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THE SPECIAL MIGRATION STATISTICS:  
A VITAL RESOURCE FOR RESEARCH  
INTO BRITISH MIGRATION

**Phil Rees and Oliver Duke-Williams**

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**THE SPECIAL MIGRATION STATISTICS:  
A VITAL RESOURCE FOR RESEARCH INTO BRITISH MIGRATION**

**Phil Rees and Oliver Duke-Williams**

**September 1994**

School of Geography  
University of Leeds  
Leeds LS2 9JT

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## **ABSTRACT**

This paper describes a new data set from the 1991 Census called the Special Migration Statistics. These consist of interaction data of some complexity. Before they were released for general use by the UK social science and geographic community, it was essential to understand and to thoroughly check the data. Checks of two kinds were carried out: external and internal. The external checks involved comparison of counts of migrants resident in an area (wards/postcode sectors in SMS Set 1, districts in SMS Set 2) with those previously published in the 1991 Census Small Area Statistics. The internal checks compared migrant totals (e.g. total out-migrants to rest of Great Britain) with the sum of area to area flows (e.g. sum of out-migrants to all wards in England and Wales and to all wards in Scotland). The SMS passes the full set of tests and users can be confident when using the statistics to describe migration in Britain in the year prior to the 1991 Census. However, the checks proved invaluable in uncovering errors of data transmission which occurred during the transfer of the multtape files, and the checking program developed will prove invaluable for users in the period prior to the creation of a full SMS database accessible via a commercial software package. The software is described in the paper and examples of its use outlined. Finally, the paper summarises the pattern of migration revealed by the statistics for two illustrative spatial systems: wards in a large northern city and regions in Great Britain.

## **ACKNOWLEDGMENTS**

Lak Bulusu and Celia Curtis of OPCS and Keith Cole of MCC have kept us supplied with suggestions for new checks to carry out on the SMS. To them we owe many thanks.

The work was carried out on the new Cray Superserver provided by JISC for the National Datasets Service at Manchester Computing Service. This computer makes the analysis of files of size 0.9 and 0.4 gigabytes seem a simple exercise.

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All of the migration data referred to in this paper are Crown Copyright, supplied through the ESRC/JISC Census Programme.

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## 1 BACKGROUND

On April 21 1991 the latest in a long line, stretching back to 1801, of decennial censuses of population of the United Kingdom was administered. The period between May and December saw the Census Offices (Office of Population Censuses and Surveys or OPCS, the General Register Office Scotland or GRO(S) and the Census Office for Northern Ireland or CONI) busy entering the household and institution forms into computer files and carrying out the editing, imputation and checking procedures. In December 1991 the first machine readable datasets from the 1991 Census were due for publication, but this had to be delayed until July 1992 because of problems with the interpretation by respondents of questions on primary and secondary economic position if they were students. From July 1992 to February 1993, the primary Small Area Statistics and Local Base Statistics were published for standard areas in Great Britain, county by county in England and Wales and Scottish region by region in Scotland. At the same time the County Monitors and Reports and the National Topic Monitors and Reports were published, a process which has continued into 1994. These publications, in printed and computer readable form constitute the general statistical output from the 1991 Census.

The period since July 1993 has seen the publication of a variety of more specialist datasets, including Small Area Statistics for secondary areas (e.g. postcode sector SAS for England and Wales), the Samples of Anonymised Records. The most recent specialist datasets to be published were the Special Workplace Statistics (SWS) and the Special Migration Statistics (SMS), which report on two types of interactions - the journey to work in the week prior to the 1991 Census and the changes of residence over the year prior to the 1991 Census.

How do these data become available for researchers in the UK academic community? Firstly, University Libraries purchase copies of the printed output from the 1991 Census. Secondly, the Economic and Social Research Council (ESRC) together with the Joint Information Systems Committee (JISC) of the Higher Education Funding Councils (HEFCs) and the Department of Education Northern Ireland (DENI) have purchased and licensed from the Census Offices most of the machine readable datasets produced from the 1991 Census. These purchases are organised in the ESRC/JISC/DENI 1991 Census of Population Programme (usually shortened to ESRC/JISC Census Programme for convenience) which funds not just the data costs, but also supports units at UK Universities to maintain and disseminate the data to members of recognised institutions, free at the point of use in return for agreement by the user of the conditions agreed with the Census Offices for use.

In particular, the ESRC/JISC Census Programme has purchased and provided the Special Migration Statistics for general use in the academic community. The Special Migration Statistics (SMS) were delivered to the Census Dissemination Unit at Manchester Computing Centre in April 1994 and were resupplied in part in August 1994.

Before their release to academic users, the ESRC funded Analysis of Migration project at the University of Leeds (Phil Rees, John Stillwell, Oliver Duke-Williams) carried out a series of validation checks to ensure that the dataset is accurate and fully specified. Section 4 of this paper describes the sequence of tests carried out and their results.

In sections 2 and 3 of the paper we provide a description of the dataset using diagrams so that potential users of the data can gain a proper understanding of the Special Migration Statistics. Section 2 provides a brief synopsis of the official description of the datasets, while section 3 tries to expand this description to unravel some of the complexities involved. Section 4 reports of the checks carried to verify the SMS data, while section 5 provides a series of illustrations of the kinds of migration tables that can be extracted from both SMS, set 1 and SMS, set 2.

The Appendices to the paper set out a description of the software, written by Oliver Duke-Williams, for accessing the SMS and producing lists of flows and associated tables for areas and matrices of flows for sets of origins and destinations. This software is designed to be used by researchers using the SMS, until it is replaced by more fully functional database software, currently still being negotiated. Appendix 1 provides a guide to the software, called **smstab**. Appendix 2 contains the UNIX manual pages for **smstab**.

## **2 THE SPECIAL MIGRATION STATISTICS OFFICIAL DESCRIPTION**

Full details of the organisation and content of the Special Migration Statistics are given in OPCS and GRO(S) (1993a, 1993b and 1993c) and summarised in Flowerdew and Green (1993). The Special Migration Statistics do not constitute a single fixed dataset. Rather, as released by the Census Offices, they constitute the output of a compilation program driven by the purchaser's specification of the areas of migrant origin and the areas of migrant destination.

The ESRC/JISC Census Programme is the largest customer for the SMS. The requirement was to purchase a dataset that covered the whole of Great Britain for a common set of geographical units. The decision was taken that these units should be wards within England and Wales and postcode sectors within Scotland. These 10,933 units were chosen as the smallest available for SMS Set 1, for which Small Area and Local Base Statistics would also be available at the anticipated time of release. This rules out the use of Scottish wards for which only SAS were published. The areas selected for SMS Set 2 were the 459 local government districts of Great Britain.

Here a simple summary is provided of the SMS procured by the ESRC/JISC Census Programme. The SMS are provided as two datasets: (1) SMS1 provides migration flow statistics for wards (England and Wales) and postcode sectors (Scotland), and (2) SMS2 provides migration flow statistics for districts in Great Britain.

### **2.1 The Special Migration Statistics, Set 1**

This dataset consists of counts associated with the migration flows between the wards of England and Wales and the postcode sectors of Scotland. There are 10,933 units involved (8,895 wards in England, 945 wards in Wales and 1,003 pseudo-sectors in Scotland). Associated with each flow are a set of 2 Tables containing 12 counts described in detail in User Guide 35. The contents of the tables are given in Figure 1. Only Tables 1 and 2 have been produced for SMS Set 1.

The dataset includes all flows between postcode sectors in Scotland and wards in England and Wales, as well as flows within Scotland and within England and Wales.

### **2.2 The Special Migration Statistics, Set 2**

This dataset consists of counts associated with the migration flows between the districts of Great Britain. There are 459 districts involved (366 districts in England, 37 in Wales and 56 in Scotland).

Associated with each flow are between 85 and 87 counts (85 for flows with a destination in England, 86 in Wales and 87 in Scotland). The counts are organised in 10 tables in England and 11 in Wales and Scotland. The contents of the tables are given in Figure 1.

**Figure 1.** Table outlines from the Special Migration Statistics  
 Source: OPCS (1993b). Crown Copyright

**Table 1 All Migrants: age (5 broad age groups) by sex**

*100% Sample*

Age	Male	Female
1-15	1	2
16-29	3	4
30-44	5	6
45-Pens.age	7	8
Pens. age+		

**Table 2 Wholly Moving Households and residents in Wholly Moving Households: counts**

*100% Sample*

Wholly moving households	Residents in wholly moving households
1	2

**Table 3 All Migrants: age (5 year groups) by sex**

*100% Sample*

Age	Male	Female
1- 4	1	2
5- 9	3	4
10-14	5	6
15	7	8
16-19	9	10
20-24	11	12
25-29	13	14
30-34	15	16
35-39	17	18
40-44	19	20
45-49	21	22
50-54	23	24
55-59	25	26
60-64	27	28
65-69	29	30
70-74	31	32
75-79	33	34
80-84	35	36
85+	37	38

**Table 4 All Migrants: marital status by sex**

*100% Sample*

Sex	Single	Married	Widowed/ Divorced
Male	1	2	3
Female	4	5	6

**Table 5 All Migrants: ethnic group**

*100% Sample*

White	Black groups	Indian Pakistani and Bangladeshi	Chinese and Other
1	2	3	

**Table 6 All Migrants: whether resident in households by whether suffering limiting long term illness***100% Sample*

	with limiting long-term illness	Without limiting long-term illness
In Households	1	2
Not in Households	3	4

**Table 7 All Migrants Aged 16+: economic position***100% Sample*

Self employed	Other employed	Unemployed	Retired	Student (inact)	Other inactive	Student (active)
1	2	3	4	5	6	7

**Table 8 Wholly Moving Households: tenure***100% Sample*

Owner Occupied	Rented from LA/New Town	Other rented
1	2	3

**Table 8 Wholly Moving Households: tenure***100% Sample*

Owner Occupied	Rented from LA	Rented from NT/ Scottish Homes	Other rented
1	2	3	4

**Table 9 Wholly Moving Households: sex and economic position of head***100% Sample*

Sex of Head of Household		Economic position of head of household					
Male	Female	Self employed	Other employed	Un employed	Retired	Other inactive	
1	2	3	4	5	6	7	

**Table 10 Residents in Wholly Moving Households: sex and economic position of head***100% Sample*

Sex of Head of Household		Economic position of head of household					
Male	Female	Self employed	Other employed	Un employed	Retired	Other inactive	
1	2	3	4	5	6	7	

**Table 11 All Migrants: Gaelic speakers***100% Sample*

Migrants resident in Scotland who speak Gaelic

1

**Table 11 All Migrants: Welsh speakers***100% Sample*

Migrants resident in Wales who speak Welsh

1

Tables 1 through 10 are produced for all district to district flows except where the flow falls below a threshold. Table 11 is produced only for districts in Wales (Welsh language) and in Scotland (Gaelic language).

The dataset includes all flows between districts in Scotland and districts in England and Wales as well as flows within Scotland and within England and Wales.

### 2.3 Thresholding and suppression in the SMS

Where thresholding and suppression are applied, the following tables are always supplied: Tables 1 and 2 with SMS Set 1 flows and Tables 1 to 3 with SMS Set 2 flows, except that Table 2 is only supplied for origin-destination pairs within Great Britain.

The thresholds applied are as follows. Tables 4, 5, 6, 7 and 11 are produced only if there are 10 or more migrants present in the origin-destination flow. Tables 8, 9 and 10 are produced only if there are 10 or more wholly moving households present in the origin-destination flow.

## 3 SPECIAL MIGRATION STATISTICS: EXPLANATION

### 3.1 The SMS three dimensional arrays

In principle, the SMS can be regarded as a pair of three dimensional arrays, as depicted in Figure 2. The array dimensions are respectively: origins, destinations and attributes, while the array cell contents are counts of migrants falling in the origin-destination-attribute combinations. The attributes are simply the cells of the tables shown in Figure 1 laid out as vectors.

