.6275	1.6528	0.0048	0.6413	0.3277	-0.0598	2.6142	0.2388	1.3694	0.8140	2.8530	2.3147	1.0996
36NMFR11	0.1190	0.4822	0.7913	1.1835	0.6510	1.3617	-0.0034	-1.5219	0.8852	1.0954	2.5760	1.9993	0.4587	1.4633	-0.6275	1.7515	-0.8088	0.3604	0.6510	-0.0423	2.4623	-0.4137	1.4552	0.1603	2.0486	1.7920	1.3203
36NMFR12	0.0287	-0.5364	0.9533	0.3496	0.0370	0.4589	0.0034	-1.5252	0.0584	0.4284	0.7952	0.4993	-1.0384	0.0191	-0.6275	1.7178	-1.0220	-0.2589	0.0370	-0.7294	2.5747	-0.6002	1.4259	-1.9733	1.9745	1.2069	1.1068
36NMFR13	-0.2987	-0.3708	0.4178	0.0065	0.1503	-0.0563	-0.5415	-1.6027	0.7906	0.5437	-0.2452	-0.4475	-0.2685	-0.3000	-0.6275	1.6236	-0.8826	-0.1717	0.1503	0.1881	2.6690	0.6580	1.2570	-0.7159	3.3270	2.1130	1.3182
36NMFR14	0.4736	1.1619	0.3723	1.8188	0.1973	1.0225	0.4785	1.7118	0.8814	1.2180	3.8266	1.6983	3.8112	2.7932	-0.6275	2.2092	-1.1090	0.2037	0.1973	-0.6109	2.4910	-0.3234	1.8534	-1.3169	2.1676	1.6808	1.3136
36NMFR15	-0.6095	2.2047	-0.4553	2.0184	-0.0350	0.6458	0.0120	2.4951	0.8927	-0.1381	3.1693	0.6228	3.2497	2.0804	-0.6275	2.3997	-1.3939	1.8259	-0.0350	-0.6277	0.9294	0.4963	2.0192	-0.2307	1.4257	1.6649	1.3073

ED	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	HEALTH	SOCECON	ENV	NEED	A1	A2	A3	A4	A5	A6	A7	A8	TRANSP	PERMOB	AWARE	ACCESS	PROVIS
35NMFR16	-0.4838	-0.2216	0.5423	1.0879	0.1145	0.7758	0.8896	0.9716	0.3462	0.6166	0.9248	1.5798	1.9343	1.4026	-0.5275	1.7574	-0.6542	0.2121	0.1145	-0.8743	2.2661	-0.0053	1.4604	-1.1019	2.2608	1.5651	1.3021
35NMFS01	-0.5344	1.6701	-0.6891	1.2331	0.6309	-0.0932	-0.7550	-1.2242	-0.1156	-0.0047	1.6797	-0.2173	-1.3445	-0.1007	-0.5275	1.1439	-1.0679	0.0970	0.6309	0.0546	-0.6006	-0.4927	0.9265	0.7146	-1.0933	0.0953	1.2059
35NMFS02	-0.0774	0.1090	-0.5319	1.2272	-0.0707	0.2407	1.4300	-1.3790	-0.4437	-0.0091	0.7269	1.6000	-1.8319	0.1045	-0.5275	0.7819	-0.3308	0.7462	-0.0707	-1.1223	-0.3420	-0.3333	0.6116	-0.7776	-0.6753	-0.2263	1.2093
35NMFS03	-0.6801	1.9695	-0.9851	1.4635	-0.4009	0.1992	-0.1922	0.3062	-0.4539	0.2518	1.7878	-0.3939	0.1041	0.3504	-0.5275	1.7656	-1.1645	2.4637	-0.4009	0.0145	0.3197	-0.1297	1.4675	0.9128	0.1900	1.0570	1.2202
35NMFS04	1.1940	0.1309	0.2982	0.0164	1.6175	0.9464	1.3442	2.0615	0.1919	0.8033	1.6395	3.9081	3.0467	2.7281	-0.5275	1.9503	1.0175	0.3565	1.6175	-1.4439	-0.0268	-0.7040	1.8282	1.5476	-0.7308	0.8356	1.2162
35NMFS05	-0.5663	1.4772	-0.7273	-0.1808	-0.7472	-0.4143	-0.5063	-1.5060	1.3985	0.0450	0.0028	-1.6678	-0.0625	-0.5761	-0.5275	-0.2654	-0.7915	1.7643	-0.7472	1.0015	-0.2156	1.2439	-0.2995	1.2171	1.0283	0.6687	1.3547
35NMFS06	-0.4043	1.5299	-0.1757	1.1871	0.0012	1.5127	0.2789	1.7535	0.7250	-0.3272	2.1370	1.7028	2.1513	1.8490	-0.5275	1.9400	-1.2359	0.1874	0.0012	-0.7260	1.2320	-0.5668	1.6192	-1.7733	0.6654	0.6990	1.1247
35NMFS07	-0.6236	0.8149	-0.0005	0.1611	-0.1155	-0.0495	-0.6064	-1.6001	0.7860	-0.2875	0.3519	-0.7714	-1.1016	-0.5364	-0.5275	0.0192	-1.2925	1.2870	-0.1155	0.5190	-0.2974	0.5690	-0.0527	0.3780	0.2716	0.2040	1.2507
35NMFS08	-0.2716	1.7853	-0.3431	0.7025	-0.8449	-0.4540	-0.2330	-1.7442	0.9599	-0.2513	1.8731	-1.5319	-1.0356	-0.3876	-0.5275	1.5892	-1.3331	2.0041	-0.8449	0.3009	-0.6553	0.0021	1.3140	0.1270	-0.6532	0.3622	1.2524
35NMFS09	-0.0928	0.3657	1.0923	0.0604	-0.4247	-0.3899	-0.0751	-1.6191	1.2914	-0.6005	1.4356	-0.8897	-0.9282	-0.2471	-0.5275	1.2263	-1.2341	0.7606	-0.4247	-0.0069	-0.8746	0.2372	0.9983	-0.9051	-0.6374	-0.0458	1.2328
35NMFS10	0.1258	-0.2074	0.5334	0.2728	0.0000	0.0268	-0.6142	-1.6544	0.8666	0.0868	0.7246	-0.5874	-0.7010	-0.2483	-0.5275	0.0169	-0.1705	-0.0607	0.0000	0.7847	-0.7216	-0.4739	-0.0539	0.5535	-1.1955	-0.4863	1.2333
35NMFS11	-0.0770	0.5104	-0.4510	0.1380	-0.1968	-0.2231	-0.7950	-1.7594	-0.4774	0.0128	0.1204	-1.2149	-2.2240	-1.1162	-0.5275	-0.5561	-0.0001	0.8179	-0.1968	0.7393	-0.2950	-0.0738	-0.5524	1.3603	-0.3688	-0.1205	1.2926
35NMFS12	-0.6024	0.0570	0.1894	0.5825	-0.5401	-0.1783	0.6493	-1.7223	1.0283	-0.1941	0.2255	-0.0691	-0.8881	-0.2627	-0.5275	-0.0065	-0.6586	0.0027	-0.5401	-0.8174	0.7758	0.0799	-0.0742	-2.0134	0.8557	-0.1126	1.2926
35NMFS13	-0.7277	1.5822	0.0673	0.0326	-0.4566	-0.4374	-0.5261	-1.6818	2.2140	-0.0006	0.9544	-1.4191	0.5316	-0.0572	-0.5275	0.6554	-1.1923	2.1208	-0.4566	0.0296	1.1870	0.7639	0.6758	0.5015	1.9509	1.4386	1.2883
35NMFT01	-0.2610	1.6051	1.0025	0.3494	-0.2346	0.0107	-0.9094	-1.4470	0.6870	-0.1536	2.5960	-1.1333	-0.9138	-0.0334	-0.5275	1.8429	-1.3405	1.4320	-0.2346	0.6407	-0.2341	0.0590	1.5347	0.3976	-0.1761	0.7792	1.0884
35NMFT02	-0.2664	-0.2017	0.9930	0.8333	-0.1650	0.4400	-0.3009	-1.6453	1.3973	0.9454	1.3582	-0.0259	0.6974	0.5634	-0.5275	1.5678	-1.2270	0.5434	-0.1650	-0.0059	1.8742	-0.1235	1.2954	-0.8545	1.7507	1.3094	1.0944
35NMFT03	-1.0076	0.4185	0.8907	0.0604	-0.2269	1.1111	0.1448	0.6228	0.3876	-0.0939	0.3820	1.0290	0.9165	0.7440	-0.5275	1.6196	-1.4404	-0.0111	-0.2269	-0.1004	1.6777	-0.1954	1.3405	-1.7788	1.4823	0.9667	1.2931
35NMFT04	-0.5275	1.3480	0.0465	1.3918	0.3036	0.4689	0.8881	2.7446	-0.4398	0.0773	2.2668	1.6508	2.3821	1.9089	-0.5275	2.2998	-0.4687	1.0317	0.3036	-1.3168	0.8302	-0.4137	1.9323	-0.4682	0.4165	1.0674	1.2856
35NMFT05	-0.7718	1.1628	0.6726	1.3074	-0.4654	0.1424	-0.2804	-0.0031	0.0302	0.3612	2.3710	-0.6034	0.3783	0.5177	-0.5275	1.5607	-1.5877	0.4825	-0.4654	0.3951	0.0511	0.3475	1.2892	-1.1755	0.3986	0.5500	1.2673
35NMFT06	-0.3164	1.4336	-0.0372	0.9984	0.0731	-0.0656	0.1775	0.0657	1.3305	0.2342	2.0784	0.1650	1.6504	1.1247	-0.5275	2.0158	-0.8322	1.0079	0.0731	-0.0413	0.5236	0.2446	1.6852	0.2075	0.7682	1.2786	1.2878
35NMFT07	-0.0213	-0.0068	0.6997	-0.6925	-0.2481	0.0268	1.3738	-1.6117	-0.4099	0.0022	-0.0229	1.1626	-2.0194	-0.2947	-0.5275	0.1478	-0.7262	0.5510	-0.2481	-1.2895	1.1703	-0.1579	0.0598	-1.7128	1.0124	0.1079	1.1964
35NMFT08	0.0121	0.6372	0.3530	0.1145	0.0000	0.1009	-0.6963	-1.6144	-0.0622	-0.5763	1.0168	-0.5944	-2.2529	-0.6949	-0.5275	1.1069	-1.0432	0.6887	0.0000	0.9049	0.8222	-0.6611	0.8944	0.5504	0.1611	0.6654	1.2819
35NMFT09	-0.1898	1.0647	-0.1452	0.4247	-0.5080	0.0119	-0.9246	-1.6852	0.5985	-0.1662	1.1546	-1.4207	-1.2529	-0.8026	-0.5275	0.9245	-0.3429	0.8045	-0.5080	0.9217	-0.5653	0.2738	0.7357	0.7753	-0.2915	0.4159	1.1292
35NMFT10	0.0009	1.0346	-0.0768	0.2930	-0.0747	0.0000	-0.2229	-1.6873	0.5946	-0.4088	1.2517	-0.2978	-1.5015	-0.2868	-0.5275	0.1441	-0.1983	1.9817	-0.0747	0.5998	1.0782	0.7141	0.0568	2.3085	1.7923	1.5017	1.1380
35NMFT11	-0.9114	2.0847	-0.9285	1.4829	-0.2428	-0.0428	0.3023	-0.5773	-0.4099	-0.5937	1.7277	0.0187	-1.5809	-0.0895	-0.5275	1.3010	-0.9894	2.3235	-0.2428	-0.7294	0.9143	-0.0138	1.0633	0.3619	0.9005	1.0724	1.1035
35NMFT12	-0.4089	1.2916	0.2313	0.6566	0.2303	-0.1640	-0.3439	-1.2364	1.3402	-0.3154	1.7706	-0.2676	-0.2116	0.2829	-0.5275	1.0464	-1.1270	0.9209	0.2303	-0.0011	-0.4039	-0.3537	0.8418	0.0231	-0.7576	0.0479	0.9727
35NMFT13	-0.5268	0.1435	1.1654	0.9271	-0.0235	0.1743	0.6388	1.3080	0.0334	-0.6105	1.7292	0.7896	0.7309	0.9391	-0.5275	1.8607	-1.3572	0.3407	-0.0235	-0.3882	1.6558	-0.1235	1.5502	-1.4282	1.5323	1.1842	0.9531
35NMFT14	0.0009	-0.2155	-0.1110	-0.6013	-0.3825	-0.1783	-1.2684	-1.6069	-0.1303	-0.1830	-0.9269	-1.8272	-1.9202	-1.4809	-0.5275	-1.2430	0.0251	0.0032	-0.3825	1.7037	1.9037	1.6549	-1.1500	1.3495	3.5586	1.5417	1.1311
35NMFT15	-0.7779	2.0627	-1.3179	1.2521	-0.7112	-0.4023	-0.9152	-0.9707	-0.4155	-0.3618	1.2191	-2.0287	-1.7480	-0.9541	-0.5275	-0.2939	-1.1737	1.7488	-0.7112	1.2466	-0.1685	0.6994	-0.3243	1.1105	0.5299	0.3904	0.8937
35NMFU01	1.1864	-1.4502	1.1805	-1.2832	-0.7759	-0.4430	0.4041	-1.6915	-0.4450	-0.6361	-0.3665	-0.8148	-2.7726	-1.2874	-0.5275	-1.6574	-0.0556	-0.9500	-0.7759	-0.0122	-0.3192	0.2778	-1.5105	-1.7937	-0.0414	-1.2244	0.1700
35NMFU02	0.7354	1.2161	0.3069	0.2195	1.5174	-0.0001	0.4726	2.4362	-0.4577	0.2386	2.4779	1.9699	2.2171	2.0218	-0.5275	1.4229	0.9756	1.5608	1.5174	-0.8212	-0.0511	-0.6654	1.1693	3.2326	-0.7165	1.0346	0.2092
35NMFU03	1.0620	-1.0407	0.8592	-1.0785	1.2182	0.4632	0.5147	2.0687	-0.4565	0.0424	-0.2060	2.1961	1.6546	1.2316	-0.5275	0.7080	1.3597	-0.8850	1.2182	-1.1532	-0.4314	-0.3333	0.5474	0.5397	-0.7647	0.0263	0.5012
35NMFU04	1.2314	-1.1597	1.2245	-0.0602	1.7564	0.0162	0.1686	2.0920	0.0169	-0.0063	1.2370	1.9392	2.1026	1.6565	-0.5275	0.6503	1.2419	-1.0273	1.7564	-0.2896	0.4775	-0.6316	0.4972	1.6614	-0.1541	0.5919	0.2616
35NMFU05	0.0756	-1.7509	1.4260	-1.2675	0.0970	-0.1163	0.3337	-1.5725	-0.4527	0.0495	-1.5168	0.3144	-1.9757	-0.9330	-0.5275	-1.6770	0.1682	-1.1668	0.0970	0.1621	0.7164	-0.1362	-1.4406	-0.7595	0.5792	-0.8206	0.1009
35NMFU06	1.3705	-0.8147	0.3787	0.4862	1.8631	0.9596	-0.6952	2.4697	0.2377	0.4759	1.4187	2.1275	3.1833	2.1249	-0.5275	1.6201	1.4569	-0.9410	1.8631	0.0296	2.0785	-0.3753	1.3409	2.4086	1.7032	2.1242	0.6888
35NMFU07	1.5211	-1.5713	0.4837	0.0533	1.6614	0.8321	0.7518	2.0241	-0.4726	1.3179	0.4868	3.2453	2.8694	2.1599	-0.5275	1.2027	1.3600	-1.1183	1.6614	-1.1283	2.3776	-0.6236	0.9778	0.7748	1.7539	1.5596	0.7957
35NMFU08	0.6150	-1.5620	0.8254	-0.6208	1.4448	1.0762	0.3756	2.1932	-0.4463	0.7198	-0.7424	2.8966	2.4667	1.6022	-0.5275	1.3952	1.3977	-1.0581	1.4448	-0.3118	1.1395	-0.0571	1.1452	1.4726	1.0614	1.4815	0.6682
35NMFU09	0.6097	-1.6750	0.7585	0.5823	1.4904	1.0526	-0.0388	2.3157	-0.4664	0.2087	0.2765	2.5042	2.0580	1.5996	-0.5275	1.6179	1.5765	-1.1382	1.4904	0.1621	1.6997	-0.8699	1.3390	2.0908	0.7998	1.5921	0.7706
35NMFU10	1.0049	-1.1577	0.9846	0.0008	1.3602	0.9464	1.0644	2.3236	-0.4539	0.0471	0.8326	3.3710	1.9168	1.9708	-0.5275	1.6473	0.7831	-1.0150	1.3602	-1.5206	1.8122	-0.3954	1.3646	-0.3923	1.4168	1.2926	0.7666
35NMFU11	1.2460	-1.9557	1.3567	-1.4530	-0.5664	-0.5560	-0.1336	-1.7969	-0.5019	0.3067	-0.8060	-1.2560	-1.9921	-1.2839	-0.5275	-1.7015	1.1536	-1.3657	-0.5664	0.0028	0.6895	0.2908	-1.5469	-0.7757	1.1803	-0.3782	0.6062
35NMFU12	0.6640	-1.3700	0.8351	-0.3929	0.0771	0.2126	-0.9888	-1.0336	-0.4264	-0.1381	-0.2639	-0.6991	-1.5981	-0.8317	-0.5275	-0.8491	0.8927	-0.7634	0.0771	1.2423	0.6207	1.0598	-0.8073	1.4587	1.6805	0.8013	0.7877
35NMFU13	0.8300	-1.5481	0.8786	-0.0959	1.0622	1.1368	0.8607	2.0955	-0.4565	-0.0216	0.0646	3.0597	1.6176	1.5752	-0.5275	1.1704	1.3202	-0.8678	1.0622	-0.7521	1.3368	-0.3281	0.9497	0.7625	1.0087	1.1698	0.2700
35NMFU14	1.6174	-1.8104	0.9462	-0.6162	1.8473	1.3490	0.0774	2.5081	0.0109	1.0397	0.3370	3.2737	3.6687	2.3617	-0.5275	1.6009	1.9332	-1.1731	1.8473	-0.7386	1.1578	-0.7632	1.3242	1.8689	0.3946	1.3266	0.1599
35NMFW01	-1.1650	-0.2382	0.0196	-0.6125	-0.7676	-0.1552	-0.3130	-1.7066	-0.1176	-0.0054	-1.9961	-1.2358	-1.8294	-1.5208	-0.5275	-1.3055	-0.5407	-0.6387	-0.7676	0.1115	-1.2821	-0.1150	-1.2044	-1.8355	-1.3971	-1.7598	0.1598
35NMFW02	-0.7249	-1.6326	0.5319	-1.3563	-0.6580	-0.5192	-0.0002	-1.7145	-0.4437	-0.1746	-3.1819	-1.1774	-2.3328	-1.9655	-0.5275	-1.4610	0.3799	-1.1282	-0.6580	0.2829	1.2732	-0.6914	-1.3396	-1.1234	0.5818	-0.6598	0.1380
35NMFW03	-0.7861	-1.4926	0.2924	-1.1723	-0.0913	-0.0075	1.4149	-1.6956	-0.4450	-0.0101	-3.1466	1.3160	-2.1507	-1.0654	-0.5275	-1.6635	0.0409	-1.1659	-0.0913	-1.0299	-0.6322	-0.5581	-1.5158	-2.2460	-1.6883	-2.1636	0.2257
35NMFW04	-0.2423	0.9897	-0.3311	0.3212	-0.9650	-0.4540	1.2215	-1.6923	-0.4291	-0.0012	0.7375	-0.1975	-2.1226	-0.5890	-0.5275	-0.6724	-0.6496	-0.5660	-0.9650	-0.9672	0.0197	-0.2449	-0.6536	-3.1378	-0.2252	-1.2239	0.3663
35NMFW05	-0.0109	1.1132	-0.5516	0.4616	-0.9377	-0.5050	-0.4141	-1.7594	0.1919	0.0167	1.0124	-1.8568	-1.5609	-0.8828	-0.5275	-0.4361	-0.3559	0.2009	-0.9377	0.8893	-0.3034	0.0173	-0.4480	-0.2044	-0.2861	-0.4182	0.3604
35NMFW06	0.7236	-1.8168	0.9657	-1.6869	-0.6712	-0.2588	-0.8710	-1.7223	-0.4488	-0.1858	-1.7144	-1.8010	-2.3569	-1.8146	0.0233	-1.7647	1.2328	-1.3344	-0.6712	1.1680	-0.9122	-0.2872	-1.5323	0.3952	-1.1994	-1.2871	0.2508
35NMFW07	-0.0967	-1.5528	0.3070	-0.6903	-0.1086	-0.2588	1.2359	-1.6828	-0.4501	0.0646	-2.0326	0.8695	-2.0763	-0.9114	-0.5275	-1.3257	1.1492	-1.1163	-0.1086	-0.8177	-1.2077	-0.4707	-1.2219	-0.8934	-1.6784	-1.6735	0.3183
35NMFW08	-0.9929	-0.5197	-0.7528	-0.1084	-0.0043	-0.2447	-0.8428	-1.7424	-0.4750	-0.0471	-2.3748	-1.0918	-2.2645	-1.7125	-0.5275	-1.3198	-0.4366	-0.7184	-0.0043	1.2099	-0.4615	-0.8561	-1.2168	0.0506	-1.3176	-1.2546	0.6454
35NMFW09	-1.2234	0.1137	-0.3403	0.2132	-0.6786	-0.2857	0.8613	-1.7936	-0.0032	-0.6982	-1.2369	-0.0830	-2.4950	-1.1685	-0.5275	-1.2556	-1.2145	-0.6249	-0.6786	-0.6993	-0.5439	-0.6530	-1.1609	-3.2173	-1.1969	-1.9832	0.6519
35NMFW10	0.8712	-1.1876	0.6910	-0.7297	0.0138	0.0000	0.7507	-1.7223	-0.4488	-0.6407	-0.1351	0.7645	-2.8118	-0.7162	-0.5275	-1.2610	0.1649	-0.7778	0.0138	-0.4253	-1.3464	-0.2233	-1.1656	-1.0242	-1.5697	-1.6237	0.2460
35NMFW11	-1.3556	1.0623	-0.5938	-0.0591	-0.8026	-0.1708	-0.0002	-1.7319	-0.1413	-0.8494	-0.9282	-0.9734	-2.5216	-1.3986	-0.5275	-1.1972	-1.0679	-0.7591	-0.8026	-1.0322	-1.2558	-0.4341	-1.1101	-3.6618	-1.6899	-2.3155	0.6820
35NMFW12	-0.3686	-1.3007	0.6661	-1.1964	-0.4826	0.1168	1.0265	-1.7406	-0.4736	0.4113	-2.1968	0.6605	-1.8031	-0.9305	0.0105	-1.1315	-0.3710	-0.8075	-0.4826	-0.3820	-0.9465	-0.2100	-0.9830	-2.0431	-1.1565	-1.5605	0.5000
35NMFW13	-1.1477	1.4041	-1.4420	0.7322	-0.7446	-0.4318	0.0236	-1.6902	-0.4264	-0.1381	-0.4534	-1.1528	-2.2547	-1.2492	-0.5275	-0.1339	-1.3423	0.1655	-0.7446	-0.0929	-1.2638	-0.0944	-0.1861	-2.0143	-1.3680	-1.2751	0.5957
35NMFX02	-0.1816	-1.6717	-0.0023	-0.9611	-0.7759	-0.5463	-0.3268	-1.7125	-0.4437	0.0683	-2.8167	-1.6490	-2.0879	-1.9498	-0.5275	-1.7339	1.1412	-1.2296	-0.7759	0.8895	2.7462	0.6160	-1.5771	0.0262	3.3622	0.8989	0.6023
35NMFX03	-0.1003	-1.5623	0.8147	-1.0187	-0.7534	1.1492	1.1280	-1.6291	-0.4345	-0.6235	-1.8668	1.5238	-2.6871	-0.8544	-0.5275	-0.8036	0.4004	-0.9828	-0.7534	-0.8536	2.2670	-0.1297	-0.7677	-2.1894	2.1373	0.1375	0.6023
35NMFX04	0.2427	-0.1264	0.2976	0.7142	0.8956	-0.1163	-0.0766	1.9084	-0.4043	-0.0939	1.1290	0.7027	1.4102	0.9866	-0.5275	1.1740	0.7469	-0.7152	0.8956	-0.1697	1.4862	-0.4137	0.9528	0.7576	1.0715	1.2016	0.4695
35NMFX05	1.2023	-0.9348	0.2328	-0.3337	1.2301	0.2265	0.8968	0.8429	-0.4331	0.5622	0.1666	2.3534	0.9720	1.1501	-0.5275	1.2870	1.4898	-0.7322	1.2301	-1.1971	-0.1946	-0.7021	1.0511	0.7896	-0.8966	0.2747	0.4557
35NMFX06	-0.9716	1.4032	-0.9982	-0.2847	-0.8643	-0.4430	-0.7316	-1.6943	-0.4318	-0.6203	-0.8513	-2.0389	-2.7464	-1.8079	-0.5275	-1.2060	-0.6883	0.5318	-0.8643	1.1791	-1.1847	1.1612	-1.1178	0.1583	-0.0035	-0.5211	0.6864
35NMFX07	-1.1688	-1.0636	-0.0031	-0.8584	-0.3223	-0.0766	-0.9696	-0.9839	-0.0073	-0.3130	-3.1139	-1.3676	-1.3042	-1.6691	-0.5275	-1.3952	0.2598	-0.9128	-0.3223	1.2799	0.9067	0.9265	-1.2824	0.3046	1.8332	0.3516	0.7110
35NMFX08	-0.8194	-0.6232	-0.9285	-0.7135	-0.8304	-0.2518	-1.2676	-1.7623	-0.4701	-0.4607	-2.9846	-2.3497	-2.6831	-2.4238	-0.5275	-1.7700	-0.0227	0.1661	-0.8304	1.2724	-0.8525	1.4997	-1.6086	0.6854	0.6472	-0.3343	0.8617
35NMFX09	-0.8115	-1.6184	0.1290	-1.2004	-0.5182	-0.3059	-1.0370	-1.7761	-0.1867	-0.6846	-3.5013	-1.8611	-2.6464	-2.3778	-0.5275	-1.7521	0.5819	-1.1861	-0.5182	1.3810	2.5931	0.6206	-1.5929	0.2586	3.2136	0.8750	0.5957
35NMFX10	0.5192	-0.0032	-0.0067	0.1036	0.5938	-0.2447	1.3189	1.8922	-0.4916	0.5571	0.6128	1.6680	1.9677	1.3818	-0.5275	1.3714	0.7129	-0.9846	0.5938	-0.8897	1.7731	-0.9397	1.1245	-0.5678	0.8334	0.8371	0.4820
35NMFX11	1.2654	-1.7946	1.3739	-1.6024	0.0159	-0.5098	0.9305	-1.6997	-0.4488	-0.6407	-0.6578	0.4366	-2.7892	-0.9486	-0.5275	-1.7078	1.4427	-1.2958	0.0159	-0.3927	1.6678	0.0163	-1.5544	-0.2297	1.6841	0.0074	0.5606
35NMFX12	0.8812	-1.8500	1.7203	-1.2455	-0.1312	0.6697	1.1949	-1.6933	-0.1468	-0.2080	-0.4940	1.7334	-2.0481	-0.2284	-0.5275	-1.6117	-0.6254	-1.1620	-0.1312	-0.6436	0.8126	-0.0026	-1.4709	-2.5622	0.8100	-0.9710	0.3424
35NMFX15	1.4475	-1.1427	0.0214	-0.8673	-0.3271	1.5243	-0.7271	-0.5531	-0.0177	3.5820	-0.5411	0.4701	3.0112	1.0252	0.4862	-0.4493	1.6145	-0.6898	-0.3271	0.2903	-0.7598	-0.4103	-0.3277	0.8879	-1.1701	-0.5269	0.0152
35NMFX16	-1.0136	1.9341	-1.0592	-0.5137	-0.4233	-0.1859	-1.2707	-1.7338	-0.1468	-0.2080	-0.6524	-1.8799	-2.0886	-1.4859	-0.5275	-1.1017	-1.2237	1.8871	-0.4233	1.3254	0.0011	0.5485	-1.0271	1.5655	0.5498	0.1526	1.0452
35NMFX17	-1.2588	1.2202	-0.9622	0.0272	-0.4986	-0.1783	-0.1345	-1.7665	-0.4810	-0.6790	-0.9736	-0.8114	-2.9265	-1.4894	-0.5275	-1.0555	-1.2888	-0.4434	-0.4986	0.6290	0.4592	-0.3672	-0.9869	-1.6018	0.0920	-0.8479	1.0200
35NMFX18	-0.8167	-0.9565	-0.4431	-0.9159	-0.2016	-0.5330	-0.4226	-1.7612	-0.4774	-0.6747	-3.1322	-1.1572	-2.9133	-2.1399	-0.5275	-1.5805	-0.2812	-0.6710	-0.2016	1.2192	-0.2496	0.2718	-1.4436	0.0654	0.0222	-0.6944	0.6879
35NMFX19	-0.0809	-0.9117	0.2399	-0.9553	0.0317	-0.0167	-0.2098	-1.7368	-0.4713	-0.0416	-1.6080	-0.1948	-2.2496	-1.2166	-0.5275	-1.5271	0.2865	-0.7240	0.0317	0.3260	0.5535	0.0761	-1.3972	-0.0808	0.6296	-0.4040	0.8937
35NMFX20	0.6746	-1.6959	1.0228	-1.0454	0.3789	0.0268	-0.7116	-1.5944	-0.3641	-0.2637	-1.0439	-0.3059	-2.2122	-1.1003	0.0066	-1.6279	1.3824	-1.1802	0.3789	1.1458	0.9544	0.9304	-1.4154	1.7269	1.8848	0.6664	0.2604

