

Article

Measures of statistical uncertainty in ONS local authority mid-year population estimates: England and Wales, 2020

Simulation-based methods for producing measures of statistical uncertainty for mid-year population estimates, by local authority, England and Wales.

Contact:
Elzemies Scott-Kortlever and
Dan Clarke
demographic.methods@ons.gov.
uk
+44 1329 444279

Release date:
28 January 2022

Next release:
To be announced

Table of contents

1. [Main temporary changes](#)
2. [Overview of measures of statistical uncertainty in ONS local authority mid-year population estimates](#)
3. [Temporary method changes](#)
4. [Location of the MYEs in their uncertainty intervals](#)
5. [Related links](#)

1 . Main temporary changes

- Incorporating the merging of local authorities
- Changes to the international migration component

2 . Overview of measures of statistical uncertainty in ONS local authority mid-year population estimates

Measures of statistical uncertainty for the local authority [mid-year population estimates](#) (MYEs) are research statistics that aim to give users of MYEs information about their quality. Uncertainty measures for 2011 to 2019 were published in 2020. These were produced for each of the then 348 local authorities in England and Wales.

The complexity of the MYE methodology makes it impossible to estimate this uncertainty directly. The methodology described in [Methodology for measuring uncertainty in ONS local authority mid-year population estimates: 2012 to 2016](#), quantifies uncertainty and indicates the relative contribution to this uncertainty by each of the three components that impact on uncertainty the most: the 2011 Census base, international and internal migration.

In this article we extend the time series to 2020. We also incorporate changes made to the geographical boundaries of local authorities in 2019 and 2020. We temporarily changed our methodology for calculating international migration uncertainty because of computational issues encountered in implementing the method.

In this article we provide empirical 95% uncertainty intervals. If the assumptions we have made in estimating uncertainty are correct, we would expect these intervals on average to capture the true population 95% of the time.

The uncertainty methodology is based on three components with the greatest impact on uncertainty. The measures do not incorporate the uncertainty associated with all of the data sources and processes involved in producing MYEs and should be considered to be conservative.

The coronavirus (COVID-19) pandemic has had an impact on the data quality of some of the sources feeding into both the mid-year estimates and their uncertainty. The International Passenger Survey (IPS), the main source of the international migration component, was suspended in March 2020 but reinstated in January 2021. To overcome the absence of IPS data from March to June 2020, [measures of LTIM were modelled](#) to estimate UK international migration.

3 . Temporary method changes

Incorporating the merging of local authorities

The three main sources of uncertainty associated with the mid-year population estimates (MYEs) are the census base, international migration, and internal migration (moves between local authorities (LAs)). Uncertainty in the other components of change (births, deaths, asylum seekers, armed forces, and prisoners) is assumed to be zero.

The methodology for producing internal migration uncertainty has remained the same for local authorities whose geographic boundaries have not changed in recent years. Further details on this process can be found in [Methodology for measuring uncertainty in ONS local authority mid-year population estimates: 2012 to 2016](#). In 2019 and 2020, a number of local authorities merged into new ones. Table 1 outlines which local authorities were affected. Because of certain features intrinsic to the internal migration methodology, it is not possible to process them the same as other local authorities.

Table 1: Boundary changes to local authorities 2019 to 2020

Old local authority		New local authority		Year of boundary change
LA code	LA name	LA code	LA name	
E06000028	Bournemouth	E06000058	Bournemouth, Christchurch and Poole	2019
E07000048	Christchurch			
E06000029	Poole			
E07000053	Weymouth and Portland	E06000059	Dorset	2019
E07000052	West Dorset			
E07000050	North Dorset			
E07000051	Purbeck			
E07000049	East Dorset			
E07000191	West Somerset	E07000246	Somerset West and Taunton	2019
E07000190	Taunton Deane			
E07000205	Suffolk Coastal	E07000244	East Suffolk	2019
E07000206	Waveney			
E07000201	Forest Heath	E07000245	West Suffolk	2019
E07000204	St Edmundsbury			
E07000004	Aylesbury Vale	E06000060	Buckinghamshire	2020
E07000005	Chiltern			
E07000006	South Bucks			
E07000007	Wycombe			

