National population projections quality and methodology information

Quality and methodology information for national population projections, detailing the strengths and limitations of the data, methods used and data uses and users.

Contact:
Population and Household Projections
pop.info@ons.gov.uk
+44 1329 444661

Release date:
28 January 2025

Next release:
To be announced

Table of contents

1 . Output information

- Statistical designation: accredited official statistics
- Data collection: using existing data
- Frequency: every two years
- How compiled: administrative data, survey data and projections methodology
- Geographic coverage: UK and constituent countries
- Related publications: Subnational population projections

2 . About this quality and methodology information report

This quality and methodology information report contains information on the quality characteristics of the data (including the European Statistical System's five dimensions of quality) as well as the methods used to create it.

The information in this report will help you to:

- understand the strengths and limitations of the data
- learn about existing uses and users of the data
- understand the methods used to create the data
- help you to decide suitable uses for the data
- reduce the risk of misusing data

3 . Important points

- National population projections (NPPs) provide statistics on potential future population levels of the UK and its constituent countries.
- Projections relate to the usually resident population, and do not include people who come to or leave the country for fewer than 12 months.
- They are not forecasts and do not attempt to predict the impact of future political and economic changes.
- They will inevitably differ to a greater or lesser extent from the actual future population.
- Projections become increasingly uncertain as they go forward into the future.

4 . Quality summary

Overview

We usually publish national population projections (NPPs) every two years, although this has changed over the last few years in response to user requests for further projections releases. NPPs are based on population estimates together with assumptions about future levels of fertility, mortality, and migration. Each new edition of the NPPs supersedes the previous one.

The most recent set of projections (2022-based) includes a range of variants which uses updated assumptions for fertility, mortality, and migration. The rationale for these are outlined in National population projections, background, methodology and assumption setting: 2022-based.

Uses and users

NPPs are used within and outside of government as the definitive set of national population projections. Examples of their uses include forming fiscal projections, identifying future demand for health and education services, and estimating the future cost of state pensions. They are also used as the base for subnational population projections and household projections.

Strengths and limitations

Strengths

- These data provide users with an indication of the potential size, age and sex structure of the future population of the UK and its constituent countries.
- Projections are produced on a nationally consistent basis using the internationally accepted cohort component methodology and the same data sources across the constituent countries of the UK.
- Variant projections offer a wide range of alternative demographic scenarios.

Limitations

- Population projections are not predictions of the future; they are an illustration of future population size and structure based on assumed levels of fertility, mortality, and migration.
- Demographic behaviour is inherently uncertain and therefore projections will inevitably differ from actual future population trends.
- In recent years, the UK has experienced relatively rapid demographic change, including declines in fertility rates, large fluctuations in international migration and continued change in mortality. Given the magnitude and pace of these changes, it is particularly challenging to make assumptions about future components of population change required for projections.
- Long-term assumptions are held constant throughout much of the projection period; each assumption is not a prediction, but an illustration of an assumed average sustained in the long-term.
- Variant population projections are illustrations of alternative scenarios and are not quantified measures of uncertainty.
- Mid-year population estimates for mid-2022, upon which these projections are built, do not include the updated long-term international migration statistics, as released on 28 November 2024.

Recent improvements

We always look for opportunities to improve our projections. Recent changes include:

- using data from the latest census, rebased population estimates and components of change since 2011 (for example, fertility, migration and mortality rates), which leads to a better baseline population
- using an age period and cohort model in mortality assumption setting, as discussed in our National population projections, mortality assumptions: 2022-based methodology
- using the latest admin-based international migration estimates from our Long-term international migration, provisional: year ending June 2024 bulletin, including updates to earlier years
- developing an online tool where users can adjust the assumptions and see their implications for future projected population change

5 . Quality characteristics of national population projections data

This section describes the quality characteristics of the data and identifies issues that should be considered when using the statistics.

We have developedGuidelines for measuring statistical qualitybased upon the five European Statistical System (ESS) quality dimensions. This report addresses the quality dimensions and important quality characteristics, which are:

- relevance
- accuracy and reliability
- coherence and comparability
- accessibility and clarity
- timeliness and punctuality

We provide more information about these quality dimensions in the following sections. Additionally, we define concepts and definitions commonly used in the national population projections (NPPs).

