Socio-demographic scenarios for children to 2020

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JOSEPH ROWNTREE FOUNDATION

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Glossary of acronyms and abbreviations

Term	*Definition*
CAMS	Controlled Access Microdata System
CASWEB	Census Area Statistics World Wide Web Interface
CCSR	Cathie Marsh Centre for Census and Survey Research
CEFMR	Central European Forum for Migration Research
ESDS	Economic and Social Data Service
FRS	Family Resources Survey
FTE	Full Time Equivalent
GAD	Government Actuary's Department
GOR	Government Office Region
GROS	General Register Office for Scotland
IPF	Iterative Proportional Fitting
ISAR	Individual Sample of Anonymised Records
JRF	Joseph Rowntree Foundation
NAW	National Assembly for Wales
NISRA	Northern Ireland Statistics and Research Agency
ODPM	Office of the Deputy Prime Minister
ONS	Office for National Statistics
SAR	Sample of Anonymised Records
SPSS	Statistical Package for the Social Sciences
UK	United Kingdom

Executive summary

In this report we describe the ways we have projected a set of tables of the future population distribution across seven variables, relevant in the analysis of child poverty, across 13 regions. The seven variables are:

1. age
2. number of dependent children in families
3. type of family
4. size of households
5. ethnic group
6. number of earners
7. housing tenure.

We have used three different approaches to projection:

1. existing official projections (for age, some household categories, employment forecasts)
2. extrapolation of inter-census trends or FRS statistics (number of dependent children, type of family, size of households, number of earners, housing tenure)
3. our own cohort-component projections (ethnic group).

For each region we projected seven sets of marginal tables, each containing number of people and each summing to the most accurate total, the total regional population estimated by combining GAD national (2004-based) and ONS sub-national (2003-based) projections. This ensured consistency of the key variable tables.

We produced a seven variable by 13 region array by aggregating the individual records in the 2001 census Individual Sample of Anonymised Records. We built a seven dimensional iterative proportional fitting algorithm and associated implementation software to adjust this 2001 census-based array to marginal tables for 2010 and 2020. If this was successful, then it would be possible to choose combinations of the seven variables as tables for re-weighting the microsimulation results produced by IFS, using the FRS. In the event, it proved difficult to achieve convergence of the adjusted array and agreement between the summed marginals and the external constraints. Nevertheless we were able to improve on initial results by re-ordering the solution sequence and ironing out inconsistencies and errors in the constraint tables.

This was a pioneering attempt to quickly generate consistent projections of the UK population across more socio-economic dimensions than has been attempted before. The results are reasonably robust and can be used to re-weigh microsimulation results for 2010 and 2020 to yield an

improved understanding of whether policy will achieve the goal of child poverty eradication. A more sophisticated approach will require moving to a dynamic microsimulation model, which is an altogether bigger undertaking.

1. Introduction

This document constitutes the final report on the construction of a set of forecast populations for 2010 and 2020. These were requested by the Joseph Rowntree Foundation (JRF) as input to their project on UK child poverty. The forecast populations are used by Mike Brewer of the Institute for Fiscal Studies, London, to re-weight, to 2010 and 2020, the results of a microsimulation model that explores policy options for 'eradicating' child poverty.

By forecast populations we mean the best central estimate that we can currently achieve of the future population of the United Kingdom, described in terms of the dimensions of age (in order to identify children), region (because child poverty varies across the country), family type, household size (because larger families are at higher risk of poverty), ethnicity (because the size of families varies considerably between ethnic groups and some minority groups face higher poverty rates), number of earners (influencing family income) and tenure (housing market position reflects poverty risk).

Where possible, we have used the latest official forecasts for each of the dimensions, available in late 2005. For example, we have used the official 2004-based Government Actuary's Department projections of the UK, England, Wales, Scotland and Northern Ireland populations together with the Government Office Region 2003-based projections made by the Office for National Statistics. These became available in October 2005 and show that that a significantly higher population is projected for the UK than in the previous 2003-based projections. Table 1 shows that 503,000 more people are expected to live in the UK in 2010 and 850,000 more in 2020, according to the projections based on 2004 assumptions, than were expected based on the 2003 assumptions. Combined with our own forecasts of how many 16-19-year-olds will be dependent and non-dependent, these official forecasts anchor the results for 2010 and 2020. Tables of the population forecast by other dimensions are constrained to sum to the same regional totals. For many of the dimensions, however, official forecasts did not exist and we have developed our own. These are mainly extrapolative models of the proportional/percentage distribution of the population across the categories of a population dimension. But in the case of ethnicity we carried out our own cohort-component projection because the planned Office for National Statistics projections will not be available until mid-2006 (Pete Large, ONS, personal communication).

Table 1
Population of the UK in 2010 and 2020 from GAD projections

(Population in millions at mid-year)

Projection	2001	2010	2020
2003-based	58.836	61.116	63.599
2004-based	58.836	61.619	64.449

Source: GAD (2004b) and GAD (2005)

In order to estimate the projected trajectories we used 2001 census data to ascertain regional differences. Using regions as a means of disaggregating the population had computational advantages. We could apply our iterative model to 13 smaller populations of about 4.5 to 5 million rather than one larger UK population of 59 to 64 million.

The document is accompanied by a database and programme that enables the Institute of Fiscal Studies to use both the forecast tables themselves and other cross-tabulations of the multi-dimensional array that we have estimated for 2010 and 2020 by updating the 2001 census Individual Samples of Anonymised Records (ISAR). The updated arrays for 2010 and 2020 have been achieved by iteratively fitting the 2001 cross-tabulation based on the ISAR to the forecast marginal populations. The results of the seven dimension iterative proportional fitting (IPF) are not yet robust enough to enable the use of arrays other than the marginals that we have constructed. We will continue to investigate the behaviour of the model.

1.1 Aims

The aims of the project are to:

- develop a benchmark cross-tabulation of the population of children that captures many socio-demographic factors that affect child poverty;
- investigate the availability of projections of the socio-demographic factors;
- acquire the key variables of those projections;
- carry out new projections where there are no existing projections of key variables;
- estimate from the projection results the marginal tables for 2010 and 2020 for direct use in updating policy micro-simulations;
- develop a method for adjusting the benchmark cross-tabulation of the child population to the projected array marginals in 2010 and 2020;
- generate a new cross-tabulation for 2010 and 2020 for indirect use in updating the policy micro-simulations.

The project generated a multi-dimensional array of the UK population from the 2001 census Individual Sample of Anonymised Records. The dimensions of the array are limited to key variables matched to those in the Family Resources Survey used in the micro-simulation modelling. These key variables are projected forward from 2001 to both 2010 and 2020 using a variety of sources and methods, described later in the report.

The array is then adjusted to projections of the dimensions to 2010 and 2020, using IPF. The IPF algorithm adjusts a multi-dimensional array to a set of marginal constraint tables in successive steps. The adjustment steps are repeated for as many times as needed to achieve a stable solution. By stable solution we mean that the population count in the array at successive iterations differ by less than a person. The IPF routine that we have developed produces a converged array but does not satisfy all of the marginal constraints simultaneously. We therefore recommend that most of the re-weighting of micro-simulation results to 2010 and 2020 be done using the marginal constraints rather than any other cross-tabulation derived from the full array.

1.2 Report outline

Section 2 of the report describes the variables to be employed in generating the benchmark 2001 census array, specifying the exact variable from the 2001 ISAR data set. Tables setting out the proposed classifications are discussed variable by variable. These are commented upon and aggregated alternatives are presented.
Section 3 of the report describes the iterative proportional fitting model that has been implemented. The notation is defined, the equations are set out and their role discussed.

Section 4 of the report discusses the constraint tables that have been projected. There are seven of these, controlling for key variables in the full array. In section 4.1 a projected data set covering the variable age is described. In section 4.2 we generate future distributions of number of dependent children per family. In section 4.3 we project the distribution of family types. In section 4.4 we present the projections of households by size. In section 4.5 we present results for the projection of ethnic groups. In section 4.6 we present a table for the distribution of number of earners. In section 4.7 we present the projected distribution by tenure. All of these distributions are based on counts of individuals rather than households (to maintain consistency throughout), and we convert from households to individuals where necessary making assumptions about the number of people in households. All constraint tables are cross-tabulated by region. Classifying all constraint tables by region has the

advantage that we can run the IPF separately for each region, which makes the computations more manageable. Each part of section 4 of the report presents the past trends examined and the methods used to forecast the variables forward to 2010 and 2020.

Section 5 describes the software written to implement the model. Section 6 sets out concluding remarks. Appendix A provides a data dictionary for the variables used in the projections. Appendix B sets the full contents of the marginal or constraint tables that we have projected, which constitute the key output of the research.

2. Specification of the benchmark multi-dimensional array

This section of the report specifies the multi-dimensional array that has been generated from the Individual Sample of Anonymised Records (ISAR) derived from the 2001 Census of Population, which is being updated to 2010 and 2020 by adjustment to projected marginal or constraint tables. We present more detailed and less detailed classifications of the eight key variables. We have generally used the less detailed classifications to keep the array size manageable.

Initially, we considered use of ONS's Individual Controlled Access Microdata System (CAMS) rather than the Individual Sample of Anonymised Records to obtain the necessary detail for key variables. On further investigation, the CAMS did not prove a viable alternative because export of individual records is not allowed. We have found suitable aggregate and survey data to generate all of the key variables.

Note that we do not recommend that the Institute for Fiscal Studies should use the full array to scale up their micro-simulation results. Rather the appropriate marginals should be used for different presentations of what the sample results mean for the full population. The generation of a full array of the population in 2010 and 2020 is a device for making sure that the different variables are consistent (i.e. add to shared sub-totals and grand totals for the UK).

The classifications set out here have evolved in the course of the project for several reasons: (1) in response to IFS comments and needs; (2) because of the need to keep the multi-way array manageable; (3) because new information or insights emerged as the detailed work was carried out. Tables 2 to 9 set out the alternative classifications for key variables while Appendix A is a data dictionary which sets out the classifications adopted. Figure 1 maps the regions used in the study and introduces a cartogram in which the area of the region on the page is proportional (roughly) to its total population.

2.1 Region classifications (r = region)

Table 2 sets out geographical classifications available in the microdata (FRS, ISAR) and projections (GAD, ONS). The format of the table will be described in detail, as it is adopted as a general device. The first column refers to the Family Resources Survey (FRS) and is there to verify that the variable is present in the FRS in a form that can generate a classification that matches that proposed for the ISAR from the 2001

census. The second column indicates the classification available for the ISAR variable. The third column sets the level of detail available from the projection data set, in this case the UK projections of GAD. The fourth column sets out **in bold** the target classification used in generating the multi-way table from the ISAR. Note that this is not necessarily the same as the most detailed ISAR classification but may be an aggregation. The fifth column sets out the values assigned to the target classification.

The regions are the same across all four data sets. The local authority spatial scale is present in the FRS and ONS data sets but not in the ISAR. We adopt a 13-region classification that combines country (Scotland, Wales, Northern Ireland) with Government Office Regions (GORs) in England, with one additional distinction – the split of London into inner and outer parts. This latter split often necessitates finding and aggregating data for 33 London boroughs (14 constitute Inner London and 19 make up Outer London). The ONS Subnational Projections (ONS 2004a) and the GAD Country Projections (GAD 2005b) both provide the age detail chosen in Table 3. The other variables can also be cross-classified by region, so that we can apply the IPF program to each region separately, which is easier to implement.

2.2 Age classifications (a=age group)

Table 3 sets out the age classifications available in the different microdata sets and in the GAD national projections. Both FRS and GAD data sets provide age in single year detail (to a very old age). However, single years of age are not used because they are absent from the ISAR and because the resulting array would be too large. So we employ a classification that follows the ISAR age groupings with two exceptions. First, the older age groups are merged, because the focus is child poverty. Second, to distinguish children as a group, we partition the 16-19 ages between dependents and non-dependents. Later we discuss the definition of dependent children for age group 16-19; they are defined in a number of different ways in the various data sets. The target classification has nine age classes. The first three define children and the next six non-children. The demographic projections for the UK, countries and GORs in England provide the necessary age detail.

Table 2
The regional classifications used in the FRS, ISAR, projection and target data sets

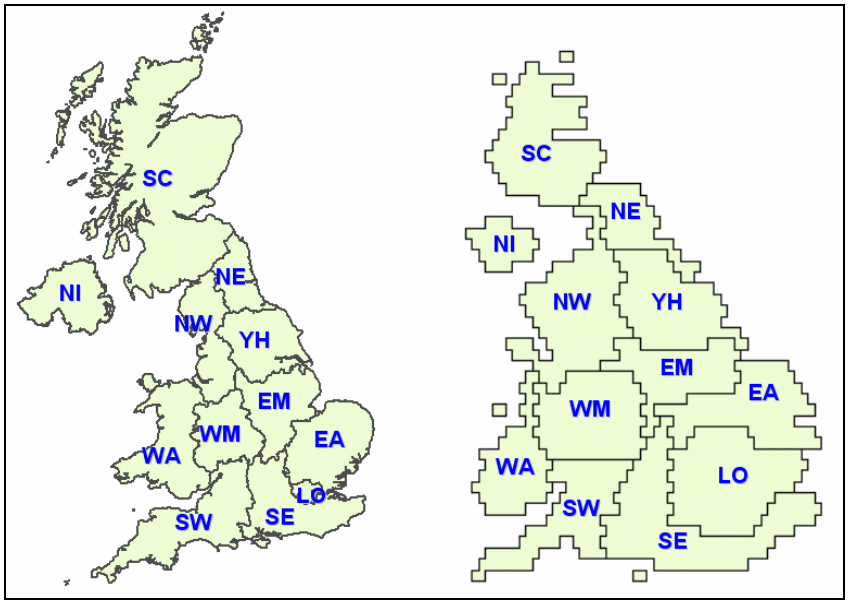
FRS	**ISAR**	**Projections (GAD & ONS combined)**	**Target categories for ISAR array**	**Value**
Government Office Region/Country/Local Authority[1]	region of usual residence	England: ONS Country: GAD	13 regions	
GVTREGN, LAC	Region		Region	
England: North East	North East	England: North East	**North East**	101
England: North West	North West	England: North West	**North West**	102
England: Yorkshire and the Humber	Yorkshire and the Humber	England: Yorkshire and the Humber	**Yorkshire and the Humber**	103
England: East Midlands	East Midlands	England: East Midlands	**East Midlands**	104
England: West Midlands	West Midlands	England: West Midlands	**West Midlands**	105
England: East	East of England	England: East	**East of England**	106
England: South East	South East	England: South East	**South East**	107
England: South West	South West	England: South West	**South West**	108
England: Inner London	Inner London	England: Inner London	**Inner London**	109
England: Outer London	Outer London	England: Outer London	**Outer London**	110
Scotland	Scotland	Scotland	**Scotland**	111
Wales	Wales	Wales	**Wales**	112
Northern Ireland	Northern Ireland	Northern Ireland	**Northern Ireland**	113

Notes:
1. The Inner and Outer London split in the FRS is achieved by using both the GVTREGN (Government Office Region) and LAC (Local Authority Council) variables. See http://www.data-archive.ac.uk/findingData/variableInfo.asp?sn=4803&recid=12&class=0&varid=64&qu=&from=sn
2. The Inner and Outer London categories can also be found by aggregating local authority codes in the England Sub-National Projections, as follows.

Inner London		Outer London	
Code	Borough	Code	Borough
00AA	City of London	00AB	Barking and Dagenham
00AG	Camden	00AC	Barnet
00AM	Hackney	00AD	Bexley
00AN	Hammersmith and Fulham	00AE	Brent
00AP	Haringey	00AF	Bromley
00AU	Islington	00AH	Croydon

00AW	Kensington and Chelsea	00AJ	Ealing
00AY	Lambeth	00AK	Enfield
00AZ	Lewisham	00AL	Greenwich
00BB	Newham	00AQ	Harrow
00BE	Southwark	00AR	Havering
00BG	Tower Hamlets	00AS	Hillingdon
00BJ	Wandsworth	00AT	Hounslow
00BK	Westminster	00AX	Kingston upon Thames
		00BA	Merton
		00BC	Redbridge
		00BD	Richmond upon Thames
		00BF	Sutton
		00BH	Waltham Forest

Figure 1
UK regions on a conventional map and on a population cartogram



SC – Scotland, NI – Northern Ireland, WA – Wales, NE – North East, NW – North West, YH – Yorkshire and the Humber, EM – East Midlands, EA – East of England, LO – London, SE – South East, SW – South West

Source: EDINA (2005), Dorling et al (2003)

Table 3
Age classifications in the FRS, ISAR, projection and target data sets

FRS[1]	**ISAR**	**Projections (GAD)**	**Target categories for ISAR array**	**Value**
Age of adult at last birthday, age of child at last birthday	Age of respondents – grouped, schoolchild or student in full time education	Quinary age groups with 15, 16-19	9 age groups	
Age	Age 0, student		Age 0, student	
0-9	0 through 9	0-4 5-9	**0-9**	1
10-19 dependants	10 through 15	10-14 15	**10-15**	2
	16 through 19 & FTE	16-19	**16-19 dependents**	3
16-24 non-dependants	16 through 19 & NFTE		**16-19 non-dependents**	4
	20-24	20-24	**20-24**	5
25-29	25-29	25-29	**25-29**	6
30-34	30-44	30-34	**30-44**	7
35-39		35-39		
40-44		40-44		
45-49	45-59	45-49	**45-59**	8
50-54		50-54		
55-59		55-59		
60-64	60-64	60-64	**60+**	9
65-74	65-69	65-69		
	70-74	70-74		
75-79	75 through 79	75-79		
80 plus	80 through 95+	80-84		
		85-89		
		90+		

Notes:
1. This is how the data are summarised. The FRS actually contains a single year of age variable: See ESDS & UKDA (2005a).
2. We will need to make school, FE and HE participation assumptions to disaggregate the 16-19 age group by full time education (FTE) and not in full time education (NFTE).

Sources: FRS: ESDS & UKDA (2005); NS/DWP (2004); ISAR: CCSR (2004), CCSR (2005); Population Projections: GAD (2005b). We use the principal projection not any of the projections variants.

2.3 Dependent children in family (d=dependent child category)

It is important to know, for assessing the risk of child poverty, the number of dependent children in a family/household. Other things being equal, the non-benefit resources of the family/households are more thinly spread in larger families. We use the following definition of dependent children:

> "Dependent children are those under 16, or aged 16-18, studying full time and living in a family with one or both parents." (ONS 2003a).

Table 4 shows that this is a problematic variable for the ISAR. The second column shows that the variable *fndepch* distinguishes families with or without dependent children but does not show how many dependent children there are. We have used 2001 census published and commissioned tables to develop a constraint table that classifies the population into four categories.

2.4 Family type (f=family type)

This classification gives important information about the kind of family dependent children live in. The risk of poverty will vary significantly between the different kinds of family. We use the *famtyp* classification available in the ISAR, shown in Table 5. The note to Table 5 shows that a similar classification can be generated from the FRS.

2.5 Household size (h=household size)

Table 6 sets out the classification used and a compressed version. We have explored how to use the official household projections for England (ODPM 1999, 2004) to make a projection of household size.

Table 4
Dependent children categories in the FRS, ISAR, census and target data sets

FRS	**ISAR**	**Census**	**Target**	**Value**
	Dependent children in family	Commissioned table used	Number of dependent children in family	
DEPCHLDH	Fndepch			
	-9 = Not applicable (not in a family / student living away)	No dependents	**No dependents**	0
	0 = no children in family			
1	1 = dependent children only	1 dependent	**1 dependent**	1
2	2 = dependent and non-dependent children	2 dependents	**2 dependents**	2
3	3 = non-dependent children only	3 + dependents	**3 + dependents**	3
4				
5				
6+				

Notes:
1. The FRS variable defined at http://www.data-archive.ac.uk/findingData/variableInfo.asp?sn=4803&recid=12&class=0&varid=188&qu=&from=sn

Table 5
Family type classification in the FRS, ISAR, projection and target data sets

FRS	**ISAR**	**Census and projection data sets**	**Target**	**Value**
		Estimated from household projections and 2001 census		
	Famtyp			
See note 1	Lone parent – male	Ungrouped individual	**Ungrouped individual**	-9
	Lone parent - female	Lone parent	**Lone parent**	1
	Married couple – no children	Married couple	**Married couple**	2
	Married couple – children all belong to both members	Cohabiting couple	**Cohabiting couple**	3
	Married couple – children do not all belong to both members	One person	**One person**	4
	Cohabiting couple – no children	Other multi-person	**Other multi-person**	5
	Cohabiting couple – children all belong to both members			
	Cohabiting couple – children do not all belong to both members			
	Ungrouped individual (not in a family)			

Note
1. FRS does have variables, RELTOHRP and HHCOMP, that can be used to create a family type classification.
See http://www.data-archive.ac.uk/findingData/variableInfo.asp?sn=4803&recid=8&class=0&varid=155&qu=&from=sn

RELTOHRP	Value labels
Value 1	Spouse
Value 2	Cohabitee
Value 3	Son/daughter (incl. adopted)
Value 4	Step-son/daughter
Value 5	Foster child
Value 6	Son-in-law/daughter-in-law
Value 7	Parent

HHCOMP	Value labels
Value 1	One adult, no children over pension age
Value 2	One adult, no children, under pension age
Value 3	Two adults, no children, both over pension age
Value 4	Two adults, no children, one over pension age
Value 5	Two adults, no children, both under pension age
Value 6	Three or more adults, no children
Value 7	One adult, one child

Value 8	Step-parent		Value 8	One adult, two children
Value 9	Foster parent		Value 9	One adult, three or more children
Value 10	Parent-in-law		Value 10	Two adults, one child
Value 11	Brother/sister (incl. adopted)		Value 11	Two adults, two children
Value 12	Step-brother/sister		Value 12	Two adults, three or more children
Value 13	Foster brother/sister		Value 13	Three or more adults, one child
Value 14	Brother/sister-in-law		Value 14	Three or more adults, two children
Value 15	Grand-child		Value 15	Three or more adults, three or more chidren
Value 16	Grand-parent			
Value 17	Other relative			
Value 18	other non-relative			

Table 6
Household size classification in the FRS, ISAR, projection and target data sets

FRS	**ISAR**	**Projections**	**Target (detailed)**	**Value**	**Target (broad)**	**Value**
	Number of usual residents in household	To be estimated from household projections and 2001 census				
Hhsize[1]	Hnresndt [2]		Hnresndt			
1	1	1	**1 person**	1	1 person	1
2	2	2	**2 persons**	2	2 persons	2
3	3	3	**3 persons**	3	3 persons	3
4	4	4	**4 persons**	4	4+ persons	4
5	5	5	**5 persons**	5		
6+	6+	6+	**6+ persons**	6		

Notes:
1. FRS variable given:
http://www.data-archive.ac.uk/findingData/variableInfo.asp?sn=4803&recid=12&class=0&varid=220&qu=&from=sn
2. Category -9 = Not in a household.

2.6 Ethnic group (e=ethnic group)

Table 7 sets out the ethnic group classifications available in the FRS, ISAR and in a recent set of academic projections (Coleman and Scherbov 2005). The ONS ethnic projections will not be available in the timeframe of this project (Pete Large, ONS, personal communication). No age tabulations are provided in the published paper reporting the Coleman and Scherbov projections. So as a result we have carried out our own ethnic population projections.

A 15 ethnic group classification is available in Table S101 of the 2001 census for GORs and Wales and a similar classification in Table S303 for Northern Ireland. However, for Scotland less detail is available. We needed to build our own model for projecting ethnicity as no sub-national projections were available in 2005. This was a challenging task so we have limited the projections to five ethnic groups. Inspection of the 2001 census tables suggests that many of the 15 ethnic groups will have too few people in many regions for proper demographic modelling. We have built a simple projection model incorporating ageing, survival rates and gross internal and international inflows and gross internal and international outflow rates from our existing projection work together with fertility rates adjusted using 2001 census child woman ratios for regions and ethnic groups. The results are constrained to the ONS/GAD projections for all groups.

2.7 Employed adults in household (n=number of earners)

Table 8 sets out the earner classification in the ISAR which will be used in generating the array. We use some information from employment projections produced by HM Treasury (2004) and Bijak *et al.* (2005).

2.8 Tenure (t=tenure type)

Table 9 sets out the tenure classification, both in a six-group classification and a reduced three-group classification. The projected dataset combines trends between 1991 and 2001 censuses in tenure distributions across regions and the ODPM household projections.

Table 7
Ethnic group classification in the FRS, ISAR, projection and target data sets

FRS	ISAR	Projections	Target (Detailed)	Value	Target (Broad)	Value
	Ethnic group for England and Wales, Ethnic group for Northern Ireland, Ethnic group for Scotland	Coleman & Scherbov				
ETHGRP	ethew, ethn, eths	4 ethnic groups	15 ethnic groups		5 ethnic groups	
White - British	British (ethew) White Scottish, Other white British (eths) White (ethn)	White	White – British	1	**White**	1
Any other white background	Irish, Other White (ethew) White Irish, Other white (eths)		White – Other	2		
Mixed – White and Black Caribbean	White and Black Caribbean (ethew)	Mixed	Mixed – White and Black Caribbean	3	**Mixed**	2
Mixed – White and Black African	White and Black African (ethew)		Mixed - White and Black African	4		
Mixed – White and Asian	White and Asian (ethew)		Mixed – White and Asian	5		
Any other mixed background	Other Mixed (ethew) Any mixed background (eths)		Mixed – Other	6		
Asian or Asian British – Indian	Indian (ethew) Indian (eths)	Asian	Asian or Asian British – Indian	7	**Asian**	3
Asian or Asian British - Pakistani	Pakistani (ethew) Pakistani (eths)		Asian or Asian British – Pakistani	8		
Asian or Asian British – Bangladeshi	Bangladeshi (ethew) Bangladeshi (eths)		Asian or Asian British – – Bangladeshi	9		
Any other Asian/Asian British background	Other Asian (ethew) Other South Asian (eths)		Asian or Asian British – any other background	10		
Chinese	Chinese (ethew) Chinese (eths)		Chinese	11	**Chinese & Other**	4
Any other	Other ethnic Group (ethew) Other ethnic group (eths) Other ethnic group (ethn)		Other ethnic group	12		

Table 7 (continued)
Ethnic group classification in the FRS, ISAR, projection and target data sets

Black or Black British – Caribbean	Black Caribbean (ethew) Caribbean (eths)	Black	Black or Black British - Caribbean	13	**Black**	5
Black or Black British –- African	Black African (ethew) African (eths)		Black or Black British - African	14		
Any other Black/Black British background	Other Black (ethew) Black Scottish or other black (eths)		Any other Black/Black British background	15		

Notes to Table 7
1. There is no satisfactory uniform classification of ethnicity in the 2001 Census across the whole UK. It is necessary to combine slightly different categories from the England and Wales, Scotland and Northern Ireland censuses.
2. FRS variable ETHGRP defined at:
http://www.data-archive.ac.uk/findingData/variableInfo.asp?sn=4803&recid=3&class=0&varid=140&qu=&from=sn
3. Also available is:

Variable Id	209
Variable Name	HHETHGRP
Variable Text	Ethnicity of Head of HH (Pub.)
Value Labels	
Value 1	White
Value 2	Mixed
Value 3	Asian or Asian British
Value 4	Black or Black British
Value 5	Chinese or Other Ethnic group

4. The Coleman and Scherbov classification is given in their Table 6.

Table 8
Employed adults classification in the FRS, ISAR, projection and target data sets

FRS[1]	**ISAR**	**Projections**	**Target (Detailed)**	**Value**	**Target (Broad)**	**Value**
		To be estimated from labour force participation rates produced by HM Treasury and CEFMR				
	Hnearnrs					
	(-9 Not in household)					
	No earners		**No earners**	0	No earners	0
	1 earner		**1 earner**	1	1+ earners	1
	2 earner		**2 earner**	2		
	3+ earners		**3+ earners**	3		

Notes:
1. Not available as a single count, would have to be derived from the associated adult records. The closest variables in the household set:
Variable 189: EMP – HoH Unemployed (Pub.) and Variable 19: EMPHRP – One or more Unemp in HH excl. HOH (Pub).

