

# Methods for producing mid-2021 population estimates rolled forward from Census 2021

Developments in producing mid-2021 population estimates rolled forward from Census 2021, by local authority district, age, and sex. Includes method changes needed to roll forward the three months from Census Day to mid-year and discusses our ongoing challenges.

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# 1 . Main points

- This methodology describes the broad methodological approach for producing population estimates for England and Wales for mid-2021 rolled forward from Census 2021.
- Rolling forward population estimates from Census Day 2021 to mid-2021 requires different methods to a standard set of mid-year population estimates.
- Births and deaths for the period between Census Day and mid-2021 are based on birth and death registrations.
- Internal migration estimates for Census Day to mid-year will be largely based on address changes in administrative data between 21 March and 30 June 2021.
- International migration estimates for Census Day to mid-year will be based on new administrative based measures.
- For special populations (home armed forces, foreign armed forces, and prisoners), we are making no adjustment for population change between Census Day and mid-year.
- Research is ongoing for both internal and international migration and will be described in more detail alongside the published mid-2021 population estimates planned for November 2022.
- We have also published a local population insights feedback framework to allow users of local population statistics to provide information to us regarding population estimates in their local area.

## 2 . Overview

Population estimates for mid-2021 are scheduled for publication in November 2022. Ordinarily, mid-year population estimates (MYEs) are released 12 months after the date they refer to. The additional production time for mid-2021 reflects the extra work needed to incorporate Census 2021 into the mid-year estimates, changes to estimates of international migration, and additional research needed for internal migration methods.

### Census and mid-year estimates

The census provides our best population estimate for Census Day 2021 (21 March). However, 21 March was during the third national lockdown and it is likely that some people would have been resident in different places if there had been no restrictions.

Meanwhile, the population estimates for mid-2021 (30 June) reference a period when most restrictions had been lifted and will reflect some of the change associated with the rolling back of restrictions. The production of mid-2021 population estimates will take the census estimates for 2021 and roll forward to 30 June 2021 by accounting for population ageing, births, deaths, and internal and international migration. While these estimates will attempt to reflect the population change that took place over this three-month period, they will not reflect a non-coronavirus (COVID-19) pandemic usually-resident population in England and Wales.

## Cohort component method

Our usual methods are designed to account for a full year's population change between 1 July and 30 June mid-year points. The objective of the mid-2021 estimates is to account for population change between Census Day 2021 (21 March) and mid-2021 (30 June), a period of just over three months.

National and local authority population estimates are produced using a well-established demographic approach called the cohort component method. This is a standard demographic method and is used by many other countries that do not have a population register. The cohort component method uses information on components of population change to update a population base (in this case the decennial census estimates). It involves combining information from a number of data sources, using the previous census population estimate as the population base, and survey data and administrative registers to measure the components of population change for the years following the census. In its simplest form, the cohort component method calculation can be expressed in equation form as:

$P$  equals  $P$  plus  $B$ , minus  $D$ , plus  $M$ ,

where  $P$  equals population at time  $t$ ;

$P$  equals population at time  $t-1$ ;

$B$ , equals births, in the interval from time  $t-1$  to time  $t$ ;

$D$ , equals deaths, in the interval from time  $t-1$  to time  $t$ ; and

$M$ , equals net migration, in the interval from time  $t-1$  to time  $t$

Some of the methods used to produce the mid-year estimates are easily scalable to cover shorter periods of time, while others require considerable change. In addition, some data sources used in the production of the mid-year estimates (for example those reflecting registration with healthcare) have been significantly affected by the coronavirus pandemic and so require further changes to our methods.

## Definitions

The MYEs refer to the usually resident population of an area on 30 June of each year. The usual resident population is defined by the [standard United Nations definition for population estimates \(PDF, 2.535KB\)](#) and includes people who reside in the area for a period of at least 12 months whatever their nationality.

Long-term international migrants (people who move into or out of the country for at least 12 months) are accounted for in the estimates. However, visitors and short-term migrants (who enter or leave the country for less than 12 months) are not accounted for. Students are taken to be resident at their term-time address. Members of Her Majesty's Armed Forces stationed in England and Wales are included in the estimates at their place of usual residence.

### 3 . Census base

In a census year, the starting point for the mid-year estimates (MYEs) is the “usually-resident population” on Census Day. The “usually-resident population” includes people who live in an area even if they were not physically present on Census Day, but does not include people who changed their “usual residence” because of the coronavirus (COVID-19) pandemic.