ED	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	HEALTH	SOCECON	ENV	NEED	A1	A2	A3	A4	A5	A6	A7	A8	TRANSP	PERMOB	AWARE	ACCESS	PROVIS
35NNFA01	0.6590	-0.8230	-0.0570	-0.9273	-0.8633	-0.4084	-0.4790	-0.9535	-0.3626	-0.5362	-1.2483	-1.7507	-1.8612	-1.5127	0.7884	-1.1110	0.6945	-0.1092	-0.8633	0.7196	-1.2696	0.8632	-0.8643	0.4406	-0.4083	-0.5252	-1.0235
35NNFA02	0.0816	-0.7284	-0.0098	-0.8046	-0.1111	-0.0384	-0.0969	-0.0673	0.2342	-0.1907	-1.2613	-0.2344	-0.0138	-0.3981	0.7843	-1.1466	0.1886	-0.6324	-0.1111	0.5947	-1.0402	0.8031	-0.8956	0.1398	-0.2371	-0.6314	-1.0207
35NNFA03																											-0.9677
35NNFA04	-0.2956	-0.5543	0.2253	-0.4559	-0.1111	-0.3673	-0.6755	-0.5004	-0.3283	-0.4919	-1.0804	-1.1439	-1.3206	-1.0916	0.9103	-1.1466	0.0643	-0.3264	-0.1111	0.3021	-0.9986	0.6349	-0.8792	-0.0611	-0.4637	-0.8842	-1.0242
35NNFA05	-0.0776	0.6387	-0.1360	-0.0350	-0.3129	-0.0428	-0.8447	0.0103	-0.0072	-0.2006	0.3899	-1.2004	-0.1976	-0.3685	-0.0901	-0.8731	-0.0829	0.9917	-0.3129	0.6468	-1.2261	-0.0386	-0.7713	1.2417	-1.2667	-0.7086	-1.0192
35NNFA06	-0.5327	0.0726	0.1375	-0.9102	-0.1671	0.5264	-0.4058	-0.9303	-0.2299	-0.3616	-1.2329	-0.0465	-1.5218	-0.8310	0.0163	-1.0103	-0.8319	-0.7702	-0.1671	-0.4050	-0.9683	0.0930	-0.8788	-1.9742	-0.8753	-1.3696	-0.9577
35NNFB01	-0.0236	-0.6165	-0.4397	-0.6957	-0.0392	0.4161	-0.1774	-0.9654	-0.1108	-0.1879	-1.7756	0.1995	-1.2641	-0.7987	1.2598	-1.1103	0.0283	0.0005	-0.0392	0.5485	-0.6726	-0.2519	-0.8022	0.6381	-0.9245	-0.7288	-1.0711
35NNFB02	-0.4958	-0.0099	-0.3426	-0.0098	-0.3670	-0.0003	0.0070	-0.5368	0.0017	-0.4416	-0.8481	-0.3603	-0.9766	-0.6577	0.8173	-1.2802	0.0001	0.0092	-0.3670	0.0342	-1.0434	0.0608	-1.0076	-0.3235	-0.9926	-1.0809	-1.0093
35NNFB03	-0.4856	-0.1619	-0.3673	-0.1330	0.0631	1.0920	-0.5562	-1.1067	0.1751	-0.2886	-1.1478	0.6199	-1.2192	-0.4867	0.8060	-1.2143	-0.0384	-0.2989	0.0631	0.8841	-0.8811	0.2388	-0.9516	0.6299	-0.6423	-0.6396	-1.0093
35NNFB04	-0.0491	-0.5077	-0.0614	-0.6608	-0.1960	0.0170	-0.4097	-0.8113	-0.2341	0.8200	-1.2790	-0.5887	-0.2264	-0.5911	1.1138	-1.1143	-0.4558	-0.4604	-0.1960	0.6202	-0.6267	0.4433	-0.6246	-0.4920	-0.1834	-0.6270	-0.7291
35NNFB05	-0.0365	0.2706	-0.5725	-0.4107	-0.1084	-0.2917	-0.3722	-0.0260	0.0104	-0.0860	-0.7491	-0.7723	-0.1016	-0.4786	0.8725	-0.7531	0.2287	0.3787	-0.1084	0.5816	-1.0731	0.0328	-0.5418	1.0786	-1.0403	-0.5214	-0.6771
35NNFB06	-0.0566	0.0667	-0.2484	0.1693	-0.3107	0.0770	-0.6349	0.0433	0.1367	0.9925	-0.0690	-0.8686	1.1716	0.0837	0.7947	-0.9616	0.0052	0.0769	-0.3107	0.2243	-0.8166	-0.1078	-0.7333	-0.0043	-0.9246	-0.8300	-1.0704
35NNFB07	-0.4761	0.0686	-0.0364	-0.6921	-0.2969	-0.2144	0.4960	-0.0137	0.7023	0.3108	-1.1461	-0.0143	0.9994	0.0418	1.2789	-0.7629	0.1068	0.4614	-0.2959	-0.7100	-0.9164	0.2388	-0.4976	-0.4377	-0.6776	-0.6970	-1.0277
35NNFC01	-0.9116	0.9648	-0.9217	1.4419	-0.2102	0.9903	-0.0286	-1.3412	-0.0636	0.4426	0.6735	0.7616	-0.9622	0.0731	-0.2559	-0.9517	-1.2378	-0.5765	-0.2102	-0.1443	-0.4042	-0.0069	-0.9612	-2.1678	-0.4111	-1.1781	-0.0496
35NNFC02	-0.8253	0.4564	0.0063	0.8310	0.1381	-0.4953	0.5866	1.3092	-0.1669	-0.0433	0.4704	0.2294	1.0990	0.5604	0.9269	0.0626	-0.8724	0.0669	0.1381	-0.9850	-1.3657	-0.5053	0.1749	-1.6524	-1.8710	-1.2612	-0.0894
35NNFC03	-1.1722	0.0007	-0.6582	0.6460	-0.6935	-0.0017	-0.2141	-1.2832	-0.1486	-0.0260	-1.0837	-0.9093	-1.4578	-1.0600	1.0404	-1.3009	-0.3631	-0.2196	-0.6935	0.3189	-1.2550	0.1269	-0.9965	-0.9573	-1.1281	-1.3016	-0.3243
35NNFC04	-0.6516	-1.0342	-0.0243	-0.4818	-0.6440	0.0574	-0.7926	-1.6202	-0.3854	-0.3048	-2.1919	-1.3791	-2.3104	-1.7778	0.9010	-1.6055	-0.5825	-0.4886	-0.6440	1.0109	-1.0092	1.3384	-1.1927	-0.7042	0.3292	-0.6078	-0.5873
35NNFD01	0.0057	-1.3920	-0.0012	-1.2895	-0.0222	-0.3836	-0.9278	-1.4617	-0.2930	-0.4463	-2.6770	-1.3336	-2.1910	-1.8441	-0.5275	-1.5157	1.3011	-0.0906	-0.0222	1.3192	-0.6699	1.0680	-1.3872	2.5076	0.3981	0.1323	-0.9749
35NNFD02	0.7159	-1.6123	0.3433	-1.2822	-0.5362	-0.0076	-0.3876	-1.6786	0.2481	0.0495	-1.8353	-0.9312	-1.3910	-1.2296	0.6082	-1.4979	1.1231	-1.1646	-0.5362	0.6279	-0.3745	-0.1495	-1.2241	0.0502	-0.5240	-0.8616	-0.9822
35NNFD03	-0.4027	1.3381	-0.5989	0.4100	-0.9021	-0.3836	-0.2249	-1.6226	-0.3883	-0.0653	0.7465	-1.5106	-2.0762	-1.0090	0.5935	-0.9959	-1.0722	-0.4424	-0.9021	-0.0423	-0.6672	-0.4137	-0.7893	-2.4590	-1.0609	-1.5499	-0.9493
35NNFD04	-0.3301	1.1203	-0.0137	0.5990	-0.5906	-0.1008	-0.4904	-1.6763	-0.4224	-0.6089	1.3755	-1.1818	-2.7066	-0.9623	-0.5275	-0.7942	-0.4036	0.7127	-0.5906	0.0716	-1.2094	-0.4739	-0.7595	-0.2100	-1.6833	-1.2739	-0.9264
35NNFD05	1.0227	-1.6260	0.9641	-1.1046	0.0035	0.4632	0.2444	-1.5902	-0.1010	-0.0006	-0.7438	0.7111	-1.6918	-0.5129	-0.5275	-1.3037	1.3194	-1.2235	0.0035	-0.0630	0.3249	-0.2663	-1.2028	0.0164	0.0586	-0.5680	-0.9569
35NNFD06	-0.5303	0.7246	-0.5092	-0.3328	-0.6547	-0.4640	-1.3016	-1.7126	-0.1266	-0.1774	-0.6477	-2.4103	-2.0165	-1.6375	-0.5275	-1.0156	-1.0878	-0.2525	-0.6547	1.4293	-1.0610	0.9558	-0.9521	-0.5657	-0.0952	-0.6651	-0.9347
35NNFD07	-1.0100	1.4149	-0.2446	-0.2672	-0.7017	0.3014	0.2326	-0.0006	-0.0613	0.4074	-0.1069	-0.1677	0.3256	0.0259	-0.0923	-0.4567	-1.1795	1.4813	-0.7017	-1.1046	-0.3887	-0.1797	-0.4093	-1.6045	-0.5684	-0.8650	-0.9539
35NNFD08																											-0.9660
35NNFE01	0.9838	-1.7699	1.4257	-1.4064	-0.4385	-0.4751	1.3470	-1.6601	-0.4169	-0.3644	-0.7668	0.4334	-2.4314	-0.8577	0.2011	-1.7201	1.3182	-1.2425	-0.4385	-1.3384	-0.4971	0.8256	-1.4703	-1.7012	0.3285	-0.9962	-0.9845
35NNFE02	0.7349	-1.5386	1.1699	-1.0538	0.2961	-0.1629	-0.7084	-1.4816	-0.4099	-0.5937	-0.6876	-0.5752	-2.4852	-1.1920	-0.5275	-1.3974	1.3690	-1.0656	0.2961	1.1458	0.0328	0.7354	-1.2843	1.7253	0.7682	0.1733	-0.9401
35NNFE03	0.7758	-1.8383	1.3915	-1.5067	0.0731	0.1066	0.0000	-1.6377	-0.4677	-0.6514	-1.1767	0.1797	-2.6468	-1.1165	-0.4462	-1.6549	1.2174	-1.3601	0.0731	-0.1243	0.0147	0.1951	-1.4980	-0.1839	0.2098	-0.6901	-0.9301
35NNFE04	0.2660	0.5830	0.1929	0.2563	-0.7387	-0.0781	0.7293	-1.0777	0.9002	0.5967	1.2982	-0.0875	0.4192	0.4351	-0.5275	0.0343	-0.5106	0.8123	-0.7387	-1.2368	0.5875	-0.0026	-0.0387	-1.8738	0.5649	-0.1554	-0.8945
35NNFE05	1.3707	-1.8607	1.3914	-1.4543	-0.4293	-0.4751	0.3786	-1.6688	-0.0848	-0.3592	-0.5529	-0.5259	-2.1128	-1.0178	-0.3963	-1.7340	1.3371	-1.1928	-0.4293	-0.1976	1.2331	0.4478	-1.5601	-0.4925	1.6809	-0.0602	-0.9105
35NNFE06	1.3760	-1.1610	0.3266	-0.9663	0.3971	-0.2928	0.4633	1.5270	-0.4762	-0.0491	-0.4058	0.5676	1.0017	0.4217	-0.2756	-1.0402	1.8199	-1.0637	0.3971	-1.3618	1.4866	-0.7281	-0.9408	-0.2086	0.7585	-0.1433	-0.9081
35NNFE07	1.5780	-1.8347	1.2028	-1.3643	-0.0320	0.0016	-0.5346	-1.6839	-0.4237	-0.6106	-0.4082	-0.5650	-2.7181	-1.1964	-0.5275	-1.7145	1.4303	-1.2417	-0.0320	0.2477	1.0378	0.3122	-1.5602	0.4043	1.3600	-0.0040	-0.8929
35NNFE08	-0.0006	1.7034	-1.1849	1.3423	0.0099	-0.1552	-0.2103	2.2379	-0.4514	-0.4274	1.8603	-0.3556	1.3591	0.7996	-0.5275	1.7235	-0.2706	1.2313	0.0099	-0.3409	-1.0918	-0.2663	1.4309	0.6297	-1.3581	0.1938	-0.8993
35NNFE09	0.8082	-0.2943	-0.1767	0.0881	0.7048	0.0405	0.0374	1.6808	1.4323	-0.3618	0.4263	0.7827	2.7513	1.2843	-0.5275	1.0828	0.1212	-0.0374	0.7048	-0.5938	-0.8497	-0.2194	0.8735	0.1948	-1.0681	-0.0491	-0.8492
35NNFE10	-0.7422	1.9655	-0.8772	1.1881	-0.7237	0.0162	-0.6707	-1.7349	-0.1650	-0.0416	1.5342	-1.3782	-1.9414	-0.7230	-0.5275	0.6186	-1.1882	2.0283	-0.7237	-0.2745	-0.9138	-0.0084	0.4696	-0.1581	-0.9222	-0.2658	-0.9191
35NNFF01	-0.5261	0.6616	-0.6957	0.5336	-0.9129	-0.4094	-0.2582	1.0552	-0.0605	-0.3217	-0.0266	-1.5796	0.6730	-0.3088	0.0086	0.6355	-0.9699	0.0330	-0.9129	-0.0444	-1.1669	-0.3700	0.5537	-1.8942	-1.5369	-0.9652	-0.6462
35NNFF02	-0.4337	1.4045	-0.2109	1.4453	-0.6202	0.1173	0.6930	1.4387	-0.2213	-0.0170	2.2052	0.1901	1.2004	1.0149	0.0053	0.9562	-1.1930	0.6684	-0.6202	-0.8860	-0.9035	-0.2986	0.8326	-2.0308	-1.2021	-0.6925	-0.8160
35NNFF03	-0.8185	1.0169	-0.5260	0.0957	-0.1084	0.4119	-0.4179	-1.2753	-0.2723	-0.4190	-0.2319	-0.1144	-1.9666	-0.7516	0.8334	-0.5941	-0.7142	0.0017	-0.1084	0.6839	-1.0361	0.0328	-0.4065	-0.1370	-1.0033	-0.7402	-0.2104
35NNFF04	-0.9872	1.7097	-0.7050	1.4196	-0.2171	-0.1431	0.5218	0.7517	0.2133	-0.2710	1.4371	0.1616	0.6940	0.6445	0.2397	0.3731	-1.4004	0.9689	-0.2171	-0.8288	-0.7444	-0.1747	0.3558	-1.4776	-0.9191	-0.6510	-0.6642
35NNFG01	0.3375	1.2706	-0.1457	1.2454	-0.3039	0.1009	0.4967	2.1966	-0.3764	-0.0463	2.7078	0.2937	1.7739	1.3662	0.4809	1.2837	-0.7526	0.2205	-0.3039	-0.8991	-1.2434	-0.4645	1.1793	-1.7360	-1.6979	-0.6931	-0.3592
35NNFG02	0.2830	-1.5561	0.7944	-1.0538	-0.5636	0.2128	0.1787	-0.0658	0.0479	0.0012	-1.5325	-0.1723	-0.0167	-0.4461	0.5935	-1.0505	1.1460	-1.0856	-0.5636	0.1048	-0.7423	0.4478	-0.8368	-0.3984	-0.2945	-0.6653	-0.3632
35NNFG03	-0.8718	-0.4330	0.0085	0.0864	-0.8362	0.0488	-0.8926	-1.3822	-0.3417	-0.0076	-1.1999	-1.6802	-1.7314	-1.4372	0.2083	-1.0603	-0.7215	0.0017	-0.8362	0.7046	-1.0277	0.5167	-0.8953	-0.8515	-0.5110	-0.9160	-0.3723
35NNFG04	0.9752	-1.7861	0.8227	-1.2128	-0.5282	-0.2657	0.4972	-1.3369	-0.4476	0.5091	-1.4010	-0.2967	-1.2753	-0.8743	-0.5275	-1.3882	1.7361	-1.3063	-0.5282	0.2708	-1.2187	1.0159	-1.2763	0.1734	-0.2029	-0.8963	-0.3122
35NNFG05	-0.4048	-1.6080	0.7854	-1.4171	-0.4058	-0.4853	0.0026	-1.5839	-0.4099	-0.3514	-2.6445	-0.8885	-2.3452	-1.7390	1.2270	-1.6161	0.9341	-1.2132	-0.4058	0.8449	-1.2278	-0.1797	-1.2456	0.1600	-1.4076	-1.2866	-0.3651
35NNFH01	-0.5691	-0.5586	-0.1183	-0.5756	0.2545	-0.2995	0.0001	-1.1981	0.0050	-0.4292	-1.8196	-0.0449	-1.6223	-1.0106	0.4270	-1.2945	-0.2444	-0.4506	0.2545	0.0398	-1.0905	0.0000	-1.0707	-0.4007	-1.0905	-1.1808	-0.7841
35NNFH02	0.0128	-0.8017	-0.0649	-0.0381	-0.7619	-0.1706	-0.5683	-0.9002	-0.4371	-0.4016	-0.8919	-1.5008	-1.7369	-1.3029	-0.1553	-1.2316	0.5129	-0.6091	-0.7619	1.1287	-1.2605	0.3802	-1.0917	0.3706	-0.8803	-0.8934	-0.1478
35NNFH03	-0.7614	0.0107	-0.9160	0.1679	-0.8129	-0.5002	-0.4937	-1.1900	-0.4616	-0.2136	-1.4688	-1.8068	-1.8650	-1.5911	-0.5276	-1.1575	-0.4050	-0.7635	-0.8129	0.8380	-1.2123	0.0424	-1.0756	-1.1434	-1.1699	-1.4086	-0.2341
35NNFJ01	-0.3182	-0.1144	-0.1905	-0.1103	-0.3053	-0.3072	-0.3061	-0.8341	0.0146	0.0671	-0.7334	-0.9186	-0.7624	-0.7437	0.7197	-0.9312	-0.3212	0.0323	-0.3053	0.0646	-0.8549	0.2306	-0.7166	-0.5296	-0.6243	-0.8029	99.0000
35NNFJ02	-0.7604	0.0164	-0.2821	0.5154	-0.6117	-0.2237	0.0809	0.0607	-0.2169	-0.3438	-0.5107	-0.7645	-0.6000	-0.5458	-0.5197	-0.4908	-0.7257	-0.0694	-0.6117	-0.0043	-0.8345	0.9441	-0.4946	-1.4311	0.1096	-0.5503	99.0000
35NNFJ03	-0.4617	0.3331	-0.0318	0.0099	-0.6406	-0.2328	0.0582	-1.2641	-0.2320	1.2638	-0.1705	-0.8152	-0.2323	-0.3918	-0.3879	-0.1250	-1.0258	0.5053	-0.6406	-0.0615	-0.7288	-0.0204	-0.1592	-1.2126	-0.7492	-0.7574	99.0000
35NNFJ04	-0.1533	0.0332	-0.7933	0.3760	-0.7794	0.0405	-0.5746	-0.6024	-0.0507	0.0236	-0.5384	-1.3136	-0.6295	-0.7823	0.7738	-0.7825	-0.0807	-0.0301	-0.7794	1.0471	-1.1523	0.9165	-0.5902	0.1569	-0.2358	-0.3688	99.0000
35NNFJ05	-0.4331	0.5504	-0.3474	0.1167	-0.4597	-0.3772	-0.0838	-1.6027	-0.3779	-0.0485	-0.1134	-0.9207	-2.0291	-1.0118	0.4968	-0.9167	-0.3917	-0.0041	-0.4597	0.0296	-0.8176	-0.0053	-0.7329	-0.9259	-0.8228	-0.9843	99.0000
35NNFK01	-0.8677	0.7518	-0.0022	-0.7271	-0.6889	-0.4023	-0.1111	-1.1667	-0.3417	-0.5088	-0.8462	-1.2023	-2.0173	-1.2846	-0.3935	-1.2923	-0.0096	1.5146	-0.6889	0.8726	-1.1626	1.0777	-1.1765	1.6886	-0.0748	-0.2030	99.0000
35NNFK02	-0.4899	0.2590	-0.1411	-0.0905	-0.5054	-0.2757	0.4784	-0.2047	0.4303	-0.4060	-0.4625	-0.3027	-0.1804	-0.2767	0.0655	-0.7504	-0.1554	0.4884	-0.5054	-0.2880	-0.0210	0.2306	-0.6443	-0.4604	0.2096	-0.3325	99.0000
35NNFK03	-0.0369	-0.5123	0.1608	-0.7940	-0.0189	0.1692	-0.5103	-0.7377	-0.1756	-0.2852	-1.1924	-0.3600	-1.1985	-0.8176	0.9972	-1.0082	-0.2263	-0.2441	-0.0189	0.7089	-0.8560	0.6008	-0.7475	0.2196	-0.2542	-0.4460	-1.0049
35NNFK04	-0.0022	1.9381	-1.0653	-0.4233	0.0012	-0.2049	-0.2368	1.4500	0.2664	0.0317	0.4473	-0.4405	1.7481	0.5477	0.4676	-0.5204	-0.4388	2.2198	0.0012	-0.0021	-0.3178	-0.2694	-0.3920	1.7801	-0.5872	-0.0446	-0.9630
35NNFK05	-0.1411	-0.1239	0.1096	-0.0239	-0.1309	0.2000	-0.0873	-1.0727	-0.1405	-0.2334	-0.1794	0.0018	-1.4466	-0.5265	0.5687	-1.0693	0.7240	0.0340	-0.1309	-0.2481	0.8592	-0.3224	-0.8564	0.3790	0.5368	-0.0851	-1.0049
35NNFK06	0.0313	-0.1634	0.0075	-0.5076	-0.4448	-0.0148	-0.5204	-0.8689	-0.0006	-0.4697	-0.6322	-0.9798	-1.3392	-0.9311	1.0941	-0.8573	-0.3148	0.7448	-0.4448	1.2211	-1.1730	0.5740	-0.6036	1.2063	-0.5990	-0.2997	-0.9630
35NNFK07	-0.6022	1.4464	-0.8274	0.0770	-0.0441	-0.1853	-0.4751	1.2902	0.1481	-0.3022	0.0928	-0.7046	1.1381	0.1671	0.8897	0.1803	-0.4320	0.8703	-0.0441	-0.4917	-0.8350	-0.4604	0.2725	-0.0976	-1.2954	-0.5358	-1.0291
35NNFK08	-0.1126	0.9919	-0.4615	-0.2647	-0.1888	-0.2591	-0.0503	-1.2200	-0.2341	-0.3676	0.1632	-0.4982	-1.8216	-0.7326	0.7176	-1.1043	-0.0372	0.4892	-0.1888	0.2078	-1.0027	0.7203	-0.8675	0.4710	-0.2824	-0.4572	-1.0283
35NNFK09	-0.0362	-0.0430	-0.0565	-1.0100	-0.2732	-0.2144	-0.4641	-0.0425	-0.1828	-0.2955	-1.1457	-0.9517	-0.5208	-0.7773	1.0755	-1.1796	0.0033	-0.0486	-0.2732	0.1259	-0.9206	0.5032	-0.8864	-0.1926	-0.4174	-0.7001	99.0000
35NNFL01	-0.3202	1.0585	-0.8478	0.9853	-0.7646	-0.0003	0.4403	-0.4554	0.0001	-0.1402	0.8768	-0.3246	-0.5955	-0.0878	1.2611	0.1933	-0.6204	0.7207	-0.7646	-0.7260	-1.0497	-0.6788	0.3321	-1.3903	-1.7266	-1.0458	99.0000
35NNFL02	0.4171	-1.9994	0.6389	-1.8689	-0.0829	-0.0379	0.8149	-1.7125	-0.4437	0.0683	-2.8123	0.6941	-2.0879	-1.1177	-0.5275	-1.7872	1.6690	-1.2752	-0.0829	-0.4371	-1.0117	-0.1696	-1.8234	-0.1262	-1.1813	-1.4339	99.0000
35NNFL03	-0.5570	-1.1168	0.0000	-0.4783	0.4770	0.1613	1.4469	0.0187	-0.4358	-0.1577	-2.1501	2.0852	-0.5748	-0.0341	-0.5275	-1.0846	1.1963	-1.0773	0.4770	-1.4582	-0.2684	-0.8272	-1.0122	-0.8622	-1.0956	-1.2695	99.0000
35NNFL04	0.0288	-0.2511	0.2249	0.1260	-0.4144	-0.0052	0.9195	1.5938	-0.1432	0.0424	0.1286	0.4999	1.4928	0.6964	-0.5275	-0.0066	0.6932	-0.3796	-0.4144	-1.0446	-1.3622	-0.7021	-0.0743	-1.1454	-2.0543	-1.3507	99.0000
35NNFL05	-0.4898	-0.7742	0.2011	-1.0508	-0.8888	0.3340	0.0003	-1.5532	0.7727	-0.5581	-2.1137	-0.5545	-1.3386	-1.1595	0.8687	-1.3348	0.3701	-0.2338	-0.8888	0.8390	-1.0499	-0.3115	-1.0483	0.0865	-1.3614	-1.1832	99.0000
35NNFL06	-1.0230	0.5190	-0.5940	-0.0413	-0.3670	0.7159	-0.6856	-0.6282	-0.2876	-0.4391	-1.1393	-0.3368	-1.3548	-0.8487	0.9818	-1.0431	-0.4315	0.4287	-0.3670	0.9652	-1.0976	0.0000	-0.7799	0.6954	-1.0976	-0.7899	99.0000
35NNFM01	-0.1603	-0.9274	-0.0006	-0.4340	0.0531	-0.1163	-0.8164	-0.7768	0.0653	-0.3354	-1.5223	-0.8796	-1.0469	-1.0227	0.2734	-0.9890	0.7989	-0.2001	0.0531	1.2421	-1.0833	1.4695	-0.8249	1.8940	0.3862	0.2542	-1.0277
35NNFM02	-0.1625	-0.0733	-0.1033	-0.5858	-0.4783	0.0084	0.0325	1.7403	-0.0490	0.2451	-0.9249	-0.4374	1.9364	0.2694	1.0073	-0.5539	0.3565	0.6029	-0.4783	0.2934	-1.2665	0.3475	-0.3509	0.7745	-0.9180	-0.4408	-1.0284
35NNFM03	0.0559	-0.0933	0.0282	-0.0731	-0.0675	-0.5146	-0.6408	-0.7206	-0.4738	0.4113	-0.0823	-1.2229	-0.7631	-0.6892	0.7822	-0.8512	0.6265	-0.0388	-0.0675	1.0886	-1.3179	0.2531	-0.6369	1.6088	-1.0646	-0.4497	99.0000
35NNFM04	-0.4534	0.0093	-0.5137	0.2833	-0.0844	0.0170	-0.9984	-0.4411	-0.2665	-0.4113	-0.6745	-1.0658	-1.1189	-0.8969	0.3494	-0.6055	-0.7565	0.0023	-0.0844	0.6344	-0.9473	0.0590	-0.4814	-0.2042	-0.8883	-0.7359	-1.0697
35NNFM05	-0.2344	-0.5658	-0.3318	-0.5311	-0.7001	-0.2917	-1.0439	-1.2977	-0.2626	-0.4060	-1.6631	-2.0357	-1.9663	-1.7499	0.8531	-1.2744	0.0552	-0.5646	-0.7001	1.5106	-1.0806	0.4763	-0.9978	0.3010	-0.6042	-0.7258	99.0000
35NNFN01	-0.7357	1.5370	-0.8246	0.0249	-0.4802	-0.3505	0.5491	-0.2043	-0.0025	-0.1774	0.0016	-0.2816	-0.3842	-0.2215	0.8177	-0.1306	-1.0401	1.3762	-0.4802	-0.4854	-1.1812	-0.0138	0.0057	-0.6295	-1.1950	-0.7620	-0.4395