Table 9
Tenure classification in the FRS, ISAR, projection and target data sets

FRS	ISAR	Projections	Target (detailed)	Value	Target (broad)	Value
	Tenure of Accommodation (England and Wales only), Tenure of Accommodation (Scotland and Northern Ireland)	To be estimated from census series				
Tentype	tenurew, tenursn					
	Not applicable (not in a household etc) (tenurew, tenursn)					
Owned outright	Owns outright (tenurew, tenursn)		Owns outright	1	**Owns**	1
Owned with a mortgage (includes part rent / part own)	Owns with a mortgage or loan (tenurew, tenursn)		Owns with a mortgage or loan	2		
LA / New Town / NIHE / Council rented	Rents from Council (Local Authority)/Scottish Homes/NI Housing (tenurew, tenursn)		Rents from Council (Local Authority etc	4	**Social rent**	2
Housing Association/Co-Op/Trust rented	Pays part rent and part mortgage (shared ownership) (tenurew,tenursn)		Pays part rent and part mortgage (shared ownership)	3		
	Rents from Housing Assoc/Housing co-operative/Charitable (tenurew,tenursn)		Rents from Housing Assoc/Housing co-operative/Charitable	5		
Other private rented unfurnished	Private rented or living rent free (tenurew) Rents from private landlord/employer/relative/other (tenursn)		Private rented etc	6	**Private rent**	3
Other private rented furnished						
Rent-free						
Squats						

Notes:
1. The FRS variable categories are taken from
http://www.data-archive.ac.uk/findingData/variableInfo.asp?sn=4803&recid=12&class=0&varid=252&qu=&from=sn.
2. There is also the variable PTENTYPE available (source as above).

Variable Id	243
Variable Name	PTENTYPE
Variable Text	Tenure type -PUB
Value Labels	
Value 1	Rented from Council
Value 2	Rented from Housing Association
Value 3	Rented privately unfurnished
Value 4	Rented privately furnished
Value 5	Owned with mortgage
Value 6	Owned outright

3. The iterative proportional fitting model

Here we set out the model that is used to update a multi-dimensional array generated from the 2001 Census Individual Sample of Anonymised Records to 2010 and 2020, using projected marginal distributions (single or multi-way tables). The account given here uses a formal notation.

3.1 The array dimensions and model notation

The SAR population of individuals is classified by the following eight dimensions:

- r = region (GOR in England, Wales, Scotland, Northern Ireland)
- a = age of respondent (0-9, 10-15, 16-24 etc)
- d = number of dependent children in family (0, 1, 2, 3+)
- f = family type (lone parent, lone married, cohabiting, not in a family/household)
- h = size of household (-9, 0, 1, 2, 3, 4, 5, 6+)
- e = ethnic group (white, Asian, other ethnic groups)
- n = number of employed adults in household (no earners, 1 earner etc)
- t = household tenure (owns, social rent, private rent).

Some of the projections and intermediate computations may divide the population by gender as well but we do not carry this variable through the model.

Appendix A shows the full set of variable values actually used and these are highlighted in Tables 2 through 9 by emboldening of the appropriate classification.

We use capital P to indicate population variable (count of people) and we used suffixes within parentheses to refer to the cells of the multi-way array. The general variable is thus $P^{year}(r,a,d,f,h,e,n,t)$ = count of people resident in region r, in age group a, with d dependents in their family of type f, within a household of size h, in ethnic group e, with n number of earners in the household and living in housing of tenure t. We start with a population for 2001 generated from the SAR, $P^{2001}(r,a,d,f,h,e,n,t)$, and aim to update this to populations in 2010, $P^{2010}(r,a,d,f,h,e,n,t)$ and 2020, $P^{2020}(r,a,d,f,h,e,n,t)$, to be consistent with forecasts numbers or distributions of marginal sums of the array, such as $P^{2020}(r,a)$, the projected population in region r and age group a in 2020, derived from national and regional projections.

We employ an extra suffix to the population variable below in square brackets, e.g. [1]. This refers to the step number in the model. We begin

with a Step 0 that enters the initial counts into the population array. Then follow Steps 1 to 7, in which the population array is adjusted to agree with the counts/distribution probabilities in the marginal tables, known as constraints. Although there are eight dimensions to the array, we only use seven constraint tables because all the tables are classified by region. That enables us to run the model for each region separately and reduces the run time of the IPF routines. Step 8 checks to see whether the estimated real values of the array cells differ between the Step 1 values and the Step 7 values. If no cell difference exceeds the small threshold value, then we stop the process and accept the Step 7 estimates. If differences for one or more cells exceed the threshold, we put the Step 7 estimates of cell values into the Step 0 version of the array, return to Step 1 and repeat the computations. This repetition is called an iterative process.

A small threshold difference (a person) is used to ensure that when we report the results using whole numbers of people, the results do not change from iteration to iteration. Note that the computation is carried out using real numbers and estimated cell values may contain decimal fractions of a person and in some cases the real number may be less than 0.5. In using the array to factor up model results based from a micro-simulation model, it may be convenient to use whole numbers rather than real numbers with decimal parts. The whole numbers, when aggregated, may not agree exactly with the numbers in the constraint tables but the difference should not make any material difference to the re-weighting process.

3.2 The IPF process

We now set out the IPF process as a formal set of equations. The year will be set to 2010 and 2020 in successive applications. Each step contains the notation $\sum_{other}$: this means that the summation is over all the indexes in the variable $P^{year}(r,a,d,f,h,e,n,t)$ that are not in the constraint variable. If the constraint variable is P(r,a), then $\sum_{other}$ means $\sum_{d,f,h,e,n,t}$, for example.

The main process is set out in a box on page 33.

Preliminary work is needed to ensure that the constraint arrays all agree; that is, they all add to the same total for the UK population in 2010 and 2020. To ensure this we assume that the total population of the UK projected by the Government Actuary's Department is the most reliable figure in the set of projections and adjust other constraint arrays accordingly. Let this figure be $P^{year}(UK)$. We ensure that the sums of all array elements add up to this grand totals. This requirement of

agreement to one number means that the task of projecting the constraint tables/partial arrays reduces to one of projecting the population distribution across the relevant variable categories rather than having to be precise about actual counts in each category.

Figure 2
The iterative proportional fitting model

Step 0: initialise array

$P^{year}(r,a,d,f,h,e,n,t)[0] = P^{2001}(r,a,d,f,h,e,n,t)$ = 2001 ISAR tabulation for UK

Step 1: constrain to age projections from GAD and ONS (GAD 2004, ONS 2004)

$$P^{year}(r,a,d,f,h,e,n,t)\,[1] = P^{year}(r,a,d,f,h,e,n,t)\,[0] \times \{P^{year}(r,a)/\Sigma_{other}\,P^{year}(r,a,d,f,h,e,n,t)\,[0]\} \quad (1)$$

Step 2: constrain to number of dependent children projections

$$P^{year}(r,a,d,f,h,e,n,t)\,[2] = P^{year}(r,a,d,f,h,e,n,t)\,[1] \times \{P^{year}(r,d)/\Sigma_{other}\,P^{year}(r,a,d,f,h,e,n,t)\,[1]\} \quad (2)$$

Step 3: constrain to family type projections adapted from ODPM (ODPM 2004)

$$P^{year}(r,a,d,f,h,e,n,t)\,[3] = P^{year}(r,a,d,f,h,e,n,t)\,[2] \times \{P^{year}(r,f)/\Sigma_{other}\,P^{year}(r,a,d,f,h,e,n,t)\,[2]\} \quad (3)$$

Step 4: constrain to household size projections adapted from ODPM (ODPM 2004)

$$P^{year}(r,a,d,f,h,e,n,t)\,[4] = P^{year}(r,a,d,f,h,e,n,t)\,[3] \times \{P^{year}(r,h)/\Sigma_{other}\,P^{year}(r,a,d,f,h,e,n,t)\,[3]\} \quad (4)$$

Step 5: constrain to ethnic projections developed for this project

$$P^{year}(r,a,d,f,h,e,n,t)\,[5] = P^{year}(r,a,d,f,h,e,n,t)\,[4] \times \{P^{year}(r,e,a)/\Sigma_{other}\,P^{year}(r,a,d,f,h,e,n,t)\,[4]\} \quad (5)$$

Step 6: constrain to labour projections from HM Treasury (2004) and other sources

$$P^{year}(r,a,d,f,h,e,n,t)\,[6] = P^{year}(r,a,d,f,h,e,n,t)\,[5] \times \{P^{year}(r,n)/\Sigma_{other}\,P^{year}(r,a,d,f,h,e,n,t)\,[5]\} \quad (6)$$

Step 7: constrain to tenure projections from ODPM (ODPM 2004) and other sources

$$P^{year}(r,a,d,f,h,e,n,t)\,[7] = P^{year}(r,a,d,f,h,e,n,t)\,[6] \times \{P^{year}(r,t)/\Sigma_{other}\,P^{year}(r,a,d,f,h,e,n,t)\,[6]\} \quad (7)$$

Step 8: check for convergence

$$D(r,a,d,f,h,e,n,t) = abs\{P^{year}(r,a,d,f,h,e,n,t)\,[7] - P^{year}(r,a,d,f,h,e,n,t)\,[0]\} \quad (8)$$

If all D < threshold,
stop the process and report results.
Else if any D > threshold,
$P^{year}(r,a,d,f,h,e,n,t)\,[0] = P^{year}(r,a,d,f,h,e,n,t)\,[7]$ (9)
go back to step 1.

3.3 Construction of initial array

Using the Statistical Package for the Social Science (SPSS), a copy of the 2001 ISAR was recoded to match the variable definitions shown in Appendix A. There was one exception which involved more complex code creation. The dependent children flag had to be converted into the number of dependent children. This was implemented programmatically as follows.

1. In the ISAR copy, create *nd_min* and *nd_max* variables, find the minimum and maximum possible number of dependent children by examining household size, family type and dependent children flag.
2. From the 2001 census, get the total number of dependent (0-3+) children in each region.
3. Sort the ISAR copy by *region*, *nd_min* and *nd_max*, and then go through each record in turn, setting ‘d’ to either 0, 1, 2 or 3, in proportion to the regional population in each category.

Standard census tables were found to be adequate for this reapportionment, without a need to use commissioned tables or the CAMS.

4. Projection of future constraint tables in 2010 and 2020

To produce the projections of the constraint arrays needed investigation of the sources listed in Table 10. Many of the leads to unpublished information proved to be premature as government departments have the correct policy of not disseminating data sets to selected individuals in advance of the public release. However, the published corpus of data, particularly associated with the census (2001 and 1991) proved richer than at first thought. So we have been able to do our work using published sources.

For each dimension/constraint, we had to analyse different trends provided by official projections, annual surveys (FRS/LFS) and censuses, and select one that was consistent with all three. We assumed that, if a method for deriving the trend worked well at national level, it should work well at regional level too. In general we used fairly simple extrapolative methods based on time series of census or survey data, from a 2001 census base. Longer term trends were established using 1981, 1991 and 2001 census information (published area tables for countries, regions and London boroughs). Short term trends (1998-2004) from the Family Resources Survey or Labour Force Survey were also examined for some constraints, particularly those for which no third party projections existed. For the ethnic dimension, we carried out our own cohort-component projection.

Census 2001 data for England and Wales were downloaded from ONS and NOMIS (2005) and 1981 and 1991 census data for all parts of the UK from the ESRC/JISC Census Programme's CASWEB facility (Census Dissemination Unit 2005). Census data for Scotland were downloaded from the Scottish Census Results Online facility (GROS 2005) and census data for Northern Ireland was downloaded from NISRA (2005). Family Resources Survey (ESDS 2005a) and Labour Force Survey (ESDS 2005b) were obtained from the Economic and Social Data Service.

Many times, a household matrix needs converting to a people matrix (to match the array created from the ISAR). We converted using an available distribution of households by size: one person households by one, two person households by two. For the open-ended category, 6 or more persons in a household, we adopted an average of 6.35 persons in 2010 and 6.30 persons in 2020. This was based on the shrinking average size of such households between 1991 and 2001 censuses and short term FRS trends.

Table 10
Projection resources for 2010 and 2020

Projection resource	Status of projection data set	Producer organisation and contact details
Projections of the UK and four country populations by age and sex by single year of age annually to 2070 and beyond. Shaw (2004a), (2004b), GAD (2004a), GAD (2004b), GAD (2005a), GAD (2005b)	2003 based projections downloaded from GAD website. 2004 based projections published 20/10/05.	Chris Shaw Government Actuary's Department Demography and Statistics Division Finlaison House, 15-17 Furnival Street London EC4 1AB Tel: 020 7211 2640 Switchboard: 020 7211 2600/2601 Email: Chris.Shaw@gad.gov.uk
Projections of the populations of Government Office Regions in England are produced by ONS. See ONS (2004a).	2003 based projections downloaded from National Statistics website	Subnational Projections ONS, Segensworth Road, Titchfield Hampshire PO15 5RR Tel 01329 813474/813865 Contact: Richard Peirara
Ethnic projections for England have been produced and are being quality assured. They will be published in 2006. See ONS (2005). New ethnic population projections are being prepared for **13 regions of the UK** for this project.	Pete Large has confirmed these will **not** be available until 2006.	Pete Large Office for National Statistics ONS, Segensworth Road, Titchfield Hampshire PO15 5RR Email: Pete.Large@ons.gsi.gov.uk
Coleman and Scherbov (2005) present new **projections for the United Kingdom by ethnicity** and also probabilistic projections capturing uncertainty. These will be compared with the GAD and project projections.	PDF paper downloaded with summary tables. No age detail given in the paper.	Professor David Coleman Department of Social Policy and Social Work University of Oxford Barnett House, 32 Wellington Square Oxford OX1 2ER Tel 01865 270345 Email: David.coleman@socres.ox.ac.uk
ODPM **projections of households for England**. See ODPM (1999 and 2004) for latest available. New projections taking into account 2001 Census information and new GAD national and ONS sub-national projections (ONS 2004).	ODPM contacted ODPM (2004) reference supplied. Data set downloaded.	Andrew Parfitt Deputy Divisional Manager Central Economic Advice Office of Deputy Prime Minister Elland House, Bressenden Place London SW1E 5DU Tel Switchboard 020 7944 4400 Email: Andrew.parfitt@odpm.gsi.gov.uk

Table 10 (continued)
Projection resources for 2010 and 2020

DWP has made **projections of family type, lone parents** etc for the Treasury (Haskey personal communication). Not published on web site.	Not followed up.	Department of Work and Pensions The Family Resources Survey InfD Incomes Monitoring 1 Department for Work and Pensions The Adelphi, 1-11 John Adam Street London WC2N 6HT Telephone: +44 (0) 20 7962 8991 Email: team.frs@dwp.gsi.gov.uk
HM Treasury has made **Labour Force participation projections**, available in HM Treasury (2004), Chart 4.1 and Employment projections in Chart 4.2.	Spreadsheet for Charts supplied by Frank Eich.	HM Treasury 1 Horse Guards Road London SW1A 2HQ Email: Frank.Eich@hm-treasury.x.gsi.gov.uk
CEFMR have made **Labour Force projections** for 27 European countries including the UK. See Bijak *et al.* (2005).	Published information in papers.	Dr Marek Kupiszewski Director, Central European Forum for Migration Research Twarda 51/55, 00-818 Warszawa, Poland Email: m.kupisz@twarda.pan.pl

The full set of constraint tables are assembled in Appendix B at the end of the report in a common format. We refer to these tables throughout Section 4. For each constraint table (with one exception) we report the constraint data in three panels, one for 2001 (census base), one for 2010 (the first projection year) and one for 2020 (the second projection year). Each panel reports regions in the rows and the constraint variable categories in the columns. The last row reports UK totals. The final column reports region totals. The bottom leftmost cell in each panel is the total UK population for 2001, 2010 and 2020 which is the same for each constraint marginal table. The region totals in the last column also agree in each constraint with the region totals for the first constraint table.

The exceptions to this common structure for marginal constraints are the ethnic population estimates and projections. A separate table is presented for each region. The rows of these tables contain the populations of the five ethnic groups. The columns of these tables report age groups for ethnic groups.

4.1 A population region by age table using GAD and ONS projections (Constraint 1)

The region by age projections in 2010 and 2020 are set out in Table B1. We explain briefly how the projected data were assembled and adjusted.

4.1.1 The projected population data

The GAD 2004-based principal projections were accessed on the GAD website and the projection population files listed in Table 11 were downloaded.

Table 11
Data files downloaded from the GAD population projections database, 2004-based projections

Territory	Description	File reference
GAD data sets	Website	www.gad.gov.uk
United Kingdom	projected populations for 5 year ages and sex	wuk045y.xls
United Kingdom	projected populations for single year ages and sex	wuk04singyear.xls
England	projected populations for 5 year ages and sex	weng045y.xls
England	projected populations for single year ages and sex	weng04singyear.xls
Wales	projected populations for 5 year ages and sex	wwal045y.xls
Wales	projected populations for single year ages and sex	wwal04singyear.xls
Scotland	projected populations for 5 year ages and sex	wsco045y.xls
Scotland	projected populations for single year ages and sex	wsco04singyear.xls
Northern Ireland	projected populations for 5 year ages and sex	wni045y.xls
Northern Ireland	projected populations for single year ages and sex	wni04singyear.xls
ONS data sets	website	www.statistics.gov.uk
GOR	projected populations for 5 year ages and sex	D8658.xls
London Boroughs	projected populations for 5 years ages and sex	D8664.xls
2001 Census of Population datasets	CASWEB website (Census Dissemination Unit, 2005)	Standard Table S028

4.1.2. Assembling and adjusting the projected populations

The relevant parts of these data were loaded into a spreadsheet and the following operations performed.

(1) Populations were aggregated to the target age groups, using a mixture of five-year and single-year ages with an assumption about the 15, 16-19 split for GORs and London boroughs. The England proportions of these two groups making up the 15-19 age group were employed.

(2) The London borough population projections were summed to yield Inner London and Outer London totals.

(3) The 16-19 age group was split between dependent and non-dependent children using a labour force participation rate computed from the 2001 census and an assumption that these rates would increase only marginally by 2020. The latest Department for Education and Science statistics suggest that FTE participation among 16-1-year-olds is currently on a flat plateau, despite government efforts to raise the rate. At most, we see a 1 per cent rise over the next five years, and 3 per cent by 2020 (i.e. 0.2 per cent per annum).

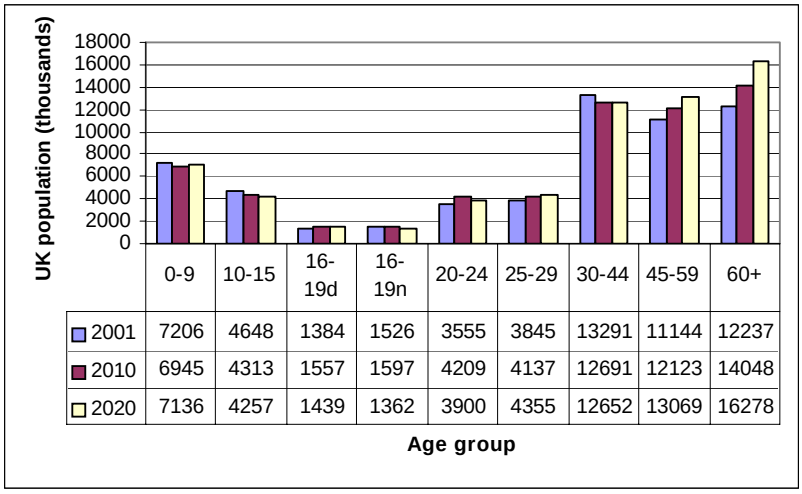
(4) The ONS GOR and Inner and Outer London projections were adjusted to agree with the England projections of GAD.

(5) The country and GOR populations were adjusted by small amounts to add exactly to the UK populations.

4.1.3 Projected population trends by age

The results are shown in Table B1 and summarised in Figure 3. The UK population is still growing in the period from 58.836 million in 2001 to 61.619 million in 2010 and 64.449 million in 2020. The numbers aged 0-15 decline from 11.855 million in 2001 to 11.258 million in 2010 but recover a little to 11.393 million in 2020. However, the reduction compared with 2001 should make it slightly easier to achieve child poverty reduction goals. Note that the 45-59 and 60+ age groups increase in population between 2001 and 2020, reflecting the ageing of the population.

Figure 3
Projected UK population by broad age 2001, 2010 and 2020



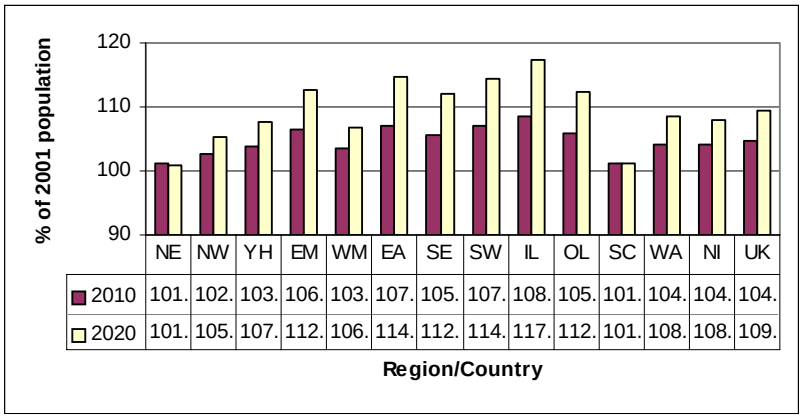
	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+
2001	7206	4648	1384	1526	3555	3845	13291	11144	12237
2010	6945	4313	1557	1597	4209	4137	12691	12123	14048
2020	7136	4257	1439	1362	3900	4355	12652	13069	16278

Source: GAD (2005b)

4.1.4 Regional population trends in the future

The national population growth is unevenly distributed across countries and regions as Figure 4 demonstrates. Scotland and the North East faces decline after 2010. Scotland, the North West, Yorkshire and the Humber, West Midlands, Wales and Northern Ireland will experience lower than average growth to both 2010 and 2020. The East Midlands, East, South East, South West and Outer London will grow faster than the UK. The highest growth is expected in Inner London (providing that sufficient new housing can be provided).

Figure 4
Projected regional populations 2010 and 2020



	NE	NW	YH	EM	WM	EA	SE	SW	IL	OL	SC	WA	NI	UK
2010	101.	102.	103.	106.	103.	107.	105.	107.	108.	105.	101.	104.	104.	104.
2020	101.	105.	107.	112.	106.	114.	112.	114.	117.	112.	101.	108.	108.	109.

Source: GAD (2005b), ONS (2004) and authors' computations

4.1.5 The dependent and non-dependent split for ages 16-19

The projections of the population by region and age needed one additional ingredient; a means of splitting the 16-19 age group into dependent and non-dependent children, following the definition given earlier in Section 2.3. The formulae applied were:
16-19 dependents = age 16 dependents + age 17 dependents + age 18 dependents
16-19 non-dependents = all people aged 16-19 less 16-19 dependents

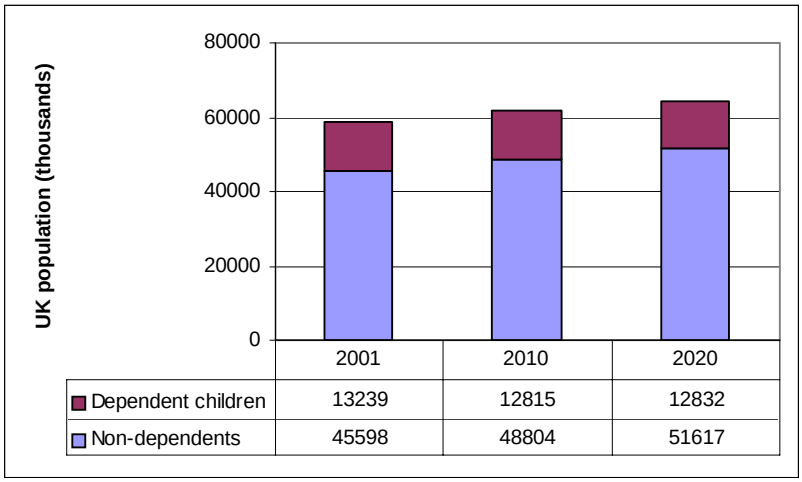
Several data sources were explored to obtain trends in the dependent/non-dependent split. DfES tables showed students in full time, part time education and training. The Labour Force Survey (LFS) provides the number of 16-18-year-olds in full time education for recent years. The data shows that there has been no increase in student participation (and hence dependency) in that age group in recent years. Long term trends from last three censuses were then examined. Looking at the trend in student dependents from the census, we think that student

participation may increase by 1 per cent between now and 2010 and 3 per cent between now and 2020

4.1.6 Trends in total number of dependent children

Combining these age groups shows that the total number of dependent children will decline slightly, while other age groups steadily increase (Figure 5). The ratio of dependent children to non-dependents will decline from 0.290 in 2001 to 0.248 in 2020.

Figure 5
Projected UK population by dependent children 2001, 2010 and 2020



From Appendix B: Constraint Tables, Table B1.

To allow direct comparisons to be made between census and survey data (because the FRS does not cover Northern Ireland), figures were aggregated to Great Britain totals and then converted to proportions. The proportions are stored as numbers between 0 and 1 in the IPF database, but shown as percentages on the charts that follow (for readability). We treat number of dependents per family as being the same as number of dependents per household, for practical purposes. There are not many multi-family households.

There are no official projections for the categories (0-3+), just the total number of dependent children calculated from GAD. These cannot be used as a constraint because the former is a measure of people that are in a household with a given number of dependent children and the latter is a count of the dependent children themselves.

A time series was prepared from FRS household data for 1998 to 2004. FRS data is available for earlier years but the number of dependent children explicitly identified is not available until 1998. The FRS data can

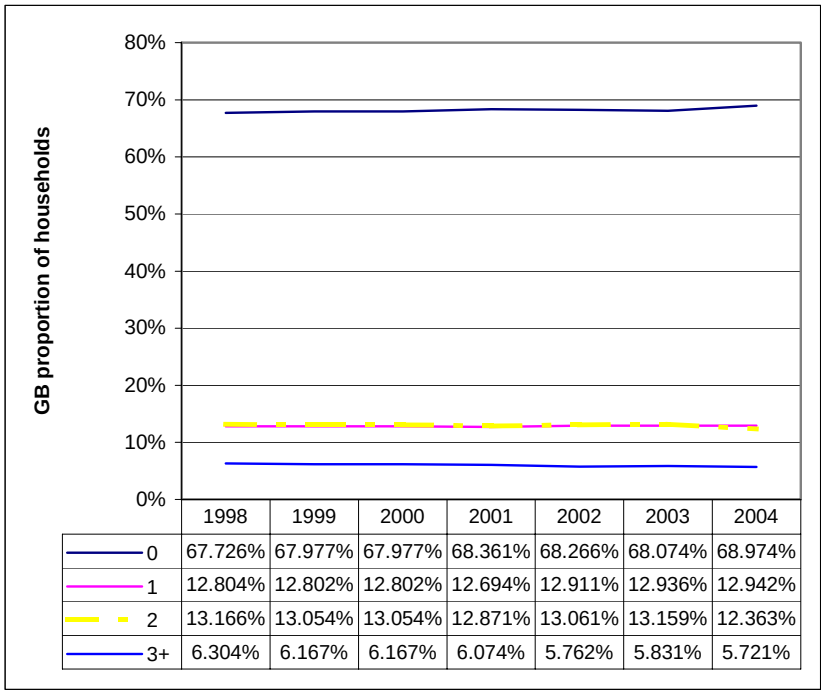
be cross-tabulated by household size and number of dependent children, and is available for categories 0 to 8+ children. However, the upper limit was set to 3+ to match available census data. The proportions from 2001 set out in Table 12 show that there is a big decline from 3 to 4 dependent children, so not much is missed by omitting that detail.

