

Article

# Admin-based population estimates: provisional estimates for local authorities in England and Wales, 2011 to 2022

Admin-based population estimates for all local authorities in England and Wales from the dynamic population model.

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# 1 . Main points

- We are continuing to develop our research into the new dynamic population model (DPM), which aims to estimate population and population change in a timely way, to better respond to user needs.
- We have used the DPM to produce admin-based population estimates (ABPEs) for mid-year 2011 to 2022 for all 331 local authorities in England and Wales.
- The initial, provisional estimates for mid-2022 have been produced four months earlier than the official statistics produced from the current mid-year estimates (MYE) process.
- ABPE best estimates for June 2022 give a total England and Wales population of 60,134,268 people: a 0.8% increase on the June 2021 estimates, with the largest increases in London local authorities.
- We have explored different versions of the model and have shown the need to incorporate a robust coverage adjustment method; while this work is under development, we have demonstrated to users what the ABPEs could look like in the future in the absence of a census.
- The DPM model and resulting ABPEs show promise and our next steps include further development of our methods and the data with a focus on measuring and understanding quality; we welcome feedback from users about these estimates and our methods.

These are not official statistics. They are estimates from a new methodology which is different from that currently used to produce official population and migration statistics. The information and research in this article should be used alongside the estimates to avoid misinterpretation. These outputs must not be reproduced without this warning.

## 2 . Overview of the admin-based population estimates using the dynamic population model

### Transforming population statistics

The census has evolved over time, providing a snapshot every 10 years into who we are and how we live. The census and our census-based mid-year estimates provide the best picture of population at a moment in time. However, the coronavirus (COVID-19) pandemic has underlined the need for more timely population estimates and we are committed to maximising the use of administrative data to increase efficiency by making the best use of data that are already available. We are researching new ways to produce population and social statistics.

In July 2022 we introduced the [dynamic population model](#) (DPM) as our future proposal for producing timely, coherent population statistics. The previously published admin-based population estimates (ABPEs) were re-branded as Statistical Population Datasets (SPD). This reflects that they are not a finalised estimate, but feed into the DPM where the strengths of the SPD are used alongside other data sources to produce coherent and timely estimates from admin data.

In November 2022 we provided [provisional population estimates for 14 case study local authorities](#). Our accompanying [Dynamic population model, improvements to data sources and methodology for local authorities England and Wales: 2011 to 2022](#) methodology sets out the developments in data sources and methodology since releasing those case study estimates. In this article we provide provisional estimates for all 331 local authorities in England and Wales from June 2011 to June 2022. We show results from our best estimate that incorporates Census 2021 data, and an estimate that approximates what users might expect to get in the future, in the absence of a census.

Comparisons between census-based and admin-based estimates for 2021 are discussed in [Transforming population statistics, comparing 2021 population estimates in England and Wales](#), which provides some guidance on how best to interpret and use each of the estimates.

Our [population statistics sources guide](#) helps users find the right population statistics for them.

## The dynamic population model

The dynamic population model (DPM) uses a range of sources to measure population counts and the components of population change. As with the current mid-year estimation (MYE) process, the [cohort component method](#) structures our population modelling.

The MYE uses census estimates as a population stock every 10 years and rolls forward the population with components of population change. Any quality issues with components can compound over the decade causing the quality of the estimate to fall, until it is corrected by a subsequent census.

The DPM aims to overcome some of these challenges within the MYE process by using more frequent population stocks, such as the [SPD](#), which are produced annually. The SPD is produced independently for each year and therefore any errors in one year are less likely to be rolled forward to the next. Our research shows the need to include a coverage adjustment process to reduce the coverage error in the SPD and to measure its quality – [this work on SPD estimation options is under development \(PDF, 1.271KB\)](#).

The DPM balances the available information on population stock at specific points in time with the flow components over time to produce a coherent set of estimates. DPM estimates and the data sources used as population stock inputs in the framework refer to the population at mid-year on 30 June for the reference year.

Another significant advantage of the DPM is its flexibility. While it uses administrative data sources as stock datasets each year, it can also incorporate other data sources as and when they become available. This could include sources relating to local areas or particular population groups, or sources that represent the total population.

## Census 2021 as an input to DPM

To provide the best possible population estimates from the DPM we include results from Census 2021 as our best picture of the population on 21 March 2021. Census 2021-based MYE data (representing Census 2021 rolled forward from Census Day to mid-year (30 June)) are used:

- as a population stock in 2021
- to inform the coverage adjustment of administrative data-based population stocks
- in the production of statistical models for birth, death and migration rates

This provisional set of estimates form our ABPE best estimate.