ED	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	HEALTH	SOCECON	ENV	NEED	A1	A2	A3	A4	A5	A6	A7	A8	TRANSP	PERMOB	AWARE	ACCESS	PROVIS
35NNFN02	-0.1223	-0.5822	-0.3996	-0.4742	-0.5116	0.1692	-0.8160	-1.1516	-0.1609	-0.2637	-1.5703	-1.1583	-1.5761	-1.3060	0.6961	-1.1774	-0.6027	-0.7771	-0.5116	1.2349	-0.7142	0.4433	-0.9340	-0.6564	-0.2709	-0.7666	-0.1499
35NNFN03	-0.7590	-0.4884	0.2890	-0.9260	0.5401	-0.4202	-0.5525	0.4355	-0.0296	-0.0294	-1.8044	-0.4326	0.3766	-0.4698	0.5486	-1.0031	0.0166	0.0440	0.5401	0.7401	-1.0277	0.6223	-0.8014	1.3398	-0.4054	-0.2685	-0.4499
35NNFN04	-0.6691	-0.3551	0.1690	-0.3104	0.0276	-0.3962	-0.3151	-1.1568	-0.0367	-0.0396	-1.1456	-0.6837	-1.2331	-0.9253	1.0190	-1.1735	-0.5453	-0.2825	0.0276	0.9804	-1.2025	0.0063	-0.8885	0.1802	-1.1962	-0.9973	-0.6030
35NNFN05	-0.5181	-0.0733	-0.1033	-0.5277	-0.7297	0.2553	-0.4587	-1.4506	-0.4210	-0.6072	-1.2224	-0.9311	-2.4786	-1.4422	0.9268	-1.4621	-0.1170	-0.5974	-0.7297	0.8760	-1.3087	1.0598	-1.1515	-0.5691	-0.2489	-0.8425	-0.6781
35NNFN06	-0.2676	-1.1218	0.5119	-0.8994	-0.1167	-0.0428	-0.8584	-1.2118	-0.3249	-0.4876	-1.7769	-1.0179	-2.0243	-1.4583	0.8897	-1.4189	0.4286	-0.5740	-0.1167	1.2488	-1.2353	0.8300	-1.1188	0.9845	-0.4053	-0.5159	-0.6197
35NNFP01	0.2811	-0.1297	-0.5144	0.3913	0.0018	0.0468	-0.0197	-0.1618	-0.2103	0.2183	0.0383	0.0287	-0.1536	-0.0321	0.9103	-0.9802	-0.0669	-0.5087	0.0018	-0.0549	-0.7752	-0.5261	-0.7344	-0.6287	-1.3013	-1.1750	-0.8815
35NNFP02	-0.0653	1.4784	-0.5530	0.7236	-0.3460	0.0348	-0.5981	-1.1986	0.1077	-0.3251	1.5836	-0.9093	-1.4159	-0.3792	0.9359	-0.7063	-0.5766	1.5416	-0.3460	0.6465	-0.2340	0.5032	-0.4928	1.2655	0.2692	0.2046	-0.9801
35NNFP03	0.6028	-1.5343	0.6697	-1.0901	0.1203	-0.1859	-0.3379	-1.6455	-0.4169	-0.6022	-1.3519	-0.4035	-2.6646	-1.3607	0.5935	-1.5408	1.1909	-0.5509	0.1203	0.9783	-1.2762	0.0601	-1.2633	1.7388	-1.2161	-0.8061	-0.9779
35NNFP04	1.0286	-1.3027	0.0692	-0.9631	-0.0448	0.0000	1.0000	-0.0640	-0.4318	-0.3920	-1.1780	0.9652	-0.8778	-0.2687	-0.4671	-1.0917	1.3616	-1.1085	-0.0448	-0.2287	-1.3881	0.6756	-1.0106	-0.0184	-0.7125	-0.8661	-0.9794
35NNFQ01	-0.7927	0.6042	-0.2405	-0.5637	-0.3524	-0.3641	0.4758	-0.8474	-0.0137	-0.2232	-0.9927	-0.2407	-1.0843	-0.6898	0.4729	-1.1831	-0.3982	0.0028	-0.3524	-0.0414	-1.0085	-0.0007	-0.9678	-0.7892	-1.0092	-1.1958	-1.0534
35NNFQ02	-0.3047	-0.1023	0.1377	-0.0044	-0.5096	0.9238	0.8089	-0.1037	-0.3927	-0.3189	-0.2737	1.2231	-0.8153	0.0676	1.0023	-1.0232	-0.1199	-0.1075	-0.5096	-1.1460	-1.1523	-0.0565	-0.7599	-1.8830	-1.2088	-1.4551	-1.0235
35NNFQ03	-0.0239	-0.2056	0.1067	-0.7566	-0.5089	-0.0304	0.0095	-1.4306	-0.0088	-0.5005	-0.8773	-0.5298	-1.9398	-1.0425	0.8916	-1.3740	-0.0401	-0.1434	-0.5089	0.0648	-1.2123	0.3514	-1.0795	-0.6278	-0.8609	-1.1272	-1.0548
35NNFQ04	0.1673	0.1641	-0.3873	-0.1330	-0.0500	-0.1962	-0.8466	-1.0786	0.1418	-0.3056	-0.1689	-1.0918	-1.2423	-0.8203	0.9853	-1.2070	0.3922	-0.0050	-0.0500	0.8842	-0.6811	1.1629	-0.9220	1.2214	0.2818	-0.0148	-0.9846
35NNFQ05	-0.7509	1.0443	-0.4747	0.4355	-0.3858	-0.2237	1.1480	-0.6023	-0.2213	-0.3498	0.2642	0.5386	-1.1734	-0.1481	0.4379	-0.7256	-0.6410	0.0553	-0.3858	-1.1006	-0.9391	-0.0204	-0.5743	-2.0720	-0.9595	-1.2849	-1.0630
35NNFQ06	-0.2246	0.0296	-0.6784	-0.7581	-0.2929	-0.0963	0.0770	-0.8226	-0.0819	0.3058	-1.6316	-0.3122	-0.5987	-0.7116	0.3829	-0.6699	-0.4266	-0.2049	-0.2929	-0.6184	-0.2977	0.9138	-0.5330	-1.5427	0.6161	-0.3441	99.0000
35NNFR01	-0.6862	-1.0674	0.8609	-0.9247	0.6491	-0.3438	-0.8177	-0.7577	-0.2800	0.3216	-1.8074	-0.5122	-0.7181	-0.8613	0.9158	-1.2588	0.2206	-0.6306	0.6491	1.0422	-0.7970	0.2318	-0.9761	1.2813	-0.5652	-0.4603	-0.8702
35NNFR02	-0.0730	0.9247	-0.3570	0.6956	-0.3684	-0.2009	-0.3085	0.6309	-0.4846	-0.6832	1.1903	-0.8778	-0.5388	-0.1740	0.2481	-0.7359	-0.7738	0.3135	-0.3684	0.3495	-1.3349	-0.2100	-0.6080	-0.4792	-1.5449	-1.1963	-0.7024
35NNFR03	-0.6621	0.0284	-0.2199	-1.2044	-0.3634	0.0670	-0.8445	-1.5513	-0.3466	-0.0112	-2.0580	-1.1409	-1.9091	-1.5312	0.6722	-1.5028	-0.5000	0.6722	-0.3634	1.2222	-1.2886	1.3467	-1.2199	1.0310	0.0781	-0.3132	-0.7948
35NNFR04	-0.7414	-1.0260	0.0349	-1.0423	-0.4783	-0.0932	-0.7615	-1.3396	-0.0490	-0.5618	-2.7749	-1.3330	-1.9503	-1.7882	0.5712	-1.4369	-0.0044	-0.0007	-0.4783	1.2213	-1.3030	0.5869	-1.1759	0.7379	-0.7161	-0.7615	-0.7412
35NNFR05																											-0.8484
35NNFS01	-0.2409	0.4070	-0.3028	-0.5779	-0.8612	-0.3707	0.6236	0.5757	-0.0217	-0.0186	-0.7146	-0.5984	0.5354	-0.1997	1.2546	0.0031	-0.2944	0.8774	-0.8612	-0.8991	-1.2144	-0.7690	0.1658	-1.1673	-1.9834	-1.2006	-0.7403
35NNFS02	-0.8916	1.4188	-0.8976	0.0760	-0.8362	-0.3436	0.8048	-0.9184	-0.0147	-0.5131	-0.2944	-0.3750	-1.4462	-0.6807	0.9921	-0.6662	-1.1916	0.8587	-0.8362	-0.8300	-1.1683	-0.5666	-0.4506	-1.9990	-1.7349	-1.5926	-0.6046
35NNFS03	-0.0797	-0.3282	-0.2447	-0.8791	-0.5705	0.1009	-0.1630	-1.5709	-0.0255	-0.5312	-1.5317	-0.6326	-2.1276	-1.3030	0.6788	-1.0857	-0.1337	-0.0398	-0.5705	0.8461	-1.2434	-0.1003	-0.8586	-0.0979	-1.3437	-1.1246	-0.5883
35NNFS04	-0.7663	0.9589	-0.5428	-0.3687	-0.2258	0.4782	-0.3389	-0.6063	-0.0269	-0.0256	-0.7189	-0.0865	-0.6588	-0.4282	-0.3935	-0.5264	-0.8334	-0.4393	-0.2258	0.5881	-1.2281	0.4206	-0.5083	-0.9124	-0.8075	-0.8860	-0.6023
35NNFT01	-1.2088	-0.8149	-0.5270	-0.8378	-0.4464	0.3854	-0.5240	-1.5092	-0.3718	-0.2787	-3.3883	-0.5840	-2.1597	-1.7616	0.6536	-1.4318	-0.6422	-0.1546	-0.4464	1.1116	-0.9475	0.6011	-1.1607	-0.1306	-0.3464	-0.7862	-0.6020
35NNFT02	-0.3896	-0.0281	-0.2317	-0.3105	0.0389	0.0486	-0.5356	-0.1227	-0.0324	0.5723	-0.9599	-0.4480	0.4172	-0.2502	0.7373	-0.4966	0.2128	-0.0100	0.0389	0.7401	-0.8869	0.8632	-0.3353	0.9818	-0.0227	0.0666	-0.6072
35NNFT03	-1.0832	-1.0196	-0.0024	-0.6839	-0.5326	-0.2606	-0.9581	-1.1796	-0.1732	-0.2817	-2.7890	-1.7411	-1.6344	-1.8224	0.9556	-1.1504	-1.0979	-0.5299	-0.5326	1.2583	-0.3999	0.2306	-0.8766	-0.9020	-0.1693	-0.7486	-0.5246
35NNFT04	-1.1969	1.1572	-0.3717	0.4558	-0.7417	-0.4594	-0.2427	-0.3065	-0.4291	0.3413	0.0444	-1.4438	-0.3943	-0.6016	0.5935	-0.7036	-0.4784	0.0343	-0.7417	-0.6358	-1.1172	-0.7604	-0.5350	-1.8216	-1.8976	-1.6717	-0.4717
35NNFT05	0.0831	-0.6993	0.0822	-0.1402	-0.3186	0.5435	0.2935	0.9657	-0.0879	-0.1516	-0.6742	0.5182	0.7262	0.2463	0.0220	-0.2221	0.0229	-0.2322	-0.3188	0.1182	-0.6920	0.0206	-0.1904	-0.4119	-0.6614	-0.4789	-0.6713
35NNFU01	-0.0610	0.4465	-0.4823	0.3478	-0.1393	-0.0146	-0.9941	-1.1891	0.2069	-0.5026	0.2610	-1.1480	-1.4848	-0.8124	0.7329	-0.9513	0.0088	-0.0408	-0.1393	1.2126	-1.1730	0.0050	-0.7324	1.0413	-1.1680	-0.6899	99.0000
35NNFU02	-0.1288	1.5110	-0.2193	1.1921	-0.0185	-0.0067	0.9306	-0.1536	-0.3400	-0.5068	2.3550	0.9053	-1.0003	0.5571	1.2520	-0.0162	-0.8722	1.4338	-0.0185	-0.8749	-0.9473	-0.2737	0.1487	-0.3318	-1.2210	-0.6191	99.0000
35NNFU03	0.1194	0.6119	-0.7259	0.6048	0.6298	0.0000	1.3029	2.7598	-0.4602	0.4619	0.6103	1.9327	2.7615	1.7173	-0.2953	1.6326	0.0000	-0.7042	0.6298	-1.6339	-1.3488	-0.9155	1.3819	-1.7083	-2.2643	-0.8683	99.0000
35NNFU04	1.0365	0.0378	0.6889	-0.1727	-0.3149	-0.1066	-0.3295	-1.6881	0.0258	-0.0017	1.5905	-0.7530	-1.6640	-0.4080	-0.5275	-1.2528	0.3244	-0.1664	-0.3149	0.1979	-0.1714	-0.0255	-1.1585	0.0409	-0.1969	-0.6675	99.0000
35NNFU05	-0.4156	0.9136	-0.7266	0.1133	-0.6677	-0.3438	0.0480	-1.2666	-0.3317	-0.4962	-0.1154	-0.9653	-2.0945	-1.0488	0.4889	-1.1707	-0.7280	0.4439	-0.6677	-0.0416	-1.0966	0.1929	-0.9550	-0.9934	-0.9037	-1.1777	99.0000
35NNFW01	-0.4528	-0.3812	0.5375	-0.3914	-0.4542	-0.1751	-0.4614	-0.8719	-0.1431	-0.2373	-0.6879	-1.0907	-1.2523	-0.9530	1.0485	-0.9892	0.1513	-0.3921	-0.4542	1.0496	-0.8273	0.4401	-0.6373	0.3546	-0.3872	-0.4236	-1.0085
35NNFW02	-0.4684	-0.8177	-0.0004	-0.7870	-0.3107	0.0607	-0.3606	-1.2304	-0.1968	-0.3154	-2.0735	-0.6106	-1.7426	-1.3028	1.1017	-0.7990	-0.0776	-0.1016	-0.3107	1.0024	-0.9491	0.6437	-0.5510	0.5126	-0.1064	-0.2001	-0.9081
35NNFW03	-0.4145	0.9918	-0.3905	-0.6767	0.0371	-0.0495	-0.6173	1.1502	-0.3317	-0.4962	-0.4899	-0.6297	0.3223	-0.2249	0.0163	-0.6936	0.0001	1.5400	0.0371	0.5527	-1.1390	0.0466	-0.5926	2.1299	-1.0924	-0.3100	-0.8717
35NNFW04	-0.7085	0.7227	-0.0384	0.3199	-0.5182	-0.0781	-0.0698	1.0552	-0.3942	-0.0755	0.2957	-0.6859	0.5855	0.0405	-0.3489	-0.6841	-0.8412	-0.0032	-0.5182	0.6052	-1.2797	0.7954	-0.6405	-0.7574	-0.4843	-0.7518	-0.9033
35NNFW05	-0.3755	-0.2087	-0.0279	-0.0316	-0.8303	-0.4540	-0.9787	-0.3113	-0.0848	-0.5988	-0.6437	-2.2830	-0.9949	-1.2469	0.5935	-0.8907	-0.0375	-0.2433	-0.8303	1.3564	-1.1019	1.2695	-0.6978	0.2453	0.1676	-0.2038	-0.9081
35NNFX01	-0.4540	-0.1537	-0.5606	-0.5994	-0.5309	-0.4374	-0.3130	-1.5650	-0.0673	-0.5816	-1.7677	-1.2813	-2.2139	-1.6070	-0.5275	-1.5424	-0.5415	-0.4795	-0.5309	0.8013	-1.2674	0.5369	-1.4105	-0.7506	-0.7305	-1.2582	-0.3110
35NNFX02	-0.2884	1.3650	-0.5282	1.1021	-0.0514	0.0170	-0.7769	1.7928	-0.2528	-0.3927	1.6645	-0.8113	1.1475	0.5257	0.9047	0.2870	-0.2804	0.0141	-0.0514	-0.0011	-0.7203	-0.2073	0.3499	-0.3188	-0.9276	-0.3686	-0.2845
35NNFX03	-0.8894	1.2222	-1.0853	0.4219	-0.1674	-0.0495	-0.0135	0.8091	-0.0623	-0.5664	-0.3306	-0.2204	0.1914	-0.0923	0.5935	0.0562	-1.4138	0.7568	-0.1574	-0.0076	-1.2473	0.0289	0.1260	-0.8219	-1.2164	-0.7517	-0.3998
35NNFY01	0.8444	-1.2736	0.0678	-1.1636	-0.4597	-0.1008	-0.1840	-1.5766	-0.3764	-0.2875	-1.5260	-0.7445	-2.2394	-1.3759	-0.1601	-1.6281	1.1639	-0.9822	-0.4597	-0.0080	-1.7039	-0.0138	-1.4360	-0.2860	-0.7977	-1.1884	99.0000
35NNFY02	-0.9188	0.1785	-0.9298	-0.2022	-0.1921	-0.2304	-0.0006	-0.6026	-0.4738	-0.2407	-1.8723	-0.4231	-1.3170	-1.0481	-0.5275	-0.8512	-0.5922	-0.2436	-0.1921	-0.3472	-1.2544	-0.1898	-0.8091	-1.3751	-1.4442	-1.4704	99.0000
35NNFY03	-0.7275	1.4850	-0.6350	-0.9389	-0.0090	-0.1859	-0.8332	-0.0289	1.3573	-0.1830	-0.8164	-1.0281	1.1454	-0.1650	-0.5275	-0.0009	-0.4900	1.8820	-0.0090	1.1053	-1.1870	0.5272	-0.0694	2.2883	-0.6598	0.2076	99.0000
35NNFY04	-1.1646	0.2964	-0.4726	0.6352	-0.4343	-0.0003	-0.7231	-0.9783	0.6757	-0.1606	-0.5056	-1.1677	-0.4632	-0.6667	-0.1250	-1.3575	-0.4208	0.0078	-0.4343	-0.2956	-1.1167	0.1448	-1.1973	-1.1428	-0.9719	-1.3703	99.0000
35NNFY05	-0.0038	-0.2529	-0.2564	-0.1195	-0.3445	-0.4853	0.0417	1.5958	-0.4331	-0.3944	-0.6326	-0.7881	0.7683	-0.1648	-0.3292	-0.3501	0.1693	-0.1358	-0.3445	-0.4413	-0.7848	-0.5219	-0.3474	-0.7623	-1.3067	-1.0151	99.0000
35NNFY06	-0.3476	0.4518	-0.0520	-0.0116	-0.4407	-0.2094	-0.4169	0.9239	-0.4640	-0.4498	0.0406	-1.0660	0.0101	-0.3418	-0.5275	0.2403	-0.1564	0.3947	-0.4407	0.0629	-1.3389	-0.7397	0.1405	-0.1495	-2.0788	-1.0064	99.0000
35NNFY07	0.0278	0.7534	-0.8173	0.1787	-0.2542	-0.3772	0.0027	-1.5871	-0.3687	-0.5429	0.1426	-0.6287	-2.4987	-1.0068	1.0174	-0.4617	-0.5047	0.3228	-0.2642	0.1846	-1.2197	-0.3234	-0.2694	-0.2618	-1.6431	-0.9692	99.0000
35NNFY08																											99.0000
35NNFZ01	-0.6264	1.1106	-0.8880	0.2756	-0.0133	-0.3772	-0.3353	-1.0923	-0.3367	-0.5026	-0.1082	-0.7258	-1.9316	-0.9129	0.9853	-1.0523	-0.5248	1.4594	-0.0133	0.6924	-1.0509	0.5167	-0.7874	1.6137	-0.5341	-0.2573	-0.0074
35NNFZ02	-0.6850	1.5028	-0.6831	1.4091	-0.6713	-0.0103	0.3764	1.6199	-0.3317	-0.0022	1.1436	-0.3062	1.2860	0.6125	1.2649	0.6560	-0.9453	0.7706	-0.6713	-0.6978	-1.1659	-0.6788	0.9092	-1.4438	-1.8447	-0.8287	-0.0961
35NNFZ03	-0.4935	-0.1865	0.0005	-0.4364	-0.2598	-0.0634	0.2933	-1.2601	-0.0338	-0.5429	-1.1159	-0.0299	-1.8368	-0.9012	0.7632	-1.2211	0.0397	-0.7408	-0.2598	0.1333	-1.1586	0.6939	-0.9631	-0.9276	-0.4647	-0.9208	-0.0705
35NNGA01	-0.5238	1.3192	-0.5745	0.5500	-0.6784	-0.3438	0.9829	0.6076	0.2069	-0.0046	0.7709	-0.0391	0.8099	0.4497	1.0339	-0.0092	-0.5746	0.0011	-0.6784	-1.1578	-1.0338	0.0050	0.1264	-2.4097	-1.0288	-1.0538	99.0000
35NNGA02	-0.7720	1.2222	-0.3395	0.9004	-0.8956	0.1009	0.1413	-1.2317	-0.0490	0.0256	1.0111	-0.6533	-1.2551	-0.3834	0.0927	-0.8678	-0.8571	-0.0018	-0.8955	-0.2434	-0.8766	-0.1472	-0.7429	-1.9978	-1.0238	-1.3828	99.0000
35NNGA03	0.0011	-1.3778	0.1006	-0.9383	0.0731	0.1066	0.2260	-1.3462	-0.4602	-0.6544	-2.2144	0.4067	-2.4608	-1.2386	-0.5275	-1.4349	1.0212	-0.7632	0.0731	0.5090	-1.2526	0.5272	-1.3169	0.8401	-0.7253	-0.8111	99.0000
35NNGB01	-0.6877	1.4550	-0.9569	0.4485	-0.6864	-0.3294	-0.4456	-0.3610	0.1982	-0.5068	0.2589	-1.4603	-0.6596	-0.6419	-0.0386	-0.3892	-1.2438	0.9312	-0.6864	0.2308	-0.4295	0.9985	-0.3436	-0.7672	0.5690	-0.0791	99.0000
35NNGB02	-0.5743	1.8459	-0.7569	-0.0792	-0.7616	-0.2995	-0.7833	-1.2078	-0.2967	-0.4611	0.4356	-1.8444	-1.9556	-1.1578	0.9010	-1.0503	-1.2460	1.6702	-0.7616	0.9252	-0.9334	1.0698	-0.7966	0.5878	0.1364	-0.1832	99.0000
35NNGB03	-0.7390	-0.1319	-0.2078	0.3628	-0.0887	-0.2049	0.0000	-0.3607	0.1130	-0.3219	-0.7159	-0.2936	-0.5596	-0.4634	0.9749	-1.0802	-0.8765	0.1729	-0.0887	0.0160	0.1263	0.3858	-0.8130	-0.7773	0.5121	-0.3448	-1.0609
35NNGB04	-0.0400	-0.0734	-0.0084	0.0040	-0.6367	-0.3989	-0.8812	-1.2317	-0.0476	-0.5599	-0.1178	-1.9078	-1.8391	-1.2784	-0.1631	-1.3517	-0.0843	0.0949	-0.6367	0.0361	-0.4218	-0.0138	-1.1972	-0.5900	-0.4356	-0.9639	-1.0541
35NNGB05	-0.7381	0.9939	-0.2486	0.1859	-0.3271	-0.0839	0.1616	0.4228	0.5730	-0.1516	0.1931	-0.2494	0.8442	0.2465	1.0371	-0.0008	-0.8355	1.1976	-0.3271	-0.6184	-0.2352	0.3002	0.1341	-0.5834	0.0650	-0.0463	-1.0569
35NNGB07	-0.5388	0.0637	-0.2021	-0.6878	-0.6160	-0.2418	0.0264	-0.7676	-0.2126	-0.3376	-1.3650	-0.8314	-1.3377	-1.0643	0.2762	-1.0170	-0.7604	-0.3156	-0.6160	0.2078	-0.6298	-0.0613	-0.8489	-1.4842	-0.6911	-1.1411	-1.0479
35NNGB08	-0.6830	0.1349	-0.4536	-0.5059	-0.3524	0.1743	-1.1496	-1.3406	-0.3400	-0.5069	-1.7075	-1.3277	-2.1873	-1.5995	0.8972	-1.4639	-0.4501	-0.1834	-0.3524	1.3993	-0.9918	1.4795	-1.1570	0.4134	0.4877	-0.2313	-0.9911
35NNGB09	-0.5514	0.4185	-0.1231	0.0804	-0.5042	-0.3573	-0.0214	0.9201	-0.3300	-0.1973	-0.1766	-0.8829	0.3928	-0.2073	0.9679	-1.0428	-0.4926	0.3167	-0.5042	0.2126	-1.0673	-0.2989	-0.7614	-0.4675	-1.3662	-1.1907	-1.0582
35NNGB10	-0.6455	1.3027	-0.4161	-0.4830	0.0012	0.7365	-0.5060	-0.8142	-0.1483	-0.2450	-0.2419	0.2317	-1.2076	-0.3857	0.0019	-0.9523	-0.8775	1.8512	0.0012	0.3307	-0.8528	0.3676	-0.8283	1.3056	-0.4850	-0.3303	-1.0548
35NNGC01	-0.0797	0.0335	-0.2895	-0.5023	0.0681	-0.1318	0.0259	-1.0076	-0.1191	-0.2009	-0.8370	-0.0379	-1.3275	-0.6644	0.2621	-0.0443	0.3186	0.5492	0.0681	0.2243	-0.2881	-0.3224	-0.0045	1.1602	-0.6105	-0.0176	-0.1989
35NNGC02	-0.4342	-0.7117	-0.4018	0.0414	-0.3460	-0.2237	0.0038	-0.6125	-0.2013	-0.3219	-1.5063	-0.5661	-1.1357	-0.9438	0.6106	-1.2107	-0.9720	-0.4201	-0.3460	0.3179	-0.9391	0.6652	-0.9739	-1.3202	-0.2739	-0.9540	-0.5703
35NNGC03	-0.2610	0.5712	-0.6872	0.4778	-0.0094	0.0888	0.0461	0.3465	-0.3764	-0.5524	0.1008	0.1266	-0.5823	-0.1271	1.2826	-0.2434	-0.5450	-0.5022	-0.0094	0.0004	-1.0826	-0.3471	-0.0450	-1.0562	-1.4297	-1.0014	-0.4683
35NNGC04	-0.5121	1.5632	-0.0512	1.1101	-0.2690	-0.0781	0.6272	1.5742	-0.4166	-0.6005	2.1100	0.2801	0.5582	0.8069	-0.3010	0.2825	-1.0136	0.6177	-0.2690	-0.7677	-0.9440	-0.8532	0.2066	-1.4326	-1.7972	-1.1535	-0.5541
35NNGC05	-0.1474	1.0736	-0.3089	0.0373	-0.1681	-0.4143	-0.8007	-1.4265	-0.3898	-0.5691	0.6546	-1.3831	-2.3854	-1.0925	0.3885	-0.7503	-0.6170	-0.0653	-0.1681	1.3010	-1.2862	0.3804	-0.6023	0.4506	-0.9048	-0.8409	-0.6114
35NNGC06	-1.0307	0.5404	-0.1925	0.1420	-0.3913	-0.1086	0.7551	-1.6266	-0.0742	-0.3434	-0.5409	0.2552	-2.0442	-0.7315	-0.5275	-0.8282	-1.2739	0.1512	-0.3913	-0.6558	-1.2674	-0.5109	-0.7874	-2.1698	-1.7783	-1.8253	-0.5389
35NNGC07	-0.7916	0.0244	-0.0089	0.1205	0.0474	-0.0707	0.0622	0.7396	0.1322	-0.2697	-0.6556	0.0389	0.6021	0.0498	-0.4617	-0.7344	-0.4137	-0.3352	0.0474	-0.5886	-1.2695	-0.7326	-0.6989	-1.2901	-2.0021	-1.6730	-0.6145
35NNGD01	-0.1112	0.0026	-0.0813	-0.7483	-0.8609	-0.3962	-0.5237	0.0015	-0.0269	-0.2576	-0.9382	-1.7809	-0.2830	-0.9225	0.4968	-0.6124	0.0130	-0.5051	-0.8609	0.6997	-1.2503	0.0005	-0.4692	-0.4633	-1.2499	-0.9748	-0.7859