We used a variety of techniques to ensure Census 2021 population estimates are as accurate a reflection as possible of the usually-resident population as it was on Census Day. We recognise that the usually-resident population at Census Day was, for some areas, different to what the usual-resident population would have been expected to be without the pandemic. More information can be found in our [Quality and Methodology Information report for Census 2021](#) and in [our report on how we ensured an accurate estimate of students](#).

The starting point for the mid-2021 population estimates is Census 2021. MYEs for mid-2011 through to mid-2020 used the 2011 census as their starting point.

We will take an extract of Census 2021 by local authority, sex, and single of year age. Importantly, the age of the population (in completed years) on Census Day will be adjusted to reflect age at the mid-year point. For example, a person aged 15 years and 11 months on Census Day in 2021 would be aged 16 years by the mid-year point, whereas a person aged 15 years and 4 months would still be aged 15 years. Further, those who were born during the period between Census Day and the mid-year point are added to the population aged zero. Those who died during the same period are removed according to what their age at the mid-year point would have been.

### 4 . Births

The method for accounting for births for the period between Census Day and mid-2021 is identical to the standard full year method. Births in England and Wales occurring in the reference period are added to the population at age zero, by sex, and allocated to the local authority of usual residence of the mother. In this case, it is births occurring between 22 March and 30 June 2021.

### 5 . Deaths

For a standard year, 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.

The method for Census Day to mid-2021 differs slightly from the full year method. For a standard year, data received for the latter half of the reference period (1 January to 30 June) are provisional as some very late registrations are not included by the time of producing the mid-year estimates. An adjustment is made to account for this by using the difference between provisional and final data for 1 January to 30 June in the previous year as a proxy for late registrations in the current year.

Estimates of deaths after Census Day (March 21) up to 30 June 2021 include registered deaths that occurred during this period plus a similar adjustment for late registrations. However, in this case a proportion of the late registrations known to have occurred for the period 1 January to 30 June 2020 is used.

### 6 . Internal migration

The production of internal migration estimates for mid-2021 cannot be simply derived using our existing methods and data sources. One significant difference from our usual method is a change in data sources from the NHS Patient Register to the Personal Demographics Service. In addition, we are conducting research to understand and address the impact of the coronavirus (COVID-19) pandemic, including the COVID-19 vaccines rollout, on the administrative data that informs our internal migration estimates. This will help ensure moves within the UK that took place between Census Day and mid-2021 (30 June) are reflected as accurately as possible.

## Moving to the Personal Demographics Service from the NHS Patient Register

For mid-2021, the primary data source underpinning internal migration will be the [Personal Demographics Service \(PDS\)](#) rather than the NHS Patient Register (PR). This reflects the discontinuation of the PR.

There is a considerable overlap between the PR and the PDS, but the PDS is informed by a wider range of interactions with health services than the PR was. In making the switch to the PDS we are ensuring that we maintain consistency with existing definitions. In particular, we are aware that the PDS has a wider coverage of the population than the PR, as those in health systems related to the armed forces and the prison service are largely excluded from the PR but are covered by the PDS. Until we understand more about the levels of coverage of these groups in the PDS, we will exclude them from internal migration estimates. We will continue to estimate the populations of the armed forces and prisons using our special population methods (described in [our Population estimates for the UK, mid-2020: methods guide](#)).

Each year our internal migration method creates a population stock file that integrates together the PDS (formerly the PR), Higher Education Statistics Agency (HESA) data, and our method for dealing with higher education (HE) leavers to provide our best understanding of where individuals are in the country. The address differences for individual records on the current and previous year's stock file indicate where individuals have moved to a different part of the country. These differences are used to produce internal migration flows.

The wider range of interactions with health services feeding the PDS means that for some individuals, their location on the PR and PDS, for the same point in time, can be different. Where differences between the PR and PDS data for 2020 occur, we have updated the existing PR stock file to reflect the address on the PDS for 2020. By making this adjustment we minimise the disruption between the transition from PR to PDS as we are in effect generating our internal migration estimates from two PDS-based stock files.

### Use of PDS for Census Day to mid-year

The standard method for producing internal migration is described in detail in [our Population estimates for the UK, mid-2020: methods guide](#). In summary, we link together administrative data (through our stock files) from consecutive years and count where an individual's address in the current year is different to the previous year. For Census Day to mid-year, we will make use of PDS data for Census Day 2021 alongside the usual extract for mid-year 2021. As such, we will make a direct estimate of internal migration using the same data as for a full year.

## Lagging in administrative data

Implicit within our internal migration estimates is the assumption that the administrative data is a good proxy for individual's real usual place of residence. In census years, we get the opportunity to directly check the consistency between administrative data and an accurate version of people's place of residence from the census.

