

National population projections, background and methodology: 2018-based

General background information on the methods used to produce the 2018-based national population projections.

Contact:
Andrew Nash
pop.info@ons.gov.uk
+44 (0)1329 44 4661

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1 . Introduction

We publish national population projections by age and sex for the UK and its constituent countries every two years. We base them on the latest mid-year population estimates together with assumptions of future levels of fertility, mortality and migration. The primary purpose of the projections is to provide information on potential future population levels. They are used as a common framework for national planning in a number of different fields.

The Government Actuary's Department (GAD) produced the first projections of the population of the UK in the 1920s. These earliest projections were mainly used in connection with long-term financial estimates under the Contributory Pensions Acts and other schemes of social insurance. However, projections made since the War have been increasingly used in all areas of government planning. The GAD produced projections each year from 1955 to 1979 and then every second year until 1991. There was then a 1992-based set, and since then projections have reverted to being produced every second year. The Office for National Statistics (ONS) took over responsibility for the production of the national population projections in 2006.

We occasionally produce additional "interim" projections. We published 2001-based projections following the 2001 Census and an additional set based on the 2003 estimates to incorporate revisions to the population estimates for England and Wales.

The main focus of the 2018-based projections is on the next 25 years up to 2043, though we also produce longer-term projections to 2118. The uncertainty of population projections increases the further they are carried forward and particularly so for smaller geographical areas and age–sex breakdowns. In addition to the principal projections, we also make available variant projections, based on alternative assumptions of future fertility, mortality and migration. For more information on how ONS projections meet user needs along with information on their fitness for purpose, please see the [Quality and Methodology Information \(QMI\) report](#).

The 2018-based projections supersede the 2016-based projections published on 26 October 2017.

We produce the projections on behalf of the National Statistician and the Registrars General for Scotland and Northern Ireland. We agree the underlying assumptions in liaison with the devolved administrations – Welsh Government, National Records of Scotland (NRS) and the Northern Ireland Statistics and Research Agency (NISRA). Information on our assumption-setting process can be found in [National population projections, how the assumptions are set: 2018-based](#).

This report contains background information for the 2018-based national population projections. This includes:

- defining the base population
- the method of projection
- background on principal and variant projections
- summary of the long-term assumptions of future levels of fertility, mortality and migration
- the datasets available
- the changes to State Pension age

2 . Base population

Definition

We use estimates of the usually resident population of the UK and its constituent countries in mid 2018 as our starting population. The usually resident population is defined by the standard United Nations definition for population estimates, and it includes people who reside in the area for a period of at least 12 months whatever their nationality. Members of HM Armed Forces in the UK are included, but members of HM Armed Forces and their families who are abroad are excluded. Members of foreign armed forces in the UK are included, with any accompanying dependants.

Base populations for individual countries

We base the projections for England and Wales on the [mid-2018 population estimates](#) published by the Office for National Statistics (ONS) on 26 June 2019. The projections for Scotland are based on the [Mid-2018 population estimates Scotland](#) published by National Records of Scotland (NRS) on 25 April 2019, and the projections for Northern Ireland are based on the [2018 Mid Year Population Estimates for Northern Ireland](#) published by the Northern Ireland Statistics and Research Agency (NISRA) on 26 June 2019. Population estimates use the 2011 Census as the starting population and then update these annually to account for population change.

Table 1: Base population estimates for 2018-based projections, UK

	Millions
England	56.0
Wales	3.1
Scotland	5.4
Northern Ireland	1.9
UK	66.4

Source: Office for National Statistics – National population projections

Estimates of the population aged 90 years and over

We prepare official mid-year population estimates by individual age to the age of 89 years, with an upper age band for all those aged 90 and over. We produce estimates of the population aged 90 to 104 years by single year of age and for the 105 years and over age group using the Kannisto–Thatcher survivor ratio method, controlling the results to agree with the official estimates of all those aged 90 years and over.

3 . Method of projection

We produce projections for successive years running from one mid year to the next. For each age, we take the starting population and then account for net migration less the number of deaths to produce the number in the population, one year older, at the end of the year. We then add survivors of those born during the year. Age is defined as completed years at the last birthday.

