

Methodology guide for mid-2012 to mid-2016 UK population estimates, England and Wales: March 2018

Methods used in the revised mid-2012 to mid-2016 usual resident population estimates of England and Wales.

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1 . Introduction

Population estimates for England and Wales

Office for National Statistics (ONS) produces annual estimates of the resident population of England and Wales as at 30 June every year. The estimates are provided broken down by local authority, sex and age. The most authoritative population estimates come from the census, which takes place every 10 years in the UK. Population estimates from a census are updated every year until the next census to produce mid-year population estimates.

Population estimates for the UK

ONS produces population estimates for England and Wales. Estimates from Scotland and Northern Ireland are also collated by ONS to produce UK totals. Estimates for Scotland are produced by the National Records of Scotland (NRS), while the Northern Ireland Statistics and Research Agency (NISRA) produces the estimates for Northern Ireland. Estimates for each of the UK constituent countries are compiled using a common methodological approach and aim to be as consistent as possible. Details of the specific data sources and methods used across the UK are summarised in a [UK comparisons](#) note.

This article relates to the estimates for England and Wales only.

A [guide](#) to the methodology used to produce the mid-year population estimates for Scotland is available from the NRS website. Details on the [methodology](#) used to create the Northern Ireland population estimates are available from the NISRA website.

Usually resident population

Population estimates refer to the usually resident population. This can mean that estimates of population do not necessarily coincide with the number of people to be found in an area at a particular time of the day or year.

For most people, defining where they usually live for the purposes of the census, for example, is quite straightforward. For a minority of people the concept of usual residence is, however, more difficult to define, for example, for students, members of the armed forces, prisoners and international migrants.

Specific rules are used for these groups:

- higher education students and schoolchildren studying away from home are resident at their term-time address
- members of the armed forces are usually resident at the address where they spend most of their time
- prisoners are usually resident in the prison estate if they have a sentence of six months or more

International migrants are usually resident if they intend to stay in England and Wales for more than 12 months.

Protection against disclosure

The estimates are produced using a variety of data sources and statistical models, including some statistical disclosure control methods, and small estimates should not be taken to refer to particular individuals.

Quality assurance

The quality of the mid-year population estimates are consistently monitored by ONS. This includes quality assurance of the administrative and survey data sources that are used to calculate the estimates; the statistical methods applied to produce the estimates and the tables of data published on the ONS website. Further details are available in the [Annual mid-year population estimates Quality and Methodology Information \(QMI\)](#) report and in the [Quality assurance of administrative data](#) (QAAD) reports, listed in Annex

2 . Cohort component method

Rolled-forward estimates

Population estimates are produced using a cohort component method. This is a standard demographic method that uses high-quality data sources to inform components of population change. The three major components of population change are summarised as follows:

- natural change
- migration
- special populations

Natural change (births, deaths and ageing)

The starting point for producing the estimates is the count of resident population from 30 June of the previous year. This population is aged on by one year. Births during the 12-month period are added to the population, while deaths during the period are removed according to recorded age, sex and usual area of residence.

Migration

Movement of people into and out of the UK (international migration) and movements between different areas in the UK (internal migration) are also accounted for in the population estimates. Note that internal migration includes both cross-border moves between the other countries of the UK and moves between local areas within each part of the UK. Migration is the most difficult part of the estimate process to measure precisely because the UK has no population register. Rather, we use the best proxy data available on a nationally-consistent basis to estimate migration.

Special populations

Adjustments to the population estimates are made for some special population groups that are not captured by the usual internal or international migration estimates: members of the armed forces and prisoners. These populations have specific age structures, which remain fairly constant over time. They are not aged-on with the rest of the population. Such populations are referred to as static populations.

Census-basing

The method in this section describes how mid-year population estimates are calculated for years when there is no census. For years in which there is a census, the mid-year population estimates are based on the census estimates and therefore, a slightly different approach is necessary. Rather than ageing on the population by one year, the population is only aged on by the period of time between the census and 30 June. Similarly, the components only need to account for change during this period rather than a whole year.

Research and development

We continue to research ways of ensuring and improving the quality of the population estimates, including analysis of new data sources that become available. The latest information on [research into new and improved methods for producing our standard population statistics](#) is available.

Uncertainty estimates have been created to give users additional information of the quality of these estimates. [Measures of statistical uncertainty](#) are available for the years mid-2012 to mid-2015.

In-depth methodology

The following sections describe in more detail how we estimate the components of population change in the mid-year estimates produced for England and Wales.

3 . Births

Change in population due to births

Births in England and Wales occurring between 1 July of the previous year and 30 June of the current year are added to the population at age zero, by sex and allocated to the local authority of usual residence of the mother.

Births data

Data on live births by sex are obtained from the Civil Registration System administered by the Office for National Statistics (ONS) and are based on births occurring (and then registered) in England and Wales. As registration of births may legally take place up to 42 days after a birth, the data received refer to the date of birth rather than the date of registration.

Births to mothers outside England and Wales

The Civil Registration System captures information on all births in England and Wales. This includes births to mothers who are usually resident elsewhere, but not necessarily those births to mothers who are usually resident in England and Wales that take place elsewhere.

We assume that the number of births for the two groups are similar in number and on average balance each other out. In this way, births to non-usually resident mothers are added to the population estimates as a proxy for those births elsewhere to usually resident mothers. We impute local authorities of residence for these births using the distribution of births we know about during the year.

