



**General Register Office for Scotland**  
*information about Scotland's people*

**Mid-Year Population Estimates for Scotland:  
Methodology Guide**

**15 October 2010**

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## 1. Introduction

The General Register Office for Scotland (GROS) produces annual estimates of the resident population of Scotland as at 30 June each year. The most authoritative population estimates come from the Census, which takes place every 10 years, the most recent being held in April 2001, and the next to be held on 27 March 2011. Population estimates from the Census are updated each year to produce mid-year population estimates for the years in between Censuses. This paper describes in detail the methodology used by GROS to produce the annual mid-year population estimates, with reference to the mid-2009 population estimates.

## 2. An introduction to population estimates

This section describes the various population estimates produced by GROS, what they are used for and how the population is defined.

### 2.1 Coverage and availability of population estimates

The latest population estimates can be found on the GROS web site – see the Population Estimates Statistics page:-

<http://www.gro-scotland.gov.uk/statistics/publications-and-data/population-estimates/index.html>

The available estimates are split under three sections:-

#### [Mid-Year Population Estimates](#)

The latest annual mid-year population estimates for Scotland and its constituent Health Board and Council areas. This section also includes historical data back to 1982 and a time series dataset.

#### [Special Area Population Estimates](#)

This section contains the Small Area Population Estimates and estimates for Settlements and Localities. Population estimates for special areas including Westminster Parliamentary Constituencies, Nomenclature of Units for Territorial Statistics (NUTS), Scottish Index of Multiple Deprivation deciles and Urban Rural classification categories can also be found here.

#### [Estimates of Special Populations](#)

Estimates of the population split by marital status, country of birth, nationality and estimates of the very old (including centenarians) are available here.

Population estimates for Scotland, Council and NHS Board areas for a particular mid-year (30 June) normally become available around ten months after the reference date. Other estimates are normally published after these, usually:-

- Small Area Population Estimates (SAPE) are published in September, 15 months after the reference date.
- Populations for Special areas such as Urban/Rural and by the Scottish Index of Multiple Deprivation index are published in February, 20 months after the reference date. It is hoped to bring this publication date forward in future years.

- Estimates of Special Populations e.g. Centenarians are usually published in September, 15 months after the reference. Population by country of birth and nationality are published using different methods and are based on the Annual Population Survey/Labour Force Survey.

Published estimates split by sex for all ages are rounded to the nearest ten at Council and NHS Board level to avoid implying spurious accuracy and for ease of aggregation. SAPE are rounded to the nearest 10 at datazone level.

Data sets may be viewed on screen or downloaded free of charge in Excel or CSV format. Other data not published on the web are available on request, for example historic estimates going back to 1971. For further information on the availability of population estimates, please contact customer services GROS.

Email: [customer@gro-scotland.gsi.gov.uk](mailto:customer@gro-scotland.gsi.gov.uk).

The Northern Ireland Statistics and Research Agency (NISRA) produces population estimates for Northern Ireland which can be found via the following link.

<http://www.nisra.gov.uk/statistics/financeandpersonnel/DMB/datavault.html>.

The Office for National Statistics (ONS) produces population estimates for England and Wales but also combines these with population estimates for Scotland and Northern Ireland to produce population estimates for the UK as a whole

(<http://www.statistics.gov.uk/STATBASE/Product.asp?vlnk=601>).

## **2.2 Uses of population estimates**

Mid-year population estimates currently have a wide variety of uses within central government, as well as being used by local authorities and health bodies, other public bodies, commercial companies and individuals in the private and academic sector.

These uses can be categorised into two broad groups:-

- Uses where the absolute numbers are of key importance. This may be in terms of allocating financial resources from central government, planning services or grossing up survey results. Some of the main central government uses are concerned with resource allocation.
- Uses where the population figures are compared with other figures such as the numbers of births or deaths in the calculation of rates and ratios.