Table 12
Percentages of numbers of children per household for Great Britain, 2001 Family Resources Survey

No. of children	0	1	2	3	4	5	6+
Per cent	68.361%	12.694%	12.871%	4.536%	1.164%	0.290%	0.084%

The FRS (Figure 6) suggests that one-child households and two-child households are similar in number and not changing proportionally. Occasionally two-child is higher than one-child, but this may just be down to sampling error, as the FRS sample is much smaller than both the ISAR and the census. There is a slight decline in 3+ and a slight increase in 0 (the dominant category), and this is more concordant with the census.

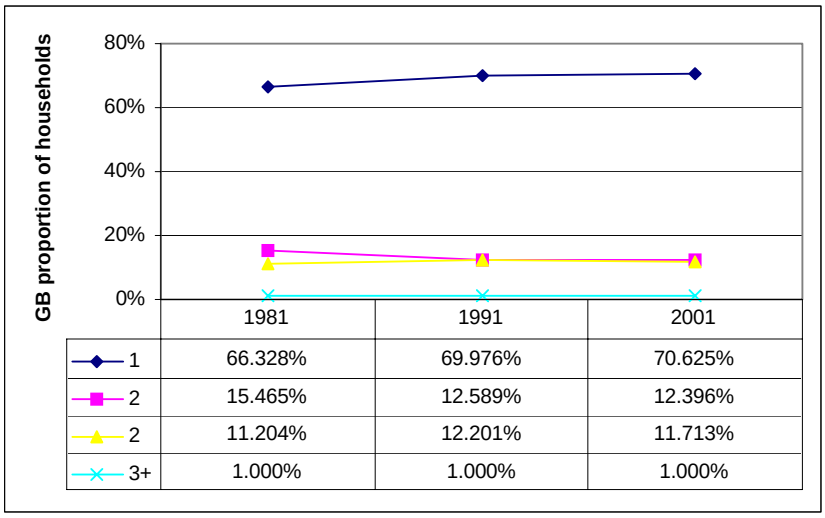
Figure 6
Trends in numbers of children for Great Britain, Family Resources Survey, 1998-2004



	1998	1999	2000	2001	2002	2003	2004
0	67.726%	67.977%	67.977%	68.361%	68.266%	68.074%	68.974%
1	12.804%	12.802%	12.802%	12.694%	12.911%	12.936%	12.942%
2	13.166%	13.054%	13.054%	12.871%	13.061%	13.159%	12.363%
3+	6.304%	6.167%	6.167%	6.074%	5.762%	5.831%	5.721%

The 2001-2004 annual increase in the FRS is a good match for the 1991-2001 annual increase in the census (Figure 7), so that adds validity to the decision to project the 1991-2001 trend forward. A straight line projection was chosen, rather than a logarithmic curve, because the latter would result in almost no proportional change at all between now and 2020, which doesn't seem credible. For many different variables, the census seems to show the 1980s as a time of big change in society, but the 1990s comparatively uneventful.

Figure 7
Trends in number of children per household 1981, 1991 and 2001 censuses



	1981	1991	2001
1	66.328%	69.976%	70.625%
2	15.465%	12.589%	12.396%
2	11.204%	12.201%	11.713%
3+	1.000%	1.000%	1.000%

The 1991-2001 trend was derived from the Census and applied to the 2001 base proportions from the Census. Rolling forward the average annual increase by 9 and 19 years, produced new proportions for 2010 and 2020, respectively.

4.2 A projection of the number of dependent children per family by region (Constraint 2)

The results are set out in Appendix Table B2. The steps were:

(1) Assemble data files: past censuses and past/current FRS data.
(2) From 2001 census, get regional household totals for each category of dependent children in household.
(3) The household totals are increased linearly from the 2001 census base using the 1998-2004 FRS trend, as this seems to be good match for both the long term and short term trends.
(4) The projected totals are then used as column marginals in an IPF routine (with the row marginals taken from Constraint 4 Household

size). The result is a household matrix, consistent across these teo dimensions.

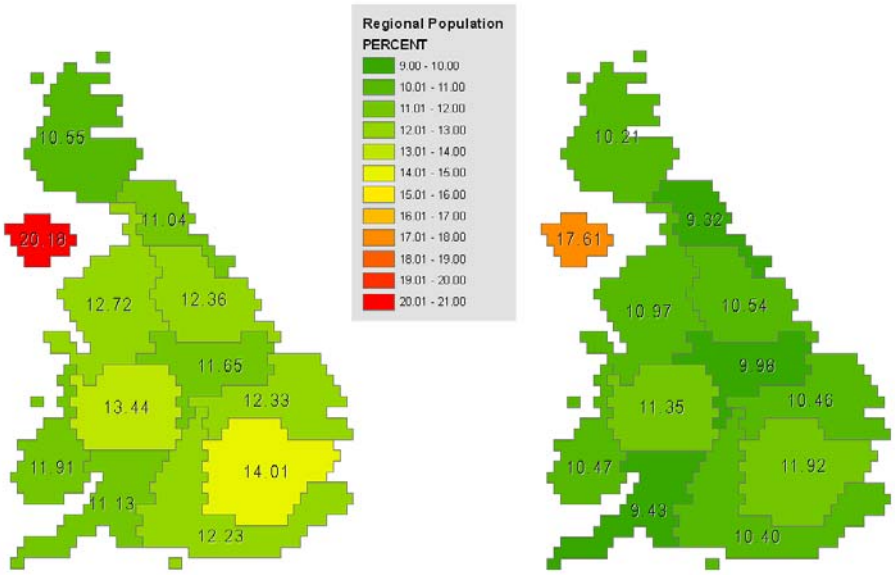
(5) The household matrix is converted into a people matrix.

(6) The population totals are adjusted to include the non-household population in the '0 dependents' total.

(7) The overall population totals are constrained to Table B1.

Figure 8 shows the regional distribution of the percentage of people in households with three or more dependent children.

Figure 8
Percentage of people in each region in 3+ dependent children households 2001 and 2020



4.3 A projection of the distribution by family type by region (Constraint 3)

The results are set out in Table B3.

Steps:

(1) Assemble data files: ODPM projections. For NI, official projections for household size only are provided, so (other than for one-person families), the Great Britain trend has to calculated and applied, before going to Step 6.

(2) For other regions, a good set of family type figures are available. They are usually for 2011 and 2021, so must be scaled to 2010 and 2020 first.

(3) The projected totals are then used as column marginals in an IPF routine (with the row marginals taken from Constraint 4 Household

size). The result is a household matrix, consistent across these two dimensions.

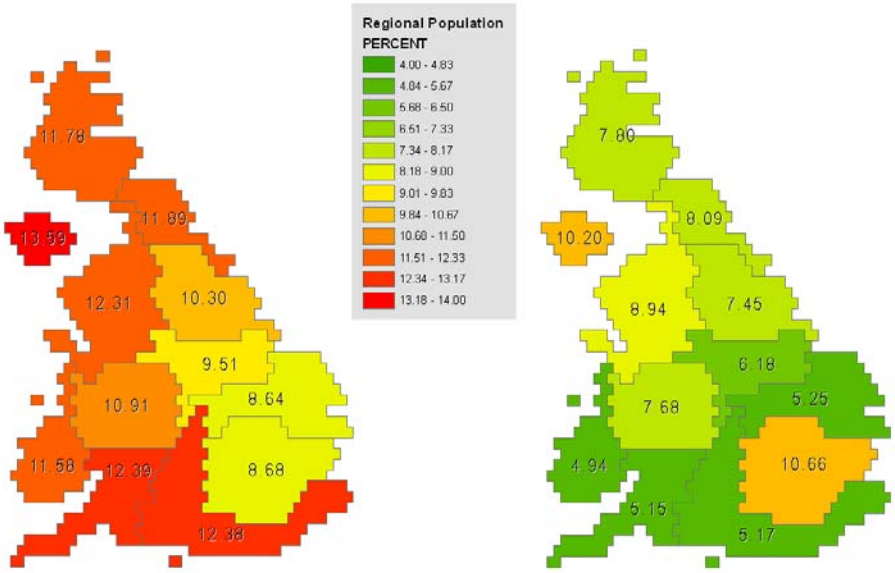
(4) The household matrix is converted into a people matrix.

(5) The projections are adjusted take account of the -9 (not in a family) proportion in the 2001 ISAR (which is held constant).

(6) The overall population totals are constrained to Table B1.

Figure 9 shows the percentage of people living in lone parent households in 2001 and 2020.

Figure 9
Percentage of people in each region in lone parent households 2001 and 2020



4.4 A projection of the distribution of household size by region (Constraint 4)

The results are set out in Appendix Table B4.

Household sizes for 2010 and 2020 were constructed first because they were also needed to convert other household-count variables (e.g. number of dependent children) into people counts.

Steps:

(1) Assemble data files: past censuses and ODPM/GROS/NAW projections. For NI, official projections for all household sizes for both years are provided by NISRA, so go straight to Step 6.

(2) For other regions, only one-person household figures are available (usually for 2011 and 2021), so these have to be scaled to 2010 and 2020 first.
(3) From 2001 census, get regional household totals for household sizes 1 to 6+.
(4) The base totals are projected linearly using the 1991-2001 census trend, as this seems to best match the assumptions behind ODPM's one-person household projections.
(5) The one-person household figures from ODPM/GROS/NAW are substituted for the estimates and the remaining proportions rescaled to equal 100 per cent for household sizes 1 to 6+ inclusive.
(6) The household matrix is converted into a people matrix.
(7) The projections are adjusted take account of the -9 and 0 household size proportions in the 2001 ISAR (which are held constant).
(8) The overall population totals are constrained to Appendix Table B1.

A matrix of population by household size (1-6+) and region must be generated first, as it is used to convert other household-related constraints from household matrices to population matrices. Partial information is provided by the ODPM projections, namely numbers of one-person households (Figure 10). The Scottish figures start from a slightly older base year. Aggregating household statistics for Great Britain (to allow direct comparison with the FRS) and converting to proportions gives the change rates set out in Table 13.

Figure 10
ODPM Interim 2003-based household projections for England

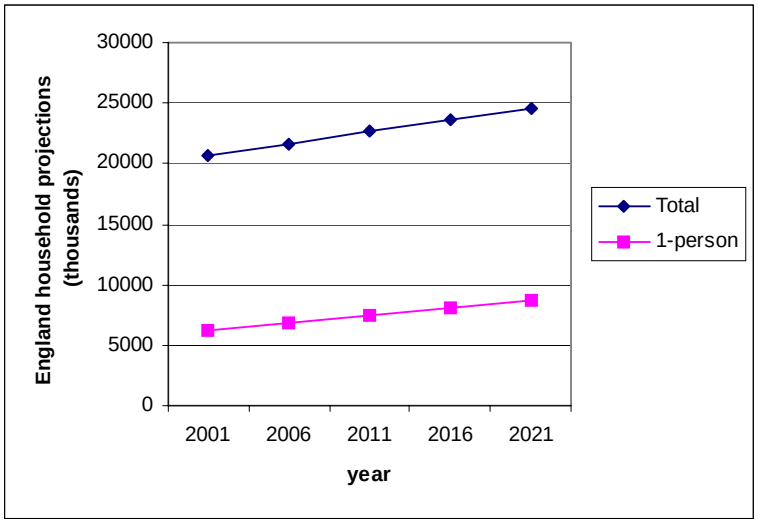


Table 13
Average annual change in the percentage of people living in households of 1 to 6+ persons

Period	1	2	3	4	5	6+
1981-2001	0.426%	0.108%	-0.078%	-0.240%	-0.124%	-0.091%
1981-1991	0.504%	0.175%	-0.073%	-0.260%	-0.193%	-0.153%
1991-2001	0.348%	0.040%	-0.082%	-0.220%	-0.056%	-0.029%

We wanted to find out which technique was the best match for the proportion of one-person households in 2010 predicted by official figures. A logarithmic projection might give best results because it takes account of the slowdown in growth in one-person households (in the 1990s compared to the 1980s) (Figure 11). It looks like ODPM used a linear projection as the basis of their results, so we have done the same, basing it on the average annual change between 1991 and 2001 (Figure 12), as before. Table 14 provides a comparison of projection results for one-person households.

Figure 11
Example of logarithmic projection of households, based on 1981-2001 censuses

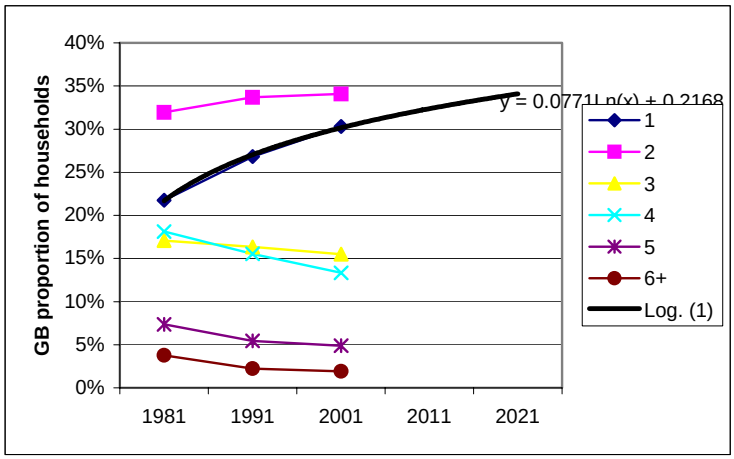


Figure 12
Trends in household size 1981, 1991 and 2001 censuses

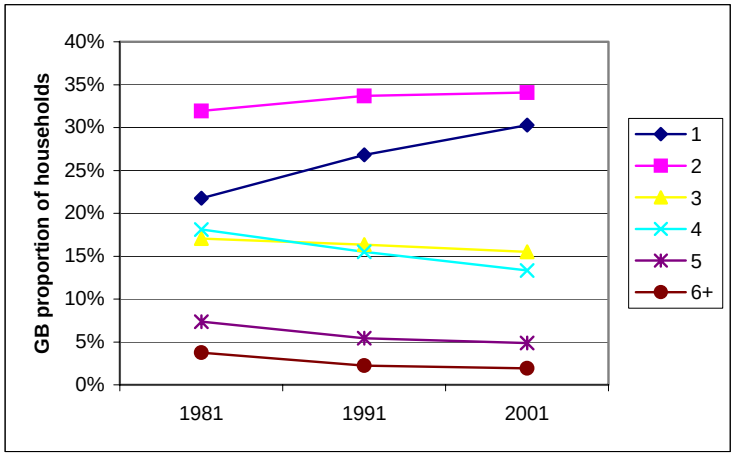
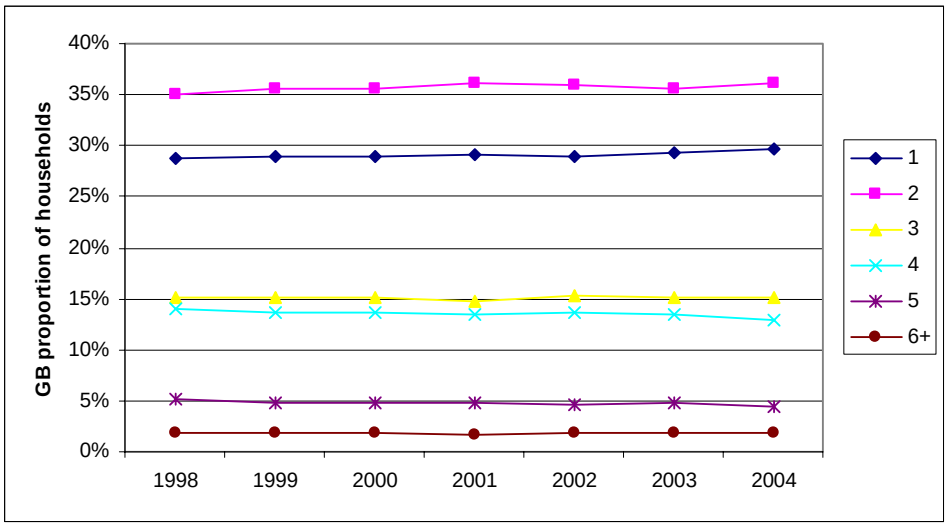


Table 14
Alternative projections of the percentage of people living in one-person households

Year	Target (ODPM)	Census linear	Census log	FRS linear
2011	32.956%	33.761% (+0.8052)	32.368% (-0.5875)	31.997% (-0.9590)
2021	35.772%	37.239% (+1.4663)	34.089% (-1.6835)	33.710% (-2.0621)
Difference		+2.2714	-2.2711	-3.0211

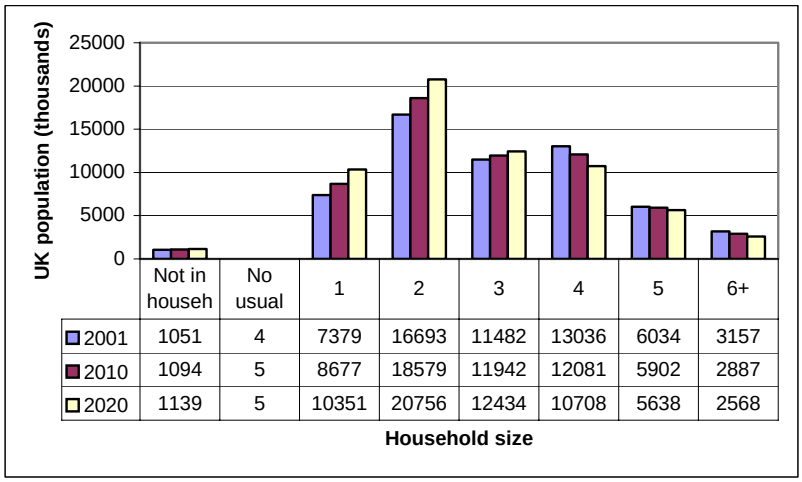
We thought a logarithmic projection would give best results but Table 14 shows that the predictions were under the ODPM figure by virtually the same amount that a linear projection was over it. The FRS short term trend can be discounted because it gave a result that was considerably under (based on the average annual increase of only 0.171 per cent between 1998 and 2004) (Figure 13). We decided to use the census linear results (rescaled after substituting the ODPM projections for one-person households), shown below. There is an apparent jump in one-person households but this is because for 2001 there is a slightly disparity in the census and ODPM household counts. The household matrix is then converted to a population matrix (using the estimate of 6.35 and 6.3 persons per 6+ household in 2010 and 2020, respectively). Figure 14 shows the final projected household size distributions.

Figure 13
Trends in household size, 1998-2004, Family Resources Survey



Period	1	2	3	4	5	6+
1998-2004	0.171%	0.164%	-0.024%	-0.199%	-0.115%	0.001%
1998-2001	0.136%	0.327%	-0.120%	-0.172%	-0.131%	-0.040%
2001-2004	0.207%	0.002%	0.072%	-0.225%	-0.099%	0.043%

Figure 14
Projected UK population by household size 2001, 2010 and 2020



	Not in household	No usual	1	2	3	4	5	6+
2001	1051	4	7379	16693	11482	13036	6034	3157
2010	1094	5	8677	18579	11942	12081	5902	2887
2020	1139	5	10351	20756	12434	10708	5638	2568

4.5 A projection of the ethnic composition of the population by region (Constraint 5)

4.5.1 Introduction

This section of the report presents results of a projection of the populations of five ethnic groupings of the United Kingdom population.

The results of the projection of ethnic groups by age and region are set out in Table B5.

4.5.2 The processes driving ethnic minority group population change

International migrants move from one country to another. Some are circulatory migrants and return to their countries of origin. Many, however, stay and settle into the population of their destination country. Because these immigrant groups and their descendants may have different demographic behaviour and geographic locations from the host population, the structure and composition of the population is changed. So when we project the population of ethnic groups within a country by region, as is done in this paper, we are analysing the consequences of past international migration and the likely effects of assumptions about future flows of international migrants classified by ethnicity. We need also to monitor and project fertility and mortality differences between the groups and the different patterns of migration within the country. International immigrants overwhelming concentrate in the UK's biggest cities and more in southern metropolises in the past two decades than in the 1950s to 1970s. They are also experiencing redistribution through internal migration, with some signs of net shifts to suburban and metropolitan rings in the London region and of shifts from the less vigorous economies of northern cities to southern ones (Rees and Butt 2004). The nature of ethnic group spatial distributions in the UK has been the subject of vigorous recent debate. This debate has so far been uninformed about the demographic processes involved in redistribution (Simpson 2004).

Table 15 shows how fast minority ethnic populations having been growing between 1981 and 2001.

Table 15
Ethnic change in England 1981-2001

	Population (1000s)			Change indexes		
Ethnic group	1981	1991	2001	1981-1991 1981=100	1991-2001 1991=100	1981-2001 1981=100
White	44682	44848	44925	100.4	100.2	100.5
Black	707	917	1286	129.7	140.2	181.9
South Asian	1031	1487	2102	144.2	141.4	203.9
Chinese and other	414	626	825	151.2	131.8	199.3
All ethnic minorities	2152	3028	4213	140.7	139.1	195.8
All groups	46834	47876	49139	102.2	102.6	104.9

Source: Rees and Butt (2004), Table 3, p.178. Authors' computations based on 1981 census small area statistics, 1991 census local base statistics, 2001 census key statistics for local authorities, estimates from Rees and Phillips (1996), estimates from the Linking censuses through time project (Dorling, Martin and Mitchell, 2003) and www.lct.mimas.ac.uk). All census data are Crown copyright.

Without this growth the population of England would have stagnated rather than growing by 5 per cent over the two decades. The white British population (the major component of the white group but the least demographically dynamic) has probably decreased by a small amount over the 20 years. Ethnic minorities grew by 96 per cent in the same period.

4.5.3 Migration data sets and trends

To forecast the population of regions within a country we need knowledge of two types of migration, internal and international, in two directions of inflow and outflow. The difficulty is to estimate the ethnic composition of these flows. We would have liked to handle internal migration through a multi-regional model in which the outflows from one region are the inflows to another and thus avoid some of the logical inconsistencies of single region projection models. However, one glance at the distribution of numbers in groups in the regions with the smallest minority ethnic populations convinced us that a mult-iregional approach was unfeasible. When projecting the population it is necessary to adopt an annual time interval and therefore a single year of age (period-cohort) framework. We therefore used four migration streams in the projection model which need to be clearly identified:

- internal in-migration = migration into a region from other regions in the country;
- internal out-migration = migration from a region to other regions in the country;
- immigration = migration into a region from outside the country;
- emigration = migration from a region to destinations the country.

The first two streams are internal to the UK; the second two streams involve international migration; the first and third streams add to the regional population; the second and fourth streams subtract from the regional population.

4.5.4 International migration data sets and trends

The UK's international migration statistics are produced by the Office for National Statistics in collaboration with the Home Office, which is responsible for the control of immigration. Results from the last census in 2001 raised concerns about whether international migration flows had

been properly estimated. A major review and re-estimation established a total international migration series from 1991 to the present (ONS 2005b). There are likely to be further investments in surveys and embarkation monitoring to improve on emigration estimates in particular. There has also been concern among utilities that they need to provide more infrastructure than indicated by current population estimates and have commissioned work to estimate the hidden and transient population, which some observers estimate may be in the 400,000-500,000 range, which implies over a 15 year period about 30, 'hidden' immigrants per year who stay.

Bearing these caveats in mind, what have been the trends in UK international migration since 1991? Table 16 sets out the net international migration balance as estimated in the revised Total International Migration series (ONS 2005b) together with the 2004 estimates (GAD 2005a). In 1992 and 1993 the balance was outward; it became positive in the mid-1990s in the 40,000-80,000 range and then moved up to over 130,000 per year from 1998, peaking in 2001 but remaining around 150,000 subsequently. Although this swelling of net immigration is often seen as a result of asylum seeker immigration, the statistics probably fail to capture well the emigration of failed asylum seekers. The substantial jump in net international migration in 2004 is due to a large flow from countries in central Europe which joined the European Union in May of that year.

Table 16
Net international migration 1992-2004

Year	Balance (1000s)
1992	-13.5
1993	-1.2
1994	+76.8
1995	+75.4
1996	+54.1
1997	+46.8
1998	+138.8
1999	+163.0
2000	+162.8
2001	+171.8
2002	+153.4
2003	+151.0
2004	+255.0

Source: ONS (2004, 2005), GAD (2005a)

Two features of international migration have effects on the composition of the population in terms of ethnicity. The first is that British citizens

experience a strong net outflow whereas non-British citizens experience a strong net inflow. Over half of emigrants in 2003 were British citizens, while only one fifth of immigrants were returning British citizens. The second feature is the importance of student immigration. Those coming for formal study make an increasingly important contribution to the UK population. In 2003 the net balance of student migration made up 82 per cent of the total net inflow. The continuing strong net inflow of students must mean that large numbers are residing in the UK for a number of years. They contribute substantial human capital and skills to the UK labour force. In Scotland, maximizing the retention of foreign graduates of Scottish universities is now a policy goal of the Scottish Executive. In 2004 the Chief Minister of Scotland, Jack McConnell, negotiated a derogation of UK immigration rules with the Home Secretary, then David Blunkett, so that all foreign graduates could obtain permission to reside for two years after graduation without the need for an already agreed work permit.

4.5.5 The 2001 Census of Population: migration data for ethnic groups

The international migration statistics contain information about both citizenship and country of origin from which some estimates of international migration could be made. However, the 2001 census did ask questions on migration over a one year period (2000-1) and on ethnicity (capturing 16 main ethnicities). This therefore provides migration data for internal migration (into and out of regions) and on immigration by ethnicity. The standard outputs do not distinguish migrants by ethnicity but a commissioned set of expansions of standard tables have been produced that identify migration by the main ethnic groups, in a way that enables approximate standardisation across English regions, Wales, Scotland and Northern Ireland. No detailed age information is available so migration intensities by age for the UK population as a whole are used. These commissioned tables provide information on three of the regional migration streams leaving emigration flows by ethnicity, region and age to be estimated. There is also migration by ethnic group available in the special migration statistics from the 2001 census but UK wide the data set has holes caused by differences between ethnic classifications in England and Wales, Northern Ireland and Scotland.

Next, we specify the projection model that will be used, before describing how the migration information described above was used to estimate the input variables needed.

4.5.6 A projection model for ethnic groups at region scale: choices

There is now a suite of models and examples of projections of ethnic or racial groups available for scrutiny. These are reviewed in a recent paper (Wilson and Rees 2005, pp.347). Models proposed for the UK are outlined in three chapters of Haskey (2002) by Simpson (single region with net migration), Murphy (microsimulation) and Rees (multi-regional with inter-ethnic births and group change). The National Statistics projections currently being finalised incorporate elements from each of these proposals, building on the case for such projections made in Haskey (2000).

There are many practical difficulties associated with implementing the Murphy or Rees models for ethnic groups for all regions within the UK. Ethnic minorities are concentrated in some regions – Inner London, Outer London, South East, West Midlands, East Midlands, North West and Yorkshire and the Humber. Their numbers are very small in the East, South West, North East, Wales and Scotland. If a projection model using single years of age and annual intervals (the only useful framework) is used, then the number of interregional migrants in the vast majority of cells is tiny and unreliable for estimating migration intensities or flows. This small number problem is further exacerbated if the age range used in projection is extended to 100+ (necessary to capture the future extent of population ageing of the oldest old).

