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**RESEARCH ON THE 1991 CENSUS  
CONFERENCE HELD AT THE UNIVERSITY  
OF NEWCASTLE UPON TYNE  
13 – 15 SEPTEMBER 1993  
A REPORT**

Tony Champion, University of Newcastle upon Tyne  
Philip Rees, University of Leeds

**WORKING PAPER 93/21**

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***RESEARCH ON THE 1991 CENSUS***

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**A REPORT**

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## **CONTENTS**

- 1. OVERVIEW**
- 2. THE CONFERENCE PROGRAMME**
- 3. THE CONFERENCE SESSIONS**
  3. 1 Deprivation
  3. 2 Social analysis: techniques and data
  3. 3 Plenary session on Census coverage
  3. 4 Migration and the labour market
  3. 5 Religion and ethnicity
  3. 6 Housing and cities
  3. 7 Local authority research
  3. 8 Plenary session on Census geography
  3. 9 Samples of anonymised records
  - 3.10 Urban-rural change
  - 3.11 Closing plenary session on data and dissemination
- 4. ABSTRACTS**
- 5. ADDRESSES**

## **PREFACE**

This document has been prepared as a report to the organisations which sponsored the Conference in kind and in cash, but is being made more widely to the Census User community. The papers presented will be published in a variety of outlets. Hence this report provides a resource which readers can use to obtain pre-publication copies of papers of interest or to contact paper presenters for further information.

The Conference would not have taken place without all the hard work of the Census Offices in carrying out, in processing the 1991 Census and in distributing the results to users in the academic, local authority, health service, commercial and other sectors. Our particular thanks are due to Eric Thompson and Chris Denham of the Office of Population Censuses and Surveys.

The Census data would not have reached academic community users without the considerable investment of the Economic and Social Research Council and the Joint Information Systems Committee (of the Higher Education Funding Council) in data purchase and dissemination via its 1991 Census of Population Programme. The ESRC Census Dissemination Unit at the University of Manchester played a particularly important role in providing online access to the Small Area Statistics/Local Base Statistics. The Conference received a generous subvention from the funds provided by ESRC to the Census Analysis Group (Grant A507265004), which made the conference accessible to a wider audience.

Our thanks are due to the representatives of the participating associations: Eric Thompson for the British Society for Population Studies, Peter Brown for the Regional Science International, British Section and John Stillwell for the Population Geography Study Group of the Institute of British Geographers. Many staff at the Universities of Newcastle and Leeds helped in the production: to Brian Allaker, Ann Rooke, Sheila Spence and Maureen Rosindale our thanks.

Tony Champion

Phil Rees

## 1. **OVERVIEW**

This conference took place on 13-15 September 1993 at Henderson Hall, Newcastle upon Tyne. It was organised by the Department of Geography at Newcastle University jointly with the British Society for Population Studies, the IBG Population Geography Study Group, the Regional Science Association International British Section and the ESRC-funded Census Analysis Group. Its primary aim was to bring together those working at the coalface of Census research, so that they could discuss together their results so far, the problems which they have encountered and how they have been tackling them.

On a range of quantitative criteria, the conference can be reckoned to have achieved its objectives. In all, attendance numbered around 140, partly thanks to the excellent publicity given by the various Newsletters and through the Census Users E-mail list but also no doubt attracted by the very low conference fee which was made possible by a £1500 grant from the Census Analysis Group and by the fact that speakers paid for themselves. Participants were drawn from a range of sources including academic institutions, local government, health authorities, one or two central government departments, and the Census Offices themselves. A total of 41 papers were presented, eight in three plenary sessions but the majority in pairs of concurrent sessions.

What people will have got out of the conference will have depended on their specific interests and expertise. From our personal points of view, the conference provided a good insight into the range of opportunities and challenges which the 1991 Census has opened up. Particularly impressive is the much larger wealth of data resulting from the extra Census questions and the more extensive cross tabulations in the SAS/LBS, which are already providing new insights. On the other hand, there is uncertainty over the likely effects of underenumeration and imputation, and many as yet unresolved questions over data quality, including the geographical referencing and boundary files.

From feedback received, one of the most important aspects was the high degree of interaction between participants - perhaps to be expected in a residential meeting with late bar extensions, but no doubt aided by the remote location of the site and the torrential rain dropped by a not-so-fading hurricane. One feature which I found rather worrying, however, was the frequency with which criticisms of papers were countered with the response that what was being suggested was not what the researchers' "clients" wanted - perhaps as clear a sign of the impact of the

market-oriented 1980s as any provided by Census analyses of 1981-91 change!

The body of the report gives further information on the conference. Section 2 summarises the Conference programme for easy reference. Section 3 is composed of profiles of the individual sessions (in programme order) as seen by their chairpersons who were asked to highlight what they saw as the main contributions or points of contention of their sessions - our thanks to them for the extra effort which this has involved for them! The whole comprises a rather more lengthy report than is normal for such meetings, but it is provided for the benefit of participants who were attending 'the other session' as well as those who were not able to be there at all.

For the record, no single set of conference papers is being produced, but a number of separate publishing outlets are being investigated - a task being co-ordinated by Phil Rees on behalf of the Census Analysis Group. However, section 4 provides a consolidated collection of paper abstracts which give more details of the papers presented, and section 5 lists the addresses of paper presenters and other participants, so the interested reader can contact authors for paper copies.

Research on the 1991 Census

The Conference Programme

2. *THE CONFERENCE PROGRAMME*

**Monday 13 September**

2.00-5.45 Parallel Session 1

**1A: DEPRIVATION (Chair: Ian Diamond)**

Michael Bradford

"Constructing an Urban Deprivation Index"

Alexander Hirschfield

"Using the Population Census to study deprivation"

Peter Lee

"Using the Census to study the development of an underclass"

Hugh Davies, Lynda Clarke and Heather Joshi

"Is it cash the deprived are short of?"

**1B: SOCIAL ANALYSIS - TECHNIQUES AND DATA**

(Chair: Peter Brown)

Ian Bracken and David Martin

"Surface representation of social change, 1981-1991"

Daniel Dorling

"Visualising changing social structure from the Census"

Kelvyn Jones, Graham Moon and Craig Duncan

"Modelling ecologies: the multilevel model as a general framework for analysing census data"

David Atkins

"Linking the 1981 and 1991 Censuses"

Vaughan Galt, Edmund Snelling and Sue Hallam

"Creation of City Challenge Baseline Data Sets"

7.30-9.00 Plenary Session A

**CENSUS COVERAGE AND QUALITY (Chair: Tony Champion)**

Ian Diamond

"Who and where are the 'missing million'?"

Steve Simpson

"Measuring and coping with local under-enumeration"

Tuesday, 14 September

9.00-12.45 Parallel Session 2

**2A: MIGRATION AND THE LABOUR MARKET**  
(Chair: Tony Fielding)

John Stillwell, Oliver Duke-Williams and Philip Rees  
"The spatial patterns of British migration in 1991  
in the context of 1981-91 trends"

Paul Boyle  
"Migration patterns in England and Wales: modelling  
flows at the district level"

Tony Warnes and Reuben Ford  
"A synthesis of Census and survey evidence on  
migration and the differentiation of old age in  
Great Britain"

Anne Green  
"Alternative measures of unemployment"

Suzanne New and Derek Bosworth  
"The impact of domestic relationships on the hours  
of work of young people: a case study of the use of  
the Samples of Anonymised Records"

**2B: RELIGION AND ETHNICITY** (Chair: John Haskey)

Malcolm Macourt  
"Religion in the Northern Ireland Census"

Charlie Owen  
"Mixed ethnic origin: the use of commissioned  
tables"

David Owen  
"Spatial variations in ethnic minority populations  
in Great Britain"

Philip Rees, Deborah Phillips and Dominic Medway  
"The socio-economic position of ethnic minorities in  
two Northern cities"

David Stott  
"Ethnic differences in limiting long-term illness  
reporting: a case study of South Bedfordshire"

2.00-5.45 Parallel Session 3

**3A: HOUSING AND CITIES** (Chair: Tony Warnes)

Angela Dale, Keith Cole, Brian Dodgeon and Malcolm Williams  
"Changes in housing tenure 1971, 1981 and 1991"

Alan Murie and Ya Ping Wang  
"Changes in Council Housing Estates in Edinburgh in  
the 1980s"

Peter Brown and Alexander Hirschfield  
"Profiling housing need in Wales: a census-based  
analysis"

Clive Morphet and Michael Barke  
"Analysing 1981-1991 change of the city of  
Newcastle: some results and a review of some of the  
methodological and technical problems"

Ron Blake  
"Towards a new typology of Census Small Areas,  
incorporating land-use data"

**3B: LOCAL AUTHORITY RESEARCH** (Chair: John Hollis)

Eileen Howes  
"The 1991 Census: Managing the London Consortium"

Simon Ellis  
"The Census Programme of Lothian Regional Council"

Andy Bates  
"Evaluation of Local Authority non-census 1991  
population estimates by comparison with the Census:  
methodological problems and some results"

Jan Howard  
"Concern about Buckinghamshire's 1991 mid-year  
estimates"

7.30-9.00 Plenary Session B

**CENSUS GEOGRAPHY** (Chair: Phil Rees)

Robert Barr  
"Census data handling in the US and the UK - a  
comparative review"

Alex Clark  
"OPCS Geography in the 90s"

Mike Coombes  
"Placing changes within changing places: responses to changing census geography"

9.00-10.45 Parallel Session 4

**4A: SAMPLES OF ANONYMISED RECORDS** (Chair: Kelvyn Jones)

Elizabeth Middleton  
"Problems of harmonising UK-wide Samples of Anonymised Records"

Ian Turton and Stan Openshaw  
"A UNIX-based diffusion package for accessing the 1991 Sample of Anonymised Records"

Paul Williamson and Mark Birkin  
"The simulation of whole populations using data from the small area statistics, samples of anonymised records and national surveys"

**4B: URBAN-RURAL CHANGE** (Chair: John Stillwell)

Tony Champion and Daniel Dorling  
"Population change for Britain's Local Labour Market Areas, 1951-91"

Andrea Hickingbotham and Alan Strachan  
"Charting counterurbanisation: the case of Powys"

11.15-1.00 Plenary Session C

**DATA AND DISSEMINATION** (Chair: Eric Thompson)

Angela Dale, Rosemary Creeser, Brian Dodgeon and Simon Gleave  
"The OPCS Longitudinal Study"

Keith Dugmore  
"Census Statistics: Demand and Dissemination - 1981, 1991 and 2001"

Paul Williamson, Philip Rees and Mark Birkin  
"A metadatabase of census variables and tables"

### 3. THE CONFERENCE SESSIONS

This section of the report provides a summary of paper contributions and discussion points. The summaries were provided by Session Chairpersons.

#### 3.1 *Deprivation (Chair: Ian Diamond)*

This session opened with a paper by Michael Bradford, Brian Robson and Rachel Tye (Manchester) who described work for the Department of the Environment in which they had calculated a new urban deprivation index. They highlighted the need to distinguish between areas which had a widely spread deprived population and those with small areas of high deprivation. Using a signed  $\chi^2$  approach, the index was based on data both from the Census and from sources such as large-scale surveys. Indices were prepared at ED, ward and local authority levels.

Next, Alexander Hirschfield (Liverpool) presented an overview of the important issues which need to be considered in studying deprivation. He highlighted the need to consider the relationship between deprivation and other concepts such as poverty and inequality. He then described the pros and cons of 1991 Census data for the construction of deprivation indices.

On a different note, Peter Lee (Heriot-Watt) described the current debate about whether the 1980s had seen the emergence of an underclass, who were detached from much of society. He explained that while there was an overlap between poverty and the underclass, they were not the same thing. He explained how Census data were likely to be used to analyse the characteristics of an underclass, but in many cases they were not the most appropriate source.

Finally, Heather Joshi, Hugh Davies and Lynda Clarke (London School of Hygiene and Birkbeck College) presented a paper which used data from the GHS and FES to examine whether typical Census indicators were good predictors of income. They presented a number of regressions using both continuous and binary dependent variables which showed that reasonably good predictions could be made using region, car access, housing tenure, unemployment and skill level. There was a clear potential for using this work to identify the most appropriate Census indices for different types of deprivation.