We assume migration occurs evenly throughout the year. For computing purposes, this is equivalent to assuming that half the migrants in a given year at a given age migrate at the beginning of the year and half at the end of the year. The number of net migrants we add to obtain the population aged x plus 1 at the end of the projection year therefore consists of half of those migrating during the year at age x and half of those migrating during the year at x plus 1.

We obtain the number of deaths in a year by adding half of the net inward migrants at each age to the number in the population at the beginning of the year and applying the mortality rate $q_{x+1/2}$, which is the probability of death between one mid-year period and the next. The mortality rates we use in the projections represent the probabilities of death between one mid-year period and the next, according to a person's age at their last birthday at the beginning of the period. We also give the appropriate rate of infant mortality (that is, the probability of a new-born child not surviving until the following mid-year). This is about 85% of the full, first year of life infant mortality rate more generally used in official statistics.

We calculate the number of births in the year by multiplying the average number of women at each single year of age during the year (taken as the mean of the populations at that age at the beginning and end of the year) by the fertility rate applicable to them during that year. We assume the total number of births in a year is divided between the sexes in the ratio of 105 males to 100 females, in line with recent experience. We calculate the number of infants aged zero at the end of the year by taking the projected number of births and deducting the number of deaths, which is found by applying the infant mortality rate and adding half the number of net migrants aged zero at their last birthday.

We compute the principal projections for each of the constituent countries of the UK and add together the results to produce projections for England and Wales, Great Britain, and the UK.

4 . Summary of long-term assumptions

We use the long-term assumptions of future fertility, mortality and net migration (that is, immigrants minus emigrants), summarised in Table 2, in the 2018-based principal projections. We agree the long-term assumptions in consultation with the Northern Ireland Statistics and Research Agency (NISRA), National Records of Scotland (NRS) and Welsh Government. Table 2 also compares assumptions for the 2018-based projections with the assumptions for the previous 2016-based projections.

Table 2: Long-term assumptions for the 2018-based national population projections compared with assumptions for the 2016-based projections, UK

	UK	England	Wales	Scotland	Northern Ireland
Fertility: Average number of children per woman by mid-2043					
2018-based	1.78	1.81	1.71	1.50	1.92
2016-based	1.84	1.85	1.85	1.65	2.00
Mortality: Life expectancy at birth in 2043 ¹					
Males 2018-based	82.6	82.9	81.9	80.7	82.0
Males 2016-based	83.6	83.9	83.0	82.0	83.0
Females 2018-based	85.5	85.8	85.0	83.9	85.1
Females 2016-based	86.4	86.6	85.9	84.8	86.0
Net international migration ² : Annual long-term assumption					
2018-based	+190,000	+173,000	+6,000	+9,500	+1,500
2016-based	+165,000	+152,000	+4,500	+7,000	+1,500

Source: Office for National Statistics – National population projections

Notes

1. Life expectancies are period expectations of life for the start of 2043. They do not account for the continuing decline in mortality rates projected after that point. [Back to table](#)
2. Net international migration does not include cross-border migration between the countries of the UK. [Back to table](#)

For the UK, the assumed average completed family size is 1.78 children per woman by mid 2043, 0.06 lower than the 2016-based projections for the same year. It increases slightly to close to 1.79 later in the projection. More information can be found in [National population projections, fertility assumptions: 2018-based](#).

Assumptions on improvements in principal mortality are broadly unchanged from the 2016-based projections. For the 2018-based projections, the assumption is that annual rates of mortality improvement would converge to 1.2% for ages 0 to 90 years by 2043 (the 25th year of the 2018-based projections) and remain constant thereafter. This is for both males and females, for all constituent countries of the UK. For ages above 90 years, annual improvement rates are set to decline from 1.2% to 0% between ages 91 and 110 years. For ages above 110 years, a 0% improvement rate is assumed.

Although we have not changed our assumptions about the long-term rate of improvement in life expectancy for most ages, actual life expectancy has increased less than projected since mid 2016. This means in each year of the 2018-based projections, the projected life expectancy is lower than in the 2016-based projections. More information can be found in [National population projections, mortality assumptions: 2018-based](#).

