METHODOLOGY FOR 2002-BASED HOUSEHOLD PROJECTIONS FOR SCOTLAND

1 Introduction

Household projections are produced approximately every two years, in line with the biennial population projections. Their purpose is to give an indication of possible future numbers of households if trends observed in past Censuses continue. It is important to acknowledge that projections are not definitive forecasts. Household projections are the outcome of calculating what happens to the number of households if certain assumptions are made about future population growth and patterns of household formation.

2 Method used for 2002-based household projections

2.1 Population projections

The first main inputs to the projection of households are the 2002-based population projections for Scotland produced by the General Register Office for Scotland (GRO(S)). These are produced for Scotland by local authority and age group using assumptions about births, deaths and migrations (see the publication *Population Projections (2002-based)* for further information on the assumptions used (www.gro-scotland.gov.uk)). The relevant population for household formation is taken to be the adult population, aged 16 or over.

The projected number of households is derived from projections of the numbers of adults living in private households. To obtain this from the population data, estimates of the numbers living in communal establishments have been subtracted from the total adult population for each projection year. The 2001 Census was used to calculate proportions of the population living in a communal establishment and these were applied to the GROS population projections. (Note that the methodology assumes constant proportions for each of the 14 projection years.)

2.2 Household composition

The second main input to the household projections is the information on the number of households from the 1991 and 2001 population Censuses. This information is available for each combination of age group, household type and area within Scotland.

Household types were classified in terms of the number of adults and children in a household (for example, one adult with two or more children). Relationships between persons in the household were not distinguished. The proportions of households by local authority area, household type, and age group of the head of household are known for each of the 1991 and 2001 Census years. The proportions of each household type sum to one within each age group within each local authority area.

An example of the Dumfries and Galloway 2001 Census data for persons aged 35 to 44 years old is given below.

Table 1: Number and proportion of heads of households aged 35-44 by household type: Dumfries and Galloway 2001

	Number	Proportion
1 adult: male	1,279	0.059
1 adult: female	673	0.031
2 adults	1,585	0.073
1 adult + 1 child	533	0.025
3+ adults	545	0.025
1 adult, 2+ children	687	0.032
2+ adults, 1+ children	6,587	0.304
Persons who are not a head of household	9,809	0.452
Total persons in age group	**21,698**	**1.000**

Source: 2001 Census

The number of persons who head particular household types will be the same as the number of households of this type. The proportion of these within any particular age group and local authority area are known as the headship rates and it is these that are projected forwards then applied to GRO(S) population projections (by age group and local authority area) to give the household projections.

We also know the residual number of persons who are in each area and age group but who are not the head of household. This allows both the 'headship' and 'non-headship' rates to be projected to avoid the theoretical possibility of negative 'non-headship' rates. This improvement was recommended from the research done by the Centre for Housing Research and Urban Studies at the University of Glasgow, on viable alternatives for the method of projecting headship rates (see section 3) and was also used in the 1994, 1996, 1998 and 2000-based projections. Previously, projected 'non-headship' rates were calculated as the residual for each group when projected headship rates were subtracted from 1.

These headship (and non-headship) rates were then projected forward using the modified two-point exponential model, the formula for which is as follows:

$$y_i = k + a \times (b^{xi})$$

where
i is each projection year, from 2002 to 2016
y_i = headship rate in year i
y_{1991} = headship rate for Census year 1991
y_{2001} = headship rate for Census year 2001
x_i = $(i - 1991)/(2001-1991)$
k = 1 if $y_{2001} >= y_{1991}$
0 if $y_{2001} <= y_{1991}$
a = $y_{1991} - k$
b = $(y_{2001} - k)/(y_{1991} - k)$

The projected headship (and non-headship) rates are constrained in two ways

- they cannot individually go above 1 or below 0
- they sum to 1 within an area and household type.

The household projections are then calculated by applying these projected headship rates to the population projections to give an estimate of the number of heads of household in each of the projection years for each household type, age group of head of household and area.

These figures are then controlled, so that figures for the structure plan areas sum to the figure for Scotland, and figures for local authorities sum to the total for their structure plan area.

Figures are then adjusted, so that the total number of households within each local authority for the base projection year (2002) equals the 2002 household estimate produced by the Scottish Executive. Any adjustments required to bring the figures for the base projection year into line with the household estimate for that year are then applied to the figures for the other projection years to preserve the trends.

Finally the figures are adjusted to ensure that the minimum number of adults required to fill the projected households (i.e. a minimum of 2 adults would live in the household type '2 or more adults') are not greater than the projected adult private household population. The Household Analyses Review Group (HARG) considered this an important adjustment because the GROS population projections (from which the private household populations are derived) are the primary input into the household projections, and therefore they should tie up.

3 Changes in earlier methods

Prior to the production of the 1994-based household projections, the (then) Scottish Office, commissioned research from the Centre for Housing Research and Urban Studies (CHRUS) at the University of Glasgow to review alternative methods for projecting household headship rates. They considered whether or not there were viable alternatives to the cross sectional, headship rate based approach used at the time.

They concluded that there was no alternative due to the absence of suitable information on which to base dynamic models which take into account transitions between different household types. However they also concluded that there was scope for improvement within the existing approach. The following recommended improvements were incorporated into the 1994-based and subsequent projections.