#### 3.2. *Social analysis: techniques and data (Chair: Peter Brown)*

This session comprised five papers: Ian Bracken (Cardiff) and David Martin (Southampton) on the surface

representation of social change, 1981-1991; Daniel Dorling (Newcastle) on visualising changing social structure from the Census; Kelvyn Jones, Graham Moon and Craig Duncan (Portsmouth) on the multilevel model as a general framework for analysing Census data; David Atkins and Daniel Dorling (Newcastle) on linking the 1981 and 1991 Censuses; and Vaughan Galt, Edmund Snelling and Sue Hallam (Nottingham Trent) on the creation of City Challenge baseline datasets.

A significant feature of three of these contributions was the evidence which they provided of the scope that now exists to employ powerful computational methods to achieve dramatic visualisation effects. Although directed towards different objectives, the surface representation and cartogram approaches create vivid and colourful images which convey a striking impression of the scale and extent of variation in population characteristics. These methods provide a means of literally revealing, for the first time, the complexity of the spatial and other patterns that are present in the data.

Efforts to apply these methods, especially in the analysis of change between 1981 and 1991, have highlighted some of the shortcomings in the accuracy or reliability of the spatial referencing of 1991 EDs in the SAS. Concern was expressed at the extent of the errors present in SAS ED header record grid reference data.

It was also clear from this session that the multilevel modelling approach promises to provide a useful means of representing the contribution that is made to explaining variation in behaviour, or patterns of social structure, by simultaneous reference to information relating to different levels of specification.

### 3.3. Plenary session on Census coverage (Chair: Tony Champion)

This session tackled what, to most users, is likely to constitute the most worrying feature of the 1991 Census - the fact that, for the first (known) time, the Census suffered from significant net underenumeration, "the missing million" of England and Wales or around 2% (over four times the net undercount in 1981). Ian Diamond (Southampton) tackled the all important question of "who and where?", while Steve Simpson (City of Bradford) went into more detail about how to measure and cope with the undercount's effects.

As the presentations progressed, the scale and nature of the challenge unfolded. The equivalent of well over half the missing million were also missed by the subsequent Census Validation Survey, so nothing at all is known about their characteristics or location: could it safely be

assumed that they were similar to the people that the CVS did manage to discover? Comparison with the results of rolling forward from the 1981 Census provides some indication of the likely sex and age of those missing at national level, but given the known weaknesses of the NHSCR data in following the movements of young adults (particularly males), how confidently can the detailed geography of those missing in 1991 be estimated? The importance of these questions was demonstrated by reference to a number of characteristics which vary markedly by age such as unemployment, ethnic composition and limiting long-term illness, with Steve Simpson showing the effect of adjusting the basic Census counts using raising factors to allow for the undercount.

'All very worrying' was indeed the tenor of the discussion; and this is before the appearance of the detailed results of the 1991 Census Validation Survey which will provide confidence limits on the answers to individual questions. And yet, as pointed out by OPCS, the 1981 SAS omitted a similar number of people who were members of 'wholly absent households': how many users were seriously worried by this? Or by the fact that the 1981 Post Enumeration Survey indicated error rates of up to 30% on individual questions? But there is a potentially significant difference in 1991: along with the imputed population, there is a real sample of only 95% of the population in the SAS and on which to draw for the SAR and LS. This issue will probably run for longer this time a round than it did after the 1981 Census.

### 3.4 *Migration and the labour market (Chair: Tony Fielding)*

This session contained five papers. The first, by John Stillwell, Oliver Duke-Williams and Philip Rees (Leeds), examined spatial patterns of British migration in 1991 in the context of 1975-92 trends. Drawing mainly on the NHSCR dataset, this highlighted the 'sea-change' in North/South migration towards the end of the 1980s, the decrease in child migration and the increase (until 1990-92) in those of the elderly. The bad news was that the correlation between the NHSCR and Census data in 1990/91 is lower than for 1980/81.

Paul Boyle (Swansea) described the results of a novel approach involving the classification of districts on the basis of their migration characteristics. When mapped, the results proved very interesting, especially the 'service class suburban/rural interface', and growth rates were also calculated for the various migration types identified.

Much of the discussion on the paper by Tony Warnes and Reuben Ford (Kings College London) focused on the lack on an increase in mobility at retirement. Clearly the

patterns of migration in 1990-91 were being affected by the peculiarities of the housing market at that time. Their Migration in Later Life Study can help to dispel myths about the migration of the very elderly.

On the labour-market theme, Anne Green (Warwick) investigated alternative measures of unemployment. She looked closely at the differences between the claimant-based figures produced by the Employment Department and those based on the Census. Taking into account the degree and nature of underenumeration in the Census (especially high for young adult males in urban areas), 'true' Census-based unemployment in 1991 was nearer 3.0 million than the 2.1 million recorded by the ED.

The paper by Suzanne New and Derek Bosworth (Manchester) provided their very first insights into using the Samples of Anonymised Records, having received the corrected datasets only six days before the conference.

### 3.5. Religion and ethnicity (*Chair: John Haskey*)

Malcolm Macourt (Northumbria) began this session by giving a fascinating account of the background and history of the question on religion in the Northern Ireland Census from its introduction in 1861 and by examining the form of wording of the question in the latest three Censuses. He then presented preliminary estimates of the Catholic and Protestant populations in 1991 using an imputation method for non-respondents. He emphasised the need for care in interpreting the answers to the religious question and drew comparisons with the situation for the ethnic question in Great Britain.

The second paper, by Charlie Owen (Thomas Coram Institute), dealt with the phenomenon of mixed ethnic origin. He gave examples of the persistence of strong disapproval towards mixed marriages over the centuries but presented evidence of a more tolerant attitude in recent decades. Data from the Labour Force Survey showed that those of mixed ethnic origin account for 12 per cent of the total ethnic minority population, and have much younger age profiles. He described plans for acquiring and analysing corresponding data from the 1991 Census.

David Owen (Warwick) described the geographical spread of the different ethnic groups and, using cluster analysis of wards by a range of socio-economic indicators, demonstrated the dramatic contrasts between the different ethnic groups in the types of areas in which they live. He then considered several measures of segregation and concluded that the isolation of ethnic minority populations tends to be most marked in northern and midland towns and cities.

A paper by Philip Rees, Deborah Phillips and Dominic Medway (Leeds) dealt with the socio-economic position of ethnic minorities in two northern cities. It outlined a new methodology for estimating the ethnic minority populations in wards in 1981 so that 1981-91 changes could be examined. This was then applied to the wards of Leeds and Bradford, leading to a comprehensive analysis of the location, change, spatial distribution, and a variety of socio-economic characteristics of the ethnic minority populations living in the two cities.

The final paper in the session was by David Stott (University of Luton) and entitled "Ethnic differences in limiting long-term illness reporting: a case study of South Bedfordshire". He began by giving a profile of the ethnic population in the study area and presenting crude LLTI reporting rates by sex and ethnic group. He then used indirect standardisation to allow for the different age distributions of the various ethnic minority populations. The results revealed wide differentials between groups, with only the White and Chinese populations having below-average standardised ratios. A number of interesting differences between the standardised ratios for the two sexes were reported and discussed, which led to some valuable comments on interpreting answers to the LLTI questions in the Census.

### 3.6 *Housing and cities (Chair: Tony Warnes)*

The five diverse papers in this session emphasised data resources, conceptual difficulties and methodological issues. Three were specifically on housing. That by Angela Dale, Keith Cole, Brian Dodgeon and Malcolm Williams (Manchester and City) on "Changes in housing tenure 1971, 1981 and 1991" anticipated the addition of 1991 Census records to the OPCS Longitudinal Study, its value for analysis of housing and household change, and some pitfalls of change analysis.

A paper Alan Murie and Ya Ping Wang (Heriot-Watt) examined the utility of the Census housing variables and presented results of a study of social change during the 1980s on Edinburgh's council estates (morphologically rather than tenurially defined). The headlines here were that 'council house sales' had disturbed general social trends little, but that a process of differentiation - perhaps polarisation - could be seen.

Peter Brown (Liverpool) reported on work which he had carried out with Alexander Hirschfield for Housing for Wales involving the development and mapping of detailed housing indices. Clive Morphet (Northumbria) summarised the results of work with Mike Barke on the development of maps of change in deprivation during 1981-91 at the local

scale within the City of Newcastle, while Ron Blake (Nottingham Trent) argued the case for consideration of land-use data in local population studies.

### 3.7 Local authority research (*Chair: John Hollis*)

In this session four papers examined aspects of the research being carried out on the Census by local authorities. Eileen Howes (London Research Centre) reported on managing the London Consortium. She said that, owing to the problems with imputation and undercounting in the Census, she was advising users needing simple age-sex information to use the mid-year estimates where appropriate but to use the Census for ratios, indicators and percentages. There was debate about the approach which a county takes in looking after its districts: some merely passed on the data, while others ran a complementary programme of research and publication. Difficulties were noted in dealing with the Voluntary Sector, who could not afford to pay much for a service and who often used non-standard 'catchment areas'. Here the advice was to prepare standard profiles at ward level and distribute them in answer to queries.

Simon Ellis (Lothian Regional Council) reported on the use of Output Area data and the relationships between migrants, imputed population and unemployment at this scale compared to results at broader spatial scales. In the discussion it was pointed out that the 10% data will be virtually unusable at OA level since the sample was drawn at the ED level. But there was general agreement that the OA level could highlight local features and was less diluted by the mixing of different areas that occurred at ED level.

Andy Bates (Hampshire County Council) explained that his particular interest, arising from his work with the project 'Estimating with Confidence', was to develop accurate statistics for the 1991 population in order to evaluate the reliability of the 1981-based projections and the non-census 1991 population estimates made by local authorities. This included reference to experience of how to use an Enhanced Electoral register, in concert with Census data, to prepare reliable local estimates.

Jan Howard (Buckinghamshire County Council) voiced his concern about Buckinghamshire's 1991 mid-year estimates and generated much discussion on methodology to improve raw Census data to prepare accurate estimates. For instance, what is the best level at which to use gender ratios in order to overcome the problems of differential enumeration? Local knowledge helps to interpret data at district level, but it is doubtful whether this can be extended to smaller areas. Potential solutions discussed included: a larger Census Validation Survey (discounted as too expensive),

ethnographic studies (too uncertain), more information on FHSA registers and migrants (work proceeding and quite promising), and methods which were clustered on authorities with particular issues in mind (should be helpful).

3.8 *Plenary session on Census geography (Chair: Phil Rees)*

The past, present and future of Census geography were debated in this evening session. Bob Barr (Manchester) provided a challenging comparison of US and UK practices, and invited us to envy the very low cost provision of both small-area data and the associated digital geography of the US Bureau of the Census.

Alex Clark (OPCS, Titchfield) reviewed the planning that was already beginning for the geography of the 2001 Census. Currently, a wide range of options were on the table. These ranged from no change to current practice through the use of EDs for collection, postcode areas for output, or use of postcode areas for collection and output to a full address-based system with the possibility of a postal Census. Census users were invited to relay their comments to OPCS either directly or via the ESRC Census Programme Coordinator (Phil Rees, Leeds).

Mike Coombes (CURDS, Newcastle) reviewed the need for and difficulties in achieving comparable geography over successive Censuses. He identified the tension between the continually changing 'tight' definitions of Urban Areas and Travel to Work Areas and the more stable geography of Local Labour Market Areas. Ensuing discussion identified the need to resolve issues of confidentiality and differencing so that flexibility in output areas could be achieved in future to satisfy the legitimate but conflicting demands of different groups of users.