The Set 1 array has a very large origin-destination face or matrix. The origins are made up of four types of area:

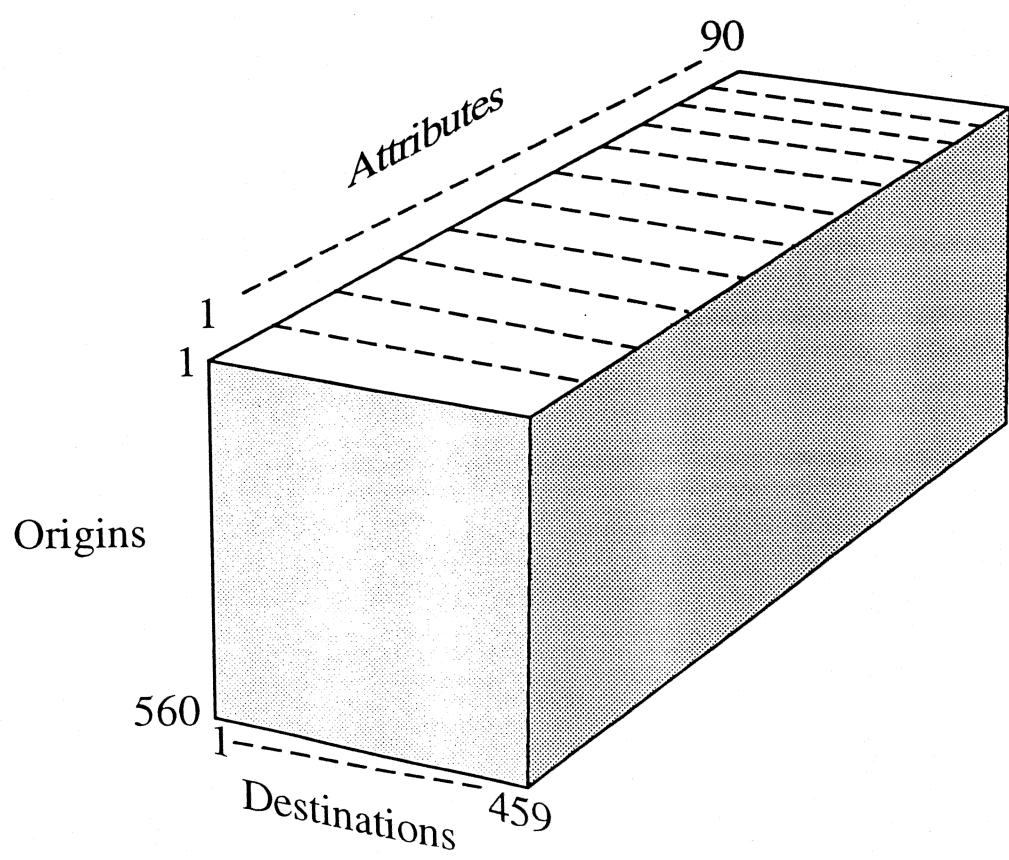
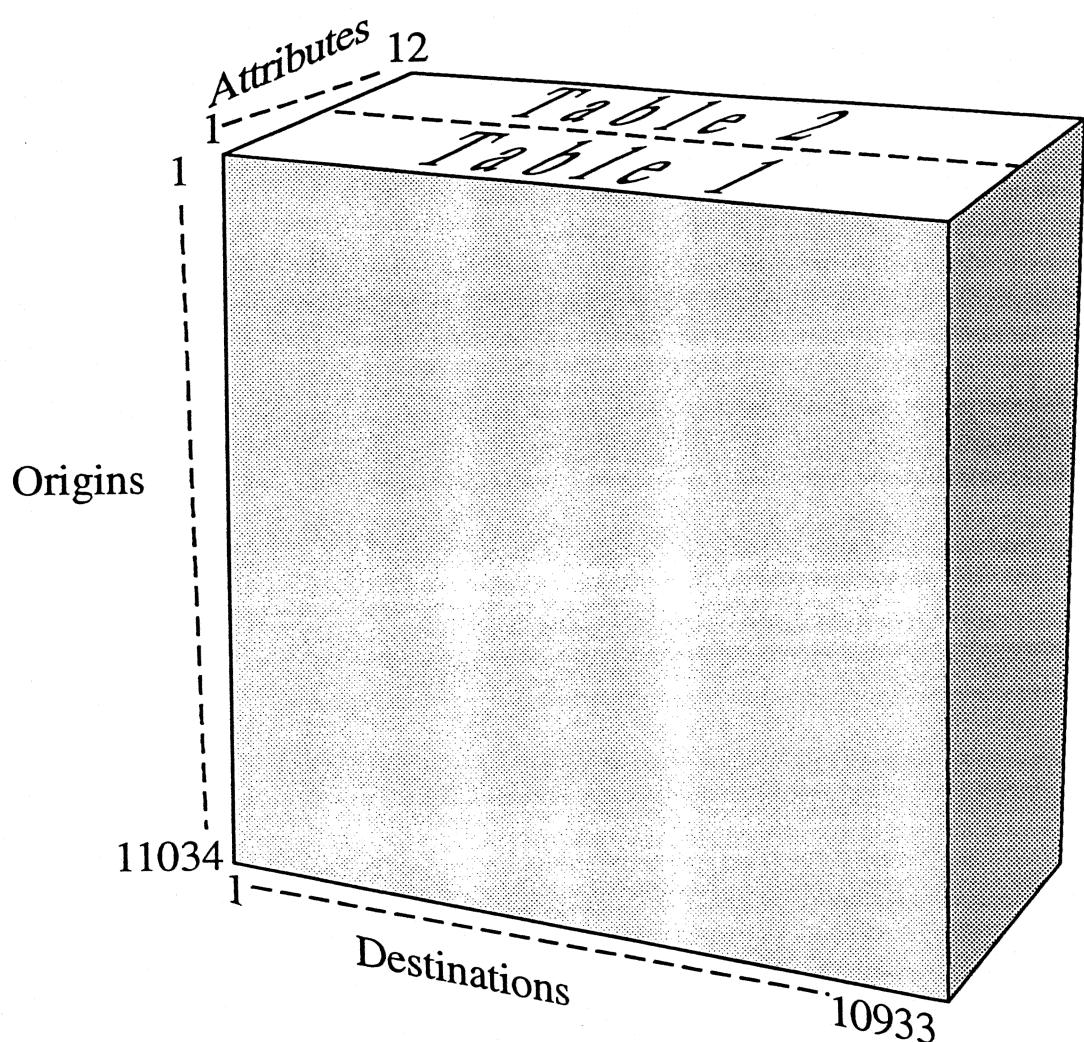
1. the 9930 wards of England and Wales
2. the 1003 pseudo (postcode) sectors of Scotland
3. the 96 areas outside Great Britain (individual countries or groupings of countries or other areas e.g. Northern Ireland).
4. an origin-not-stated category

The destinations are made of the first two types of area listed above. There is no information on migration to areas outside Great Britain, which were not, of course, included in the Great Britain enumeration. The third dimension consists of the age-sex groups of SMS Table 1 and the categories of wholly moving households and residents in such households as shown in SMS Table 2.

The Set 2 array has a much smaller origin-destination face or matrix. The origins are made up of three types of area:

1. the 459 local government districts of Great Britain
2. the 96 areas outside Great Britain (as in Set 1)
3. an origin-not-stated category

**Figure 2**      **The SMS represented as a pair of arrays**



The attribute dimension for SMS Set 2 is considerably larger than that for Set 1 and consists of a maximum of 90 codes (for districts in Scotland) with 89 associated with Welsh districts and 88 with English districts.

### 3.2 Migrant totals in the SMS

The arrays depicted in Figure 2 do not show the row (origin), column (destination) or layer (attribute) totals. No independent layer totals exist in the SMS dataset because you cannot sensibly add counts of migrants from several different classifications. What in practice is done is to sum the cells of Table 1 which provides the total for any origin-destination flow. No other Table sum can be used for reasons which will be made clear in a while.

Figure 3 shows the totals that are provided for the origin-destination-faces (matrices) of both Sets 1 and 2. The origin totals labelled 1 in the diagram (and coded 111111 in the datafile) are the total of migrants from the area of interest (ward or sector in Set 1, district in Set 2) to all other areas in Great Britain. In other words it is the sum of the migrant counts in the origin rows of the matrix, ignoring (i.e. setting to zero) the within area count. Similar destination totals are provided. They are labelled 2 in the diagram (and coded 222222 in the data file) and are the total of migrants to the area of interest from all other areas within Great Britain. These totals are the sum of migrant counts in the columns of the matrix, ignoring or setting to zero the counts of within area migrants.

Further totals are provided for destination areas. Those labelled 3 on the diagram (and coded 333333 in the datafile) are the sum of migrants to the area of interest from all origins outside Great Britain.

The totals labelled 4 on the diagram (and coded 444444 in the datafile) are the sum of migrants into the area of interest from all other migrants including those from origin not stated, but excluding migrants within areas. The total marked 4 is thus the sum of total 2 and 3 plus the count of migrants from origins not stated.

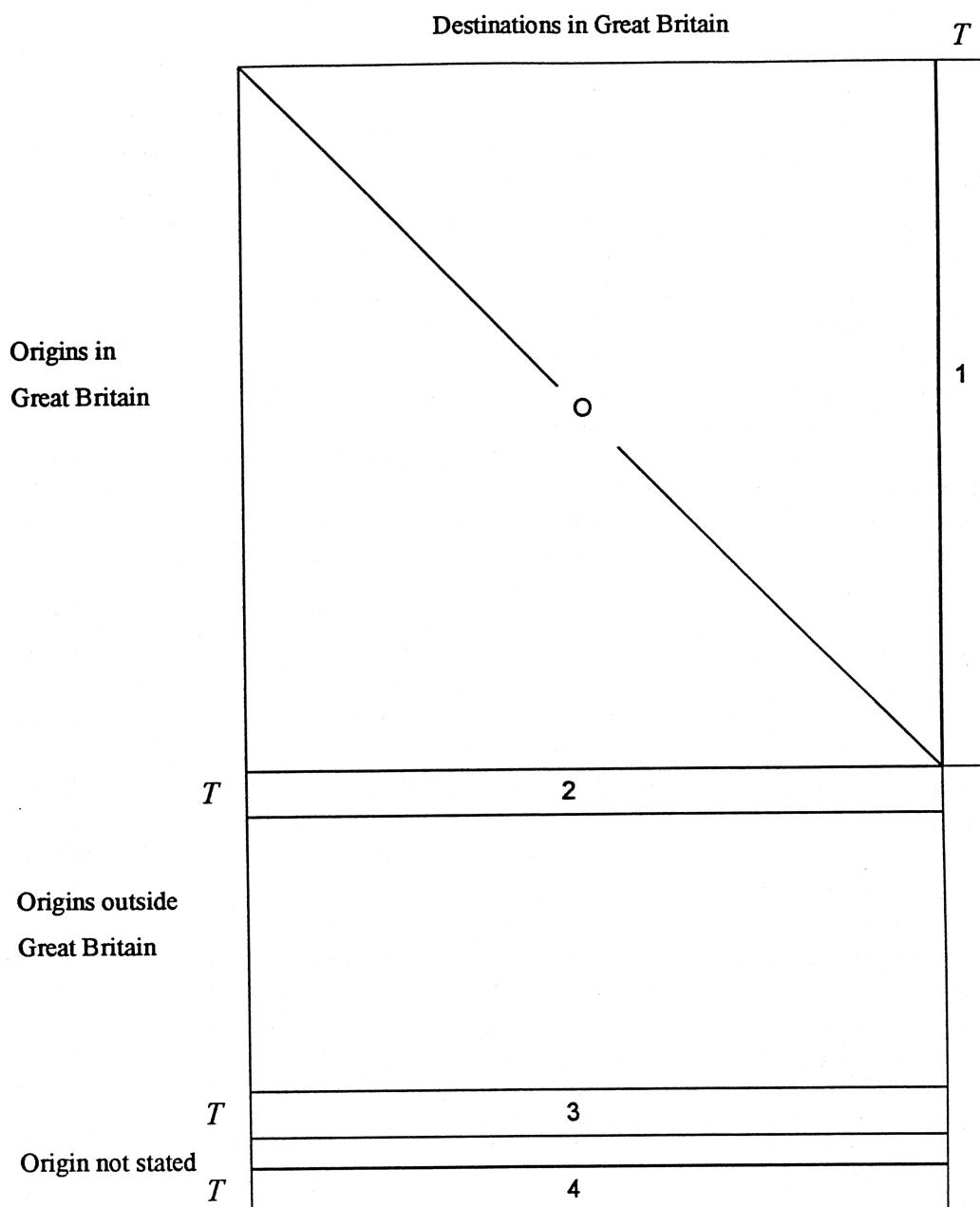
This description suggests that it should be a relatively simple task to load the two arrays shown in Figure 2 into suitable database software and so make the SMS available to researchers/students of migration. Unfortunately, this happy and simple picture is darkened by the three clouds of confidentiality thresholding and suppression.

### 3.3 Confidentiality, thresholding and suppression

The Census Offices (the Office of Population Censuses and Surveys with responsibility for England and Wales, and the General Register Office for Scotland) are enjoined by the Census Acts of 1920 and 1990 to maintain the confidentiality of Census data. This essentially means taking precautions to prevent the recognition of individual persons when statistical abstracts such as the SMS are published and then perused by third parties. In particular, the Census Offices are reluctant to publish tables of statistics in which cells with very small counts appear.