Relevance

Relevance is the degree to which the statistical product meets user needs for both coverage and content.

The NPPs serve a wide range of users across government and beyond. We produce the projections at the request of the National Statistician and the Registrars General for Scotland and Northern Ireland. As such, their content and method of production have been formally agreed and are regularly revisited to see if changes are required.

The Office for Statistics Regulation (OSR) assessed the NPPs, along with other population projections and estimates, for their compliance with theCode of Practice for Statistics. OSR published its findings inReport Number 309 in July 2015, and confirmed the NPPs' reaccreditation with National Statisticsstatus (now known as accredited official statistics status) in April 2019. More recently, in May 2021, the OSR published a Review of population estimates and projections produced by the Office for National Statistics (ONS) and found that the approach taken to produce projections is fit for purpose. The ONS responded to this by providing a response, a number of update articles and an Update on research and plans for population estimates and projections: May 2022. Since then, we have continued to update users through our regular population statistics newsletter.

The NPP Committee oversees the projections process. This committee includes representatives from the ONS and the devolved administrations and is accountable to the National Statistician and Registrars General. Within the projections process, we and the devolved administrations consult leading stakeholders, including representatives from relevant government departments. User engagement meetings allow stakeholders to highlight potential new data requirements or to request changes to presentation or the publication timetable. As far as possible, we take into account stakeholder views and suggestions, within the Code of Practice for Statistics.

We employ a robust and objective methodology to create national population projections that are relevant for all types of users. The projections do not attempt to predict the impact of future political and economic changes. This means, for example, that the principal projections do not directly seek to make adjustments for the possible demographic consequences of migration policy changes. The projections cover a period of 100 years, but uncertainty necessarily increases the further into the future they go. Long-term figures should be treated with great caution, especially projections by single year of age when looking beyond 25 years.

We regularly consider which user needs are not being met by our published statistics. We identify these needs using the processes described in the Uses and users section.

Accuracy and reliability

Accuracy and reliability refer to the degree of closeness between an estimate and the true value.

With the 2022-based NPPs, we have published our Comparing National Population Projections to estimates report . This follows our standard practice of publishing a comparison of projections and estimates, once rebasing of population estimates has taken place. The report shows national population projections releases over time, compared with outcomes (estimates and components of change). Previous versions of these reports include:

- our National Population Projections Accuracy Report (2016)
- our Fifty years of United Kingdom population projections report (PDF, 868 KB) (2007)
- previous analyses covering the projections made during the period 1971 to 1991 (Population Trends Number 77); details of these analyses are in our Index to Articles 1975 to 2003 document (PDF, 383KB).

All these articles consider the proximity of the NPPs to the actual outcome, when compared with each of the three individual assumptions, and whether accuracy has improved in more recent projections. They also discuss the variant projections. These analyses are inevitably dependent on comparisons with the latest population estimates. Revisions to estimates of the past and current population (for example, the revisions made to population estimates following the 2001 Census and the 2011 Census) also play a part in explaining projection error. Revisions may make the projections look more or less accurate than they really are.

The UK national population projections in perspective article (PDF, 565KB) by Professor Nico Keilman (University of Oslo) offers an international comparison of accuracy.

The NPPs use official mid-year population estimates for each UK country as their base year and are dependent on the accuracy of these estimates. The accuracy of these estimates can be assessed after a census has been carried out. Following the release of the 2021 Census data for England and Wales, the population estimates for mid-2012 to mid-2020 were rebased to ensure a consistent time series. More information is available in our Rebasing of mid-year population estimates following Census 2021, England and Wales bulletin. This involved identifying parts of the population estimates that were under- or over-estimated between 2012 and 2020, using 2021 Census data and other sources. In Northern Ireland and Scotland, similar exercises have been completed:

- for Rebased population estimates, Scotland, mid-2011 to mid-2021
- for Rebased Mid-Year Population Estimates for Northern Ireland between 2011 and 2021

Data from these releases are now used in the NPPs for the development of assumptions for fertility, migration and mortality. They are also used as a denominator for demographic rates, such as five years of cross-border (within UK) migration data.