3.9 *Samples of Anonymised Records (Chair: Kelvyn Jones)*

A novel feature of the 1991 Census is the availability of individual Census information in the SARs. This session consisted of three papers that examined the content, dissemination and use of the SARs. Elizabeth Middleton (Census Microdata Unit, Manchester) discussed the problems of producing a UK-wide set of information, focusing attention on differences between the mainland and Northern Ireland in terms of questions, coding, definitions and processing. Ian Turton and Stan Openshaw (Leeds) provided an overview of their UNIX-based package for accessing the SARs. This aims to be fast and comprehensive, with considerable value-added functionality and capacities for data exploration, and will have uses quite generally in survey analysis. The third paper by Paul Williamson, Mark Birkin and Phil Rees (Leeds) outlined the genetic algorithm

approach to the local estimation of income using GHS, FES and SAR datasets.

### 3.10 *Urban-rural change (Chair: John Stillwell)*

The two papers in this session both gave most attention to population change over 1971-81-91. That by Tony Champion and Daniel Dorling (Newcastle) demonstrated that population concentration still dominates the geography of Britain's Functional Regions despite continuing evidence of urban-rural shifts during the 1980s. Discussion points included the reasons for London's 1% growth between 1981 and 1991 and the value of a new double classification of Local Labour Market Areas according to the proportions of their workforce in different SEGs and to changes in these proportions since 1981.

The paper by Andrea Hickingbotham and Alan Strachan (Leicester) focused more specifically on counterurbanisation in Powys, representing one element of a suite of materials being assembled as part of the 1991 Census Training Initiative. Whilst audience response was positive in terms of the value of this resource, particularly to students undertaking dissertations, it was suggested that great care should be taken in ensuring adequate description of handling data from three Censuses in terms of the definition of the variables and areas used and in the interpretation of the results.

### 3.11 *Closing plenary session on data and dissemination (Chair: Eric Thompson)*

Three papers were presented in this final session: Angela Dale, Rosemary Creeser, Brian Dodgeon and Simon Gleave (City University) on the OPCS Longitudinal Study; Keith Dugmore (MVA Systematica) on "Census Statistics: Demand and Dissemination - 1981, 1991 and 2001"; and Paul Williamson, Philip Rees and Mark Birkin (Leeds) on a metadatabase of census variables and tables.

A key point of the first paper was the value of Census data in measuring change over time. The LS provides an excellent way of using data linked at the individual level from the 1971, 1981 and (soon!) 1991 Censuses - plus related demographic information collected by OPCS. Like the new SARs, the LS supplements the now-traditional SAS analyses, and users need to ensure the best combination is employed.

Census data use seems to have grown exponentially over the last three decades, but areas for further growth were identified. The very increase in output makes it difficult to find what is available, so there was an enthusiastic response to metadatabase work being done at Leeds. In the

Research on the 1991 Census

The Conference Sessions

commercial sector, Census data use seems correlated with competitive pressure, and the privatisation (and subdivision) of public utilities could mean particularly rapid growth there. Better boundary definitions - a common theme at the conference - would also facilitate increased use of Census data.

There was general agreement that this had been a very successful conference, and the major contribution which Tony Champion had made to this was greatly appreciated.

#### 4. **ABSTRACTS**

The abstracts are arranged in alphabetical order of the first named author.

**David ATKINS & Daniel DORLING (Newcastle University)**

#### **Linking the 1981 and 1991 Censuses Spatially**

This paper describes the work undertaken at Newcastle to link the 1981 and 1991 censuses at the smallest level of geographical detail possible. Unlike 1981, the 1991 census is not being linked to its predecessor by OPCS to provide comparable small area statistics. The many boundary changes since 1981 mean that comparisons for large geographical areas, such as local authority districts and even some whole counties, can be flawed due to their changing geographical extents. At higher geographical resolutions, and for less standard areas, simple comparisons becomes impossible. For instance, many local government wards have had their boundaries or names changed, disappeared or been newly created since the last census was held. Alternative geographical units, such as travel to work areas or parliamentary constituencies, are usually defined in terms of 1981 wards for change analysis and so for them also, comparable statistics for a fixed geography are not officially available.

The solution attempted here was to aggregate all the 1991 census data from the enumeration district and output area level into the digitized boundaries of 1981 wards (and part-postcode-sectors in Scotland). This results in a "best-fit" of 1991 data into the smallest practicable set of 1981 basic spatial units to facilitate the comparison of local level change over time. The problems of achieving this were numerous. Most importantly, many of the centroids originally provided by OPCS had to be cross-checked as a far higher level of reliability is needed in change analysis than for static work. The 1981 digitized boundaries had to be validated; all district boundary changes were identified; importing, exporting and special enumeration districts were dealt with; and the nuances of the spatial allocation of visitors and many other minor technicalities were addressed.

The work described here took many months to complete but provided the basis for local level comparisons of the population of Britain, free from the ravages of the Boundary Commission. Having previously linked the 1971 and 1981 censuses in a similar manner, we can now access the entire Small Area Statistics of three censuses for the same set of wards (or any of their aggregates) simultaneously on workstations at Newcastle University. A full research report has been produced and the inter-censual lookup is being made available for research use to the academic community as a whole.

Robert BARR (University of Manchester)

Census data handling in the United States and the UK - a comparative review

In principle there are close parallels between the US and the British decennial censuses. However, detailed differences in the way the respective censuses are administered, published and have their data disseminated lead to a more radical divergence between the two data sources.

The absence of an adequate map base in the US has led to the development of a census Geography which is based on the compilation of addresses for what is largely a mail and return operation. The address base and the associated TIGER (Topologically Integrated Geographical Referencing) system provide a particularly valuable resource for the integration of other data sets with census data. This resource is also regarded as a key part of a National Spatial Data Infrastructure which is very much more flexible than any equivalent we currently have in the UK.

Technologically the US census relies more heavily on the availability of more sophisticated data handling technology among users than is the case in the UK. The US has no equivalent to SASPAC and raw data files are distributed, primarily on CD-ROM together with some extraction software. It is assumed that users will have access to, and will use, a dBase compatible database management system to handle the data. This puts different pressures on users and creates different demands for technical support. This policy of providing some software support along with the data now extends to the post-census release of TIGER which will include some mapping, and database search, software on the CD-ROM together with the enhanced version of the data. Both software and data are in the public domain and freely copyable. As a result a large and diverse secondary industry has developed around the re-packaging of both statistical and geographical census data. It is argued by the US Bureau of Census that this large industry, which has no direct parallel in the UK, returns, through taxation and economic growth, a repayment return to US taxpayers. The UK view is that such exploitation of government produced data sets serves only small sectional interests and that taxpayers need to be recompensed through royalties paid by users to the government departments that produced the data to allow the direct recovery of part of the costs of production.

The nature of government's relationship with the people in the US is radically different from that in the UK. In the case of the census and other government data this difference is best exemplified by the Freedom of Information legislation. However, an interesting case study of the impact of these differences is the mandatory re-drawing of electoral boundaries after each census. In theory the public, but in practice a large number of

special interest groups, are encouraged to participate actively in the process of redrawing boundaries using freely available special census data sets and geographical boundary information. The 1991 Congressional re-districting exercise was probably the largest in history, with the largest number of participating groups submitting plans for scrutiny and the most technically sophisticated checking operation carried out by the US Department of Justice. This was made possible because GIS based custom written re-districting software was widely available together with the block group boundaries and data from the census. It is ironic that the impact of the Voting Rights legislation, which was designed to ensure adequate representation for ethnic minorities in Congress combined with the available technology led to some of the most geographically bizarre solutions to the re-districting problem since the famous Gerrymandering of 1812. In this case however districts were drawn to increase minority representation rather than, to reduce it.

Despite the success of the re-districting programme, and the immense value of TIGER, the US Census Bureau is under attack, and our own OPCS does not look entirely secure. In 1991 both the US and the UK censuses have suffered from significant undercount problems, particularly in the poorer urban areas and both have substantial over-runs in cost. As a result, the traditional methods of taking, processing and publishing the results of the census are being closely scrutinized in both countries. In the US the possibility of a head count only census with less detailed geography is being canvassed, while in the UK OPCS will probably face similar attention.

Andy BATES (Hampshire County Council)

**Evaluation of Local Authority non-Census 1991 Population estimates by comparison with the Census: methodological problems and some results**

This paper describes an *Estimating with Confidence*, which project began early in 1991 to help Local Authorities producing Population Estimates and Forecasts to compare the accuracy of their figures with the results from the 1991 Census, and to assess which estimation methods work well. Support was given from Laria (Local Authorities Research & Intelligence Association) and an initial questionnaire was sent to all Local Authorities to gauge their interest in participating in such an exercise.

Nearly 90 per cent of County Councils and two-thirds of both Metropolitan Authorities and Scottish Regional Councils said they produced their own population estimates, either on a regular or occasional basis. Some 76 authorities expressed an interest in the project, including County and District Councils in England and Wales, Scottish Regional and District Councils, Local

Authority Research Organisations, Metropolitan Councils and a London Borough.

Members of the Estimating with Confidence group, coming largely from participating Local Authorities, designed a pack for interested authorities to complete, comprising three main parts: a questionnaire on methods used in estimation, a specification of the data required by the project using their own estimates and data from the 1991 Census, and guidance for a preliminary analysis against which to measure the accuracy of estimates/forecasts.

The intention of this pack was two-fold: to encourage local producers and users of population estimates and forecasts to evaluate their population estimates by comparison with the 1991 Census, and to compare methodologies of population estimating and forecasting in order to assess which methods work well in given circumstances. The importance of this work lies in the once a decade opportunity to ask 'How well did we do?'

The data requested to be provided (in the form of Proformas) included 1981 and 1991 Census population figures and a 1991 (or nearest) estimate of the total population made independently from the 1991 Census for Local Authority Districts and sub-Districts (such as Parishes or Wards). Also requested was a standard analysis using summary statistics from the Proformas, the purpose of this was to summarise differences between estimates and the Census in terms of under or over estimates and percentage differences.

A preliminary analysis on the first 13 (of 78) responses based on 66 Districts and 2,700 small areas suggests that recent Enhanced Electoral Registration Surveys give significantly better results than other methodologies. The least accurate sets of estimates had been produced by basing the estimates on a distant year and then projecting forward.

An analysis by Hampshire County Council, providing data for 267 Wards showed a higher level of population over estimating at Ward level than under estimating, and the percentage of wards with greater than 5% difference between the 1991 Census and their own 1991 estimates to be 11%. This highlights one of the problems in comparing authorities' own estimates with the Census, as with under enumeration from the Census nationally around 2%, this will tend to exaggerate levels of over estimation in estimates when compared to the Census.

A joint project based at Southampton and Manchester Universities starting this September, funded by the Economic and Social Research Council (ESRC), will help to analyse all the data that local authorities supply to the Estimating with Confidence project. It is also intended that the Estimating with Confidence project will set up a national series of workshops starting in Spring 1994 to assist in the development of training in

population estimation and forecasting and that all participating authorities will receive regular summaries of the results, detailing those estimating methods which give results most consistent with the census.

Ron BLAKE (The Nottingham Trent University)

Towards a new typology of Census Small areas, incorporating land-use data

This paper departs slightly from the main focus of the Conference, offering an environmental perspective on the Census. Demography and land use have long been the twin pillars of urban analysis but over recent decades there has been some divergence in the quality and availability of the two data-sets. Broadly, the Census has become more organised and informative while land-use surveys have all but disappeared from planning offices and geographical laboratories. Whereas Census data are now fully computerised, permitting longitudinal comparison, land-use data remain so patchy that evolutionary studies of the urban landscape are virtually impossible (R H Best, Land Use and Living Space, 1981).

What relevance does this have for Census users? In a recent paper Michael Barke and co-researchers (Geographical Magazine, July 1993) described how socio-economic conditions can be mapped more effectively by modifying the spatial units imposed by the Registrar General. The authors observed, correctly (p. 38, col.1), that where enumeration districts (EDs) contain a lot of uninhabited space they can appear unduly dominant if high ratios or percentages are symbolised by heavy colour washes over their entire areas. This effect can be ameliorated by extracting open spaces and industrial land from the base maps and confining all shadings appertaining to domestic conditions to the residential zones.