EQ	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	HEALTH	SOCECON	ENV	NEED	A1	A2	A3	A4	A5	A6	A7	A8	TRANSP	PERMOB	AWARE	ACCESS	PROVIS
35NNGD02	0.2907	-0.9701	0.0116	-0.4426	-0.3688	-0.0707	1.2167	1.4799	-0.0169	-0.5172	-1.1103	0.7772	0.9468	0.2968	1.2123	-0.5562	0.7563	-0.1270	-0.3688	-1.5422	-1.1739	-0.5489	-0.3263	-1.2817	-1.7228	-1.3450	-0.8374
35NNGD03	0.0637	-1.4188	1.0092	-1.0348	0.5319	0.0211	0.8901	-1.1216	-0.3995	-0.3299	-1.3903	1.4131	-1.8500	-0.4907	1.4079	-1.4872	1.2040	-0.8698	0.5319	-0.2483	-0.9625	-0.0001	-1.1108	0.6178	-0.9626	-0.8823	-0.7939
35NNGD04	0.1305	-0.9698	-0.0001	-0.0848	-0.8207	-0.0384	0.5829	-1.5307	-0.0088	-0.5005	-0.9038	-0.2742	-2.0400	-0.9974	0.1975	-1.2660	-0.0513	0.1814	-0.8207	-0.3765	-1.2239	-0.0780	-1.0770	-1.0671	-1.3019	-1.4562	-0.8314
35NNGD05	-0.5075	-1.3958	0.7205	-1.2859	-0.5746	0.0574	0.1090	-1.5737	-0.3594	-0.2646	-2.4485	-0.4082	-2.1977	-1.4774	0.7653	-1.5890	0.0129	-0.5913	-0.5746	0.0001	-1.0076	1.2197	-1.2829	-1.1529	0.2121	-0.8236	-0.8322
35NNGD07																											-0.8288
35NNGD08																											-0.8441
35NNGE01	-0.8569	1.1818	-0.7085	0.9106	-0.1270	-0.2757	-0.6890	-0.6476	-0.2800	-0.4292	0.7270	-1.0917	-1.3667	-0.6344	0.9341	-0.7979	-0.4937	0.6502	-0.1270	0.8303	-0.9512	0.5077	-0.6727	0.8598	-0.4436	-0.2932	-1.0263
35NNGE02	0.3061	-0.1076	-0.1027	-0.4068	-0.3810	-0.1203	0.0768	0.0089	-0.1136	-0.1923	-0.3109	-0.4245	-0.2970	-0.3182	1.0613	-0.0476	0.7319	0.0013	-0.3810	0.2243	-0.0337	0.0013	0.0966	0.5766	-0.0324	0.1762	-1.0263
35NNGE03	0.0054	0.4620	-0.1368	-0.5984	-0.0030	-0.2838	-0.8337	-1.2909	0.0050	-0.4292	-0.2669	-1.1205	-1.7161	-1.0119	1.0896	-1.0998	-0.1481	0.7065	-0.0030	0.8841	-1.0581	0.0930	-0.8162	1.4396	-0.9651	-0.5303	-1.0266
35NNGE04	-0.4431	0.0121	-0.2781	0.4926	-0.0109	-0.3673	0.2864	-0.7161	-0.0088	-0.5005	-0.2166	-0.0798	-1.2244	-0.4889	1.1621	-1.0903	-0.0714	-0.0068	-0.0109	0.0629	-0.8339	0.3921	-0.7988	-0.0360	-0.4418	-0.6291	-1.0277
35NNGF01	0.0512	-0.6567	0.0001	0.0000	-0.3687	-0.1203	0.1170	-0.9309	-0.1024	-0.1747	-0.6054	-0.3620	-1.2080	-0.6747	0.8609	-0.4163	0.2451	-0.0830	-0.3687	-0.0781	-0.6497	0.0701	-0.2494	-0.2747	-0.5796	-0.4832	-0.8246
35NNGF02	0.0591	-0.5168	-0.4606	-0.3124	-0.2462	-0.2676	0.0066	-0.9639	-0.2486	-0.3872	-1.2207	-0.5062	-1.5997	-1.0071	0.0258	-1.1789	-0.0098	-0.8074	-0.2462	0.0464	-0.7464	0.0590	-1.0223	-0.8160	-0.6874	-1.0589	-0.9779
35NNGF03	-0.5318	0.0806	-0.4636	0.9213	-0.1279	-0.3673	-0.1973	1.3267	0.9326	-0.4898	0.0164	-0.6825	1.7684	0.3661	0.5662	-0.3760	-0.5538	0.7936	-0.1279	0.3961	-1.1262	0.0608	-0.2536	0.5072	-1.0754	-0.5377	-0.9845
35NNGF04	-0.8529	-0.8061	-0.4709	-0.2128	-0.0419	-0.3962	-0.8867	-0.9441	0.1773	-0.2328	-2.1417	-1.3248	-0.9996	-1.3102	0.4542	-1.2880	0.0680	-0.8045	-0.0419	1.0366	-1.2503	0.8031	-1.0616	0.2582	-0.4472	-0.6898	-0.9882
35NNGF05	-0.9144	0.6734	-0.5382	-0.0807	-0.7270	0.0027	0.2098	0.0046	-0.2762	-0.4241	-0.6599	-0.6146	-0.6955	-0.6183	1.1420	-0.8660	-0.8546	-0.0221	-0.7270	-0.4112	-0.9112	-0.1124	-0.6050	-2.0148	-1.0236	-1.3180	-0.7375
35NNGF06	-0.6374	0.6204	-0.5448	0.4956	-0.8207	-0.0146	-0.5236	-0.4866	-0.3317	-0.2006	-0.0662	-1.3589	-1.0178	-0.8088	0.9341	-0.7129	-0.3265	-0.2727	-0.8207	0.5627	-1.1742	0.9643	-0.4988	-0.8672	-0.2099	-0.5712	-0.7216
35NNGG01	-0.3039	1.2766	-0.5551	-0.0673	-0.3300	-0.3605	0.0963	-0.8076	1.7509	0.7099	0.3602	-0.6852	1.6532	0.4436	0.9503	0.6233	-0.3940	1.6980	-0.3300	-0.6640	-0.8135	-0.1943	0.6658	0.3100	-1.0078	-0.0935	-0.8202
35NNGG02	-0.1683	1.1684	-0.5723	0.1917	-0.7616	0.3131	0.2212	-1.4624	-0.2949	-0.4487	0.6095	-0.2273	-2.2060	-0.6587	1.0057	-0.9987	-0.2253	-0.0074	-0.7616	0.0718	-1.0355	0.0508	-0.7364	-0.9226	-0.9847	-1.0913	-1.0085
35NNGG03	-0.4874	0.8436	0.3200	-0.1088	0.0474	0.2286	0.0650	-1.2943	1.8753	1.1617	0.5674	0.3310	1.7427	0.8331	-0.5275	-0.7344	-0.9109	0.1920	0.0474	-0.2434	-0.8659	0.9304	-0.7076	-0.9149	0.0646	-0.5602	-0.8399
35NNGG04	-0.0426	0.7611	0.4604	0.2603	-0.3913	-0.0384	-0.7377	-1.6609	-0.4014	-0.5833	1.4293	-1.1654	-2.6358	-0.9097	-0.5275	0.2935	-1.1068	1.1692	-0.3913	0.9717	-1.1026	0.1238	0.1868	0.6330	-0.9787	-0.2377	-0.8676
35NNGG05	0.3154	-1.4716	0.8592	-1.0686	-0.0186	-0.4903	-0.8457	-1.6732	-0.4169	-0.3644	-1.3664	-1.3545	-2.4545	-1.6113	-0.5275	-1.5246	1.2067	-0.8078	-0.0186	0.9703	-0.5071	0.7654	-1.3950	1.3507	0.2583	-0.2307	-0.8692
35NNGG06	1.3081	-2.0095	1.1363	-1.6781	-0.7988	-0.2231	-0.4692	-1.6370	-0.3956	-0.5763	-1.2442	-1.4911	-2.6089	-1.6777	0.2565	-1.7746	2.0388	-1.3417	-0.7988	0.8564	0.0032	0.9383	-1.5106	0.7537	0.9395	-0.0971	-1.0064
35NNGG07	1.3213	-1.9030	1.1622	-1.2628	0.3316	-0.5376	-0.1081	-1.3277	-0.4640	-0.2190	-0.6723	-0.3140	-2.0107	-0.9430	1.0404	-1.5626	1.8172	-1.3403	0.3316	0.9475	-0.5311	-0.1797	-1.2242	1.7560	-0.7108	-0.5285	-0.8717
35NNGG08	-0.1167	1.1439	-0.2878	1.3616	0.1786	0.1495	0.1109	2.0232	-0.1523	-0.2162	2.1019	0.4390	1.6547	1.2234	0.4352	1.0967	-0.5412	1.7588	0.1786	-1.1110	-1.2522	-0.7632	1.0107	0.2852	-2.0164	-0.4311	-0.8709
35NNGG09	-0.1190	0.9978	-0.2617	1.2792	0.8399	0.0268	0.4640	2.4483	-0.4398	0.0773	1.8963	1.3207	2.0858	1.6096	-0.5275	1.8388	-0.6808	0.8997	0.8399	-0.7677	-1.1260	-0.5782	1.5312	0.2911	-1.7042	-0.0137	-0.8700
35NNGG10	0.2901	0.1160	-0.0608	0.3340	0.1988	0.0486	-0.0357	1.7916	-0.3965	-0.0833	0.6783	0.2116	1.3098	0.6767	0.0972	1.0534	0.5026	-0.3949	0.1988	-0.5434	-0.8124	-0.5114	0.9291	-0.2372	-1.3238	-0.2567	-0.8717
35NNGG11	-0.0502	-0.6628	-0.0813	-0.7493	-0.4066	0.0888	0.0435	-0.8166	-0.0217	0.0811	-1.6426	-0.2733	-0.7572	-0.7292	0.6676	-1.0028	0.4068	-0.5061	-0.4066	-0.3409	-1.2503	-0.4916	-0.7856	-0.6468	-1.7418	-1.4762	-0.9720
35NNGG12	1.1441	-1.8916	1.0834	-1.4396	0.0030	-0.6376	0.1766	-1.5377	-0.4690	0.0380	-1.1036	-0.3679	-1.9587	-1.0481	1.4079	-1.6742	1.8676	-1.2677	0.0030	0.0745	-1.3621	0.2446	-1.2736	0.6873	-1.1176	-1.0237	-0.9882
35NNGG13	0.0593	0.2544	-0.1026	0.0007	-0.6282	-0.1706	1.2421	-0.0014	-0.4460	-0.1774	0.2119	0.5433	-0.6238	0.0261	1.4079	-0.2085	0.3389	-0.7810	-0.5282	-1.1626	-0.8922	-0.7021	0.0016	-2.1129	-1.5943	-1.3246	-0.9882
35NNGG14	0.2714	-1.3495	0.6924	-0.9074	-0.7592	-0.1163	-0.1495	-1.6027	-0.3749	-0.5506	-1.2931	-1.0250	-2.6282	-1.5077	0.5712	-1.6043	1.1390	-0.8412	-0.7592	0.8384	-1.0793	0.9644	-1.3216	0.3750	-0.1149	-0.6245	-1.0093
35NNGH01	-0.4099	0.5525	-0.2003	-0.2160	-0.5849	-0.3147	-0.1072	-0.6817	0.0009	0.0133	-0.2727	-1.0068	-0.6876	-0.6263	0.7926	-1.1319	-0.7574	-0.1113	-0.5849	-0.0048	-1.0481	-0.1124	-0.8817	-1.4584	-1.1606	-1.3857	-1.0751
35NNGH02	-0.3079	0.8938	-0.4842	-0.2126	-0.4066	-0.3772	-0.6626	-0.9923	-0.3609	-0.6332	-0.1208	-1.4453	-1.8864	-1.1408	0.6203	-1.2168	-0.6187	-0.0123	-0.4066	0.7251	-1.2271	0.5349	-0.9780	-0.3116	-0.6922	-0.9130	-1.0751
35NNGH03	-0.4238	-0.3314	0.1332	-0.8147	-0.2452	-0.2917	-0.6453	-0.8903	0.4707	-0.3699	-1.4367	-1.1822	-0.8095	-1.0231	1.1986	-1.2288	-0.0379	-0.5584	-0.2452	1.0371	-1.0776	0.5077	-0.9132	0.1956	-0.5698	-0.6926	-1.0765
35NNGH04	0.0017	-0.7077	-0.1032	-0.3663	-0.6841	-0.3573	-0.3278	-1.3437	-0.3300	-0.0016	-1.1755	-1.3493	-1.6753	-1.3021	0.9140	-1.2840	-0.3636	0.4641	-0.6841	0.3729	-0.8405	0.8169	-0.9983	-0.2007	-0.0236	-0.5611	-1.0431
35NNGH05	0.0969	1.2604	-0.7619	0.4391	-0.6074	-0.2049	0.0568	1.1679	0.0837	0.5898	1.0346	-0.7555	1.8314	0.6173	0.6951	0.4070	-0.6683	-0.1626	-0.6074	-0.6058	-0.7764	-0.4604	0.4445	-2.0341	-1.2388	-0.9057	99.0000
35NNGH06	-0.3425	0.6428	-0.1192	-0.3353	-0.3017	0.6212	0.1616	-0.8377	-0.0819	-0.1420	-0.1542	0.4810	-1.0616	-0.2321	1.3666	-0.0106	-0.6204	0.0052	-0.3017	-0.6184	-0.5232	-0.2619	0.1685	-1.5353	-0.7751	-0.6871	99.0000
35NNGH07	-0.5053	0.0103	-0.5389	-0.1628	-0.3551	-0.3072	-0.6677	-1.1033	-0.2866	-0.4366	-1.2167	-1.2300	-1.8265	-1.3227	0.4023	-1.0224	-0.1867	0.6986	-0.3551	0.7417	-0.8526	0.9891	-0.8372	0.8894	0.1365	-0.1280	-1.0006
35NNGH08	-0.3016	-0.1397	0.0547	0.2022	-0.5061	-0.1640	-0.7447	-0.2382	0.2133	-0.2710	-0.1844	-1.4048	-0.2939	-0.6123	-0.1579	-0.8493	-0.9504	-0.3020	-0.5061	1.0594	-0.0665	0.4401	-0.7594	-0.6991	0.3836	-0.3627	-0.9600
35NNGJ01	0.0710	0.0895	0.1464	0.4266	-0.6426	-0.1751	-0.4328	-1.1928	-0.1828	-0.2955	0.7325	-1.1505	-1.6711	-0.7574	0.5306	-0.0980	-0.9501	0.2174	-0.8428	0.0620	-0.6622	-0.0452	-0.0163	-1.2133	-0.7074	-0.6652	-0.9246
35NNGJ02	-1.0809	-0.0733	0.0018	-0.5804	-0.3300	0.1579	-0.0004	-0.9926	-0.3350	-0.5005	-1.7328	-0.1725	-1.8281	-1.1001	0.9556	-0.7910	-0.3773	0.0012	-0.3300	0.2664	-0.9416	0.9926	-0.5639	-0.4397	0.0509	-0.3664	-0.7983
35NNGJ03	-0.5576	-0.0776	-0.0421	0.0354	-0.8403	-0.4084	-0.3938	-0.6620	0.4446	0.2399	-0.6418	-1.4423	0.0225	-0.6337	1.1287	-0.5846	-0.0617	-0.1300	-0.8403	0.6171	-0.9997	0.5740	-0.3619	-0.2149	-0.4267	-0.4475	-0.8617
35NNGJ04	-0.2608	0.9846	-0.9920	0.0155	-0.0007	-0.3573	-0.6520	-0.4021	-0.3641	-0.0294	-0.2527	-0.9100	-0.7958	-0.6317	0.9140	-0.6020	-0.3737	0.7017	-0.0007	0.4770	-1.1236	0.1568	-0.3179	0.8043	-0.9668	-0.4413	-0.9324
35NNGJ05	0.1625	0.9716	-0.6624	-0.2698	-0.2776	0.2266	-0.1086	-0.0004	-0.3216	0.0000	0.2018	-0.1575	-0.3219	-0.1094	1.2177	0.4320	-0.2879	0.0054	-0.2776	-0.0470	-0.7800	-0.2478	0.5341	-0.6070	-1.0278	-0.3986	-0.9727

ii. **Outcomes (enumeration district)**

The matrix of results, on the following pages, illustrates the calculated scores for outcomes at the ED scale of analysis.

LEGEND

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
ED	OPCS enumeration district code	DEMAND	Calculated scores for disadvantaged demand
NEED	Overall composite score for need	DRANK	Ranked disadvantaged demand scores
NRANK	Ranked NEED scores	GPU	Calculated scores for GP utilization
ACCESS	Overall composite score for accessibility	URANK	Ranked GPU scores
ARANK	Ranked ACCESSIBILITY scores	REALIZE	Calculated scores for realized demand
PROVIS	Overall calculated score for provision	RRANK	Ranked REALIZE scores
PRANK	Ranked PROVISION scores		

Note: Values of 99 indicate excluded EDs
Values of 100 indicate unpopulated ED
Blank cells indicate that the value has not been ranked, since it was either excluded or unpopulated.

ED	NEED	NRANK	ACCESS	ARANK	PROVIS	PRANK	DEMAND	DRANK	GPU	URANK	REALIZE	RRANK
35NJFA01	0.7919	157	-0.4336	338	-0.9401	530	0.1792	189	0.2854	269	1.1235	42
35NJFA02	-1.3908	605	-1.9411	680	-0.8717	496	-1.6660	687	-0.3214	390	0.9129	489
35NJFA03	0.9288	144	-0.4535	348	-0.8872	506	0.2377	183	0.4951	230	1.1234	43
35NJFA04	1.0922	134	-0.7956	479	-0.8774	501	0.1483	194	1.0104	144	1.1124	51
35NJFA05	1.4083	97	-0.3649	317	-0.8864	505	0.5217	160	0.8868	166	1.1545	22
35NJFA06	0.5727	181	-0.8754	508	-0.8717	495	-0.1514	254	0.5764	219	1.0789	92
35NJFA07	1.3184	109	-0.3153	301	-0.8782	502	0.5016	162	0.7555	187	1.1513	24
35NJFB01	1.2267	116	0.2934	170	-0.8500	479	0.7601	130	0.0833	305	1.1760	11
35NJFB02	0.2856	214	-0.0261	224	-0.8424	469	0.1298	199	-0.5307	427	1.1062	61
35NJFB03	-0.4175	318	-0.6920	437	-0.5476	390	-0.5548	356	-0.2731	375	0.9992	298
35NJFB04	-0.7797	408	-1.1559	597	-0.8433	470	-0.9678	532	-0.4671	416	0.9864	331
35NJFB05	-0.6075	355	-1.8718	679	-0.6995	424	-1.2397	628	0.5648	220	0.9419	434
35NJFB06	-1.5549	644	-2.4266	689	-0.7215	431	-1.9908	689	0.1502	291	0.8632	575
35NJFC01	-0.6957	380	-1.0323	566	-1.0937	641	-0.8640	482	-0.7571	463	1.0258	219
35NJFC02	-0.7000	382	-0.7445	464	-1.0326	607	-0.7223	425	-0.9881	504	1.0346	194
35NJFC03	-0.5956	352	-0.4663	351	-0.9089	516	-0.5310	344	-1.0382	513	1.0416	166
35NJFC04	-0.0285	249	-0.6942	443	-0.7129	427	-0.3614	302	-0.0472	326	1.0378	180
35NJFC05	-1.1556	543	-1.0365	567	-1.0798	633	-1.0961	577	-1.1989	538	0.9982	304
35NJFC06	-1.3555	598	-0.5807	398	-0.9882	570	-0.9681	533	-1.7630	607	1.0022	289
35NJFC07	-1.0243	503	-0.6089	405	-0.8542	483	-0.8166	470	-1.2696	544	1.0041	283
35NJFD01	-0.9219	463	-1.5566	659	99.0000		-1.2393	627	99.0000		99.0000	
35NJFD02	-1.4697	624	-0.6457	417	99.0000		-1.0577	563	99.0000		99.0000	
35NJFD03	-1.5187	635	-1.1667	599	99.0000		-1.3427	652	99.0000		99.0000	
35NJFE01	-0.8569	438	-0.6507	419	-0.4522	378	-0.7538	444	-0.6584	447	0.9684	371
35NJFE02	0.1402	228	-0.8436	494	-0.6124	403	-0.3517	297	0.3714	254	1.0278	211
35NJFE03	-0.8252	423	-1.0978	584	-0.1139	344	-0.9615	531	0.1587	289	0.9143	487
35NJFE04	-2.0478	685	-0.9386	530	0.5234	234	-1.4932	674	-0.5858	436	0.8084	623
35NJFF01	-1.5069	630	-0.4042	331	-0.6401	407	-0.9556	524	-1.7428	605	0.9663	374
35NJFF02	-0.8951	451	-1.1032	586	-0.5563	393	-0.9992	544	-0.3482	394	0.9531	412
35NJFF03	-0.8575	440	-0.7165	452	-0.7440	439	-0.7870	459	-0.8850	481	0.9954	310
35NJFF04	100.0000		100.0000		-0.6966	422	100.0000	-	100.0000		100.0000	
35NJFF05	-0.7411	397	-0.1217	252	-0.5563	392	-0.4314	319	-1.1757	536	1.0132	251
35NJFF06	-0.6743	371	-0.1533	258	-0.5246	386	-0.4138	314	-1.0456	514	1.0117	260
35NJFF07	-1.4591	622	-0.5635	392	-0.6662	412	-1.0113	550	-1.5618	588	0.9630	382
35NJFG01	-1.2878	581	-0.8962	517	-1.0990	644	-1.0920	574	-1.4906	578	1.0008	294
35NJFG02	0.9109	145	-1.0261	562	-0.9970	576	-0.0576	230	0.9400	157	1.1043	63
35NJFG03	0.4001	202	-0.6357	413	-1.0944	642	-0.1178	249	-0.0586	331	1.1097	53
35NJFG04	-0.8439	432	-0.2204	268	-1.0970	643	-0.5322	345	-1.7205	604	1.0634	121
35NJFH01	-0.3769	307	-0.2786	291	-0.9801	564	-0.3278	290	-1.0784	521	1.0723	104
35NJFH02	-0.1277	267	-0.6289	411	99.0000		-0.3783	308	99.0000		99.0000	
35NJFH03	-0.8603	443	-0.8683	503	-0.9386	528	-0.8643	483	-0.9306	492	1.0082	271
35NJFH04	-0.9915	481	-0.9092	520	-0.9254	520	-0.9504	521	-1.0077	507	0.9972	306
35NJFH05	-1.0477	509	-0.8601	499	-0.8314	464	-0.9539	523	-1.0190	511	0.9866	330
35NJFH06	-1.0642	517	-1.0116	555	-0.8467	473	-1.0379	560	-0.8993	485	0.9791	353
35NJFH07	-1.3706	601	-1.0745	577	-0.7841	444	-1.2226	623	-1.0802	522	0.9524	416
35NJFH08	-1.4155	609	-0.7976	480	-0.7129	426	-1.1066	585	-1.3308	553	0.9576	397
35NJFH09	0.8043	155	-0.3699	323	-0.6810	419	0.2172	187	0.4932	231	1.0964	72
35NJFH10	-0.7548	404	-1.1673	600	-0.7886	447	-0.9611	528	-0.3761	399	0.9813	349
35NJFH11	-0.4308	322	-1.1040	587	-0.6692	413	-0.7674	450	0.0040	319	0.9895	323
35NJFJ01	100.0000		100.0000		-0.9882	569	100.0000		100.0000		100.0000	
35NJFJ02	-1.2963	583	-1.0276	564	-1.0319	606	-1.1620	602	-1.3006	547	0.9855	336
35NJFJ03	-0.7456	399	-0.6668	426	-1.0562	619	-0.7062	416	-1.1350	528	1.0391	175
35NJFJ04	-0.3847	310	-1.3185	633	-1.0375	609	-0.8516	476	-0.1037	349	1.0207	229
35NJFK01	-0.6972	381	0.0506	208	99.0000		-0.3233	287	99.0000		99.0000	
35NJFK02	-0.5556	346	-1.0404	568	99.0000		-0.7980	462	99.0000		99.0000	
35NJFK03	0.0203	244	-0.4280	335	99.0000		-0.2039	269	99.0000		99.0000	
35NJFK04	-1.0074	490	0.1698	187	99.0000		-0.4188	316	99.0000		99.0000	
35NJFK05	0.0026	248	-0.5771	395	99.0000		-0.2873	279	99.0000		99.0000	
35NJFK06	-1.0184	499	-0.6129	406	99.0000		-0.8157	468	99.0000		99.0000	
35NJFK07	0.1992	224	-0.2534	282	99.0000		-0.0271	227	99.0000		99.0000	
35NJFL01	-0.4674	327	-0.7863	477	-0.9794	561	-0.6269	386	-0.6605	449	1.0391	174
35NJFL02	-0.8350	426	-0.9069	519	-1.0312	605	-0.8710	487	-0.9593	497	1.0179	236
35NJFL03	0.6198	173	-0.8723	505	-1.0396	611	-0.1263	251	0.4525	238	1.1019	64
35NJFL04	-0.8603	444	-0.8044	482	-0.9720	554	-0.8324	473	-1.0279	512	1.0155	243
35NJFL05	-1.4212	611	-0.9369	529	-0.9734	557	-1.1791	609	-1.4577	573	0.9772	359
35NJFL06	-1.2327	564	-0.4940	361	-0.9630	547	-0.8634	481	-1.7017	602	1.0109	263
35NJFL07	-1.1652	548	-0.9747	540	-0.8758	499	-1.0700	565	-1.0663	518	0.9787	356
35NJFM01	-1.1792	552	-2.0340	684	-0.9432	533	-1.6066	682	-0.0884	346	0.9268	460
35NJFM02	1.7009	69	-0.4332	337	-0.8913	507	0.6339	146	1.2428	111	1.1674	14
35NJFM03	-1.2513	572	-1.2661	622	-0.8750	497	-1.2587	633	-0.8602	477	0.9580	395
35NJFM04	1.4742	91	-0.1332	255	-0.9577	541	0.6705	143	0.6497	205	1.1801	9
35NJFM05	0.6284	171	-0.3394	308	-0.8758	498	0.1445	195	0.0920	302	1.1118	52
35NJFM06	1.9553	50	0.4071	157	-0.8840	504	1.1812	92	0.6642	201	1.2265	4
35NJFM07	-1.4189	610	-1.0628	573	-0.8774	500	-1.2409	629	-1.2335	542	0.9602	389
35NJFM08	1.5742	86	0.6861	121	-0.9667	551	1.1302	96	-0.0786	339	1.2321	2
35NJFM09	1.1771	120	-0.1656	260	-0.9547	538	0.5058	161	0.3880	247	1.1615	19
35NJFM10	-0.7526	402	-2.2318	687	-0.9501	536	-1.4922	673	0.5291	223	0.9401	436
35NJFM11	-1.1519	542	-1.6655	668	-0.7477	440	-1.4087	661	-0.2341	370	0.9286	457
35NJFM12	-1.0703	520	-1.8338	678	-0.8692	489	-1.4521	670	-0.1057	351	0.9362	439