NPPs also use the latest available data on births, deaths, internal and international migration. However, the NPPs are not forecasts, and because of the inherent uncertainty of demographic behaviour, any set of projections will inevitably differ from actual future outcomes to a greater or lesser extent. It would be improbable for any projection to correspond entirely with the actual demographic outcome. Changes in government policy, in the economy, in individual, family and household behaviour, and in events both in and outside the UK will influence the three main components of population change. This will inevitably include longer-term impacts from the coronavirus (COVID-19) pandemic.

We consider each component of the projections (fertility, mortality and migration) separately when setting demographic assumptions. Assumptions are based largely on the extrapolation of past trends. Inevitably, there is an element of subjective judgement. Our choice of assumptions is produced by analysis of historical trends to determine plausible scenarios, and we consult with an independent advisory panel of academic experts to help us. Expert advisory panels do not have direct influence over our final assumptions; these are produced by the ONS and agreed solely by the NPP Committee. Further information on the expert advisory panels can be found in National population projections, background, methodology and assumption setting: 2022-based.

Because of the inherent uncertainty around future demographic behaviour, we often hold constant long-term assumptions for each component. We publish articles covering assumptions for fertility, migration and mortality, which provide information on this. For example, for international migration, we assume a constant level from just a few years into the projection period. In the 2022-based projections, for the UK, in the principal projection we assume annual net migration of 340,000 per year from the year ending mid-2028 onwards. This should be considered as a long-term average.

Fertility measures are less volatile, although as a period measure, the total fertility rate (TFR) is affected by when women have their children, as well as the number they have. We measure mortality in terms of improvements in mortality rates. As changes in mortality are more gradual and stable, we assume the current rates gradually converge to a standard rate of improvement at the same level, for all but the oldest ages, 25 years into the projection. We review all these time periods for each new set of projections.

Variant population projections based on alternative assumptions about the future give users of the projections an indication of uncertainty. They offer a set of plausible alternative scenarios according to higher or lower assumptions about the trajectories of fertility, mortality and migration. Some of the variants combine alternative assumptions -- for example, a "young" population assumption (high fertility, high migration and low life-expectancy assumptions).

Other variants allow users to decompose the projections to increase understanding of how changes in the assumptions affect the projected population. For example, by comparing the zero net migration variant with the principal projection, we can assess the impact of the level of assumed migration in the principal projection. Information on the range of variants for our latest release, is available in our National population projections, variant projections: 2022-based methodology. Our Variant national population projections for the UK and subnational population projections and household projections for England: user guide provides guidance and examples of how our variants are used.

The method we use to produce the projections does not enable statements of probability to be attached to them, or for confidence intervals to be ascribed to the variant projections. This is because the variants are based on different demographic scenarios. Therefore, the levels of uncertainty for the fertility, mortality and migration assumptions are not directly comparable.

Actual population change is almost certain to differ from what is projected. Because updated projections are usually produced every two years, we do not go back and change old projections retrospectively.

Coherence and comparability

Coherence is the degree to which data that are derived from different sources or methods but refer to the same topic, are similar. Comparability is the degree to which data can be compared over time and domain, for example, geographic level.

Each set of NPPs is unique, comprising assumptions made using the best information available at a point in time. This means that each new set of projections, using the most up-to-date background data available, supersedes the previous set. Although the results of subsequent projections can be compared, this will not be comparing like with like, but instead observing what effect the most recent data has on the projected future population of the country.

We compute the population for each of the constituent countries of the UK and add the results together to produce projections for Great Britain and the UK. Therefore, the projections for the UK and its constituent countries are both geographically coherent, and additive and coherent with the definitions used for population estimates. In the past, we have released England and Wales as a combined geography; this was not part of the 2022-based NPPs. International migration numbers for the UK may differ to those in the UK estimates of long-term international migration for some years. This is because the estimates for Northern Ireland used in the NPPs include international migration estimates published by NISRA, which differ from the ONS's estimates.