So a single region model was adopted for the current task. The model is a component model using period-cohorts. Period-cohorts are age-time spaces in which demographic components add to or subtract from the starting population. For example, the 20-year-old population at the start of a projection interval becomes the 21-year-old population one year later, having lost members through mortality, internal out-migration and emigration and having gained members through internal in-migration and immigration. For the current model all these variables must be estimated for each ethnic group. Several researchers have suggested that an ethnic group model must have a process for creating a mixed group population. Two processes have been proposed: birth of a mixed ethnicity child to parents of different ethnicities and transitions during the life course from one self-identified ethnic group to another. Neither process is included in the current projection model given the speed with which it had to be developed and the difficulty of measuring such interactions and transitions at region scale. However, the National Statistics model will incorporate the first process (Peter Large, personal communication, 2005) and so do other national models. Investigations are in train of microdata sets suitable for making estimates (the

Longitudinal Study and the Sample of Anonymised Records) of intermarriage and mixed ethnicity births.

4.5.7 A projection model for ethnic groups at region scale

The components equation linking start and end of interval populations for each ethnic group is as follows:

$P^F(r,c,g,t+1) = P^S(r,c,g,t) – D(r,c,g,t) – O(r,c,g,t) – E(r,c,g,t) + M(r,c,g,t) + I(r,c,g,t)$ (10)

The variables are defined as: P = population, P^F = final population in a period-cohort, P^S = start population in a period-cohort, D = deaths, O = internal out-migrants, E = emigrants, M = internal in-migrants, I = immigrants.

Note that we have used the person form of the migration variable (i.e. migrants) rather than the events form (i.e. migrations) because most of the migration data are sourced from the 2001 census where the census question generates counts of migrants not migrations.

The indexes/subscripts (in parentheses) are defined as r = region, c = period-cohort (age x at time t to age x+1 at time t+1), g = gender (sex), t = time at start of interval, t+1 = time at end of interval, one year later, for flow components t means the interval starting with time t, i.e. to t+1.

Equation (17) applies to cohorts from c=0 to 100+. At the start of the next time interval the populations are moved to the next cohort thus:

$P^S(r,c+1,g,t+1) = P^F(r,c,g,t+1)$ (11)

except for the final period-cohort, designated C, where two final populations must be combined:

$P^S(r,C,g,t+1) = P^F(r,C-1,g,t+1) + P^F(r,C,g,t+1)$ (12)

i.e. the 100+ population at the start of the new interval is the population of 99-year-olds at the start who survive and the 100+ year-olds.

The first or infant period-cohort components equation is slightly different:

$P^F(r,-1,g,t+1) = B(r,g,t) – D(r,-1,g,t) – O(r,-1,g,t) – E(r,-1,g,t) + M(r,-1,g,t) + I(r,-1,g,t)$ (13)

where c = -1 designates the period-cohort of birth during the interval stretching to the end of the interval. So D(r,-1,g,t) refers to deaths of infants born in region r of gender g in interval t to t+1.

Births were projected using estimated fertility rates for each ethnic group; a sex proportion was applied to derive male and female births:

$B(r,g,t) = \sum_{a=a1,a2} f(r,a) \times P(r,a,F,t) \times sexp(g)$ (14)

Equation (17) is merely an accounting equation. For projection the change components must be changed into models.

Deaths are modelled as the start population multiplied by a period-cohort survival probability:

$D(r,c,g,t) = P^S(r,c,g,t) \times s(r,c,g,t)$ (15)

The survival probability is derived from a UK life table adjusted to regional mortality conditions by applying a standardised mortality ratio:

$s(r,c,g,t) = [1 – \{SMR(r,g)/100\} \times \{1 – s(u,c,g,t)\}]$ (16)

where u = UK. This technique shifts the mortality by age schedule up or down uniformly. Improved estimates could be developed employing regional deaths by age.

Out-migrants are modelled as the start population multiplied by a period-cohort survival probability:

$O(r,c,g,t) = P^S(r,c,g,t) \times o(r,c,g,t)$ (17)

where o = out-migration probability. The estimation of these probabilities is described later.

Emigrants are modelled as the start population multiplied by a period-cohort survival probability:

$E(r,c,g,t) = P^S(r,c,g,t) \times e(r,c,g,t)$ (18)

where e = emigration probability. The estimation of these probabilities is described later.

Internal in-migrants, M(r,c,g,t), and immigrants, I(r,c,g,t), are entered as estimated flows into the projection equation.

4.5.8 Alternative ways of handling migration in projection models

The projection model outlined above is one of a number of alternative ways of handling the four migration streams in a single region model. Table 17 sets out some choices. Each stream can be modelled using intensities (multiplied by a population at risk) or as flows. Both intensities and flows can be held constant or trajectories developed for those intensities.

Table 17
Models for handling migration in projections

Model	Internal out-migration	Emigration	Internal in-migration	Immigration
Migration model 1	Intensities	Intensities	Flows	Flows
Migration model 2	Intensities	Intensities	Intensities	Flows
Migration model 3	Intensities	Intensities	Intensities	Intensities
Migration model 4	Flows	Flows	Flows	Flows

Intensities are either probabilities (transition case) or occurrence exposure rates (movement case).

The first model is the one used in this report. Migrants leaving a region for either an internal or external destination are projected using migration intensities multiplied by populations at risk. The internal and external are handled as flows as they do not originate from the regional population but will be determined by events in the region and populations elsewhere. The second model also handles internal in-migration using intensities and populations at risk, arguing that opportunities for in-migration are related to the size and development of the regional population. This has some logic for internal migration where there are no restrictions on moving from one region to another. The third model extends intensities to all migration streams, saying that if the region population grows so will the number of immigrants. The fourth model enters counts of migrants for the four streams. This is equivalent, if the flows are held constant, to a net migration model that using net migrant counts. However, if the flow trajectories are projected independently then this will not be true. The flows may be projected using an exogenous model (e.g. an explanatory migration model). The effects of using the same base information in these alternative models will need to be researched.

4.5.9 Estimation of projection inputs

To drive a projection of ethnic groups, it is necessary to estimate population, mortality, fertility and migration variables specified for ethnic groups. For the whole population, the necessary demographic components are available as UK National Statistics. The same is not true for those statistics when classified by ethnicity. Estimates must be made from partial or indirect data. This section describes the methods used. We begin with a brief note on the ethnic groups adopted.

4.5.9.1 Ethnic groups

The projection is carried out for the five major groups identified in the outputs of the 2001 Census for England and Wales. Although there are important differences within these groups in demographic behaviour, it was felt that it would be difficult to carry out a projection for the more detailed 16 ethnic groups. The ethnic classification for Northern Ireland as a whole is quite close to that of England and Wales but the Scotland classification is not directly comparable. Table 18 sets out how the Scottish scheme was harmonised with that of England and Wales.

Table 18
Ethnic groups reported from the 2001 Census of Population

Ethnic groups England and Wales	Ethnic groups: Scotland	Ethnic groups: Northern Ireland
WHITE White: British White: Irish White: Other	WHITE	WHITE White Irish traveller
MIXED Mixed: White and Black Caribbean Mixed: White and Black African Mixed: White and Asian Mixed: Other	MIXED Estimated Other × E & W proportion mixed	MIXED
ASIAN or ASIAN BRITISH Asian or Asian British: Indian Asian or Asian British: Pakistani Asian or Asian British: Bangladeshi Asian or Asian British: Other	ASIAN Indian Pakistani and other	ASIAN Indian Pakistani Bangladeshi Other Asian
BLACK or BLACK BRITISH Black or Black British: Caribbean Black or Black British: African Black or Black British: Other	BLACK Estimated Other × E & W proportion Black	BLACK Black Caribbean Black African Other Black
CHINESE or OTHER Chinese Other	CHINESE or OTHER Estimated Chinese Other × E & W proportion Other	CHINESE or OTHER Chinese Other ethnic group

4.5.9.2 Estimation of single year ethnic group populations

The 2001 Census Standard Tables provide a 22-age-group breakdown for each ethnic group (mostly five-year ages to 90+ but with more detail at the childhood ages). To achieve a single year of age classification, the proportions in each single year of age in the all group regional population were computed an applied to the aggregate age for each ethnicity. The assumption was that the age distribution within each broad age was the same across all ethnic groups in a region.

4.5.9.3 Estimation of single year survival probabilities

There is no direct source, except in a few local authorities with their own statistical systems, of deaths classified by ethnicity. There are ways of using local deaths information and census ethnic group populations to impute ethnic mortality differences but the procedure would have been experimental and not verifiable. It was decided to apply the survival probabilities for all groups to each group, as others have done in the UK. The survival probabilities were generated from a life table for 1998 for the UK. This was a full single year life table with ages from 0 to 100+ that the authors estimated from available mortality and population data. Published life tables only extend to 90, which was considered too young a final age. Table 19 shows an extract from this table, computed from the inputs of the age interval, n, fraction of life spent before death in an interval, a_x, deaths, ${}_nD_x$, and mid-year population, ${}_nP_x$, using the standard life model. The survival probabilities, ${}_nS_x$, are for the start and end ages given in the final two columns (i.e. for period-cohorts). The regional survival probabilities were computed using published standardised mortality ratios, as noted above.

Table 19
Single year survival probabilities, males, United Kingdom 1998

Age at death	Age interval	Fraction live	Deaths	Population	Mortality rate	Mort. prob.	Surv. prob.	End age
x	N	ax	nDx	nPx	nMx	nqx	npx	x+n
0	1	0.1	2327	364800	0.006379	0.006342	0.993658	0
1	1	0.5	190	375100	0.000507	0.000506	0.999494	1
2	1	0.5	117	369000	0.000317	0.000317	0.999683	2
3	1	0.5	86	373600	0.000230	0.000230	0.999770	3
4	1	0.5	70	384000	0.000182	0.000182	0.999818	4
:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:
89	1	0.5	5677	26900	0.211041	0.190897	0.809103	89
90	1	0.5	4781	21453	0.222881	0.200534	0.799466	90
91	1	0.5	3793	16041	0.236488	0.211482	0.788518	91
92	1	0.5	3025	11631	0.260084	0.230154	0.769846	92
93	1	0.5	2289	8234	0.277981	0.244059	0.755941	93
94	1	0.5	1728	5688	0.303892	0.263807	0.736193	94
95	1	0.5	1245	3795	0.328116	0.281873	0.718127	95
96	1	0.5	832	2456	0.338759	0.289691	0.710309	96
97	1	0.5	562	1542	0.364661	0.308426	0.691574	97
98	1	0.5	370	922	0.401356	0.334274	0.665726	98
99	1	0.5	215	561	0.382851	0.321338	0.678662	99
100+	1	2.1	319	678	0.469674	1.000000	0.000000	100+

Age at death	Cohort surv.	Cohort non-surv.	Life years	Rem. life years	Life exp.	Surv. prob.	Start age	End age
X	Lx	dx	nLx	Tx	ex	nSx	x	x+n
0	100000	634	99429	7472831	74.73	0.994292	-1	0
1	99366	50	99341	7373402	74.20	0.999109	0	1
2	99315	31	99300	7274062	73.24	0.999588	1	2
3	99284	23	99273	7174762	72.27	0.999726	2	3
4	99261	18	99252	7075489	71.28	0.999794	3	4
:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:
89	12061	2302	10910	46585	3.86	0.819297	88	89
90	9759	1957	8780	35675	3.66	0.804793	89	90
91	7802	1650	6977	26895	3.45	0.794602	90	91
92	6152	1416	5444	19918	3.24	0.780286	91	92
93	4736	1156	4158	14474	3.06	0.763797	92	93
94	3580	944	3108	10316	2.88	0.747439	93	94
95	2636	743	2264	7208	2.73	0.728533	94	95
96	1893	548	1619	4944	2.61	0.714859	95	96
97	1344	415	1137	3325	2.47	0.702528	96	97
98	930	311	774	2188	2.35	0.681007	97	98
99	619	199	520	1414	2.28	0.670896	98	99
100+	420	420	894	894	2.13	0.632565	99+	100+

4.5.9.4 Estimation of age-specific fertility rates for ethnic groups

The published birth statistics do not provide a classification by ethnicity of mothers and fathers. Country of birth classificatios are available but these will be biased as estimators of ethnic specific births because a large proportion of the fertile age minority ethnic population was born in the UK.

The age information in the 2001 census provides one method for estimating regional and ethnic specific fertility rates by age (ASFRs) of mother. We computed the child-woman ratio, the ratio of children aged 0-4 to women aged 15-44, for the population of each of the five ethnic groups and for all groups. The ethnic ASFRs were computed as follows:

$$f^{e}(r,a) = CWR^{e}/CWR^{*} \times f^{*}(r,a) \quad (19)$$

where superscript e refers to ethnic group and superscript * all groups. Table 20 shows a sample calculation for Inner London.

Table 20
Using the child-woman ratio to estimate ethnic group fertility rates

Inner London	All groups	White	Mixed	Asian	Black	Chinese & Other
2001 census						
Children 0-4	190116	95098	18173	28753	43233	4859
Women 15-44	762092	488683	27813	77929	136480	31187
CWR	249	195	653	369	317	156
Vital statistics data						
ASFRs						
15-19	26	20	68	38	33	16
20-24	59	46	155	87	75	37
25-29	73	57	191	108	93	46
30-34	94	73	246	139	119	59
35-39	59	46	155	87	75	37
40-44	15	12	39	22	19	9
TFR	1.62	1.27	4.27	2.41	2.07	1.02

There is a potential mis-specification revealed. The CWR for the Mixed group is probably much too large for Mixed ethnicity women, because many of the births will be to mothers in other groups. However, we use the high rates to compensate for not having introduced a mixing process in the fertility model.

4.5.9.5 Estimation of internal migration flows and immigration by ethnicity

Customised census output, know as commissioned tables, were required (ONS, 2005c). Commissioned tables M816e (Government Office Regions), M816g (Great Britain), M816f (Wales), M821b (Inner and Outer London), Table UV23 (Scotland) and Table S387 (Northern Ireland) were used to produce for each region and ethnic group tables of all age migration for three migration streams (internal out-migration, internal in-migration and immigration) captured in the 2001 census. The first sub-table in Table 21 shows an example for the West Midlands. Emigration estimates were derived from an annual average of the Total International Migration series for 2000-2003 (Table 21's second sub-table) and distributed to ethnic groups in the same proportions as internal out-migration. These totals were then used to control an estimate based on applying rates of internal migration and immigration by single year of age for the UK (supplied by ONS through the good offices of Emeritus Professor Tony Champion, University of Newcastle) to the single year populations of each ethnic group in the region. The calculations are set out in the third and fourth sub-tables of Table 21.

Table 21
Estimating internal and external migration by ethnicity: illustration for the West Midlands

A. Migration totals from 2001 census (except emigration), by ethnic group

2001 census ethnic group	Internal out-migration	External emigration	Internal in-migration	External immigration
White: all	80495	17664	73794	13802
Mixed: all	1444	317	1531	699
Asian: all	5312	1166	4823	3230
Black: all	1535	337	2016	1751
Chinese & Other	2014	442	1973	4024
All groups	90800	19925	84137	23506

B. Total international migration around 2001, all groups

TIM data	2000	2001	2002	2003	Ave 2000-3
Inflow	23	39.4	36.3	31.2	32.475
Outflow	16.6	16.9	23.6	22.6	19.925
Balance	6.4	22.6	12.7	8.5	12.55

C. First round computations

2000 age	2001 age	Population	UK Migration Rates		Migration estimates			
		2001	Internal Migration	External Immigration	Internal Out-migration	External Emigration	Internal In-migration	External Immigration
White	Males							
Births	Aged 0	24785	21.6%	0.82%	5347	204	5347	204
Aged 0	Aged 1	24383	18.9%	0.73%	4605	177	4605	177
Aged 1	Aged 2	25943	16.1%	0.72%	4171	186	4171	186
Aged 2	Aged 3	26667	14.1%	0.63%	3759	167	3759	167
:	:	:	:	:	:	:	:	:
All ages	persons	4674296			509640	30448	509640	30448

D. Second round computations

2000 age	2001 age	Adjusted flows				Intensities			
		Internal Out-migration	External Emigration	Internal In-migration	External Immigration	Internal Out-migration	External Emigration	Internal In-migration	External Immigration
White	Males								
Births	Aged 0	844	118	774	92	0.0341	0.0048	0.0312	0.0037
Aged 0	Aged 1	727	103	667	80	0.0298	0.0042	0.0273	0.0033
Aged 1	Aged 2	659	108	604	84	0.0254	0.0042	0.0233	0.0033
Aged 2	Aged 3	594	97	544	76	0.0223	0.0036	0.0204	0.0028
:	:	:	:	:	:	:	:	:	:
All ages	Persons	80495	17664	73794	13802				

Formally, the estimation method was:
for internal out-migration
$O(r,c,g,t) = P(r,c,g,t) \times m^{U}(c,g) \times [O(r,t)/\sum_a P(r,c,g,t) \times m^{U}(c,g)]$ (20)
for emigration
$E(r,c,g,t) = P(r,c,g,t) \times m^{U}(c,g) \times [E(r,t)/\sum_a P(r,c,g,t) \times i^{U}(c,g)]$ (21)
for internal in-migration
$M(r,c,g,t) = P(r,c,g,t) \times m^{U}(c,g) \times [O(r,t)/\sum_a P(r,c,g,t) \times m^{U}(c,g)]$ (22)
for immigration
$I(r,c,g,t) = P(r,c,g,t) \times i^{U}(c,g) \times [O(r,t)/\sum_a P(r,c,g,t) \times i^{U}(c,g)]$ (23)
where
$m^{u}(c,g)$ = the UK internal migration rate for period-cohort c and gender g
$i^{U}(c,g)$ = the UK immigration rate for period-cohort c and gender g.

Table 21 shows how these estimates were made for the White population of the West Midlands

4.5.10 Projection assumptions

A very simple set of assumptions was adopted for these projections, given that they would need to be adjusted to the combined GAD country and ONS region projections (a consequence of the IPF method used in the child poverty project).

Fertility rates were assumed to remain constant from 2001 to 2020 at their 2001 levels. This assumption is in line with GAD assumptions for the national projections.

Mortality was assumed to decline at a constant 2 per cent rate from the 1998 base to 2001, the jump-off year for the projection, and to continue thereafter. This was probably marginally more optimistic than GAD national projections but probably made little difference in the 19 years of the projection.

A natural increase only projection was carried out using these assumptions, before the migration estimation was completed.

The two sets of migration intensities and two sets of migration flows were assumed to be constant over the projection horizon (2001-2020).

4.5.11 Projection results, 2010 and 2020

The full results for three countries (Scotland, Wales and Northern Ireland) and eight England Government Office regions with one GOR split into two parts, Inner and Outer London, are provided in the Table B5 for reference. The projection results for each ethnic group by region and age are adjusted to sum to the 2004-based UK and region projections set out in Appendix B1. For each area a three-part table of population counts is given. The first part is an ethnic group by broad age table for mid-year 2001 (based on the 2001 census). The second part is an ethnic group by broad age table for 2010. The third part is an ethnic group by broad age table for 2020. The 2010 and 2020 parts were entered as probability distributions into the IPF routine.

4.5.12 How much is each group projected to change from 2001 to 2020?

Table 22 sets out the projections for the different ethnic groups in the UK as a whole. The broad results for the 2001-2020 period are generally close to the changes in the 1981-2001 period reported

earlier, though the comparisons are not exact because the Rees and Butt (2004) analysis was for England only and did not use a mixed group.

Table 22
Projected ethnic group populations 2010 and 2020, United Kingdom

	Population in 1000s			Change indexes (2001=100)		Shares (%)		
0-15	2001	2010	2020	2010	2020	2001	2010	2020
White	10459	9635	9444	92	90	88.2	85.6	82.9
Mixed	336	428	570	127	169	2.8	3.8	5.0
Asian	669	761	893	114	133	5.6	6.8	7.8
Black	300	312	329	104	110	2.5	2.8	2.9
Chinese & Other	89	122	157	137	176	0.8	1.1	1.4
All groups	11855	11258	11393	95	96	100.0	100.0	100.0
16-59	2001	2010	2020	2010	2020	2001	2010	2020
White	32694	33384	33266	102	102	94.1	91.9	90.5
Mixed	199	322	417	162	210	0.6	0.9	1.1
Asian	1090	1440	1693	132	155	3.1	4.0	4.6
Black	517	726	855	140	165	1.5	2.0	2.3
Chinese & Other	245	441	546	180	223	0.7	1.2	1.5
All groups	34745	36313	36777	105	106	100.0	100.0	100.0
60+	2001	2010	2020	2010	2020	2001	2010	2020
White	11273	12656	14399	112	128	92.1	90.1	88.5
Mixed	140	218	319	155	227	1.1	1.6	2.0
Asian	487	671	892	138	183	4.0	4.8	5.5
Black	239	321	409	134	171	2.0	2.3	2.5
Chinese & Other	98	182	259	185	264	0.8	1.3	1.6
All groups	12237	14048	16278	115	133	100.0	100.0	100.0
All ages	2001	2010	2020	2010	2020	2001	2010	2020
White	54426	55675	57108	102	105	92.5	90.4	88.6
Mixed	676	968	1306	143	193	1.1	1.6	2.0
Asian	2246	2872	3479	128	155	3.8	4.7	5.4
Black	1056	1359	1593	129	151	1.8	2.2	2.5
Chinese & Other	432	745	963	172	223	0.7	1.2	1.5
All groups	58837	61619	64449	105	110	100.0	100.0	100.0

The white population as a whole increases by 4 per cent, more than the earlier period. Substantial increases occur at old ages and decreases in the working ages and particularly in the childhood ages. The fastest growing population is the Chinese and Other group, where the older ages post dramatic increases. The mixed group grows substantially in all ages. The rates of growth in the Asian and Black groups slow significantly from the earlier period. The Asian group average probably hides greater growth in the Pakistani and Bangladeshi groups and lesser growth in the Indian group. The Black group average hides greater growth in the Black

African population and slow growth in the Black Caribbean group. Note that all groups experience the greatest increases in the older ages.

The changing ethnic composition of the population is shown in the final three columns of Table 22. Overall by 2020 some 11.5 per cent of the UK population will be minority ethnic. For children the minority ethnic share will be 17.1 per cent and in the labour force ages the share will be 12.8 per cent, while the elderly share will be only 5 per cent. The differences in ethnic mix by age show that this process of transition from a largely white population will continue well beyond 2020, as a result of demographic momentum, even if all net immigration ceased.

4.5.13 How do these results vary across regions of the UK?

Table 23 provides a summary of the projections across the 13 regions. The regions mirror the UK picture and the well known difference in growth rates between peripheral and core regions. Scotland is projected to lose population but its minority ethnic population will nevertheless increase, though generally at lower rate than elsewhere.

One interesting and surprising result is the contrast in projected changes between Inner and Outer London. Inner London is projected to increase by 19 per cent in population by 2020 and the white population growth at 18 per cent almost matches this. The Black population of Inner London is forecast to decline. Outer London has lower growth at 12 per cent and the white population declines by 4 per cent. Outer London is set to take over from Inner London as the most important region for ethnic minorities.

In Figure 15 and 16 we show the white and Asian composition of UK regions in 2001 and 2020. The white percentages decrease in all regions and the Asian percentages increase.

Table 23
Regional projections of ethnic groups

All ages	Pop 1000s	Change indexes	
	2001	2010	2020
WHITE			
North East	2451	100	99
North West	6378	101	101
Yorkshire & Humberside	4639	101	103
East Midlands	3906	104	109
West Midlands	4691	100	100
East	5129	105	111
South East	7617	104	108
South West	4809	106	112
Inner London	1912	106	115
Outer London	3346	96	96
Scotland	4968	101	101
Wales	2844	103	107
Northern Ireland	1677	104	107
United Kingdom	54426	102	105

All ages	Pop 1000s	Change indexes	
	2001	2010	2020
MIXED			
North East	12	151	204
North West	63	142	193
Yorkshire & Humberside	45	154	222
East Midlands	44	152	216
West Midlands	75	149	218
East	59	154	219
South East	86	152	209
South West	38	152	210
Inner London	105	119	137
Outer London	117	137	172
Scotland	9	136	183
Wales	18	140	184
Northern Ireland	3	142	187
United Kingdom	676	143	193

All ages	Pop 1000s	Change indexes	
	2001	2010	2020
ASIAN			
North East	32	136	173
North West	223	133	166
Yorkshire & Humberside	216	131	164
East Midlands	162	126	149
West Midlands	373	126	152
East	117	132	166
South East	177	135	171
South West	31	141	179
Inner London	292	115	132
Outer London	559	126	149
Scotland	55	119	138
Wales	25	128	155
Northern Ireland	3	90	87
United Kingdom	2246	128	155

All ages	Pop 1000s	Change indexes	
	2001	2010	2020
BLACK			
North East	4	169	216
North West	38	142	178
Yorkshire & Humberside	31	140	172
East Midlands	35	146	185
West Midlands	95	130	156
East	43	166	225
South East	51	154	202
South West	19	142	179
Inner London	449	106	106
Outer London	300	142	176
Scotland	14	118	134
Wales	7	145	182
Northern Ireland	1	153	188
United Kingdom	1056	129	151

All ages	Pop 1000s	Change indexes	
	2001	2010	2020
CHINESE & OTHERS			
North East	9	203	273
North West	37	171	228
Yorkshire & Humberside	20	220	296
East Midlands	18	200	267
West Midlands	27	197	264
East	32	181	238
South East	56	191	257
South West	20	180	233
Inner London	94	133	155
Outer London	96	163	207
Scotland	18	113	124
Wales	10	196	269
Northern Ireland	5	178	250
United Kingdom	432	172	223

All ages	Pop 1000s	Change indexes	
	2001	2010	2020
ALL GROUPS			
North East	2509	101	101
North West	6740	103	105
Yorkshire & Humberside	4950	104	108
East Midlands	4166	107	113
West Midlands	5261	103	107
East	5379	107	115
South East	7988	106	112
South West	4918	107	114
Inner London	2852	109	117
Outer London	4418	106	112
Scotland	5064	101	101
Wales	2903	104	109
Northern Ireland	1689	104	108
United Kingdom	58837	105	110

Figure 15
Percentage of people who are white 2001 and 2020

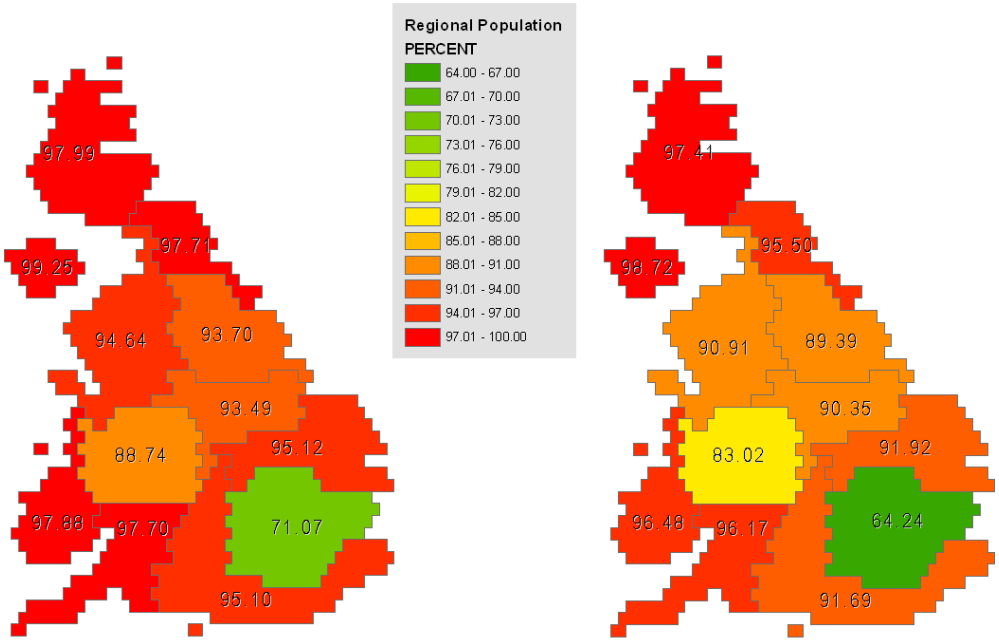


Figure 16
Percentage of people who are Asian 2001 and 2020

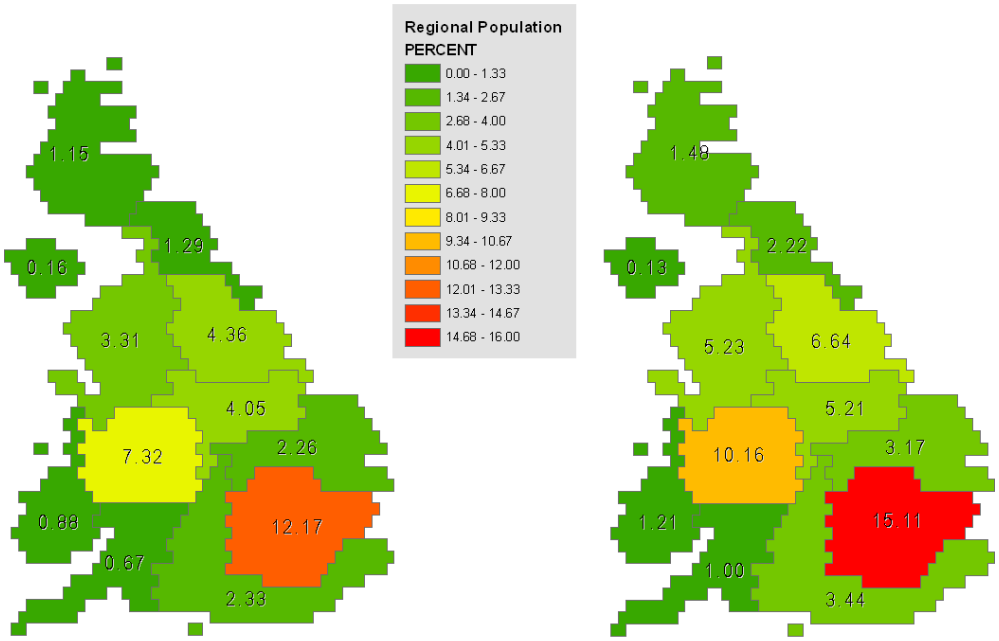


Table 24 presents more detailed figures by age for the three regions of South East England. Note that the greatest gains by ethnic minorities will be in the South East GOR. Ethnic minorities are deconcentrating from the metropolitan core just as did whites until recently.