Source: Office for National Statistics

We calculated the relative width and position of the uncertainty intervals for each LA in the newly merged LAs. We combined them into a weighted average to produce uncertainty intervals for the 2020 MYE in the following manner:

$$1. \quad x_{LB} = \frac{(MYE_{2019} - LB_{2019})}{MYE_{2019}}$$

$$2. \quad x_{UB} = \frac{(UB_{2019} - MYE_{2019})}{MYE_{2019}}$$

Where MYE_{2019} is the 2019 mid-year estimate, LB_{2019} is the lower bound of the uncertainty interval for the 2019 mid-year estimate, UB_{2019} is the corresponding upper bound, and x_{XB} are the corresponding relative uncertainty bounds.

The relative uncertainty bounds for the merged LAs are calculated as a weighted average of those of its constituent LAs:

$$3. \quad w_a x_a + w_b x_b + w_c x_c + \dots = x_T$$

Where x_i is the relative uncertainty bound for LA_i and w_i is the proportion of the population in LA_i and x_T is the relative uncertainty bound for the merged LA. Equation 3 is calculated separately for the lower and upper bound of the mid-year estimate.

The relative uncertainty bounds for the 2020 mid-year estimates are then calculated as:

$$4. \quad MYE_{2020} - (MYE_{2020} * x_T) = LB_{2020}$$

$$5. \quad MYE_{2020} + (MYE_{2020} * x_T) = UB_{2020}$$

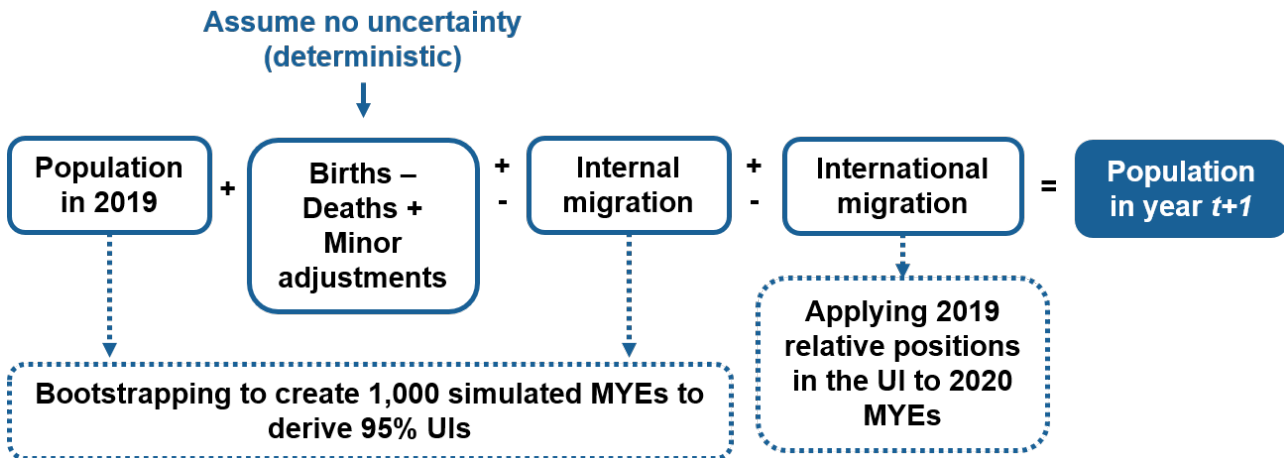
This was calculated for all local authorities in Table 1.

Changes to the international migration component

We use bootstrapping to simulate uncertainty around the international migration component, however this was not possible because of computational issues encountered in implementing the method. Instead, we use the international migration point estimate and uncertainty interval from 2011 to 2019 for each LA. This is to identify patterns in the widths of the intervals and the position of the point estimate in the interval over time. No specific patterns were found. Therefore, we calculate the relative width of the 2019 uncertainty intervals and apply to the 2020 MYE for the international migration component.

The estimates for the 2020 international migration component are based on the International Passenger Survey (IPS) data up to March 2020, and [modelled migration estimates](#) for the period after March 2020 when the IPS was suspended because of coronavirus (COVID-19). Figure 1 summarises the changes that have been made to produce the 2020 mid-year estimate uncertainty.