All NPP publications from the 2014-based onwards are available on our website. The complete set of online materials up to the 2014-based NPPs is available on the National Archives website. This includes the NPP historic series page containing data from the 1954-based to 2004-based projections.

The only known official population projections for the UK, apart from those produced by the Office for National Statistics (ONS), are those produced by Eurostat and those produced by the United Nations (UN). The UN produces worldwide population projections every two years. They publish a combination of population estimates and projections. The UN uses a Bayesian method to project fertility and mortality assumptions, and then the standard cohort component model to project the population forward. Individual countries such as the UK have no input in the UN population projections.

Accessibility and clarity

Accessibility is the ease with which users are able to access the data, also reflecting the format in which the data are available and the availability of supporting information. Clarity refers to the quality and sufficiency of the release details, illustrations and accompanying advice.

The NPPs are available online and can be downloaded free of charge in Microsoft Excel and CSV format. Graphs, textual background information and supporting documents are provided as part of each release.

If you have any additional enquiries regarding national population projections, you can contact us:

- by email, at pop.info@ons.gov.uk
- by telephone on +44 1329 444661

It may be possible to meet additional data requests, but these may be chargeable depending on the time required to produce the additional data requested. Metadata describing the limitations of additional data are provided with individual requests. These requests are also published on the Office for National Statistics (ONS) website.

Our recommended format for accessible content is a combination of HTML web pages for narrative, charts and graphs, with data being provided in usable formats such as CSV and Excel file types. We also offer users the option to download the narrative in PDF format. In some instances, other software may be used or may be available on request. For further information, please refer to the contact details at the beginning of this report.

For information regarding conditions of access to data, please refer to the following:

- terms and conditions (for data on the website)
- freedom of information
- accessibility

Timeliness and punctuality

Timeliness refers to the lapse of time between publication and the period to which the data refer. Punctuality refers to the gap between planned and actual publication dates.

We usually publish the NPPs every two years, typically in the October following the reference year (for example, we published the 2018-based NPPs in October 2019). However, the timing of the publication of national population projections for subsequent rounds has varied from this schedule because it has been necessary to await rebased population estimates following the latest censuses, and to meet our primary users' needs including the requirement to use latest international migration estimates.

The starting point for the projections is the population estimates for:

- England and Wales,as published in our Population estimates for the UK, England, Wales, Scotland, and Northern Ireland: mid-2022 bulletin
- Scotland,as published in the National Records of Scotland's (NRS's) Mid-2022 population estimates publication
- Northern Ireland, as published in the Northern Ireland Statistics and Research Agency's (NISRA's) 2022 Mid-Year Population Estimates for Northern Ireland publication,

These are produced by the ONS, National Records of Scotland (NRS) and the Northern Ireland Statistics and Research Agency (NISRA), respectively. The last of these estimates generally become available at the end of June of the year following the reference year, and we usually publish the NPPs approximately four months later. The 2021-based NPPs were published three months later than is typical for NPP releases because of delays to rebasing, as explained in our Rebasing of mid-year population estimates following Census 2021, England and Wales bulletin. This allowed the inclusion of the latest international migration data from the long-term international migration release of November 2023.

The release of the 2022-based NPPs relied upon the publication of a full set of UK estimates, including mid-year estimates data for all UK countries and a revised mid-year estimate back series 2011 to 2021 for Scotland. For this reason, at the time our production commenced, it was necessary to use a 2022 base year. In October 2024, a decision was made to delay the 2022-based release to January 2025 enabling the assumptions to reflect the latest fertility data for 2023 and data in our Long-term international migration, provisional: year ending June 2024 bulletin.

For more details on related releases, ourRelease calendarprovides 12 months' advance notice of release dates where available. In the event of a change to the pre-announced release schedule, public attention will be drawn to the change and the reasons for the change explained at the same time, as set out in the Code of Practice for Statistics.

Concepts and definitions

Concepts and definitions describe the legislation governing the output and a description of the classifications used in the output.