4 . Deaths

Change in population due to deaths

Deaths that are registered in England and Wales between 1 July of the previous year and 30 June of the current year are subtracted from the population by sex, age and local authority of usual residence.

Deaths data

Deaths data are obtained from the Civil Registration System administered by the Office for National Statistics (ONS). The data are supplied by sex, age and local authority of usual residence in England and Wales. To be consistent with the mid-year reference date we adjust age at death to 30 June.

The Civil Registration System captures information on all deaths in England and Wales. This includes deaths to people usually resident elsewhere (outside England and Wales). In the calculation of subnational population estimates, these people are allocated to a local authority, imputed using the distribution of deaths by age and sex we know about during the year.

The Civil Registration System does not record deaths of usual residents of England and Wales that have occurred abroad and which are not registered in England and Wales. These deaths are excluded from the deaths data and do not feature in the calculation of the mid-year population estimate.

Unknown local authority of residence

Local authority of residence is not recorded for a number of deaths. For these, a local authority is imputed using the distribution of deaths by age and sex we know about during the year.

Late registrations

We make a small adjustment for anticipated late registrations to allow for deaths that were not registered at the time the data were extracted. The number of late registrations in the previous year is used as a proxy for late registrations in the current year, given the assumption that the number of late registrations does not vary much year-to-year.

5 . Internal migration

To account for migration of people within the UK, data are obtained for flows of migrants between each pair of local authorities in England and Wales as well as flows of migrants between England and Wales and the rest of the UK (so called cross-border flows).

Internal migration data

Internal migration estimates are primarily based on data that flags up when people change their doctor as they change address. Since most people re-register with a new doctor after moving, these data are considered to provide a good proxy indicator of migration. Similar data sources are used both for cross-border flows and moves within England and Wales.

A combination of three administrative data sources are used in this way as a proxy for internal migration within England and Wales. These are:

- the National Health Service Central Register (NHSCR)
- the Patient Register Data Service (PRDS)
- Higher Education Statistics Agency (HESA) data

NHSCR data

The NHSCR records the movements of patients between former health authority areas (HAs) and is combined with PRDS data held by individual former HAs to produce estimates of migration between local authorities.

Similar data sources are used to obtain estimates of cross-border flows to and from Scotland and Northern Ireland. The total flows to and from constituent countries of the UK are agreed between the Office for National Statistics (ONS), the National Records of Scotland (NRS) and the Northern Ireland Statistics and Research Agency (NISRA), based on records of in-migration to the relevant country.

PRDS data

Each former HA holds lists of patients registered with GPs. ONS gets a snapshot of data extracted from each area's Patient Register as at 31 July each year. This reference date is based on the assumption that it takes about a month to register with a GP and hence appear on the Patient Register after moving to a new area. This enables migration estimates to be produced for the year ending 30 June.

By obtaining an extract from each Patient Register on an annual basis and combining all the extracts together, a total Patient Register for the whole of England and Wales is created. Duplicate and temporary NHS records are removed from the register when combining the extracts and a small number of missing data fields are imputed to improve data quality.

The records are compared between the current year and the previous year, and this enables the identification of people who have changed their postcode during the period. For the purpose of estimating the population, it is assumed that a person who changes their local authority of residence between one year and the next is a migrant.

Reconciling NHSCR and PRDS

Unlike the NHSCR, the PRDS provides migration estimates down to local authority level. However, the PRDS has one major limitation: it cannot capture the migration of those who move during the year who were not registered with a GP at one of the two mid-year time points.

The largest group missed in this situation are migrant babies aged less than one year. This is because they don't appear on the GP record at the previous mid-year. Similarly, international in-migrants won't have been registered with a GP at the previous mid-year and so will be missed if they moved between registering with a GP and the current mid-year. Other missing data arise in cases where people move during the year but do not appear on the PRDS at the current mid-year point, for example, because they have emigrated. This is also the case for deaths.

To address these issues, data are combined with more complete information in the NHSCR and then used to produce the migration estimates for local authorities. Since migrant babies aged zero are not captured by the Patient Register data, these moves are estimated by combining the data for zero-year-olds in the NHSCR with the local authority distribution of moves of one-year-olds in the PRDS.

The NHSCR data source was discontinued in February 2016. Consequently, England and Wales internal migration estimates for 2016 have been calculated by combining the 2016 PRDS data with the 2015 NHSCR data.

HESA data

One of the known limitations of relying on GP registration changes is that young people, particularly young men, can be slow to change their registration when they move. Given one of the most common reasons for migration among young people is to attend a course at a higher education establishment, we use HESA data to supplement GP data. HESA data contains records of students at higher education establishments in England and Wales. Data are available for both domicile address and term-time address, which allows potential internal migrants to be identified and an adjustment to be made to the internal migration estimates.

Internal migration and special populations

Movements of members of the armed forces are not included in the internal migration estimates. Whilst the NHSCR records movements of people into and out of the armed forces, movements of serving members are not recorded. For similar reasons, movements of prisoners are also not included in the internal migration estimates. The population of armed forces and prisoners are estimated separately.

Changes to methods

The method for calculating internal migration estimates will undergo further planned changes before the 2017 mid-year estimates are produced. Details of these changes can be found in Appendix 2.

6 . International migration

An international migrant is defined as a person who changes his or her country of usual residence for a period of at least a year. International migration estimates are made up of immigration, emigration, asylum seekers and refugees plus their dependants. Estimates of international migration exclude the armed forces, whose movements are estimated separately.