The argument has never been accepted by a substantial body of academic opinion. In order for such statistics to be used to reveal anything about an individual, the third party involved has to know about the characteristics *a priori*. The cell count of 1 cannot reveal the name of the individual or household concerned.

**Figure 3** Migrant totals in the SMS



- |          |  |
|----------|--|
| <i>T</i> | Totals   |
| <i>0</i> | Within area migrants   |
| <i>1</i> | Total migrants to other areas in GB                              |
| <i>2</i> | Total migrants from other area in GB                             |
| <i>3</i> | Total migrants from areas outside GB                             |
| <i>4</i> | Total migrants from all other areas including origin not-stated. |

These arguments have made a little headway with the Census Offices. We were able to persuade the Census Offices to regard any statistics classifying migrants by age or sex, or placing them in a wholly moving household as uncontroversial. For Set 1 therefore, the SMS provides counts for all non-empty origin-destination pairs for Table 1 and all origin-destination pairs within Great Britain for Table 2. For set 2, the SMS provides similar counts contained in Tables 1 and 2, and for all origin-destination pairs the counts in Table 3.

So what happened to Table 2 counts of wholly moving households and the residents within them from origins outside Great Britain. They have been suppressed - i.e. not published. The grounds for suppressing such flows but not those within the country are unclear since their magnitude is not much different.

The statistics contained in Tables 1, 2 and 3 were regarded by the Census Offices as uncontroversial. The statistics in Tables 4 to 11 covering the topics marital status (Table 4), ethnic group (Table 5), limiting long-term illness (table 6), economic position (Table 7), tenure (Table 8), sex and economic position of head (Tables 9 and 10) and language (Table 11) were felt to be sensitive. Rules have been adopted to ensure that the tables are made available only for the origin-destination flows involving 10 or more migrants (Tables 5, 6, 7 and 11) or involving 10 or more households (Tables 8, 9 and 10). If the count of migrants or of wholly moving households falls between 1 and 9 then the table is suppressed.

The consequence of these suppression rules is that socioeconomic tables are produced for only a minority of the  $459 \times 459$  origin-destination pairs with non-zero migrant flows in SMS Set 2.

Figures 4 and 5 provide raster images of the SMS 2 dataset. Figure 4 captures flows while Figure 5 represents the flows of wholly moving households. Each figure consists of a rectangular matrix, each element (a small square or pixel) of which represents a flow associated with an origin (row) and a destination (column). The matrix contains 460 columns, (the 459 districts of Great Britain plus 1 total), and 559 rows (459 districts, 96 origins in foreign countries, and 4 totals). The column of totals on the RH side is the number of migrants from the districts to the Rest of Great Britain, whilst the 4 rows of totals are (1) the number of migrants with origin not stated, (2) all migrants to the districts from the Rest of Great Britain, (3) all migrants to the districts from all origins outside GB and (4) all migrants from all origins to the districts.

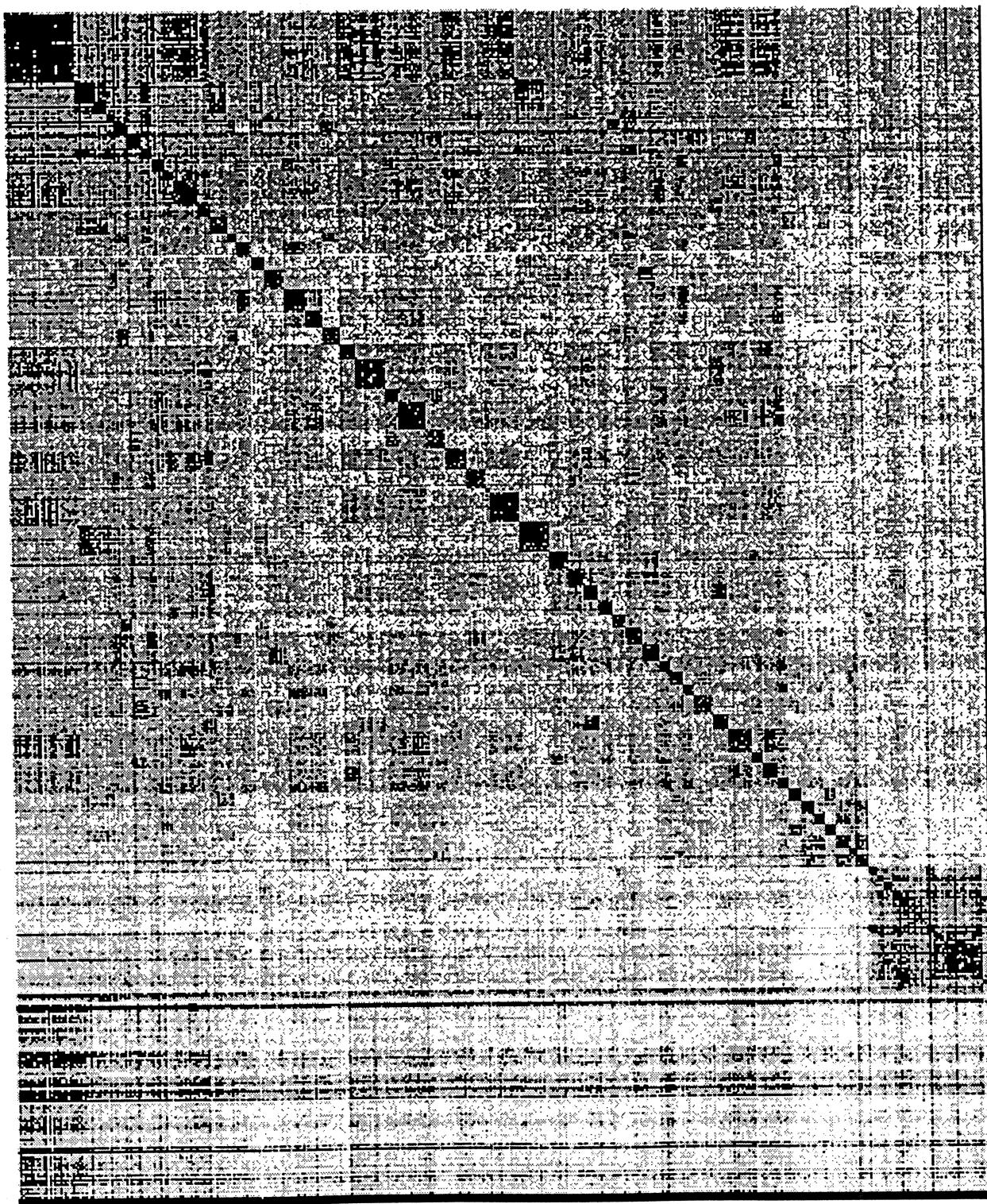
Each cell in the matrix is given one of three shades:

1. white, which indicates that the cell is empty;
2. grey, which indicates the flow count is between 1 and 9;
3. black, which indicates the flow count is 10 or more.

The count refers to individual migrants in Figure 4 and to wholly moving households in Figure 5. It is immediately apparent that a great many cells in both figures are empty - i.e. nobody migrated between the origin and destination pair that the cell represents. The majority of cells are shaded grey and represent a small flow, while a minority are shaded black and contain 10 or more migrants (Figure 4) or wholly moving households (Figure 5).

Note that no information at all is provided about the number of wholly moving households originating outside Great Britain (the white panel at the bottom of Figure 5).

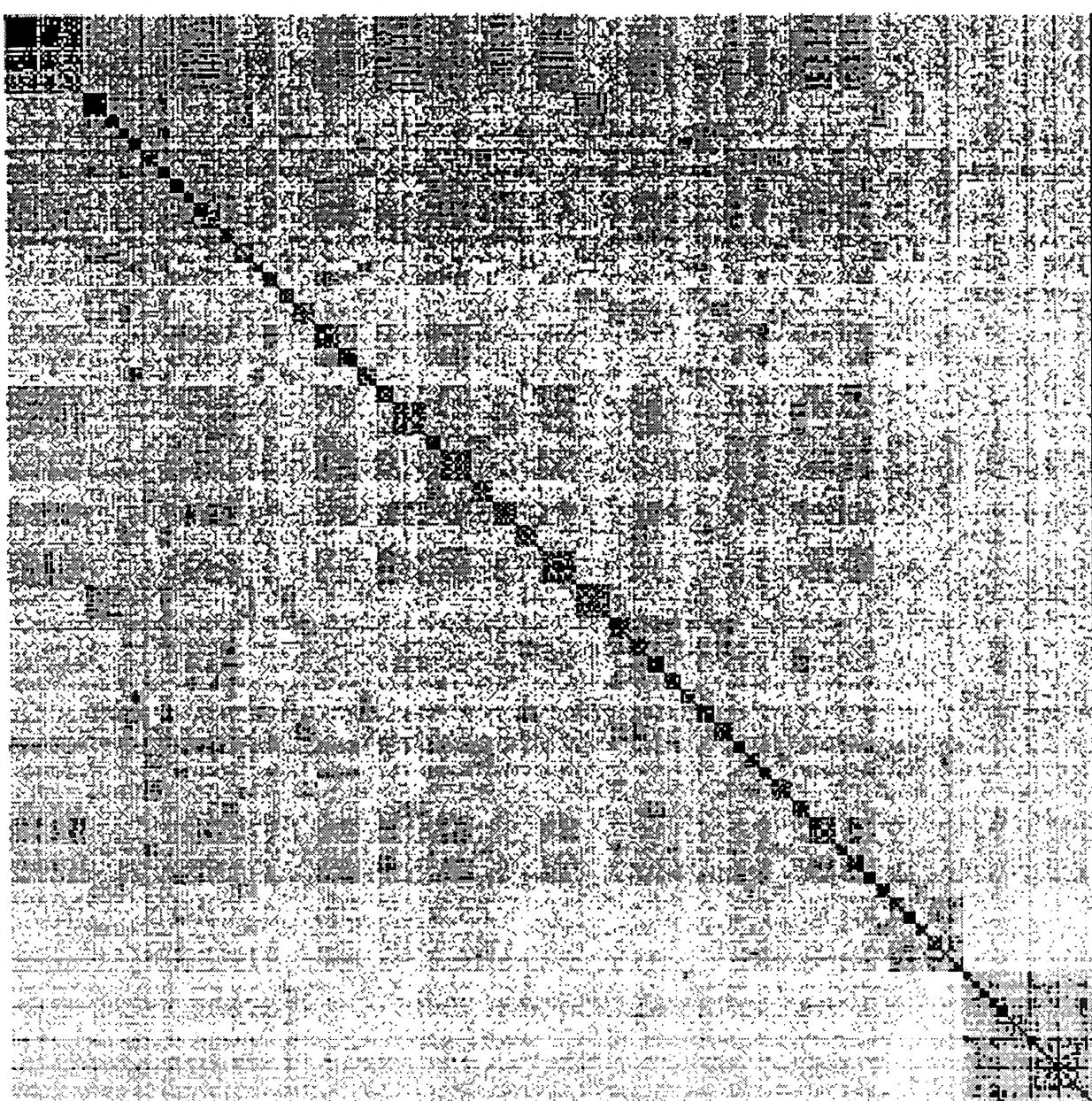
**Figure 4** A raster image of the district level flows of migrants in SMS, Set 2  
Source: 1991 Census. Crown Copyright. ESRC/JISC Purchase