### 3 . Admin-based population estimates for June 2022

Our best possible population estimates from the dynamic population model (DPM) are those that incorporate Census 2021-based mid-year estimates (MYEs) as our best picture of the population in June 2021. The DPM uses this information along with birth and death counts and statistical models for birth, death, and migration rates to produce estimates for June 2022.

Our first provisional research estimate for the June 2022 population of England and Wales is 60,134,268, a 0.8% increase on the June 2021 estimate.

The change in population between two years for a given age group is not only affected by components of change (births, deaths, and migration), but also by different sizes of single year age groups. The population of children aged under 10 years is estimated to have decreased, while there are relatively large increases for the oldest age groups. Changes around age groups from 70 to 79 years reflect rapid changes in birth cohort sizes immediately after World War Two.

Table 1: The change in population from 2021 to 2022 varies by age group

Age group	ABPE best estimate 2022	% change from 2021 to 2022
0 to 4 years	3,183,627	-0.9%
5 to 9 years	3,471,328	-1.3%
10 to 14 years	3,641,898	1.1%
15 to 19 years	3,464,002	2.1%
20 to 24 years	3,627,893	1.1%
25 to 29 years	3,894,607	0.4%
30 to 34 years	4,194,649	1.1%
35 to 39 years	4,060,972	1.7%
40 to 44 years	3,866,122	2.4%
45 to 49 years	3,672,388	-2.3%
50 to 54 years	4,091,024	-0.8%
55 to 59 years	4,078,940	0.9%
60 to 64 years	3,586,050	3.0%
65 to 69 years	3,008,839	1.8%
70 to 74 years	2,829,754	-4.8%
75 to 79 years	2,424,477	9.3%
80 to 84 years	1,528,643	1.1%
85 to 89 years	956,216	2.0%
90 years and over	552,838	2.5%
<b>Total</b>	<b>60,134,268</b>	<b>0.8%</b>

Source: Office for National Statistics – ABPE best estimates

#### Figure 1: The largest changes in population between 2021 and 2022 are in London local authorities

Percentage change in total local authority population from June 2021 to June 2022

## Download the data

[.xlsx](#)

Two local authorities with very small population sizes have outlying results (City of London (16.4%) and Isles of Scilly (11.1%)) and are excluded from the charts in Figure 1. Estimates for these populations are included in totals for England and Wales and are shown in the population pyramids in Figure 2.

Excluding these outliers, the largest percentage increases in population are in London local authorities: Tower Hamlets (4.9%), Westminster (4.7%), and Camden (4.4%).

Outside London, the largest increases are in Exeter (3.2%) and Cambridge (3.1%).

Out of the 331 local authorities, 25 show a decrease in population between June 2021 and June 2022, with the largest decrease in South Staffordshire (negative 0.9%) in the West Midlands.

## England and Wales local authority estimates 2011 to 2022

Figure 2 shows population pyramids for 2011 to 2022 for all local authorities, comparing the admin-based population estimate (ABPE) best estimate with the official MYE for the given year.

### Figure 2: Local authority population pyramids

**Admin-based population estimates (ABPE) and mid-year estimate (MYE) population estimates by local authority, sex and age, England and Wales**

## Download the data

[.xlsx](#)

In this section we use two example local authorities to describe some changes in population seen between 2019 and 2022; before, during and beginning to move on from the coronavirus (COVID-19) pandemic. We also demonstrate some areas for further development of our estimation approach.

### Tower Hamlets estimates 2019 to 2022

ABPE best estimates for the population of females in Tower Hamlets from 2019 to 2022 are shown as an example of a trend seen in several London authorities. They show a stable or slightly decreasing population from 2019 to 2020, followed by an increase in younger age groups up to June 2022. Similar trends are seen for males and females.

The estimates shown in Figure 3 include [credible intervals](#) to demonstrate the levels of uncertainty in the estimates. The estimates for June 2021 where Census 2021-based MYE is used as a population stock have narrower credible intervals than those for 2019 and 2020 where a Statistical Population Dataset (SPD) is used as the input population stock. Estimates for June 2022 have wider credible intervals as we do not yet have an SPD to use as a population stock for June 2022.

The population growth is largely caused by increases in migration rates with international immigration being particularly high in the year to June 2022. Restrictions on international travel began to be lifted following the coronavirus pandemic and world events such as the war in Ukraine, resettlement of Afghan refugees and the new visa route for Hong Kong nationals have contributed to an increase in migration.