Figure 1: 2020 mid-year estimate cohort component method and statistical uncertainty



Source: Office for National Statistics

4 . Location of the MYEs in their uncertainty intervals

We produce [uncertainty intervals for all local authorities in England and Wales](#).

Table 2 shows that for most local authorities, the mid-year population estimates (MYEs) no longer sit within its uncertainty interval in 2020.

Over time, a growing number of local authority MYEs fall outside of their empirical 95% uncertainty bounds. By 2020, this is the case for 161 local authorities. This is consistent with our understanding that estimation of the population becomes progressively more difficult as we move away from the census.

Table 2: Position of local authority mid-year population estimates relative to their empirical 95% uncertainty intervals, 2011 to 2020

Year	Number within	%	Number above	%	Number below	%
2011	348	100.00				
2012	347	99.71	1	0.29		
2013	316	90.80	28	8.05	4	1.15
2014	271	77.87	66	18.97	11	3.16
2015	237	68.10	95	27.30	16	4.60
2016	218	62.64	108	31.03	22	6.32
2017	195	56.03	120	34.48	33	9.48
2018	187	53.74	123	35.34	38	10.92
2019	177	50.86	130	37.36	41	11.78
2020	161	47.92	125	37.20	50	14.88

Source: Office for National Statistics – measures of statistical uncertainty

Table 3 outlines how the local authorities are interacting with the uncertainty interval. Figures 2 to 7 provide illustrative examples of local authorities for each position in this table.

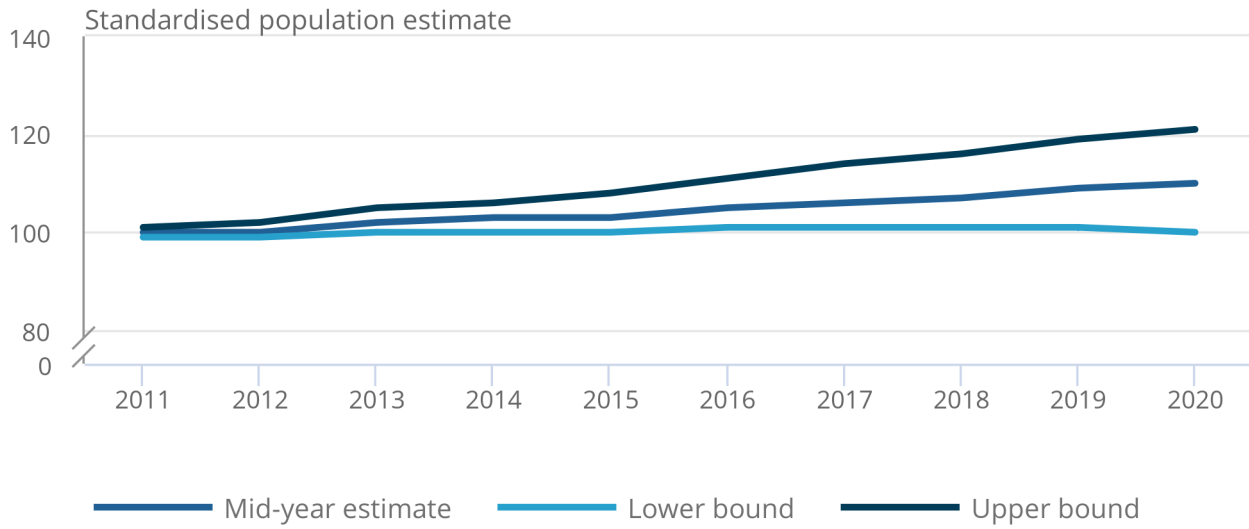
Table 3: Position of local authority mid-year population estimates relative to their uncertainty intervals

Position over time	Empirical 95%
MYE sits within the uncertainty interval	76
MYE drifts to upper bound	44
MYE drifts to lower bound	34
MYE crosses upper bound	125
MYE crosses lower bound	47
MYE follows none of these trends	10
Total	336

Source: Office for National Statistics – measures of statistical uncertainty

Figure 2: The mid-year population estimate sits within its uncertainty intervals, 2011 to 2020 – Boston