ED	NEED	NRANK	ACCESS	ARANK	PROVIS	PRANK	DEMAND	DRANK	GPU	URANK	REALIZE	RRANK
35NJFN01	-1.1300	535	-0.8518	498	-0.8913	508	-0.9909	540	-1.1695	535	0.9891	326
35NJFN02	-0.7028	386	-0.6692	428	-0.9432	531	-0.6860	406	-0.9768	503	1.0284	208
35NJFN03	-0.7187	391	-0.8925	514	-0.6421	408	-0.8056	464	-0.4683	417	0.9825	345
35NJFN04	-0.6172	357	-0.8246	488	-1.0396	610	-0.7209	423	-0.8322	473	1.0356	189
35NJFN05	100.0000		100.0000		-1.0049	579	100.0000		100.0000		100.0000	
35NJFP01	-1.1144	530	-1.4027	647	-0.6976	423	-1.2586	632	-0.4093	407	0.9397	437
35NJFP02	-1.7033	661	-0.7172	453	-0.6512	410	-1.2103	618	-1.6373	599	0.9402	435
35NJFP03	100.0000		100.0000		-0.6360	406	100.0000		100.0000		100.0000	
35NJFP04	-1.0054	487	-1.2072	613	-0.6712	415	-1.1063	584	-0.4694	419	0.9534	409
35NJFP05	0.4009	201	-1.0201	558	-0.4978	383	-0.3096	285	0.9232	160	1.0198	232
35NJFP06	-0.6542	365	-0.8202	485	-0.4774	381	-0.7372	433	-0.3114	385	0.9727	366
35NJFP07	-1.2451	567	-0.6719	429	-0.4933	382	-0.9585	527	-1.0665	519	0.9511	418
35NJFQ01	-0.5939	351	-0.9433	531	-1.0871	636	-0.7686	451	-0.7377	460	1.0357	188
35NJFQ02	-0.3995	315	-0.5372	380	-1.0831	635	-0.4684	326	-0.9454	494	1.0689	113
35NJFQ03	-0.4645	326	-0.9760	542	-1.0818	634	-0.7203	422	-0.5703	433	1.0405	170
35NJFQ04	-0.8047	414	-0.5633	391	-1.0630	624	-0.6840	404	-1.3044	550	1.0424	165
35NJFQ05	-1.1659	549	0.0464	211	-1.0718	629	-0.5598	360	-2.2841	631	1.0573	136
35NJFQ06	-1.0500	513	-0.5023	364	-0.8609	484	-0.7762	456	-1.4086	568	1.0093	268
35NJFQ07	0.1529	226	-1.1020	585	-0.9432	532	-0.4746	330	0.3117	266	1.0517	147
35NJFR01	-1.3711	602	-0.8828	512	-0.9493	534	-1.1270	592	-1.4376	571	0.9804	350
35NJFR02	0.6265	172	-0.8772	510	-0.7206	429	-0.1254	250	0.7831	181	1.0641	119
35NJFR03	0.6840	166	-0.8445	495	-0.7486	441	-0.0803	233	0.7799	182	1.0722	106
35NJFR04	-1.3087	591	-1.6152	665	-0.7606	442	-1.4620	671	-0.4541	414	0.9241	469
35NJFR05	1.8549	56	-0.3371	306	-0.7431	438	0.7589	131	1.4489	80	1.1623	18
35NJFR06	2.2634	23	0.1469	190	-0.7291	432	1.2052	88	1.3874	91	1.2086	5
35NJFR07	1.9198	51	-0.1330	254	-0.7206	428	0.8934	121	1.3322	101	1.1739	13
35NJFR08	2.2501	25	0.0557	206	-0.6771	416	1.1529	93	1.5173	72	1.1963	6
35NJFS01	-0.3055	295	-0.2864	293	-0.9904	573	-0.2960	282	-1.0095	508	1.0771	98
35NJFS02	-0.4863	331	0.4105	156	99.0000		-0.0379	229	99.0000		99.0000	
35NJFS03	-0.7511	400	-0.8743	507	-1.0403	612	-0.8127	467	-0.9171	488	1.0254	220
35NJFS04	-1.5836	648	-0.4557	349	-1.0375	608	-1.0197	554	-2.1654	628	1.0020	290
35NJFS05	-0.7153	389	-1.0904	582	-0.9890	572	-0.9029	497	-0.6139	441	1.0096	267
35NJFS06	-1.0372	507	-0.8769	509	-0.9838	565	-0.9571	525	-1.1441	530	1.0030	286
35NJFT01	-0.9178	462	-1.0740	576	-0.8458	472	-0.9959	542	-0.6896	455	0.9836	342
35NJFT02	-0.9952	483	-1.3620	640	-0.7992	453	-1.1786	608	-0.4324	410	0.9587	394
35NJFT03	-1.3671	600	-0.5108	365	-0.8036	454	-0.9390	512	-1.6599	601	0.9853	337
35NJFT04	0.5964	176	-0.9769	543	-0.7366	434	-0.1903	265	0.8367	172	1.0590	132
35NJFT05	-0.3444	303	-1.2597	620	-0.7939	449	-0.8021	463	0.1214	296	0.9991	299
35NJFT06	-1.5304	639	-0.7346	458	-0.8080	457	-1.1325	593	-1.6038	596	0.9647	377
35NJFT07	0.8343	150	-0.3704	324	-0.9270	522	0.2320	185	0.2777	271	1.1277	37
35NJFT08	-1.1870	554	-0.2550	283	-0.9660	550	-0.7210	424	-1.8980	617	1.0271	214
35NJFU01	-1.8707	677	-0.6846	432	-0.3424	362	-1.2777	641	-1.5285	583	0.9033	506
35NJFU02	-1.2431	566	-0.5811	399	-0.2057	349	-0.9121	503	-0.8677	478	0.9279	459
35NJFU03	-1.6989	660	-0.9479	532	-0.0036	330	-1.3234	650	-0.7546	461	0.8680	570
35NJFU04	0.8283	152	0.2959	169	0.5799	221	0.5621	157	1.1123	135	0.9983	302
35NJFU05	-1.4539	619	-1.0887	581	0.2022	274	-1.2713	637	-0.1630	359	0.8556	585
35NJFU06	-1.2281	562	-1.6080	664	0.7624	163	-1.4181	664	1.1423	128	0.7974	631
35NJFW01	-0.6872	376	-0.2639	286	-0.9386	527	-0.4756	331	-1.3619	558	1.0511	149
35NJFW02	0.0667	237	-0.7559	470	-0.9363	526	-0.3446	294	-0.1137	353	1.0652	118
35NJFW03	-0.8458	433	-0.6970	446	-0.9992	577	-0.7714	453	-1.1480	532	1.0253	221
35NJFW04	-1.1036	529	-0.4810	355	-0.8150	458	-0.7923	460	-1.4376	572	1.0025	288
35NJFW05	-1.2129	559	-0.5610	389	99.0000		-0.8870	491	99.0000		99.0000	
35NJFW06	-1.0050	486	-1.4142	649	-0.2772	355	-1.2096	617	0.1320	295	0.9041	502
35NJFW07	-1.3184	593	-1.4492	652	-0.2104	351	-1.3838	657	-0.0796	340	0.8801	546
35NJFX01	-1.7047	662	-0.9849	548	-0.8517	481	-1.3448	653	-1.5715	591	0.9461	426
35NJFX02	-0.8135	417	-0.6929	440	-0.8045	455	-0.7532	443	-0.9251	490	1.0056	277
35NJFX03	0.2534	218	-0.5929	400	-0.6840	421	-0.1698	260	0.1623	288	1.0552	140
35NJFX04	-1.7600	666	-0.5324	377	-0.7778	443	-1.1462	599	-2.0054	622	0.9600	390
35NJFX05	-0.8028	413	-0.9234	526	-0.8467	474	-0.8631	480	-0.7261	458	0.9982	303
35NJFX06	-1.7689	668	-0.4998	363	-0.8509	480	-1.1344	595	-2.1200	627	0.9689	370
35NJFY01	-0.5708	347	-0.4793	354	-0.8609	485	-0.5251	341	-0.9524	495	1.0367	186
35NJFY02	-0.7914	410	-0.7045	449	-0.8534	482	-0.7480	438	-0.9403	493	1.0115	261
35NJFY03	-0.8528	436	-0.3438	309	-0.8484	476	-0.5983	377	-1.3574	557	1.0273	212
35NJFY04	-0.1190	263	-0.6941	442	-0.8484	477	-0.4066	313	-0.2733	376	1.0483	156
35NJFY05	-1.0264	505	-0.3565	313	-0.7966	451	-0.6915	411	-1.4665	575	1.0114	262
35NJFY06	0.3226	211	-0.2432	279	-0.8071	456	0.0397	216	-0.2413	371	1.0921	76
35NJFZ01	0.6362	170	-0.4955	362	-0.5279	388	0.0704	210	0.6038	216	1.0632	123
35NJFZ02	-1.4238	612	-0.7363	461	-0.4313	374	-1.0801	567	-1.1188	526	0.9322	452
35NJFZ03	0.7255	162	-1.0642	574	-0.8305	463	-0.1694	259	0.9592	154	1.0721	108
35NJFZ04	-0.7001	383	-0.9988	551	-0.5820	396	-0.8495	475	-0.2833	378	0.9716	367
35NJFZ05	-0.2307	282	-0.1133	249	-0.6840	420	-0.1720	261	-0.8014	469	1.0550	141
35NJGA01	-1.2095	558	-0.2899	294	99.0000		-0.7497	439	99.0000		99.0000	
35NJGA02	-0.1027	261	-0.3180	302	-1.0904	640	-0.2104	273	-0.8751	479	1.0988	68
35NJGA03	0.1243	230	0.0504	209	-1.1443	648	0.0874	206	-1.0704	520	1.1391	29
35NJGA04	-0.8996	454	-1.0226	560	-1.0898	639	-0.9611	529	-0.9668	498	1.0144	248
35NJGA05	-0.9089	457	-0.1373	256	-1.0878	637	-0.5231	339	-1.8594	613	1.0634	122
35NJGB01	0.5589	185	-0.9775	544	-1.0277	601	-0.2093	271	0.5087	227	1.0912	77
35NJGB02	0.3636	207	-1.3724	643	-1.0214	590	-0.5044	337	0.7146	193	1.0576	135
35NJGB03	0.5100	192	0.0676	203	-1.0284	602	0.2888	180	-0.5860	437	1.1468	27

ED	NEED	NRANK	ACCESS	ARANK	PROVIS	PRANK	DEMAND	DRANK	GPU	URANK	REALIZE	RRANK
35NJGB04	-1.0539	515	-1.7770	676	-1.0596	622	-1.4155	662	-0.3365	392	0.9602	388
35NJGB05	-0.6827	375	-1.1969	610	-0.9970	575	-0.9398	513	-0.4828	420	1.0064	276
35NJGC01	100.0000		100.0000		-1.1443	647	100.0000		100.0000		100.0000	
35NJGC02	-0.5030	335	-1.2718	625	99.0000		-0.8874	493	99.0000		99.0000	
35NJGC03	-0.3090	297	-0.3578	314	-1.1068	646	-0.3334	292	-1.0580	516	1.0869	80
35NJGC04	-0.5410	343	-0.0461	230	-1.0878	638	-0.2936	280	-1.5827	593	1.0891	78
35NJGC05	-0.4297	321	-0.5587	387	-1.1042	645	-0.4942	334	-0.9752	502	1.0686	114
35NJGC06	-1.5744	647	-1.0806	579	-0.9838	566	-1.3275	651	-1.4776	576	0.9619	385
35NMFA01	-1.2490	569	0.0130	216	1.2851	24	-0.6180	384	0.0231	316	0.8313	605
35NMFA02	-0.8774	447	-0.0661	237	1.2711	26	-0.4718	328	0.4598	237	0.8454	594
35NMFA03	-0.9040	456	0.4841	148	1.1585	59	-0.2100	272	-0.2296	368	0.8774	552
35NMFA04	1.1810	119	1.9038	15	1.2418	34	1.5424	47	0.5190	224	1.0267	217
35NMFA05	0.6709	168	0.7982	111	1.2711	27	0.7346	135	1.1438	126	0.9524	414
35NMFA06	-0.1929	274	1.1865	70	1.2963	17	0.4968	163	-0.0831	345	0.9292	456
35NMFA07	0.5911	179	2.1997	4	1.3417	2	1.3954	66	-0.2669	374	1.0048	280
35NMFA08	-0.1231	265	0.9898	96	1.3331	4	0.4334	170	0.2202	281	0.9206	476
35NMFA09	-0.3270	301	0.5167	143	1.2345	37	0.0949	205	0.3908	246	0.8986	515
35NMFA10	0.5396	189	1.4614	48	1.2407	35	1.0005	112	0.3189	264	0.9786	358
35NMFA11	0.4959	193	0.4975	145	1.2894	21	0.4967	164	1.2878	108	0.9298	455
35NMFA12	0.3811	204	1.3228	56	1.3089	13	0.8520	123	0.3672	255	0.9596	392
35NMFA13	0.3591	208	2.1031	7	1.3031	15	1.2311	85	-0.4409	412	0.9936	317
35NMFA14	0.8682	149	0.8025	109	1.3120	12	0.8354	126	1.3777	92	0.9579	396
35NMFA15	-0.2017	276	1.5580	38	1.2081	46	0.6782	142	-0.5516	429	0.9527	413
35NMFB08	-0.9704	479	-0.4351	339	0.0388	311	-0.7028	415	-0.4965	423	0.9261	464
35NMFB09	-1.8764	678	-0.3059	297	0.1848	275	-1.0912	573	-1.3857	566	0.8747	561
35NMFB10	-1.3037	588	-0.6021	401	0.0549	306	-0.9529	522	-0.6467	444	0.8998	513
35NMFB11	2.0881	37	0.9779	97	0.1201	295	1.5330	49	1.2303	113	1.1396	28
35NMFB12	-1.1593	545	-0.8226	486	0.2057	273	-0.9910	541	-0.1310	355	0.8827	541
35NMFB13	0.9980	137	0.4873	146	0.1689	280	0.7427	133	0.6796	197	1.0564	137
35NMFB14	1.9712	47	1.4863	44	0.1489	286	1.7288	33	0.6338	208	1.1557	21
35NMFB15	1.6730	74	1.1980	69	0.1305	292	1.4355	60	0.6055	215	1.1288	35
35NMFB16	2.4957	13	1.0126	93	0.0875	299	1.7542	32	1.5706	65	1.1652	16
35NMFB17	-0.8229	421	0.6405	126	0.0820	300	-0.0912	241	-1.3814	565	0.9828	343
35NMFB18	-1.5702	646	0.1458	191	0.3532	253	-0.7122	419	-1.3628	559	0.8971	518
35NMFB19	-0.5491	345	-0.7554	469	0.1295	293	-0.6523	394	0.3358	261	0.9228	473
35NMFB20	2.0634	40	1.5545	40	0.1348	290	1.8090	27	0.6437	207	1.1652	17
35NMFC01	-1.4548	620	-0.9165	524	0.7486	168	-1.1857	613	0.2103	284	0.8200	617
35NMFC02	-1.1450	540	-1.0204	559	0.7505	166	-1.0827	568	0.6259	211	0.8295	607
35NMFC03	-0.9339	470	-1.1465	594	0.7633	162	-1.0402	561	0.9759	151	0.8324	604
35NMFC04	-0.2994	292	-0.9241	527	0.7679	158	-0.6118	382	1.3926	90	0.8719	566
35NMFC05	-1.2808	576	-0.9096	521	0.7823	153	-1.0952	575	0.4111	241	0.8259	610
35NMFC06	0.3132	212	-0.0968	244	0.9238	117	0.1082	202	1.3338	100	0.9253	467
35NMFC07	0.7098	163	-0.5534	386	0.9615	111	0.0782	208	2.2247	21	0.9194	479
35NMFC08	-0.3228	300	-1.6914	672	0.9057	119	-1.0071	549	2.2743	20	0.8246	613
35NMFC09	-2.0184	684	-0.6059	403	0.9025	120	-1.3122	648	-0.5100	425	0.7969	632
35NMFC10	1.7614	63	-0.0881	240	0.9262	116	0.8367	125	2.7757	9	0.9918	320
35NMFC11	0.0870	233	-0.4820	356	0.9409	114	-0.1975	268	1.5099	73	0.8960	519
35NMFD01	2.4031	16	0.1103	197	1.1042	79	1.2567	82	3.3970	1	1.0137	249
35NMFD02	1.5260	89	1.3064	59	1.1190	70	1.4162	64	1.3386	99	1.0267	216
35NMFD03	0.2038	222	-0.1038	247	1.1087	76	0.0500	214	1.4163	84	0.9047	501
35NMFD04	0.9063	146	0.4144	155	1.1145	73	0.6604	144	1.6064	62	0.9591	393
35NMFD05	1.7355	64	0.8070	108	1.1254	68	1.2713	79	2.0539	32	1.0131	254
35NMFD06	1.5728	87	1.6766	24	1.1664	56	1.6247	42	1.0626	142	1.0410	168
35NMFD07	0.6905	165	0.4539	152	1.0891	85	0.5722	154	1.3257	104	0.9534	408
35NMFD08	-0.0658	255	1.2086	66	1.0858	87	0.5714	155	-0.1886	361	0.9536	405
35NMFD09	0.7883	158	1.4270	51	0.8782	130	1.1077	100	0.2395	279	1.0211	228
35NMFD10	1.3968	100	0.6675	123	0.8019	146	1.0322	110	1.5312	70	1.0213	227
35NMFD11	1.1253	126	0.4521	153	0.8262	140	0.7887	129	1.4994	76	0.9965	309
35NMFD12	1.0956	133	1.0063	95	0.8517	134	1.0510	108	0.9410	156	1.0184	235
35NMFD13	1.4451	95	1.1471	77	0.8750	131	1.2961	76	1.1730	122	1.0387	177
35NMFD14	1.7332	65	0.9741	98	0.8228	142	1.3537	72	1.5819	64	1.0491	154
35NMFD15	2.2674	22	1.6508	26	1.0021	99	1.9591	14	1.6187	60	1.0870	79
35NMFD16	1.6496	79	0.5233	139	1.0534	92	1.0865	104	2.1797	23	1.0030	285
35NMFD17	1.4676	93	1.0164	92	1.0312	94	1.2420	84	1.4824	77	1.0191	233
35NMFD18	1.7724	61	1.0169	91	0.8977	122	1.3947	67	1.6532	59	1.0456	163
35NMFD19	0.8789	147	0.5952	129	0.8517	135	0.7371	134	1.1354	129	0.9894	324
35NMFE01	1.6593	75	0.6243	127	0.2724	259	1.1418	95	1.3074	107	1.0846	81
35NMFE02	2.7964	4	1.7499	20	-0.1964	347	2.2732	4	0.8501	171	1.2519	1
35NMFE03	1.6211	81	0.4719	151	0.6452	203	1.0465	109	1.7944	44	1.0377	183
35NMFE04	0.5630	183	0.2609	176	0.7751	155	0.4120	173	1.0772	140	0.9663	373
35NMFE05	2.2476	26	0.0554	207	0.7459	169	1.1515	94	2.9381	4	1.0377	181
35NMFE06	2.3731	18	0.7583	114	0.5410	230	1.5657	45	2.1558	24	1.0972	70
35NMFE07	2.1823	31	0.9424	100	0.7796	154	1.5624	46	2.0195	35	1.0726	103
35NMFE08	2.2407	27	0.1284	195	0.5703	222	1.1846	90	2.6826	12	1.0582	134
35NMFE09	1.6531	78	-0.4759	352	0.7168	175	0.5886	153	2.8458	5	0.9880	328
35NMFE10	1.6857	73	0.5182	141	0.7957	148	1.1020	101	1.9632	36	1.0284	207
35NMFE11	2.6868	9	1.5924	32	0.9734	108	2.1396	8	2.0678	31	1.1063	59
35NMFE12	3.1057	1	1.1556	76	0.8382	137	2.1307	9	2.7883	8	1.1192	45
35NMFE13	1.1285	125	0.7558	116	0.8271	139	0.9422	117	1.1998	117	1.0106	264