### Figure 3: Tower Hamlets young female population shows an increase in June 2021 to June 2022

**Tower Hamlets female population estimates by age, 2019 to 2022**

## Download the data

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## Oxford estimates 2019 to 2022

ABPE best estimates for the population of males in Oxford from 2019 to 2022 represent a trend seen in several university towns and cities. They show a population age profile peaking at age 20 years, shifting to age 19 years in 2021 and being particularly large and sharp at age 20 years in 2022. The same trend is seen for both males and females.

The Census 2021-based MYE age profile has a sharp peak at age 19 years. This is used in the DPM model as an unbiased input with relatively low uncertainty.

The SPD population age profiles peak at age 20 years and our smoothed coverage adjustment does not change this. SPD is used as the input population stock for 2019 and 2020, and the ABPE best estimate in those years reflect that profile.

In 2022, the DPM does not use a population stock dataset for these first, provisional estimates as we do not yet have an SPD for June 2022. The estimates for young adults are significantly influenced by migration rates. Migration rates are calculated using age at end of June. The immigration rate peaks sharply at age 19 years in most local authorities with a significant student population, though most of the moves to the local authority occur at age 18 years at the start of the academic year. This leads to a shift to older ages in the mid-year population age profile. We are investigating methods to reflect migration by age at the time of the move. We are also investigating population stock datasets for June 2022 to inform updated estimates.

The increase in the Oxford student age population from 2021 to 2022 is caused by a strong increase in international immigration. This is also seen in other university towns and cities that attract large numbers of international students.

### Figure 4: Oxford male population shows a shift in peak age over time

Oxford male population estimates by age, 2019 to 2022

Download the data

[.xlsx](#)

## 4 . Admin-based population estimates without Census 2021

To inform the development of admin-based population estimates (ABPEs) as we move away from Census 2021, we produce dynamic population model (DPM) estimates that approximate to a future scenario without a full census but with a robust coverage adjustment process to improve estimation from administrative data.

### ABPE future estimate

Our previous Statistical Population Dataset (SPD) research highlighted the need for a coverage adjustment strategy, and [work on SPD estimation options is in development](#) (PDF, 1,271KB). To demonstrate DPM estimation with a coverage adjustment strategy for SPD, we run the model using SPD-based stocks for 2021 and use the smoothed ratio of SPD version 4.0 to Census 2021-based MYE as a proxy for the coverage adjustment. As in DPM estimation with Census 2021-based MYE (ABPE best estimate), this coverage adjustment impacts estimates for years before 2021, as we assume a linear change in coverage ratios by age and sex, within local authorities, between 2011 and 2021.

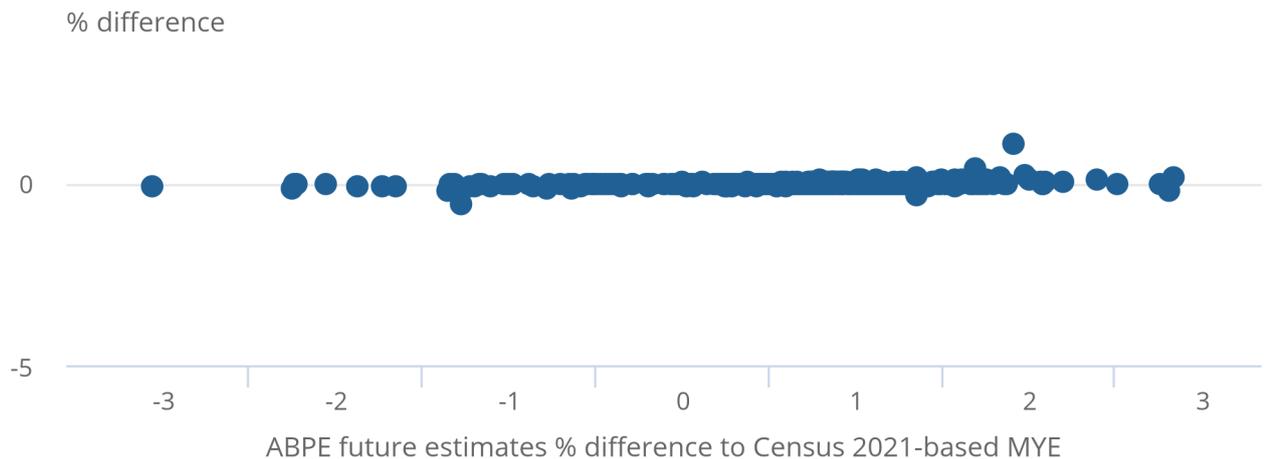
## Comparison with Census 2021-based MYE by local authority