International Passenger Survey

The Office for National Statistics (ONS) national estimates of international migration are based on the International Passenger Survey (IPS). The IPS is a long-running ONS survey that operates at UK ports of arrival and departure. The IPS is the only source of data on UK migration that is specifically designed to identify people who change their country of usual residence for at least 12 months. This is consistent with the usual residence definition for international migrants in the population estimates.

Sample survey

The IPS is a sample survey and so only a sample of migrants to or from the UK are interviewed. Within this sample, only a small proportion will be long-term international migrants.

The IPS is based on voluntary, face-to-face interviews with a sample of passengers travelling via airports, sea routes and the Channel Tunnel. The migrant respondents sampled are scaled to produce national migration estimates using a complex weighting system. Because the IPS is a sample survey, the results are subject to a degree of statistical uncertainty.

Limitations of use at local authority level

The IPS estimate is not reliable enough to be used at local authority level, as the sample of people in each local authority is too small – with many local authorities having little or no IPS respondents.

Furthermore, a migrant's initial intentions about where they will settle may not be realised. For example, there is a tendency for in-migrants to state an intention to migrate to London, but actually settle in another part of the UK. Therefore, the IPS estimate at local authority level may not be a reliable indicator as to where people migrate from or to.

Local authority estimates of international migration are derived using a variety of data sources and methods as described in the following methodology for immigration and emigration.

Visitor switchers and migrant switchers

The IPS does not take into account the changing intentions of passengers. Some migrants intend to remain in or out of the UK for 12 months, but actually go on to spend less than a year. These are called migrant switchers. Other migrants intend to remain in or out of the UK for less than a year but actually spend longer. These are called visitor switchers.

Migrant and visitor switchers are identified by the IPS as they complete their journey. The passenger is asked how long they intended to stay in the UK or overseas when they initially arrived or departed, and for how long they actually remained in or out of the UK. An estimate is calculated for the proportion of migrants or visitors who changed their intentions on the duration of their stay.

The likelihood of a visitor changing their intentions can vary depending on their citizenship and place of last or next residence. Therefore, visitor switchers are split into four groups: those entering the UK who are European Economic Area (EEA) and non-EEA citizens, those leaving the UK who are EEA citizens going to the EU, and all other citizens leaving the UK going to anywhere in the world. However, unlike visitor switchers, there is no distinction between citizenships or countries of last or next residence for migrant switcher calculations.

International migration estimates are adjusted for migrant and visitor switchers, as part of the methodology for immigration and emigration.

Immigration

Local authority level estimates

Streams

The IPS total data for England and Wales are streamed, mainly by reason for migration (for example, worker, student, other) and relevant administrative sources are used to distribute immigrants to each local authority. Record linkage is used both within and between the administrative sources to minimise definitional differences and duplication.

The following data sources are used:

- Migrant Worker Scan (MWS): provides a count of foreign nationals applying for a National Insurance Number (NINo); this is the main source used to distribute immigrant workers
- Customer Information System (CIS): this provides data that enables the MWS, HESA and PRDS to be more accurately linked together (note: this only applies to mid-2015 onwards)
- Higher Education Statistics Agency (HESA) data: used for distributing publicly-funded higher education students and private higher education students
- administrative data sources from Department for Business, Energy and Industrial Strategy (BEIS) and Welsh Government (WG): used to distribute further education student immigrants from the EU
- Home Office visa data: numbers of non-EU international migrants at educational institutions with a Certificate of Acceptance to Study and data on non-EU international migrants granted Leave to Remain status – these are used to estimate the distribution at local authority level of non-EU international migrants who are further education students
- census data: used for distributing UK-born returning migrant flows
- Patient Register Data Service (PRDS): data on migrants who register for a GP whose previous address was outside of England and Wales – these are used alongside the other administrative sources to distribute the remaining immigrants, such as children, those aged 17 to 59 years who are not students or workers and those aged 60 and over

Sex and age breakdown

Census cluster analysis

2011 Census data on immigrants have been used to group local authorities into clusters with similar age and sex structures. Census immigrants are defined as those who stated that they had arrived in England and Wales in the year before the census and intended to stay more than 12 months. Recent research, carried out by ONS, has confirmed that the 2011 Census is still the best available data source for sex and age distributions of immigrants at local authority level.

Sex and age breakdown

Each year, the cluster analysis of immigrants is used to inform the sex and age distribution of the local authority immigration estimates. Each local authority level record is assigned to the cluster group based on local authority, and sex and age is imputed based on the average sex and age distribution of that cluster group.

International emigration

Local authority level estimates

Modelling the estimates

A statistical model is used to estimate emigration at local authority level. The model estimates the numbers of emigrants over the year, using relationships established between the estimate of emigration from the IPS and estimates from other data sources (covariates) that can predict a more robust estimate of emigration at local authority level than the IPS alone can provide.

The model includes an “offset term” representing the (previous year’s) population of an area. This transforms the model from a model of counts to a model of rates – in effect modelling the “risk” of a resident emigrating over the year. This is a standard approach adopted for such models and ensures that the modelled emigration remains related to the population at risk.

Response variable

The IPS weighted estimate of emigration is used as the response variable and is based on a three-year average; the year estimated and the previous two years. This is necessary because the number of emigrants sampled in one year is small and the spread of the sample across the country is uneven, with many local authorities having no sampled emigrants.

Covariates

The covariates used in the model come from census, administrative and survey data sources and have been found to have a strong relationship with emigration at local authority level. Each covariate is fixed in the model to avoid problems of instability in the year-on-year emigration estimates.

The covariates in the model are listed in Table 1.