We would expect to find that the administrative data would exhibit patterns of lagging compared with the census (which is not subject to lagging). Lagging in administrative data occurs when a real change in circumstances (such as a change in address) is not accompanied by an immediate update to administrative data sources. Higher levels of lagging are associated with groups that do not interact with public services on a regular basis. Traditionally, the level of lagging in PDS (or PR) data was highest for males in their 20s and 30s.

For Census Day to mid-2021 there is a significant risk of disruption to the relatively stable patterns of lagging we would expect. During the coronavirus pandemic in the first half of 2021, higher levels of interaction between individuals and the NHS were seen, for example, through the rollout of vaccines and mass testing. This makes it likely that the PDS data for mid-2021 will be much less lagged than the PDS data for Census Day 2021 (in turn the PDS data for Census Day 2021 is likely to be less lagged than the equivalent for mid-2020). This will almost certainly have implications for internal migration flows and additional adjustments may be needed.

In some cases, changes in administrative data between Census Day and mid-2021 will reflect the catching up of administrative data with reality; this will generate internal migration moves that happened prior to Census Day that we implement after Census Day. Internal migration in the period after Census Day could in effect migrate people into their address at Census Day.

To some extent this process happens after every census but the impact of the COVID-19 vaccines rollout means that the typical gradual realisation of lagged moves will be concentrated into the period between Census Day and mid-year.

Between 17 March and 18 June 2021, appointments for COVID-19 vaccinations were rolled out to everyone aged 18 to 50 years between Census Day to mid-year. In England, [14 million people received a first dose of a COVID-19 vaccine](#) (nearly 36 million received a first dose in the period between 1 January and 30 June 2021). This unusually high level of interaction with health services will have changed patterns of lagging which risks the MYEs reporting a higher level of internal migration than occurred, should the usual methods be applied without adjustment.

## Evidence for changes to lagging in PDS data

Our provisional research into internal migration for mid-2021 suggests that internal migration flows for the period between Census Day and mid-year exhibit some unusual patterns. In particular, we observed higher proportions of moves among groups of individuals which are inconsistent with historical and anticipated trends. Specifically, internal migration flows for this period included a much higher proportion of moves by males in their 20s and 30s, a group who tend to be slower at updating their administrative records.

A reasonable interpretation of this is that the PDS, the main administrative data source underpinning our internal migration estimates, has to some extent been "de-lagged" over the last year. The change from a more lagged PR (in 2020) to a substantially less lagged PDS (in 2021) means that the level of moves indicated will incorporate a higher proportion of moves that likely occurred prior to the reference period. Therefore, when identifying moves between Census Day and mid-2021, there is a risk of moving individuals again to an address they were already at on Census Day.

## Comparing PDS internal migration with alternative data sources

We have also compared how internal migration rates differed between survey and administrative data sources. We wanted to understand if survey data sources which are not affected by lagging, were also picking up the changes in levels of moves captured in the PDS related to the coronavirus pandemic (including the rollout of the vaccine). The two data sources investigated were the Labour Force Survey and Understanding Society.

Unfortunately, this work has shown the difficulty in measuring internal migration from survey sources and relatively little about the representativeness of internal migration from the PDS. Differences in data collection and production methods between the data sources prevented simple comparisons of estimates derived from each source.

We are also investigating the use of census data to address a large volume of moves indicated by the PDS to have occurred post Census Day 2021, which we suspect to be lagged moves from prior to Census Day. Our proposed approach involves linking census data to the PDS so that we can potentially eliminate moves on the PDS that put people into the same local authority as they appeared in the census. Further research and testing are required before this approach can be implemented. The final methods used will be fully documented in the methodology publication accompanying the final estimates. The primary objective of any adjustments to our methods will be to minimise the impact of changes to administrative data to produce more accurate internal migration and population estimates for mid-2021.

## 7 . International migration

Estimates of international migration in the mid-year population estimates have historically been based on long-term international migration estimates (LTIM), of which the International Passenger Survey (IPS) was the largest component until its suspension in March 2020. Stretched beyond its original purpose, the IPS had known limitations which led us to launch the migration statistics transformation programme. This was accelerated in August 2020 when we announced that we would not return to producing official migration statistics from the IPS.

We now focus on measuring migration using primarily administrative data (admin-based migration estimates (ABMEs)). Therefore, for the mid-2021 population estimates we will be using these ABMEs. However, the full methods to produce [international migration estimates by single year of age, sex and local authority](#) using administrative data are still being developed.

Experimental statistics on UK level international migration for the year to mid-2021, based on administrative data, were published in [our Long-term international migration, provisional: year ending June 2021 bulletin](#). Further improvements to the methods for mid-2021 estimates and [long-term international migration estimates](#) up to the year ending June 2022 will be published in November 2022. The estimates planned for November 2022 will feed into the mid-2021 population estimates.