**Figure 5: The differences between admin-based population estimates (ABPEs) and Census 2021-based mid-year estimates (MYEs) vary by local authority**

Total percentage difference by local authority (LA) for ABPEs to Census 2021-based MYE, England and Wales

Figure 5: The differences between admin-based population estimates (ABPEs) and Census 2021-based mid-year estimates (MYEs) vary by local authority

Total percentage difference by local authority (LA) for ABPEs to Census 2021-based MYE, England and Wales



**Source: Office for National Statistics - Mid-year estimates, admin-based population estimates**

Two local authorities with very small population sizes (City of London and Isles of Scilly) are outliers and are excluded from the chart in Figure 5 and the commentary in this local authority comparison section.

As expected, when Census 2021-based MYE is used as an input to the model (ABPE best estimates presented in [Section 3: Admin-based population estimates for June 2022](#)), outputs are very similar to Census 2021-based MYE. The largest difference for total population by local authority in this case is a 1.1% overestimate in Eden. Cambridge shows the largest underestimate (0.6%).

In a future scenario without a full census but with robust coverage adjustment processes to improve estimation (ABPE future estimates), the range of percentage difference is increased. The largest overestimate compared with Census 2021-based MYE is 2.8% for Bradford, Richmondshire and Kensington and Chelsea, and the largest underestimate is 3.1% for Cardiff.

For the total population of England and Wales in 2021 the ABPE future estimate is 0.6% above Census 2021-based MYE.

Further comparisons in this section demonstrate the quality of ABPE future estimates in non-census years with assumed coverage adjustment of SPD in place and highlight the areas for improvement where we are continuing our development work.

## Comparison with Census 2021-based MYE 2021 by age and sex

The agreement of estimates for total population at the national and local authority level shown earlier in this section mask differences by age and sex, with some groups underestimated and others overestimated.

## ABPE best estimate

With Census 2021-based MYE included as an input population stock, ABPE best estimates show minimal difference (less than 0.3%) to Census 2021-based MYE for any single year of age group of either sex.

## ABPE future estimate

With an assumed coverage adjustment mechanism in place, young children of both sexes are overestimated compared with Census 2021-based MYE, as are those aged 66 to 72 years. There is greater overestimation of female population than males aged 29 to 54 years.

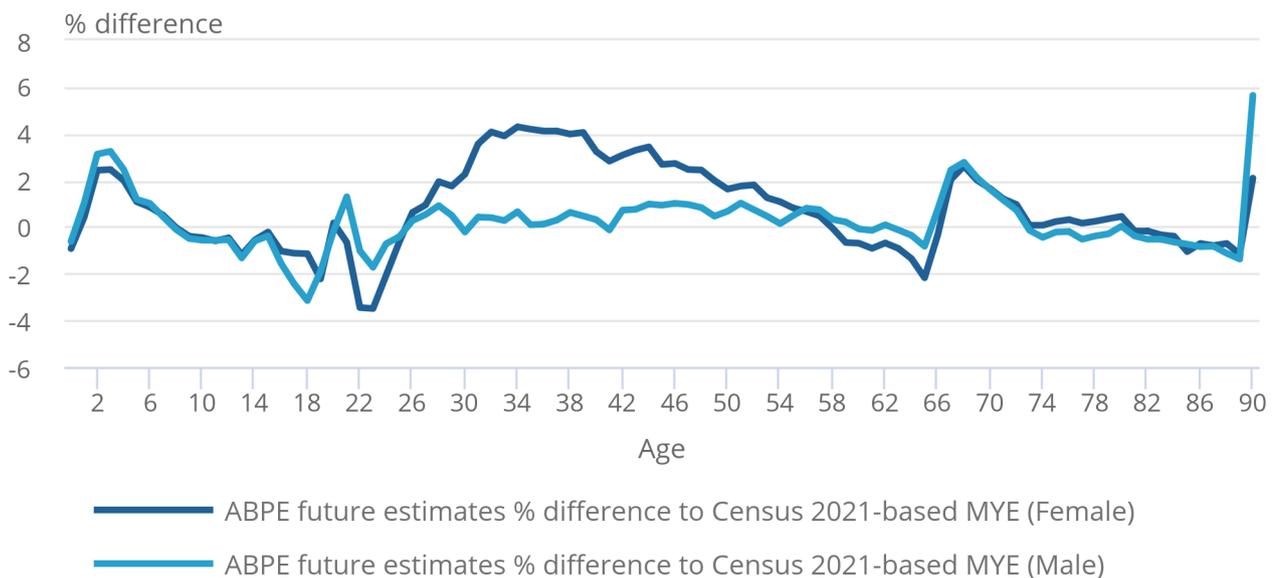
The DPM framework balances the available information on population stock with flow components to produce a coherent set of estimates. Additional constraints are placed on the female population of child-bearing age; birth counts are treated as exact and statistical models for age-specific fertility rates link these to the female population. Further research will explore what is causing over coverage in ABPE future estimates and whether it is corrected with more mature population stock data and more refined coverage adjustment processes.