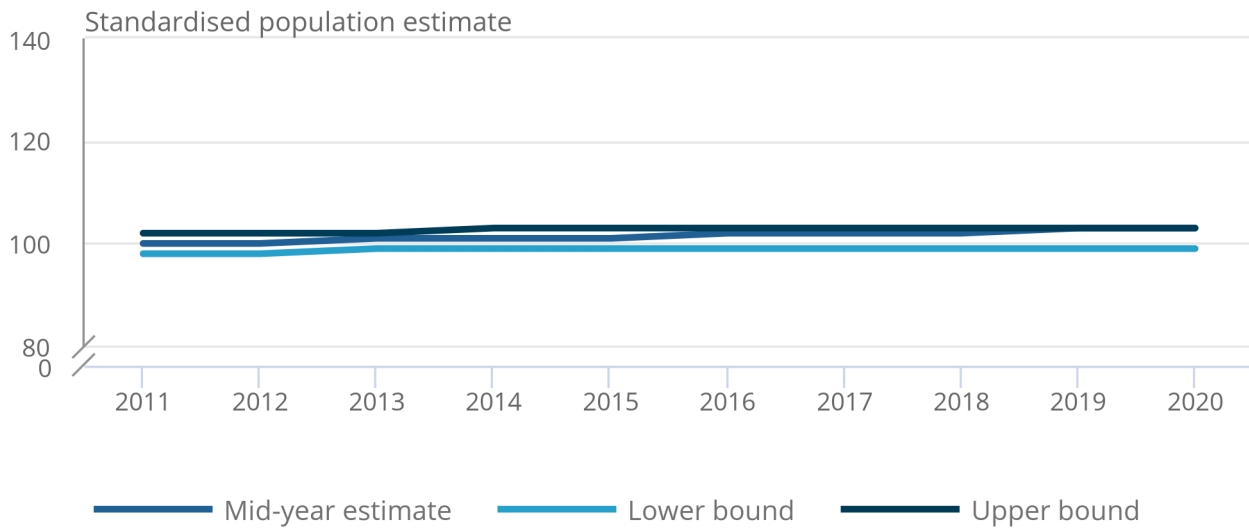
Figure 2: The mid-year population estimate sits within its uncertainty intervals, 2011 to 2020 – Boston



Source: Office for National Statistics – measures of statistical uncertainty

Figure 3: The mid-year population estimate drifts to the upper bound of the uncertainty intervals, 2011 to 2020 – Castle Point

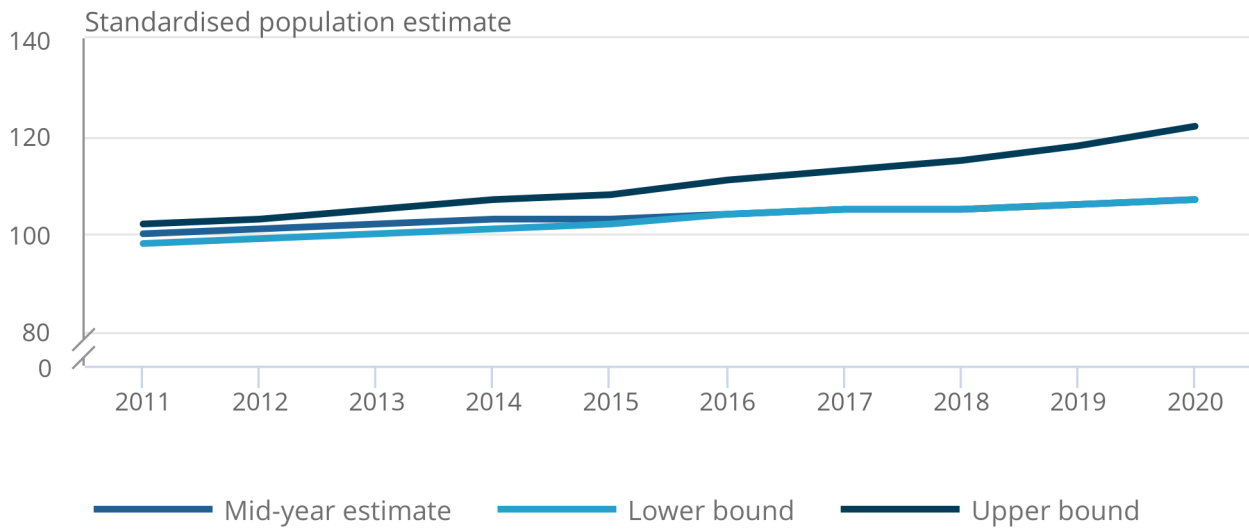
Figure 3: The mid-year population estimate drifts to the upper bound of the uncertainty intervals, 2011 to 2020 – Castle Point