Work along these lines has been proceeding at the Nottingham Trent University. A Greater Nottingham and Environs Land Use Survey was undertaken in 1991 to complement the Census. The original idea was to make an inventory for comparison with those of Stamp and Coleman, sixty and thirty years ago respectively. From this resource the extent of residential, employment, recreational and derelict land has been effectively quantified. The project helped the new University win a contract to provide baseline data and monitoring for the Nottingham City Challenge Initiative.

For Census purposes there are two clear applications of land-use data:

- (1) To assist in re-defining the spatial units for socio-economic analysis, particularly with regard to population density which has received limited scholarly attention.

The precise extent of residential areas can only be determined from land-use maps based on systematic field survey.

- (2) To provide environmental inputs to an extended typology of EDs, Wards and Administrative Areas. Assessments of social disadvantage and quality of life can be assisted by incorporating scores for the percentage of ground covered by factories, roads, natural spaces and other critical land uses.

The Nottingham Survey affords a rare glimpse of the land-use content of EDs. Opportunities were missed on previous occasions, due to misplaced reliance on air photos, remote sensing and property registers and other fast-track methods of data capture. Geographical Information Systems will succeed in integrating socio-economic and environmental variables only when good field data are supplied. It is hoped that the 2001 Census will be accompanied by a national land-use survey, adopting some of the ideas discussed at this Conference.

**Paul BOYLE (University College of Swansea)**

**Defining Migrant Profile Clusters Using Data from the 1991 Small Area Statistics and the Local Base Statistics**

Macro-level migration analysis often involves the discussion of mobility patterns between a set of areal units. These may be rather arbitrarily defined administrative zones, such as regions, districts or wards or they may be areas defined on the basis of social and economic information, such as functional regions or the OPCS classification of districts. However, these types of areal units are not necessarily particularly relevant to migration research as they may disaggregate areas containing similar migrants. The 1991 Census 'Small Area Statistics' and 'Local Base Statistics' offer a wealth of migrant information for small areas, which was not available in the 1981 Census Small Area Statistics, and this may be utilised to derive clusters of areas with similar migrant attributes, labelled here as 'Migrant Profile Clusters'. Preliminary results suggest that these areas have certain similarities with the OPCS district classification, but also some significant differences. The spatial realisation of these clusters is described.

**Ian BRACKEN and David Martin, (University of Wales, Cardiff and Southampton)**

**Surface Representation of Social Change, 1981-1991**

This paper reports on research supported by ESRC's Census Development Programme into ways of representing social change revealed by the 1981 and 1991 Censuses. The work involves

further development of surface models of population and related data using a probabilistic approach in which the data associated with the census zones are transformed onto a regular grid. As the resulting grid database is independent of the zonal geography of each particular census it follows that the technique potentially allows insights into the spatial dimension of social change unaffected by the changing zonal administration of successive censuses. The paper shows that it is entirely practicable to create 'national surface' databases at fine resolution which can readily support analysis with great flexibility of scale, from national to local. It is suggested that such surfaces have an important role in the visualisation of census data and social change. As a condition of ESRC's funding the databases will be made available in due course to the academic community though details have still to be finalised.

In the work described a standard raster cell size of 200 m is used which previous study has shown to be highly appropriate for the representation of British census data. Key variables which have been processed include both 1981 and 1991 basic population counts for persons and households, and a range of variables covering age structure, unemployment, permanent sickness, car ownership, dwelling overcrowding, presence of central heating, etc. In all about 30 such 'key' variables have been remodelled onto a consistent population/household grid. From these databases a range of ratio and percentage surfaces have been generated such as percentage of elderly population, percentage of household without car, and so on. These variables feature widely in social indicator work.

The integration of 1981 and 1991 Census data for surface construction is however far from straightforward due to changes in census geography and definitions, in the administration of the census, and in the format and nature of the data. This paper describes an outline how these difficulties have been overcome and how consistent surface models for both 1981 and 1991 have been achieved. Attention is then given to some preliminary findings about social change between 1981 and 1991 using the initial dataset of population and households. The paper concludes with information about the surface databases themselves and their potential role in spatial analysis, with illustrations of some of the key variables processed to date.

**Michael BRADFORD (University of Manchester)**

#### **Constructing an Urban Deprivation Index**

The major determination of an index is the purpose for which it will be used. However, in many instances the purpose is not fully known, may be varied and may change over time. When the topic of the index is urban deprivation the problems multiply because the concept is so complex and its meaning so contested. Yet governments typically require such an index in order to

allocate finance and guide the development and implementation of their policies. This paper examines the issues associated with the construction of such an index and some of the solutions to them.

The first issue is the meaning of the concept and the establishment of its coverage and the dimensions that may be included. The second is the way that the meaning may be measured through a range of indicators that have been chosen to reflect the dimensions and their availability at various spatial scales.

Further issues are the extent to which different spatial distributions of indicators are identified and represented in the final index and the scale at which deprivation is measured. The spatial occurrence of deprivation may be reflected at more than one geographical scale with different scales being more relevant to particular allocational or policy uses. The project therefore uses enumeration district (ED), ward and district scales and presents a matrix of deprivation reflecting all three scales rather than one single index. This enables the representation of the overall incidence of deprivation in a district, the degree of its concentration and intensity and its spatial distribution.

A signed chi-square measure is used to measure and standardise the indicators. It is much more appropriate for use with ED data and some of the ward data than the familiar z-score because of the size and variability of the denominators. At the district scale the chi-square measure reflects both the relative and absolute occurrence of deprivation. Correlation and various forms of factor analysis allow the coincidence of spatial distributions to be explored and dimensions identified and their stability checked. No weighting is applied to any individual indicators when formulating an index for each scale.

The final matrix consists of the number and percentage of a district's EDs and wards that are in the worst 7% in the country together with the mean of the worse three wards and the district index value. The spacing of deprived EDs is described on the basis of nearest neighbours.

**Peter BROWN and Alexander Hirschfield (University of Liverpool)**

#### **Profiling Housing Need in Wales: A Census-Based Analysis**

This paper describes the approach adopted to the creation of a digest of housing need information derived by URPERRL - Liverpool from the 1991 Census on behalf of the Welsh Housing Corporation, Tai Cymru/Housing for Wales. The project involved the production of a large number of maps in the form of an atlas of ward level housing need indicators for each of the 37 local authority districts in Wales, together with a series of district level indicator plots and a commentary to provide an overall national context for the local atlases.

The individual atlases have been produced primarily to provide local housing associations with additional information about the characteristics of their client populations. A set of maps, and accompanying tables of indicators, serve as a profile which can contribute to an assessment of the scale and nature of the need for social housing in a district.

The paper focuses on a number of technical issues faced in the preparation of the housing need profiles, including how the problem of small numbers in some of the more remote and sparsely populated rural districts was addressed. The form of tabular display used to present the basic census variable count and percentage information was given particular attention. Histograms were displayed as a complement to most maps in order to convey an impression of the distributional characteristics of the variable concerned, an important property which can otherwise be impossible to discern from a choropleth map in which a quartile-based shading convention is employed.

The tables serve to identify both the housing conditions experienced by specific client groups, such as large families, or lone elderly people, and the characteristics of the population experiencing particular housing problems, such as overcrowding or limited access to amenities.

The paper illustrates some of the conventions adopted in overpowering a series of problems that were anticipated or encountered in the course of the implementation of the project.

**Tony CHAMPION and Daniel Dorling, (University of Newcastle upon Tyne)**

**Population Change for Britain's Local Labour Market Area, 1951-91**

This paper highlights results derived from an aggregation of 1991 Census data to the CURDS Local Labour Market Areas (LLMAs). The principal features of population distribution in 1991 are presented, and changes since 1981 are analysed and compared with earlier trends. Attention is particularly focused on analysis by urban and metropolitan status in order to follow up the counterurbanisation work of the 1970s.

The LLMA framework proved its worth in the analysis of the 1981 Census. It differs considerably from Local Government Districts, being identified on the basis of urban centres and commuting to these. This makes it valuable for the analysis of urban and regional change and particularly useful for work on employment, housing markets and retailing. This paper uses a static definition as developed for work on the 1981 Census; when available, the 1991 Census data on journey to work will allow the identification of changes.

In terms of population distribution in 1991, Britain's population remains highly concentrated in a few large cities. London's LLMA contained 7.8 residents in the country and much larger than second-placed Birmingham (1.4 million). Indeed, London accounted for more people than the next eight largest LLMAs combined. In all, 14 LLMAs contained more than 500,000 residents, making up 33 per cent of Britain's population.

This high level of concentration persists despite three decades of significant population deconcentration. London's population shrank by 4.9% in the 1960s and by a further 8.6% in the 1970s, while Britain's five Conurbation Dominants (Birmingham, Glasgow, Liverpool, Manchester and Newcastle upon Tyne) averaged 3.1 and 8.2% losses over these decades respectively. The 1981-91 period signalled a major change in London's fortunes, with a 1.1% growth over the decade, though the conurbation Dominants' overall decline of 5.1% marked a relatively small improvement, particularly if the increase in national growth rate of 1.9 percentage points is taken into account.

This reduction in the rate of population losses from the largest cities contributed to a slowing of the urban-rural shift compared with the 1970s. Nevertheless, there remained a clear overall relationship between growth rate and urban status in the 1980s, with Large Dominants averaging -1.2%, Cities 2.7%, Towns 5.2% and Rural Areas 7.8%. The South totally dominated growth, with a 5.2% increase compared to -0.1% for the North, but the urban-rural shift was evident in both halves of Britain. The London Metropolitan Region exceeded the national growth rate of 2.5%, but not surprisingly the fastest growth rates were recorded by the Rest of the South, averaging 8.2% for the decade. On an LLMA basis the growth rankings are headed by Milton Keynes (37%) and Horsham (21%), with Liverpool (-8.8) and Glasgow (-7.5) at the other end of the scale.

A tentative attempt to classify LLMAs by the occupational components of 1981-91 social change is also made in the paper using data from the 10% sample.

#### **Alex CLARK (Office of Population Censuses and Surveys)**

#### **OPCS Geography in the 90s**

The paper will cover two aspects of the development of the geographic base used by OPCS to support statistical processing of its data acts in the 90s:

- a      Geographic Support Service
- b      the development of a geographic base for the 2001 Census.

The Geographic Support Service is being set up in two phases. The first of these is partly operational and will be fully operational later this year. The first phase is mainly internal to OPCS and will consolidate the different geographic systems and coding frames into a single service which will support the processing of all data sets. This paper will describe the entities held within the system, the naming and coding standards which have been adopted and will go on to outline plans for phase 2 of the development. Benefits for users will include the adaption of standards within OPCS, the potential wider use of these standards within the user community and the opportunity to influence the development of the second phase via user consultation.

The second part of the paper will consider the options for the geographic base for the 2001 Census and will review how OPCS is setting out to involve users in a wide ranging discussion to help shape the base and contribute to the research to be carried out. A big consideration is the architecture of the base and how this might permit the separation of collection and dissemination geographies and whether an address based solution is viable.

**Mike COOMBES (NE. RRL, CURDS University of Newcastle upon Tyne)**

**Placing changes within changing places: responses to changing census geography**

The paper begins by recognising the constraints within which the geographical framework of the census was developed. The differing responses to these constraints shown by the census geographies of Northern Ireland, Scotland and England and Wales are discussed briefly. The implications which are drawn out then provide the challenge for researchers who wish to analyse change between censuses, at the small area level, consistently across the country.

The geographer's response to these technical challenges is often to make them even more difficult by defining a special set of areas for which the analysis is required! A case in point is the CURDS set of Functional Regions (FRs) which were created for 1971-81 census analysis. The paper illustrates the task involved in grouping 1991 census areas into the boundaries of FRs - does the fairly large size of most FRs make this a relatively straightforward process in which any errors die to the 'best fit' can be assumed to be self-cancelling?

The third part of the paper briefly restates the need for areas such as FRs, regardless of the technical problems which they pose. The key point is that the results of a spatial analysis are strongly affected by the choice of areal units for that analysis. Given this "modifiable areal unit problem" the ideal response is to adopt areas which have been carefully defined to represent geographical "objects" such as urban systems. Some

evidence from an analysis of counterurbanisation is presented to illustrate that this is by no means a simple task - but that the effects of adopting one set of areas rather than another can lead to a dramatic change in the results of these different analyses of the same original data.