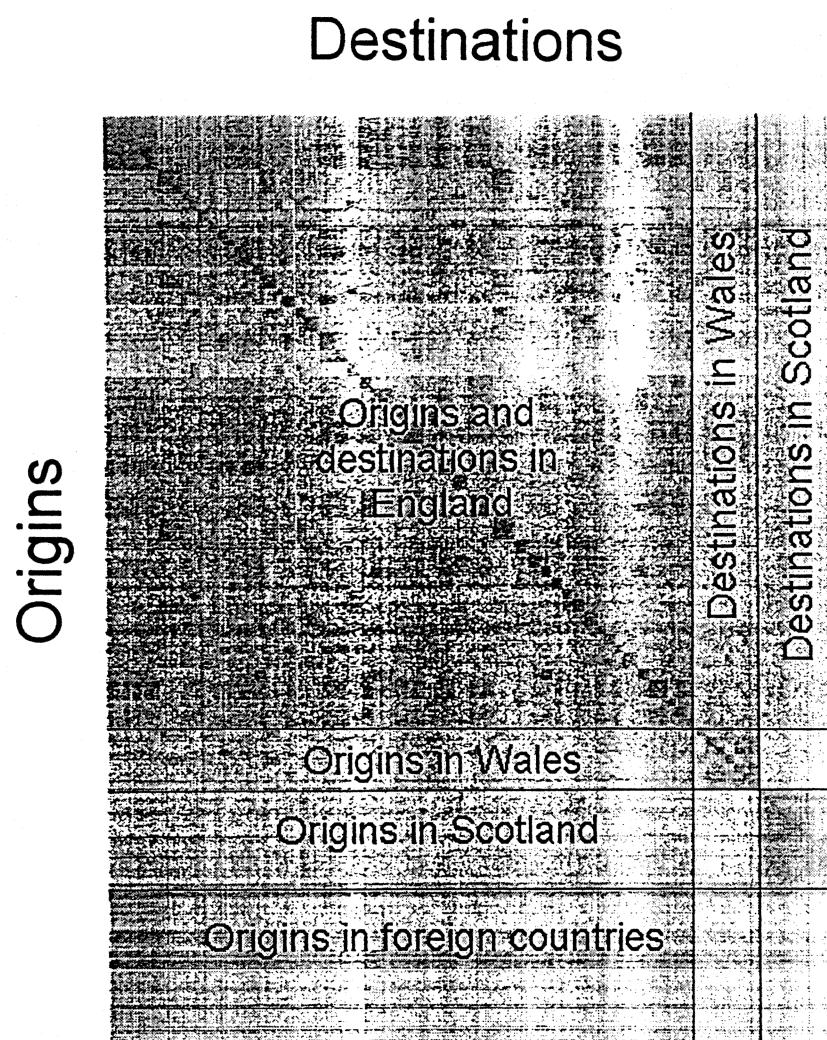
**Figure 5**

**A raster image of the district level flows of wholly moving households in SMS, Set 2**

**Source: 1991 Census. Crown Copyright. ESRC/JISC Purchase**



**Figure 6** A locational key to Figures 4 and 5



The data for Figure 4 was extracted from Table 1 of SMS2 while that for Figure 5 was obtained from Table 2. The figures show where users can expect to find data for Tables 4, 5, 6 and 7 (Figure 4) and Tables 8, 9 and 10 (Figure 5); where the cells are shaded black only. Tables for the grey cells are suppressed.

It is possible to work out what the values of the total of grey cells in any row or column is by subtracting the sum of black cell counts from the totals, which are always provided.

Why does this state of affairs exist in which users are deprived of most of the information about, for example, the flows of migrants in different ethnic groups between districts?

The main argument appears to be that suppression protects confidentiality. Such an argument cannot be supported. Why is it alright to reveal the age and sex group of a migrant but not the ethnicity, marital status or employment status? There is no way of reorganising an individual from either set of statistics. Information can only be used in the opposite direction: if you know a person has moved over the year prior to the Census between one district and another and you also know their characteristics, then you can identify the counts to which they belong.

The disadvantages for analysis of the information of suppression are very many, as will be shown in section 6. They are so grave that it will be necessary to estimate from all available published migrant tables in the 1991 Census the suppressed cell table counts. Only then will full description and analysis of the pattern of migration in Britain be possible.

#### 4 CHECKING THE SPECIAL MIGRATION STATISTICS

The previous section of the paper has demonstrated that the Special Migration Statistics are a large and complex dataset. The SMS were generated in a long computer run at OPCS/s Data Processing Facility and written onto 21 half inch magnetic tapes for transfer to Manchester Computing Centre. A series of checks have been carried out to ensure that the datasets as loaded on the Manchester Cray Superserver were those described in the User Guides 35,5/ and 53.

It was vital to carry out checks on the SMS for several reasons.

1. The first reason was that the data files prepared by the Office of Population Censuses and Surveys (OPCS) were very large. In raw form they occupied 1.3 gigabytes (since reduced by simple truncation of abstracting blanks in records to 0.4 gigabytes), so that the possibility of error in production or transfer was quite large.
2. The second reason was that it was necessary to understand thoroughly the nature of the dataset and to disseminate an understanding of its structure through the academic community. The 1981 Census SMS has had relatively little use. The thresholding and suppression procedures applied severely reduced the utility of the data. Data for small flows were suppressed and their values added into flow totals for larger areas so that experience showed that the district migration dataset was usable only at county and not at district scale, while the ward scale data provided only simple counts of migrants.
3. The SMS1 and SMS2 files are complex in structure, being interaction data (concerning the flows of migrants from place to place) not simple attribute data. The number of persons who thoroughly understand the nature of the data probably number only a dozen in the country (a handful of statisticians and programmers within the Census Office, some commercial programmers and a few geographer academics). The checks were thus an essential learning

process, the benefits of which are being disseminated to the much wider community of academic researchers interested in migration research in this paper.

Two kinds of checks of the SMS were carried out. Firstly, the SMS statistics were compared with comparable data in other, independently derived Census data. These are called here external checks. Secondly, the internal consistency of the data was checked in a variety of ways. These are called here internal checks.

#### 4.1 The external checks

The external checks compare SMS counts with exactly comparable figures from the published Small Area Statistics (SAS). Originally, statistics from the Local Base Statistics (LBS) were used, but the procedures for protecting confidentiality through blurring (random addition of 0, -1 or +1 to the interior cells of tables) produces a much wider dispersion of values about their true level in the LBS than in the SAS. It is possible, for example, for the total number of migrants resident in a ward or postcode sector reported in the LBS to differ from the true total by + or - 504, whereas the equivalent range for the same SAS statistic is + or - 30. The Census Offices advice is always to use the SAS statistic where the same count appears in both sets of tables.

##### 4.1.1. Comparison of SMS1 total in-migrants with SAS counts

The SAS contains tables of migrant characteristics by residence area at the time of the 1991 Census. Counts from these tables can be used as a rough check on the validity of the SMS. The comparison will not be exact because of the blurring procedures applied to the SAS but we should expect that the differences between SMS and SAS counts would lie within fixed ranges and that the SAS counts would form a normal distribution around the true SMS values with confidence intervals as stated in OPCS and GRO(S) (1993d).

###### 4.1.1.1 The SMS migrant count used

SMS Set 1 was checked by computing migrant totals (consisting of all age/sex migrants into and within the area or all resident migrants with a different address one year ago) for all England and Wales wards and all postcode sectors in Scotland. The migrant totals were computed by adding together within ward migrants and total in-migrants from all areas. The former were recognised in the dataset where the origin and destination areas were the same. Technically, movetype 1 was selected (zonea = destination, zoneb = origin) where zonea = zoneb. The total in-migrant counts from all areas were recognised for zonea by a zoneb code set to 444444. The counts in the Table 1 record (ages 1-15, 16-29, 30-44, 45 pensionable age, pensionable age and over by male, female - 10 in all) were summed to give one total.

###### 4.1.1.2 The SAS counts used

The composite totals were then initially compared with Local Base Statistics count L150001 for wards in England and Wales, and count LS150001 for postcode sectors in Scotland. However, there were a lot of cases where the SMS count was positive but the LBS count was zero, because the ward or postcode sector population fell below the threshold for disclosure. So an equivalent set of SAS statistics, count S150001 and SS150001 were extracted and used instead.

###### 4.1.1.3 Distribution of the SMS-SAS differences

These SMS and SAS counts were not expected to be the same, because of the blurring procedures applied to the LBS/SAS. Differences were computed and their distribution

examined. Some 96% of the differences fell within the 95% confidence limits specified in OPCS/GRO(S) User Guide 48 p.11 and were normally distributed. Table 1 shows the distribution of SMS-SAS differences.

It should be noted that the SMS-LBS and SMS-SAS differences were exactly the same, except where the LBS data were suppressed. This implies that the published descriptions of LBS blurring procedures may not be correct. These descriptions imply that LBS counts were blurred twice in the fashion described above, whereas SAS counts were blurred only once. However, if this were the case in terms of Tables L15 and S15, observation of the same totals in the tables for all areas is so unlikely that the hypothesis that LBS were double blurred must be rejected. An experiment was carried out to replicate the distribution of differences between SMS and LBS under a double blurring assumption with the following probabilities of adding zero, -1 and +1: 0.50, 0.25 and 0.25. This experiment produced a distribution of differences much broader than the observed differences. This again suggests that the LBS, in this case, were singly blurred only.

Virtually all of the differences between the SMS and SAS counts of total migrants resident in the wards of England and Wales and the pseudo postcode sectors of Scotland fell within the theoretical bounds dictated by the SAS blurring procedure. Some 30 interior cells in Table S15 in the SAS contribute to the migrant total used in the comparison so that if all cell counts had been modified by +1 then the SAS count would be 30 greater than the SMS count. Similarly, if -1 had been subtracted from all cells, then the SAS count would have been 30 lower than the SMS.

Table 1 reveals that the differences between SMS and SAS counts for 5 wards fell outside these theoretical bounds of + or - 30. The wards are listed in Table 2. The differences are due to the measures taken to preserve confidentiality of the Small Area Statistics. Where wards have fewer than 50 residents or 16 households, the ward counts are suppressed and added to a neighbouring ward. Wards in the City of London, in particular, have very few residents. The Bishopsgate migrants have been transferred into Walbrook ward, for example. It makes sense, when using the SMS to regard the City of London as one area, equivalent to a ward, when analysing resident counts.

#### *4.1.2 Comparison of SMS2 and SAS migrant counts*

The SMS Set 2 was checked by comparing migrant counts from Table 1 in the SMS by 10 age/sex groups shown in Table 3 for all districts in Great Britain with the equivalent counts computed from Table L15 or LS15 in the Local Base Statistics.

There was perfect agreement between SMS and SAS counts. Note that the district level counts in the SAS have not been blurred.

#### **4.2 The internal checks**

The external checks provided reassurance that the SMS datasets had been consistently produced but they involved checking only a few SMS totals. It proved vital that all flows were checked. The initial checks revealed holes in the data not uncovered by the external checks. These holes occurred in the files where the records were located at the end of each magnetic tape when the multtape file was being read. These holes were readily filled by rereading the tapes, avoiding the previous difficulty. However, the checks were extended considerably in a second round in order to ensure that even the tiniest holes in the datasets could not escape discovery. These checks are described in this section.

**Table 1 Frequency distribution of SMS-SAS differences**

Differences	Frequency	Percent
>-30	4	.04
-30 to -25	0	.00
-24 to -19	3	.03
-18 to -13	65	.60
-12 to -7	873	7.99
-6 to -1	3848	35.20
0	1303	11.92
1 to 6	3965	36.27
7 to 12	825	7.55
13 to 18	45	0.41
19 to 24	1	0.01
25 to 30	0	0.00
>30	1	0.01
Total	10933	100.00

Source: 1991 Census. Crown Copyright. ESRC/JISC Purchase

**Table 2 Wards with SMS-SAS differences between resident migrant counts falling outside the absolute limits allowed by the SAS blurring procedure**

Census Code	Ward name	Total migrants resident		
		SMS	SAS	Difference
01 AAFE	Bishopsgate	49	0	49
01 AAGB	Walbrook	0	86	- 86

Source: 1991 Census. Crown Copyright. ESRC/JISC Purchase

**Table 3 SMS2 and LBS migrant counts used in the comparison**

Count	SMS Table 1 ages	Sex	LBS Table L15
(1)	1-15	Males	1-4 + 5-9 + 10-14 +15
(2)	1-15	Females	1-4 + 5-9 + 10-14 +15
(3)	16-29	Males	16-19 + 20-24 + 25-29
(4)	16-29	Females	16-19 + 20-24 + 25-29
(5)	30-44	Males	30-34 + 35-39 + 40-44
(6)	30-44	Females	30-34 + 35-39 + 40-44
(7)	45-PA	Males	45-49 + 50-54 + 50-59 + 60-64
(8)	45-PA	Females	45-49 + 50-54 + 50-59
(9)	PA+	Females	60-64 + 65-69 + 70-74 + 75-84 + 85+
<b>LBS SASPAC codes</b>			
(1)	21 + 40 + 59 + 78		
(2)	22 + 41 + 60 + 79		
(3)	97 + 116 + 135 + 154 + 173		
(4)	97 + 117 + 136 + 155 + 174		
(5)	211 + 230 + 249		
(6)	212 + 231 + 250		
(7)	268 + 287 + 306 + 325		
(8)	269 + 288 + 307		
(9)	344 + 363 + 382 + 401		
(10)	326 + 345 + 364 + 383 + 402		

**Notes:**

1. The SMS 2 counts are a sum of all total inflows, where zonea=444444 plus within ward migrants.
2. The LBS counts total residents with different address one year ago.
3. PA = pensionable age = 65 for men and 60 for women.

All the checks were carried out using Table 1 in the SMS (present in both SMS1 and SMS2). This table reported all non-zero flows with no suppression being applied. None of the other tables was suitable for the checks because of suppression or because they were only provided for the SMS2 dataset.