Usually resident

Population projections, and the estimates they are based on, include the “usually resident” population only. This is the standard United Nations (UN) definition and includes only people who reside in a country for 12 months or more. As such, short-term international migrants are excluded.

Components of change

Population changes between one year and the next are caused by three components of change:

- births (fertility)
- deaths (mortality)
- migration

To inform the projections, we make assumptions about how each of these will change in future.

Fertility

In a demographic or projections context, "fertility" relates to how many children a group of women have, rather than their ability to conceive (which is the common understanding of fertility).

Mortality

The likelihood of death, often presented as mortality rates – the proportion of a group of a particular age and sex who die during the course of the year.

Mid-year

"Mid-year" refers to 30 June of any given year, where the period from one mid-year to the next is from 1 July of year x until 30 June of year x plus one, for example, 1 July 2023 to 30 June 2024.

Geography

UK and constituent countries; some datasets are available for Great Britain.

Why you can trust our data

We use the best available data at the time we start production of NPPs. Quality assurance of the underlying data in use is completed in detail at each stage and where appropriate with NPP Committee. Expert advisory panel input is sought on each assumptions topic area and we keep this under review as the production of the NPPs progresses. Detailed quality assurance of results is completed by a range of ONS staff and NPP Committee. Methods are regularly reviewed, and improvements made where possible. Staff are encouraged to apply "curiosity" to each component of population change. The result is that each element of the population projections is rigorously checked by multiple people to ensure that changes over time are plausible.

6 . Methods used to produce national population projections data

Main data sources

We calculate the national population projections (NPPs) using a number of standard demographic methods. Full details of our methods can be found in National population projections, background, methodology and assumption setting: 2022-based. Some of the main methodological points are detailed in this section.

We make the projections for successive years running from one mid-year to the next using the cohort component method, which can be summarised as:

Population (year x) plus Births (between years x and y) minus Deaths (between years x and y) plus In-Migrants (between years x and y) minus Out-Migrants (between years x and y) equals Population (year y).

For each age, the starting population plus or minus the net number of migrants (immigrants minus emigrants) less the number of deaths produces the number in the population, one year older, at the end of the year. To this, we add survivors of those born during the year. We define "age" as "completed years at the last birthday".

We use the mid-year population estimates from each country as the starting population. These are calculated using the internationally recognised cohort component method -- starting with the population data from the last decennial census and updating each year with the available data on births, deaths and migration. Our Population estimates for local authorities across UK constituent countries: a comparison of data sources and methods report (PDF, 182KB) compares the population estimates methodology used across the four UK countries.

We calculate the numbers of births, deaths and migrants using the assumptions of future levels of:

- fertility
- mortality
- migration

We determine these levels using a mixture of data observation and extrapolation, as well as consideration of expert opinion. We may also adjust the assumptions for the first year of the projection to take into account the very latest data.

In 2012, we commissioned a migration assumptions methodology review from the University of Southampton. This made various recommendations on the methodology for setting international migration assumptions with the intention of increasing transparency and streamlining previous processes.

From the 2012-based NPPs onwards, we have applied overall international migration assumptions, rather than breaking them down by world area. We have also produced separate international migration assumptions for each UK country from this round of projections onwards.

The 2012-based NPPs used Autoregressive integrated moving average (ARIMA) models (a standard approach to time series extrapolation) to determine the principal international migration assumptions. However, the rise in net migration by 2014 led to the models projecting values that were deemed improbably high. So, for the 2014-based NPPs, we used a 25-year rolling average of international migration to and from the UK.

During the production of the 2012-based NPPs we also used ARIMA models for the cross-border flows between the four nations of the UK. However, since the 2014-based NPPs, we have calculated the cross-border flows using rates of movement by age and sex rather than fixed numbers. This prevents the projections producing implausible values, such as negative population stocks, when projected fixed levels of out-migration are bigger than the initial population size.

The 2016-based NPPs used a straight 25-year average of international migration to and from the UK, covering the period 1992 to 2016, avoiding the weighting towards the latter end of the series. This approach supported by our migration Expert Advisory Panel and through stakeholder consultation, was adopted for the 2018-based and 2020-based interim projections.