The conclusions of the paper are in terms of the guidelines, which have emerged from the earlier discussion, for the creation of consistent areas for census change analysis.

**Angela DALE and Keith Cole (Census Microdata Unit, University of Manchester); Brian Dodgeon (SSRU, City University); Malcolm Williams (University of Plymouth)**

#### **Changes in housing tenure, 1971, 1981 and 1991**

In the last twenty years there have been very marked changes in the availability of different kinds of housing tenure. Since 1971 there has been a steady increase in owner occupation, strongly stimulated by government policy, for example council house sales during the 1970's followed by the 1980 Housing Act giving local authority tenants 'the right to buy'. Simultaneously there have been restrictions on the ability of local authorities to build housing to rent and therefore this tenure has taken on an increasingly residual role, housing those who are unable to buy their own property. By contrast, Housing Associations have been increasingly active in providing social housing, whilst Housing Action Trusts have also taken over much local authority housing. Private rented accommodation has declined steeply since the 1970s, although still occupies an important role for some groups of the population.

This paper establishes the changing characteristics of households in the major tenure groups over the period 1971-1991 in England and Wales. Census microdata will be used for 1971 and 1981 from the OPCS Longitudinal Study (LS) and for 1991 from the Samples of Anonymised Records (SARs). The LS is a 1% sample of the population of England and Wales, which can provide a representative sample of households. The household SAR is a 1% sample of households enumerated in Great Britain. Together, these datasets provide a unique opportunity to analyse census microdata over three time points. Of particular importance is the ability to include a measure of ethnic group at each time point.

The analysis begins by identifying the change in the composition of the main tenure categories over time, in terms of the social, economic and demographic characteristics of the households in them. It then goes on to establish the predictors of tenure at each of the three time periods, in terms of a range of variables including household composition; employment status, social class and ethnic group of the household head; and type of area (eg Greater London, metropolitan county etc). The analysis



Ian DIAMOND (University of Southampton)

**Who and Where are the Missing Million?**

Censuses are never perfect counts of the population and there are many strategies for estimating the extent of under (or over) enumeration and of making suitable adjustments. In Great Britain two approaches are used. First an accounting procedure to adjust for certain groups such as students who, in 1991, were required to be at their term time address. Second, and most importantly, a Census Validation Survey (CVS) is undertaken. This is carried out in a sample of enumeration districts shortly after the census and is used to identify the extent of any underenumeration (a) of missing dwellings or households and (b) of missing individuals in enumerated households.

In past censuses, adjustments based on the accounting and on the CVS have results in a final count which is similar to that "expected" by rolling forward the population from the previous census by accounting for natural increase and internal migration. In 1991, this did not happen and so there was a new problem of how to allow for the unexplained underenumeration. The first step was to undertake some basic demographic analysis to identify those people who had been missed. This showed them to be largely men and women aged 18-35 with some younger and some older. At a national level this is reasonably straightforward to undertake but at a subnational level the additional complication of internal migration makes life very difficult.

This paper has two main aims. First, it describes the strategies used by OPCS to identify to which local authorities the unexplained underenumeration should be allocated. These varied from a simple pro rata approach to one based on expected sex ratios. Second, the paper discusses who the people missed were and why they were missed. The paper finishes by suggesting the key areas which need to be addressed for the next census.

Daniel DORLING (Newcastle University)

**Visualising Changing Social Structure from the Census**

This paper demonstrates how new visualisation techniques are being used to analyse the first results of the British 1991 census and other large datasets. Of greatest interest are questions about how localities have developed over time. Which neighbourhoods have experienced gentrification and in which places have the recessions of the previous decades had their worst effects? Overall, do we see a picture of polarisation or an evening out of social disparities?

These questions cannot be answered by conventional quantitative techniques because the answers are unlikely to be simple enough to be presentable in tables or by equations. Pictures are needed

to show how different processes occurred in different places; while holistic patterns need also to be seen without generalizing out the detail. Neither traditional thematic mapping nor commercial geographic information systems can do this.

Computer cartography is developing into spatial visualisation, in which the researchers choose what they wish to see and how they wish to view it. Almost every new problem required a new method of visualisation for its exploration. Examples will be given from the writer's past work and the preparation of a new social atlas of Britain, which not only uses new statistics, but uses radically different ways of envisioning information to show those statistics in a new light.

**Keith DUGMORE (MVA Systematica)****Census Statistics: Demand and Dissemination - 1981, 1991 and 2001**

There has been a great growth in the demand for Census statistics in recent years. More people in more organisations now value small area information for the purposes of targeting services and markets. This has led to demand for new data products and improved methods of disseminating Census data, and also raised expectations for the future.

This paper is organised in three sections. The first reviews the growth in the use of 1981 Census data for targeting in both the public and private sectors, and touches on such subjects as area classifications and customer profiling.

The second section outlines the new tools that are becoming available with the 1991 Census, including more statistics, the Enumeration District/postcode directory, digital boundaries and better computing facilities. It also discusses the effectiveness of dissemination, both in the design of products and the pricing and purchasing arrangements.

The paper then anticipates the likely demand for and dissemination of 1991 census statistics during the 1990's, touching on such issues as markets, media, merging, modelling and mapping, and concludes by anticipating demand and options for dissemination of the next Census in 2001.

**Simon ELLIS (Department of Planning, Lothian Regional Council)****The Census Programme of Lothian Regional Council**

Lothian Regional Council began its programme for analysis of the 1991 Census well before the arrival of the Census data. Regular meetings were held within the authority and with the district councils of Lothian. Lothian was an early subscriber to SASPAC and the Planning Department chaired the Technical Group. At the

same the council was seeking to set up a corporate Geographic Information System, and the Census was chosen as a pilot application. Lothian gained considerable experience in developing the application with the suppliers. Lothian received the 100% Census data in December 1992. Profiles of the Regional Electoral Divisions were published in May 1993, and work is now concentrating on more complex analysis.

The Scottish Census data is somewhat different from that used in England and Wales. The most important difference is the use of Output Area (OA) as the smallest unit of analysis. The OA was designed to be the smallest amalgam of postcodes that would maintain confidentiality, and builds up into postcode sectors rather than district wards. The average OA consists of 120 people, or 50 households. This is about one quarter of the size of the Enumeration District. In Lothian the smallest regular Output Area has 50 inhabitants, while the largest has 325. The use of such small units is of great significance for the future of the Census. There are other less important differences in the Scottish data. Some tables were specially adapted for Scotland. The analysis of Gaelic speakers is an obvious example, another significant variable is the count of households by the lowest level of accommodation.

Lothian Region is carrying out a wide range of different analyses on the Census. Many projects are only just beginning, and there is not time to report on all the council's activities. Like many local authorities we have been looking at the degree of accuracy in the Census and have been trying to account for the imputed population, and under-enumeration.

An important area of interest is the use of migration data, which the Department of Planning is keen to use for analysis of the housing market. At OA level it seems as if the major concentrations of migration within postcodes sector can be related to new housing or rehousing schemes. Such housing schemes also seem to explain the main concentrations of the imputed population.

The Census topic which most interests local community groups is ethnicity. Comparisons have been made between the demographic and economic characteristics for ethnic groups. Study of maps at Output Area level shows that none of the major Edinburgh minorities is concentrated in any particular location.

The Department of Corporate Services has been engaged in assessing deprivation. Following a similar exercise at the Scottish Office this has been carried out at Output Area level. The major areas of deprivation are generally as expected however use of OAs has produced some more unexpected outlying smaller zones.

The General Register Office for Scotland advise that the main purpose of Output Areas is to enable aggregation to larger units.

However, the effect of the blurring of the data to ensure confidentiality makes accurate results very difficult to achieve. The main use of OA data would seem to be obtain an approximate idea of the spread of a variable across an area. In this regard the use of OAs will help to demonstrate the shortcomings of the Enumeration District as an area unit.

Output Areas should perhaps be adopted nationally as the basis for the next Census, but the difficulties in dealing with such small counts indicate that the Census could not consider smaller areas without loss of confidentiality.

**Vaughan GALT, Edmund Snelling and Susan Hallam (The Nottingham Trent University)**

#### **Creation of City Challenge Baseline Data Sets**

The City Challenge Initiative is the latest in the Government's Inner City Policies. The Initiative concentrates a range of policy instruments covering people and property issues in a defined area of a city with the hope that, over a period of five years, the area chosen will have the basis for self-sustained growth.

The strength of the Initiative, it is argued, is its emphasis on partnership between the public sector, private sector and the community. There are 31 City Challenges now in operation with 11 Pacemakers' leading the way. In April 1992 Nottingham was chosen as one of the Pacemakers.

A feature of the Initiative is the emphasis on monitoring by internal staff and evaluation by independent outside evaluators. (In Nottingham this outside evaluation is undertaken by Nottingham Trent University). The evaluators measure the impact on the chosen area of the total set of policy instruments. The basis for the measurement of impact is a set of performance indicators which over the last twelve months have been discussed with the Department of the Environment.

In calculating these performance measures, the first requirement has been the establishment of a baseline data set against which future performance can be compared. In establishing the baseline a variety of data sources have been used, eg Census of Employment, local authority data, primary surveys etc, to obtain as much information about the area as possible. A major source of data is the Census of Population 1991.

The Census of Population data has been acquired and transferred to spreadsheets. In order to define the specific City Challenge area and, since the baseline concerns comparison with other areas, data has been collected at County, District, Ward and ED level. The Census data has been used in a number of ways:

- (a) it provides basic data on population, households, economic status etc and
- (b) it is used in conjunction with other data to calculate various rates (eg unemployment rates) and indices.

The paper covers a number of these different uses, concentrating on two: Lone Parents and Labour Market Issues. The paper also looks at the limitations of Census data for this type of longitudinal study.

**Jan HOWARD (Buckinghamshire County Council)****Concern about Buckinghamshire's 1991 Mid-year Estimates**

Using simple graphical illustrations of age-specific gender ratios, the paper raises questions about the efficacy of recent methods used by the Office of Population Censuses and Surveys (OPCS) to correct for census undercount at local authority district level within Buckinghamshire.

A preliminary study played a small part in bringing about an improvement in the way in which the adjustments made for census undercount were redistributed to local authorities in the provisional rebased mid-1991 population estimates. This further research investigates how successful those changes have been for Buckinghamshire and its local authority districts and borough.

The evidence indicates that the gender ratios for Buckinghamshire may have been distorted by OPCS' adjustments methodology, and the purpose of this paper is to prompt research that should enable OPCS to correct for future census undercounts more appropriately. This could be brought about by taking account of each district's historical patterns for gender ratios.

The paper also contains some suggestions that may make the occurrence of undercount in censuses less problematic: by increasing the size of the follow-up survey; improving other secondary sources of data for quality and coverage checks; and investigating ethnographically the reasons why potential non-respondents may avoid completing their census forms.

**Eileen HOWES (London Research Centre)****The 1991 Census: Managing the London Consortium**

This paper will focus on the areas listed below. The most interesting part (to us) is the analysis, but it has involved a lot of hard work to get to the position where any analysis could be done. The paper will describe the main tasks undergone, and the one which affects all the others - consulting and getting 33 different local authorities, of different political compositions, to agree with our plans at each stage. It will outline our plans

at each stage. It will outline our initial reaction to the data, which so far has raised more questions than it has answered.