#### 4.2.1 Checks of sums of migrant flows against totals

To carry out internal checks on the SMS1 and the SMS2, the smstab program was adapted to compute the quantities set out in Table 4 from the individual inter-area flows through summation of the SMS Table 1 counts.

These counts were compared with the equivalent input totals found in separate records

### 5 PATTERNS OF MIGRATION IN GREAT BRITAIN: ILLUSTRATIONS

So what kind of new information about the patterns of migration in Great Britain do the Special Migration Statistics reveal? We focus here on two case studies as illustrations of the value of the statistics. The first looks at the pattern of migration between and within the wards of Leeds, a large northern city of just over 700 thousand inhabitants. The second looks at the pattern of interregional migration for four ethnic groups. In each case study, the unique information available in the SMS is highlighted and compared with that available in the SAS or LBS or in the national and regional migration volumes (OPCS 1994a, 1994b, 1994c).

#### 5.1 Ward level migration in Leeds

To extract a matrix of inter-ward migrant flows for the metropolitan district of Leeds involving running an smstab job on the Manchester Cray Superserver. The command arguments were as follows:

```
smstab-set 1 -tab1 -zonea 08 da* -zoneb 08 da* -matrix 2 >leedswds.tab
```

The arguments had the following meaning.

-set 1	= extract the flows from the SMS Set 1
-tab 1	= extract the flows from Table 1
-zonea 08 da*	= use as destinations all wards with census codes starting with 08da (08-West Yorkshire, da=Leeds)
-zoneb 08 da*	= use as origins all wards with census codes starting with 08da
-matrix 2	= extract a matrix flows and write it out in table form with ward names as row and column labels
>leedswds.tab	= the UNIX command for redirecting output into a file with name given

Full details of the way to set up smstab jobs are given in Appendices 1 and 2.

Table 5 displays a portion of the flows matrix together with derived net migrant statistics and sets of totals. The flows matrix is normally produced in order of the area Census codees (08daaa, 08 daab ..., 08 dass) but in Table 5 the flows have been rearranged to provide a focus on North West Leeds (see Figure 7 for their location).

What features does the Table show?

**Table 4 The sums of flows and totals in the SMS compared**

Comparison	Sum	Total
(1)	Sum of migrants from an area to all other areas in GB	Total out-migrants to Rest of GB [ where zoneb=111111 ]
	$\sum_{j \neq i; i, j \in G} M^{ij}$	$O^i$
(2)	Sum of migrants to an area from all other areas in GB	Total in-migrants from Rest of GB [ where zoneb=222222 ]
	$\sum_{i \neq j; i, j \in G} M^{ij}$	$D^j$
(3)	Sum of migrants to an areas from outside GB	Total in-migrants from Outside GB [ where zoneb=333333 ]
	$\sum_{i \in O} M^{ij}$	$I^j$
(4)	Sum of all migrants to an area  = sum (2) + sum (3) + migrants with origin not stated	Total in-migrants [ where zoneb=444444 ]
		$T^j$

#### Notes

1. The 'area' = wards / pseudo sectors in SMS Set 1

The 'area' = districts in SMS Set 2

2. The algebraic notation is as follows:

- $M^{ij}$  Count of migrants from area  $i$  to area  $j$
- $O^i$  Origins total for area  $i$
- $D^j$  Destinations total for area  $j$
- $i \in G$  Area  $i$  belongs to the Great Britain set of areas
- $i \in O$  Area  $i$  belongs to the Outside Great Britain set of areas

**Table 5** Part of an inter-ward migration matrix: Leeds 1991 Census

Origin Ward	Destination ward and census code					
	North DAFX	Otley DAFY	Cookridge DAFJ	Horsforth DAFP	Weetwood DAGG	Moortown DAFT
<b>Gross Migrants</b>						
North	383	28	24	22	12	88
Otley & Wharfedale	23	553	33	46	21	6
Cookridge	30	37	346	79	57	20
Horsforth	18	47	80	443	34	9
Weetwood	15	28	90	41	387	69
Moortown	131	11	11	10	30	251
<b>Net Migrants</b>						
North	0	5	-6	4	-3	-43
Otley & Wharfedale	-5	0	-3	-1	-7	-5
Cookridge	6	3	0	-1	-33	9
Horsforth	-4	1	1	0	-7	-1
Weetwood	3	7	33	7	0	39
Moortown	43	5	-9	1	-39	0

Source: 1991 Census: Crown Copyright. ESRC/JISC Purchase

1. Migrants move rather short distances. The intra-ward count is always by far the largest. The wards in the table are close together and virtually all interward counts are in double figures. Many interactions with other wards in Leeds are in single figures.
2. There is also a pattern of migration net gains and losses that reflect continued suburbanisation: Moortown ward loses to North ward, Cookridge loses to Otley and North wards, Weetwood ward loses to Cookridge ward. These flows reflect the continued development of new housing of better quality in the outermost low density wards, creating opportunities taken up by households from denser wards closer to the inner city.

The migrant pattern can be explored further through mapping. Figure 7 contains 3 out of the possible 99 ward migration fields that can be generated from the Leeds 33 origin wards by 33 destination wards matrix. The in-migrant, out-migrant and net migrant fields of Cookridge ward are displayed. The fields all exhibit tight distance decay though the in-migrant field is slightly more closely grouped around Cookridge than the out-migrant field. Net gains come principally from wards located on the same North West axis of the City but closer to the centre along with a scattering of gains in the eastern middling. Losses occur to all peripheral wards, particularly to the North.

Faced with the wealth of information provided at ward scale, one strategy is to summarise the information for groups of wards with a wider significance. In the key to Figure 7 wards are classified as belonging to North or South Leeds (divided by the River Aire) and to the Inner and Outer City, leading to fourfold classification of North Inner, North Outer, South Inner and South Outer. There is a social gradient from Inner to Outer Leeds, and the Northern wards rank higher in social status than the Southern wards. However development of new housing has been more constrained through green belt restriction on the northern fringes than the southern.

Table 6 assembles the migrant statistics aggregated from the ward level. The table distinguishes between the various types of entry that could be placed in the peripheral diagonal of the table and in its row and column marginals. The following pattern of net gains and losses emerges.

ORIGIN	DESTINATION			
	NI	NO	SI	SO
North Inner (NI)	0	502	150	293
North Outer (NO)	-502	0	-63	269
South Inner (SI)	-150	63	0	281
South Outer (SO)	-293	-269	-281	0

The hierarchy of choice is

- 1 South Outer
- 2 North Outer
- 3 South Inner
- 4 Northern Inner

with each zone gaining from the one below and losing to the one above.

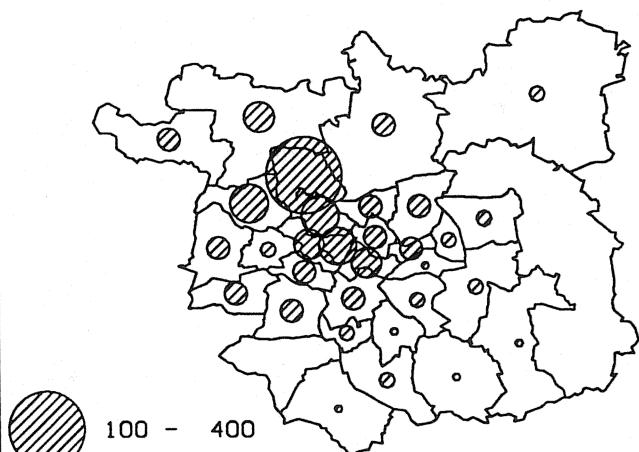
Figure 7

Migration fields for Cookridge ward, Leeds

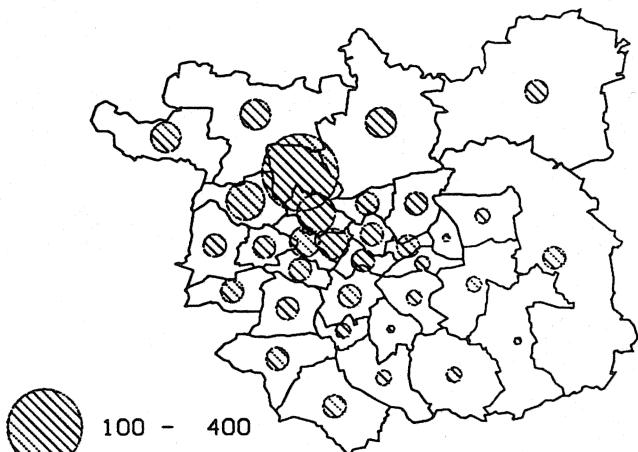
Source: 1991 Census. Crown Copyright. ESRC/JISC Purchase

Migration Fields for Cookridge Ward, Leeds  
1991 Census. Crown Copyright. ESRC Purchase

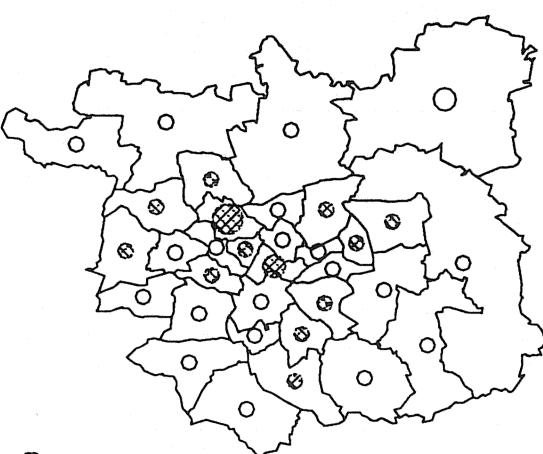
In-migrants, 1990–91



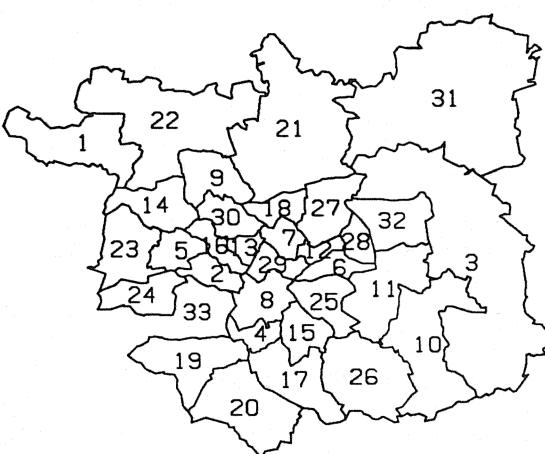
Out-migrants, 1990–91



Net migrants, 1990–91



Key to wards



**Table 6 Migrants in Leeds by broad zone**

FROM	TO	DESTINATION 1991				TOTALS			
		North Inner	North Outer	South Inner	South Outer	a	b	c	d
ORIGIN 1990	North Inner	4285 <sup>1</sup> 3400 <sup>2</sup> 7685 <sup>3</sup>	2402	1077	769	11933	4556	12204	16489
	North Outer	1900	6442 <sup>1</sup> 4443 <sup>2</sup> 10876 <sup>3</sup>	827	1073	14676	6972	15206	21648
	South Inner	927	890	2823 <sup>1</sup> 1418 <sup>2</sup> 4241 <sup>3</sup>	1594	7652	1665	6494	9317
	South Outer	476	804	1313	4653 <sup>1</sup> 2205 <sup>2</sup> 6858 <sup>3</sup>	9451	2877	7675	12328
Totals		1098 3254 9957 14242	14972 5498 14028 20470	7458 1403 6038 8861	10294 2889 8530 13183	43712			

Notes

1 Within ward migrants

2 Between ward migrants

3 Total within group of wards

a Total out-migrants within Leeds

b Total out-migrants to RGB outside Leeds

c Total migrants from origin to Rest of GB

d Total migrants from origin to all areas

e Total in-migrants within Leeds

f Total in-migrants from RGB outside Leeds

g Total migrants to destination from RGB

h Total migrants to destination from all areas

Note the number of alternative counts that can be entered into the peripheral diagonal and marginal cells, as a result of aggregation. The principal diagonal can be broken down into migrants within wards ? the zone and migrants between wards inside zone. The marginal totals report not only the matrix sums (Totals a and e) but also the flows from and to areas outside Leeds (totals b and f) and the sum of within Leeds and outside Leeds migration in two forms - ignoring within ward migrants (totals c and g) or including them (totals d and h). This enables us to distinguish between gains and losses to zones from within and from outside Leeds (in GB).

Net Migration			
	Leeds	Outside Leeds	Total
North Inner	-945	-1302	-2247
North Outer	296	-1474	-1178
South Inner	-194	-262	-456
South Outer	843	12	855

Both inner city zones experience net losses in migrant exchanges within Leeds and outside Leeds. The Northern Outer zone gains from other Leeds zones but loses to areas outside Leeds while the South Outer zone makes gains from other Leeds zones and marginally from other areas within Great Britain.