Table 1: Covariates used in the emigration model

Covariate source and name	Description of covariate
2011 Census	
lillness	Usual residents with limiting or long-term illness
mfeasia	Usual residents of Mid-or Far East-Asian country of birth
oceania *	Usual residents of Oceania country of birth
namerica *	Usual residents of North American country of birth
sasia	Usual residents of South-Asian country of birth
Hostels *	Usual residents living in hostels
Annual Population Survey	
APS_mortgage	Accommodation owned with mortgage
APS_rent	Accommodation rented
APS_retired	Retired people
APS_emp16p *	Employed aged 16 and over
Births	
COBM_EU2	Number of births with country of birth of mother in EU2
COBM_EU8	Number of births with country of birth of mother in EU8
Higher Education Statistics Agency	
HESA_FYSTUD_2025_EU	Students of EU (EU2, EU8 and EU15, excluding UK) nationality in higher education in their final year of study, aged 20 to 25 years
Migrant Worker Scan	
MWS_EU8 *	Migrant workers of EU8 nationality
MWS_EU8	Migrant workers of EU8 nationality aged 26 to 59 years
ONS population estimates	
Intlinmig	International in-migration estimates for the year of interest
Patient Register	
PR_515	Registered patients aged 5 to 15 years

Source: Office for National Statistics

Notes:

1. Covariates marked with an asterisk (*) also appeared in the previous version of the model.

Covariates marked with an asterisk also appeared in the previous version of the model. One covariate was present in the previous model but was dropped from the current model: this is “africa” – the 2011 Census estimate of usual residents with country of birth in Africa. This variable was not shown to have a statistically significant contribution to the accuracy of the model.

Constraining

The modelled estimates of emigration at the local authority level are constrained to the IPS estimates at regional level.

Sex and age breakdown

A combination of 2011 Census and IPS data are used to add sex and age detail to the modelled local authority emigration estimates. This process groups local authorities into clusters based on sex, age and citizenship data gained from the census.

Local authority cluster analysis

Census data for immigrants are used to classify local authorities into clusters that have similar patterns of UK born and non-UK born migration, as a proportion of the total population.

We use census data to classify local authorities into groups as IPS data are not reliable at local authority level. Immigration data are used because census data on emigration are unavailable to produce estimates of emigration. We assume that immigration data are likely to show similar patterns of UK born and non-UK born migration to that exhibited in emigration patterns at local authority level.

Citizenship and sex

Using the local authority clusters derived from census data, IPS data for emigrants are used to create a distribution by citizenship (British, non-British) and sex, for each cluster. The IPS is broken down by citizenship because it is assumed that British and non-British emigrants are likely to have a different age structure.

Single year of age

Three years of IPS data (current year and previous two years) are used to provide a detailed single year of age distribution, by citizenship and sex. This age distribution is smoothed using a centred average to remove noise.

The smoothed single year of age distribution is applied to the cluster, citizenship and sex distribution.

Applying to modelled emigration estimates

The local authority level emigration estimates are assigned a cluster group. Citizenship, sex and age are then imputed onto each record, based on cluster group.

Asylum seekers and dependants

Most movements of asylum seekers are not captured by the IPS. The UK Border Agency of the Home Office provides ONS with data on asylum seeker applications and their dependants, including removals, refusals, withdrawals and appeals. This information is used to adjust the estimated international migration inflows and outflows for asylum seekers.

Any asylum seekers counted by the IPS on arrival or departure to or from England and Wales are excluded from our processing and Home Office data for asylum seekers used to ensure flows are not double-counted.

Asylum seeker inflows

Estimates of asylum seeker flows into England and Wales are based on the number of asylum seeker applicants. An adjustment is made for the small number of asylum seekers who are recorded as both a principal applicant and a dependant. Counts of applicants who returned to their country of origin within a year of their application are removed.

Asylum seeker outflows

Data on asylum seeker flows out of England and Wales are estimated based on asylum applicants that are assumed to have left England and Wales after staying for at least a year, using information on removals, refusals and withdrawals.

Local authority

Estimates of asylum seeker inflows and outflows are only available by region. Data for asylum seekers at local authority level are available for those who receive support from the National Asylum Support Service (NASS). There are no data sources that provide local authority level information for those who claim asylum but do not request any associated support.

Estimates of asylum seekers are broken down from region to local authority using a broad assumption that 60% receive support and 40% are unsupported. The 60% assumed to receive support are distributed to local authority level using the local authority distribution for asylum seekers receiving support for accommodation. The remaining 40% are assumed to have the same geographical distribution of residence as those given subsistence-only support by NASS (for example, those who are not dispersed to accommodation in particular areas).

Single year of age

A single year of age distribution for both asylum seekers and their dependants is derived using a combination of data from the Home Office and the national mid-year population estimates from the previous year.

Refugees

The Home Office operates a number of international resettlement schemes that result in people entering the UK. Such people are granted humanitarian protection and while they are commonly referred to as “refugees”, it is important to note that they do not have refugee status according to the strict UN definition. The Home Office database covering such schemes includes the [Gateway Protection Programme](#), the [Mandate Scheme](#) and [Syrian Vulnerable Persons Resettlement Scheme](#) (SVPR), but not those resettled to the UK under the [“ex gratia scheme” for Afghan locally engaged civilians](#).

In September 2015, the [government pledged to receive 20,000 Syrian refugees over the subsequent five years](#). Consequently, flows of refugees became sufficiently large to justify refugees being treated as a separate component within the calculation of the mid-year population estimates for England and Wales.

