

Assessment of compliance with the Code of Practice for
Statistics

Admin-based population estimates for England and Wales

(produced by the Office for National Statistics)

Office for Statistics Regulation

We provide independent regulation of all official statistics produced in the UK. Statistics are an essential public asset. We aim to enhance public confidence in the trustworthiness, quality and value of statistics produced by government.

We do this by setting the standards they must meet in the [Code of Practice for Statistics](#). We ensure that producers of government statistics uphold these standards by conducting assessments against the Code. Those found to comply with the standards of trustworthiness, quality and value in the Code are given accredited official statistics status, (called National Statistics in the Statistics and Registration Service Act 2007). We also report publicly on system-wide issues and on the way statistics are being used, celebrating when the standards are upheld and challenging publicly when they are not.

1. Overview

Background

- 1.1 The Office for National Statistics (ONS) has traditionally produced its population estimates for England and Wales primarily using information from a survey it carries out every 10 years – the census. However, to improve statistics on population to better reflect changes in society and technology and meet user needs, ONS has developed Admin-Based Population Estimates (ABPEs) for England and Wales using a ground-breaking and innovative new method – the Dynamic Population Model (DPM).
- 1.2 The DPM uses a Bayesian statistical model to produce a coherent estimate of population counts (stock) and changes (flows) using births, deaths and migration data. The work that ONS is doing to improve estimates of the population in England and Wales is at the forefront of harnessing technological advancements for statistics production. The results will influence how population data are compiled and used in the production of official statistics and wider research across the UK.

Aims and approach of our assessment

- 1.3 ONS requested this assessment to reflect new developments as part of UK Government's broader ambition to move away from undertaking a census every 10 years and make more use of administrative data. The production of the ABPEs using the DPM represents a significant development in the way that the population of England and Wales will be estimated. In this report, we set out our findings and requirements to support ONS in its continued development of the ABPEs as it works towards achieving [accredited official statistics](#) status for these statistics.
- 1.4 Our phased [assessment](#) reflects the scale and ambition of the development of these statistics and the wider transformation context. It will consider whether the statistics meet the professional standards set out in the statutory [Code of Practice for Statistics](#). This phase of our assessment, the first, aims to provide reassurance to users on the new approach and therefore focused on three areas:
 - a) the extent to which ONS is benchmarking the state of readiness of population estimates to replace the cohort component method currently used.
 - b) the suitability and quality assurance of the data and methods used in the DPM to produce population estimates for England and Wales.
 - c) an initial investigation into user understanding of, and confidence in, the proposed new method, and ONS's communications on the method.
- 1.5 We conducted a desk-based review of the statistical publications, associated methodology papers and relevant documentation that ONS has shared. We also spoke with some key users, including demographers and local authorities, to gauge user confidence in, and wider understanding of, the new approach.
- 1.6 To help inform our judgements, specifically in relation to (b) above, we sought independent expertise from Arkadiusz Wiśniowski, Professor of social statistics and demography at the University of Manchester, who specialises in population estimation, data integration and Bayesian methods. A copy of Professor Wiśniowski's report is [available here](#).

Summary of findings and requirements

- 1.7 We support ONS's ambition to make use of technological advances in developing innovative new methods for the production of population statistics to increase the accuracy of these statistics and better meet the needs of their users. As it improves its population estimation methods, ONS can also share its learning with other statistics producers, both more widely in the UK and internationally.
- 1.8 Population statistics not only provide insight about the size and composition of the population in a society, but also serve as the bedrock of many other important statistics that are used to underpin decisions affecting people's lives. Maintaining statistical quality, user confidence and trust in its population statistics is crucial as ONS transitions to using the new method to produce ABPEs. Our review and findings are focused on three areas: the readiness of the ABPEs to replace the current mid-year estimates (MYEs), the suitability and quality assurance of the data and methods used in the DPM and user understanding of and confidence in the new approach.
- 1.9 Demonstrating the moving landscape and pace at which the ABPEs are being developed, ONS has already made several commitments and plans to improve these statistics, which are dependent on whether it can secure appropriate resourcing over the coming months. We support these commitments and so our requirements for the first phase of this assessment are focused on areas beyond these commitments.
- 1.10 We have identified eleven requirements for ONS to address to ensure that these statistics are on course to meet the high standards of public value, quality and trustworthiness associated with accredited official statistics status. These requirements cover areas such as governance, data quality, methods, revisions, user engagement, and communication.