Table 24
Region-age projections for selected regions, South East and Inner London: counts in 2001, time series indices in 2010 and 2020

South East	Year	0-15	16-59	60+	All ages
White	2001	1485	4517	1616	7617
	2010	95	103	114	104
	2020	95	104	131	108
Mixed	2001	42	26	18	86
	2010	136	169	165	152
	2020	186	221	245	209
Asian	2001	49	89	40	177
	2010	120	137	146	135
	2020	148	170	200	171
Black	2001	11	28	12	51
	2010	128	161	163	154
	2020	157	208	229	202
Chinese & Other	2001	11	32	13	56
	2010	143	201	206	191
	2020	192	260	303	257
All ages	2001	1597	4691	1699	7988
	2010	97	105	117	106
	2020	100	108	136	112

Inner London	Year	0-15	16-59	60+	All ages
White	2001	258	1408	246	1912
	2010	112	106	101	106
	2020	123	114	113	115
Mixed	2001	47	43	15	105
	2010	110	131	112	119
	2020	122	154	131	137
Asian	2001	88	164	40	292
	2010	103	122	110	115
	2020	118	140	145	163
Black	2001	131	257	62	449
	2010	86	120	93	106
	2020	75	124	94	106
Chinese & Other	2001	16	66	13	94
	2010	115	137	132	133
	2020	141	158	160	155
All ages	2001	539	1938	375	2852
	2010	104	111	102	109
	2020	111	120	114	117

4.5.14 How different are these results from GAD/ONS?

Recall that the projection results for ethnic groups were subject to adjustment in order that they agree with the GAD/ONS projections of the 13 areas. How much impact did the adjustments have? Table 25 assembles some relevant results for two regions, the North East and Inner London. In general, the migration model before adjustment projected lower numbers in both regions and all ethnic groups. The reasons for this difference need to tracked down by carefully computing the components of change for each interval.

Table 25
Comparison of GAD/ONS, current projections before adjustments and a natural increase projection for two regions, North East and Inner London

	2010			2020		
	Natural increase	Migration model 1	GAD/ONS constrained	Natural increase	Migration model 1	GAD/ONS constrained
North East						
White	2423594	2392436	2449.400	2391396	2339877	2419.845
Mixed	15597	17531	18.250	20748	22982	24.646
Asian	39174	44055	44.154	45174	54412	56.232
Black	4172	6347	6.015	4275	7849	7.687
Chinese & Others	10757	20094	18.968	10981	26498	25.462
All groups	2493294	2480462	2536.787	2472573	2451618	2533.869
Inner London						
White	1877291	1971843	2031.240	1870848	2146368	2198.895
Mixed	145482	129578	125.011	191993	145656	143.439
Asian	348435	341233	335.253	404317	387017	383.873
Black	520294	458402	478.520	575479	453701	475.477
Chinese & Others	100109	125349	124.385	103611	148962	145.619
All groups	2991611	3026405	3094.409	3146248	3281705	3347.300

4.5.15 How much difference does introducing migration by ethnicity make?

Table 25 also reports results from a natural increase-only projection. In the case of the North East, which loses population through migration, the natural increase projection produces a larger population than the projection which also includes migration in the forecast. The opposite is true for Inner London, which has become a region that gains migrants both from the rest of the country and from abroad.

4.5.16 How different is the current projection from another recent projection?

Table 26 compares the current projection with that of Coleman and Scherbov (2005). The total population of the UK is comparable in 2020 with the GAD/ONS forecast though they make higher assumptions about inward migration of minority ethnic groups which means that their forecast is higher later in the century than the GAD principal projection.

Their forecast sees virtually no growth in the white population and greater growth in ethnic minorities (though the classification is a little different). This comparison reminds us of the uncertainty behind any population forecast. Again the reasons for the difference need to be carefully tracked down.

Table 26
Comparison of current projections and Coleman/Scherbov projections

Projections, ethnic groups	2001	2010	2020	2001	2010	2020
MigMod1 projection, constrained to GAD/ONS						
White	54426	55675	57108	100	102	105
Mixed	676	968	1306	100	143	193
Asian	2246	2872	3479	100	128	155
Black	1056	1359	1593	100	129	151
Chinese & Other	432	745	963	100	172	223
Sum of groups	58837	61619	64449	100	105	110
Coleman & Scherbov						
White	54158	54387	54172	100	100	100
Mixed	661	1047	1689	100	158	256
Asian	2792	3748	4989	100	134	179
Black	1170	1787	2726	100	153	233
Sum of groups	58871	60969	63576	100	104	108

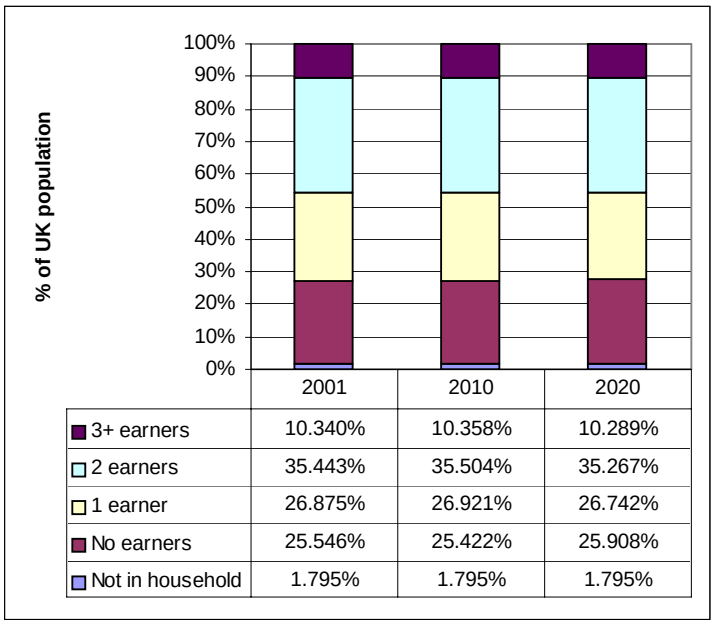
Source: authors' computations and Coleman and Scherbov (2005), Appendix Table 2a, p.50
Notes: The Coleman & Scherbov figures are the means of their suite of probabilistic projections.

4.6 A projection of the number of earners per household by region (Constraint 6)

The results are set out Appendix Table B6.
Steps:
(1) Assemble data files: past and current censuses/ISAR and HM Treasury projections for total number of employed adults.

(2) Construct base population from 2001 census.
(3) The household matrix is converted into a people matrix.
(4) The projections are increased linearly from the 2001 census base, in line with the overall Treasury trend, maintaining the number of employed adults:total people ratio (the latter from Table 1).
(5) The overall population totals are constrained to Table B1.

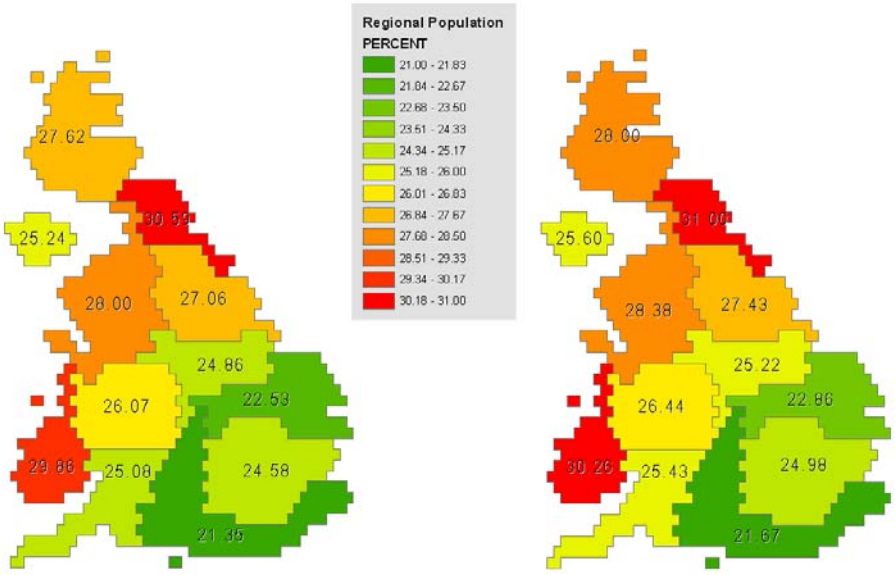
Figure 17
Projected UK population by the number of earners per household 2001, 2010 and 2020



	2001	2010	2020
3+ earners	10.340%	10.358%	10.289%
2 earners	35.443%	35.504%	35.267%
1 earner	26.875%	26.921%	26.742%
No earners	25.546%	25.422%	25.908%
Not in household	1.795%	1.795%	1.795%

Figure 17 shows that, in 2010, there's a slight proportional increase in earners, but in 2020 it slips to back under the 2001 level (proportionally). Figure 18 shows that there is expected to be very little change, proportionally, between 2001 and 2020.

Figure 18
Percentage of people in each region in households with no earners 2001 and 2020



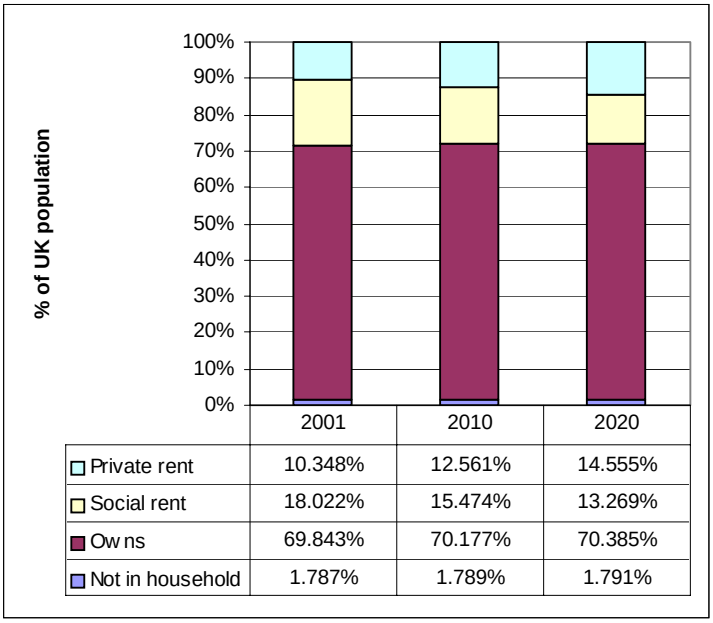
4.7 A projection of the distribution of households by tenure by region (Constraint 7)

The results are set out in Table B7.
Steps:

(1) Assemble data files: past and current censuses/ISAR and NISRA projections.
(2) Construct base population from 2001 census.
(3) The projections are increased linearly from the 2001 census base using the NISRA trend for Northern Ireland and the 1991-2001 census trend for all other regions.
(4) The household matrix is converted into a people matrix.
(5) The overall population totals are constrained to Table B1.

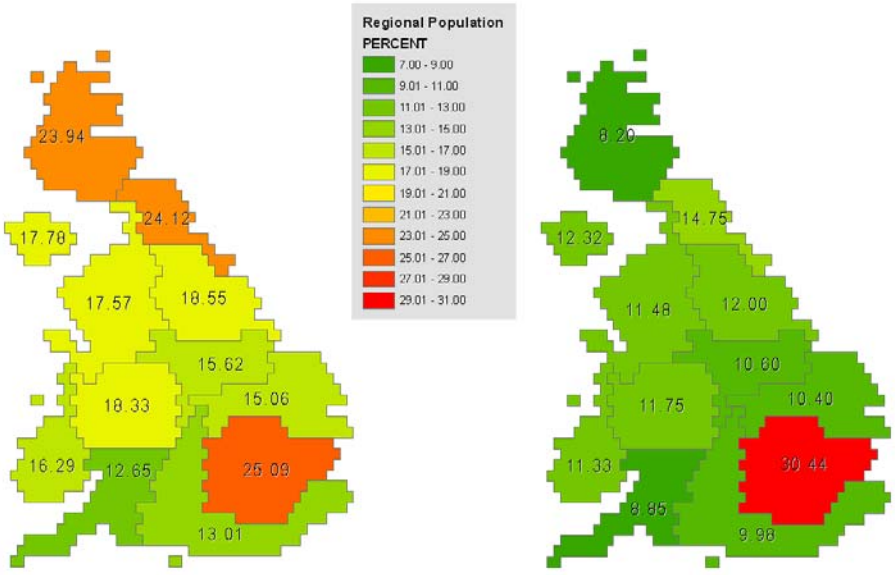
Figure 19 shows the projected changes in housing tenure, while Figure 20 illustrates the results by mapping the percentage of households in the social rent tenure.

Figure 19
Projected UK population by tenure 2001, 2010 and 2020



	2001	2010	2020
Private rent	10.348%	12.561%	14.555%
Social rent	18.022%	15.474%	13.269%
Owns	69.843%	70.177%	70.385%
Not in household	1.787%	1.789%	1.791%

Figure 20
Percentage of people in each region in social rent households, 2001 and 2020



5. Software for implementing the model

5.1 The IPF implementation

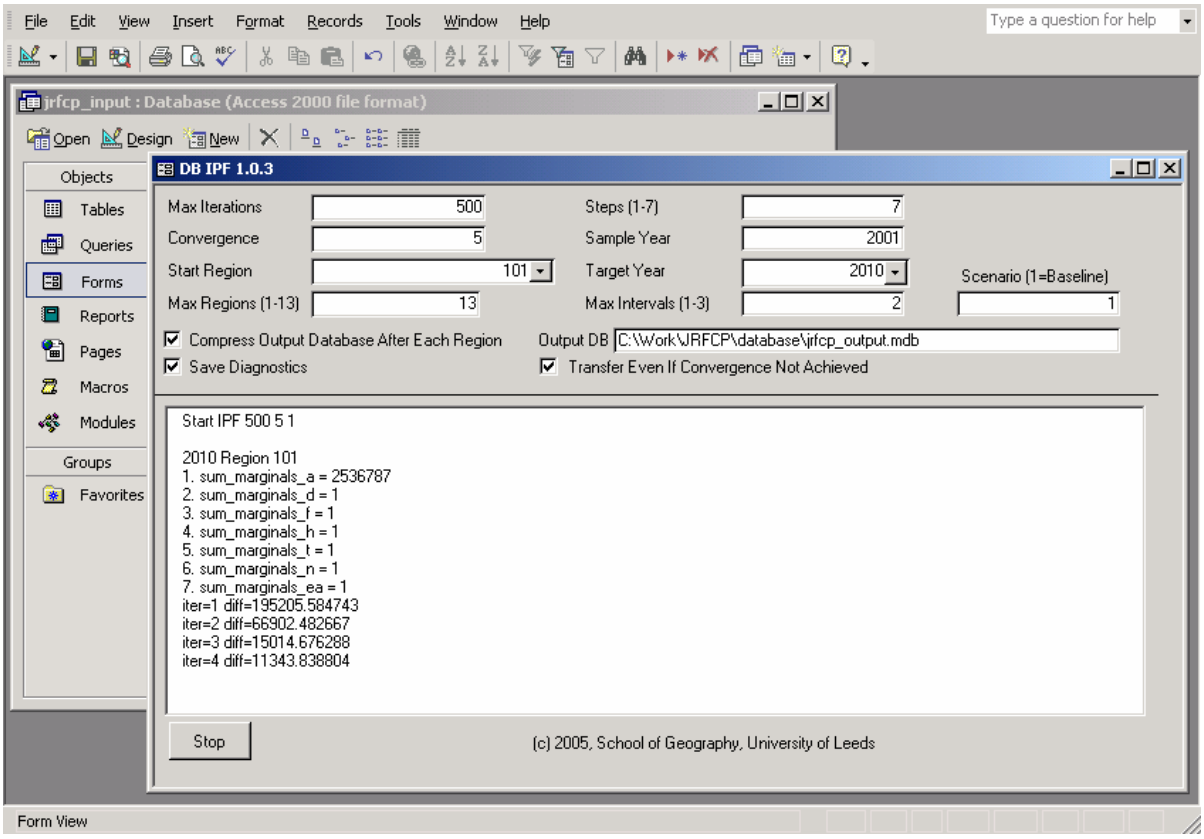
Initially, this routine was implemented in Fortran for just two dimensions, so that the results could be validated against an existing Excel spreadsheet model that was restricted to two dimensions (Norman 1999). The experiment was successful. However, the multi-dimensional IPF was implemented in Access SQL/VBA because:

- The large array size and number of dimensions could prove problematic to store in memory all at once using Fortran arrays.
- IPF requires only simple mathematical operations (plus, minus, times, divide by), making it possible to implement in any language.
- The constraint tables can be implemented as database tables which can be queried dynamically (e.g. one region at a time), as opposed to having to create all possible permutations of input file in advance (the standard Fortran approach).
- Relational databases are optimised for handling large amounts of data.
- A single SQL statement can select, transform and store data all in one go, hence requiring no intermediate memory.
- VBA syntax is very similar to Fortran and should be easy to understand for anyone looking at the code.

5.2 The interface

Figure 21 illustrates the interface set-up for using the IPF model.

Figure 21
An IPF run in progress – here creating a 2010 projection for region 101 (North East)



5.3 Running the model

By selecting the right sequence of choices on the interface the IPF routine runs with the selected region. The software initiates a sequence of database operations. The screen reports on progress through the iterations and a new database is created at the end of the run.

By increasing the convergence statistic from 0.5 to 5 (i.e. to the nearest 10 people), it was nearly possible to get every region to converge in under 500 iterations. The complete run took several hours. Regions that take longer than average to run (e.g. West Midlands) may have more inconsistencies in their constraint tables.

Table 27 summarises how long each region took to converge.

Table 27
Number of iterations and time taken for model to converge

2010

Region	Iterations	Time taken (mins:secs)	Records (non-zero cells)
NE	114	05:15	3296
NW	103	07:48	5872
YH	153	10:18	5260
EM	182	11:10	4864
WM	500 diff=5.5	45:32	6336
EA	70	04:33	5049
SE	60	05:46	5843
SW	216	19:51	4223
IL	47	04:49	8031
OL	48	04:51	7925
SC	122	06:50	4196
WA	87	04:08	3570
NI	63	02:04	2368

2020

Region	Iterations	Time taken (mins:secs)	Records (non-zero cells)
NE	161	06:50	3296
NW	78	05:47	5872
YH	100	06:40	5260
EM	333	21:21	4864
WM	479	55:50	6336
EA	72	08:07	5049
SE	57	07:33	5843
SW	466	44:33	4223
IL	53	09:44	8031
OL	55	09:59	7925
SC	90	08:52	4196
WA	118	09:37	3570
NI	91	05:10	2368

The IPF has been improved through elimination of constraint table inconsistencies so it now produces much better results than initially. The sums of the full array (as shown in Appendix C) are now within 2-7 per cent of marginal constraints.

5.4 Use of the projected database

The constraints and IPF outputs are available for download in the following set of files.

ConstraintTables/Appendix B Constraint Tables 2004 Based Updates.xls
database/jrfcp_output.mdb
output/logs/2001_creation.txt
output/logs/2010_baseline_creation.txt
output/logs/2020_baseline_creation.txt
output/min/p2020.xls
output/min/p2010_baseline.xls
output/min/p2020_baseline.xls
output/full/p2001_full.csv
output/full/p2010_full_baseline.csv
output/full/p2020_full_baseline.csv

If validating output against constraints using Stata, use the full files (including -9s), not the min ones, so that you are comparing like with like.

If you add jrfcp_output.mdb to your hard disk and open it in Access, you will see that some queries have been added (output_table_a, output_table_d) which tabulate the results for direct comparison with the constraints. This is an alternative to using Stata. Please note that the constraints are in thousands and the database input/output is in units. Despite fixing a few bugs/omissions, the output totals are still not the same as the constraint totals. For some constraints (e.g. a,d,e), the match is generally within 5 per cent - which is not bad. For others (e.g. n,t), the match is still poor.

6. Concluding remarks

6.1 Summary

In this report we describe the ways we have projected a set of tables of the future population distribution across seven variables, relevant in the analysis of child poverty, across 13 regions. To recap the seven variables are:

(1) age
(2) number of dependent children in families
(3) type of family
(4) size of households
(5) number of earners
(6) housing tenure
(7) ethnic group.

We have used three different approaches to projection:

- existing official projections (for age, some household categories, employment forecasts);
- extrapolation of inter-census trends or FRS statistics (number of dependent children, type of family, size of households, number of earners, housing tenure);
- our own cohort-component projections (ethnic group).

For each region we projected seven sets of marginal tables, each containing number of people and each summing to the most accurate total, the total regional population estimated by combining GAD national (2004-based) and ONS sub-national (2003-based) projections. This ensured consistency of the key variable tables.

We produced a seven variable by 13 region array by aggregating the individual records in the 2001 census Individual Sample of Anonymised Records. We built a seven dimensional iterative proportional fitting algorithm and associated implementation software to adjust this 2001 census based array to marginal tables for 2010 and 2020. If this was successful, then it would be possible to choose combinations of the seven variables as tables for re-weighting the micro-simulation results produced by IFS, using the FRS. In the event, it proved difficult to achieve convergence of the adjusted array and agreement between the summed marginals and the external constraints. Nevertheless we were able to improve on initial results by re-ordering the solution sequence and ironing out inconsistencies and errors in the constraint tables.

This was a pioneering attempt to quickly generate consistent projections of the UK population across more socio-economic dimensions than attempted before. The results are reasonably robust and can be used to re-weigh micro-simulation results for 2010 and 2020 to yield an improved understanding of whether policy will achieve the goal of child poverty eradication. A more sophisticated approach would require moving to a dynamic micro-simulation model, which is an altogether bigger undertaking. There are also other techniques for constructing an array from the constraint tables that IFS are looking into.

6.2 Evaluation

It is useful in this concluding section of the report to draw out the lessons learnt for future exercises of this kind.

6.2.1 The ISAR database needs modification for Northern Ireland

For Northern Ireland, the results of the IPF model are distorted by the failure of ONS/NISRA to include a full ethnic classification. The Northern Ireland constraint tables are correct in both the database and the source spreadsheets. The IPF routine is also working correctly but the Northern Ireland results are unreliable because the minimum set of ethnic groups (White, Mixed, Asian, Black, Chinese & Other) does not exist in the ISAR for Northern Ireland. Only groups White and Other are recognised (variable *ethn* as reported in Table 10). In the 2001 census the Northern Ireland ISAR contains a White count of 5,760 and an Other ethnic group count of 386. The ‘fix-up’ to this problem would be to carry out Monte Carlo sampling on the 386 ‘Others’ to assign them Mixed, Asian, Black and Chinese & Other ethnicity using the probabilities from the published ethnicity table which is the basis of the Northern Ireland ethnicity constraint table (Table B5, Northern Ireland, panel 1, page 79). This modification may be implemented in a future piece of work.

6.2.2 The FNDEPCH variable has been withdrawn from the ISAR

There is a problem with one of the ISAR variables, FNDEPCH, the flag for dependent children in a family, which has come to light after we raised a query with the SARs Helpdesk at CCSR.

The codebook for the ISAR says the following (edited into a table for clarity):

4.2 Dependent Children in Family - fndepch

Code	Value Label	Count	Percentage
-9	Not applicable (not in a family/student living away)	364250	19.76
0	no children in family	625690	33.94
1	dependent children only	789000	42.80
2	dependent and non-dependent children	39728	2.16
3	non-dependent children only	24857	1.35

Notes: A dependent child is a person aged 0 to 15 in a household (whether or not in a family) or aged 16 to 18 in full time education and living in a family with his or her parent(s). This is a change from the 1991 definition which was a person aged 0 to 15 in a household or a person aged 16 to 18, never married, in full time education and economically inactive. An ‘adult’ in a household is any person who is not a dependent child.

We used this variable with census table data to arrive at the likeliest values of variable d (i.e. d=0=no dependents, d=1=1 dependent children, d=2=2 dependents, d=3=3+ dependents). However, we found that "29.4 per cent of lone parents have 'no children in family'", so raised a query (24/10/2005) with the SARs Helpdesk and were assured that "no children in family" meant "no dependent children in family". We continued our work. But on 16/12/2005 the SARs team issued the following notice:

> “Temporary removal of FNDEPCH
> A user query has highlighted an anomoly [sic] in this variable. Investigations by CCSR and ONS have failed to find a fix for this problem and further work will be required. Consequently the variable has been removed pending further work. Users who downloaded data prior to 13 December 2005 are advised not to use this variable. We would like to apologise for the obvious inconvenience this may have caused."

This is an issue to be aware of if using the ISAR multi-way table. We point out that, when selecting variables, start by filtering out impossible combinations. This should enable a user to work around these difficulties.