The new long-term assumption for net international migration to the UK is +190,000 each year compared with +165,000 each year in the 2016-based projections. We calculate cross-border migration (moves between countries of the UK) by applying rates of movement between each pair of countries to the population by age and sex. The rates are derived as an average of the last five years' estimates (2014 to 2018). More information can be found in [National population projections, migration assumptions: 2018-based](#).

5 . Datasets available

We have published projections to 100 years ahead. For each country and variant combination, we have made two summary tables and a zipped open data file (XML format) available to download.

The first summary table contains the total projected population for all years of the projection, the components of change and other summary statistics.

The second summary table contains the projected population in five-year age groups for all years of the projection.

The XML open data files contain:

- population by single year of age (0 to 104 years), age groups (105 to 109 years, 110 years and over) and sex
- fertility assumptions by single year of age of mother (15 to 46 years)
- mortality assumptions by single year of age (0 to 125 years) and sex
- cross-border rates for each country flow by single year of age (0 to 125 years) and sex
- births by age of mother (15 to 46 years)
- deaths by age (0 to 105 years and over) and sex
- in, out and net cross-border migration by age (0 to 105 years and over) and sex
- in, out and net international migration by age (0 to 105 years and over) and sex
- in, out and net total migration by single year of age (0 to 105 years and over) and sex

6 . Changing State Pension age

Pensionable ages for men and women

Since 2010, the State Pension age has been increasing. By 2020, it will change from 65 years for men and 60 years for women, to 66 years for both sexes. State Pension age will then increase to 67 years for both men and women between 2026 and 2028. Under the current law, State Pension age is due to increase to 68 years between 2044 and 2046.

The proportions used to calculate the population of working age and pensionable age, along with a worked example of how these proportions are applied, are available in the [Calculating State Pension age: Pensions Act 2014 dataset](#).

Full details about the current and planned changes to the State Pension age under the Pensions Acts of 1995, 2007, 2011 and 2014 can be found in the following.

Changes to State Pension age

The following tables show how the legislated increases in State Pension age will be phased in. The published national projections output tables include the projected number and percentage of those of working age and pensionable age based on the phasing detailed in this section.

Table 3: Date State Pension age was achieved for women born between 6 April 1950 and 5 December 1953, UK

Date of birth	Date State Pension age reached
6 April 1950 to 5 May 1950	6 May 2010
6 May 1950 to 5 June 1950	6 July 2010
6 June 1950 to 5 July 1950	6 September 2010
6 July 1950 to 5 August 1950	6 November 2010
6 August 1950 to 5 September 1950	6 January 2011
6 September 1950 to 5 October 1950	6 March 2011
6 October 1950 to 5 November 1950	6 May 2011
6 November 1950 to 5 December 1950	6 July 2011
6 December 1950 to 5 January 1951	6 September 2011
6 January 1951 to 5 February 1951	6 November 2011
6 February 1951 to 5 March 1951	6 January 2012
6 March 1951 to 5 April 1951	6 March 2012
6 April 1951 to 5 May 1951	6 May 2012
6 May 1951 to 5 June 1951	6 July 2012
6 June 1951 to 5 July 1951	6 September 2012
6 July 1951 to 5 August 1951	6 November 2012
6 August 1951 to 5 September 1951	6 January 2013
6 September 1951 to 5 October 1951	6 March 2013
6 October 1951 to 5 November 1951	6 May 2013
6 November 1951 to 5 December 1951	6 July 2013
6 December 1951 to 5 January 1952	6 September 2013
6 January 1952 to 5 February 1952	6 November 2013
6 February 1952 to 5 March 1952	6 January 2014
6 March 1952 to 5 April 1952	6 March 2014
6 April 1952 to 5 May 1952	6 May 2014
6 May 1952 to 5 June 1952	6 July 2014
6 June 1952 to 5 July 1952	6 September 2014
6 July 1952 to 5 August 1952	6 November 2014
6 August 1952 to 5 September 1952	6 January 2015
6 September 1952 to 5 October 1952	6 March 2015
6 October 1952 to 5 November 1952	6 May 2015
6 November 1952 to 5 December 1952	6 July 2015
6 December 1952 to 5 January 1953	6 September 2015
6 January 1953 to 5 February 1953	6 November 2015
6 February 1953 to 5 March 1953	6 January 2016