ED	NEED	NRANK	ACCESS	ARANK	PROVIS	PRANK	DEMAND	DRANK	GPU	URANK	REALIZE	RRANK
35NMFE14	1.6926	71	1.1060	80	0.8475	136	1.3993	65	1.4341	82	1.0509	150
35NMFE15	2.7161	8	1.9383	14	0.9749	107	2.3272	3	1.7527	47	1.1232	44
35NMFE16	0.9317	143	0.2859	171	0.7496	167	0.6088	150	1.3954	89	0.9869	329
35NMFE17	1.7304	66	1.6358	29	0.8791	129	1.6831	35	0.9737	152	1.0739	101
35NMFE18	1.9712	48	1.5551	39	0.8953	123	1.7632	30	1.3114	106	1.0797	88
35NMFE19	-0.6774	373	0.0147	215	0.8348	138	-0.3314	291	0.1427	294	0.8924	521
35NMFE20	1.1013	131	1.3151	57	0.8584	133	1.2082	87	0.6446	206	1.0322	201
35NMFE21	1.3466	106	1.3780	52	0.7633	160	1.3623	70	0.7319	192	1.0557	139
35NMFF01	0.8723	148	-0.2287	272	0.5936	219	0.3218	178	1.6946	56	0.9743	362
35NMFF02	-0.4691	328	-0.2336	276	0.6731	194	-0.3514	296	0.4376	240	0.9040	503
35NMFF03	-0.4183	319	0.2001	183	0.6869	187	-0.1091	246	0.0685	308	0.9255	466
35NMFF04	0.0097	247	-0.2415	278	0.6859	188	-0.1159	247	0.9371	158	0.9250	468
35NMFF05	-0.5264	340	-0.9661	537	0.4888	242	-0.7463	437	0.9285	159	0.8822	542
35NMFF06	0.7659	160	1.1813	72	0.6093	212	0.9736	115	0.1939	286	1.0343	196
35NMFF07	0.5936	178	0.3827	160	0.6810	192	0.4882	167	0.8919	165	0.9820	348
35NMFF08	1.9194	52	1.0796	84	0.6062	213	1.4995	54	1.4460	81	1.0842	83
35NMFF09	1.3520	104	0.5645	133	0.6114	211	0.9583	116	1.3989	87	1.0327	199
35NMFF10	0.9866	138	-0.1201	250	0.6051	215	0.4333	171	1.7118	52	0.9838	340
35NMFF11	-0.7034	387	-0.0693	238	0.5617	223	-0.3864	310	-0.0724	334	0.9102	491
35NMFF12	0.3881	203	0.2492	178	0.6279	207	0.3187	179	0.7668	185	0.9709	368
35NMFF13	2.2081	29	-0.0945	243	0.5045	237	1.0568	107	2.8071	7	1.0526	144
35NMFF14	0.4176	200	0.7125	119	0.3878	249	0.5651	156	0.0929	301	1.0171	240
35NMFG01	-0.5115	336	0.7223	118	1.1609	57	0.1054	203	-0.0729	335	0.9054	499
35NMFG02	0.9649	140	0.4783	149	0.8872	127	0.7216	136	1.3738	95	0.9847	338
35NMFG03	-0.7223	392	-0.3935	328	0.7043	181	-0.5579	358	0.3755	251	0.8821	543
35NMFG04	-1.3287	595	0.1386	192	0.6947	183	-0.5951	375	-0.7726	467	0.8794	549
35NMFG05	0.9467	141	0.1036	199	1.0249	95	0.5252	159	1.8680	39	0.9547	402
35NMFG06	-0.3015	294	0.1212	196	0.7823	152	-0.0902	240	0.3596	257	0.9191	480
35NMFG07	-1.0331	506	-0.3101	299	1.0164	98	-0.6716	402	0.2934	268	0.8467	593
35NMFG08	1.6987	70	0.5413	138	0.7633	161	1.1200	99	1.9207	37	1.0331	198
35NMFG09	0.4659	195	-0.2094	267	0.6820	191	0.1283	200	1.3573	97	0.9482	423
35NMFG10	-1.2054	557	-1.1649	598	0.6652	195	-1.1852	612	0.6247	212	0.8265	608
35NMFG11	-0.8513	435	-0.6761	430	0.6632	197	-0.7637	448	0.4880	233	0.8662	571
35NMFG12	-1.0915	523	-1.1119	588	0.6350	206	-1.1017	581	0.6554	202	0.8367	599
35NMFH01	-0.8858	449	0.1476	189	0.9592	112	-0.3691	304	-0.0742	336	0.8788	551
35NMFH02	-1.0781	522	-0.7346	459	0.7366	171	-0.9064	499	0.3931	245	0.8470	592
35NMFH03	-0.9642	478	-0.3536	312	0.6502	202	-0.6589	398	0.0396	311	0.8771	556
35NMFH04	0.2005	223	-0.0928	241	0.9734	109	0.0539	213	1.2667	110	0.9162	485
35NMFH05	0.1401	229	0.8091	107	0.9890	105	0.4746	168	0.3200	262	0.9532	410
35NMFH06	0.7714	159	-0.0446	227	0.9970	102	0.3634	176	1.8130	43	0.9424	431
35NMFH07	1.1828	118	0.5108	144	1.1455	61	0.8468	124	1.8175	42	0.9732	364
35NMFH08	-0.5133	338	-1.0045	553	1.0771	89	-0.7589	447	1.5683	66	0.8343	600
35NMFH09	-0.6686	370	0.9064	101	1.2040	50	0.1189	201	-0.3710	397	0.9032	507
35NMFH10	-0.3493	304	0.0455	212	1.2063	47	-0.1519	255	0.8115	175	0.8788	550
35NMFH11	-0.0427	253	0.3963	158	1.3213	8	0.1768	190	0.8823	167	0.8989	514
35NMFH12	0.2695	216	-0.6529	421	1.2046	49	-0.1917	266	2.1270	29	0.8754	557
35NMFJ01	-0.8977	453	-1.0539	571	0.8254	141	-0.9758	535	0.9816	150	0.8337	602
35NMFJ02	-0.7926	411	-1.6294	667	0.9081	118	-1.2110	620	1.7449	49	0.8057	626
35NMFJ03	-1.7866	670	-1.0728	575	0.9897	104	-1.4297	667	0.2759	272	0.7798	636
35NMFJ04	1.6430	80	0.3072	168	0.9764	106	0.9751	114	2.3122	18	0.9999	296
35NMFJ05	1.1577	123	0.0218	214	1.0013	101	0.5898	152	2.1372	27	0.9626	383
35NMFJ06	1.7808	60	0.3890	159	0.9963	103	1.0849	105	2.3881	16	1.0081	272
35NMFJ07	2.6506	10	1.2116	65	1.0013	100	1.9311	18	2.4403	14	1.0844	82
35NMFJ08	2.2532	24	1.4781	47	1.0185	97	1.8657	24	1.7936	45	1.0769	99
35NMFJ09	2.4211	15	1.3663	53	1.0931	84	1.8937	20	2.1479	26	1.0721	107
35NMFJ10	2.2987	21	0.7254	117	1.1113	75	1.5121	52	2.6846	11	1.0361	187
35NMFJ11	-1.1334	536	-0.6496	418	1.1374	64	-0.8915	495	0.6536	203	0.8178	620
35NMFJ12	-1.5021	629	-0.6455	416	1.0745	91	-1.0738	566	0.2179	282	0.8060	625
35NMFJ13	0.1423	227	0.3247	167	1.0771	88	0.2335	184	0.8947	163	0.9238	470
35NMFJ14	1.7659	62	0.2751	172	1.2145	43	1.0205	111	2.7053	10	0.9827	344
35NMFJ15	2.3524	20	1.7425	21	1.1603	58	2.0475	11	1.7702	46	1.0796	89
35NMFJ16	2.4777	14	1.8761	16	1.2401	36	2.1769	7	1.8417	41	1.0833	85
35NMFK01	1.1679	121	0.3369	166	0.7532	165	0.7524	132	1.5842	63	0.9999	297
35NMFK02	1.4005	99	1.3050	60	0.7158	176	1.3528	73	0.8113	176	1.0594	130
35NMFK03	2.0307	42	1.8599	17	0.6908	184	1.9453	15	0.8616	170	1.1173	47
35NMFK04	2.0469	41	1.9575	12	0.6582	199	2.0022	12	0.7476	190	1.1261	38
35NMFK05	1.9940	46	1.5653	35	0.2712	260	1.7797	29	0.6999	195	1.1469	26
35NMFK06	1.7997	58	1.0349	89	0.1566	285	1.4173	63	0.9214	161	1.1241	40
35NMFK07	2.2389	28	1.6442	28	0.1610	282	1.9416	17	0.7557	186	1.1752	12
35NMFK08	1.3493	105	1.9799	11	0.6010	216	1.6646	38	-0.0296	323	1.1003	65
35NMFK09	2.1841	30	2.8224	1	0.6155	210	2.5033	2	-0.0228	321	1.1778	10
35NMFK10	1.6888	72	0.8367	105	0.5563	226	1.2628	81	1.4084	85	1.0669	116
35NMFK11	1.4282	96	1.2792	63	0.5223	235	1.3537	71	0.6713	199	1.0790	91
35NMFK12	2.8313	3	2.2002	3	0.1745	277	2.5158	1	0.8056	177	1.2301	3
35NMFK13	1.1055	129	0.2684	174	0.2893	258	0.6870	141	1.1264	130	1.0387	178
35NMFK14	0.0901	232	-0.0325	225	0.2496	265	0.0288	218	0.3722	253	0.9786	357
35NMFK15	1.3228	108	1.5257	42	0.1478	287	1.4243	62	-0.0551	329	1.1258	39
35NMFK16	1.5528	88	1.4863	45	0.2128	271	1.5196	51	0.2793	270	1.1280	36
35NMFK17	1.1628	122	1.0941	83	0.0480	308	1.1285	97	0.1167	297	1.1074	56

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35NMFK18	2.0192	44	0.5594	135	0.0444	310	1.2893	77	1.5042	74	1.1239	41
35NMFK19	1.9993	45	1.0125	94	0.0032	325	1.5059	53	0.9900	149	1.1502	25
35NMFK20	1.9051	54	1.9400	13	0.0688	302	1.9226	19	0.0339	313	1.1841	7
35NMFK21	-0.7540	403	-0.5132	367	0.0480	309	-0.6336	388	-0.1928	362	0.9322	451
35NMFK22	-1.5174	634	0.3567	164	0.0336	314	-0.5804	371	-1.8405	612	0.9388	438
35NMFK23	-0.9931	482	-1.0142	556	0.1242	294	-1.0037	546	0.1453	293	0.8886	528
35NMFK24	-1.3855	604	-0.3372	307	0.0503	307	-0.8614	479	-0.9980	506	0.9093	494
35NMFL01	2.5902	12	1.2981	61	0.7309	172	1.9442	16	2.0230	34	1.1130	50
35NMFL02	3.0027	2	0.5228	140	0.7661	159	1.7628	31	3.2460	2	1.0926	75
35NMFL03	1.4903	90	1.1020	82	0.5541	227	1.2962	75	0.9424	155	1.0703	111
35NMFL04	-1.0217	500	-0.7320	457	0.3496	254	-0.8769	489	0.0599	310	0.8815	544
35NMFL05	-0.8377	431	-0.0619	235	0.5179	236	-0.4498	321	-0.2579	373	0.9080	496
35NMFL06	2.7759	6	0.5753	132	0.6442	204	1.6756	36	2.8448	6	1.0969	71
35NMFL07	1.4680	92	-0.1778	261	0.5389	232	0.6451	145	2.1847	22	1.0101	265
35NMFL08	1.7819	59	0.7580	115	0.5410	231	1.2700	80	1.5649	68	1.0692	112
35NMFL09	-1.3553	597	0.4725	150	-0.0820	341	-0.4414	320	-1.9098	620	0.9638	379
35NMFL10	-1.1619	547	-0.2530	281	0.0323	315	-0.7075	417	-0.8766	480	0.9263	463
35NMFL11	-0.9245	465	-0.2221	270	-0.0525	338	-0.5733	366	-0.7549	462	0.9476	424
35NMFL12	-1.4004	608	-0.9842	546	0.0381	312	-1.1923	614	-0.3781	400	0.8774	553
35NMFL13	-1.0182	498	0.0723	202	0.1791	276	-0.4730	329	-0.9114	487	0.9358	440
35NMFL14	0.5732	180	-0.7399	462	0.4325	247	-0.0834	234	1.7456	48	0.9504	419
35NMFL15	-0.8361	429	-0.3582	315	0.2257	269	-0.5972	376	-0.2522	372	0.9196	478
35NMFL16	-1.5248	638	-1.3435	637	0.0923	298	-1.4342	669	-0.0890	347	0.8487	591
35NMFL17	-1.0527	514	-1.1234	589	0.1337	291	-1.0881	572	0.2044	285	0.8794	548
35NMFL19	1.3361	107	-0.4445	342	0.0662	303	0.4458	169	1.8468	40	1.0377	182
35NMFL20	-0.6423	364	-1.5936	663	0.0104	322	-1.1180	589	0.9617	153	0.8873	532
35NMFL21	-1.8422	675	-0.0556	233	0.0748	301	-0.9489	518	-1.7118	603	0.8984	516
35NMFL22	-2.2346	687	-0.2290	273	0.1000	297	-1.2318	625	-1.9056	618	0.8681	569
35NMFL23	-1.2203	561	-0.9787	545	0.1734	278	-1.0995	579	-0.0682	333	0.8748	558
35NMFL24	-1.8790	679	-0.3675	319	0.1467	288	-1.1233	591	-1.3648	560	0.8748	559
35NMFL25	-1.9973	683	-0.7196	454	0.0180	318	-1.3585	654	-1.2597	543	0.8626	576
35NMFL26	-1.4284	614	-0.0249	223	0.0604	305	-0.7267	428	-1.3431	554	0.9218	475
35NMFL27	-0.3750	306	0.4842	147	0.1644	281	0.0546	212	-0.6948	457	0.9892	325
35NMFL28	-1.5467	642	0.0917	201	0.0077	323	-0.7275	429	-1.6307	598	0.9265	461
35NMFL29	-0.7014	385	-0.1998	263	0.0032	326	-0.4506	322	-0.4984	424	0.9546	403
35NMFL30	-1.9474	680	-0.4927	360	0.0362	313	-1.2201	622	-1.4185	569	0.8748	560
35NMFL31	-1.2949	582	-0.8735	506	0.0305	316	-1.0842	570	-0.3909	402	0.8889	527
35NMFL32	-1.5535	643	0.2627	175	0.0269	317	-0.6454	390	-1.7893	610	0.9330	447
35NMFL33	-0.9101	459	-0.9299	528	0.0051	324	-0.9200	505	0.0249	315	0.9075	497
35NMFL34	-1.6275	653	-0.2725	290	0.0006	327	-0.9500	520	-1.3544	555	0.9049	500
35NMFL35	-1.1167	533	-1.1506	595	-0.0018	328	-1.1337	594	0.0321	314	0.8868	533
35NMFL36	-1.0150	495	0.6212	128	-0.0190	333	-0.1969	267	-1.6552	600	0.9822	347
35NMFL37	-0.1229	264	-1.1988	611	0.0166	320	-0.6609	399	1.0925	137	0.9324	449
35NMFL38	-1.1802	553	-0.8459	496	-0.0349	334	-1.0131	551	-0.3692	395	0.9018	511
35NMFL39	-0.1692	271	-0.5796	397	-0.0466	335	-0.3744	307	0.3638	256	0.9671	372
35NMFM01	-1.5416	641	-1.2474	617	-0.3759	369	-1.3945	658	-0.6701	451	0.8942	520
35NMFM02	-1.1455	541	-1.3845	645	-0.3937	372	-1.2650	636	-0.1547	357	0.9093	493
35NMFM03	-0.8927	450	-0.9638	534	-0.3783	370	-0.9283	509	-0.3072	384	0.9428	430
35NMFM04	-1.4654	623	-1.7206	673	-0.3842	371	-1.5930	681	-0.1290	354	0.8743	562
35NMFM05	-0.9878	480	-1.0263	563	-0.3544	365	-1.0071	548	-0.3159	388	0.9323	450
35NMFM06	-1.2505	571	-0.5343	378	-0.4488	376	-0.8924	496	-1.1650	533	0.9536	406
35NMFM07	-1.4273	613	-0.2508	280	-0.3460	363	-0.8391	474	-1.5225	582	0.9489	422
35NMFM08	-1.5615	645	-1.4261	650	-0.3339	361	-1.4938	675	-0.4693	418	0.8800	547
35NMFM09	-1.2826	577	-1.5205	657	-0.3207	359	-1.4016	659	-0.0828	344	0.8883	529
35NMFM10	-0.9997	485	-1.5743	660	-0.2269	353	-1.2870	646	0.3477	259	0.8915	524
35NMFM11	-1.2675	573	-1.9676	681	-0.2116	352	-1.6176	684	0.4885	232	0.8564	584
35NMFM12	-1.0160	496	-1.3421	636	-0.0629	339	-1.1791	610	0.2632	274	0.8877	530
35NMFM13	-1.3481	596	-0.5468	382	-0.0161	332	-0.9475	515	-0.8174	470	0.9067	498
35NMFM14	-0.4335	323	-0.3748	325	0.0662	304	-0.4042	312	0.0075	318	0.9532	411
35NMFM15	0.0124	246	-0.4212	333	0.2317	267	-0.2044	270	0.6653	200	0.9574	398
35NMFM16	0.4947	194	-0.4505	347	0.2305	268	0.0221	219	1.1757	121	0.9796	351
35NMFM17	1.2928	110	0.5644	134	0.5573	225	0.9286	119	1.2857	109	1.0352	192
35NMFM18	-0.8351	428	-1.9682	682	0.4843	243	-1.4017	660	1.6174	61	0.8200	615
35NMFN01	-1.6296	654	-1.2221	614	-0.0466	336	-1.4259	666	-0.4541	415	0.8614	579
35NMFN02	-1.0249	504	-0.4833	358	0.0175	319	-0.7541	445	-0.5241	426	0.9229	472
35NMFN03	-1.1336	537	-0.3803	327	0.3002	257	-0.7570	446	-0.4531	413	0.8974	517
35NMFN04	-1.5238	637	-1.3252	635	0.3818	250	-1.4245	665	0.1832	287	0.8261	609
35NMFN05	-1.5130	633	-1.7231	674	0.6258	208	-1.6181	685	0.8359	173	0.7888	635
35NMFN06	-0.1820	273	-0.3684	320	0.4020	248	-0.2752	277	0.5884	218	0.9349	444
35NMFN07	-1.2789	575	-0.6032	402	0.6227	209	-0.9411	514	-0.0530	328	0.8528	588
35NMFN08	-0.8570	439	-0.2204	269	0.6731	193	-0.5387	349	0.0365	312	0.8865	535
35NMFN09	-0.8244	422	-1.0751	578	0.6542	201	-0.9498	519	0.9049	162	0.8494	589
35NMFN10	-0.8202	419	-0.2711	289	0.6956	182	-0.5457	353	0.1465	292	0.8839	540
35NMFN11	-0.4161	317	0.2389	179	0.6432	205	-0.0886	239	-0.0118	320	0.9312	453
35NMFN12	-0.3097	298	0.0057	218	0.6622	198	-0.1520	256	0.3468	260	0.9236	471
35NMFN13	-1.1763	551	-0.2820	292	0.7072	180	-0.7292	430	-0.1871	360	0.8658	572
35NMFN14	-0.0812	256	-0.5595	388	0.7149	177	-0.3204	286	1.1932	120	0.9033	505
35NMFN15	-0.2145	278	0.3585	163	-0.0030	329	0.0720	209	-0.5760	435	1.0075	274
35NMFP01	-1.4534	618	-0.7611	472	0.6642	196	-1.1073	586	-0.0281	322	0.8339	601

ED	NEED	NRANK	ACCESS	ARANK	PROVIS	PRANK	DEMAND	DRANK	GPU	URANK	REALIZE	RRANK
35NMFP02	-1.4313	615	-1.3038	631	0.7542	164	-1.3676	655	0.6267	210	0.8027	628
35NMFP03	-0.7010	384	-0.8946	516	0.6830	190	-0.7978	461	0.8766	169	0.8614	578
35NMFP04	-1.6940	659	-0.0398	226	0.6849	189	-0.8669	485	-0.9693	499	0.8548	587
35NMFP05	-1.6893	658	-0.7122	451	0.7449	170	-1.2008	616	-0.2322	369	0.8189	618
35NMFP06	-1.1371	538	-0.8343	491	0.5367	233	-0.9857	536	0.2339	280	0.8554	586
35NMFP07	-0.8350	427	-0.5468	383	0.7733	156	-0.6909	410	0.4851	234	0.8641	574
35NMFP08	-1.0759	521	-0.8401	492	0.7082	179	-0.9580	526	0.4724	236	0.8444	596
35NMFP09	-0.9442	473	-2.1210	685	0.9025	121	-1.5326	678	2.0793	30	0.7766	637
35NMFP10	-0.8369	430	-1.1366	592	1.0758	90	-0.9868	537	1.3755	93	0.8138	621
35NMFP11	-0.8575	441	-0.5795	396	0.9285	115	-0.7185	421	0.6505	204	0.8493	590
35NMFP12	-1.3080	590	-0.5126	366	1.1087	77	-0.9103	501	0.3133	265	0.8183	619
35NMFP13	0.2277	221	-0.0999	246	0.7930	149	0.0639	211	1.1206	132	0.9324	448
35NMFP14	-0.7659	406	-0.7841	475	0.7291	174	-0.7750	455	0.7473	191	0.8598	580
35NMFP15	0.3779	205	0.0630	205	0.8115	144	0.2205	186	1.1264	131	0.9453	427
35NMFP16	0.3584	209	-0.5310	375	0.8027	145	-0.0863	237	1.6921	57	0.9177	482
35NMFP17	-1.0978	526	0.7776	113	0.7291	173	-0.1601	257	-1.1463	531	0.9171	483
35NMFQ01	-1.3927	606	-1.0282	565	1.1171	71	-1.2105	619	0.7526	189	0.7906	634
35NMFQ02	1.7260	67	1.1393	79	1.1126	74	1.4327	61	1.6993	55	1.0289	206
35NMFQ03	1.3845	101	1.1049	81	0.8929	126	1.2447	83	1.1725	123	1.0323	200
35NMFQ04	2.1491	34	0.5808	131	0.8115	143	1.3650	69	2.3798	17	1.0512	148
35NMFQ05	-0.5159	339	0.5171	142	1.2446	33	0.0006	221	0.2116	283	0.8894	526
35NMFQ06	1.2837	112	1.1741	73	1.2651	30	1.2289	86	1.3747	94	0.9968	307
35NMFQ07	1.8980	55	1.0387	88	1.1803	54	1.4684	58	2.0396	33	1.0258	218
35NMFQ08	2.1146	36	1.6450	27	1.2122	44	1.8798	22	1.6818	58	1.0595	129
35NMFQ09	2.6181	11	1.1431	78	1.1683	55	1.8806	21	2.6433	13	1.0638	120
35NMFQ10	1.6588	76	1.6136	30	1.1845	53	1.6362	39	1.2297	114	1.0404	171
35NMFQ11	2.3969	17	2.0357	9	1.1579	60	2.2163	6	1.5191	71	1.0949	73
35NMFQ12	1.2697	113	1.6075	31	1.2162	41	1.4386	59	0.8784	168	1.0199	231
35NMFR01	2.1709	32	1.1640	75	1.1436	62	1.6675	37	2.1505	25	1.0470	159
35NMFR02	0.8057	154	1.5629	36	1.1305	66	1.1843	91	0.3733	252	1.0048	279
35NMFR03	1.1035	130	2.0588	8	1.3326	5	1.5812	44	0.3773	250	1.0219	226
35NMFR04	1.0991	132	0.5489	137	1.3341	3	0.8240	127	1.8843	38	0.9550	401
35NMFR05	0.5536	187	1.4444	49	1.3295	6	0.9990	113	0.4387	239	0.9708	369
35NMFR06	1.2442	114	1.7402	22	1.3260	7	1.4922	56	0.8300	174	1.0147	247
35NMFR07	2.0689	39	1.8493	18	1.1981	51	1.9591	13	1.4177	83	1.0680	115
35NMFR08	0.0391	241	1.3575	54	1.0937	83	0.6983	139	-0.2247	366	0.9644	378
35NMFR09	0.5953	177	2.0243	10	1.1145	72	1.3098	74	-0.3145	386	1.0176	237
35NMFR10	1.1240	128	2.3147	2	1.0996	81	1.7194	34	-0.0911	348	1.0558	138
35NMFR11	1.4633	94	1.7920	19	1.3203	9	1.6277	41	0.9916	148	1.0272	213
35NMFR12	0.0191	245	1.2069	67	1.1068	78	0.6130	149	-0.0810	342	0.9555	400
35NMFR13	-0.3000	293	2.1130	6	1.3182	10	0.9065	120	-1.0948	524	0.9636	380
35NMFR14	2.7932	5	1.6808	23	1.3136	11	2.2370	5	2.4260	15	1.0816	87
35NMFR15	2.0804	38	1.6648	25	1.3073	14	1.8726	23	1.7229	51	1.0500	152
35NMFR16	1.4026	98	1.5851	34	1.3021	16	1.4939	55	1.1196	133	1.0170	241
35NMFS01	-0.1007	260	0.0953	200	1.2058	48	-0.0027	222	1.0098	145	0.8922	522
35NMFS02	0.1045	231	-0.2263	271	1.2093	45	-0.0609	231	1.5401	69	0.8867	534
35NMFS03	0.3504	210	1.0570	87	1.2202	40	0.7037	138	0.5136	225	0.9540	404
35NMFS04	2.7281	7	0.8356	106	1.2162	42	1.7819	28	3.1087	3	1.0504	151
35NMFS05	-0.5761	348	0.6687	122	1.3547	1	0.0463	215	0.1099	299	0.8848	538
35NMFS06	1.8490	57	0.6990	120	1.1247	69	1.2740	78	2.2747	19	1.0134	250
35NMFS07	-0.5364	342	0.2040	182	1.2507	32	-0.1662	258	0.5103	226	0.8741	563
35NMFS08	-0.3876	312	0.3622	162	1.2524	31	-0.0127	224	0.5026	228	0.8876	531
35NMFS09	-0.2471	284	-0.0458	229	1.2328	39	-0.1465	253	1.0315	143	0.8772	554
35NMFS10	-0.2483	285	-0.4863	359	1.2333	38	-0.3673	303	1.4713	78	0.8575	582
35NMFS11	-1.1162	531	-0.1205	251	1.2926	19	-0.6184	385	0.2969	267	0.8308	606
35NMFS12	-0.2627	287	-0.1126	248	1.2926	20	-0.1877	264	1.1425	127	0.8689	568
35NMFS13	-0.0572	254	1.4386	50	1.2883	22	0.6907	140	-0.2075	363	0.9471	425
35NMFT01	-0.0334	251	0.7792	112	1.0884	86	0.3729	175	0.2758	273	0.9355	442
35NMFT02	0.5634	182	1.3094	58	1.0944	82	0.9364	118	0.3484	258	0.9858	333
35NMFT03	0.7440	161	0.9667	99	1.2931	18	0.8554	122	1.0704	141	0.9612	386
35NMFT04	1.9089	53	1.0574	86	1.2856	23	1.4832	57	2.1371	28	1.0175	238
35NMFT05	0.5177	191	0.5500	136	1.2673	29	0.5339	158	1.2350	112	0.9349	443
35NMFT06	1.1247	127	1.2786	64	1.2678	28	1.2017	89	1.1139	134	0.9941	313
35NMFT07	-0.2947	291	0.1079	198	1.1964	52	-0.0934	244	0.7938	179	0.8848	537
35NMFT08	-0.6949	379	0.6654	125	1.2819	25	-0.0148	225	-0.0784	338	0.8851	536
35NMFT09	-0.6026	354	0.4159	154	1.1292	67	-0.0934	243	0.1107	298	0.8901	525
35NMFT10	-0.2868	290	1.5017	43	1.1380	63	0.6075	151	-0.6505	445	0.9524	415
35NMFT11	-0.0895	258	1.0724	85	1.1035	80	0.4915	166	-0.0584	330	0.9449	429
35NMFT12	0.2829	215	0.0479	210	0.9727	110	0.1654	192	1.2077	115	0.9264	462
35NMFT13	0.9391	142	1.1842	71	0.9531	113	1.0617	106	0.7080	194	1.0099	266
35NMFT14	-1.4809	626	1.5417	41	1.1311	65	0.0304	217	-1.8915	615	0.9011	512
35NMFT15	-0.9541	477	0.3804	161	0.8937	124	-0.2869	278	-0.4408	411	0.8916	523
35NMFU01	-1.2874	580	-1.2244	616	0.1700	279	-1.2559	631	0.1070	300	0.8598	581
35NMFU02	2.0218	43	1.0346	90	0.2092	272	1.5282	50	1.1964	118	1.1292	34
35NMFU03	1.2316	115	0.0263	213	0.5012	240	0.6290	147	1.7065	53	1.0122	258
35NMFU04	1.6565	77	0.5919	130	0.2616	262	1.1242	98	1.3262	103	1.0841	84
35NMFU05	-0.9330	469	-0.6206	408	0.1009	296	-0.7768	457	-0.2115	364	0.9131	488
35NMFU06	2.1249	35	2.1242	5	0.6888	185	2.1246	10	0.6895	196	1.1343	32
35NMFU07	2.1599	33	1.5596	37	0.7957	147	1.8598	25	1.3960	88	1.0986	69