Benchmarking the state of readiness of ABPEs to replace MYEs

- 1.11 ONS faces challenges in governance, decision-making and communication in the transition from the MYEs to the ABPEs. There are dependencies between the current MYEs and the ABPEs, particularly in the way that census data are used. To explore these dependencies further, ONS has presented the ABPEs in different ways, with varying reliance on census data. However, the evidence around the quality of the ABPEs is currently not conclusive, as the ABPEs are dependent on the input data used. It is essential that ONS understand and communicate these dependencies between the two estimates. In considering when the ABPEs will replace the MYEs, ONS needs to develop and publish criteria to support its decision; there is a significant risk that without defined criteria ONS's decision-making will undermine user confidence.
- 1.12 The ONS team working to produce and develop these estimates is relatively small, and as ONS reorganises its team structure, there are challenges in terms of staff capability and financial position. As with any major transformation programme, it is important that appropriate senior oversight and governance is in place to manage change, support decision-making, and to identify and mitigate any risks.
- 1.13 **Requirement 1:** To maintain public confidence in its population statistics, ONS needs to understand the current dependencies between the ABPEs and MYEs. Together with key stakeholders, such as the Welsh Government, ONS should also develop and publish criteria to support its decision about when the ABPEs will

replace the MYEs. The criteria should include statistical quality, operational readiness, planned evaluation and assurance processes and contingency plans, and be usefully applied to the ABPEs and MYEs.

- 1.14 **Requirement 2:** To ensure that there is sufficient oversight and leadership of the production of ABPEs in a way that is joined-up across ONS, and support the ongoing development of ABPEs, ONS should strengthen its governance structure. Work here should include establishing clearly defined decision-making responsibilities to manage any risks associated with funding, capability and prioritisation across the ABPEs production process.

Understanding the suitability and quality assurance of the data and methods

- 1.15 Given the complexity of the methods used in the DPM and in formulating our view against the Code, we commissioned an independent review from Professor Arkadiusz Wiśniowski which contains additional recommendations for ONS to address.

- 1.16 **Requirement 3:** To improve and quality assure the methods used in the DPM in a way that supports public confidence in the ABPEs, ONS should publish a response by October 2024 detailing how it plans to address the recommendations and suggestions in Professor Wiśniowski’s report, and, in particular, the essential recommendations (R1-R7). Any recommendations that ONS decides not to take forward should be clearly explained within the response, setting out how it has considered the recommendation.

R1.	To provide a comprehensive and detailed methods guide that will ensure that the Dynamic Population Model (DPM) is reproducible. The guide should describe in detail: <ul style="list-style-type: none"> a. data inputs, b. modelling framework, c. assumptions regarding population components, d. computational methods, e. model testing, and f. analysis of the outputs. The methods guide should contain versioning similar to the versioning of the Statistical Population Dataset (SPD).
R2.	To provide in the documentation (R1) a clear differentiation between bias and accuracy (or precision) of the data inputs and assess each data input in terms of bias and accuracy. The assessment should inform the DPM. Such a distinction is essential for the DPM to produce reliable (i.e. unbiased and accurate) population estimates.
R3.	To quantify in the documentation (R1) the assumptions in the model, e.g., for precision this could be done by providing coefficients of variation around the mean, rather than stating that one source is more precise than the other. The current version of the DPM relies on informative priors and such quantification is required as an input to the model. It will ensure that the various assumptions can be tested and their impact on ABPEs assessed.
R4.	To test and document the impact of using a coverage benchmark in the DPM (Option 1: correct in the data inputs, Option 2: Correct in the DPM)