#### 1. Pre census:

involvement in the consultation  
estimating the budget required  
the technical preparation  
planning the initial analysis

#### 2. The Census:

involvement in the field - to be a Census Officer?  
the training in SASPAC and what would be in the datasets  
keeping up the interest through the delays  
the retraining in SASPAC and the data

#### 3. The Data:

processing the data and delivering it to 33 local authorities  
the advice and helpline - the most common questions  
technical problems with the size of the datasets etc  
planning the special tables, how to decide what is missing from  
the huge datasets

#### 4. The analysis:

initial analysis  
planning the programme of analysis  
the first results and reports  
interesting questions raised

#### 5. Raising income:

The Census Centre  
Commissioned research

**Kelvyn JONES, Graham Moon and Craig Duncan (University of Portsmouth)**

**Modelling ecologies: the multilevel model as a general framework for analysing census data.**

It is now sixty years since Gehlke and Biehl showed that differing relationships could be found between census variables at different scales; and it is over forty years since Robinson demonstrated the ecological fallacy of transferring ecological sensus findings to the individual level. This paper aims to revisit these topics of scale, level and ecologies from the recently-developed viewpoint of data at several levels simultaneously, thereby allowing compositional effects to be disentangled from contextual differences. The argument will be

illustrated by a relatively simple three-level model of unemployment based on this SAS for Southern England. Individuals with certain characteristics (at level 1) are seen as nested within Enumeration Districts (at level 2) which are, in turn, nested within Travel-to-Work areas (at level 3). Unemployment can then be modelled in terms of individual characteristics (age, gender) and the ecological characteristics of the ED's and TWA's. The paper will conclude with the need to consider developments of the multilevel framework (multivariate responses, repeated measures, and cross-classified models) as providing a general framework for the analysis of census data with a complex structure.

Peter LEE (Edinburgh College of Art/Heriot Watt University)

#### Using the Census to Study the Development of an Underclass

Since the publication of the 1981 population census, technical change throughout the 1980's has meant major improvements in access to computing power witnessing inevitable improvements in access to census data. The availability of census data in the form of machine readable datasets constitutes a major resource for research in British social science and the release of Local Base statistics for larger geographic units, provides the kind of detail only previously published for local government districts. Furthermore, arrangements for the use and dissemination of census data has been planned and coordinated by the ESRC/JISC such that the scope for research potential is much enhanced from previous years. Technological improvements (the availability, ease of use and access to hardware and software) and improvements in data availability (more cross-tabulations of census data and new questions on ethnicity and long-term illness) has meant that users are in a more advantageous position to exploit the census.

At the same time as such technological changes, the politics of Thatcherism has contributed to a new social and political agenda which has changed the emphasis of how data and the byproducts of the technical revolution will be used and deployed in answering some of the theoretical debates emerging from ten years of social change in Britain. Recent poverty debates in the UK and USA, for example, have focused upon the emergence of an underclass characterised by a self-perpetuating detachment from society's normative behaviour and values. At a PSI conference on the underclass in early 1991, the meeting called for more empirical evidence to test the validity of the thesis. The pursuit of empirical evidence and the emergence of the database has coincided with the release of latest census data, which will be used extensively in the continuing debate. However, the increase in computational power and access to large datasets does not carry with it the necessary sensitivity with which to deploy such technological armoury, whilst the proliferation of census use may presage an exploration into areas of social research that the

census is either not suitable or capable of fully exploiting or revealing. The underclass, for example is not the same as poverty, but a particular type of poverty, which has been exemplified by the interventions of Charles Murray in the United States and which requires qualitatively rich data on life-cycles and individuals in order to validate the thesis.

This paper, therefore, assesses some of the key contributions to the underclass debate as it is perceived in the United Kingdom, whilst considering which variables from the 1981 and 1991 census could be used to estimate the development of an underclass. Finally, some of the major problems with the underclass debate and methodological problems beset by enhancing the census to address the underclass using microsimulation, are alluded to before concluding that the census is a poor dataset for use by social scientists to assess the emergence of a new social class detached from the mainstream of society.

**Malcolm MACOURT (University of Northumbria at Newcastle)**

#### **Religion in the Northern Ireland Census**

After much acrimonious debate in 1860 the UK Parliament agreed to include in the 1861 Census of Population of Ireland a question concerning religion for the first time. A question on religion has appeared all in the decennial censuses covering (what is now) Northern Ireland ever since. Since the data collected from that question is of relevance to studies of social structure, unemployment and civil disorder, it is important to consider the controversy over inclusion of the question, meanings of the question, and the uses of the data. Such consideration offers parallels to the inclusion of ethnic questions in the Great Britain Census.

The inclusion of the religious question was the subject of fierce debate in 1860, not least because comprehensive and accurate information on denomination affiliation was not otherwise available. The place of the (then) Established Church, and the position of Roman Catholics, was a matter of much political and social controversy of the day. Once included the question appears not to have been controversial until the 1971 Census, since when it has been a subject of some public debate.

The nature of the questions, and the understandings exhibited by those answering it, has produced considerable difficulties in the use of the data collected from this inquiry. It is certainly no longer the case that, in stating the name of a Christian denomination, respondents are necessarily indicating an adherence to the credal formularies of that denomination, or an involvement in its religious practices. For many, it would appear that by giving a denomination answer to the question they are merely identifying themselves with one of Northern Ireland's two social-political-'tribal' groupings while in each census up to and

including 1951 at least 99.5% gave an answer which identified their tribal grouping, those who for whom no tribal grouping can be immediately imputed increased to 2% in 1961, 10% in 1971, 19% in 1981 (when campaigners urged non-completion) and in 1991 constituted 13% of the enumerated population.

Some of the problems involved in using the data for the study of religious practice on the one hand, and for the study of social-political-'tribal' groupings on the other hand are examined. Using Census material published in printed form only, new estimates of the total population who may be described as 'Catholic' and of the total may be described as 'Protestant' are derived. Stated assumptions are made and the estimates are based on evidence from 'ghetto' wards in the Belfast area, and acknowledge factors relating to socio-economic composition and levels of unemployment.

Parallels between the debates and first and subsequent inclusion of religion and the debates concerning the inclusion of an ethnic question in Great Britain are considered. Parallels are also drawn concerning the uses to which the data emerging from those inquiries may properly be put.

#### Elizabeth MIDDLETON (University of Manchester)

#### Problems of harmonising UK-wide Samples of Anonymised Records

For the first time in British Census, Samples of Anonymised Records are available from the 1991 Census. The Census Microdata Unit has been established at the University of Manchester to undertake research using the SARs and to make the SARs available to both the academic and non-academic sectors.

Great Britain is now following the example set by the United States, Canada and Australia. Other European countries have placed more restrictions on the availability of microdata and this paper briefly reviews the approaches of different countries to the release of census microdata.

In the British Census, census forms for England, Scotland and Wales differ in some small respects but are all processed in the same way by OPCS and the General Register Office for Scotland. However, the Northern Ireland Census is the responsibility of the Northern Ireland Census Office and all data processing is carried out in Northern Ireland. SARs for Northern Ireland are likely to be available early in 1994 and will be as similar as possible to the Great Britain SARs.

In the past United Kingdom wide census reports have not been produced and so a harmonised United Kingdom SAR dataset would be extremely useful. The problems of producing such a dataset are discussed and fall into the following categories.

- (a) Differences in Questions on the Census Form  
While most questions are the same, Northern Ireland does not include ethnicity question but does have additional questions on religion, fertility, amenities and the Irish Language. There are also major differences in the questions on qualifications.
- (b) Differences in Coding  
Even when the wording of questions on the census form is the same, information can be lost when being transferred from form to computer. Examples of this are discussed.
- (c) Differences in Definitions  
There are differences in the Northern Ireland and Great Britain definitions of the family. In Northern Ireland a cohabiting couple is not regarded as a family unit as it is in Great Britain. Again, the census definition of a dependant child differs in the two censuses.
- (d) Differences in Processing  
These include differences in the way families are identified within a household, differences in the calculation of distances and differences in the methods of editing the data and imputing missing values.

Although there are some problems it is felt that producing a harmonised SAR dataset would provide researchers with a valuable new resource for comparison of the regions of the United Kingdom.

**Clive MORPHET and Michael Barke (University of Northumbria at Newcastle)**

**Analysing 1981-1991 change in the city of Newcastle: some results and a review of some of the methodological and technical problems.**

This paper is concerned with the analysis of inter-censal change at the intra urban scale. It argues that for most detailed policy purposes the local authority ward scale is an inappropriate one, masking much of the pattern of spatial variation which does not respect ward boundaries. On the other hand the enumeration district is argued to be statistically problematic (in respect of most census variables) due to small counts and the process of data randomisation (Barnardisation) which protects confidentiality. In addition we argue that even statistically accurate ED counts may generate spurious patterns of variation at small scales, due to the arbitrary ('modifiable') choice of ED boundaries. Some scale between the ED and the ward would therefore constitute a more robust spatial frame for such analysis.

Whichever spatial frame is chosen, the lack of correspondence between the spatial units of the 1981 and 1991 census creates additional problems for the analysis of change at a detailed scale. The approach adopted in this paper results in the description of social data as a moving local best estimate

arranged on a regular grid. Thus for any particular census variable each point on a 200m lattice has a value drawn from the values of that census variable in the proximate area - in fact in a 600m square cell of which the lattice point is the centre.

The production of such a data set involves the spatial manipulation of ED data first into 200m square cells and subsequently the generation of a moving average of this data in which each cell assumes the average of the nine cells of which this is the centre. The problem of edge cells are recognised and discussed.

The operation of this process on 1981 and 1991 data results in a spatially conforming frame on which differences can be identified and change analysed.

The data presented in this paper is a welfare index (the Townsend Phillipmore and Beattie index). Derived maps for 1981 and 1991 are presented, and a tentative representation of spatial change critically examined. Attempts are made to asses the levels of accuracy which may be attached to the results, both in formal statistical terms and by an evaluation of the resulting patterns informed by a knowledge of the changing social geography of the city.

**Alan MURIE and Ya Pink Wang (Edinburgh College of Art/Heriot-Watt University)**

#### **Changes in Council Housing Estates in Edinburgh in the 1980s**

In social, political and economic terms, the most important element in the privatisation programmes of the 1980s was the sale of publicly owned dwellings principally through the Right to Buy introduced in the Housing Acts of 1980s. In Scotland alone about 248 thousands (24%) of public sector dwellings were sold between 1979 and 1991. Among them 74% of sales were by local housing authorities. Edinburgh District Council has sold over 27% of its housing stock. What social impacts have this policy had in public sector housing estates? Has this policy caused significant changes in household composition in these areas? Small Area Statistics (SAS) of the Population Census offer a useful way to evaluate these changes. This research will firstly identify where public housing was the monopoly major tenure in 1981. Relevant data sets from the 1981 and 1991 Census will be abstracted to carry out various analysis of these areas.

**Suzanne J NEW (Census Microdata Unit, University of Manchester) and Derek L Bosworth (Manchester School of Management, UMIST)**

**The impact of domestic relationships on the hours of work of young people: a case study of the use of Samples of Anonymised Records**

Standard output from the 1991 GB Census has been complemented by a new form of output: two files of individual level data, known as the 'Samples of Anonymised Records', housed at and disseminated by the Census Microdata Unit at the University of Manchester. The release of SARs from the Census marks an exciting new development in the use of Census data as, for the first time, users of Census data will be able to manipulate a sample of Census records in the same manner in which they would manipulate data from any other sample survey.

The 2% individual SAR will undoubtedly appeal to geographers due of its finer geographical detail (278 SAR areas with populations of 120,000 upwards), whilst the 1% household SAR is likely to have a greater appeal to sociologists and social policy analysts, for whom geographical detail (only 12 areas based on Standard Regions) is less important than the possibilities for exploring complex relationships within households and the inter-relationships between household structure and other variables. It is the potential of the SARs for conducting new forms of Census-based research in this latter area which will be explored in this paper, based on the authors' early experiences of using the SARs for a piece of research not previously possible using aggregated Census output.

The substantive topic of interest is concerned with the effect of household structure on the economic activity of young people, exploring in particular the effect of parenthood on young people's hours of work and their participation in secondary labour markets. By using the fine detail of the household SAR, it is possible to construct new categories of economic activity based on both primary and secondary economic activity, whilst the inclusion of a question on hours of work in the 1991 Census provides a rich source for exploring the distribution of hours within households. This research is currently at an early stage, so few conclusions with regard to the substantive topic itself can as yet be drawn. However, the paper will outline the strengths and weaknesses of using SAR data in comparison with other data sources and will comment on the potential for more advanced research using the household SAR.