## **2.3 Definition of the population**

The latest series of population estimates (mid-2001 onwards) are based on the 2001 Census and relate to the usually resident population. In simple terms, this means that population estimates are estimates of people where they usually live. The usually resident population does not always coincide with the number of persons to be found in an area at a particular time of the day or year. The daytime populations of cities and the summertime populations of holiday resorts will normally be larger than their usually resident populations.

The population base from the 2001 Census underpins the mid-year population estimates resident base and is defined as follows:-

The 2001 Census has been conducted on a resident basis. This means the statistics relate to where people usually live, as opposed to where they are on Census night. Students and schoolchildren studying away from home are counted as resident at their term-time address. As in 1981 and 1991, residents absent from home on Census night

were required to be included on the Census form at their usual/resident address. Wholly absent households were legally required to complete a Census form on their return. No information is provided on people present but not usually resident.

For most people, defining where they 'usually' live for the purposes of the Census is quite straightforward. However for a minority of people the concept of 'usual residence' is more difficult and it may be difficult to apply a general rule to assign people to where they are 'usually' living. Groups included in this category are:

- students;
- armed forces;
- prisoners;
- seasonal workers;
- contract workers and others who frequently move with their job;
- some people living in communal establishments;
- people sleeping rough;
- foreign students and au pairs;
- people with frequently used second homes in the UK or abroad;
- people who live and work away from a family home for part of the week;
- children who regularly move between a mother and father's home;
- adults who live with a partner for part of the time but maintain a separate residence; and
- any other groups of people with more than one residence.

The usual residence for students is specifically referred to in the definition of resident population for the 2001 Census given above. For other groups, guidance was provided either on the Census form or in the enumerators' instructions. In general, the definitions used in the 2001 Census are carried through into the population estimates, mainly because the Census is used as a base for the population estimates. However, although efforts are made to ensure comparability of definitions in intercensal data and sources used in the population estimates, sometimes it is not possible to obtain data using the same definition as used in the Census. For example, in the International Passenger Survey (IPS), used to estimate international migration, a person is defined as an in-migrant and therefore a resident if they are intending to stay in Scotland for at least 12 months. However in the Census, individuals temporarily living in Scotland are left to provide their own interpretation of their usual residence. In practice, when compiling a population estimate, a number of data sources have to be used, each with its own definition of usual residence. These differences in definition are becoming increasingly important, and are the subject of current research within GROS and ONS.

## **2.4 Other population products**

### Population projections

The Office for National Statistics (ONS) produces national population projections for the UK and on behalf of its constituent countries. The projections by age and sex are normally produced every second year and the assumptions on which they are based are agreed in consultation with the statistical offices of England, Scotland, Wales and Northern Ireland. The primary purpose of the projections is to provide an indication of future population if current trends in fertility, mortality and migration continue into the future. They are used as a common framework for national planning in a number of different fields. For further information, see:

<http://www.statistics.gov.uk/STATBASE/Product.asp?vlnk=8519>

Sub-national population projections for areas within Scotland are produced by GROS and give an indication of future trends in population by age and sex over the next 25 years. They are trend-based projections, which means assumptions for future levels of births, deaths and migration are based on observed levels over the previous five years. They show what the population will be if recent trends in these continue. The projections do not take into account any future policy changes that have not yet occurred. They are constrained at a national level by the national projections produced by ONS. For further information and data on sub-national projections, see: <http://www.gro-scotland.gov.uk/statistics/publications-and-data/popproj/index.html>

#### Migration statistics

GROS produce mid-year to mid-year estimates of migration, within Scotland, between Scotland and England, Wales and Northern Ireland and also overseas. More information is available at: <http://www.gro-scotland.gov.uk/statistics/migration/index.html>

Research into population estimates and projections by ethnic group.