The universe within which migrants move is constrained in Tables 5 and 6 and in Figure 7 to Great Britain. All areas receive migrants ("immigrants" from outside Great Britain and send migrants "emigrants") overseas. The SMS provides statistics on immigrants over the year prior to the 1991 Census but not on emigrants (which must be very widely estimated from statistics derived from the International Passenger Survey). Table 7 sets out for the sample of North West Leeds wards the further migrant counts available in the SMS or derivable from it. Totals (1) through (10) report the within/outside Leeds in-and out-totals already discussed for the aggregate spatial system of zones. Totals (11) through (15) need further explanation.

Total (11) is the total of in-migrants from Outside Great Britain; total (12) is the total of persons with origin not stated (including some where an area was given but not a precise address); total (13) is total of all in-migrants to an area which is the sum of totals (5), (11) and (12). Total (14) is the total, recorded at the destination, of all residents reporting a different address one year earlier. This total is equivalent to count 450001 in the LBS or 5150001 in the SAS.

Comparison of the total in-migrants from Outside Great Britain with the counts of net migrants from the Rest of Great Britain show that this inflow helps, in part, to compensate for the losses. However, the number of migrants to the rest of the world is unknown, so the final balance of migration cannot be computed from the 1991 Census alone. An estimate of emigrants needs to be constructed.

Some further compensation is provided if we add in the migrants with origin not stated, which need to be distributed across possible origins on a pro rata basis proportional to the size of recorded flows. So, for example, the losses of 191 internal migrants from Cookridge ward are compensated by the in-migration of 92 migrants from Outside Great Britain or origin not stated.

**Table 7 Migrant totals for selected Leeds wards**

Total	Destination ward, code and sequence					
	North DAFX 21	Otley DAFY 22	Cookridge DAFJ 09	Horsforth DAFP 14	Weetwood DAGG 30	Moortown DAFT 18
( 1) Within ward migrants	383	553	346	443	387	251
( 2) In-migrants from RL	629	427	572	643	758	847
( 3) Out migrants to RL	581	407	609	612	981	625
( 4) Net migrants from RL	47	20	-37	31	-223	222
( 5) In-migrants from RGB	1009	941	848	1022	1158	1127
( 6) Out-migrants to RGB	993	1004	1039	1138	1542	1020
( 7) Net migrants from RGB	17	-63	-191	-116	-384	107
( 8) In-migrants from GB-L	380	514	276	379	400	280
( 9) Out-migrants to GB-L	412	597	430	526	561	395
(10) Net migrants from GB-L	-32	-83	-154	-147	-161	-115
(11) In-migrants from OGT	107	66	56	84	123	77
(12) Origin not stated (ONS)	61	59	36	75	95	47
(13) Total in-migrants	1177	1066	940	1181	1376	1251
(14) Total resident migrants	1560	1619	1286	1624	1763	1502
(15) Total migrants with origin	1376	1557	1194	1465	1545	1378

#### Notes

##### 1. Definitions

RL = Rest of Leeds = Leeds - ward

RGB = Rest of great Britain = Great Britain - ward

GB-L = Great Britain - Leeds

OGB = Outside Great Britain

##### 2. Relationships

(4) = (2) - (3); (7) = (5) - (6); (10) = (8) - (9)

(13) = (5) + (11) + (12)

(14) = (1) + (13)

(15) = (1) + (6)

##### 3. SMS codes for totals

(5) = 222222

(6) = 111111

(11) = 333333

(13) = 444444

This discussion of the pattern of ward migration in Leeds is meant to be illustrative of what a rich resource the SMS provides. The analysis clearly needs to be extended by a careful consideration of destinations and origins outside Leeds, by an analysis of the age composition of migrant streams (using the Table 1 counts) and by an analysis of the degree to which migration is a phenomenon involving whole households or people moving out of or into households as individuals (using the table 2 counts and comparing cell 2 with the table 1 totals).

Similar analyses can be carried out at district scale using the SMS Set 2 data with the added attraction of the more detailed age-sex desegregation provided in Table 3. The age-sex breakdown of ward and district migration will be extremely useful as input to population estimation and projection models at small area and district scales (Rees 1994).

## 5.2 Migration between standard regions by ethnic group

Migration tabulations have been provided in two sets of published reports and four sets of machine readable datasets.

1. the County/Scottish Region reports (published by HMSO)
2. the National Migration reports (published by HMSO)
3. the Regional Migration Reports (to be published as machine readable tables by OPCS/GRO(S))
4. the Small Area Statistics and Local Base Statistics (published as machine readable datasets by OPCS/GRO(S))
5. the Samples of Anonymised Records (purchased by the ESRC/JISC Census Programme)
6. Local Base Statistics Table 100 tabulating students by ward of term-time residence against county Scottish region of (usual/parental) residence

### What new information is added in the Special Migration Statistics?

The essential difference between the SMS and the other data sources is that the SMS provides information on flows by origins as well as destinations, for wards/pseudo postal sectors and districts whereas the only origin information provided elsewhere is in the inter-area tables in the National and Regional Reports which are restricted to a small set of pre-defined areas (though much extended from the 1981 Census equivalents). The SARs and Table LBS 100 restrict the origin classification to standard region and county/Scottish region. The SAS and LBS provide information on migrants by residence area only, that is, for destinations. Valuable though these other datasets are, they only provide half the picture of migration.

The SMS uniquely provides origin-destination flows for a symmetric set of origins and destinations within the country (Great Britain).

The value of the SMS is enhanced by cross-classification of the origin-destination flows by sets of attributes organised into tables (Figure 1). Here we concentrate on examining what can be learnt from the tables that are subject to thresholding and suppression (as explained in section 3), using ethnic groups as our example. SMS Table 5 provides counts of migrants in 4 ethnic categories which match the standard 10 ethnic classification used elsewhere in the 1991 Census as follows.

<u>SMS group</u>	<u>SAS/LBS group</u>
White	White
Black	Black Caribbean
	Black African
	Black other
Indian, Pakistani & Bangladeshi	Indian
	Pakistani
	Bangladeshi
Chinese and Other	Chinese
	Other groups: Asian
	Other groups: other

Table 8 presents the counts of migrants moving between standard regions. This table was constructed by aggregating the district migrant counts in Table 1 of the SMS to standard regions. The age/sex group counts were summed for each flow and the flow assigned to the origin-region-destination region pair that the origin-district - destination-district pair belongs via a look-up table.

This table could also have been extracted from the tables published in the National Migration Reports OPCS (1994a, b, c).

What SMS2 provides that the National Migration Reports do not is the further classification of inter-regional migration by ethnic group. Such a classification provides information on whether the ethnic groups have different migration patterns, whether a group is tending to concentrate in a region or not. These questions have been explored by Robinson.

Table 9 sets out the ethnic make up of the first column of the standard origin matrix using the 4 group classification available. It is immediately apparent that the ethnic group counts derived from SMS Table 5 fail to sum to the totals derived from SMS Table 1. The reason for this is that SMS Table 5 is suppressed for small flows (1 to 9 migrants) and, as shown earlier, very many inter-district flows fall in this category. The degree of suppression increases as the size of the inter-area flow decreases. So the Table 5 count makes up 99.9% of the intra-Greater London migrant flows but only 33.2% of the flows from Greater London to Wales.

It is not therefore possible to use the SMS Set 2 Tables from 5 upwards without making an attempt to fill the holes in the migration array. Fortunately, the estimation problem is made easier by the existence of total counts to and from the Rest of Great Britain, and from Outside Great Britain which are unsuppressed. Table 10 sets out the GB total counts for the four ethnic groups at standard region scale. Table 11 provides the independently derived Table 1 counts for all districts in the country. The reader can verify quite easily that the Table 10 counts sum across ethnic groups to give the Table 11 totals. Note that these counts are not the total of migrants out of or into the region to or from the Rest of Great Britain outside the region, but rather district counts of migrants to/from the Rest of Great Britain outside the district summed to form totals for regions. (know it sounds complex but such features make the SMS live up to its title of "Special"!). However, because the number of migrants out of districts in one region to other districts in that region is equal to the number of migrants into districts in a region from other districts in that region, the resulting net migrant figures for the ethnic groups in Table 10 (columns 3 and 6) are the same as the net migrants into those regions.

**Table 8 Migrants between standard regions**

Destinations	GL	NW	YH	NO	WM	SW	SW
Greater London GL	471632	6734	5567	3186	5515	8963	48700
North West NW	6928	414940	8177	4358	6617	4695	10728
Yorks & Humberside YH	6046	8694	346817	6253	4332	4009	10117
North NO	3505	4967	6093	208412	1890	2207	6026
West Midlands WM	6249	7047	4029	1910	328741	7430	12203
South West SW	15230	6186	4709	2178	9179	360756	36149
South East SE (minus GL)	85311	11228	9948	5567	11222	26383	772629
East Anglia EA	8221	2163	2868	1313	2329	3314	17041
East Midlands EM	6990	6007	10432	2406	8618	4680	15184
Wales WA	4010	6035	1696	749	4993	5229	7721
Scotland SC	6299	4587	3899	4141	2511	4010	9640
Destination	EA	EM	Wales	Scotland			
Greater London	4613	5185	3223	4935			
North West	1647	5160	4386	3840			
Yorks & Humberside	2495	9009	1581	3269			
North	1170	2311	783	3736			
West Midlands	1947	7541	4656	2113			
South West	3266	5517	5867	3651			
South East (minus GL)	11293	12812	6916	8502			
East Anglia	152089	5616	1179	1933			
East Midlands	5082	259087	1868	2657			
Wales	1052	1977	176900	1171			
Scotland	2072	2787	1374	432435			

Source: 1991 Census. Crown Copyright. ESRC/JISC Purchase

**Table 9 Out-migrants from Greater London by ethnic group**

Destination	Origin = Greater London			CO	SUM	Table 1 Total	Difference (total- sum)	Sum % of Difference
	White	Black	IPB					
Greater London GL	367554	45682	31446	26577	471259	471632	373	99.9
North West NW	3062	121	245	159	3587	6928	3341	51.8
Yorks & HUMB YH	3201	151	202	146	3700	6046	2346	61.2
North	1175	13	40	38	1266	3505	2239	36.1
West Midlands	2600	182	399	140	3321	6249	2928	53.1
South West	10835	118	150	226	11329	15230	3901	74.3
South East	74691	1308	2152	1939	80090	85311	5221	93.9
East Anglia	6367	131	116	148	6762	8221	1459	82.3
East Midlands	2977	125	294	122	3518	6990	3472	50.3
Wales	1182	27	70	52	1331	4010	2679	33.2
Scotland	2698	39	45	81	2863	6299	3436	45.5
	476342	47897	35159	29628	589026	620421	31395	94.9

Notes

IPB = Indian, Pakistani and Bangladeshi

CO = Chinese and Other

Source: 1991 Census. Crown Copyright. ESRC/JISC Purchase

**Table 10      Ethnic group district Migrants to and from the Rest of Great Britain  
by standard region**

Region	White			Black		
	In	Out	Net	In	Out	Net
Greater London	241793	292713	-50920	22958	23179	-221
North West	143286	150375	-7089	1564	1515	49
Yorks & HUMB	1111529	112699	-1170	769	849	-80
North	68143	67403	740	244	256	-12
West Midlands	125951	127704	-1753	1623	1787	-164
South West	182464	161755	20709	899	863	36
South East (exc GL)	419530	405644	13886	3540	3209	331
East Anglia	83009	71971	11038	901	764	137
East Midlands	128001	122031	5970	1154	1112	42
Wales	67524	64586	2938	276	301	-25
Scotland	140465	134814	5651	341	434	-93
Total	1711695	1711695	0	34269	34269	0

Region	Indian, Pakistani and Bangladeshi			Chinese and Other		
	In	Out	Net	In	Out	Net
Greater London	16848	17580	-732	16173	16468	-295
North West	3129	3199	-70	2472	2474	-2
Yorks & HUMB	1984	2443	-459	1391	1294	97
North	786	830	-44	741	798	-57
West Midlands	4638	4904	-266	1780	1678	102
South West	849	766	83	1582	1399	183
South East (-GL)	6085	4830	1255	6069	5868	201
East Anglia	532	478	54	995	884	111
East Midlands	2949	2880	69	1441	1513	-72
Wales	668	638	30	763	906	-143
Scotland	1222	1142	80	1173	1298	-125
Total	39690	39690	0	34580	34580	0

Source: 1991 Census. Crown Copyright. ESRC/JISC Purchase

**Table 11 Sums of ethnic group migrants**

SMS Table 5 totals District Migrants to/from RGB			
Region	In	Out	Net
Greater London	29772	349940	-52168
North West	150451	157563	-7112
Yorks & HUMB	115673	117285	-1612
North	69914	69287	627
West Midlands	133992	136073	-2081
South West	185794	164783	21011
South East (exc GL)	435224	419551	15673
East Anglia	85437	74097	11340
East Midlands	133545	127536	6009
Wales	69231	66431	2800
Scotland	143201	137688	5513
Total	1820234	1820234	0

Source: 1991 Census. Crown Copyright. ESRC/JISC Purchase

Here, at last we have some reliable aggregated SMS Table 5 data. Interesting differences emerge between the groups, which are displayed in Figure 8. There is a common pattern of net gains and losses in Southern England across all groups; heavy losses from Greater London and gains to the Rest of the South East, South West and East Anglia. However, the white pattern is more dispersed: higher gains to the South West and East Anglia relative to the Rest of the South East than the other groups. The non-white groups show much higher relative gains to the Rest of the South East, and are, in effect, at an earlier stage their migration experience.