6.2.3 Lessons in applying iterative proportional fitting to a high dimensional array

It proved difficult to achieve an exact fit between all marginal constraint tables and the seven dimensional array derived from the ISAR for each region. A succession of errors or difficulties were identified and eliminated in the review process. The errors or difficulties were as follows.

(1) An incorrect SQL query about n, the number of earners, was corrected. We checked all of the other queries and believe the routine to be performing correctly.

(2) We tracked down a number of errors in the constraint tables and eliminated them. The IPF routine is not tolerant to external inconsistencies.

(3) We revised the order in which the constraints were applied, applying the most detailed constraint, the ethnic group by age tables, last. Results for tenure, number of earners and size of household are poor as a result because the adjusted array agrees best with the final constraint, as might be expected. The best results are obtained for the attribute constraint that is placed last. In the revised ordering ethnic group was last and therefore best. In a previous run, tenure was last and so best.

(4) It would have been useful to have developed constraint tables for household size and tenure together and household size and number of earners together, to capture the likely dependencies.

(5) A general lesson can be drawn from our IPF work. The generic problem that we faced was trying to use two techniques simultaneously which should have been tried out in sequence. First, we should have tested the IPF technique with a data set and constraints drawn from the same source, so that constraint errors and routine features could be distinguished from the start. This issue could be tackled given further research time. Second, we had to use, for the constraints, a set of forecast marginal tables generated from incomparable sources. The reason this causes problems is that there is no guarantee that the interdependencies between variables have been properly represented in the marginal distributions. This will remain a problem until such time as the UK has a full and perfect population register of persons, households and housing units.

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Appendix A

Data dictionary

r = region

Value	Description
101	North East
102	North West
103	Yorkshire and The Humber
104	East Midlands
105	West Midlands
106	East of England
107	South East
108	South West
109	Inner London
110	Outer London
111	Scotland
112	Wales
113	Northern Ireland

a = age of respondent

Value	Description
1	0-9
2	10-15
3	16-19 dependents
4	16-19 non-dependents
5	20-24
6	25-29
7	30-44
8	45-59
9	60+

d = number of dependent children in family

Value	Description
0	No dependents
1	1 dependent
2	2 dependents
3	3+ dependents

(Changed from whether dependent to actual number of dependents, based on census)

f = family type

Value	Description
-9	Ungrouped individual (not in a family)
1	Lone parent
2	Married couple
3	Cohabiting couple
4	One person
5	Other multi-person

(Categories aggregated/extended to match those in ODPM projections, plus -9 to match ISAR)

h = size of household

Value	Description
-9	Not applicable (not in a household)
0	No usual residents (only visitors)
1	1
2	2
3	3
4	4
5	5
6	6+

(-9 and 0 added to match ISAR)

e = ethnic group

Value	Description
1	White
2	Mixed
3	Asian
4	Chinese & Other
5	Black

n = number of employed adults in household

Value	Description
-9	Not applicable (not in a household)
0	No earners
1	1 earner
2	2 earners
3	3+ earners

t = household tenure

Value	Description
-9	Not applicable (not in a household)
1	Owns
2	Social rent
3	Private rent

Appendix B

Constraint tables

Table B1
Constraint 1 – UK and region populations by age in 2001, 2010 and 2020, adjusted to agree with GAD's 2004-based UK projections

Population in 1000s at mid year

2001		0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	sum
GOR/Country	Value	1	2	3	4	5	6	7	8	9	
North East	101	295.351	201.642	58.678	70.621	150.999	145.936	550.538	485.936	548.830	2508.531
North West	102	834.997	559.642	165.684	179.396	394.697	413.290	1480.046	1285.341	1426.408	6739.501
Yorks & Humb	103	613.478	403.503	112.053	140.293	305.807	303.332	1082.929	939.722	1049.154	4950.271
East Midlands	104	504.237	334.227	94.723	110.281	245.697	251.461	925.380	818.299	881.213	4165.518
West Midlands	105	662.263	434.005	125.317	142.271	309.790	326.792	1145.775	1004.579	1110.490	5261.282
East	106	666.217	417.813	123.679	126.517	299.183	335.370	1197.926	1055.165	1157.159	5379.029
South East	107	978.952	618.428	183.349	197.338	463.029	496.456	1794.038	1557.099	1699.308	7987.997
South West	108	564.263	375.320	108.648	122.540	265.700	277.832	1038.710	981.625	1183.092	4917.730
Inner London	109	355.156	184.079	66.672	62.213	236.146	349.842	822.274	400.703	374.841	2851.926
Outer London	110	559.931	336.927	112.530	105.004	288.292	350.330	1108.453	775.350	781.614	4418.431
Scotland	111	582.074	388.300	104.183	148.043	315.372	314.847	1163.296	979.238	1068.732	5064.085
Wales	112	351.913	234.753	72.311	74.433	169.582	164.640	605.962	570.698	658.803	2903.095
Northern Ireland	113	237.602	159.548	56.199	46.564	110.384	114.850	375.960	290.487	297.685	1689.279
United Kingdom	Total	7206.434	4648.187	1384.026	1525.514	3554.678	3844.978	13291.287	11144.242	12237.329	58836.675

2010		0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	sum
GOR/Country	Value	1	2	3	4	5	6	7	8	9	
North East	101	265.686	177.277	63.841	71.350	177.599	155.412	477.866	533.324	614.432	2536.787
North West	102	780.035	492.519	183.178	184.251	486.164	458.961	1362.810	1377.961	1596.006	6921.885
Yorks & Humb	103	575.552	368.205	128.761	149.672	378.207	336.398	1008.066	1012.368	1185.853	5143.082
East Midlands	104	488.510	313.558	111.970	121.077	297.266	268.827	888.978	891.135	1058.116	4439.437
West Midlands	105	637.870	393.389	139.720	147.339	369.066	344.194	1087.223	1062.158	1262.295	5443.254
East	106	660.871	410.746	145.979	138.726	344.619	356.357	1177.976	1131.505	1389.033	5755.812
South East	107	955.132	597.653	216.715	216.684	542.864	529.442	1728.041	1678.299	1979.714	8444.545
South West	108	542.316	365.530	130.418	136.632	331.573	302.509	998.486	1051.781	1401.108	5260.353
Inner London	109	390.119	171.531	65.671	56.916	265.731	366.441	910.758	483.334	383.908	3094.409
Outer London	110	577.984	317.422	119.619	103.673	335.990	385.049	1116.566	873.075	846.154	4675.532
Scotland	111	527.688	345.458	111.992	147.848	345.227	326.406	1016.460	1087.537	1209.638	5118.254
Wales	112	325.753	216.436	82.051	78.606	204.656	184.653	560.974	604.046	767.789	3024.964
Northern Ireland	113	217.877	143.355	56.792	43.755	129.848	122.342	356.655	336.407	353.947	1760.978
United Kingdom	Total	6945.393	4313.079	1556.708	1596.530	4208.811	4136.991	12690.859	12122.929	14047.993	61619.293

2020		0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	sum
GOR/Country	Value	1	2	3	4	5	6	7	8	9	
North East	101	258.108	163.051	54.317	56.245	156.599	157.551	454.021	524.692	709.285	2533.869
North West	102	792.615	475.808	161.267	150.302	431.209	478.322	1352.985	1442.455	1812.807	7097.770
Yorks & Humb	103	595.713	356.206	115.150	123.995	345.764	355.598	1004.396	1071.703	1358.533	5327.059
East Midlands	104	506.101	311.775	103.484	103.684	277.060	287.384	869.665	978.442	1253.018	4690.613
West Midlands	105	653.956	389.095	128.284	125.350	337.189	360.132	1054.018	1150.018	1428.644	5626.684
East	106	693.194	420.203	142.287	125.273	335.351	383.214	1188.130	1242.482	1640.272	6170.405
South East	107	993.809	604.312	206.168	191.003	521.147	573.739	1744.386	1822.871	2306.474	8963.909
South West	108	568.125	361.589	123.278	119.673	320.140	332.620	1008.626	1143.741	1646.855	5624.646
Inner London	109	407.803	190.638	66.983	53.757	249.803	378.165	957.044	616.259	426.848	3347.300
Outer London	110	599.187	330.706	116.457	93.462	316.976	404.440	1138.715	1000.562	960.806	4961.312
Scotland	111	513.608	317.965	97.553	118.864	305.695	326.386	947.801	1085.719	1414.143	5127.734
Wales	112	337.250	204.754	73.028	64.636	188.620	196.866	571.761	627.151	889.183	3153.249
Northern Ireland	113	216.510	131.330	50.656	35.996	114.057	121.010	360.241	363.117	431.608	1824.525
United Kingdom	Total	7135.980	4257.431	1438.910	1362.240	3899.611	4355.427	12651.789	13069.211	16278.475	64449.074

Table B2
Constraint 2 – UK and region populations by number of dependent children, 2001, 2010 and 2020

Population in 1000s at mid year

2001		0 children	1 child	2 children	3+ children	sum
GOR/Country	Value	0	1	2	3	
North East	101	1371.029	379.167	482.120	276.214	2508.531
North West	102	3639.331	983.967	1260.287	855.916	6739.501
Yorks & Humb	103	2700.148	697.291	939.612	613.220	4950.271
East Midlands	104	2301.230	578.429	798.980	486.879	4165.518
West Midlands	105	2825.308	736.580	994.382	705.012	5261.282
East	106	2956.042	710.743	1049.961	662.283	5379.029
South East	107	4436.889	1045.382	1532.163	973.562	7987.997
South West	108	2842.448	629.469	899.945	545.868	4917.730
Inner London	109	1685.488	362.195	402.122	402.122	2851.926
Outer London	110	2372.698	600.906	826.246	618.580	4418.431
Scotland	111	2861.208	729.228	936.856	536.793	5064.085
Wales	112	1592.489	418.464	546.328	345.814	2903.095
Northern Ireland	113	796.447	226.590	324.667	341.576	1689.279
United Kingdom	Total	32360.172	8119.461	11002.458	7354.584	58836.675

2010		0 children	1 child	2 children	3+ children	sum
GOR/Country	Value	0	1	2	3	
North East	101	1451.835	385.804	470.888	228.261	2536.787
North West	102	3905.385	992.588	1287.116	736.795	6921.885
Yorks & Humb	103	2944.966	709.544	961.612	526.960	5143.082
East Midlands	104	2586.066	590.483	833.042	429.846	4439.437
West Midlands	105	3075.744	757.410	1009.399	600.701	5443.254
East	106	3351.300	724.287	1095.986	584.240	5755.812
South East	107	4931.307	1061.646	1598.583	853.009	8444.545
South West	108	3205.679	638.370	933.977	482.328	5260.353
Inner London	109	1897.244	410.229	433.594	353.342	3094.409
Outer London	110	2555.772	666.074	904.372	549.315	4675.532
Scotland	111	3106.651	722.281	785.807	503.515	5118.254
Wales	112	1732.474	427.437	557.098	307.956	3024.964
Northern Ireland	113	855.976	258.996	347.283	298.723	1760.978
United Kingdom	Total	35599.272	8344.806	11220.421	6454.793	61619.293

2020		0 children	1 child	2 children	3+ children	sum
GOR/Country	Value	0	1	2	3	
North East	101	1437.441	385.617	474.638	236.174	2533.869
North West	102	3982.187	1014.089	1323.101	778.392	7097.770
Yorks & Humb	103	3035.280	731.987	998.054	561.736	5327.059
East Midlands	104	2716.199	622.464	883.851	468.098	4690.613
West Midlands	105	3164.399	779.426	1044.210	638.649	5626.684
East	106	3572.699	773.942	1178.586	645.178	6170.405
South East	107	5208.565	1122.561	1700.822	931.960	8963.909
South West	108	3413.332	680.152	1000.918	530.244	5624.646
Inner London	109	2046.343	441.222	467.691	392.044	3347.300
Outer London	110	2703.337	701.558	957.756	598.661	4961.312
Scotland	111	3083.086	725.791	795.077	523.779	5127.734
Wales	112	1797.775	443.754	581.609	330.111	3153.249
Northern Ireland	113	874.970	265.523	362.771	321.261	1824.525
United Kingdom	total	37032.722	8687.235	11772.461	6956.656	64449.074

Table B3
Constraint 3 – UK and region populations by family type, 2001, 2010 and 2020

Population in 1000s at mid year

2001		Not in a family	Lone Parent	Married Couple	Cohabiting Couple	One person	Other multi-person	sum
GOR/Country	Value	-9	1	2	3	4	5	
North East	101	42.695	298.162	1429.662	223.494	320.132	194.385	2508.531
North West	102	114.871	829.789	3732.325	606.510	866.093	589.912	6739.501
Yorks & Humb	103	84.066	509.870	2841.464	486.155	598.362	430.353	4950.271
East Midlands	104	77.969	396.207	2469.043	409.999	476.037	336.263	4165.518
West Midlands	105	82.233	573.774	3039.048	468.542	618.173	479.513	5261.282
East	106	91.536	464.837	3257.153	526.756	616.533	422.214	5379.029
South East	107	191.751	989.308	3398.479	743.792	1158.578	1506.090	7987.997
South West	108	115.441	609.389	2093.376	458.157	713.654	927.713	4917.730
Inner London	109	48.868	242.871	1685.547	274.043	329.094	271.504	2851.926
Outer London	110	46.080	388.328	2637.752	411.450	538.641	396.180	4418.431
Scotland	111	86.977	596.428	2827.173	403.018	701.715	448.774	5064.085
Wales	112	43.140	336.250	1670.361	243.683	346.220	263.441	2903.095
Northern Ireland	113	25.645	229.635	1009.298	72.225	185.957	166.519	1689.279
United Kingdom	Total	1051.272	6464.849	32090.682	5327.822	7469.189	6432.861	58836.675

2010		Not in a family	Lone Parent	Married Couple	Cohabiting Couple	One person	Other multi-person	sum
GOR/Country	Value	-9	1	2	3	4	5	
North East	101	43.176	216.522	1390.764	258.543	385.581	242.202	2536.787
North West	102	117.979	637.719	3647.030	802.405	996.107	720.646	6921.885
Yorks & Humb	103	87.341	396.297	2771.751	671.729	720.885	495.080	5143.082
East Midlands	104	83.096	286.641	2504.791	590.584	571.758	402.566	4439.437
West Midlands	105	85.077	424.325	2982.568	691.211	722.204	537.869	5443.254
East	106	97.947	326.441	3268.426	766.476	762.971	533.550	5755.812
South East	107	202.710	469.547	4573.527	1209.199	1138.793	850.770	8444.545
South West	108	123.485	289.837	2943.488	664.258	717.690	521.595	5260.353
Inner London	109	53.023	331.609	1153.691	576.625	499.564	479.897	3094.409
Outer London	110	48.761	504.467	1755.077	877.203	759.973	730.053	4675.532
Scotland	111	87.907	438.319	1839.512	286.457	846.034	1620.026	5118.254
Wales	112	44.952	165.441	1297.555	238.539	403.924	874.554	3024.964
Northern Ireland	113	26.734	195.624	761.237	59.508	218.889	498.987	1760.978
United Kingdom	Total	1102.294	4681.415	30898.251	7694.741	8742.927	8499.665	61619.293

2020		Not in a family	Lone Parent	Married Couple	Cohabiting Couple	One person	Other multi-person	sum
GOR/Country	Value	-9	1	2	3	4	5	
North East	101	43.127	205.047	1304.264	270.290	450.172	260.969	2533.869
North West	102	120.977	634.422	3494.547	867.972	1170.557	809.294	7097.770
Yorks & Humb	103	90.465	397.085	2698.439	737.941	853.586	549.543	5327.059
East Midlands	104	87.797	289.806	2508.973	652.493	699.332	452.212	4690.613
West Midlands	105	87.944	432.349	2884.840	761.398	853.704	606.449	5626.684
East	106	105.002	323.861	3302.241	856.242	942.724	640.335	6170.405
South East	107	215.177	463.355	4530.770	1357.490	1385.037	1012.080	8963.909
South West	108	132.035	289.560	2970.921	737.012	876.384	618.733	5624.646
Inner London	109	57.357	355.392	1121.530	670.075	606.629	536.319	3347.300
Outer London	110	51.742	530.349	1673.655	999.950	905.270	800.346	4961.312
Scotland	111	88.070	399.985	1678.632	261.404	996.513	1703.129	5127.734
Wales	112	46.857	155.629	1235.428	253.686	481.082	980.567	3153.249
Northern Ireland	113	27.699	186.055	724.002	56.596	272.670	557.504	1824.525
United Kingdom	total	1154.500	4661.763	30147.877	8489.518	10490.111	9505.304	64449.074

Table B4
Constraint 4 – UK and region populations by household size, 2001, 2010 and 2020

Population in 1000s at mid year

2001		Not applicable	No usual residents	1 person	2 persons	3 persons	4 persons	5 persons	6+ persons	sum
GOR/Country	Value	-9	0	1	2	3	4	5	6	
North East	101	42.695	0.096	321.816	717.821	527.195	565.250	227.559	106.098	2508.531
North West	102	114.871	0.321	880.941	1856.123	1361.280	1470.535	693.715	361.714	6739.501
Yorks & Humb	103	84.066	0.224	607.572	1430.376	974.832	1093.407	471.903	287.890	4950.271
East Midlands	104	77.969	0.320	486.443	1252.838	824.872	934.955	403.073	185.048	4165.518
West Midlands	105	82.233	0.384	614.472	1472.506	1042.849	1168.342	543.759	336.737	5261.282
East	106	91.536	0.287	617.898	1621.726	1013.116	1241.062	549.150	244.255	5379.029
South East	107	191.751	0.542	926.669	2342.846	1509.569	1818.225	828.627	369.769	7987.997
South West	108	115.441	0.478	619.119	1544.147	912.312	1058.860	460.267	207.106	4917.730
Inner London	109	48.868	0.827	508.324	706.080	520.062	497.744	308.189	261.833	2851.926
Outer London	110	46.080	0.513	556.487	1091.379	859.247	1035.544	536.111	293.069	4418.431
Scotland	111	86.977	0.185	711.346	1464.391	1028.493	1126.873	468.786	177.035	5064.085
Wales	112	43.140	0.128	356.930	834.608	593.593	644.766	295.164	134.765	2903.095
Northern Ireland	113	25.645	0.128	171.278	357.919	314.899	380.754	247.321	191.335	1689.279
United Kingdom	Total	1051.610	4.404	7376.650	16698.793	11484.406	13040.947	6030.877	3148.988	58836.675

2010		Not applicable	No usual residents	1 person	2 persons	3 persons	4 persons	5 persons	6+ persons	sum
GOR/Country	Value	-9	0	1	2	3	4	5	6	
North East	101	43.176	0.097	385.476	767.039	490.277	494.720	239.938	116.065	2536.787
North West	102	117.979	0.329	996.059	2113.146	1350.684	1362.922	661.014	319.751	6921.885
Yorks & Humb	103	87.341	0.233	720.852	1577.225	1008.133	1017.267	493.373	238.659	5143.082
East Midlands	104	83.096	0.340	571.638	1376.993	880.149	888.123	430.737	208.360	4439.437
West Midlands	105	85.077	0.398	722.151	1686.738	1078.132	1087.900	527.629	255.229	5443.254
East	106	97.947	0.307	762.930	1780.978	1138.368	1148.683	557.109	269.490	5755.812
South East	107	202.710	0.573	1138.399	2584.475	1651.949	1666.916	808.451	391.072	8444.545
South West	108	123.485	0.511	717.303	1607.934	1027.762	1037.074	502.979	243.306	5260.353
Inner London	109	53.023	0.897	499.272	924.657	591.024	596.379	289.242	139.915	3094.409
Outer London	110	48.761	0.543	759.663	1406.903	899.267	907.415	440.094	212.887	4675.532
Scotland	111	87.907	0.187	846.003	1522.464	973.131	981.948	476.243	230.373	5118.254
Wales	112	44.952	0.134	403.906	937.303	599.108	604.535	293.199	141.829	3024.964
Northern Ireland	113	26.734	0.133	218.873	430.069	341.793	376.537	225.740	141.100	1760.978
United Kingdom	Total	1102.294	4.680	8741.077	18716.516	12030.096	12170.714	5945.856	2908.059	61619.293

2020		Not applicable	No usual residents	1 person	2 persons	3 persons	4 persons	5 persons	6+ persons	sum
GOR/Country	Value	-9	0	1	2	3	4	5	6	
North East	101	43.127	0.097	450.049	816.691	487.122	417.553	219.619	99.611	2533.869
North West	102	120.977	0.338	1170.501	2323.669	1385.971	1188.033	624.865	283.417	7097.770
Yorks & Humb	103	90.465	0.241	853.547	1754.094	1046.243	896.824	471.699	213.946	5327.059
East Midlands	104	87.797	0.360	699.277	1562.137	931.748	798.681	420.079	190.533	4690.613
West Midlands	105	87.944	0.411	853.284	1875.058	1118.392	958.668	504.227	228.700	5626.684
East	106	105.002	0.330	942.674	2050.095	1222.796	1048.161	551.298	250.049	6170.405
South East	107	215.177	0.608	1385.295	2946.764	1757.621	1506.605	792.424	359.416	8963.909
South West	108	132.035	0.547	876.386	1847.294	1101.833	944.474	496.762	225.314	5624.646
Inner London	109	57.357	0.971	606.450	1073.604	640.360	548.907	288.706	130.947	3347.300
Outer London	110	51.742	0.577	905.163	1602.419	955.776	819.276	430.912	195.446	4961.312
Scotland	111	88.070	0.188	996.476	1618.096	965.126	827.291	435.128	197.359	5127.734
Wales	112	46.857	0.139	481.060	1050.659	626.674	537.175	282.536	128.148	3153.249
Northern Ireland	113	27.699	0.138	272.649	511.495	360.090	358.674	194.316	99.465	1824.525
United Kingdom	total	1154.500	4.942	10489.263	21033.077	12600.527	10851.146	5713.024	2602.595	64449.074

Table B5

Constraint 5 – UK and region populations by ethnic group and age, 2001, 2010 and 2020

North East

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	283.669	194.927	56.623	67.697	144.919	142.214	543.005	482.353	535.735	2451.142
Mixed	3.432	1.934	0.528	0.555	0.846	0.577	0.964	0.556	2.668	12.061
Asian	6.681	3.685	1.087	1.570	3.532	2.024	4.407	2.122	7.326	32.431
Black	0.442	0.265	0.088	0.196	0.463	0.340	0.557	0.349	0.863	3.563
Chinese & Other	1.127	0.831	0.352	0.603	1.240	0.781	1.605	0.556	2.238	9.335
All groups	295.351	201.642	58.678	70.621	150.999	145.936	550.538	485.936	548.830	2508.531
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	249.140	169.046	61.252	67.687	166.567	147.977	466.803	528.220	592.707	2449.400
Mixed	4.912	2.354	0.707	0.800	1.892	1.029	1.477	0.728	4.352	18.250
Asian	8.893	4.448	1.345	1.614	4.745	3.582	5.632	3.008	10.887	44.154
Black	0.777	0.363	0.107	0.242	0.849	0.702	0.991	0.425	1.559	6.015
Chinese & Other	1.963	1.066	0.430	1.008	3.546	2.122	2.962	0.942	4.927	18.968
All groups	265.686	177.277	63.841	71.350	177.599	155.412	477.866	533.324	614.432	2536.787
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	237.806	152.118	51.153	52.731	146.361	147.723	437.708	517.031	677.214	2419.845
Mixed	6.496	3.225	0.870	0.786	1.867	1.519	2.245	1.001	6.637	24.646
Asian	10.453	5.732	1.643	1.585	4.415	4.425	8.037	4.292	15.651	56.232
Black	0.893	0.487	0.145	0.223	0.761	0.852	1.477	0.609	2.240	7.687
Chinese & Other	2.462	1.489	0.505	0.920	3.197	3.033	4.553	1.760	7.544	25.462
All groups	258.108	163.051	54.317	56.245	156.599	157.551	454.021	524.692	709.285	2533.869

North West

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	755.205	513.751	151.022	162.531	363.382	390.681	1433.419	1260.884	1347.079	6377.953
Mixed	20.189	10.996	2.668	2.312	3.887	2.914	4.542	2.110	13.256	62.874
Asian	49.374	27.697	9.306	11.008	20.448	13.063	29.583	14.073	48.723	223.274
Black	5.358	3.611	1.225	1.410	3.051	3.571	5.871	5.369	8.825	38.292
Chinese & Other	4.871	3.589	1.463	2.135	3.929	3.061	6.631	2.905	8.525	37.107
All groups	834.997	559.642	165.684	179.396	394.697	413.290	1480.046	1285.341	1426.408	6739.501
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	676.801	440.947	166.552	165.827	430.005	419.682	1295.094	1345.834	1478.405	6419.148
Mixed	25.945	12.650	3.971	3.582	7.735	4.670	7.372	2.908	20.200	89.033
Asian	62.970	31.192	9.778	10.377	32.191	22.609	38.828	19.038	68.899	295.880
Black	6.697	3.831	1.359	1.765	5.846	5.336	10.460	5.882	13.033	54.208
Chinese & Other	7.622	3.901	1.519	2.700	10.388	6.664	11.054	4.298	15.470	63.616
All groups	780.035	492.519	183.178	184.251	486.164	458.961	1362.810	1377.961	1596.006	6921.885
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	664.149	409.094	141.625	132.248	380.779	424.518	1260.526	1392.858	1646.681	6452.478
Mixed	35.652	16.585	4.571	3.631	8.532	7.072	10.908	4.619	30.032	121.603
Asian	74.936	39.963	11.736	10.290	27.779	29.962	51.091	29.989	95.229	370.975
Black	7.965	4.659	1.537	1.639	5.174	6.753	14.805	7.637	17.952	68.121
Chinese & Other	9.912	5.507	1.798	2.493	8.947	10.017	15.654	7.351	22.913	84.592
All groups	792.615	475.808	161.267	150.302	431.209	478.322	1352.985	1442.455	1812.807	7097.770

Table B5
Constraint 5 – UK and region populations by ethnic group and age, 2001, 2010 and 2020 (continued)

Yorkshire and Humberside

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	542.165	363.871	100.212	124.685	277.195	284.454	1046.017	919.143	980.778	4638.519
Mixed	15.502	8.314	1.671	1.696	2.863	2.027	2.446	1.255	9.508	45.283
Asian	49.344	26.831	8.540	11.280	20.707	12.040	26.716	13.435	47.015	215.909
Black	4.026	2.804	0.853	1.155	2.427	3.122	4.619	4.733	7.240	30.979
Chinese & Other	2.441	1.683	0.776	1.478	2.615	1.689	3.131	1.156	4.612	19.581
All groups	613.478	403.503	112.053	140.293	305.807	303.332	1082.929	939.722	1049.154	4950.271
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	482.797	321.930	114.700	131.684	326.843	302.734	953.324	986.405	1083.257	4703.673
Mixed	21.454	10.164	3.018	3.107	6.105	3.514	4.832	1.605	15.763	69.562
Asian	61.659	30.980	9.165	10.856	31.786	20.910	34.944	17.349	65.736	283.384
Black	4.585	2.854	1.019	1.531	4.668	4.337	8.794	5.105	10.462	43.355
Chinese & Other	5.057	2.277	0.860	2.495	8.804	4.904	6.172	1.901	10.635	43.104
All groups	575.552	368.205	128.761	149.672	378.207	336.398	1008.066	1012.368	1185.853	5143.082
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	479.992	296.552	98.438	106.377	298.035	310.043	926.526	1031.918	1213.848	4761.729
Mixed	31.175	14.093	3.630	3.208	7.433	5.539	8.156	2.685	24.597	100.515
Asian	72.666	38.894	10.930	10.796	28.070	27.513	47.182	27.199	90.253	353.504
Black	5.338	3.221	1.055	1.357	4.297	5.258	12.507	6.322	14.032	53.386
Chinese & Other	6.540	3.446	1.097	2.257	7.929	7.245	10.026	3.578	15.802	57.920
All groups	595.713	356.206	115.150	123.995	345.764	355.598	1004.396	1071.703	1358.533	5327.059