GROS has produced a methodology paper based on work carried out by ONS. A paper presenting the results and method is available in the papers of our main ScotStat user group, the Population and Migration Statistics Committee, through the following link: <http://www.gro-scotland.gov.uk/statistics/user-consultation-groups-seminars/pams/pams-17-may-2010.html>

#### Household Estimates and Projections

GROS produces estimates and projections of the numbers of households in Scotland. The household projections are based on the population projections. The latest household estimates and household projections can be found at: <http://www.gro-scotland.gov.uk/statistics/household-estimates-projections/index.html>

#### Other outputs

GROS also produces a range of other outputs and more information can be found on the GROS website at: <http://www.gro-scotland.gov.uk/statistics/index.html>

### **3. Methodology for producing population estimates**

#### **3.1 Introduction**

Population estimates for Scotland and its Council and NHS Board areas are made using the cohort component method. This is a standard demographic method and is used by several other national statistics institutions that also have access to high quality data sources for the components of population change. For example, this method is used by the Office for National Statistics (ONS), Northern Ireland Statistics Agency (NISRA), the Australian Bureau of Statistics and by the US Bureau of the Census.

Mid-year population estimates are made for the population resident on 30 June of the reference year. The starting point for the estimates is the resident population on 30 June in the previous year. This population by single year of age is then aged on by one year (for example all three-year-olds become four-year-olds one year later). Those who have been born during the 12 month period prior to the mid-year point are then added on to the population and all those who have died during the 12 month period are removed according to their age, sex, and their usual place of residence. The other factor to be taken into account in estimating the national population is the movement of

people in and out of Scotland from the rest of the UK and from overseas (international migration). Internal migration includes both cross-border moves between the four constituent countries of the UK and moves between local areas within each part of Scotland. Migration is the most difficult part of the population estimate process to estimate precisely, as migratory moves are not registered in the UK, either at the national or local level. The best proxy data available on a nationally consistent basis are used to estimate migration. GROS, with ONS, is continually researching ways of ensuring and improving the quality of the population estimates. This research includes analysis of possible new data sources that may become available.

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### **Summary of the cohort component method**

- Take the previous mid-year resident population and age-on by one year.
- Then estimate the population change between 1 July and 30 June by:-
  1. Adding births occurring during the year.
  2. Removing deaths occurring during the year.
  3. Allowing for migration to and from the area.

In addition to the process summarised above, adjustments are also made for some special population groups that are not captured by the internal or international migration estimates: members of the armed forces and prisoners. These populations have specific age structures, which remain fairly constant over time. Therefore these groups are not aged-on with the rest of the population. Such populations are referred to as 'static populations'.

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When the Population and Migration Statistics team within GROS receives data for the various components, checks are carried out and comparisons made with previous years' data to gauge consistency and completeness of coverage. The data are then processed electronically to produce the mid-year estimates. Quality assurance takes place at each stage of this process. This may include calculation of demographic rates and ratios to help check the plausibility of the data.

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The method above describes how mid-year population estimates are calculated for years when there is no Census. For Census years such as 2001, a slightly different approach is necessary. Rather than ageing on the population by one year, the population only needed to be aged on by the period of time between the Census and 30 June 2001 (nine weeks in 2001). Similarly, the components only needed to account for change during this period rather than a whole year. Further details of how this was done in 2001 can be found in the '2001 Population Report'

(<http://www.gro-scotland.gov.uk/statistics/publications-and-data/population-Á estimates/mid-year/01-populations/index.html>).

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Population estimates for Scotland, Council and NHS Board areas are produced first. Then estimates for small areas (datazones) are produced and constrained to the Council area estimates (as datazones nest into Council areas). The datazone population estimates are then aggregated to various geographies e.g. urban and rural populations or feed into the calculation of settlement and locality population estimates. Sections 3.2 and 3.3 below explain in detail how the estimates for Scotland and its Council and NHS Board areas are compiled. Sections 3.4 to 3.10 explain how the data for the different components of the population estimates are obtained and processed. Information on how datazone population estimates are produced can be found here:

<http://www.gro-scotland.gov.uk/statistics/publications-and-data/population-Á estimates/special-area/sape/sape-background-and-methodology.html>