Refugee inflows

For the purpose of the mid-year population estimates, refugee inflows are estimated by single year of age and sex for each local authority in England and Wales.

Most movements of refugees into the UK are not captured by the IPS; any that are counted are excluded from processing to ensure that no double-counting occurs. ONS is sent an extract of the resettlement database by the Home Office for people arriving in the year up to 30 June of the reference year. The data includes information on the age, sex and citizenship of the refugees.

For those refugees entering under SVPR, information on their initially assigned local authority is also available. These refugees are allocated to a local authority in advance of resettlement and this has been recorded on the Home Office dataset that ONS receives. Analysis on the actual regional distribution of SVPR persons within England and Wales supports the use of the initially assigned local authority as their place of usual residence.

For a minority of refugees, information on their initial local authority of residence is not known. For these, a local authority is imputed using the distribution of SVPR refugees within England and Wales.

Refugee outflows

Outward flows of refugees are thought to be very small at this stage; refugees leaving the UK would be covered by the IPS, as they would leave from a UK port of departure.

7 . Home armed forces

Who's included?

The population estimates include all members of the UK armed forces (UKAF) who are stationed in England and Wales. Members of UKAF deployed on operations and temporary assignments overseas are also included in the population estimates where their last permanent station is in England and Wales. Personnel that are serving on overseas postings are removed from the population estimates, but we account for their flows and those of their accompanying dependants into and out of England and Wales.

Special population

UKAF are treated as a special population as the movements of military personnel are not captured by the data sources used to estimate international and internal migration.

It is assumed that UKAF personnel and their dependants travel by military flights into and out of England and Wales when serving in posts overseas; routes that are not covered by the International Passenger Survey (IPS). It is also assumed that UKAF personnel are not on GP registers and are therefore not counted in the internal migration estimates. However, it is assumed that dependants are on GP registers, so movements of dependants within England and Wales are not part of the special population.

Home armed forces data

Office for National Statistics (ONS) receives aggregated UKAF data from the Ministry of Defence (MOD). These data include military personnel counts by age, sex and local authority of base.

ONS also receives aggregate data from British Forces Germany (BFG) by sex and age, of dependants (partners and children) who accompany members of UKAF stationed in Germany. Germany has the second-largest population of UKAF after the UK and accounts for approximately three-quarters of all UKAF posted overseas.

Census data for the home armed forces are also used to inform distributions for local authority of usual residence.

Change in UKAF stationed in England and Wales

Data are obtained from MOD for UKAF by sex, age and local authority of base, stationed in England and Wales. To fit in with the population estimates usual residence definition, the UKAF population is estimated at the residence at which they spend most of their time. A base to residence distribution based on census data is used to adjust UKAF from their local authority of base to their local authority of residence.

Change in civilian population

Any change in the population of UKAF from one year to the next will be reflected in the civilian population of England and Wales – those joining and leaving the UKAF will create a resulting inflow and outflow between UKAF and the civilian population.

This flow between the UKAF population and the civilian population must also take account of UKAF serving overseas if they are usually resident in England and Wales.

A reduction factor is applied to all UKAF (including those stationed overseas) to estimate those who would be usually resident in England and Wales, as opposed to other parts of the UK. The proportion of UKAF (excluding those stationed overseas) stationed in England and Wales is used as a proxy for calculating this reduction factor.

To account for the change in the population of UKAF stationed in England and Wales, the previous year's estimated population is subtracted from the current year's estimated population, by sex, age and local authority of usual residence.

A local authority of residence is imputed for each net flow using a local authority distribution derived from the census for the permanent home of members of the home armed forces.

Change in overseas dependants

It is assumed that dependants (partners and children) of members of the UKAF who are serving overseas are not picked up by the IPS and are therefore treated as part of the home armed forces special population.

BFG data on dependants accompanying UKAF stationed in Germany are used to provide a ratio (number of dependants per UKAF member) and sex and age distribution that can be applied to UKAF serving overseas to estimate the overseas dependant population.

A reduction factor is also applied to the estimated overseas dependant population to estimate those who are usually resident in England and Wales. The reduction factor is calculated using the same proportion as previous, so that only the overseas dependants who are usually resident in England and Wales are estimated.

To account for the change in the overseas dependant population, the current year's estimated overseas dependant population who are usually resident in England and Wales is subtracted from the previous year's overseas dependant population, by sex and age.

A local authority of residence is imputed for each net flow using a local authority distribution derived from the census for members of the home armed forces living with a partner.

Compilation

To calculate the total change of home armed forces, we calculate by sex, age and local authority using the following equation:

Net change in UKAF stationed in England and Wales plus net change in the civilian population plus net change in overseas dependants

8 . Foreign armed forces

Special population

Foreign armed forces based in England and Wales are treated as a special population in the population estimates as it is assumed that they are also not picked up by the methods used to estimate internal and international migration.

It is again assumed that foreign armed forces personnel travel by military flights into and out of England and Wales; routes that are not covered by the International Passenger Survey (IPS). It is also assumed that foreign armed forces personnel are not on GP registers and are therefore not counted in the internal migration estimates.

Changes as part of the revised back-series of population estimates for mid-2012 to mid-2016

The movements of dependents of foreign armed forces personnel are covered by the IPS. However, the methods used to distribute international migration flows to local authority level are unlikely to capture the movements of this group accurately as they tend not to appear on the GP patient registers, Migrant Workers Scan or data on higher education. This meant that we tended to “age on” the dependents found in the 2011 Census rather than updating them in line with the foreign armed forces personnel. To produce more accurate population estimates, we have extended our special population adjustment for foreign armed forces personnel to cover dependents.