Firstly, as mentioned in section 2.2, both headship and non-headship rates were projected to avoid the theoretical possibility of negative 'non-headship' rates. Other changes related to changes in the categories of household type, largely due to lack of census information on relationships within households. The decision was taken to only identify the numbers of adults and children within a household, so a 'lone parent' would not be identified as such, but would be included in the categories which have one adult with child(ren). In addition, the sex of the head of household would be restricted to one person households. More detailed information on these changes can be found in *1996-based Household Projections for Scotland* (HSG/1998/5 www.scotland.gov.uk/library/stats-w/hsg5-00.htm).

For the 2002-based projections, we have been able to update our headship rates using data from the 2001 Census. These have been used with 1991 headship rates to give a more up to date set of headship rate projections.

4. Alternative methods

Headship information – covering the household categories for which we currently project - is available from the 2001 Census on two different bases:

- Head of Household: This is from special analyses provided by GRO(S) and is the equivalent for 2001 of the basis on which headship information was supplied for previous Censuses.
- Household Reference Person: This is a new form of analysis of headship information used in 2001. Rates calculated on this basis are generally referred to as 'household representative rates'.

In projecting trends in household formation patterns it is important that household formation rates on any basis are, as far as possible, calculated on a consistent basis from 1991 and 2001 Census information. The 'household reference person' concept was introduced in the Census for the first time in 2001. For 1991, the information about the relationship between members of the household needed to identify the household reference person was coded for only 10% of Census records. Thus the 1991 household representative rates for each council are supplied in a specially commissioned analysis from GRO(S) based on the 10% sample.

From discussions in the Household Analysis Review Group, it was agreed that we would compare projections using headship calculated on both concepts – with headship in each case projected from 1991 to 2001 change using the 'standard' two point exponential methodology described above. A detailed comparison of the outcomes of the two variants presented to the Household Analysis Review Group is summarised below. The full paper is available at http://www.scotland.gov.uk/about/DD/EAS/00014635/Meet7Paper20049.pdf

Comparison of projections based on head of household and household reference person

Table 2 shows the projected growth in the number of households between 2002 and 2016 from the two variants by council. The main points are:-

- For Scotland as a whole, both sets project significantly lower rate of household growth than the 2000 based projections – around 12th – 13th households a year compared with 18th households a year in the 2000-based projections.
- The lower growth reflects the combined effects of lower projected growth in the population and more modest change in household formation patterns measured between the 1991 and 2001 Censuses.
- Generally the head of household basis gives lower growth than household reference person.
- For all but one council, the general pattern of growth is the same in both sets of projections
- However, for Clackmannanshire, projected growth using the household reference person base is significantly lower than using the head of household base.

Table 2: Comparison of projected household growth

	Projected % change in number of households from 2002 to 2016 on the basis of	
Council	**Household reference person**	**Head of household**
Aberdeen City	*2.2*	*1.0*
Aberdeenshire	*9.1*	*8.5*
Angus	*2.0*	*0.9*
Argyll & Bute	*5.6*	*5.1*
Clackmannanshire	*3.0*	*7.2*
Dumfries & Galloway	*3.8*	*3.9*
Dundee City	*-5.0*	*-5.1*
East Ayrshire	*2.2*	*1.2*
East Dunbartonshire	*3.8*	*3.5*
East Lothian	*18.2*	*16.8*
East Renfrewshire	*11.9*	*11.4*
Edinburgh, City of	*14.0*	*14.0*
Eilean Siar	*1.3*	*-0.2*
Falkirk	*13.4*	*12.9*
Fife	*12.3*	*11.3*
Glasgow City	*6.0*	*5.6*
Highland	*6.7*	*6.4*
Inverclyde	*0.4*	*-0.8*
Midlothian	*12.5*	*12.6*
Moray	*-0.3*	*-0.3*
North Ayrshire	*5.2*	*4.6*
North Lanarkshire	*9.7*	*8.7*
Orkney Islands	*5.5*	*4.3*
Perth & Kinross	*10.5*	*9.7*
Renfrewshire	*1.7*	*0.9*
Scottish Borders	*9.8*	*9.6*
Shetland Islands	*14.3*	*14.2*
South Ayrshire	*3.1*	*1.7*
South Lanarkshire	*9.1*	*8.0*
Stirling	*19.3*	*16.7*
West Dunbartonshire	*3.6*	*2.6*
West Lothian	*24.6*	*23.3*
Scotland	***8.1***	***7.4***

Scale of adult adjustment

In previous years, the choice between detailed projections methodologies has been informed by the number of council for which it was necessary to adjust the projected household mix to ensure that there are sufficient adults in the projected population to form the projected number and mix of households.

For this suite of projections, only two very minor adjustments were needed on both sets of projections.

Changes in household formation patterns

In almost every age group, the standard deviation of the changes to 2016 in the projected proportion of the population heading a separate household are slightly higher for the household representative based projections when compared with projections on a head of household basis, with greater volatility for smaller councils. The higher volatility of the household reference person based projections is likely to be due to the necessary use of the 10% data to compile household reference person rates for 1991.

Summary and decision on methodology

The main points of the comparison between the two sets of projections are:

- Both sets of projections show, for Scotland as a whole, significantly lower household growth than the 2000 based projections.
- For Scotland as a whole, projections on both bases give very similar overall patterns of household growth.
- For most councils, the head of household and household reference person bases give very similar results.
- However, at a more detailed level, projected changes in the proportions of each age group forming a household show greater volatility on a household reference person basis compared with head of household.

As a result, members of HARG agreed that projections on the basis of head of household were preferable.