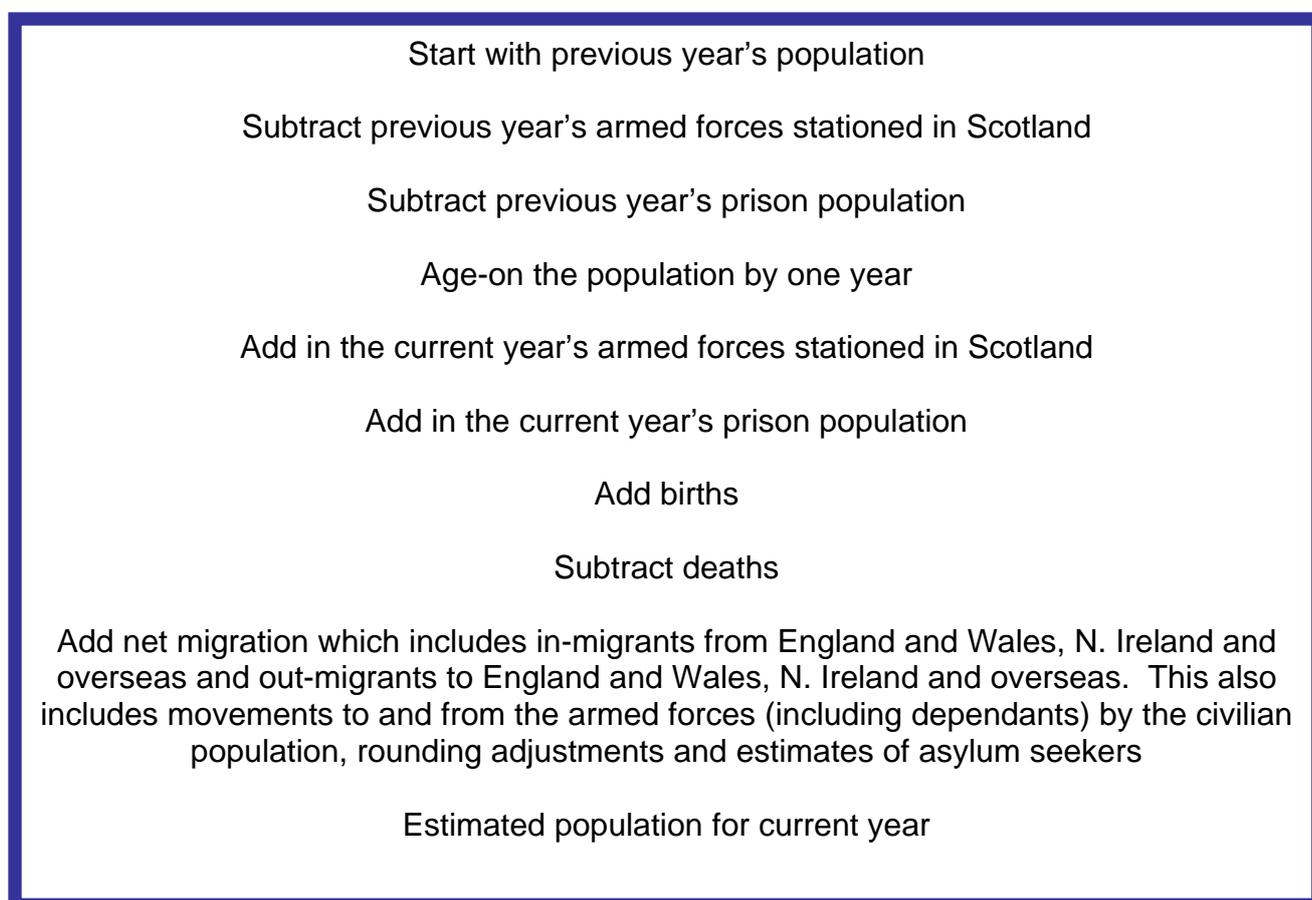
And information on populations calculated by aggregated datazones to various geographies on a "best fit" basis can be found here: <http://www.gro-Á>