**Charlie OWEN (Thomas Coram Research Unit, Institute of Education, University of London)**

#### **Mixed Ethnic Origin: the Use of Commissioned Tables**

Marriages between races have been deprecated at least since Elizabethan times. However, the persistence - and often vehemence - of the denunciations testify that such marriages did continue to take place. Data from Gallup Polls and from the British Social Attitudes Survey are used to show that attitudes towards mixed marriages have become considerably more accepting. Nevertheless, concern has continued to be expressed about the potential difficulties for the children of such relationships. Only recently have studies begun to ask how people of mixed ethnic origin see themselves (see especially Tizard and Phoenix, 1993). Little is known about the demography of people of mixed ethnic origin.

Until the 1991 Census the biggest national sample that collected data on ethnic group was the Labour Force Survey (LFS). The LFS is an annual survey of approximately 60,000 households. (Since 1992 it has become a quarterly survey, with the same sample size per quarter). It is regularly employed by OPCS to estimate Britain's ethnic minority populations. As part of a wider study of the changing circumstances of families with children, the LFS was used to look at mixed marriages and people of mixed ethnic origin. This paper reports on that part of the study and describes the use of commissioned tables on ethnic group from the Census.

The study defined three broad ethnic groups: white, black (consisting of 'West Indian' and 'African') and South Asian (consisting of 'Indian', 'Pakistani' and 'Bangladeshi'). Three types of mixed ethnic origin were also defined: black and white; South Asian and white; and other mixed. (This last group mostly consisted of people coded as "mixed: insufficient information".) These three mixed categories together accounted for 0.56% of the total population, using the combined LFS for 1989-1991. All ethnic minorities combined formed 4.8% of the population, so that those of mixed ethnic origin constituted 12% of the ethnic minority population.

Although small as a percentage of the total population, the group of people of mixed ethnic origin has a very young age profile, with over half being children aged under 16 (as compared to 21% of the total population being that age). Consequently, they are a group that is going to constitute an increasing proportion of the population. Because overall the percentage is so small, even three years of the LFS yields quite small numbers for analysis. By including a question on ethnic group the 1991 Census gives the opportunity for the analysis of larger numbers. The answers to the ethnic question have been assigned to 35 categories, including four mixed origin categories. OPCS are planning to publish only one tabulation using this full 35-way

classification: this is a straightforward count under each category, at the level of district. For all other purposes these 35 codes will be grouped into 10 broader categories, with the mixed origin codes assigned to different classes. This recode will apply to the Small Area Statistics, the Local Base Statistics, the Sample of Anonymised Records and the Longitudinal Study. Consequently it will not be possible to carry out analysis on mixed ethnic origin using any of these datasets. However, it is possible to commission tables from OPCS, using the 35-way classification. The paper will describe the stages involved and some of the difficulties in using commissioned tables.

David OWEN (Centre for Research in Ethnic Relations, University of Warwick)

#### Spatial variations in ethnic minority populations in Great Britain

This paper is concerned with analysing and comparing the spatial pattern of settlement of the minority ethnic groups identified by the 1991 Census of Population. It is well known that the minority ethnic population of Britain is spatially concentrated, but the details of the settlement pattern and the contrasts in the location of individual ethnic groups are not so familiar. Amongst the general public (and politicians such as Winston Churchill), there is considerable ignorance even of the number of people from minority ethnic groups, though awareness of very high local concentrations of ethnic minorities may lead such people to assume that the proportion of the population accounted for by minority ethnic groups is far higher than is the case in reality.

The paper therefore considers the question of the spatial concentration of particular ethnic groups at a range of spatial scales. Three approaches are adopted. The first part of the paper provides a brief overview of the ethnic composition of the population of Great Britain, and then describes the geographical pattern of concentration of major ethnic groupings, through mapping location quotients calculated for local authority districts.

The focus of the paper then shifts to the intra-urban settlement patterns of minority ethnic groups, identifying the tendency of individual ethnic groups to cluster together at the neighbourhood scale. The second set of analyses examines the spatial pattern of concentration of ethnic groups at the scale of electoral wards. It demonstrates considerable differences in the geographical location of white people and people from minority ethnic groups, with South Asian groups tending to concentrate in wards in which minorities constitute a large percentage of the resident population. A cluster analysis classification of wards was used to demonstrate that different ethnic groups tend to live

in wards with contrasting socio-economic characteristics. White people form a larger part of the population in more rural areas and traditional industrial areas, while minority ethnic groups are more strongly represented in areas of high unemployment and overcrowding.

The third approach is concerned with measuring the extent of spatial segregation of individual ethnic groups. Segregation indices are calculated using data at the enumeration district scale, for all local authority districts in Great Britain. The paper presents tables of the most segregated local authority districts for individual ethnic groups. The results of calculating the Index of Dissimilarity are compared with those yielded by the P\* index of isolation for each ethnic group. The reasons for the different results yielded by the two measures are investigated. The paper suggests that the Index of Dissimilarity tends to reflect the absence of an ethnic group in a particular area, while the isolation index is more useful in the British context, highlighting areas in which significant representations of individual ethnic groups in which these groups are highly concentrated in space.

**Philip REES, Deborah Phillips and Dominic Medway (University of Leeds)**

**The socioeconomic position of ethnic minorities in two Northern cities.**

For the first time, a British Census has provided not only data on ethnicity but has crossclassified ethnic status by a variety of socioeconomic indicators in the Local Base Statistics of the 1991 Census. This paper explores the patterns revealed by these new data.

Section 2 of the paper outlines the spatial distribution of six ethnic groups: Whites, Blacks (an aggregation of three groups), Indians, Pakistanis, Bangladeshis and Others in two Northern cities - Leeds and Bradford. Non-white groups all show a familiar inner city concentration but with some interesting locational differences. The section also looks at the degree of change over the 1981-91, utilising synthetic estimates of ethnic group for 1981 based on country of birth (COB) converted into ethnic group using conditional probabilities of ethnicity given COB. The degree of spatial change and dispersion is evaluated.

Sections 3 and 4 then examine the socio-demographic characteristics of each ethnic group using some 30 indicators grouped into six domains: demographic, household, employment, education, social class and housing/consumption. The rationale for indicator extraction and use is first described and the degree of reliance which can be placed in the statistics is assessed. The differences in profile between ethnic groups are established at city level first, and then the pattern of

variation across wards in each city is described. A fascinating picture unfolds of disadvantage and advantage across the ethnic groups which establishes their socioeconomic position in the two Northern city societies.

The ranking of the ethnic groups differs from domain to domain. The simple picture of white advantage and non-white disadvantage must be abandoned. The Indian group and to some extent the composite other ethnicities group are close to whites on many indicators while Bangladeshis are very disadvantaged. Pakistanis and Blacks are more misadvantaged than whites, Indians and Others. One surprising finding is that in most wards whites have the highest percentages of households with no car available. This points up the need to standardise the socioeconomic measures for determining household and individual attributes (particularly age and household size). This standardisation can be accomplished, it is hoped, through careful use of SAR and national crosstabulations in future work.

**Steve SIMPSON (City of Bradford Metropolitan Council)**

**Measuring and coping with local under-enumeration**

Incomplete enumeration in the 1991 Census is not a critical limitation when put in the context of the overall quality of 1991 Census output. The shortfall between the number of usual residents according to the Census output and the total number of usual residents in Britain is in fact smaller in 1991 than in 1981.

Nonetheless under-enumeration in 1991 has already been a major issue, for two reasons. The traditional means of measuring the completeness of enumeration, the Census Validation Survey, was not successful in 1991. Secondly, assessment of the geographical distribution of the under-enumeration has not been conclusive. Thus allocation of resources on the basis of official mid-1991 population estimates must be regarded as approximately related to need.

OPCS has made assumptions about the age, gender and broad geographical distribution of under-enumeration in the preparation of its final mid-1991 population estimates, deriving 'raising factors' to reflect the under-enumeration in each population sub-group. This and other evidence about local levels of under-enumeration in the 1991 Census is reviewed. Local here refers to subnational areas, including Local Authority Districts and smaller areas.

Users need to be aware of the sizeable under-enumeration of some sub-populations (for example OPCS estimates that more than 20% of all males in their 20s were missed across the major city areas in London, metropolitan and non-metropolitan Districts).

Practical guidance is also needed on how to adjust census output for under-enumeration when it would be misleading not to do so.

Using the OPCS 'raising factors', the impact of adjusting census output on various common social indicators is explored. This is achieved by weighting census output, for example of the number and percentage unemployed, by the raising factor specific to each age, sex and geographical area.

The results quantify how such adjustments affect comparisons of local social conditions. In general, contrasts of social conditions between urban and other areas are understated if the census is not adjusted for its incomplete coverage. Thus allocation of resources on the basis of census variables should use adjusted statistics. National estimates are also affected.

Further studies may indicate other characteristics of those missing from Census output - that is apart from their age, sex and broad geographical distribution. Such results would help guide interpretation of census results which remains in doubt in many applications, for example those relating to households and to comparisons between very local areas.

**John STILLWELL, Oliver Duke-Williams and Philip Rees (University of Leeds)**

**The spatial patterns of British migration in 1991 in the context of 1981-91 trends**

Migration is measured in the 1991 Census through a question on place of residence one year before. A similar question was asked in the 1981 Census. In between, there were nine years in which no equivalent question was asked nationally. However, an administrative register, the National Health Service Central Register (NHSCR) is used by the Census Office (OPCS) to produce counts of NHS patients re-registering in different Family Health Service Authorities (FHSAs). The NHSCR movement data can be used to establish how unique or typical the migration occurring in the year prior to the Census was in relation to that for the whole decade. This monitoring is important because of the fluctuations in the volume and distribution of migration flows from year to year which are illustrated in the paper.

The second part of this paper describes a database system called TIMMIG, that provides access to the NHSCR time series of inter-FHSA migration from 1975-76 to the current year and a parallel mid-year population estimate series. TIMMIG provides researchers with highly flexible control of output of in-, out- and net migration indicators desegregated by age and gender for FHSAs or any aggregation thereof.

The third part of the paper describes examples of the valuable information that can be extracted from the database. National time series of migration levels are examined and changing spatial patterns of net and gross migration at different regional scales are identified. In particular, the shifts in position of North and South from the end of the 1980s are identified. Although the situation fluctuates from year to year with the economic cycle, "drift to the South" is no longer an accurate description. In addition, the value of using TIMMIG for local analysis is demonstrated through a more detailed analysis of migration flows within, into and out of Yorkshire and Humberside.

The fourth part of the paper looks in detail at the two migration data sets for 1990-91. At the time of writing, information on in-migration only is available from the 1991 Census Local Base Statistics. Comparisons are made between the levels of in-migration to FHSA areas recorded in the 1991 Census and in the 1990-91 NHSCR using aggregate data but also using data by quinary age group and gender. Because it is possible to deduce 'student migration' from the 1991 Census, the two data sets are conceptually closer than in 1980-81. The paper reports on the closeness of fit of the two data sets and on where the greatest differences occur. In general, the fit between the two data sets, though still high, is lower in 1990-91 than a decade earlier.

David STOTT (The University of Luton)

#### Ethnic Differentials in Limiting Long-term Illness Reporting: A Case Study of South Bedfordshire

The 1991 Census included two new questions on ethnicity and limiting long-term illness. While it is straightforward to calculate crude limiting long-term illness reporting rates for the different ethnic groups, these rates are difficult to interpret since they refer to populations with wide variations in age structure. The County Reports do not contain any breakdown of the 'ethnic illness' by age/sex. However overall age/sex specific illness rates can be calculated from the Census. Since these rates have to be applied to residents, they have to include residents in households and in communal establishments. These age specific rates can then be used to generate Standard Limiting Long-term Illness Reporting Ratios (Standard LLIR Ratios) using the same demographic method that is applied to mortality data to generate Standard Mortality Ratios.

The Standard LLIR Ratios for ethnic groups in South Bedfordshire reveal wide differentials between ethnic groups and between sexes within the same group. The ratios are highest for the Bangladeshi population (males 240.2, females 175.9) and lowest for the Chinese population (males 68.5, females 73.4). The rates for the White population are 96.0 (males) and 97.4 (females).