Given that the dependents of Foreign armed forces are now theoretically counted twice by the mid-year population estimates (through international migration and the special population adjustment), we have introduced a further adjustment that counterbalances this; the population estimate of England and Wales including the special population adjustment for dependents is constrained back to the population excluding the adjustment.

Who’s included?

All foreign armed forces personnel and their dependents (partners and children) usually resident in England and Wales should be included in the population estimates. The United States Air Force (USAF) make up the majority of foreign armed forces; however, there are a number of military personnel from other US service arms (US Army, Navy and Marine Corps) that are also based in England and Wales.

The foreign armed forces component only accounts for military personnel and their dependents from the USAF, with the exception of a small adjustment made for other US service arms currently located in Harrogate and North Kesteven. Foreign armed forces that are not from the US are not accounted for as part of the special population as there are no data currently available. However, these are considered very small in number.

United States Air Force (USAF) data

Data for USAF based in England and Wales are supplied to Office for National Statistics (ONS) annually on or around the reference date of 30 June for the number of USAF military personnel and their dependents, by sex, age and base in England and Wales.

Adjustment for Harrogate and North Kesteven

An adjustment is made for the local authorities of Harrogate and North Kesteven for other US service arms to account for pockets of localised foreign forces resident in these local authorities. The adjustment is based on data from the US Department of Defence's Statistical Information Analysis Division (SIAD) on the total number of US Army, Navy and Marine Corps personnel based in the UK.

Base to local authority of residence

The population of England and Wales is estimated at the local authority of usual residence. USAF data is only provided by base and therefore local authority of usual residence is imputed using data derived from the 2011 Census. For any bases in the USAF data where there is no base to residence information available in the census, residence is assumed to be at the local authority of the base. This is a valid assumption as the majority of members of the US armed forces live on base.

Change in foreign armed forces population

The change in the foreign armed forces population between the two mid-year points is estimated by subtracting the previous year's estimated foreign armed forces population from the current year's estimated foreign armed forces population, by local authority of residence, sex and age.

The exception to this approach is the method for estimating zero-year-olds. At the beginning of the process of calculating the mid-year estimates (MYE), all zero-year-olds of the previous year's special population must be subtracted. This is to avoid ageing on any zero-year-olds that will be accounted for at the end of the MYE calculation process through addition of the current year's special population one-year-olds.

However, when the current year special population is added at the end of the MYE calculation process, none of the zero-year-olds should be added. The zero-year-olds in the current year special population will already have been counted into the population because they were born in the UK and are part of the births data that are added to the MYEs as a matter of course. Some additional special population zero-year-olds will have been born outside the UK and migrated in within the last year and won't be counted, but these would be broadly balanced by those zero-year-olds born to the special population in the last year who then migrate out of the country, assuming a broadly similar resident special population over the year. There may be larger variations in this fraction if bases increase or decrease their personnel significantly.

Assumptions not stated elsewhere

Further assumptions are made in how we estimate the foreign armed forces special population. It's assumed that joiners and leavers of the foreign armed forces population are not taken from or put back into the general England and Wales population.

9 . Prisoners

Special population

Population estimates include all prisoners imprisoned in England and Wales with a sentence of six months or more. Prisoners are treated as a special population in the population estimates as it is assumed that movements of people into and out of prisons are not picked up by GP registers used to estimate internal migration.

Prisoners data

The Ministry of Justice supplies data on the number of people resident in prisons in England and Wales on 30 June of the reference year, by prison location, sex and age. For the purposes of the population estimates, a person is regarded as usually resident in a prison if they have been sentenced to serve six months or more.

Change in prisoners population

Change in the prisoner population between the two mid-year points is estimated by subtracting the previous year's estimated prisoner population from the current year's estimated prisoner population, by local authority, sex and age. This change can only be indicative as the prison estate population can fluctuate widely between mid-year points due to operational needs.

Change in non-prisoner population

Any change in the estimated prisoner population from one year to the next will be reflected in the general population of England and Wales – those joining and leaving the prisoner population will create a resulting inflow and outflow between the general population.

To distribute inflows and outflows of prisoners to and from the general population of England and Wales, the local authority distribution of the previous year's population estimate is used and we distribute flows to the local authorities with the highest populations.

Foreign national offenders and offenders from other parts of the UK

The prisoners component of the population estimates assumes that all prisoners in England and Wales remain in England and Wales following the completion of their sentence. Foreign national offenders who are deported following completion of their sentence or ex-prisoners who move to other parts of the UK are not accounted for in this method. Owing to difficulties in accurately estimating this population, it is assumed that the flow of ex-prisoners returning to England and Wales from elsewhere balances out these flows.

10 . Compilation

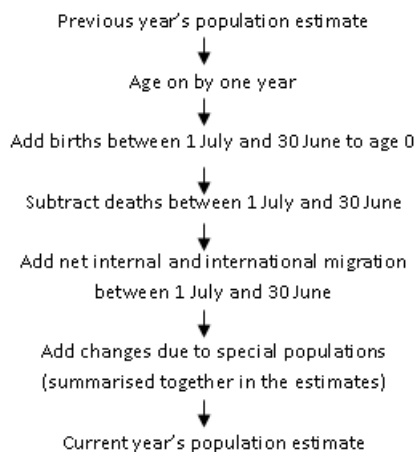
National (England and Wales) and subnational (local authority) estimates from each component are compiled to produce subnational and national population estimates.