### 3.2 Overview of the method

Figure 1 shows how the population estimates for Scotland and its Council and NHS Board areas are produced. All these processes are carried out by single year of age and sex up to age 89. Those aged 90 and over are processed as a single group. The first main stage is the ageing on by one year of the previous year's resident population. Before ageing on can be carried out, all armed forces stationed in Scotland in the previous year are removed from the resident population

Following ageing on and the armed forces adjustments, the main components of change – births, deaths and net migration – are applied. Both migration to and from England and Wales and Northern Ireland and migration to and from the rest of the world must be taken into account. Having applied these components, and rounded the resulting estimates the final result is the population for Scotland, Council and NHS Board areas by single year of age to 89 then 90+ and by sex.

#### Figure 1 – The method



### 3.3 Births

Data on births are obtained from the compulsory civil registration system administered by GROS and the Local Registration Offices. The Population and Migration Statistics team is supplied with data on live births by sex for the period from 1 July of the previous year to 30 June of the current year. Because registration of a birth may legally take place up to 21 days after the birth, the data received refer to the date of birth rather than the date of registration. Births are added to the population at age zero and are allocated to the area of usual residence of the mother.

### **3.4 Deaths**

As for births, data for deaths are obtained from the compulsory civil registration system. The Population and Migration Statistics team is supplied with data on deaths by age and sex for the period from 1 July of the previous year to 30 June of the current year. Data refer to the date of death rather than the date that the death was registered. Deaths are subtracted from the mid-year population by age and sex at the area of usual residence of the deceased. In order for this to work correctly, the age at death is calculated to be the age that the deceased person would have been on 30 June. (This age calculation is carried out by the GROS Vital Events team.) No adjustments are made for non-resident deaths.

### **3.5 Sources of migration data**

Migration is the most difficult component of population change to estimate, as there is no comprehensive system which registers migration in the UK, either moves to or from the rest of the world, or moves within the UK. Estimates of migration have therefore to be based on survey data and the best proxy data that exist.

Migration estimates are derived from three key sources of data. The National Health Service Central Register (NHSCR) is used to calculate moves between NHS Board areas within the UK, with migration at Council area and below estimated using anonymised data from the Community Health Index (CHI). The International Passenger Survey (IPS) provides information on moves into and out of Scotland information is used for migrants to and from the Republic of Ireland and asylum seekers. These three main sources are described in more detail in the remainder of this section.

#### Internal migration within the UK

The NHSCR system records the movements of patients between NHS Board areas in the UK. Each time a patient transfers to a new NHS doctor in a different NHS Board area, the NHSCR is notified and then the patient is considered to have made a migrant move. Counts of these re-registrations are used as a proxy indicator for moves within the UK.

The CHI holds records of people registered with an NHS doctor in Scotland. Unlike the NHSCR, the records provided to the General Register Office for Scotland (GROS) contain the postcode of the patient's address, which enables migration to be estimated for councils, and for smaller areas. The approach used for estimating council-level migration involves matching CHI patient records extracted from a database which reflects the 'live' CHI system on two occasions one year apart.

Currently, GROS migration data derived from the NHSCR is considered to be the most reliable data available at NHS Board level, so estimates from the CHI are controlled to ensure that they are consistent with the NHSCR data for moves across a NHS Board boundary by origin, destination, age and sex.

Due to an improvement in data sources, the accuracy of cross border migration data between Scotland and Northern Ireland will be improved from mid-2009. More information on the nature of the improvements is in a paper of the Population and Migration Statistics Committee (PAMS): <http://www.gro-scotland.gov.uk/statistics/user-consultation-groups-seminars/pams/index.html>.