### Figure 6: Admin-based population estimates (ABPEs) future estimates overestimate the population in some age groups

Percentage difference between ABPE future estimate and Census 2021-based mid-year estimate (MYE) for England and Wales by age and sex

#### Figure 6: Admin-based population estimates (ABPEs) future estimates overestimate the population in some age groups

Percentage difference between ABPE future estimate and Census 2021-based mid-year estimate (MYE) for England and Wales by age and sex



Source: Office for National Statistics - Mid-year estimates, admin-based population estimates

## Swindon estimates 2021

Population estimates for females in Swindon, shown in Figure 7, are an example where ABPE future estimates closely match Census 2021-based MYE. ABPE best estimates are not shown on the chart but almost exactly align with Census 2021-based MYE.

In this local authority, like many others, the administrative datasets closely approximate the resident population with coverage ratios that are relatively similar in 2011 and 2021. The data on population flows appear broadly consistent with the population stocks and the DPM framework produces a coherent set of estimates with the population in agreement with Census 2021-based MYE.

### **Figure 7: For females in Swindon, admin-based population estimate (ABPE) future estimates closely match Census 2021-based mid-year estimates (MYE)**

Population estimates for Swindon, 2021, females by age

Download the data

[.xlsx](#)

## Richmondshire estimates 2021

Population estimates for males in Richmondshire, shown in Figure 8, are an example where ABPE future estimates significantly overestimate the population compared with Census 2021-based MYE. ABPE best estimates are not shown on the chart but almost exactly align with the Census 2021-based MYE. The total population for Richmondshire is overestimated compared with Census 2021-based MYE because the population of young men is overestimated.

### **Figure 8: For males in Richmondshire, admin-based population estimate (ABPE) future estimates overestimate compared with Census 2021-based mid-year estimates (MYE)**

Population estimates for Richmondshire, 2021, males by age

## Download the data

[.xlsx](#)

This local authority has a relatively small total population, heavily influenced by a substantial home armed forces population. Armed forces personnel can be difficult to account for in administrative datasets as they tend to interact with public services, such as health services, in a different way to the general population.

The administrative datasets used as stock inputs give very different estimates for this younger, male part of the population through the time period. Our proxy for a coverage adjustment method takes quite a generic approach and might not cope well with particular population groups.

In this Richmondshire example, smoothing of the ratio of SPD version 4.0 to Census 2021-based MYE does not capture some sharp peaks and dips in the 18 to 24 years age group. Also, SPD version 3.0 in 2016 shows a population peak for ages 22 to 29 years, which is not present in other years and is not accounted for by assuming linear change of coverage between 2011 and 2021. This inconsistency not only affects the population stock input for 2016 but also impacts on the modelled input rates, because SPD version 3.0 from 2016 to 2020 is used in population denominators for earlier years.

These findings will be factored into our development of a robust coverage adjustment method in future.

Migration counts used in the calculation of modelled input rates show significantly different age profiles for 2021 and 2022; there are large peaks of in and out migration at ages 18 to 20 years. These come from the international migration estimates. While only present in the last two years of the time series, our approach to smoothing rates over age and time results in distortion of the input migration rates at these ages for all years.

The DPM approach balances information on population stocks and flows and the uncertainty of the data to produce a coherent account. In cases where there are strong inconsistencies between different input data sources the model performance is reduced, and estimates are less reliable.

Our estimates for local authorities such as Richmondshire will improve in future iterations of the ABPE through further research into:

- how best to account for special populations in DPM modelling
- improved methods for apportioning international migration by local authority, sex and age
- further improvements to our modelling methods for rates
- coverage adjustment strategies for SPD

## 5 . Admin-based population estimates for local authorities England and Wales data

[Admin-based population estimates for local authorities in England and Wales](#)

Dataset | Released 28 February 2023

Admin-based population estimates for all local authorities in England and Wales from the dynamic population model.