The previous year's population estimate by sex, age and local authority of usual residence is aged on by one year. The number of births between the two mid-year points is added into the population at age zero. Deaths between the two mid-year points are removed from the population estimates.

Net flows of internal migration within the UK and net flows of international migration are then added into the population estimates. Changes because of special populations are also added into the population.

The resulting population estimate is the final population estimate for 30 June of the current year, by sex, age and local authority.

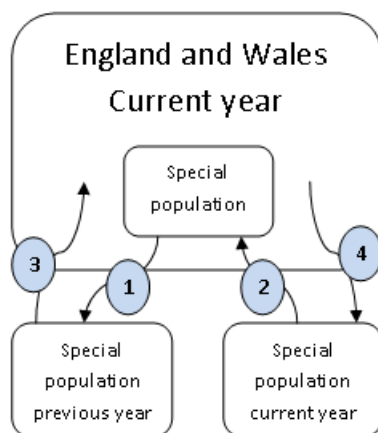
Figure 1: Flow diagram of the cohort component method



Special populations

Arrows 1 and 2 in Figure 2 show the process used to calculate the change in each special population between the previous year and current year. The main concept is that people move from the general population into a special population (for example, when joining the armed forces) and when they leave a special population they return to the general population. Arrows 3 and 4 show the process used to calculate the change in the England and Wales population that is due to a change in the special population between the previous year and current year.

Figure 2: Special populations, England and Wales, current year



11 . Appendix 1: Quality assurance of administrative data reports

We quality assure the administrative data used in the estimation of the annual mid-year population estimates to ensure that they are suitable for this purpose. To gain further insight on data quality issues and the impact on population statistics, please see the quality assurance of administrative data reports for each data source:

- [Births](#)
- [Deaths](#)
- [UK Armed Forces](#)
- [US Armed Forces](#)
- [Patient Register](#) (PR)
- [Higher Education Statistics Agency](#) (HESA)
- [Prisoners](#)
- [National Health Service Central Register](#) (NHSCR)
- [Migrant Workers Scan](#) (MWS)
- [Asylum Seeker Data and Non-Asylum Enforced Removals](#)
- [Home Office Immigration](#)
- [Asylum Seekers Support](#)

12 . Appendix 2: Proposed changes in methods

This appendix contains descriptions of a proposed change to the methods used to produce internal migration estimates that feed into the population estimates for local authorities in England and Wales. We welcome any comments or questions on this proposal via email to pop.info@ons.gsi.gov.uk.

Internal migration

The largest element of population change at the local authority level is internal migration – that is, people moving from one local authority in the UK to another. Three areas of improvement to internal migration methodology that are being implemented for 2017 and subsequent mid-year population estimates (MYEs). They are:

- graduate destinations
- cross-border flows
- estimating within-year moves

“Graduate” destinations

The fundamental approach to estimating internal migration within England and Wales is to compare people's area of residence on their health registration with that in the previous year. We know that one weakness of that approach was that people moving to (or leaving) higher education might be slow to update their registration, so we would not identify all the moves into student areas, or into areas where graduates tended to move to after completing their studies. We have used several methods to try to account for these moves.

We improved our methods in 2013 by linking the health registration data with data from the Higher Education Statistics Agency (HESA). The HESA data showed where students were registered by their university as living and this allowed us to make more accurate estimates of the numbers of people moving to study in each area. However, it did not tell us where people (in particular, those people who were slow in updating their health registration) moved after completing their studies.

Rather than simply assume that those people stayed in the area in which they studied (which would result in over-estimating the population of that area), we used a simple model in which people completing their studies and not updating their health registration record would be assumed to move back to their health registration address over time.

We plan to improve this model for the 2017 (and subsequent) MYEs by introducing a new end-of-studies methodology – the Higher Education Leavers Methodology (HELM). This method will distribute those higher education leavers who have not updated their Patient Register address after leaving higher education, using the movement patterns of students who have previously left higher education.

The method can be summarised as follows:

- identify those people who need to have their area of residence imputed; these will be health registration records previously linked to the HESA data where there is no longer a HESA record (so the person has left higher education) and where the health registration record has not been updated during the year
- identify similar people (that is, leaving higher education in that area and not updating their health registration in the first year) from three years previously and use the health registration record to estimate the distribution of destinations (we use data from three years previously so we can collect information from a largely completed cohort of movers; using three years is judged to be the best balance between using recent data to reflect current patterns and using older data to maximise the proportion of people who have updated their health registration)
- apply the estimated distribution to those people to be imputed; the random imputation is done in such a way that there will be no systematic biases in destinations chosen but the final distribution will be very close to the initially-estimated distribution

Though we do not yet have quantitative evidence for this, we can reasonably expect the estimates produced using the HELM to be more accurate than those produced using the existing method. Recognising that higher education leavers might disperse to any of the 348 local authorities in England and Wales will mean the internal migration estimates should better reflect reality. Furthermore, by not simply keeping the higher education leavers at their HESA address or returning them to their health registration address, we can also expect the methodology to improve the number of post-student-aged individuals remaining in “student” local authorities.

It's important to note that some people do, in reality, remain in their local authority of study following higher education. The HELM does recognise and deal with this too, as the destination distributions still reflect a number of individuals staying in their local authority of study. Though we do not yet have quantitative evidence for this, we can reasonably expect the estimates produced using the HELM to be more accurate than those produced using the existing method.