While further research is needed to enable adjustment to be made for variations in social class, housing circumstances etc., the scale of these raw differentials suggests that additional research must also focus on the general 'validity' of these reporting rates. How far do they represent cultural interpretations of illness rather than objective health differences? Are they unduly influenced by the perceptions of the member(s) of the household that completed the Census form?

Ian TURTON and Stan Openshaw (University of Leeds)

**A UNIX based diffusion package for accessing the 1991 Sample of Anonymised Records**

The remit of this ESRC funded UNIX based project is to develop portable data access software and SAR data that could be distributed via FTP over JANET to any UNIX workstation with sufficient disk space. The software and associated databases will be distributed by the Census Microdata Unit at Manchester University as an alternative means of accessing the SARS and as a complementary supplement to the SAR services provided at Manchester. It is regarded as essential that the system should be easy to use and possess some value added functionality.

It is axiomatic that the system should provide a fast response to table requests. A size adaptive sampling approach has been developed to meet this objective, with the sampling fraction being modified to yield real-time results on different speed platforms.

There is a comprehensive table design capability able to handle up to 10 way tables (ie 10 variables crosstabulated simultaneously) with the variables being grouped or recoded in any arbitrary manner. Standard recode lists are provided to make it as easy as possible for the user to create standard tables. Additionally, some basic tabled data visualisation tools are provided. It is also important to draw the user's attention to those parts of the table where the reported counts are likely to be so unreliable as to be useless. Sparsity is another problem. With the SARS it is expected that even seemingly mild levels of data disaggregation will produce massively empty tables. Therefore a semi-automated table design process is offered. The user specifies the crosstabulating variables and the proportion of non-zero results required; and the auto-table designer attempts to meet the stated requirements.

In addition to normal boolean database queries a fuzzy search is provided. This is based on a probability that a particular record meets the stated "select if" criterion even when it would fail the criterion if applied deterministically. Fuzzy searching in USAR is implemented by the user specifying a template or ideal set of values and then requesting the identification of cases that have a certain fraction of the variables in common (ie 4 out

of 8) but not necessarily all of them. Further facilities are provided to allow a user to "explore" the database by specifying a variable value of interest. The program will then produce a list of variables which match records of this type most often. The user can repeat this process until either something of interest is discovered or no further records match.

Tony WARNES and Reuben Ford (King's College, University of London)

**A Synthesis of Census and Survey Evidence on Migration and the Differentiation of Old Age in Great Britain**

Analyses of data from the 1980-81 census round in the USA and UK, of continuous registration data in the Netherlands and the UK (the FHSA data) and of survey data has led to the formulation of hypotheses about the age-migration propensity relationship. In particular, notions have developed that two departures from the exponential decline of migration with age are found in contemporary affluent societies: a retirement peak of long distance moves undertaken predominantly by relatively prosperous married couples in good health; and a 'late age slope' of rising migration propensity after the mid-70s, comprising mainly short distance housing adjustments.

Our current research is investigating the extent to which distinctive migration patterns can be identified between early and late old age. Is it the case that an unusually high proportion of moves very late in life are short distance and therefore have relatively little impact on the demand for social and health services as between settlements and health authority areas? In which areas are the inflows of people around retirement age an unusually large share of the relatively long distance in-migration? To what extent can compensating return migrations at late ages be identified?

In advance of publication of the 1991 census migration origin-destination data, analyses have been undertaken of the changing distribution of the older population of Great Britain by three age groups. These provide evidence of change in the favoured destinations for retirement peak migrations, but less of distributional effects of moves in advanced old age. Some signs of a modest concentration of very old people in certain prosperous metropolitan suburbs are detectable, but a stronger effect is that of ageing-in-place. The reduction of the rate of young adult household formation since the early 1970s, and the virtual cessation of population displacements associated with planned housing estates and new and expanded towns may be leading to more systematic metropolitan age structure distributions. Migration propensities by age and the geographical type (ie distance class and to and from urban areas) have also been analysed using the 1991 Local Base Statistics. Profiles of

migration into a number of districts of South East England are presented.

The propensity of people to move in advanced old age has also been investigated as part of an ESRC research project on "Residential Mobility in Later Life". This is focusing on decisions to move in later life with particular reference to (a) the extent to which people develop and act upon a strategy for the entire anticipated period of their retirement, and (b) negotiation among household members, most commonly a husband and wife, and the resolution of inconsistent perceptions of the advantages and disadvantages of moving and of particular locations. Preliminary findings from this study on the housing and locational aspirations of people for both the early and late phases of retirement will be in the light of the 1991 census evidence and the FHSA patient re-registration data for the late 1980s. In particular, the dispersion of the destinations of young retired migrants and the geographical patterns of migration in advanced old age are reviewed. The distributional impacts of the accomplished and anticipated rapid growth of private sector residential homes for elderly people are assessed.

**Paul WILLIAMSON, Mark Birkin and Phil Rees (University of Leeds)**

**The simulation of whole populations using data from small area statistics, samples of anonymised records and national surveys**

The demand for detailed small area population estimates made by researchers, policy makers and others often far exceeds the level of detail released in existing Census output, particularly when there is need to extend the set of attributes being considered to include key variables, such as income, not measured in the Census. This paper sets out a new approach, A Genetic Algorithm for Population Estimation (AGAPE), which yields highly detailed small area population estimates onto which non-Census attributes may readily be appended.

The approach described adopts a list of processing methodology, whereby individuals and households are represented as lists of attributes, much as they are in data sources such as the Samples of Anonymised Records (SARs). In this sense AGAPE has more in common with population estimation techniques such as microsimulation, rather than with more traditional count based solutions. By storing population estimates as attribute lists, highly flexible tabulations may be derived, ranging from simple individual attribute tabulation (eg age by sex), to much more complex tabulations combining elements of both household and individual attributes (eg ethnicity of head of household by number of pre-school children in household).

AGAPE estimates small area populations by selecting a combination of households (and their individual members) from the household SAR which best fit known small area data constraints. For each combination of households, the relevant SAR data are aggregated into Census Small Area Statistics (SAS) look-a-like tables and evaluated for goodness of fit. The selection of an optimal

solution is driven by a genetic algorithm, which rapidly yields a result without first having to evaluate every possible combination of households contained in the SAR. In the paper, various alternative test statistics are considered and rejected, before the adoption of Absolute Relative Error (ARE). A generalised solution is also presented to the common problem of aggregating list data into pre-determined tabulations, needed for solution evaluation as described above.

Having obtained an estimate of the small area population in terms of Census/SAR based on attributes, attention is turned to the inclusion of another, non-Census, attribute. Income is added to the core population estimate, using Mote Carlo sampling of a conditional probability derived from the combination of General Household and Family Expenditure Survey data. The probability estimation involved draws heavily upon iterative proportional fitting.

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#### A meta-database of census variables and tables

When searching for a desired cross-tabulation amongst published 1981 Census data, researchers could (just) trust to their memory of the fifty odd SAS tables available. However, the wealth of information contained in the LBS/SAS tables for 1991 means that exhaustive searching for a desired distribution has become practically impossible without use of a referencing tool (whether published or machine-readable). Although OPCS User Guides such as numbers 24, 25 and 38 and other sources do provide fully exhaustive or comprehensive coverage, none provides fully exhaustive or comprehensive coverage. Hence, not only has it been previously impossible to reference a particular cross-tabulation of age by any other variable, or of age by a given age grouping, but the lists of tables containing age classifications have themselves generally been incomplete.

After attempts to obtain the requisite information from other sources, the conclusion was finally reached that a 'bespoke' meta-database needed to be created from scratch. This paper describes the result, MetaC91, a meta-database of Census contents for LBS and SAS tables.

MetaC91 allows for searching upon keyterms (such as age) or upon more detailed variables (eg specific age groupings), as well as upon table type, level of spatial resolution and population base. In this way users of MetaC91 are enabled to uncover the existence (or non-existence) of LBS or SAS tables suitable for answering very specific queries . MetaC91 has been compiled on a PC database package called Idealist and a read-only version is available "free" to all users (barring basic reproduction costs), in either a Windows or DOS version. This paper sets out a number

of examples of the database in use, providing some idea of the scope (and the limitations) of the package, along with some more technical specifications.

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highlights the extent to which there has been a change over time in the characteristics of those living in the various tenure groups and highlights, for example, whether there is now greater or less polarisation in the characteristics of owner-occupiers versus local authority tenants.

**Angela DALE (Census Microdata Unit, University of Manchester)  
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#### The OPCS Longitudinal Study

The OPCS Longitudinal Study (LS) is based upon data from the 1971, 1981 and 1991 Censuses with information from vital events (births, cancers, deaths) routinely collected by OPCS for a 1% sample of the population of England and Wales. Initially, all people born on one of four dates each year and enumerated at the 1971 Census were selected for the study. From 1971, the LS has been updated as new births occur on one of these four dates each year and as immigrants with these birth dates register with the National Health Service. The fully linked dataset will be available in Spring 1994, giving longitudinal census data for three time points for many members of the study. While census data are also available for other individuals living in the same household the LS does not "follow up" household members from census to census.

In addition to its original use for research into health inequalities, the LS has been used by those working in the area of geography, demography, epidemiology and sociology, in the UK and abroad. The inclusion of a large number of area-based variables facilitates a wide range of area-based and migration analyses. Once the 1991 Census data are linked the LS will include information on the usual address in 1966, 1970, 1971, 1980, 1981, 1990 and 1991, and it will serve as a unique data source providing migration data over this period.

The LS receives support from the ESRC to facilitate the use of the data among the academic community. This funds a team of researchers working on the LS Support Programme at the Social Statistics Research Unit (SSRU), City University. Members of the LS Support Programme are involved, in collaboration with OPCS, in promoting and facilitating academic access, providing documentation and user support. Training activities include the regular 2-day LS Workshops, held three times a year and ad-hoc seminars, such as the recent series to publicise the research potential of the linked 1991 Census data. SSRU also maintain an LS User Group which provides a forum for the exchange of news and information on the LS. There is annual meeting of the *LS User Group*, organised by SSRU and a thrice yearly newsletter *Update - News from the LS User Group*.

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### Is it cash the deprived are short of?

In using Census data, a range of indicators are commonly used to indicate deprivation or affluence. Examples include no access to a car (Carstairs and Townsend indices), not owner/occupied (Townsend index) and unemployment (Jarman, DoE, Townsend and Carstairs indices). This paper attempts to examine the validity of these indicators by exploring how well they predict income in survey data in which income data is also available. Two surveys are used: the Family Expenditure Surveys (FES - for 1983 and 1990) and the General Household Survey (GHS - for 1984).

Income is measured by the log of net household equivalent income, and the unit of observation is the (adult) individual. Regressions are estimated to examine how well a range of indicator variables predict the net equivalent income of the household to which an individual adult belongs, or the log odds of their falling below an arbitrary poverty line. These variables include housing tenure, car ownership, lone-parenthood, skill level and unemployment. Coefficients appear reasonably stable across sex, and the three surveys.

We found that a reasonably parsimonious set of seven socio-economic variables (as well as controls for age and region) explain about 35%-45% of the variation in income. Our regression parameters provide a set of weights for a deprivation index. The data offer no support for the practice of assigning equal weights to the indicators.

Our results confirm the importance of car access and housing tenure as indicators of deprivation. Unemployment and economic activity are also important indicators of deprivation, but skill level, though significant, plays only a minor role. Household composition effects also have a role to play. These correlates of low income resemble those of mortality. This association with mortality differentials arguably reinforces the common practice of equating disadvantage, poverty and low living standards with census indicators of social deprivation.

Do the census indicators of deprived circumstances indeed coincide with the lowest income group? Not entirely. Of people whose actual income puts them among the 20% worst off, half to two thirds would also be classified as among the 20% most 'deprived'. Likewise the same proportions of the most deprived fall into the bottom income group. These results suggest that a census-based proxy would miss a sizable minority of the actual poor, and misclassify some with higher incomes. A majority of the 'deprived' are poor by a cash yardstick, but some are not.



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