In the most recent NPPs releases, based on the views from the Migration Expert Advisory Panel, the long-term international migration time series has shortened from the 25-year average used in the 2020-based interim release, to a 10-year average, to determine the assumptions for the 2021-based and 2022-based NPPs releases.

In 2015, we initiated a new review into the methodology for setting mortality assumptions. We implemented some enhancements for the 2014-based NPPs, including a new method of smoothing historical mortality data to analyse past trends and determine the rates of mortality improvement. In the 2020-based interim NPPs, an adjustment to the mortality improvement rates was made for the impact of coronavirus (COVID-19). For the 2022-based NPPs, we are using a new Age-Period-Cohort model. In early 2023, we engaged with users on our proposal to use the new method, and this was accompanied by our Prospective new method for setting mortality assumptions article, also showing comparisons of results from the model. Further information is available in our National population projections, mortality assumptions: 2022-based methodology.

For several rounds of projections, we have used a consistent method for setting fertility assumptions. We assume a completed family size (CFS) for the 25th year of the projections and then set the trajectory between the current level of fertility and the long-term CFS using analysis of recent trends, an assessment of their implications for future CFS, and expert opinion. Further information is available in our our National population projections, fertility assumptions: 2022-based methodology.

We produce variant projections using the same method but with alternative assumptions of future levels of fertility, mortality and migration. We have published details of these alongside the release.

How we quality assure and validate the data

In 2015, the Office for Statistics Regulation (OSR) issued the Regulatory Standard for the quality assurance of administrative data. This new standard applies to all official statistics where administrative data are used in the production of these statistics. All producers of official statistics that use administrative data need to implement this requirement, by embedding good practice into their production to assure the quality of the data.

In response, the Office for National Statistics (ONS) Demography team has published a set of Quality Assurance of Administrative Data(QAAD) reports for all its relevant administrative datasets, the links to the QAAD reports can be found in Section 6 of our Mid-year population estimates QMI.

How we disseminate the data

National population projections principal and variants, where available, can be found online for:

- United Kingdom
- Great Britain
- England
- Scotland
- Wales
- Northern Ireland

The National population projections table of contents provides links to the tables for the 2022-based NPPs on the ONS website and to previous releases going back to the 2014-based publication. Earlier NPPs releases are available from the National Archives website. This includes the NPP historic series page containing data from the 1954-based to 2004-based projections.

Links from the release calendar make clear the release date and location of each new set of national population projections. National population projections can be downloaded free of charge in Excel format. A statistical bulletin accompanies each publication. The underlying data for the charts and tables in the bulletin can also be downloaded. Supporting documentation is also available on the national population projections web page and linked to the statistical bulletin.

Enquiries regarding the national population projections can be made by emailing pop.info@ons.gov.uk. It may be possible to meet additional data requests, but these may be chargeable, depending on the time required to produce the additional data requested. Metadata describing the limitations of the data for more detailed tables are provided with each individual request.

7 . Related links

National population projections, background, methodology and assumption setting: 2022-based
Methodology| Released 28 January 2025
Information on the data, methods and assumption setting process used to produce the 2022-based national population projections.

National population projections, fertility assumptions: 2022-based
Methodology | Released 28 January 2025
The data sources and methodology used to produce fertility assumptions in the 2022-based national population projections.

National population projections, mortality assumptions: 2022-based
Methodology | Released 28 January 2025
The data sources and methodology used to produce mortality assumptions in the 2022-based national population projections.

National population projections, migration assumptions: 2022-based
Methodology | Released 28 January 2025
The data sources and methodology used to produce migration assumptions in the 2022-based national population projections.

National population projections variant projections: 2022-based
Methodology | Released 28 January 2025
The variant projections, a range of scenarios with alternative demographic assumptions, used in the 2022-based national population projections.

8 . Cite this methodology

Office for National Statistics (ONS), released 28 January 2025, ONS website, quality and methodology information report, National population projections: quality and methodology information.