Recognising that higher education leavers might disperse to any of the 348 local authorities in England and Wales will mean the internal migration estimates should better reflect reality. Furthermore, by not simply keeping the higher education leavers at their HESA address or returning them to their health registration address, we can also expect the methodology to improve the number of post-student-aged individuals remaining in “student” local authorities.

In contrast to the current methodology, which continues to distribute students over time, the HELM distributes all higher education leavers to their imputed destination in the first year after they finished higher education. Although this will introduce some inaccuracy, as some of the moves informing the destination distributions took place in the second or third year after leaving higher education, this is offset to some extent by the fact that although those moves may have been recorded in the second or third year following leaving higher education, some of these will have been “lagged” moves that actually took place in the first year after leaving study. There is a further offsetting effect in that the destination distributions assume that any individuals who did not change address in any of the three years after leaving higher education remained in their local authority of study while some of these may have moved (but not updated their health registration).

As with the current methods, the approach of imputing place of residence for individual records has substantial advantages over making aggregate adjustments, as any incorrect imputation would be automatically corrected when that person updates their health registration record. We plan to implement this method for the 2017 MYEs and subsequent MYEs.

Cross-border flows

The main internal migration methods are used to estimate internal migration between areas in England and Wales. Slightly different methods are used to estimate migration flows between areas in England and Wales (as a whole), and Scotland and Northern Ireland.

Prior to 2018, estimates for flows from Scotland and Northern Ireland into England and Wales were produced using health registration data obtained through the NHS Central Register (NHSCR) and Patient Register (PR) sources (unlike the estimates of moves within England and Wales, these data are not linked to higher education data to better estimate moves to and from study). We now obtain health registration data primarily through the Personal Demographic Service (PDS). Whilst the underlying data (relating to people registered with GPs) used in the estimates remains the same using the PDS, the level of detail available from that data source allows us to adopt a more straightforward approach.

For the 2017 MYEs being published in 2018 and subsequent MYEs, we plan to estimate cross-border flows by using the counts of moves from Scotland and from Northern Ireland obtained from weekly extracts of PDS record changes. This will be the first use in the population estimates of data obtained through the PDS and we will publish a quality assurance of administrative data report on that data source in 2018.

Estimating within-year moves

The majority of internal migration moves reflect someone living in one area of England and Wales at the start of the year and another one at the end of the year. This type of move is called a “transition”. However, not all moves are of this type. People may move multiple times within the year, babies might be born after the start of the year and move to a new address before the end of the year, and people present at the start of the year might move and then die or emigrate before the end of the year. These types of moves are collectively called “within-year moves”.

Within-year moves are calculated by estimating the ratio of within-year moves to transitions and then applying that ratio to the estimated number of transitions. Rather than assuming that this ratio is the same for all places and at all times, we use health registration data for each year and for areas within England and Wales to estimate these ratios.

As noted previously, we now obtain health registration data via a different system to that previously used and this means we now have access to more detailed information on the area of the start- and end-place of within-year moves. However, we have not yet demonstrated that using this more detailed information results in more reliable population estimates. Therefore, we intend to follow the existing method of estimating within-year moves as closely as possible for the 2017 MYEs until we have completed further research ahead of the 2018 MYEs.

The inclusion of within-year moves in the internal migration estimates means that we will not be changing the target concept for these estimates, as had been proposed in the [population estimates methodology guide](#) in June 2017.

13 . Appendix 3: Historical methods

The mid-year population estimates release each year contains population estimates from 2001 to the present year. Some of the main differences between the methods outlined previously and those used between 2001 and 2011 are discussed in this appendix.

Internal migration estimates (mid-2002 to mid-2011)

Internal migration estimates for mid-2002 to mid-2011 are based on Patient Register data (both the Patient Register Data Service (PRDS) and the National Health Service Register (NHSCR)) enhanced using aggregate data from Higher Education Statistics Agency (HESA) and 2001 Census data to better account for the movements of students. Further [details on this method](#) are available.

International immigration estimates (mid-2006 to mid-2011)

This method is broadly similar to the one currently used; international immigration at the England and Wales level is distributed to local authorities by stream using administrative data. Further details on this method are available in [Improved methodology for estimating immigration to local authorities \(LAs\) in England and Wales](#).

International immigration estimates (mid-2002 to mid-2006)

For mid-2002 to mid-2006, international immigration at the local authority level was calculated using a regression model, much like that currently used for international emigration, to distribute immigrants to local authorities. Further details on this method are available in [Improving migration and population statistics](#) (PDF, 1.3MB).

International emigration estimates (mid-2002 to mid-2011)

For mid-2002 to mid-2011, international emigration at the local authority level was calculated using a regression model, much like that currently used, to distribute emigrants to local authorities. Further details on this method are available in [Improving migration and population statistics](#) (PDF, 1.3MB).

Migration to and from Ireland (mid-2002 to 2007)

Historically, Office for National Statistics (ONS) used data from the Central Statistics Office (CSO) in Ireland to estimate migration flows between the UK and the Republic of Ireland. Their data were used because there were no routes between the two countries surveyed by the International Passenger Survey (IPS).

From mid-2008, flows to and from Ireland were covered by the IPS. Further details can be found in [Improving estimates of international migration in Northern Ireland, and between the UK and Republic of Ireland](#) (PDF, 57.3 KB).

As part of the revised back-series of population estimates for mid-2001 to mid 2010 produced as following the Census, additional changes were made. These changes are detailed in [Methods used to revise the subnational population estimates for mid-2002 to mid-2010](#) (PDF, 640KB).