## International migration

An international migrant is defined by the United Nations (UN) as someone who changes country of residence for 12 months or more. There is no single, all inclusive system in place to measure all movements of population into and out of the UK. Therefore, it is necessary to use a combination of data from different sources that have different characteristics and attributes in order to produce estimates of international migration. While offering the best data currently available, none of the data sources used is specifically designed to capture information solely on international migration. Three sources of data are used to compile the national estimates of international migration into Scotland:

- The International Passenger Survey (IPS) is a continuous sample survey conducted by the Office for National Statistics (ONS) at the principal air, sea and Channel Tunnel routes between the United Kingdom and countries outside the British Isles. It is the prime source of migration data to and from the UK, providing estimates of both inflows and outflows, but does not cover all migration types;
- Home Office (HO), which provides data on asylum seekers and their dependants;
- The Labour Source Survey (LFS), which collects information on where international migrants live.

Given that the IPS collects information on intentions which may or may not be realised, an adjustment is made to the IPS data for visitor and migrant switchers (people who change their intentions and their migratory status). The Long-Term International Migration (LTIM) estimate (previously referred to as Total International Migration, TIM) is derived by combining these components.

The IPS provides an estimate of international migrants into the United Kingdom. The allocation of these migrants to Scotland is based on the LFS. The LFS provides more reliable data on the geographical distribution of immigrants than the destination provided in the IPS as it is based on where migrants actually live rather than on their initial intentions. The outflow of international migrants from Scotland is based directly on the IPS data. More information on the LTIM method can be found in the Office for National Statistics (ONS) website:

<http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=507>

The LTIM estimate for Scotland has been used for the mid-year estimates for Scotland since mid-2007. Previously, GROS used a similar method based on the IPS, but this did not use the LFS distribution or include estimates of migrant switchers. It did however use an adjustment for unmeasured migration. The results of the 2001 Census indicated that the previously published 2000 mid-year estimates had been overestimated as a result of cumulative errors in estimating migration. To ensure that migration estimates did not continue to be overestimated, an unmeasured migration adjustment was included. The LTIM methodology does not include this adjustment. Rather the assumption is that, since the census and estimates are calculated using different methodologies, differences inevitably arise.

An evaluation of the impact of changing method has been carried out and is detailed in the Population and Migration Statistics Committee paper PAMS (07)02 at <http://www.gro-scotland.gov.uk/statistics/user-consultation-groups-seminars/pams/pams-26-june-2007.html>. The conclusion was that the GROS method estimated a cumulative net migration gain around 9,700 higher than the TIM method between the census and the 2006 estimates. There are currently no plans to revise the previous mid-year estimates.

## Distribution of International Migrants to Scotland

International migration flows to NHS Boards were allocated by using overseas inflows recorded on the NHSCR. However, NHSCR records hold limited data on international outflows from NHS Boards to overseas, as patients rarely de-register with their doctor when moving overseas. As a result international outflows were allocated using averaged proportions based on international inflows, outflows to the rest of the UK and the population size of each NHS Board.

Age and sex distributions of international in-migrants are obtained directly from the NHSCR. The age/sex distribution of moves for international out-migrants was based on the distribution of migrants to the rest of the UK, as recorded by the NHSCR.

The distribution of migrants to Council areas is based on records from the Community Health Index (CHI), which are made consistent with the NHSCR geographic and age / sex distributions. International in-migrants were allocated using records appearing on the CHI extract where the patient had arrived from overseas. Like the NHSCR, the CHI extract holds limited data on people leaving Scotland for overseas and so international out-migrants were allocated using a combination of in-migrants to Scotland from overseas and migrants leaving Scotland for the rest of the UK. More information on how the CHI extract is used in the mid-year estimates process and more detail of the methodology is available in papers of the ScotStat Population and Migration Statistics Committee: <http://www.gro-scotland.gov.uk/statistics/user-consultation-groups-seminars/pams/pams-3-april-2003.html>

- [PAMS \(03\) 10 - Improving the GROS migration data for Council Areas – proposals for 2002](#)
- [Supplement to PAMS \(03\) 10 - Validation of Proposed Methodology](#)

Work to improve the method used to allocate international out-migrants to NHS Board and Council areas is continuing and further improvements will be considered for future publications.