Source: Office for National Statistics – measures of statistical uncertainty

Figure 4: The mid-year population estimate drifts to the lower bound of the uncertainty intervals, 2011 to 2020 – Cardiff

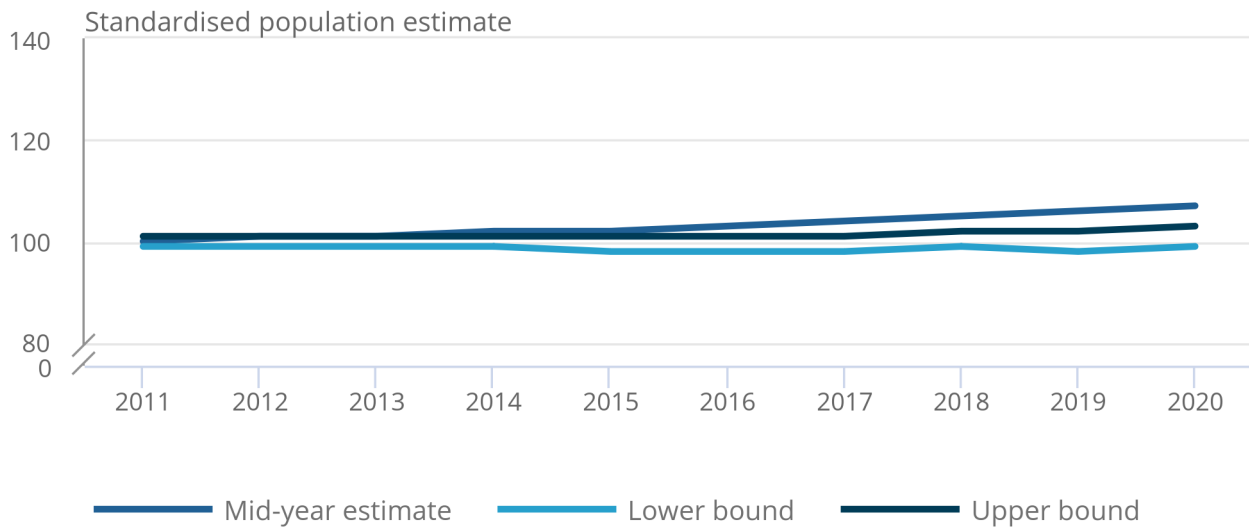
Figure 4: The mid-year population estimate drifts to the lower bound of the uncertainty intervals, 2011 to 2020 – Cardiff



Source: Office for National Statistics – measures of statistical uncertainty

Figure 5: The mid-year population estimate crosses the upper bound of the uncertainty intervals, 2011 to 2020 - Mid Devon

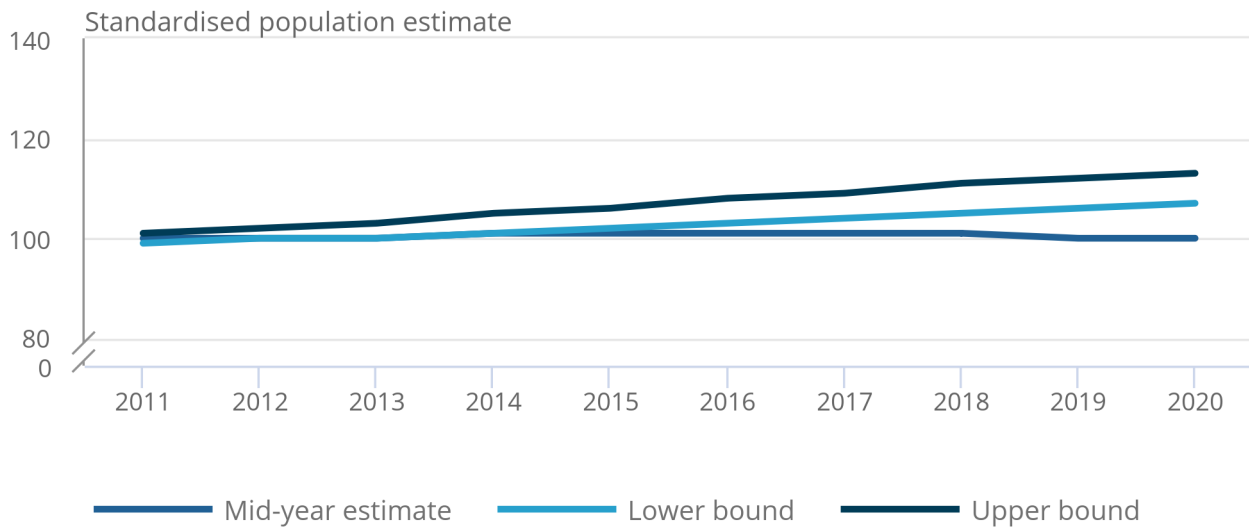
Figure 5: The mid-year population estimate crosses the upper bound of the uncertainty intervals, 2011 to 2020 - Mid Devon