## 8 . Special populations

Unlike the standard full-year method, we are not making an adjustment for special populations (armed forces and prisoners) for the period between Census Day and mid-year. These populations and their age-structures are generally stable and the short period between Census Day and mid-year means any change is assumed to be small. Further, the annual adjustments we make are based on annual stock estimates, and there is a lack of suitably detailed data available to allow for an effective estimate of changes to special populations between Census Day and mid-year to be made.

## 9 . Future developments

Alongside the mid-2021 population estimates we will publish documentation describing the final methods used. The release will also include information about the quality of the estimates. However, it will not be possible to publish confidence intervals alongside the mid-2021 population estimates as the changes to methodology require additional changes to our measures of uncertainty that cannot be completed in time. We will aim to publish these alongside the mid-2022 population estimates in June 2023.

The mid-2021 estimates rolled forward from Census 2021 will be accompanied by a set of mid-2021 population estimates rolled forward from the mid-2020 population estimates (including components of population change for the year to mid-2021). The comparison of these two sets of estimates forms the basis of the reconciliation exercise that will look to explain the causes of intercensal drift between 2011 and 2021. Following the reconciliation process a set of rebased population estimates for mid-2012 to mid-2020 will be published (planned for spring 2023). More information about our plans is available in our article, [Rebasing and reconciliation of mid-year population estimates following Census 2021 – an update for users of population statistics](#).

Following the reconciliation and rebasing exercise we will work on the development of assumptions for the 2021-based population projections. We plan for the rebased annual components of change to be used to inform the assumptions used in 2021-based projections. Starting the development of assumptions from using the rebased components of change will provide the best possible long-term assumptions for projections. Wherever possible, we will seek to use a sufficiently long historic timeseries from our rebased components of change for developing our assumptions.

The production of assumptions for projections will only commence when rebased components of change are available. Therefore, we plan for national population projections (NPPs) to be published in the second half of 2023, with subnational population projections (SNPPs) for England and household projections (HHPs) for England to follow by early 2024. Our HHPs require SNPPs as input data and SNPPs require NPPs as input data.

### Transforming population statistics

The census has evolved throughout the decades, providing an insight every 10 years into who we are and how we live. While the census and mid-year population estimates based on the census provide the best picture of society at a moment in time, how we produce our population and social statistics is changing.

We are using a variety of data sources, to provide more frequent, relevant, and timely statistics. This will allow us to understand population change in local areas this year and beyond.

[Our Dynamic population model for England and Wales: July 2022 article](#) was the first in a series of publications that outlined our plans to transform population and migration statistics. It described our initial research into a dynamic population model (DPM).

In autumn 2022, we will publish our research on provisional June 2022 population estimates for a selection of local authorities.

In winter 2022, we will publish our research on provisional June 2022 population estimates for all local authorities.

### Local population insights feedback framework

We have also published a [Local population insights feedback framework](#) to allow users of local population statistics to provide information to us regarding population estimates in their local area. The feedback tool enables us to collect information about local data sources that have the potential to highlight differences and provide comparisons with our population estimates.

We will use the information received through this feedback tool to help us understand local data sources and insight, as well as feeding into ongoing research programmes. While we are not proposing to make quantitative adjustments to the mid-2021 population estimates on an area-by-area basis, decisions about evidence-based adjustments to future population estimates may be guided in part by data provided through this feedback framework.



## 10 . Related links

### [Population estimates for the UK, mid-2020: methods guide](#)

Methodology | Released 25 June 2021

Methodology guidance on national and subnational mid-year population estimates for the UK and its constituent countries, which are broken down by administrative area, age, sex and components of population change.

### [Methodology Guide for Mid-2011 Population Estimates, England and Wales \(PDF, 180KB\)](#)

Methodology | Released September 2012

Methodology guidance on national and subnational mid-2011 population estimates for England and Wales.

### [International migration statistical design progress report: July 2022](#)

Methodology | Released 14 July 2022

An update on the future of international migration statistics in 2022 and beyond.

### [Population and household estimates, England and Wales: Census 2021](#)

Statistical Bulletin | Released 28 June 2022

Census 2021 rounded population and household estimates for local authorities in England and Wales, by sex and five-year age group.

### [Population statistics and sources guide](#)

Methodology | Released 15 July 2022

A comparison of the different types of population estimate that are planned for or are published in 2022 and early 2023. Includes information about whether these are official estimates of the population or used only for wider research, as well as the sources, coverage and main uses and comparability issues for the estimate.

## 11 . Cite this methodology

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