## 6 . Glossary

## Administrative data

Collections of data maintained for administrative reasons, for example, registrations, transactions, or record-keeping. They are used for operational purposes and their statistical use is secondary. These sources are typically managed by other government bodies.

## Dynamic population model

A dynamic population model (DPM) is a statistical modelling approach that uses a range of data to measure the population and population changes in a fully coherent way.

## Credible intervals

The range in which the true value of the quantity being estimated is likely to be contained. This is a similar concept to the confidence intervals published for the current mid-year estimates (MYEs) and census estimates. We use 95% credible intervals in this article by taking 2.5th and 97.5th percentiles from the distributions of counts produced by our estimation process as the lower and upper bounds of our intervals respectively. In this case, we can say that the probability that the true value lies in the credible interval is 95%.

## Smoothing

Calculating a line of best fit through non-linear data. Generalised Additive Models (GAM) have been used within the DPM to model and smooth raw stock and flow data. This was done to reduce the amount of random variation and attempt to represent the true underlying pattern. This approach is particularly useful when working with data that fluctuate a lot year-on-year or rare events.

# 7 . Future developments

The dynamic population model (DPM), and resulting admin-based population estimates (ABPEs), are showing potential for producing timely, coherent population statistics.

With these results, we have demonstrated our ability to produce early estimates for mid-2022 for all 331 local authorities in England and Wales, and the need for a coverage adjustment method.

In summer 2023 we will publish an update to our ABPEs for all local authorities from 2011 to 2022 and compare against the new official mid-year estimates (MYE) for 2022.

We plan to incorporate the following improvements:

- replace Statistical Population Dataset (SPD) version 3.0 with version 4.0
- update internal and international migration data
- include a first implementation of a coverage adjustment method using survey data

In further work, we will continue to research how we adjust our population stock data to account for coverage error. This will also include investigating how we are accounting for special populations including armed forces and students.

We will continue to develop our methods of generating estimates of uncertainty. We will investigate our ability to produce credible intervals for aggregate estimates, giving estimates of uncertainty at local authority level, or by grouped age or sex combinations.

We will continue to investigate possible adjustments to improve the coherence across data sources by using age at time of event, rather than age at mid-year.

We will continue to develop our methods for splitting combined migration into internal and international migration components.

## 8 . Provide feedback

We welcome your feedback on the dynamic population model (DPM), our transformation journey, and our latest progress and plans. If you would like to contact us, please email us at [pop.info@ons.gov.uk](mailto:pop.info@ons.gov.uk).

We have launched our [Local population statistics insight feedback framework](#), which enables users of population statistics to provide feedback at local authority level and suggest data sources for us to better understand the quality of our estimates.

You can also sign up to [email alerts from the Office for National Statistics Population team](#) for updates on our progress, and to hear about upcoming events and opportunities to share your views.

## 9 . Collaboration

The Office for National Statistics (ONS) has been supported in this research by the University of Southampton. Specifically, we would like to thank John Bryant, Peter Smith, Paul Smith, Jakub Bijak and Jason Hilton for their guidance and support.

## 10 . Related links

[Dynamic population model, improvements to data sources and methodology for local authorities in England and Wales: 2011 to 2022](#)

Methodology | Released 28 February 2023

Developments of methods and data used in the dynamic population model.

[Developing Statistical Population Datasets, England and Wales: 2021](#)

Article | Released 28 February 2023

Aggregate comparisons between the Statistical Population Dataset version 4.0 (v4.0) and Census 2021.

[Reconciliation of mid-year population estimates with Census 2021, England and Wales](#)

Article | Released 28 February 2023

Analysis of differences between mid-year population estimates rolled forward from mid-2020 and official estimates rolled forward from Census 2021.

[Transforming population statistics, comparing 2021 population estimates in England and Wales](#)

Article | Released 28 February 2023

Evaluating progress towards a transformed population statistics system, using comparisons between census-based and admin-based population estimates and Census 2021.

[Understanding quality of Statistical Population Dataset in England and Wales using the 2021 Census - Demographic Index linkage](#)

Article | Released 28 February 2023

Analysis of Statistical Population Dataset version 4.0 2021 using a linkage between Census 2021 and the Demographic Index.

## 11 . Cite this article

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