East Midlands

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	454.243	303.034	85.363	99.503	225.221	233.775	884.903	796.137	823.807	3905.984
Mixed	15.750	8.302	1.799	1.498	2.398	1.655	2.141	1.266	9.111	43.920
Asian	27.668	18.084	5.649	6.722	13.144	10.889	29.774	14.587	35.676	162.193
Black	4.459	3.183	1.002	1.272	2.889	3.627	5.404	5.237	8.338	35.410
Chinese & Other	2.117	1.625	0.911	1.286	2.045	1.516	3.159	1.073	4.280	18.010
All groups	504.237	334.227	94.723	110.281	245.697	251.461	925.380	818.299	881.213	4165.518
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	426.483	280.024	100.611	107.209	260.468	243.334	829.654	861.721	971.358	4080.862
Mixed	21.469	10.354	3.146	2.834	5.199	2.730	4.079	1.567	15.419	66.798
Asian	31.167	17.908	6.166	7.279	19.830	14.338	38.130	20.050	49.246	204.113
Black	5.607	3.317	1.195	1.690	5.084	4.854	11.024	5.890	12.905	51.567
Chinese & Other	3.784	1.955	0.852	2.064	6.686	3.572	6.090	1.906	9.189	36.097
All groups	488.510	313.558	111.970	121.077	297.266	268.827	888.978	891.135	1058.116	4439.437
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	428.850	270.468	91.091	90.779	242.300	253.709	798.150	932.783	1132.073	4240.202
Mixed	30.645	14.083	3.702	2.977	6.271	4.351	6.508	2.510	23.939	94.986
Asian	35.289	20.406	6.338	6.481	17.832	18.035	40.914	31.365	65.225	241.884
Black	6.470	4.010	1.340	1.553	4.688	5.907	15.382	8.011	18.017	65.379
Chinese & Other	4.847	2.808	1.013	1.893	5.970	5.383	8.711	3.773	13.762	48.160
All groups	506.101	311.775	103.484	103.684	277.060	287.384	869.665	978.442	1253.018	4690.613

Table B5
Constraint 5 – UK and region populations by ethnic group and age, 2001, 2010 and 2020 (continued)

West Midlands

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	541.722	363.308	103.210	117.526	262.484	289.114	1071.211	957.249	985.468	4691.292
Mixed	27.532	14.596	3.152	2.510	3.920	2.880	3.098	1.676	15.437	74.800
Asian	75.932	43.943	14.680	17.480	33.693	23.091	54.227	28.590	81.289	372.927
Black	13.451	9.722	3.025	2.882	6.148	9.440	13.012	15.331	21.932	94.943
Chinese & Other	3.626	2.436	1.250	1.873	3.545	2.267	4.227	1.733	6.363	27.320
All groups	662.263	434.005	125.317	142.271	309.790	326.792	1145.775	1004.579	1110.490	5261.283
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	487.587	316.883	115.088	119.325	291.070	288.421	975.729	1006.188	1083.917	4684.209
Mixed	36.822	17.250	5.285	4.809	8.722	4.519	6.735	2.075	25.022	111.239
Asian	92.665	47.237	14.791	16.364	47.912	35.024	69.681	36.123	110.383	470.180
Black	14.050	8.896	3.346	4.110	11.334	10.375	26.986	15.167	29.600	123.864
Chinese & Other	6.745	3.123	1.210	2.731	10.026	5.856	8.092	2.605	13.373	53.762
All groups	637.870	393.389	139.720	147.339	369.066	344.194	1087.223	1062.158	1262.295	5443.254
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	470.355	293.227	100.166	98.187	265.188	287.147	909.232	1066.856	1186.055	4676.414
Mixed	55.302	23.836	6.130	5.070	11.218	7.837	10.793	3.640	39.337	163.164
Asian	103.743	57.812	17.194	15.949	41.277	43.801	86.761	55.465	145.187	567.189
Black	15.919	9.575	3.247	3.566	10.575	12.557	34.841	19.213	38.380	147.874
Chinese & Other	8.637	4.643	1.545	2.577	8.930	8.790	12.390	4.844	19.683	72.040
All groups	653.956	389.095	128.284	125.350	337.189	360.132	1054.018	1150.018	1428.644	5626.684

East

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	615.061	388.205	114.122	116.626	278.637	317.539	1159.958	1038.000	1100.648	5128.796
Mixed	20.467	10.370	2.422	1.827	3.088	2.469	3.729	2.083	12.453	58.907
Asian	21.188	12.812	4.418	4.923	10.316	7.794	20.002	8.984	26.148	116.584
Black	6.126	3.768	1.243	1.530	3.775	4.724	7.246	4.363	10.408	43.182
Chinese & Other	3.375	2.657	1.475	1.611	3.368	2.844	6.991	1.736	7.503	31.559
All groups	666.217	417.813	123.679	126.517	299.183	335.370	1197.926	1055.165	1157.159	5379.029
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	590.670	375.202	134.173	125.600	307.620	326.976	1118.921	1106.197	1296.589	5381.948
Mixed	28.625	13.751	4.090	3.359	6.573	4.020	6.684	2.639	21.244	90.984
Asian	26.660	13.927	4.707	5.119	14.979	11.988	25.711	12.999	38.061	154.150
Black	9.222	4.901	1.677	2.121	6.954	7.426	14.994	6.047	18.344	71.686
Chinese & Other	5.693	2.965	1.333	2.527	8.492	5.947	11.667	3.623	14.796	57.043
All groups	660.871	410.746	145.979	138.726	344.619	356.357	1177.976	1131.505	1389.033	5755.812
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	602.541	373.020	127.963	112.163	299.350	343.816	1107.540	1201.611	1507.660	5675.663
Mixed	40.664	18.858	5.173	3.707	7.712	6.209	10.138	4.169	32.555	129.185
Asian	31.792	17.559	5.406	4.924	13.866	15.420	32.050	20.178	52.011	193.207
Black	11.175	6.656	2.153	2.126	6.673	9.486	22.755	9.513	26.740	97.278
Chinese & Other	7.022	4.109	1.592	2.353	7.750	8.282	15.647	7.013	21.306	75.074
All groups	693.194	420.203	142.287	125.273	335.351	383.214	1188.130	1242.482	1640.272	6170.405

Table B5
Constraint 5 – UK and region populations by ethnic group and age, 2001, 2010 and 2020 (continued)

South East

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	908.854	575.941	168.844	182.067	429.656	469.555	1734.626	1531.798	1616.122	7617.462
Mixed	27.915	14.240	3.591	2.946	4.951	3.859	6.944	3.529	18.219	86.196
Asian	30.396	18.793	6.412	7.250	17.040	12.778	31.359	13.732	39.636	177.397
Black	6.211	4.303	1.700	2.051	5.164	5.338	8.940	4.849	12.088	50.644
Chinese & Other	5.576	5.151	2.803	3.024	6.216	4.926	12.169	3.191	13.242	56.298
All groups	978.952	618.428	183.349	197.338	463.029	496.456	1794.038	1557.099	1699.308	7987.998
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	858.835	548.558	199.546	195.090	480.634	483.580	1638.431	1639.350	1844.945	7888.969
Mixed	38.602	18.787	5.677	5.093	10.698	6.305	10.889	4.865	30.065	130.980
Asian	38.949	20.322	7.017	8.262	24.598	19.695	41.671	20.503	57.701	238.718
Black	8.672	4.733	1.835	2.696	8.893	8.464	16.323	6.953	19.674	78.243
Chinese & Other	10.075	5.252	2.640	5.544	18.042	11.398	20.727	6.627	27.329	107.635
All groups	955.132	597.653	216.715	216.684	542.864	529.442	1728.041	1678.299	1979.714	8444.545
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	870.296	539.491	185.793	170.230	461.417	511.329	1620.763	1759.765	2114.756	8233.839
Mixed	53.267	25.228	7.089	5.436	11.797	9.525	15.967	7.348	44.708	180.366
Asian	46.853	25.891	8.081	7.816	22.943	25.429	53.953	32.232	79.279	302.476
Black	10.339	6.157	2.118	2.499	8.275	10.726	24.058	10.712	27.637	102.521
Chinese & Other	13.054	7.547	3.087	5.023	16.713	16.729	29.646	12.815	40.094	144.709
All groups	993.809	604.312	206.168	191.003	521.147	573.739	1744.386	1822.871	2306.474	8963.909

South West

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	543.300	361.852	104.200	117.938	256.674	270.510	1024.993	974.079	1155.938	4809.484
Mixed	11.885	6.672	1.565	1.294	2.090	1.602	2.743	1.522	8.971	38.344
Asian	4.923	2.931	1.157	1.483	3.281	2.258	4.771	2.293	7.873	30.969
Black	2.082	1.745	0.587	0.709	1.603	1.815	2.748	2.628	5.022	18.939
Chinese & Other	2.074	2.121	1.139	1.117	2.052	1.647	3.455	1.102	5.287	19.993
All groups	564.263	375.320	108.648	122.540	265.700	277.832	1038.710	981.625	1183.092	4917.730
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	513.589	349.932	124.488	130.420	314.875	286.131	957.374	1027.144	1387.537	5093.324
Mixed	16.156	8.464	2.586	2.710	5.850	4.295	8.727	4.743	2.728	56.011
Asian	6.746	3.520	1.117	1.171	3.817	4.452	12.291	7.461	4.298	44.708
Black	2.546	1.628	0.629	0.658	2.209	2.468	8.407	5.788	3.916	28.186
Chinese & Other	3.279	1.988	1.039	1.089	4.822	5.162	11.686	6.645	2.629	38.125
All groups	542.316	365.531	129.860	136.047	331.572	302.509	998.485	1051.781	1401.107	5260.352
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	531.128	341.444	116.896	113.044	302.615	315.854	975.576	1127.806	1583.699	5408.062
Mixed	22.287	11.160	3.129	2.494	5.353	4.066	6.756	3.107	22.180	80.531
Asian	7.854	4.497	1.402	1.525	4.434	4.710	9.578	5.139	16.417	55.556
Black	2.896	1.907	0.690	0.809	2.509	3.123	7.790	3.953	10.196	33.873
Chinese & Other	3.960	2.582	1.161	1.802	5.230	4.867	8.927	3.735	14.363	46.628
All groups	568.125	361.589	123.278	119.673	320.140	332.620	1008.626	1143.741	1646.855	5624.646

Table B5
Constraint 5 – UK and region populations by ethnic group and age, 2001, 2010 and 2020 (continued)

Inner London

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	172.485	85.866	32.122	40.439	172.219	232.825	608.171	322.009	246.167	1912.304
Mixed	32.536	14.386	4.105	2.363	7.162	10.247	14.581	4.990	14.595	104.966
Asian	55.302	32.440	12.528	8.353	23.123	29.477	66.294	24.194	39.892	291.603
Black	85.171	45.446	14.899	7.827	24.949	65.587	101.109	42.765	61.584	449.335
Chinese & Other	9.661	5.941	3.018	3.231	8.693	11.706	32.119	6.746	12.603	93.718
All groups	355.156	184.079	66.672	62.213	236.146	349.842	822.274	400.703	374.841	2851.927
Sum	355.156	184.079	66.672	62.213	236.146	349.842	822.274	400.703	374.841	2851.926
Differences	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	204.591	84.757	31.487	32.017	180.304	258.090	614.610	375.650	249.734	2031.240
Mixed	36.449	15.371	5.203	3.069	8.880	10.722	22.185	6.785	16.345	125.011
Asian	63.092	27.467	11.094	8.819	31.805	35.629	79.758	33.742	43.846	335.253
Black	73.409	38.546	15.443	9.522	26.987	45.374	157.466	54.394	57.379	478.520
Chinese & Other	12.577	5.389	2.444	3.489	17.755	16.625	36.739	12.764	16.603	124.385
All groups	390.119	171.531	65.671	56.916	265.731	366.441	910.758	483.334	383.908	3094.409
Sum	390.118	171.531	65.671	56.916	265.732	366.440	910.758	483.335	383.908	3094.409
Differences	-0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	218.049	98.913	33.830	30.458	168.555	269.631	649.856	450.618	278.984	2198.895
Mixed	39.909	17.422	5.781	3.260	9.201	11.118	26.875	10.809	19.064	143.439
Asian	70.607	33.014	11.287	8.123	28.913	39.384	90.315	51.418	50.812	383.873
Black	64.037	34.569	13.640	8.705	26.583	37.477	150.564	82.076	57.825	475.477
Chinese & Other	15.202	6.721	2.445	3.210	16.552	20.554	39.434	21.338	20.163	145.619
All groups	407.803	190.638	66.983	53.757	249.803	378.165	957.044	616.259	426.848	3347.300

Outer London

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	369.581	223.534	73.526	73.501	210.751	250.516	879.895	682.194	582.267	3345.764
Mixed	38.415	18.339	4.757	3.128	6.671	7.347	11.746	5.715	21.342	117.460
Asian	81.004	54.403	20.310	17.574	42.637	49.498	135.233	55.516	102.694	558.869
Black	58.525	32.652	10.664	7.771	20.322	33.071	54.244	25.634	57.467	300.350
Chinese & Other	12.406	7.999	3.273	3.031	7.911	9.898	27.336	6.291	17.843	95.988
All groups	559.931	336.927	112.530	105.004	288.292	350.330	1108.453	775.350	781.614	4418.430
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	344.729	197.658	74.966	61.783	200.675	252.696	791.275	730.198	574.566	3228.546
Mixed	48.130	22.763	7.259	5.067	11.671	9.777	18.987	7.687	29.751	161.093
Asian	93.611	49.637	20.089	20.207	68.780	65.032	171.015	84.337	131.703	704.410
Black	72.665	37.934	13.460	11.830	35.684	40.270	95.763	37.494	80.020	425.120
Chinese & Other	18.849	9.429	3.846	4.787	19.180	17.274	39.528	13.360	30.113	156.365
All groups	577.984	317.422	119.619	103.673	335.990	385.049	1116.566	873.075	846.154	4675.532
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	328.278	189.051	68.101	53.745	185.440	244.426	746.438	773.527	609.995	3199.000
Mixed	59.220	27.292	8.466	5.446	13.101	12.114	25.736	11.402	39.457	202.233
Asian	107.212	57.458	19.951	17.806	63.645	78.595	192.953	130.412	165.945	833.977
Black	81.228	44.569	15.575	11.975	36.683	46.677	125.075	60.921	104.585	527.288
Chinese & Other	23.250	12.334	4.365	4.490	18.106	22.628	48.513	24.299	40.826	198.811
All groups	599.187	330.706	116.457	93.462	316.976	404.440	1138.715	1000.562	960.806	4961.312

Table B5
Constraint 5 – UK and region populations by ethnic group and age, 2001, 2010 and 2020 (continued)

Scotland

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	563.564	377.458	101.024	142.746	305.626	307.986	1149.310	973.282	1047.265	4968.260
Mixed	2.891	1.466	0.320	0.448	0.715	0.386	0.618	0.252	1.906	9.003
Asian	10.790	6.227	1.784	2.978	5.550	3.866	8.138	3.581	12.306	55.221
Black	2.478	1.423	0.401	0.669	1.400	1.254	1.971	0.954	3.174	13.724
Chinese & Other	2.352	1.725	0.654	1.203	2.081	1.355	3.258	1.169	4.080	17.876
All groups	582.074	388.300	104.183	148.043	315.372	314.847	1163.296	979.238	1068.732	5064.086
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	507.419	334.200	108.755	143.567	334.082	317.050	998.085	1078.885	1181.851	5003.893
Mixed	3.620	1.777	0.473	0.532	1.035	0.665	0.890	0.357	2.852	12.202
Asian	11.793	6.561	1.874	2.445	6.280	5.339	10.312	5.169	15.957	65.730
Black	2.471	1.504	0.439	0.554	1.425	1.457	3.106	1.288	3.990	16.233
Chinese & Other	2.386	1.415	0.452	0.750	2.405	1.895	4.067	1.837	4.988	20.195
All groups	527.688	345.458	111.992	147.848	345.227	326.406	1016.460	1087.537	1209.638	5118.254
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	492.026	305.640	94.135	114.954	296.272	316.319	925.435	1072.440	1377.449	4994.670
Mixed	4.706	2.255	0.552	0.562	1.167	0.915	1.381	0.569	4.330	16.437
Asian	12.283	7.146	1.996	2.261	5.394	5.705	12.600	7.763	20.999	76.148
Black	2.337	1.469	0.442	0.515	1.260	1.374	3.915	1.985	5.089	18.386
Chinese & Other	2.256	1.455	0.427	0.573	1.604	2.074	4.469	2.960	6.276	22.093
All groups	513.608	317.965	97.553	118.864	305.695	326.386	947.801	1085.719	1414.143	5127.734

Wales

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	339.679	227.450	69.967	71.900	164.441	160.817	598.072	566.386	644.828	2843.540
Mixed	5.213	3.003	0.753	0.604	1.067	0.794	1.550	0.961	4.008	17.953
Asian	4.659	2.729	0.971	1.115	2.429	1.567	3.544	1.787	5.775	24.575
Black	0.936	0.561	0.224	0.247	0.538	0.538	1.013	0.947	1.604	6.607
Chinese & Other	1.428	1.011	0.396	0.567	1.106	0.923	1.784	0.618	2.588	10.419
All groups	351.913	234.753	72.311	74.433	169.582	164.640	605.962	570.698	658.803	2903.096
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	309.852	207.990	79.147	75.346	195.137	177.905	549.041	598.334	745.532	2938.284
Mixed	6.593	3.438	1.138	0.984	2.078	1.238	2.266	1.177	6.192	25.105
Asian	5.696	3.007	1.003	1.076	3.224	2.519	4.460	2.463	8.109	31.557
Black	1.235	0.713	0.245	0.317	1.006	0.862	1.680	1.034	2.512	9.604
Chinese & Other	2.378	1.287	0.518	0.884	3.211	2.129	3.526	1.037	5.444	20.413
All groups	325.753	216.436	82.051	78.606	204.656	184.653	560.974	604.046	767.789	3024.964
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	317.592	194.263	69.687	61.579	179.645	187.963	554.919	618.601	857.860	3042.109
Mixed	8.732	4.305	1.277	0.946	2.262	1.804	3.101	1.643	8.895	32.966
Asian	6.385	3.552	1.148	0.996	2.852	2.965	5.965	3.521	10.743	38.125
Black	1.459	0.854	0.294	0.299	0.917	1.067	2.394	1.307	3.457	12.049
Chinese & Other	3.083	1.780	0.622	0.816	2.944	3.067	5.382	2.079	8.228	28.003
All groups	337.250	204.754	73.028	64.636	188.620	196.866	571.761	627.151	889.183	3153.249

Table B5
Constraint 5 – UK and region populations by ethnic group and age, 2001, 2010 and 2020 (continued)

Northern Ireland

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	235.034	158.134	55.764	46.111	109.270	113.823	374.189	289.643	295.463	1677.432
Mixed	1.151	0.580	0.157	0.094	0.190	0.164	0.236	0.178	0.589	3.338
Asian	0.457	0.219	0.061	0.068	0.271	0.228	0.545	0.282	0.473	2.603
Black	0.164	0.094	0.032	0.049	0.121	0.103	0.162	0.107	0.199	1.031
Chinese & Other	0.797	0.521	0.186	0.242	0.533	0.532	0.827	0.278	0.960	4.875
All groups	237.602	159.548	56.199	46.564	110.384	114.850	375.960	290.487	297.685	1689.279
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	214.604	141.630	56.177	43.241	127.889	120.671	353.988	335.137	350.296	1743.633
Mixed	1.488	0.748	0.240	0.149	0.346	0.242	0.377	0.214	0.947	4.750
Asian	0.341	0.210	0.070	0.037	0.163	0.212	0.469	0.359	0.478	2.340
Black	0.245	0.123	0.044	0.046	0.194	0.184	0.260	0.144	0.341	1.579
Chinese & Other	1.200	0.643	0.261	0.281	1.256	1.034	1.561	0.554	1.885	8.675
All groups	217.877	143.355	56.792	43.755	129.848	122.342	356.655	336.407	353.947	1760.978
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	212.430	129.190	49.937	35.480	112.207	118.942	356.285	361.330	426.094	1801.895
Mixed	1.928	0.923	0.294	0.162	0.374	0.305	0.558	0.269	1.433	6.246
Asian	0.309	0.178	0.062	0.034	0.142	0.187	0.447	0.367	0.543	2.269
Black	0.270	0.153	0.052	0.045	0.171	0.198	0.385	0.183	0.480	1.937
Chinese & Other	1.574	0.887	0.311	0.277	1.163	1.378	2.567	0.968	3.058	12.182
All groups	216.510	131.330	50.656	35.996	114.057	121.010	360.241	363.117	431.608	1824.525

United Kingdom

2001	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	6321.552	4137.791	1222.458	1347.929	3177.048	3512.271	12624.944	10808.890	11273.090	54425.974
Mixed	223.357	113.124	26.707	22.798	42.197	33.189	48.491	25.225	140.430	675.518
Asian	418.898	250.580	84.490	97.325	204.661	155.435	371.939	176.572	486.550	2246.450
Black	190.566	109.431	33.232	33.953	82.564	105.426	155.764	106.197	239.177	1056.309
Chinese & Other	52.061	37.261	17.139	23.509	48.207	38.656	90.150	27.357	98.082	432.423
All groups	7206.434	4648.187	1384.026	1525.514	3554.677	3844.978	13291.288	11144.242	12237.328	58836.674
2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	5866.304	3768.422	1372.346	1375.736	3575.258	3648.854	11727.720	11684.309	12655.711	55674.660
Mixed	290.526	137.965	42.004	37.987	78.824	50.564	80.405	32.026	218.006	968.308
Asian	504.557	256.565	86.736	102.349	305.812	233.915	473.532	237.401	670.902	2871.769
Black	202.341	109.420	38.655	46.532	126.428	123.201	270.178	121.198	321.489	1359.443
Chinese & Other	81.663	40.707	16.966	33.925	122.488	80.457	139.024	47.996	181.884	745.110
All groups	6945.393	4313.079	1556.708	1596.530	4208.811	4136.991	12690.859	12122.929	14047.993	61619.293
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	5852.715	3591.251	1232.020	1155.601	3303.283	3744.197	11409.727	12420.796	14398.824	57108.416
Mixed	390.300	179.635	50.351	39.460	89.136	71.581	118.756	47.776	318.733	1305.727
Asian	580.623	312.622	94.771	94.273	274.367	290.818	586.542	352.608	892.220	3478.843
Black	210.460	118.527	41.940	42.258	121.811	136.628	347.635	164.471	409.330	1593.058
Chinese & Other	101.882	55.397	19.828	30.647	111.014	112.204	189.129	83.560	259.368	963.029
All groups	7135.980	4257.431	1438.910	1362.240	3899.611	4355.427	12651.789	13069.211	16278.475	64449.074

Table B6
Constraint 6 – Projected UK and region populations by number of employed adults in household

Population in 1000s at mid year

2001		Not in hsld	0 earners	1 earner	2 earners	3+ earners	Total
GOR/Country	Value	-9	0	1	2	3	
North East	101	42.791	767.429	642.863	828.815	226.631	2508.531
North West	102	115.191	1886.957	1762.236	2302.480	672.634	6739.501
Yorks & Humb	103	84.290	1339.471	1283.299	1764.884	478.326	4950.271
East Midlands	104	78.288	1035.580	1086.579	1558.866	406.205	4165.518
West Midlands	105	82.617	1371.588	1386.402	1873.686	546.990	5261.282
East	106	91.823	1211.858	1453.368	2047.488	574.492	5379.029
South East	107	192.293	1705.303	2151.989	3065.912	872.502	7987.997
South West	108	115.919	1233.297	1282.731	1805.149	480.634	4917.730
Inner London	109	49.695	787.119	940.767	779.515	294.831	2851.926
Outer London	110	46.593	1000.118	1274.190	1535.138	562.392	4418.431
Scotland	111	87.161	1398.590	1326.376	1741.688	510.270	5064.085
Wales	112	43.268	866.836	766.954	969.213	256.825	2903.095
Northern Ireland	113	25.773	426.360	462.129	573.174	201.842	1689.279
United Kingdom	Total	1056.014	15030.612	15812.632	20853.464	6083.952	58836.675

2010		Not in hsld	0 earners	1 earner	2 earners	3+ earners	Total
GOR/Country	Value	-9	0	1	2	3	
North East	101	43.274	772.559	651.436	839.867	229.653	2536.787
North West	102	118.308	1928.910	1813.315	2369.219	692.131	6921.885
Yorks & Humb	103	87.573	1385.013	1335.696	1836.944	497.856	5143.082
East Midlands	104	83.436	1098.262	1159.960	1664.142	433.638	4439.437
West Midlands	105	85.474	1412.169	1436.851	1941.866	566.894	5443.254
East	106	98.254	1290.176	1557.514	2194.208	615.659	5755.812
South East	107	203.283	1793.512	2278.254	3245.801	923.695	8444.545
South West	108	123.996	1312.778	1374.416	1934.175	514.988	5260.353
Inner London	109	53.920	850.006	1022.640	847.354	320.489	3094.409
Outer London	110	49.305	1052.949	1350.361	1626.907	596.011	4675.532
Scotland	111	88.093	1406.868	1343.041	1763.570	516.681	5118.254
Wales	112	45.084	899.086	800.743	1011.913	268.139	3024.964
Northern Ireland	113	26.867	442.283	482.556	598.509	210.764	1760.978
United Kingdom	Total	1105.957	15664.911	16588.792	21877.052	6382.581	61619.293

2020		Not in hsld	0 earners	1 earner	2 earners	3+ earners	Total
GOR/Country	Value	-9	0	1	2	3	
North East	101	43.224	785.374	645.498	832.214	227.560	2533.869
North West	102	121.315	2014.413	1845.818	2411.686	704.538	7097.770
Yorks & Humb	103	90.706	1461.381	1373.715	1889.230	512.026	5327.059
East Midlands	104	88.157	1182.762	1217.625	1746.872	455.195	4690.613
West Midlands	105	88.355	1487.450	1475.186	1993.675	582.019	5626.684
East	106	105.332	1410.638	1659.884	2338.426	656.124	6170.405
South East	107	215.786	1942.235	2404.799	3426.088	975.002	8963.909
South West	108	132.583	1430.614	1459.920	2054.502	547.026	5624.646
Inner London	109	58.327	936.530	1098.252	910.006	344.186	3347.300
Outer London	110	52.318	1139.561	1424.488	1716.216	628.729	4961.312
Scotland	111	88.257	1435.617	1335.838	1754.111	513.911	5127.734
Wales	112	46.997	954.057	828.219	1046.636	277.340	3153.249
Northern Ireland	113	27.837	467.040	496.683	616.032	216.934	1824.525
United Kingdom	Total	1156.747	16697.154	17234.889	22729.115	6631.169	64449.074

Table B7
Constraint 7 – Projected UK and region populations by tenure

Population in 1000s at mid year

2001		Not in hlsd	Owns	Social rent	Private rent	Total
GOR/Country	Value	-9	1	2	3	
North East	101	42.695	1661.919	605.063	198.852	2508.530
North West	102	114.871	4819.332	1184.067	621.229	6739.499
Yorks & Humb	103	84.066	3448.075	918.199	499.929	4950.270
East Midlands	104	77.969	3066.070	650.562	370.917	4165.518
West Midlands	105	82.233	3773.903	964.495	440.652	5261.283
East	106	91.536	3984.030	810.068	493.395	5379.029
South East	107	191.751	5909.390	1038.849	848.008	7987.998
South West	108	115.441	3601.798	622.194	578.297	4917.730
Inner London	109	48.868	1116.533	1079.605	606.920	2851.927
Outer London	110	46.080	3062.296	744.752	565.302	4418.430
Scotland	111	86.977	3305.558	1212.278	459.274	5064.086
Wales	112	43.140	2108.433	472.974	278.549	2903.096
Northern Ireland	113	25.645	1236.064	300.353	127.217	1689.279
United Kingdom	Total	1051.272	41093.401	10603.459	6088.542	58836.674