## Asylum seekers

Both inward and outward asylum seekers are included in the LTIM estimate (outward asylum seekers are people who arrive looking for asylum but for one reason or another don't stay). Most of these asylum seekers are assumed to be NASS (this essentially means they go to Glasgow City) and a small number are assumed to be non-NASS (they can go elsewhere in Scotland) Asylum Seekers. The NASS asylum seekers are not included in the control totals when distributing international migrants around Scotland. It is assumed that they all go to Glasgow City as it is the only Scottish Local Authority with a contract with the UK Borders Agency for the dispersal of asylum seekers. The age/sex distribution of asylum seekers is calculated by using the UK level distribution provided by ONS (5 year age bands).

## Additional Migration Data

The GROS website now includes a migration section which provides additional tables showing migration estimates associated with mid-year population estimates as well as Local Area Migration Reports which draw together a range of sources of data on migration to enable analysis of migration at local area level. This can be accessed through the following link:

<http://www.gro-scotland.gov.uk/statistics/migration/index.html>

## Research into improving Migration and Population Statistics

It is increasingly important to have high quality statistics on migration and the population, for policy development and for planning and providing public services. Achieving this aim is challenging in the context of increasingly complex lifestyles and changes in migration to and from the UK over the last decade.

It was in this context that the National Statistician set up the Inter-Departmental Task Force on Migration Statistics to make recommendations on timely improvements that could be made to estimates of migration and migrant populations in the United Kingdom, both nationally and at a local level. The report of the Inter-Departmental Task Force on Migration Statistics was published on 15 December 2006 by the ONS. GROS represented the devolved administrations on this task force, and is working with the ONS on the implementation of the recommendations through the Improvements to Migration and Population Statistics (IMPS) cross-government programme.

The IMPS workplan involves:

- improving the data available on numbers entering and leaving the United Kingdom;
- making effective use of new and existing administrative and survey data sources;
- improving local population estimates and projections used in allocating resources and developing services;
- improving the public reporting of population and migration statistics; and
- establishing a wider range of timely indicators and analysis to inform the evidence base on migration and its impacts on policy and public services.

GROS is involved in a number of workstreams within this programme with the aim of incorporating the research into their outputs. More details can be found on the GROS website <http://www.gro-scotland.gov.uk/statistics/migration/migration-statistics-improvements.html>

More detail on the IMPS programme is available from the following link on the ONS website

<http://www.statistics.gov.uk/about/data/methodology/specific/population/future/imps/updates/default.asp>

### **3.6 Armed forces**

The estimate of the armed forces population is constructed using information from the Defence Analytical Services Agency's (DASA) TSP10 and TSP8 publications which are on their website:

<http://www.dasa.mod.uk/applications/newWeb/www/index.php?page=66&pubType=1>

and also from information on the change in the armed forces from the GROS Station Commanders return. GROS ask station commanders in Scotland how many armed forces personnel live in each council area by postcode if possible/available.

Changes in the armed forces populations from the station commanders return between the current and previous year are examined to determine whether they are real or whether they are because a certain unit has not responded (there is no statutory obligation for bases to respond). DASA's TSP10 publication is also looked at to see if there's evidence of a change in the area in question in the DASA statistics. Once it has been decided that there is a real change in an armed forces area the changes are rounded and then applied to the previous year's population to get totals by Council and NHS Board area. The age distribution from DASA's TSP8 publication is then applied to these totals for base areas and 2001 Census distributions are used for non-base areas.

### **3.7 Prisoners**

Information on those sentenced to 6 months or more at 30 June by age, sex and establishment is obtained from the Scottish Prisons Service (SCS). The prison population of the previous year is removed. After ageing on the prison population for the current year is added on.