The industrial heartland regions (West Midlands, North West and Yorkshire and Humberside, North) show losses for most groups, except for the Chinese and Other who experience net gains in two regions, Whites who show gains in the North and Blacks who show gains in the North West. Gains in Scotland and Wales are characteristic of Whites and South Asians, while the other groups show losses. Further elucidation of the pattern of net flows would need some linkage to the size of the groups in each region and a properly adjusted full matrix of flows (yet to be created).

## 6 CONCLUSIONS

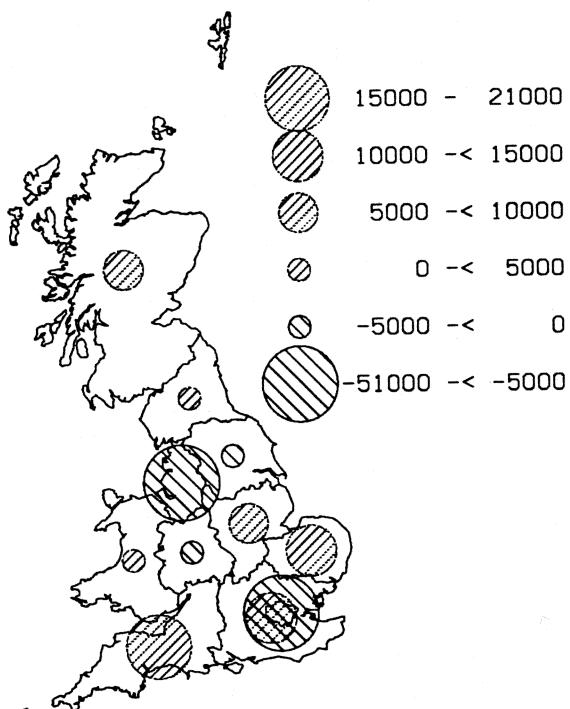
The Special Migration Statistics constitute a complex dataset which was produced from the 1981 Census of Population and the 1991. In 1981 the area basis was the ward only and table statistics were produced for ward-to-ward flows but with severe thresholding, suppression and cascading procedures applied. As a result, most use was made of the sample counts of migrants by sex in 1981 SMS Set (2) rather than the more detailed counts by socioeconomic category in SMS Set (1).

It was clear from this experience that users wanted simpler and more useful migration statistics. The Census Offices responded by making available simple counts of ward-to-ward migrants classified by broad age and sex, and by wholly moving household and residents within them (1991 SMS Set 1), and district-to-district migrant counts (1991 SMS Set 2) classified in the same way and also by five age groups. However, concern for preservation of confidentiality persisted in the design of the socioeconomic tables attached to district-to-district flows. The procedures adopted were, thankfully, simpler: suppression of socioeconomic tables where flows were small but provision of selected marginal totals for all areas and classifications. Although this means that great care needs to be taken in extracting and analysing these statistics, useful information can be generated and there are good possibilities for regenerating reliable estimates of the missing flows (see Appendix 4). A second problem experienced in the use of the 1981 Special Migration Statistics was the difficulty users had in understanding the nature of ? the software for accessing the data (Manchester Computing Centre 1989). This paper has addressed these twin problems with the aim of delivering census data on migration to the desks of social science researchers throughout the U.K. We hope it succeeds.

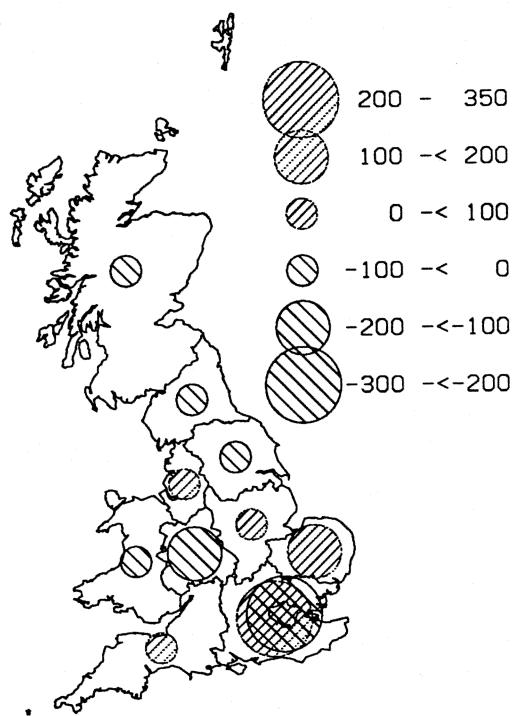
**Figure 8** Net migration by ethnic groups  
 Source: 1991 Census. Crown Copyright. ESRC/JISC Purchase.

Net migration by ethnic groups  
 1991 Census. Crown Copyright. ESRC Purchase

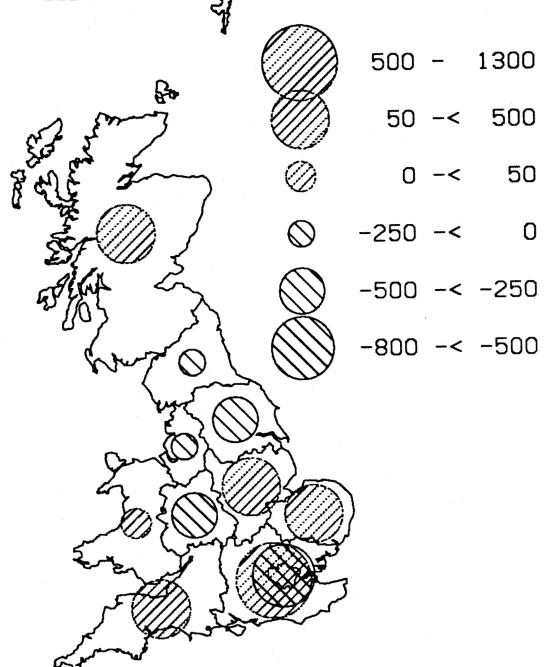
White



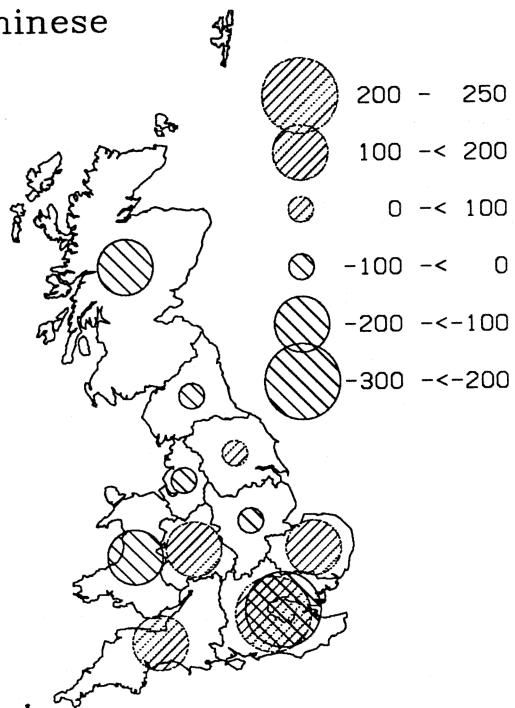
Black



Indian



Chinese



## REFERENCES

OPCS = Office of Population Censuses and Surveys

GRO(S) = General Register Office (Scotland)

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OPCS and GRO(S) (1994a) *1991 Census Migration. Great Britain Part 1 (100% tables) Volume 1 of 2. CEN91 MIG*. HMSO, London

OPCS and GRO(S) (1994b) *1991 Census Migration. Great Britain Part 1 (100% tables). Volume 2 of 2. CEN91 MIG*. HMSO, London

OPCS and GRO(S) (1994c) *1991 Census Migration. Great Britain Part 2 (10% tables)*. HMSO, London

Rees, P.H., 1994) Estimating and projecting the populations of urban communities *Environment and Planning A*, in press

## **APPENDIX 1 HOW TO ACCESS THE SMS**

This Appendix provides details on how to access the datasets at Manchester Computing Centre. The information contained may change quite rapidly over the four months after the first edition. Users are kept informed of changes to dataset availability and access software via the census news list. To begin with the data will be released in raw form to give expert users access and can be accessed via the program **smstab**. However, it is intended to load the datasets into a user friendly database package as soon as possible so that less expert users can have easy access.

To access the **sms** you must

- (1) be registered as a user on the midas computer (MCC)
- (2) be registered as a user of the sms
- (3) be able to connect to midas from your own local network
- (4) use the MCC gopher to find out about the SMS and software
- (5) read the information about the SMS and how to use smstab
- (6) use the examples provided to help you construct your own job.

Midas stands for Manchester Information Datasets and Associated Services.

### **A1.1 Registration as a user on midas at MCC**

Intending users must register with Manchester Computing Centre for access to the Cray Superserver 6400 on which the Special Migration Statistics datasets and software are to be found. See your the Manchester representative in your local computing service who will have the necessary forms and through whom you register. NB Allow a week for all registration procedures to be completed.

### **A1.2 Registration as user of the sms and sws**

Intending users must register with Manchester Computing Centre to use the SMS and SWS datasets. To do this request the User Registration Pack from the Manchester representative at your local computing service. You should complete the User Registration Form provided with the User Registration Pack, sign yourself and obtain the other necessary signatures. These should include your institution's MCC representative, your supervisor if you are a student (undergraduate or postgraduate) and the head of the department you are visiting if you are an overseas visitor. Before signing you should read the conditions of use carefully, paying particular attention to the requirement to insert the proper acknowledgement when including parts of the raw or processed data in publications and to supply MCC with copies of your publications. The Census Offices should be consulted if you think your publication goes beyond the allowable extracts mentioned in clause 4 of the Conditions of Use (see section 5 of the User Registration Pack).

Users register to use both the SMS and SWS at the same time, saving administrative effort on part of yourself and MCC.

Higher Education Institutions may set up their own registration systems by agreement with the Census Dissemination Unit at MCC, but these should involve a registration system similar in all respects to that set out in this document bar the name of the institution. You may copy any material from this document that is needed for your local registration system. Arrangements for data transfer should be made with the Census Dissemination Unit.

### A1.3 Connecting to midas

How you do this will vary from site to site.

If your site uses Coloured Book software, then you will need to access the Packet Assembler-Disassembler(PAD) connected to the Joint Academic Network (JANET) and issue a call command

PAD> call cs6400.mcc

where cs6400.mcc is the JANET name of the Cray Superserver 6400 at MCC.

If your site uses TCIP protocols for communication over wide area networks, then you can issue an appropriate command such as

% telnet cs6400.mcc

where % stands for the prompt character(s) on the computer that allows you access to JANET (which may be your own PC or a campus PC server or Unix server).

In many cases, the name midas may be substituted for cs6400.mcc.

After connecting to midas, you will need to supply your computer username at the login prompt and your computer password at the password prompt.

### A1.3 Using the MCC gopher

Once you have logged you can then use the hierarchical menu system for providing meta-information about the SMS and smstab. This can be accessed by typing

% gopher

From the first menu, select

3. MIDAS Datasets Service/

From the this menu, select

1. Datasets Information

From the this menu select

### **3. UK Census of Population Statistics**

From this menu select

#### **4. 1991 Special Migration Statistics**

when you will be presented with the following options to read

1. Introduction to 1991 Special Migration Statistics
2. Guide to the tables
3. Documentation
4. 1991 SMS - Registration Procedures
5. OPCS Country of Birth codes
6. The data checks on the SMS
7. man page on smstab program
8. smstab examples/

Item 5 references the codes and names of areas of origin outside Great Britain.

#### **A1.4 The SMS files**

The SMS Sets 1 and 2 are mounted as two files in the filespace of midas.mcc.  
The name of the SMS Set 1 file is:

/db/census91/swssms/smsward.txt

and that for the Set 2 file is

/db/census91/swssms/smsdist.txt

to which registered users are given read only access permission.