2010		Not in hlsd	Owns	Social rent	Private rent	Total
GOR/Country	Value	-9	1	2	3	
North East	101	43.176	1754.288	491.989	247.334	2536.787
North West	102	117.979	4929.266	1001.631	873.009	6921.885
Yorks & Humb	103	87.341	3597.510	781.094	677.138	5143.082
East Midlands	104	83.096	3294.613	575.922	485.807	4439.437
West Midlands	105	85.077	3927.321	812.537	618.319	5443.254
East	106	97.947	4317.801	725.001	615.063	5755.812
South East	107	202.710	6227.554	964.784	1049.496	8444.545
South West	108	123.485	3832.896	559.641	744.332	5260.353
Inner London	109	53.023	611.755	1807.350	622.281	3094.409
Outer London	110	48.761	3609.535	355.368	661.869	4675.532
Scotland	111	87.907	3633.174	781.982	615.191	5118.254
Wales	112	44.952	2183.122	414.933	381.959	3024.964
Northern Ireland	113	26.734	1318.205	267.391	148.648	1760.978
United Kingdom	Total	1102.294	43242.300	9534.880	7739.820	61619.293

2020		Not in hlsd	Owns	Social rent	Private rent	Total
GOR/Country	Value	-9	1	2	3	
North East	101	43.127	1824.632	373.627	292.484	2533.869
North West	102	120.977	5034.220	814.599	1127.974	7097.770
Yorks & Humb	103	90.465	3741.067	639.196	856.332	5327.059
East Midlands	104	87.797	3506.563	497.088	599.165	4690.613
West Midlands	105	87.944	4081.722	661.378	795.642	5626.684
East	106	105.002	4681.157	641.525	742.720	6170.405
South East	107	215.177	6591.562	894.611	1262.558	8963.909
South West	108	132.035	4079.450	497.623	915.537	5624.646
Inner London	109	57.357	198.988	2445.786	645.169	3347.300
Outer London	110	51.742	4077.137	87.498	744.935	4961.312
Scotland	111	88.070	3879.098	420.647	739.920	5127.734
Wales	112	46.857	2262.335	357.168	486.889	3153.249
Northern Ireland	113	27.699	1399.677	224.823	172.326	1824.525
United Kingdom	total	1154.500	45362.195	8551.765	9380.612	64449.074

Appendix C

IPF results summary

Table C1
Totals to compare with Constraint 1 – UK and region populations by age, 2010 and 2020

Population in 1000s at mid year

2010		0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	sum
GOR/Country	Value	1	2	3	4	5	6	7	8	9	
North East	101	265.685	177.278	63.841	71.109	177.599	155.412	477.866	533.323	614.432	2536.546
North West	102	780.035	492.520	183.178	184.251	486.164	458.961	1362.809	1377.961	1596.006	6921.884
Yorks & Humb	103	575.552	368.205	128.761	149.672	378.206	336.398	1008.065	1012.366	1185.853	5143.079
East Midlands	104	488.511	313.557	111.970	121.077	297.267	268.827	888.977	891.135	1058.116	4439.437
West Midlands	105	637.870	393.389	139.720	147.339	369.064	344.195	1087.223	1062.158	1262.295	5443.253
East	106	660.870	410.746	145.979	138.726	344.618	356.357	1177.977	1131.505	1389.033	5755.812
South East	107	955.134	597.652	216.715	216.685	542.864	529.442	1728.041	1678.298	1979.714	8444.544
South West	108	542.316	365.531	130.418	136.631	331.573	302.508	998.486	1051.780	1401.108	5260.353
Inner London	109	390.118	171.531	65.671	56.916	265.732	366.440	910.758	483.335	383.908	3094.409
Outer London	110	577.984	317.422	119.620	103.673	335.990	385.048	1116.568	873.076	846.154	4675.535
Scotland	111	527.689	345.458	111.992	147.848	345.227	326.406	1016.460	1087.537	1209.638	5118.255
Wales	112	325.753	216.435	82.051	78.606	204.656	184.653	560.974	604.046	767.789	3024.964
Northern Ireland	113	215.803	0.643	0.261	0.281	1.256	1.034	1.561	0.554	1.885	223.279
United Kingdom	Total	6943.319	4170.367	1500.178	1552.815	4080.218	4015.683	12335.765	11787.073	13695.931	60081.349

2020		0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	sum
GOR/Country	Value	1	2	3	4	5	6	7	8	9	
North East	101	258.109	163.051	54.317	56.022	156.600	157.552	454.020	524.693	709.285	2533.649
North West	102	792.614	475.809	161.267	150.302	431.210	478.321	1352.984	1442.455	1812.807	7097.769
Yorks & Humb	103	595.711	356.205	115.150	123.995	345.764	355.598	1004.396	1071.702	1358.533	5327.055
East Midlands	104	506.100	311.774	103.484	103.684	277.061	287.385	869.664	978.442	1253.017	4690.611
West Midlands	105	653.956	389.094	128.283	125.350	337.188	360.132	1054.017	1150.018	1428.644	5626.681
East	106	693.194	420.203	142.287	125.273	335.351	383.214	1188.130	1242.483	1640.272	6170.406
South East	107	993.809	604.313	206.168	191.003	521.146	573.739	1744.387	1822.872	2306.474	8963.911
South West	108	568.125	361.590	123.278	119.673	320.141	332.620	1008.627	1143.741	1646.855	5624.649
Inner London	109	407.804	190.638	66.983	53.756	249.804	378.164	957.044	616.259	426.848	3347.302
Outer London	110	599.187	330.705	116.458	93.462	316.975	404.440	1138.715	1000.560	960.807	4961.309
Scotland	111	513.609	317.964	97.553	118.865	305.696	326.386	947.800	1085.718	1414.143	5127.734
Wales	112	337.251	204.754	73.028	64.636	188.620	196.866	571.762	627.151	889.183	3153.251
Northern Ireland	113	214.003	0.887	0.311	0.277	1.163	1.378	2.567	0.968	3.058	224.611
United Kingdom	Total	7133.473	4126.985	1388.566	1326.298	3786.720	4235.795	12294.113	12707.061	15849.925	62848.938

Table C2
Totals to compare with Constraint 2 – UK and region populations by number of dependent children, 2010 and 2020

Population in 1000s at mid year

2010		0 children	1 child	2 children	3+ children	sum
GOR/Country	Value	0	1	2	3	
North East	101	1451.894	385.704	470.734	228.215	2536.546
North West	102	3905.375	992.591	1287.121	736.797	6921.884
Yorks & Humb	103	2944.952	709.547	961.617	526.963	5143.079
East Midlands	104	2586.076	590.480	833.036	429.844	4439.437
West Midlands	105	3075.756	757.407	1009.393	600.697	5443.253
East	106	3351.321	724.282	1095.971	584.237	5755.812
South East	107	4931.333	1061.637	1598.568	853.007	8444.544
South West	108	3205.686	638.367	933.974	482.326	5260.353
Inner London	109	1897.253	410.236	433.595	353.326	3094.409
Outer London	110	2556.323	665.879	904.127	549.205	4675.535
Scotland	111	3106.660	722.277	785.804	503.514	5118.255
Wales	112	1732.589	427.383	557.050	307.941	3024.964
Northern Ireland	113	5.729	85.191	86.065	46.294	223.279
United Kingdom	Total	34750.948	8170.981	10957.053	6202.366	60081.349

2020		0 children	1 child	2 children	3+ children	sum
GOR/Country	Value	0	1	2	3	
North East	101	1437.556	385.503	474.467	236.123	2533.649
North West	102	3982.209	1014.088	1323.089	778.382	7097.769
Yorks & Humb	103	3035.267	731.991	998.059	561.739	5327.055
East Midlands	104	2716.208	622.461	883.846	468.096	4690.611
West Midlands	105	3164.379	779.430	1044.217	638.654	5626.681
East	106	3572.779	773.932	1178.542	645.152	6170.406
South East	107	5208.776	1122.542	1700.704	931.888	8963.911
South West	108	3413.342	680.150	1000.916	530.242	5624.649
Inner London	109	2046.415	441.222	467.673	391.993	3347.302
Outer London	110	2704.517	701.316	957.227	598.249	4961.309
Scotland	111	3083.133	725.771	795.058	523.771	5127.734
Wales	112	1797.907	443.702	581.555	330.088	3153.251
Northern Ireland	113	6.568	90.258	85.225	42.560	224.611
United Kingdom	total	36169.055	8512.366	11490.578	6676.939	62848.938

Table C3
Totals to compare with Constraint 3 – UK and region populations by family type, 2010 and 2020

Population in 1000s at mid year

2010		Not in a family	Lone Parent	Married Couple	Cohabiting Couple	One person	Other multi-person	sum
GOR/Country	Value	-9	1	2	3	4	5	
North East	101	44.071	219.112	1407.477	261.679	359.052	245.154	2536.546
North West	102	120.160	650.027	3717.424	817.894	881.826	734.554	6921.884
Yorks & Humb	103	89.470	405.963	2839.360	688.114	613.017	507.155	5143.079
East Midlands	104	84.771	292.463	2555.663	602.578	493.218	410.743	4439.437
West Midlands	105	86.577	431.810	3035.172	703.401	638.936	547.357	5443.253
East	106	99.886	333.773	3341.834	783.692	651.093	545.533	5755.812
South East	107	207.721	482.358	4698.296	1242.189	940.004	873.977	8444.544
South West	108	126.913	297.878	3025.140	682.684	591.673	536.065	5260.353
Inner London	109	54.360	335.289	1166.456	582.996	470.100	485.209	3094.409
Outer London	110	50.607	523.733	1822.285	910.882	609.842	758.187	4675.535
Scotland	111	91.662	459.453	1928.207	300.268	640.542	1698.123	5118.255
Wales	112	45.948	164.599	1291.061	237.349	415.761	870.247	3024.964
Northern Ireland	113	0.212	26.844	181.117	10.230	0.770	4.105	223.279
United Kingdom	Total	1102.359	4623.301	31009.490	7823.957	7305.835	8216.407	60081.349

2020		Not in a family	Lone Parent	Married Couple	Cohabiting Couple	One person	Other multi-person	sum
GOR/Country	Value	-9	1	2	3	4	5	
North East	101	43.933	207.028	1317.066	272.970	429.069	263.583	2533.649
North West	102	123.099	643.499	3544.544	880.395	1085.347	820.884	7097.769
Yorks & Humb	103	92.289	405.073	2752.724	752.787	763.585	560.597	5327.055
East Midlands	104	89.672	295.997	2562.573	666.433	614.062	461.874	4690.611
West Midlands	105	89.248	438.763	2927.647	772.697	782.880	615.445	5626.681
East	106	107.324	331.335	3378.434	875.999	822.195	655.118	6170.406
South East	107	221.022	476.174	4656.035	1395.037	1175.544	1040.099	8963.911
South West	108	135.687	297.564	3053.041	757.384	745.137	635.836	5624.649
Inner London	109	58.880	356.832	1126.033	672.783	594.273	538.501	3347.302
Outer London	110	53.835	549.276	1733.308	1035.783	759.759	829.349	4961.309
Scotland	111	91.860	421.953	1770.825	275.760	770.676	1796.658	5127.734
Wales	112	50.304	153.288	1216.913	249.886	516.897	965.964	3153.251
Northern Ireland	113	0.241	16.937	188.754	12.654	1.379	4.646	224.611
United Kingdom	total	1157.394	4593.720	30227.898	8620.569	9060.803	9188.555	62848.938

Table C4
Totals to compare with Constraint 4 – UK and region populations by household size, 2010 and 2020

Population in 1000s at mid year

2010		Not applicable	No usual residents	1 person	2 persons	3 persons	4 persons	5 persons	6+ persons	sum
GOR/Country	Value	-9	0	1	2	3	4	5	6	
North East	101	43.369	0.005	359.052	776.606	496.342	500.796	242.884	242.884	2661.938
North West	102	116.630	0.017	881.826	2155.313	1377.637	1390.122	674.206	674.206	7269.958
Yorks & Humb	103	83.583	0.012	613.017	1617.906	1034.137	1043.510	506.100	506.100	5404.364
East Midlands	104	76.505	0.018	493.218	1408.044	899.995	908.147	440.450	440.450	4666.828
West Midlands	105	81.963	0.018	638.936	1718.290	1098.298	1108.247	537.498	537.498	5720.747
East	106	88.569	0.014	651.093	1825.195	1166.627	1177.197	570.937	570.937	6050.569
South East	107	180.863	0.038	940.004	2664.808	1703.292	1718.733	833.580	833.580	8874.897
South West	108	115.111	0.034	591.673	1656.867	1059.039	1068.633	518.285	518.285	5527.928
Inner London	109	53.467	0.047	470.107	935.391	597.910	603.326	292.615	292.615	3245.477
Outer London	110	48.022	0.017	609.842	1461.893	934.403	942.865	457.287	457.287	4911.614
Scotland	111	86.489	0.010	640.542	1597.802	1021.287	1030.544	499.810	499.810	5376.294
Wales	112	45.039	0.005	416.531	932.714	596.189	601.582	291.768	291.768	3175.594
Northern Ireland	113	0.208	0.000	0.770	2.290	86.648	86.316	26.259	26.259	228.749
United Kingdom	Total	1019.818	0.236	7306.611	18753.118	12071.803	12180.017	5891.678	5891.678	63114.959

2020		Not applicable	No usual residents	1 person	2 persons	3 persons	4 persons	5 persons	6+ persons	sum
GOR/Country	Value	-9	0	1	2	3	4	5	6	
North East	101	43.564	0.005	429.069	824.940	491.980	421.700	221.794	221.794	2654.845
North West	102	120.586	0.018	1085.348	2358.033	1406.467	1205.603	634.107	634.107	7444.267
Yorks & Humb	103	87.436	0.012	763.585	1791.398	1068.495	915.900	481.732	481.732	5590.291
East Midlands	104	82.022	0.019	614.062	1598.692	953.550	817.367	429.908	429.908	4925.527
West Midlands	105	85.794	0.019	782.880	1904.247	1135.805	973.597	512.079	512.079	5906.499
East	106	96.254	0.016	822.195	2101.951	1253.720	1074.661	565.236	565.236	6479.270
South East	107	194.603	0.041	1175.544	3039.193	1812.740	1553.840	817.267	817.267	9410.494
South West	108	124.846	0.037	745.137	1902.907	1135.003	972.906	511.716	511.716	5904.269
Inner London	109	58.248	0.052	594.301	1078.464	643.274	551.399	290.019	290.019	3505.778
Outer London	110	51.486	0.018	759.759	1660.980	990.667	849.174	446.639	446.639	5205.361
Scotland	111	87.405	0.010	770.676	1708.803	1019.233	873.670	459.519	459.519	5378.835
Wales	112	47.249	0.006	519.946	1034.988	617.335	529.165	278.323	278.323	3305.336
Northern Ireland	113	0.236	0.000	1.379	3.654	91.661	85.327	27.842	27.842	237.941
United Kingdom	total	1079.730	0.252	9063.881	21008.248	12619.930	10824.308	5676.182	5676.182	65948.713

Table C5
Totals to compare with selected region populations by ethnic group and age, 2010 and 2020

North East

2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	3238.823	2197.598	796.279	879.937	2165.375	1923.700	6068.443	6866.858	7705.192	31842.204
Mixed	63.857	30.608	9.192	10.395	24.595	13.378	19.197	9.458	56.573	237.254
Asian	115.610	57.826	17.479	20.983	61.680	46.571	73.219	39.105	141.531	574.003
Black	10.103	4.716	1.393	0.000	11.039	9.121	12.887	5.528	20.264	75.052
Chinese & Other	25.514	13.862	5.592	13.103	46.102	27.592	38.510	12.250	64.054	246.579
All groups	3453.906	2304.610	829.935	924.417	2308.791	2020.362	6212.255	6933.200	7987.615	32975.093
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	3091.478	1977.536	664.994	685.499	1902.699	1920.398	5690.201	6721.400	8803.783	31457.987
Mixed	84.449	41.922	11.315	10.222	24.265	19.749	29.180	13.013	86.279	320.393
Asian	135.883	74.513	21.357	20.606	57.395	57.521	104.484	55.791	203.466	731.016
Black	11.607	6.335	1.887	0.000	9.890	11.077	19.207	7.921	29.115	97.039
Chinese & Other	32.005	19.351	6.569	11.956	41.555	39.428	59.190	22.880	98.067	331.002
All groups	3355.422	2119.657	706.121	728.283	2035.804	2048.173	5902.262	6821.006	9220.710	32937.437

North West

2010	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	8798.409	5732.311	2165.172	2155.753	5590.069	5455.868	16836.226	17495.848	19219.264	83448.919
Mixed	337.280	164.449	51.622	46.565	100.551	60.711	95.838	37.810	262.597	1157.423
Asian	818.607	405.497	127.112	134.899	418.477	293.917	504.764	247.492	895.681	3846.445
Black	87.066	49.797	17.672	22.946	75.993	69.366	135.984	76.461	169.423	704.708
Chinese & Other	99.092	50.707	19.741	35.100	135.042	86.627	143.705	55.876	201.115	827.004
All groups	10140.455	6402.760	2381.319	2395.263	6320.132	5966.488	17716.516	17913.487	20748.080	89984.498
2020	0-9	10-15	16-19d	16-19n	20-24	25-29	30-44	45-59	60+	Sum
White	8633.932	5318.226	1841.129	1719.225	4950.129	5518.733	16386.836	18107.155	21406.848	83882.214
Mixed	463.480	215.600	59.426	47.205	110.922	91.931	141.803	60.053	390.421	1580.839
Asian	974.172	519.523	152.567	133.775	361.123	389.501	664.183	389.857	1237.976	4822.676
Black	103.546	60.570	19.977	21.311	67.256	87.793	192.468	99.280	233.377	885.577
Chinese & Other	128.858	71.597	23.374	32.415	116.306	130.218	203.498	95.566	297.863	1099.695
All groups	10303.987	6185.516	2096.473	1953.930	5605.735	6218.175	17588.788	18751.910	23566.485	92271.000

Table C6
Totals to compare with Constraint 6 – projected UK and region populations by number of employed adults in household

Population in 1000s at mid year

2010		Not in hsld	0 earners	1 earner	2 earners	3+ earners	Total
GOR/Country	Value	-9	0	1	2	3	
North East	101	43.374	0.000	2133.450	0.000	2176.824	43.374
North West	102	116.647	0.252	5923.411	0.000	6040.310	116.647
Yorks & Humb	103	83.594	0.413	4446.467	0.000	4530.474	83.594
East Midlands	104	76.523	493.022	3869.695	0.000	4439.241	76.523
West Midlands	105	81.982	638.011	4722.335	0.000	5442.328	81.982
East	106	88.584	651.085	5016.135	0.000	5755.803	88.584
South East	107	180.900	940.000	7323.640	0.000	8444.541	180.900
South West	108	115.145	591.437	4553.534	0.000	5260.117	115.145
Inner London	109	53.514	3039.915	0.570	0.000	3093.999	53.514
Outer London	110	48.038	610.698	4016.775	0.000	4675.512	48.038
Scotland	111	86.499	0.367	4391.214	0.000	4478.079	86.499
Wales	112	45.044	0.319	2562.698	0.000	2608.061	45.044
Northern Ireland	113	0.208	0.727	222.300	0.000	223.235	0.208
United Kingdom	Total	1020.054	6966.246	49182.225	0.000	57168.524	1020.054

2020		Not in hsld	0 earners	1 earner	2 earners	3+ earners	Total
GOR/Country	Value	-9	0	1	2	3	
North East	101	43.569	0.000	2059.976	0.000	2103.546	43.569
North West	102	120.603	0.174	5891.802	0.000	6012.579	120.603
Yorks & Humb	103	87.448	0.235	4476.022	0.000	4563.704	87.448
East Midlands	104	82.041	613.686	3994.508	0.000	4690.235	82.041
West Midlands	105	85.813	2.378	4757.988	0.000	4846.179	85.813
East	106	96.270	822.140	5251.940	0.000	6170.350	96.270
South East	107	194.643	1175.499	7593.723	0.000	8963.866	194.643
South West	108	124.883	744.585	4754.629	0.000	5624.097	124.883
Inner London	109	58.300	3288.197	0.193	0.000	3346.691	58.300
Outer London	110	51.504	760.047	4149.735	0.000	4961.287	51.504
Scotland	111	87.415	0.155	4269.642	0.000	4357.212	87.415
Wales	112	47.255	0.299	2585.473	0.000	2633.027	47.255
Northern Ireland	113	0.236	1.291	222.996	0.000	224.523	0.236
United Kingdom	Total	1079.982	7408.687	50008.629	0.000	58497.297	1079.982

Table C7
Totals to compare with Constraint 7 – projected UK and region populations by tenure

Population in 1000s at mid year

2010		Not in hlsd	Owns	Social rent	Private rent	Total
GOR/Country	Value	-9	1	2	3	
North East	101	43.369	838.694	821.012	833.470	2536.546
North West	102	116.630	2316.999	2217.308	2270.947	6921.884
Yorks & Humb	103	83.583	1733.505	1631.729	1694.262	5143.079
East Midlands	104	76.505	1491.195	1440.913	1430.824	4439.437
West Midlands	105	81.963	1825.779	1769.579	1765.932	5443.253
East	106	88.569	1928.529	1879.399	1859.315	5755.812
South East	107	180.863	2806.993	2739.464	2717.224	8444.544
South West	108	115.111	1745.653	1713.624	1685.965	5260.353
Inner London	109	53.467	1013.727	1013.748	1013.468	3094.409
Outer London	110	48.022	1556.086	1535.145	1536.282	4675.535
Scotland	111	86.489	1710.392	1638.966	1682.407	5118.255
Wales	112	45.039	1003.844	978.266	997.815	3024.964
Northern Ireland	113	0.208	101.911	44.745	76.414	223.279
United Kingdom	Total	1019.818	20073.307	19423.899	19564.325	60081.349

2020		Not in hlsd	Owns	Social rent	Private rent	Total
GOR/Country	Value	-9	1	2	3	
North East	101	43.564	836.110	821.809	832.166	2533.649
North West	102	120.586	2375.669	2271.144	2330.371	7097.769
Yorks & Humb	103	87.436	1797.915	1685.865	1755.838	5327.055
East Midlands	104	82.022	1580.480	1515.502	1512.607	4690.611
West Midlands	105	85.794	1906.960	1786.617	1847.310	5626.681
East	106	96.254	2072.225	2005.128	1996.799	6170.406
South East	107	194.603	2984.323	2895.024	2889.961	8963.911
South West	108	124.846	1868.773	1826.800	1804.230	5624.649
Inner London	109	58.248	1096.403	1096.449	1096.201	3347.302
Outer London	110	51.486	1652.185	1626.623	1631.015	4961.309
Scotland	111	87.405	1713.262	1640.265	1686.801	5127.734
Wales	112	47.249	1044.887	1021.245	1039.870	3153.251
Northern Ireland	113	0.236	107.281	42.518	74.576	224.611
United Kingdom	Total	1079.730	21036.473	20234.990	20497.746	62848.938

Appendix D

Extract from ODPM household projections report – technical annex

Source: http://www.gro-scotland.gov.uk/files/harg0007652.pdf.
Annex A - Definitions and Concepts

A **household** is defined as in the 1981 and 1991 census as:
- One person living alone, or
- A group of people who share common housekeeping or a living room.

This differs from the definition used in the 1971 and earlier censuses. Previously, people who catered separately were to be counted as separate households even if they shared a living room. For example, three people each with a room of their own and catering separately, but sharing a sitting room or living room would, under the 1971 census definition, have been counted as three 'one person households', but would in 1981 and 1991 be counted as one 'other multi-person household'.

A **family** is defined as in the 1991 census as:
a) a married couple with or without their never married child(ren) including childless married couples (**married couple families**);
b) a cohabiting couple with or without their never married child(ren) including childless cohabiting couples (**cohabiting couple families**);
c) a father or mother together with his or her never married child(ren) (**lone parent families)**; or
d) grandparent(s) with grandchild(ren) if there are no apparent parents of the grandchild(ren) usually resident in the household.

Families of type (d) are classified as a married couple family, cohabiting couple family or lone parent family as appropriate. This definition differs from that used in the 1981 and earlier censuses in its inclusion of cohabiting couple families. In the context of the household projections, the term 'child' is taken to refer only to a dependent child, that is one aged 0 -15; or aged 16 - 18, never married and in full time education. A lone parent living with his/her non-dependent children (only) would not therefore constitute a lone parent family. This contrasts with the 1989-based and earlier projections where the 'children' could be of any age. It should be noted that the terms 'household' and 'family' are not synonymous. A household may contain no families (for example one person

living alone, or a household of unrelated, non cohabiting adults), or it may consist of one or more families with or without additional non family members.

Households are sub divided into five **household types**:
a) **Married couple household**: a household which contains one or more married couple families;
b) **Cohabiting couple household**: a household which contains one or more cohabiting couple families, but no married couple families;
c) **Lone parent household**: a household which contains one or more lone parent families, but no married couple or cohabiting couple families;
d) **Other multi person household**: a multi person household that is neither a married couple household nor a cohabiting couple household nor a lone parent household. Examples include, lone parents with only non dependent children, brothers and sisters and unrelated (and non-cohabiting) adults sharing a house or flat;
e) **One person household**: a person living alone who shares neither housekeeping nor a livingroom with anyone else.

The definitions (a), (b), (c) and (d) are as in the 1992-based projections, but differ from earlier projections. The category of ‘married couple household’ includes households which contain a married couple but in which an individual other than the husband and wife was recorded as the head of household by the census. An example would be a married couple living with an elderly relative, where the relative was entered first on the census form, for instance because he or she owned the house. The definition of ‘lone parent household’ is restricted to exclude lone parents with only non-dependent children: in most contexts, the interest in lone parents is in lone parents with dependent children. Lone parents with only non-dependent children belong to the ‘other multi- person household’ category. Cohabiting couples are distinguished as a separate household type. Before the 1992-based projections, cohabiting couples were included among lone parent households and ‘other households’ (now called ‘other multi-person households’) according to whether the household included children and whose children they were. The definition of ‘one person households’ is the same as in all previous projections.

The **household membership** variable has eleven categories. All household members are classified to one (and only one) of these categories:

a) **Married couple household representative**: the eldest married couple husband in the household;
b) **Cohabiting couple household representative**: the eldest male cohabiter in a cohabiting couple household;
c) **Lone parent household representative**: the eldest male lone parent in a lone parent household, if any; the eldest female lone parent if not.
d) **Other multi-person household representative**:
i. in an other multi person household containing a lone parent (of non-dependent children only), the eldest lone parent if any; the eldest female lone parent if not; or
ii. in an other multi-person household containing no lone parents, the eldest male, if any; the eldest female if not.
e) **One person household representative**;
f) **Husband in a concealed married couple family**: any husband in a married couple family who is not included in (a);
g) **Male cohabiter in a concealed cohabiting family**: any cohabiting male who is not included in (b);
h) **Parent in a concealed lone parent family**: any lone parent who is not included in (c);
i) **Wife in married couple family**;
j) **Female cohabiter**;
k) **Other individual**.