Source: Office for National Statistics – measures of statistical uncertainty

Figure 6: The mid-year population estimate crosses the lower bound of the uncertainty intervals, 2011 to 2020 – Cheltenham

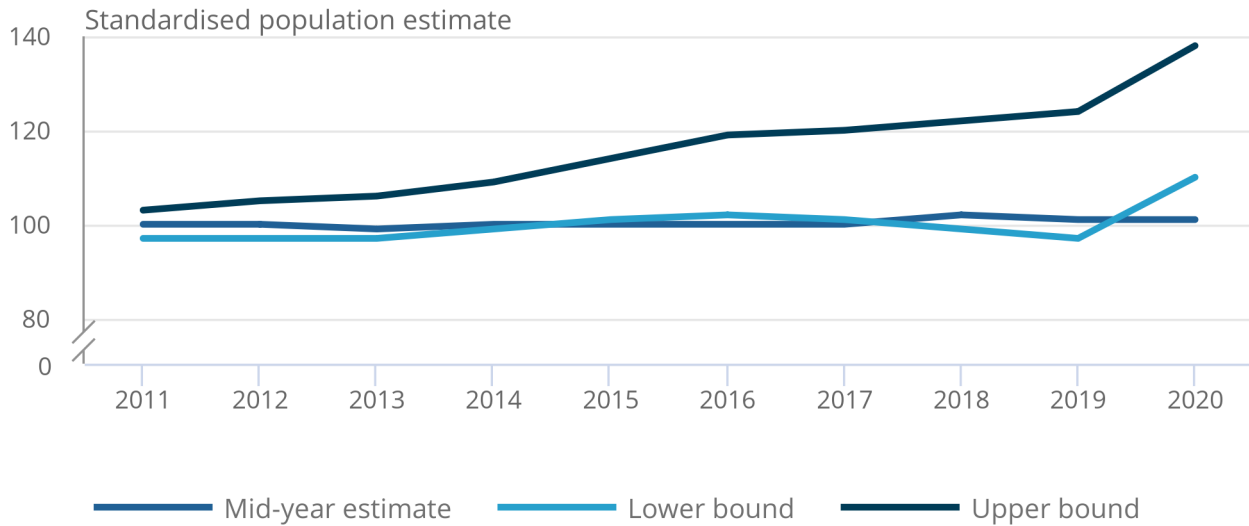
Figure 6: The mid-year population estimate crosses the lower bound of the uncertainty intervals, 2011 to 2020 – Cheltenham



Source: Office for National Statistics – measures of statistical uncertainty

Figure 7: The mid-year population estimate follows none of the trends seen elsewhere, 2011 to 2020 – Hammersmith and Fulham

Figure 7: The mid-year population estimate follows none of the trends seen elsewhere, 2011 to 2020 – Hammersmith and Fulham



Source: Office for National Statistics – measures of statistical uncertainty

5 . Related links

[Population estimates for the UK, England and Wales, Scotland and Northern Ireland: mid-2020](#)

Statistical bulletin | Released on 25 June 2021

National and subnational mid-year population estimates for the UK and its constituent countries by administrative area, age and sex.