6 March 1953 to 5 April 1953	6 March 2016
6 April 1953 to 5 May 1953	6 July 2016
6 May 1953 to 5 June 1953	6 November 2016
6 June 1953 to 5 July 1953	6 March 2017
6 July 1953 to 5 August 1953	6 July 2017
6 August 1953 to 5 September 1953	6 November 2017
6 September 1953 to 5 October 1953	6 March 2018
6 October 1953 to 5 November 1953	6 July 2018
6 November 1953 to 5 December 1953	6 November 2018

Source: Department for Work and Pensions – State Pension age timetable

Table 4: Date State Pension age will be achieved for men and women born between 6 December 1953 and 5 April 1960, UK

Date of birth	Date State Pension age reached
6 December 1953 to 5 January 1954	6 March 2019
6 January 1954 to 5 February 1954	6 May 2019
6 February 1954 to 5 March 1954	6 July 2019
6 March 1954 to 5 April 1954	6 September 2019
6 April 1954 to 5 May 1954	6 November 2019
6 May 1954 to 5 June 1954	6 January 2020
6 June 1954 to 5 July 1954	6 March 2020
6 July 1954 to 5 August 1954	6 May 2020
6 August 1954 to 5 September 1954	6 July 2020
6 September 1954 to 5 October 1954	6 September 2020
6 October 1954 to 5 April 1960	66th birthday

Source: Department for Work and Pensions – State Pension age timetable

Table 5: State Pension age for men and women born between 6 April 1960 and 5 April 1977, UK

Date of birth	State Pension age
6 April 1960 to 5 May 1960	66 years and 1 month
6 May 1960 to 5 June 1960	66 years and 2 months
6 June 1960 to 5 July 1960	66 years and 3 months
6 July 1960 to 5 August 1960	66 years and 4 months ¹
6 August 1960 to 5 September 1960	66 years and 5 months
6 September 1960 to 5 October 1960	66 years and 6 months
6 October 1960 to 5 November 1960	66 years and 7 months
6 November 1960 to 5 December 1960	66 years and 8 months
6 December 1960 to 5 January 1961	66 years and 9 months ²
6 January 1961 to 5 February 1961	66 years and 10 months ³
6 February 1961 to 5 March 1961	66 years and 11 months
6 March 1961 to 5 April 1977	67 years

Source: Department for Work and Pensions – State Pension age timetable

Notes

1. A person born on 31 July 1960 is considered to reach the age of 66 years and 4 months on 30 November 2026. [Back to table](#)
2. A person born on 31 December 1960 is considered to reach the age of 66 years and 9 months on 30 September 2027. [Back to table](#)
3. A person born on 31 January 1961 is considered to reach the age of 66 years and 10 months on 30 November 2027. [Back to table](#)
4. For people born after 5 April 1969 but before 6 April 1977, under the Pensions Act 2007, the State Pension age was already 67 years. [Back to table](#)

Table 6: Date State Pension age will be achieved for men and women born from 6 April 1977 onwards, UK

Date of birth	Date State Pension age reached
6 April 1977 to 5 May 1977	6 May 2044
6 May 1977 to 5 June 1977	6 July 2044
6 June 1977 to 5 July 1977	6 September 2044
6 July 1977 to 5 August 1977	6 November 2044
6 August 1977 to 5 September 1977	6 January 2045
6 September 1977 to 5 October 1977	6 March 2045
6 October 1977 to 5 November 1977	6 May 2045
6 November 1977 to 5 December 1977	6 July 2045
6 December 1977 to 5 January 1978	6 September 2045
6 January 1978 to 5 February 1978	6 November 2045
6 February 1978 to 5 March 1978	6 January 2046
6 March 1978 to 5 April 1978	6 March 2046
6 April 1978 onwards	68th birthday

Source: Department for Work and Pensions – State Pension age timetable

Sources: Pensions Act 1995, Chapter 26, Part II, Section 126 and Schedule 4; Pensions Act 2007, Chapter 22, Part I, Section 13 and Schedule 3; Pensions Act 2011, Part 1, Section 1 and Schedule 1; Pensions Act 2014, Part 3, Section 26 and Section 27.