ED	NEED	NRANK	ACCESS	ARANK	PROVIS	PRANK	DEMAND	DRANK	GPU	URANK	REALIZE	RRANK
35NMFU08	1.6022	83	1.4815	46	0.6582	200	1.5419	48	0.7789	183	1.0829	86
35NMFU09	1.5896	84	1.5921	33	0.7706	157	1.5909	43	0.7681	184	1.0762	100
35NMFU10	1.9708	49	1.2926	62	0.7886	150	1.6317	40	1.4668	79	1.0781	94
35NMFU11	-1.2839	578	-0.3782	326	0.6062	214	-0.8311	472	-0.2995	382	0.8645	573
35NMFU12	-0.8317	425	0.8013	110	0.7877	151	-0.0152	226	-0.8453	474	0.9256	465
35NMFU13	1.5752	85	1.1698	74	0.2700	261	1.3725	68	0.6754	198	1.1074	55
35NMFU14	2.3617	19	1.3266	55	0.1599	283	1.8442	26	1.1950	119	1.1658	15
35NMFW01	-1.5208	636	-1.7596	675	0.1588	284	-1.6402	686	0.3976	244	0.8229	614
35NMFW02	-1.9655	682	-0.6598	422	0.1380	289	-1.3127	649	-1.1677	534	0.8569	583
35NMFW03	-1.0654	519	-2.1636	686	0.2257	270	-1.6145	683	1.3239	105	0.8200	616
35NMFW04	-0.5890	349	-1.2239	615	0.3663	251	-0.9065	500	1.0012	147	0.8772	555
35NMFW05	-0.8828	448	-0.4182	332	0.3604	252	-0.6505	392	-0.1042	350	0.9024	508
35NMFW06	-1.8146	673	-1.2671	623	0.2508	264	-1.5409	679	-0.2967	381	0.8252	611
35NMFW07	-0.9114	460	-1.6735	671	0.3183	256	-1.2925	647	1.0804	139	0.8439	597
35NMFW08	-1.7125	663	-1.2546	618	0.5454	229	-1.4836	672	0.0875	304	0.8076	624
35NMFW09	-1.1685	550	-1.9832	683	0.5519	228	-1.5759	680	1.3666	96	0.7983	630
35NMFW10	-0.7162	390	-1.6237	666	0.2460	266	-1.1700	605	1.1535	124	0.8618	577
35NMFW11	-1.3966	607	-2.3155	688	0.5820	220	-1.8561	688	1.5009	75	0.7696	638
35NMFW12	-0.9305	467	-1.5805	661	0.5000	241	-1.2555	630	1.1500	125	0.8328	603
35NMFW13	-1.2492	570	-1.2751	627	0.5957	218	-1.2622	635	0.6216	213	0.8247	612
35NMFX02	-1.9498	681	0.8989	102	0.5023	238	-0.5255	342	-2.3464	634	0.9021	510
35NMFX03	-0.8544	437	0.1375	193	0.5023	239	-0.3585	300	-0.4896	421	0.9180	481
35NMFX04	0.9866	139	1.2016	68	0.4695	245	1.0941	103	0.2545	278	1.0597	128
35NMFX05	1.1501	124	0.2747	173	0.4557	246	0.7124	137	1.3311	102	1.0246	222
35NMFX06	-1.8079	672	-0.5211	369	0.8864	128	-1.1645	603	-0.4004	404	0.8116	622
35NMFX07	-1.6691	656	0.3516	165	0.7110	178	-0.6588	397	-1.3097	551	0.8721	565
35NMFX08	-2.4238	689	-0.3343	305	0.8617	132	-1.3791	656	-1.2278	540	0.7937	633
35NMFX09	-2.3778	688	0.8750	103	0.5957	217	-0.7514	441	-2.6571	637	0.8729	564
35NMFX10	1.3618	103	0.8371	104	0.4820	244	1.0995	102	1.0067	146	1.0589	133
35NMFX11	-0.9486	474	0.0074	217	0.5606	224	-0.4706	327	-0.3954	403	0.9023	509
35NMFX12	-0.2284	281	-0.9710	539	0.3424	255	-0.5997	378	1.0850	138	0.9089	495
35NMFX15	1.0252	135	-0.5269	372	0.0152	321	0.2492	182	1.5673	67	1.0234	225
35NMFX16	-1.4859	627	0.1526	188	1.0452	93	-0.6667	400	-0.5933	439	0.8450	595
35NMFX17	-1.4894	628	-0.8479	497	1.0200	96	-1.1687	604	0.3785	249	0.8014	629
35NMFX18	-2.1399	686	-0.6944	444	0.6879	186	-1.4172	663	-0.7576	464	0.8030	627
35NMFX19	-1.2168	560	-0.4040	330	0.8937	125	-0.8104	465	0.0809	306	0.8436	598
35NMFX20	-1.1003	528	0.6664	124	0.2604	263	-0.2170	274	-1.5063	579	0.9535	407
35NNFA01	-1.5127	632	-0.5252	371	-1.0235	591	-1.0190	553	-2.0110	624	1.0005	295
35NNFA02	-0.3981	314	-0.5314	376	-1.0207	589	-0.4648	325	-0.8874	482	1.0618	126
35NNFA03	100.0000		100.0000		-0.9577	540	100.0000		100.0000		100.0000	
35NNFA04	-1.0916	524	-0.6842	431	-1.0242	593	-0.8879	494	-1.4316	570	1.0152	244
35NNFA05	-0.3685	305	-0.7086	450	-1.0192	588	-0.5386	348	-0.6791	452	1.0535	143
35NNFA06	-0.8310	424	-1.3696	641	-0.9577	542	-1.1003	580	-0.4191	409	0.9842	339
35NNFB01	-0.7987	412	-0.7288	456	-1.0711	628	-0.7638	449	-1.1410	529	1.0344	195
35NNFB02	-0.6577	366	-1.0809	580	-1.0093	587	-0.8693	486	-0.5861	438	1.0156	242
35NNFB03	-0.4867	332	-0.6396	414	-1.0093	585	-0.5632	361	-0.8564	476	1.0496	153
35NNFB04	-0.5911	350	-0.6270	410	-0.7291	433	-0.6091	381	-0.6932	456	1.0129	256
35NNFB05	-0.4786	330	-0.5214	370	-0.6771	417	-0.5000	336	-0.6343	443	1.0190	234
35NNFB06	0.0837	234	-0.8300	490	-1.0704	627	-0.3732	306	-0.1567	358	1.0781	95
35NNFB07	0.0418	239	-0.6970	447	-1.0277	600	-0.3276	289	-0.2889	379	1.0780	96
35NNFC01	0.0731	235	-1.1781	603	-0.0495	337	-0.5525	355	1.2017	116	0.9495	421
35NNFC02	0.5604	184	-1.2612	621	-0.0894	342	-0.3504	295	1.7322	50	0.9737	363
35NNFC03	-1.0600	516	-1.3016	630	-0.3243	360	-1.1808	611	-0.0827	343	0.9115	490
35NNFC04	-1.7778	669	-0.6078	404	-0.5873	397	-1.1928	615	-1.7573	606	0.9357	441
35NNFD01	-1.8441	676	0.1323	194	-0.9749	558	-0.8559	477	-2.9513	638	1.0132	253
35NNFD02	-1.2296	563	-0.8615	500	-0.9622	544	-1.0456	562	-1.3303	552	0.9908	321
35NNFD03	-1.0090	491	-1.5499	658	-0.9493	535	-1.2795	643	-0.4084	406	0.9635	381
35NNFD04	-0.9523	475	-1.2739	626	-0.9254	521	-1.1131	587	-0.6038	440	0.9793	352
35NNFD05	-0.5129	337	-0.5680	393	-0.9569	539	-0.5405	351	-0.9018	486	1.0460	161
35NNFD06	-1.6375	655	-0.6651	423	-0.9347	525	-1.1513	601	-1.9071	619	0.9761	360
35NNFD07	0.0259	243	-0.8650	501	-0.9539	537	-0.4196	317	-0.0630	332	1.0591	131
35NNFD08	100.0000		100.0000		-0.9660	549	100.0000		100.0000		100.0000	
35NNFE01	-0.8577	442	-0.9962	549	-0.9645	548	-0.9270	508	-0.8260	472	1.0042	282
35NNFE02	-1.1920	555	0.1733	186	-0.9401	529	-0.5094	338	-2.3054	633	1.0475	158
35NNFE03	-1.1165	532	-0.6901	436	-0.9301	523	-0.9033	498	-1.3565	556	1.0030	287
35NNFE04	0.4351	198	-0.1554	259	-0.8945	510	0.1399	197	-0.3040	383	1.1136	49
35NNFE05	-1.0178	497	-0.0602	234	-0.9105	517	-0.5390	350	-1.8681	614	1.0409	169
35NNFE06	0.4217	199	-0.1433	257	-0.9081	515	0.1392	198	-0.3431	393	1.1152	48
35NNFE07	-1.1964	556	-0.0040	219	-0.8929	509	-0.6002	379	-2.0853	626	1.0321	203
35NNFE08	0.7996	156	0.1938	184	-0.8993	511	0.4967	165	-0.2935	380	1.1534	23
35NNFE09	1.2843	111	-0.0491	232	-0.8492	478	0.6176	148	0.4842	235	1.1603	20
35NNFE10	-0.7230	393	-0.2658	287	-0.9191	518	-0.4944	335	-1.3763	563	1.0468	160
35NNFF01	-0.3088	296	-0.9652	536	-0.6462	409	-0.6370	389	0.0102	317	1.0010	293
35NNFF02	1.0148	136	-0.6925	438	-0.8150	459	0.1612	193	0.8923	164	1.1063	60
35NNFF03	-0.7516	401	-0.7402	463	-0.2104	350	-0.7459	436	-0.2218	365	0.9452	428
35NNFF04	0.6445	169	-0.6510	420	-0.6642	411	-0.0033	223	0.6313	209	1.0708	110
35NNFG01	1.3662	102	-0.6931	441	-0.3592	366	0.3366	177	1.7001	54	1.0722	105
35NNFG02	-0.4461	324	-0.6653	425	-0.3532	364	-0.5557	357	-0.1340	356	0.9790	355
35NNFG03	-1.4372	616	-0.9160	523	-0.3723	368	-1.1766	607	-0.8935	484	0.9165	484

ED	NEED	NRANK	ACCESS	ARANK	PROVIS	PRANK	DEMAND	DRANK	GPU	URANK	REALIZE	RRANK
35NNFG04	-0.8743	446	-0.6963	445	-0.3122	358	-0.7853	458	-0.4902	422	0.9512	417
35NNFG05	-1.7390	664	-1.2866	629	-0.3651	367	-1.5128	677	-0.8175	471	0.8809	545
35NNFH01	-1.0106	492	-1.1808	604	-0.7841	445	-1.0957	576	-0.6139	442	0.9662	375
35NNFH02	-1.3029	586	-0.8934	515	-0.1478	345	-1.0982	578	-0.5573	430	0.9034	504
35NNFH03	-1.5911	649	-1.4086	648	-0.2341	354	-1.4999	676	-0.4166	408	0.8704	567
35NNFJ01	-0.7437	398	-0.8029	481	99.0000		-0.7733	454	99.0000		99.0000	
35NNFJ02	-0.5458	344	-0.5503	385	99.0000		-0.5481	354	99.0000		99.0000	
35NNFJ03	-0.3918	313	-0.7574	471	99.0000		-0.5746	368	99.0000		99.0000	
35NNFJ04	-0.7823	409	-0.3688	322	99.0000		-0.5756	369	99.0000		99.0000	
35NNFJ05	-1.0116	493	-0.9843	547	99.0000		-0.9980	543	99.0000		99.0000	
35NNFK01	-1.2845	579	-0.2030	265	99.0000		-0.7438	435	99.0000		99.0000	
35NNFK02	-0.2767	289	-0.3325	304	99.0000		-0.3046	284	99.0000		99.0000	
35NNFK03	-0.8176	418	-0.4460	343	-1.0049	581	-0.6318	387	-1.3765	564	1.0415	167
35NNFK04	0.5477	188	-0.0446	228	-0.9630	545	0.2516	181	-0.3707	396	1.1344	31
35NNFK05	-0.5265	341	-0.0651	236	-1.0049	580	-0.2958	281	-1.4663	574	1.0788	93
35NNFK06	-0.9311	468	-0.2997	296	-0.9630	546	-0.6154	383	-1.5944	594	1.0385	179
35NNFK07	0.1671	225	-0.5358	379	-1.0291	604	-0.1844	263	-0.3262	391	1.0942	74
35NNFK08	-0.7325	396	-0.4572	350	-1.0263	597	-0.5949	374	-1.3016	548	1.0481	157
35NNFK09	-0.7773	407	-0.7001	448	99.0000		-0.7387	434	99.0000		99.0000	
35NNFL01	-0.0878	257	-1.0458	569	99.0000		-0.5668	363	99.0000		99.0000	
35NNFL02	-1.1177	534	-1.4339	651	99.0000		-1.2758	640	99.0000		99.0000	
35NNFL03	-0.0341	252	-1.2695	624	99.0000		-0.6518	393	99.0000		99.0000	
35NNFL04	0.6964	164	-1.3507	639	99.0000		-0.3272	288	99.0000		99.0000	
35NNFL05	-1.1595	546	-1.1832	605	99.0000		-1.1714	606	99.0000		99.0000	
35NNFL06	-0.8487	434	-0.7899	478	99.0000		-0.8193	471	99.0000		99.0000	
35NNFM01	-1.0227	501	0.2542	177	-1.0277	598	-0.3843	309	-2.3046	632	1.0717	109
35NNFM02	0.2684	217	-0.4408	340	-1.0284	603	-0.0862	236	-0.3192	389	1.1050	62
35NNFM03	-0.6892	377	-0.4497	345	99.0000		-0.5695	365	99.0000		99.0000	
35NNFM04	-0.8969	452	-0.7359	460	-1.0697	626	-0.8164	469	-1.2307	541	1.0284	209
35NNFM05	-1.7498	665	-0.7258	455	99.0000		-1.2378	626	99.0000		99.0000	
35NNFN01	-0.2215	279	-0.7520	468	-0.4395	375	-0.4868	332	0.0910	303	0.9951	311
35NNFN02	-1.3060	589	-0.7666	474	-0.1499	346	-1.0363	559	-0.6893	454	0.9100	492
35NNFN03	-0.4698	329	-0.2685	288	-0.4499	377	-0.3692	305	-0.6512	446	1.0085	269
35NNFN04	-0.9253	466	-0.9973	550	-0.6030	400	-0.9613	530	-0.5310	428	0.9619	384
35NNFN05	-1.4422	617	-0.8425	493	-0.6781	418	-1.1424	598	-1.2778	545	0.9502	420
35NNFN06	-1.4583	621	-0.5159	368	-0.6197	405	-0.9871	538	-1.5621	589	0.9608	387
35NNFP01	-0.0321	250	-1.1750	601	-0.8815	503	-0.6036	380	0.2614	275	1.0305	205
35NNFP02	-0.3792	308	0.2046	181	-0.9801	563	-0.0873	238	-1.5639	590	1.0990	67
35NNFP03	-1.3607	599	-0.8051	483	-0.9779	559	-1.0829	569	-1.5335	585	0.9884	327
35NNFP04	-0.2687	288	-0.8661	502	-0.9794	562	-0.5674	364	-0.3820	401	1.0457	162
35NNFQ01	-0.6898	378	-1.1858	606	-1.0534	615	-0.9378	511	-0.5574	431	1.0129	255
35NNFQ02	0.0675	236	-1.4551	653	-1.0235	592	-0.6938	412	0.4991	229	1.0367	185
35NNFQ03	-1.0425	508	-1.1272	591	-1.0548	618	-1.0849	571	-0.9701	500	0.9966	308
35NNFQ04	-0.8203	420	-0.0148	221	-0.9845	567	-0.4176	315	-1.7900	611	1.0629	124
35NNFQ05	-0.1481	268	-1.2849	628	-1.0630	625	-0.7165	420	0.0738	307	1.0388	176
35NNFQ06	-0.7115	388	-0.3441	310	99.0000		-0.5278	343	99.0000		99.0000	
35NNFR01	-0.8613	445	-0.4503	346	-0.6702	414	-0.6558	395	-1.0812	523	1.0014	292
35NNFR02	-0.1740	272	-1.1963	609	-0.7024	425	-0.6852	405	0.3199	263	1.0019	291
35NNFR03	-1.5312	640	-0.3132	300	-0.7948	450	-0.9222	507	-2.0128	625	0.9862	332
35NNFR04	-1.7882	671	-0.7615	473	-0.7412	437	-1.2749	639	-1.7679	608	0.9424	432
35NNFR05	100.0000		100.0000		-0.8484	475	100.0000		100.0000		100.0000	
35NNFS01	-0.1997	275	-1.2006	612	-0.7403	436	-0.7002	414	0.2606	276	1.0043	281
35NNFS02	-0.6807	374	-1.5925	662	-0.5045	385	-1.1366	596	0.4073	242	0.9334	446
35NNFS03	-1.3030	587	-1.1246	590	-0.5883	398	-1.2138	621	-0.7667	466	0.9335	445
35NNFS04	-0.4282	320	-0.8860	513	-0.5023	384	-0.6571	396	-0.0445	325	0.9837	341
35NNFT01	-1.7616	667	-0.7862	476	-0.6020	399	-1.2739	638	-1.5774	592	0.9285	458
35NNFT02	-0.2502	286	0.0665	204	-0.6072	401	-0.0919	242	-0.9239	489	1.0549	142
35NNFT03	-1.8224	674	-0.7485	465	-0.5246	387	-1.2855	645	-1.5985	595	0.9197	477
35NNFT04	-0.6016	353	-1.6717	669	-0.4717	380	-1.1367	597	0.5984	217	0.9302	454
35NNFT05	0.2463	220	-0.4789	353	-0.5713	395	-0.1163	248	0.1539	290	1.0483	155
35NNFU01	-0.8124	416	-0.6899	435	99.0000		-0.7512	440	99.0000		99.0000	
35NNFU02	0.5571	186	-0.6191	407	99.0000		-0.0310	228	99.0000		99.0000	
35NNFU03	1.7173	68	-0.8683	504	99.0000		0.4245	172	99.0000		99.0000	
35NNFU04	-0.4080	316	-0.6675	427	99.0000		-0.5378	347	99.0000		99.0000	
35NNFU05	-1.0488	512	-1.1777	602	99.0000		-1.1133	588	99.0000		99.0000	
35NNFW01	-0.9530	476	-0.4236	334	-1.0085	583	-0.6883	408	-1.5379	586	1.0356	190
35NNFW02	-1.3028	585	-0.2001	264	-0.9081	513	-0.7515	442	-2.0108	623	1.0172	239
35NNFW03	-0.2249	280	-0.3100	298	-0.8717	492	-0.2675	276	-0.7866	468	1.0662	117
35NNFW04	0.0405	240	-0.7518	467	-0.9033	512	-0.3557	298	-0.1110	352	1.0602	127
35NNFW05	-1.2469	568	-0.2038	266	-0.9081	514	-0.7254	427	-1.9512	621	1.0201	230
35NNFX01	-1.6070	651	-1.2582	619	-0.3110	357	-1.4326	668	-0.6598	448	0.8842	539
35NNFX02	0.5257	190	-0.3686	321	-0.2845	356	0.0786	207	0.6098	214	1.0374	184
35NNFX03	-0.0923	259	-0.7517	466	-0.3996	373	-0.4220	318	0.2598	277	0.9977	305
35NNFY01	-1.3759	603	-1.1884	607	99.0000		-1.2822	644	99.0000		99.0000	
35NNFY02	-1.0481	510	-1.4704	655	99.0000		-1.2593	634	99.0000		99.0000	
35NNFY03	-0.1650	270	0.2075	180	99.0000		0.0213	220	99.0000		99.0000	
35NNFY04	-0.6667	369	-1.3703	642	99.0000		-1.0185	552	99.0000		99.0000	
35NNFY05	-0.1648	269	-1.0151	557	99.0000		-0.5900	373	99.0000		99.0000	
35NNFY06	-0.3418	302	-1.0064	554	99.0000		-0.6741	403	99.0000		99.0000	

ED	NEED	NRANK	ACCESS	ARANK	PROVIS	PRANK	DEMAND	DRANK	GPU	URANK	REALIZE	RRANK
35NNFY07	-1.0068	488	-0.9692	538	99.0000		-0.9880	539	99.0000		99.0000	
35NNFY08	100.0000		100.0000		99.0000		100.0000		100.0000		100.0000	
35NNFZ01	-0.9129	461	-0.2573	285	-0.0074	331	-0.5851	372	-0.6630	450	0.9422	433
35NNFZ02	0.6125	175	-0.8287	489	-0.0961	343	-0.1081	245	1.3451	98	0.9988	300
35NNFZ03	-0.9012	455	-0.9208	525	-0.0705	340	-0.9110	502	-0.0509	327	0.9154	486
35NNGA01	0.4497	196	-1.0536	570	99.0000		-0.3020	283	99.0000		99.0000	
35NNGA02	-0.3834	309	-1.3828	644	99.0000		-0.8831	490	99.0000		99.0000	
35NNGA03	-1.2386	565	-0.8111	484	99.0000		-1.0249	555	99.0000		99.0000	
35NNGB01	-0.6419	363	-0.0791	239	99.0000		-0.3605	301	99.0000		99.0000	
35NNGB02	-1.1578	544	-0.1832	262	99.0000		-0.6705	401	99.0000		99.0000	
35NNGB03	-0.4634	325	-0.3448	311	-1.0609	623	-0.4041	311	-1.1795	537	1.0735	102
35NNGB04	-1.2784	574	-0.9639	535	-1.0541	616	-1.1212	590	-1.3686	562	0.9925	319
35NNGB05	0.2465	219	-0.0463	231	-1.0569	620	0.1001	204	-0.7641	465	1.1294	33
35NNGB07	-1.0643	518	-1.1411	593	-1.0479	614	-1.1027	583	-0.9711	501	0.9939	315
35NNGB08	-1.5985	650	-0.2313	275	-0.9911	574	-0.9149	504	-2.3583	635	1.0085	270
35NNGB09	-0.2073	277	-1.1907	608	-1.0582	621	-0.6990	413	-0.0748	337	1.0402	173
35NNGB10	-0.3857	311	-0.3303	303	-1.0548	617	-0.3580	299	-1.1102	525	1.0779	97
35NNGC01	-0.6644	368	-0.0175	222	-0.1999	348	-0.3410	293	-0.8468	475	0.9856	335
35NNGC02	-0.9438	472	-0.9540	533	-0.5703	394	-0.9489	517	-0.5601	432	0.9599	391
35NNGC03	-0.1271	266	-1.0014	552	-0.4683	379	-0.5643	362	0.4060	243	0.9899	322
35NNGC04	0.8069	153	-1.1535	596	-0.5541	391	-0.1733	262	1.4063	86	1.0403	172
35NNGC05	-1.0925	525	-0.6409	415	-0.6114	402	-0.8667	484	-1.0630	517	0.9728	365
35NNGC06	-0.7315	395	-1.8253	677	-0.5389	389	-1.2784	642	0.5549	221	0.9218	474
35NNGC07	0.0498	238	-1.6730	670	-0.6145	404	-0.8116	466	1.1083	136	0.9790	354
35NNGD01	-0.9225	464	-0.9748	541	-0.7859	446	-0.9487	516	-0.7336	459	0.9823	346
35NNGD02	0.2968	213	-1.3450	638	-0.8374	467	-0.5241	340	0.8044	178	1.0342	197
35NNGD03	-0.4907	334	-0.8823	511	-0.7939	448	-0.6865	407	-0.4023	405	1.0117	259
35NNGD04	-0.9974	484	-1.4562	654	-0.8314	465	-1.2268	624	-0.3726	398	0.9569	399
35NNGD05	-1.4774	625	-0.8236	487	-0.8322	466	-1.1505	600	-1.4860	577	0.9653	376
35NNGD07	100.0000		100.0000		-0.8288	462	100.0000		100.0000		100.0000	
35NNGD08	100.0000		100.0000		-0.8441	471	100.0000		100.0000		100.0000	
35NNGE01	-0.6344	362	-0.2932	295	-1.0263	596	-0.4638	324	-1.3675	561	1.0627	125
35NNGE02	-0.3182	299	0.1762	185	-1.0263	595	-0.0710	232	-1.5207	581	1.1065	58
35NNGE03	-1.0119	494	-0.5303	374	-1.0256	594	-0.7711	452	-1.5072	580	1.0283	210
35NNGE04	-0.4889	333	-0.6291	412	-1.0277	599	-0.5590	359	-0.8875	483	1.0522	146
35NNGF01	-0.6747	372	-0.4832	357	-0.8245	461	-0.5790	370	-1.0160	509	1.0268	215
35NNGF02	-1.0071	489	-1.0589	572	-0.9779	560	-1.0330	557	-0.9261	491	0.9939	314
35NNGF03	0.3661	206	-0.5377	381	-0.9845	568	-0.0858	235	-0.0807	341	1.0997	66
35NNGF04	-1.3102	592	-0.6898	434	-0.9882	571	-1.0000	545	-1.6086	597	0.9987	301
35NNGF05	-0.6183	358	-1.3180	632	-0.7375	435	-0.9682	534	-0.0378	324	0.9751	361
35NNGF06	-0.8088	415	-0.5712	394	-0.7215	430	-0.6900	409	-0.9591	496	1.0034	284
35NNGG01	0.4436	197	-0.0935	242	-0.8202	460	0.1751	191	-0.2831	377	1.1084	54
35NNGG02	-0.6587	367	-1.0913	583	-1.0085	584	-0.8750	488	-0.5759	434	1.0148	246
35NNGG03	0.8331	151	-0.5502	384	-0.8399	468	0.1415	196	0.5434	222	1.1071	57
35NNGG04	-0.9097	458	-0.2377	277	-0.8676	487	-0.5737	367	-1.5396	587	1.0322	202
35NNGG05	-1.6113	652	-0.2307	274	-0.8692	488	-0.9210	506	-2.2498	630	0.9943	312
35NNGG06	-1.6777	657	-0.0971	245	-1.0064	582	-0.8874	492	-2.5870	636	1.0132	252
35NNGG07	-0.9430	471	-0.5285	373	-0.8717	493	-0.7358	432	-1.2862	546	1.0149	245
35NNGG08	1.2234	117	-0.4311	336	-0.8709	491	0.3962	174	0.7836	180	1.1388	30
35NNGG09	1.6096	82	-0.0137	220	-0.8700	490	0.7980	128	0.7533	188	1.1826	8
35NNGG10	0.6767	167	-0.2567	284	-0.8717	494	0.2100	188	0.0617	309	1.1185	46
35NNGG11	-0.7292	394	-1.4752	656	-0.9720	555	-1.1022	582	-0.2260	367	0.9856	334
35NNGG12	-1.0481	511	-1.0237	561	-0.9682	552	-1.0359	558	-0.9926	505	0.9925	318
35NNGG13	0.0261	242	-1.3246	634	-0.9682	553	-0.6493	391	0.3825	248	1.0353	191
35NNGG14	-1.5077	631	-0.6245	409	-1.0093	586	-1.0661	564	-1.8925	616	0.9937	316
35NNGH01	-0.6263	359	-1.3857	646	-1.0751	631	-1.0060	547	-0.3157	387	1.0077	273
35NNGH02	-1.1408	539	-0.9130	522	-1.0751	630	-1.0269	556	-1.3029	549	1.0054	278
35NNGH03	-1.0231	502	-0.6926	439	-1.0765	632	-0.8579	478	-1.4070	567	1.0245	223
35NNGH04	-1.3021	584	-0.5611	390	-1.0431	613	-0.9316	510	-1.7841	609	1.0124	257
35NNGH05	0.6173	174	-0.9057	518	99.0000		-0.1442	252	99.0000		99.0000	
35NNGH06	-0.2321	283	-0.6871	433	99.0000		-0.4596	323	99.0000		99.0000	
35NNGH07	-1.3227	594	-0.1280	253	-1.0006	578	-0.7254	426	-2.1953	629	1.0306	204
35NNGH08	-0.6123	356	-0.3627	316	-0.9600	543	-0.4875	333	-1.2096	539	1.0523	145
35NNGJ01	-0.7574	405	-0.6652	424	-0.9246	519	-0.7113	418	-1.0168	510	1.0235	224
35NNGJ02	-1.1001	527	-0.3664	318	-0.7983	452	-0.7333	431	-1.5320	584	1.0071	275
35NNGJ03	-0.6337	361	-0.4475	344	-0.8617	486	-0.5406	352	-1.0479	515	1.0351	193
35NNGJ04	-0.6317	360	-0.4413	341	-0.9324	524	-0.5365	346	-1.1228	527	1.0437	164
35NNGJ05	-0.1094	262	-0.3986	329	-0.9727	556	-0.2540	275	-0.6835	453	1.0796	90

iii. Outcomes (ward)

The matrix of results, on the following pages, illustrates the calculated outcome scores at the ward scale of analysis.

LEGEND

ITEM NAME	DESCRIPTION	ITEM NAME	DESCRIPTION
WARD	OPCS ward code	AWARE	Composite score for service awareness
HEALTH	Composite score for health status	A_RANK	Ranked AWARE scores
H_RANK	Ranked HEALTH scores	ACCESS	Overall composite score for accessibility
SOCECON	Composite score for social and economic disadvantage	ARANK	Ranked ACCESSIBILITY scores
S_RANK	Ranked SOCECON scores	PROVIS	Overall calculated score for provision
ENV	Composite score for environment	PRANK	Ranked PROVISION scores
E_RANK	Ranked ENV scores	DEMAND	Calculated scores for disadvantaged demand
NEED	Overall composite score for need	DRANK	Ranked disadvantaged demand scores
N_RANK	Ranked NEED scores	GPU	Calculated scores for GP utilization
TRANSP	Composite score for transport availability	URANK	Ranked GPU scores
T_RANK	Ranked TRANSP scores	REALIZE	Calculated scores for realized demand
PERMOB	Composite score for personal mobility	RRANK	Ranked REALIZE scores
P_RANK	Ranked PERMOB scores		

Note: Blank cells indicate that one or more of the ward's EDs was excluded and the ward average, and ranking, was not calculated.