The two datasets have been thoroughly checked by Phil Rees and Oliver Duke-Williams  
of the University of Leeds.

#### **A1.5 Software for accessing the SMS**

Oliver Duke-Williams has written a FORTRAN program for reading the SMS datasets.  
The program is made available to registered users as

/software/smstab

The program serves two purposes. It can be used to extract single counts or tables of counts for selected areas or all areas. Programmers can also use the embedded reading routine to help them in writing their own software for analysing the data. The program is offered with no guarantees: please report errors to Oliver Duke-Williams .

To run the program, issue the command

**smstab**

followed by a set of arguments, the detailed definitions of which are set out in Appendix 2 which reproduces the Unix man pages on midas. The latest version of these pages can be inspected via the command

**man smstab**

The output from the program is written to the standard output (the screen) which can be redirected into a file thus

**smstab [list of arguments] > myfile.out**

#### A1.6 Examples of use of the smstab command to extract flows and tables

The following examples include an extract of the output they produce. Note that the prompt may vary, depending on which shell you use. Here the prompt used is a \$.

(1) All tables for all areas in SMS Set 1 (not really recommended and so is disabled!)

```
$ smstab  
> SMS Set: 1  
> Tables: 1 2  
  
01AAFA 01AAFA Table= 1 Movetype= 1 Tot=      17  
01AAFA 01AAFA Table= 2 Movetype= 1 Tot=      18  
01AAFA 01AAFQ Table= 1 Movetype= 2 Tot=      10  
01AAFA 01AAFQ Table= 2 Movetype= 2 Tot=       8  
01AAFA 01ABFE Table= 1 Movetype= 2 Tot=       1
```

(2) Total migrant counts for Table 1 into all wards and postcode sectors

```
$ smstab -set 1 -style 0 -tab 1 -zoneb 444444  
> SMS Set: 1  
> Tables: 1  
  
01AAFA 444444 Table= 1 Movetype= 3 Tot=    192  
01AAFB 444444 Table= 1 Movetype= 3 Tot=      3  
01AAFE 444444 Table= 1 Movetype= 3 Tot=     49  
01AAFF 444444 Table= 1 Movetype= 3 Tot=      3  
01AAFG 444444 Table= 1 Movetype= 3 Tot=      1
```

Note that '-zoneb 444444' restricts the search to cases where zoneb=444444. This is a special code which identifies the total inflow into zonea. See User Guide 53 for this and other codes.

(3) Total migrant counts for Table 1 into all wards and postcode sectors including migrants moving within an area

```
$ smstab -set 1 -style 0 -tab 1 -test 1

> SMS Set: 1
> Tables: 1
> Using special test rules #1
>     Test type 1 = total dest + internal

01AAFA  444444 Table= 1 Movetype= 3 Tot=    209
01AAFB  444444 Table= 1 Movetype= 3 Tot=      3
01AAFE  444444 Table= 1 Movetype= 3 Tot=     49
01AAFF  444444 Table= 1 Movetype= 3 Tot=      3
01AAFG  444444 Table= 1 Movetype= 3 Tot=      1
```

Note that this search is similar to search (2). However the implicit rules included by using the option -test 1 make smstab include those flows internal to a zone, and thus the totals for each ward may be higher, as is the case for the first ward, 01AAFA. It is apparent that the revised total includes the flow within 01AAFA that is illustrated at the beginning of the output of example (1).

(4) Total migrant counts for Table 1 out of all wards and postcode sectors

```
$ smstab -set 1 -style 0 -tab 1 -zoneb 111111

> SMS Set: 1
> Tables: 1

01AAFA  111111 Table= 1 Movetype= 2 Tot=    83
01AAFB  111111 Table= 1 Movetype= 2 Tot=      4
01AAFD  111111 Table= 1 Movetype= 2 Tot=      6
01AAFE  111111 Table= 1 Movetype= 2 Tot=    26
01AAFF  111111 Table= 1 Movetype= 2 Tot=      1
```

Note that the zoneb code 111111 gives the total outflow from zonea.

(5) Migrant counts by age and sex for Table 1 into a ward or postcode sector

```
$ smstab -set 1 -tab 1 -style 2 -zonea 08DAGF -zoneb 444444

> SMS Set: 1
> Tables: 1

08DAGF  444444 Table= 1 Movetype= 3 Tot=   2883
          male   female
1-15      175     114
16-29     946     949
30-44     306     158
45-pens   89      51
```

pens+            36            59

(6) Migrant counts by age and sex for Table 1 out of a ward or postcode sector

```
$ smstab -set 1 -tab 1 -style 2 -zonea 08DAGF -zoneb 111111
```

```
> SMS Set: 1  
> Tables: 1
```

08DAGF	111111	Table= 1	Movetype= 2	Tot= 2707
		male	female	
1-15		126	131	
16-29		915	919	
30-44		230	159	
45-pens		62	59	
pens+		27	79	

Examples (5) and (6) use the total inflow and outflow codes to extract counts for the University ward in Leeds.

(7) Migrant counts by ethnic group for Table 5 from one district to another

```
$ smstab -set 2 -tab 5 -style 2 -zonea 08DA -zoneb 05CG
```

```
> SMS Set: 2  
> Tables: 5
```

08DA	05CG	Table= 5	Movetype= 2	Tot= 239	
		white	black	indian	chinese
<counts>		226	3	7	3
--					
08DA	05CG	Table= 5	Movetype= 3	Tot= 254	
		white	black	indian	chinese
<counts>		222	11	8	13

Because the '-move' option was not used, smstab has tabulated flows in both directions between 08DA (Leeds, West Yorks) and 05CG (Sheffield, South Yorks).

Note that the same data could have been extracted by swapping the arguments to the options '-zonea' and '-zoneb' (i.e. smstab ... -zonea 05CG -zoneb 08DA ). Furthermore, the data would have extracted slightly more quickly, because flows with '05CG' as a zonea occur earlier in the SMS data than the flows with '08DA' as a zonea.

(8) Migrant counts by economic position for Table 7 from a list of zones into a district

```
$ smstab -set 2 -tab 7 -style 2 -zonea 03BN -zbf znlist -move 3
```

```
> SMS Set: 2  
> Tables: 7  
> Applying following filters:  
> Use only these zoneb values
```

05 08 08 37  
> Use only movetype 3

		Table= 7	Movetype= 3	Tot=	182			
		selfemp	othemp	unemp	retd	stud_in	oth_in	stud_ac
03BN	05	4	101	23	1	37	11	5
<counts>								
03BN	08	14	195	49	1	70	35	7
<counts>								
03BN	28	1	61	6	0	17	7	0
<counts>								
03BN	37	2	52	16	0	31	9	3
<counts>								

This example tabulates the migrants from the counties 05, 08, 28 and 37 (the counties which make up Yorkshire and Humberside) into district 03BN (Manchester district in Greater Manchester). The option '-move 3' is used to isolate only those flows which are from the zoneb areas to the zonea area. The example uses a support file, *znlist*, to include the list of zone codes that were to be used. This is shown below:

```
$ cat znlist
05
08
28
37
```

Note that there is not currently a facility to add together these flows automatically.

## APPENDIX 2. THE MANUAL PAGES FOR SMSTAB

SMSTAB ( 1L )

Misc. Reference Manual Pages

SMSTAB ( 1L )

### NAME

smstab - a skeleton program to tabulate data from the 1991 Census of Population Special Migration Statistics datasets. It works with the SMS set 1 and SMS set 2.

### SYNOPSIS

smstab [ -set set ] [ -style style ] [ -rec limit ] [ -tab n(,m) ] [ -move movetype ] [ -test n ] [ -zonea zoneid ] [ -zoneb zoneid ] [ -zaf filename ] [ -zbf filename ]

### DESCRIPTION

smstab has been designed as a simple tool to extract data from the Special Migration Statistics. It allows the user to search the SMS data, using filters on all the 'header variables'. These variables are those used in records of type 2 and 3 in the raw SMS data (see OPCS Census User Guide 53), namely:

#### \* zonea and zoneb

A pair of zones between which migrations have occurred.

#### \* movetype

A variable which denotes the direction of migration flow. The values of this variable are:

- 1 - a move within zonea.
- 2 - a move from zonea to zoneb.
- 3 - a move from zoneb to zonea.

#### \* table

A table as outlined in OPCS Census User Guide 51.

A further filter allows the user to restrict a search to the first <n> records in the dataset.

This is to allow the user to test different search filters before running a search on the whole dataset.

An additional option offers a variety of output formatting styles. Output is written to the standard output, which may be directed into a file as normal.

The program source is available, and has been designed to facilitate adaptation to more complex user requirements. The -test option allows the program to call pragmatic blocks of code.

## OPTIONS

### **-set set**

Which SMS set to use. Permitted values are 1 and 2. The default value is 1.

### **-style style**

This option determines the way output will look. Permitted values of style are 0, 1, and 2. The result of these options are as follows:

0 (the default), lists the header variables, plus a total of the cell counts contained within the table.

1 shows zonea and zoneb from the header, followed by a list of the cell counts plus the total of the cell counts.

2 constructs tables using the layout and (abbreviated) labels from the table descriptions in the OPCS Census User Guide 51.

### **-rec limit**

limit is the number of records to limit the search to. If this is not included or set to 0, then \*all\* records will be used. Using all records may take some length of time, e.g. 15 to 20 minutes.

### **-move movetype**

Filter data by a selected movetype . Default is to use all movetypes, and possible values are 1, 2 or 3.

### **-tab n,(m)**

Which tables to write out. See Table A.1 for a list of available table in the SMS.

The default is all tables, (which is dependent on the SMS set being used).

The argument may be a list of numbers or a number range. Numbers should be separated by commas or spaces, but if spaces are used then the whole string

\*must\* be enclosed in quotes. Examples:

-tab 2

-tab 3,5

-tab '3 5 7'

-tab 4-8

### **-test n**

This is used to instruct smstab to use an internal set of rules regarding which data

to use. This may override other filters if there is a conflict of interest. At present the only value of n allowed is 1. This calculates the total inflow into an area, plus the internal movement. More formally,'-test 1' will look for pairs of zonea and zoneb areas where movetype=1 (i.e. zonea=zoneb) or where zoneb=444444 (the code used to signify total inflow).

### **-zonea zoneid**

Used to restrict the search to a chosen instance of zonea. *zoneid* should be a valid zonea code. All records with the chosen zonea will then be processed subject to any other filters which are being used.

**-zoneb *zoneid***

Used to restrict the search to a chosen instance of zoneb. *zoneid* should be a valid zoneb code. All records with the chosen zoneb will then be processed subject to any other filters which are being used.

**-zaf *filename***

*filename* is used to specify a file which contains a list of zonea codes, that will be used to constrain the search.

**-zbf *filename***

*filename* is used to specify a file which contains a list of zoneb codes, which will be used to constrain the search.

Notes regarding -zaf and -zbf files:

These files (if used) should contain lists of zone codes, arranged one to a line, and starting in the leftmost column. Code validation is not carried out, so it is up to the user to ensure that valid codes are used.

If both -zaf and -zbf are used, then the search will be constrained to the intersection of the two lists, rather than the union.

smstab will try to stop a run after reaching the end of possible data. In practice this is easy if the search is constrained by zonea codes (i.e. a -zaf file has been specified, or a single zone using -zone), but cannot be done for zoneb codes on their own. Thus if a -zbf file is used, but a -zaf file (or a -zone option) is \*not\* used, then all the records in the file will have to read (subject to any limit imposed by -rec). On the other hand, if the options -zone or -zaf are used, then smstab will stop as soon as all the selected values of zonea have been processed.

**Table A.1.** Arguments for the smstab -tab (table) option

Option	Argument	Meaning
-tab	1	Table 1: Broad age by sex (SMS1 and SMS2)
	2	Table 2: Wholly moving households; residents in wholly moving households (SMS1 and SMS2)
	3	Table 3: 5 year age group by sex (SMS2)
	4	Table 4: Sex by marital status (SMS2)
	5	Table 5: Ethnic group (SMS2)
	6	Table 6: Limiting long-term illness by in households, not in households (SMS2)
	7	Table 7: Economic position (SMS2)
	8	Table 8: Tenure (SMS2) - different versions for England & Wales and Scotland (SMS2)
	9	Table 9: Wholly moving households by sex of head and by economic position of head (SMS2)
	10	Table 10: Residents in wholly moving households by sex and by economic position of head (SMS2)
	11	Table 11: Migrants resident in Scotland who speak Gaelic (Scotland version); Migrants resident in Wales who speak Welsh (Wales version)