WARD	HEALTH	H RANK	SOCECON	S RANK	ENV	E RANK	NEED	NRANK	TRANSP	T RANK	PERMOB	P RANK	AWARE	A RANK	ACCESS	ARANK	PROVIS	PRANK	DEMAND	DRANK	GPU	URANK	REALIZE	RRANK
35NJFA	0.34	15	0.47	11	1.30	6	0.67	9	0.90	5	-1.40	78	-1.68	79	-0.74	46	-0.89	47	-0.03	14	0.53	15	1.09	2
35NJFB	0.32	16	0.16	13	-1.33	69	-0.31	23	0.08	17	-1.26	76	-1.41	75	-0.96	67	-0.75	39	-0.64	41	-0.06	30	1.01	37
35NJFC	-0.52	43	-0.82	60	-1.18	63	-0.79	57	-0.72	53	-0.34	41	-0.59	39	-0.74	47	-0.95	57	-0.77	56	-1.01	56	1.02	30
35NJFD	-1.93	79	-0.63	48	-1.83	77	-1.30	79	-1.20	79	-0.70	62	-0.69	48	-1.12	75			-1.21	77				
35NJFE	-0.92	64	-0.68	50	-1.32	70	-0.90	70	-0.89	73	-0.92	66	-0.42	27	-0.88	63	-0.16	24	-0.89	68	-0.18	34	0.93	61
35NJFF	-0.81	54	-1.09	74	-1.37	71	-1.02	73	-0.94	76	-0.09	29	-0.04	14	-0.51	27	-0.63	36	-0.77	57	-1.13	62	0.96	48
35NJFG	0.05	21	-0.40	35	-0.25	17	-0.21	21	-0.47	31	-1.13	71	-0.35	20	-0.69	39	-1.07	69	-0.45	27	-0.58	41	1.07	5
35NJFH	-0.41	36	-0.78	59	-0.99	56	-0.69	50	-0.73	55	0.09	22	-0.96	61	-0.82	58	-0.82	42	-0.76	54	-0.72	47	1.00	40
35NJFJ	-1.06	67	-0.47	40	-1.16	61	-0.81	60	-0.68	49	-0.69	60	-0.96	64	-1.00	68	-1.03	64	-0.91	70	-0.85	51	1.02	28
35NJFK	-0.46	40	-0.69	51	-0.28	18	-0.44	33	-0.56	36	0.56	10	-0.49	34	-0.38	21			-0.41	21				
35NJFL	-0.76	53	-0.84	63	-0.88	44	-0.77	56	-0.78	62	-0.01	25	-0.87	54	-0.83	60	-0.96	59	-0.80	59	-0.92	54	1.02	29
35NJFM	-0.71	48	0.91	7	0.04	14	0.14	13	-0.44	29	-0.48	49	-1.00	65	-0.84	61	-0.90	50	-0.35	19	0.08	24	1.06	9
35NJFN	-0.85	58	-0.74	53	-1.00	57	-0.79	58	-0.85	67	-0.51	50	-0.51	37	-0.81	56	-0.90	48	-0.80	60	-0.86	52	1.01	39
35NJFP	-0.89	61	-1.08	76	-0.91	48	-0.89	68	-0.80	61	-0.59	56	-0.86	57	-0.97	65	-0.59	34	-0.93	73	-0.50	38	0.96	54
35NJFQ	-0.72	49	-0.56	43	-0.76	37	-0.62	43	-0.73	56	-0.32	39	-0.42	26	-0.65	33	-1.03	61	-0.64	42	-0.99	55	1.04	20
35NJFR	-0.47	41	1.68	3	1.27	7	0.86	8	0.13	16	0.07	24	-1.29	74	-0.56	30	-0.78	40	0.15	13	0.67	12	1.10	1
35NJFS	-0.51	42	-0.99	72	-1.07	54	-0.81	59	-0.76	59	0.33	15	-0.46	29	-0.53	28	-1.01	62	-0.67	43	-1.17	64	1.02	32
35NJFT	-0.15	29	-0.84	61	-0.89	45	-0.61	42	-0.54	34	-0.29	37	-0.95	62	-0.82	59	-0.84	45	-0.72	49	-0.63	43	1.01	38
35NJFU	-1.10	68	-1.36	79	-1.15	62	-1.11	76	-0.57	39	-0.61	55	-0.66	45	-0.77	50	0.17	20	-0.94	75	-0.18	35	0.89	69
35NJFW	-1.17	69	-0.90	65	-0.84	42	-0.87	67	-0.85	66	-0.03	28	-0.74	51	-0.80	54	-0.70	37	-0.84	66	-0.67	46	0.99	43
35NJFX	-1.26	72	-1.12	75	-1.23	66	-1.10	75	-0.83	65	-0.44	44	-0.36	21	-0.70	42	-0.80	41	-0.90	69	-1.20	67	0.99	44
35NJFY	-0.21	32	-0.61	46	-0.75	36	-0.51	34	-0.72	51	0.42	13	-0.43	28	-0.47	25	-0.84	44	-0.49	30	-0.87	53	1.04	19
35NJFZ	-0.70	47	-0.41	36	0.34	11	-0.20	20	-0.37	27	0.08	23	-1.03	67	-0.68	37	-0.61	35	-0.44	25	-0.13	32	1.02	26
35NJGA	-0.85	59	-0.60	45	-0.56	24	-0.60	40	-0.76	54	0.93	2	-0.39	25	-0.34	19	-1.10	72	-0.47	28	-1.19	66	1.08	4
35NJGB	0.28	17	0.09	16	-0.49	23	-0.06	18	-0.33	25	-1.16	72	-1.19	72	-1.05	71	-1.03	65	-0.56	32	-0.04	28	1.05	12
35NJGC	-0.90	63	-0.95	68	-0.39	21	-0.67	47	-0.62	42	-0.45	46	-0.48	33	-0.66	34	-1.09	71	-0.67	44	-1.27	68	1.05	15
35NMFA	0.74	12	-0.08	20	-0.23	15	0.06	16	0.64	9	-0.22	32	1.57	2	1.05	2	1.27	1	0.57	8	0.30	19	0.94	58
35NMFB	-0.13	27	0.57	9	0.23	12	0.23	11	-0.16	20	1.15	1	0.29	9	0.35	9	0.14	21	0.29	11	0.02	26	1.02	25
35NMFC	-0.74	51	0.15	14	-0.84	41	-0.42	31	-0.31	24	-0.65	59	-0.90	59	-0.77	51	0.65	9	-0.59	36	1.20	5	0.87	70
35NMFD	1.92	1	0.62	8	1.82	3	1.29	3	1.61	1	-1.05	70	0.63	7	0.86	5	0.99	8	1.06	5	1.42	4	1.01	35
35NMFE	1.88	2	1.59	4	2.25	1	1.75	1	1.46	3	0.22	18	0.12	12	0.85	7	0.72	12	1.30	2	1.62	2	1.05	11
35NMFF	1.05	5	0.14	15	0.66	10	0.53	10	0.89	6	-0.45	45	-0.33	18	0.17	12	0.59	14	0.35	10	0.95	7	0.98	45
35NMFG	0.87	9	-0.39	34	-1.00	55	-0.25	22	0.28	15	-0.26	35	-0.44	30	-0.15	15	0.81	10	-0.20	16	0.71	11	0.91	64
35NMFH	1.01	7	-0.53	41	-0.71	33	-0.16	19	0.64	10	-0.55	53	-0.38	24	-0.01	14	1.04	7	-0.08	15	0.88	8	0.90	67
35NMFJ	0.63	13	1.05	6	1.26	8	0.93	7	0.75	8	0.36	14	-0.34	19	0.29	11	1.05	6	0.61	7	1.69	1	0.96	51
35NMFK	0.09	20	1.95	1	1.57	5	1.19	4	0.60	12	0.88	4	1.06	3	1.05	3	0.30	18	1.12	4	0.45	16	1.08	3
35NMFL	-0.12	26	-0.37	33	-1.19	64	-0.55	37	-0.85	70	0.22	17	0.18	11	-0.28	17	0.17	19	-0.42	23	-0.10	31	0.94	60
35NMFM	-0.88	60	-0.44	38	-1.51	73	-0.87	66	-0.76	58	-1.12	69	-0.70	49	-1.01	69	-0.13	23	-0.94	76	0.01	27	0.92	62
35NMFN	0.36	14	-0.62	47	-2.25	79	-0.87	64	-0.07	18	-1.35	74	-0.31	17	-0.53	29	0.47	16	-0.70	46	0.13	23	0.89	68
35NMFP	-0.20	31	-0.74	52	-1.73	74	-0.87	65	-0.55	35	-0.74	61	-0.36	22	-0.64	32	0.79	11	-0.76	55	0.55	14	0.86	71
35NMFQ	0.80	11	1.36	5	2.19	2	1.38	2	1.25	4	0.85	6	0.42	8	1.05	4	1.13	5	1.22	3	1.47	3	1.01	34
35NMFR	1.53	3	0.54	10	1.74	4	1.14	5	1.51	2	-0.77	63	2.14	1	1.63	1	1.24	2	1.39	1	0.75	9	1.01	36
35NMFS	1.05	6	-0.11	23	-0.33	20	0.12	14	0.63	11	0.14	18	-0.03	13	0.34	10	1.24	3	0.23	12	1.02	6	0.91	63
35NMFT	1.33	4	-0.23	26	-0.44	22	0.11	15	0.85	7	-0.02	27	0.87	5	0.86	6	1.14	4	0.48	9	0.39	17	0.94	57
35NMFU	0.23	18	1.72	2	1.09	9	1.00	8	0.38	13	0.90	3	0.71	6	0.77	8	0.48	15	0.88	6	0.71	10	1.04	16
35NMFW	-1.36	74	-0.46	39	-2.20	78	-1.22	77	-1.06	77	-1.61	79	-1.09	70	-1.48	79	0.37	17	-1.35	79	0.62	13	0.83	72
35NMFX	-1.31	73	-0.28	30	-1.41	72	-0.89	69	-0.85	69	-0.01	26	0.98	4	0.06	13	0.61	13	-0.41	22	-0.35	36	0.91	65
35NNFA	-0.89	62	-0.88	64	-0.98	53	-0.84	62	-0.86	71	-0.04	30	-0.65	44	-0.76	48	-1.00	60	-0.80	61	-1.09	60	1.02	31
35NNFB	-1.00	66	-0.25	27	-0.23	16	-0.41	30	-0.77	60	0.14	19	-0.77	52	-0.73	45	-0.94	56	-0.57	35	-0.62	42	1.04	17
35NNFC	-0.56	44	-0.33	29	-0.91	47	-0.55	38	-0.72	52	-1.37	75	-0.77	53	-1.09	73	-0.26	25	-0.82	63	0.27	20	0.94	59
35NNFD	-0.56	45	-0.97	70	-1.68	76	-1.02	72	-0.96	74	-0.31	38	-0.50	36	-0.81	57	-0.95	55	-0.92	72	-1.17	65	1.00	41
35NNFE	0.11	19	-0.15	24	-0.88	43	-0.32	25	-0.56	37	-0.15	31	0.23	10	-0.20	16	-0.91	51	-0.26	17	-1.03	57	1.07	6
35NNFF	0.85	10	-0.34	31	0.15	13	0.15	12	0.33	14	-1.38	77	-1.17	71	-0.76	49	-0.58	32	-0.31	18	0.33	18	1.03	23
35NNFG	-0.81	55	-0.55	42	-0.72	34	-0.63	44	-0.61	41	-0.53	51	-0.82	56	-0.85	62	-0.35	27	-0.74	52	-0.13	33	0.96	53
35NNFH	-1.39	77	-1.12	77	-1.74	75	-1.30	78	-1.08	78	-0.39	43	-1.05	68	-1.16	76	-0.39	28	-1.23	78	-0.53	39	0.91	66
35NNFJ	-0.41	37	-0.94	66	-0.83	40	-0.70	51	-0.54	33	-0.77	64	-0.46	31	-0.69	40			-0.69	45				
35NNFK	-0.42	38	-0.60	44	-0.63	28	-0.51	36	-0.66	48	0.55	11	-0.31	16	-0.34	20	-1.00	58	-0.43	24	-1.07	58	1.07	7
35NNFL	-1.17	70	0.34	12	-0.74	35	-0.43	32	-0.70	50	-0.47	48	-1.42	77	-1.18	77			-0.80	62				
35NNFM	-0.97	65	-1.13	78	-0.60	25	-0.82	61	-0.66	47	0.87	5	-0.62	41	-0.42	23	-1.04	68	-0.62	40	-1.28	70	1.07	8
35NNFN	-1.25	71	-0.75	55	-1.22	65	-0.97	71	-0.81	64	0.11	20	-0.62	42	-0.69	41	-0.49	30	-0.83	64	-0.77	49	0.96	55
35NNFP	-0.23	33	-0.08	21	-1.28	67	-0.51	35	-0.88	72	0.59	9	-0.74	50	-0.66	35	-0.95	54	-0.59	37	-0.80	50	1.04	18
35NNFQ	-0.61	46	-0.07	19	-1.14	58	-0.56	39	-0.81	63	-0.95	67	-0.52	38	-0.90	64	-1.04	67	-0.73	50	-0.55	40	1.03	24
35NNFR	-1.36	75	-0.97	69	-1.28	68	-1.09	74	-0.99	75	0.64	8	-0.69	47	-0.68	38	-0.75	38	-0.88	67	-1.14	63	0.98	49
35NNFS	-0.81	56	-0.42	37	-0.92	49	-0.65	46	-0.41	28	-1.04	68	-1.47	78	-1.20	78	-0.58	33	-0.93	74	-0.04	29	0.96	52
35NNFT	-1.55	78	-0.74	56	-0.61	26	-0.84	63	-0.62	43	-0.46	47	-0.60	40	-0.72	44	-0.56	31	-0.78	58	-0.67	45	0.98	47
35NNFU	0.94	8	-0.01	17	-0.70	32	0.00	17	-0.26	21	-0.39	42	-1.15	69	-0.80	55			-0.40	20				
35NNFW	-0.72	50	-1.06	73	-0.62	27	-0.74	55	-0.62	44	0.50	12	-0.38	23	-0.38	22	-0.92	52	-0.56	33	-1.28	69	1.04	22
35NNFX	-0.15	30	-0.77	57	-0.29	19	-0.39	28	-0.31	23	-0.63	57	-0.96	63	-0.79	53	-0.33	26	-0.59	38	0.07	25	0.97	50
35NNFY	-0.74	52	-0.63	62	-0.66	29	-0.68	48	-0.57	38	-0.24	34	-1.26	73	-0.97	68			-0.83	65				
35NNFZ	-0.03	24	-0.35	32	-0.83	39	-0.40	29	-0.28	22	-0.22	33	-0.95	60	-0.67	36	-0.06	22	-0.53	31	0.21	21	0.95	56
35NNGA	-0.14	28	-0.10	22	-0.97	52	-0.39	27	-0.64	46	-1.19	73	-0.93	58	-1.08	72			-0.74	53				
35NNGB	-0.38	35	-0.95	67	-0.95	51	-0.73	54	-0.74	57	-0.26	36	-0.13	15	-0.50	26	-1.05	70	-0.61	39	-1.12	61	1.05	14
35NNGC	-0.10	25	-0.18	25	-0.90	46	-0.39	26	-0.42	30	-0.81	65	-1.26	76	-1.04	70	-0.51	29	-0.71	48	0.14	22	0.98	46
35NNGD	-1.36	76	-0.05	18	-1.06	59	-0.72	53	-0.85	68	-0.67	58	-1.00	66	-1.10	74	-0.82	43	-0.91	71	-0.44	37	0.99	42
35NNGE	-0.02	23	-0.68	49	-1.15	60	-0.61	41	-0.52	32	0.71	7	-0.47	32	-0.32	18	-1.03	63	-0.47	29	-1.32	71	1.06	10
35NNGF	-0.81	57	-0.79	58	-0.63	30	-0.68	49	-0.62	45	-0.53	52	-0.67	46	-0.78	52	-0.87	46	-0.73	51	-0.77	48	1.02	27
35NNGG	0.04	22	-0.28	28	-0.67	31	-0.31	24	-0.33	26	0.10	21	-0.86	55	-0.57	31	-0.92	53	-0.44	26	-0.65	44	1.05	13
35NNGH	-0.44	39	-0.99	71	-0.80	38	-0.71	52	-0.59	40	-0.64	54	-0.49	35	-0.70	43	-1.04	66	-0.70	47	-1.37	72	1.02	33
35NNGJ	-0.34	34	-0.77	54	-0.92	50	-0.65	45	-0.15	19	-0.33	40	-0.62	43	-0.46	24	-0.90	49	-0.56	34	-1.08	59	1.04	21

APPENDIX 7

Sample GP data

i. FHSA supplied

The following illustrates a sample of data supplied by the Northampton FHSA. Surgery location, GP availability, surgery hours, hours of consultation and catchment area are determined from the details. Data for all GP surgeries was obtained in this form.

GP's name:	WIJAYAWARDENA S		
Sex:	Male		
Qualifications:	MBBS DRCOG MRCOG		
Date of registration:	1972		
Partner's name:	J L. Bourdillon		
Surgery Address:	Health Centre, Brackley, Northants, NN13 6EJ		
Hours of surgery openings:	8.30-6.30	Mon-Fri	
	8.30-11.30	Sat (emergencies only)	
Disabled access Yes/No:	Yes		
Hours of usual attendance:	Mon	8.30-10.30	4.30-6.30
	Tues	8.30-10.30	4.30-6.30
	Wed	8.30-10.30	
	Thur	8.30-10.30	4.30-6.30
	Fri	8.30-10.30	4.30-6.30
	Sat	8.30-11.30	
By appointment:	Yes		
Services offered:	Maternity Medical		
	Obstetric		
	Contraceptive (own patients)		
	Contraceptive (other patients)		
	Child health surveillance		
	Minor surgery		
Clinics and their frequency:	Well person	monthly	
	Hypertension	monthly	
	Weight control	monthly	
	Hormone replacement	monthly	
	Diabetic	monthly	
	Asthma	monthly	
	Antenatal	weekly	
Details of other staff:	1 Practice Manager		
	Receptionists/Secretaries		
	4 Treatment Room Nurses		
	1 District Nurse		
	1 Health Visitor		
Languages spoken:	English; Singhalese		
Clinical interests:	Obstetrics; Gynaecology; Family Planning; Paediatrics		
Practice area radius:	Ten miles		

ii. NDHA supplied

The following illustrates a sample of data supplied by the Northampton DHA. Total list size is determined from the details as well as breakdowns indicating proportions of patients in certain age groups and the proportion of patients from other DHAs. Data for all GP surgeries was obtained in this form.

Dr. Wijayawardena & Bourdillon

Patients age 64 & under				Patients age 65-74				Patients age over 75				
BU	NO	OX	TOTAL	BU	NO	OX	TOTAL	BU	NO	OX	TOTAL	GRAND TOTAL
83	2605	116	2804	2	266	14	282	2	199	5	206	3292

where: BU = Patients resident in Buckingham DHA
NO = Patients resident in Northampton DHA
OX = Patients resident in Oxford DHA

APPENDIX 8

Indicator comparison analyses

Page

i. Matrix of indicator scores

Colour legend
Rank 1-16
Rank 17-32
Rank 33-48
Rank 49-64
Rank 65-79

Indicators are ranked in descending order with higher values (increased disadvantage) being ranked 1.

WARD	Disadvantaged Demand	RANK	Jarman UPA	RANK	Townsend	RANK	Index of Local Conditions	RANK	Young Persons Support Index	RANK
35NMFR	1.39	1	39.06	1	9.18	1	12.05	1	5195.10	4
35NMFE	1.30	2	32.20	3	8.22	2	9.39	3	10680.10	2
35NMFQ	1.22	3	19.53	5	7.49	3	4.33	4	5842.40	3
35NMFK	1.12	4	20.60	4	6.38	4	2.26	5	11471.70	1
35NMFD	1.08	5	34.51	2	6.06	5	11.54	2	1736.30	9
35NMFU	0.88	6	14.91	8	4.03	9	-0.50	9	4513.60	6
35NMFJ	0.61	7	16.24	7	5.54	6	1.84	6	4743.60	5
35NMFA	0.57	8	12.04	11	3.88	10	0.00	8	-350.70	50
35NMFT	0.48	9	17.13	6	3.02	13	-3.56	14	-120.90	22
35NMFF	0.35	10	12.24	10	4.42	8	1.02	7	655.70	11
35NMFB	0.29	11	14.36	9	3.61	12	-3.46	13	2522.00	7
35NMFS	0.23	12	10.69	12	2.28	17	-2.14	10	-107.50	21
35NJFR	0.15	13	6.81	13	3.80	11	-3.11	12	1813.20	8
35NJFA	-0.03	14	4.29	15	2.70	14	-2.72	11	725.10	10
35NMFH	-0.08	15	4.98	14	1.90	18	-5.92	18	-318.80	45
35NMFG	-0.20	16	1.99	18	0.47	29	-8.51	44	-58.00	15
35NNFE	-0.26	17	3.57	16	0.03	34	-11.15	74	48.40	13
35NNFF	-0.31	18	-8.09	26	0.31	30	-4.73	16	-526.90	64
35NJFM	-0.35	19	-5.41	22	2.57	15	-8.77	48	-78.30	19
35NNFU	-0.40	20	2.77	17	0.27	31	-6.53	22	63.00	12
35NJFK	-0.41	21	-20.82	63	1.57	20	-6.92	25	-69.10	17
35NMFX	-0.41	22	-9.03	29	4.83	7	-10.29	65	-1018.70	72
35NMFL	-0.42	23	-3.24	21	-1.30	55	-14.44	79	-1359.10	77
35NNFK	-0.43	24	-11.78	39	-1.77	65	-9.24	59	-400.00	56
35NJFZ	-0.44	25	-11.93	40	1.72	19	-8.07	34	-77.00	18
35NNGG	-0.44	26	1.82	19	0.75	24	-9.13	56	-842.30	71
35NJFG	-0.45	27	-6.77	23	1.22	21	-5.74	17	-55.40	14
35NNGE	-0.47	28	-19.21	59	-2.57	77	-7.04	27	-202.80	33
35NJGA	-0.47	29	-16.38	50	-2.52	76	-6.80	24	-238.60	39
35NJFY	-0.49	30	-17.82	55	-2.42	74	-6.35	20	-274.90	43
35NNFZ	-0.53	31	-24.99	72	-0.50	41	-7.01	26	-159.10	27
35NJGB	-0.56	32	-0.36	20	-0.09	35	-7.22	30	-145.20	26
35NNGJ	-0.56	33	-17.74	54	0.65	26	-8.36	39	-219.30	37
35NNFW	-0.56	34	-20.57	62	-1.20	54	-9.00	52	-360.40	53
35NNFB	-0.57	35	-18.78	57	0.15	32	-6.11	19	-202.80	32

table continued...

WARD	Disadvantaged Demand	RANK	Jarman UPA	RANK	Townsend	RANK	Index of Local Conditions	RANK	Young Persons Support Index	RANK
35NNFX	-0.59	36	-24.89	71	-1.64	62	-7.43	32	-78.40	20
35NNFP	-0.59	37	-7.91	25	-0.48	40	-8.70	47	-310.60	44
35NMFC	-0.59	38	-14.11	46	0.60	27	-10.44	67	-1072.70	73
35NNGB	-0.61	39	-10.21	34	-1.89	69	-11.67	75	-511.20	61
35NNFM	-0.62	40	-17.70	53	-0.74	44	-9.17	57	-144.50	25
35NJFB	-0.64	41	-10.62	36	0.53	28	-8.17	36	-208.50	35
35NJFQ	-0.64	42	-22.03	66	-0.84	46	-7.16	28	-256.60	41
35NJGC	-0.67	43	-29.54	76	-0.62	42	-7.19	29	-203.50	34
35NJFS	-0.67	44	-20.22	60	-0.66	43	-10.33	66	-547.10	66
35NNFJ	-0.69	45	-16.74	51	2.29	16	-6.73	23	-260.40	42
35NNGH	-0.70	46	-21.53	65	0.15	33	-8.78	49	-324.00	47
35NMFN	-0.70	47	-11.53	38	-1.68	64	-11.14	73	-1330.20	76
35NNGC	-0.71	48	-10.58	35	-0.24	38	-8.70	46	-61.70	16
35NJFT	-0.72	49	-9.21	31	-1.00	51	-10.80	71	-763.00	70
35NNFQ	-0.73	50	-9.61	32	1.07	23	-8.97	51	-325.30	48
35NNGF	-0.73	51	-29.83	77	-1.18	53	-8.11	35	-390.80	54
35NNGA	-0.74	52	-8.70	27	-0.90	48	-8.28	38	-235.00	38
35NNFG	-0.74	53	-13.78	45	1.20	22	-8.50	43	-577.50	67
35NJFH	-0.76	54	-7.25	24	-1.45	59	-9.08	54	-1152.80	74
35NMFP	-0.76	55	-12.22	41	-1.41	57	-13.31	78	-1770.10	78
35NJFF	-0.77	56	-23.43	67	-2.36	73	-9.05	53	-210.30	36
35NJFC	-0.77	57	-11.14	37	-3.55	79	-9.64	63	-522.20	62
35NNFT	-0.78	58	-20.31	61	0.71	25	-7.34	31	-137.40	24
35NNFA	-0.80	59	-9.09	30	-0.92	50	-9.50	62	-187.40	29
35NJFN	-0.80	60	-15.99	48	-1.78	67	-6.45	21	-238.90	40
35NNFL	-0.80	61	-13.02	42	-0.25	39	-9.75	64	-594.40	68
35NJFL	-0.80	62	-13.46	44	-1.97	71	-9.09	55	-620.80	69
35NNFC	-0.82	63	-21.20	64	-0.21	36	-4.54	15	-185.00	28
35NNFN	-0.83	64	-17.34	52	-1.42	58	-10.46	68	-325.80	49
35NNFY	-0.83	65	-9.01	28	-0.23	37	-10.64	69	-421.80	57
35NJFW	-0.84	66	-19.18	58	-1.77	66	-8.45	41	-188.50	30
35NNFR	-0.88	67	-27.73	75	-1.45	60	-9.49	61	-194.00	31
35NJFE	-0.89	68	-30.67	79	-2.48	75	-8.65	45	-319.10	46
35NJFX	-0.90	69	-25.02	73	-1.65	63	-10.78	70	-523.50	63
35NJFJ	-0.91	70	-24.02	69	-1.34	56	-8.82	50	-135.30	23
35NNGD	-0.91	71	-16.06	49	-2.04	72	-9.30	60	-351.70	51
35NNFD	-0.92	72	-15.30	47	-0.79	45	-10.91	72	-504.20	60
35NNFS	-0.93	73	-13.21	43	-0.91	49	-7.54	33	-356.90	52
35NJFP	-0.93	74	-24.09	70	-0.84	47	-8.48	42	-435.30	58
35NJFU	-0.94	75	-18.13	56	-1.16	52	-8.42	40	-470.40	59
35NMFM	-0.94	76	-10.01	33	-1.82	68	-13.14	77	-1180.90	75
35NJFD	-1.21	77	-25.08	74	-3.14	78	-9.22	58	-394.90	55
35NNFH	-1.23	78	-30.18	78	-1.56	61	-8.25	37	-526.90	65
35NMFW	-1.35	79	-23.52	68	-1.93	70	-11.81	76	-2510.10	79

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