	via model parameters). The documentation should contain a description which option has been implemented.
R5.	To analyse the sensitivity of the ABPEs to a variety of prior distributions assumed for the accuracy (precision) of each of the data inputs. Special attention should be paid to precision of migration (currently internal, cross-border and international migration being jointly modelled as in- and out-flows to and from LAs). Sensitivity analysis should be carried out for the prior distributions for the coverage adjustment parameters. These analyses will inform if the ABPEs are robust to the assumptions about data quality and help identify extreme situations where the DPM may require further research.
R6.	To continue developing a quality assurance processes at each stage of producing ABPEs, i.e. starting with producing data inputs, assessment of their bias and accuracy, quantification in terms of data-corrections and/or model parameters, as well as robustness and sensitivity analyses of the DPM and ABPEs. This is to ensure the sustainability of the DPM if data inputs change or new sources are introduced in the future.
R7.	To provide a statement that accompanies the DPM-based ABPEs on the potential sources of uncertainty or bias that are unaccounted for and, where possible, an assessment of their importance in a given situation, e.g. when considering estimates for age groups or LAs.

- 1.17 The DPM is in development, and ONS is continuing to learn about the model's capability, both in terms of its strengths and limitations. The model relies primarily on administrative data supplied by other government departments, with one of the benefits being that it can incorporate new data sources over time. This is dependent on overcoming practical challenges and continuing to build strong relationships with data suppliers. ONS's Data Pipeline Maturity framework and strong governance helps ONS to manage any risks associated with its data supply.
- 1.18 Whilst in theory the DPM can flex and overcome data supply issues, understanding the quality and associated uncertainty of the data inputs is crucial to the model being able to produce unbiased population estimates. ONS should therefore prioritise further work to document and understand more about the sensitivity of the model and how the data inputs and technical assumptions in the DPM affect the quality of the ABPEs.
- 1.19 **Requirement 4:** To maximise the capability of the DPM and the quality of the ABPEs, ONS should:
- address the practical implications of incorporating new data sources into the DPM over time and ensure it is appropriately resourced.
 - continue with its plans to conduct sensitivity analysis to explore how the model's performance is affected by the availability and quality of different data sources.
 - review and test the capability of the DPM, at suitable intervals, to account for the integration of any novel and volatile/changeable data sources that are included in the model over time.

- implement regular fully audited assumption checking and validation to support reproducibility and to help keep the model sustainable.
- 1.20 The DPM uses the Statistical Population Dataset (SPD), which is based on linked administrative data and derived from the Demographic Index (DI), as its main stock measure (the count of the population on a given day). The SPD is subject to over-coverage and under-coverage, due to the nature of the data collected for administrative purposes. Therefore, methods are applied to adjust for coverage issues using census-based data. The SPD estimates, particularly at a granular level, vary when compared to Census-based 2021 estimates by different population group characteristics, therefore pointing to a need for ONS to understand those differences and any potential sources of bias that may exist in the SPD.
- 1.21 **Requirement 5:** To maximise appropriate use of the ABPEs, and avoid inappropriate use of these statistics, ONS should:
- better understand the source of any bias in the SPD and introduce documented quality metrics for the DI that quantify errors (in particular, linkage errors) and any associated uncertainty that may propagate into the SPD and subsequently the DPM.
 - publish information on the DI, including on how it is created, reviewed, updated and quality-assured.
 - communicate and present, in a simple way, how the stock data (and other data inputs to the model) change over time, as this may affect the quality of the ABPEs and how it compares to that of other population estimates, such as the MYEs.
 - ensure its published quality information includes explanation of any strengths and limitations, and reflects the latest data inputs used, for example, updating to the latest version of the SPD.
- 1.22 Quality assurance arrangements covering the end-to-end process are not yet well established across the production of ABPEs in ONS. A well-documented approach is necessary to support the reproducibility and user understanding of the ABPEs' strengths and limitations.
- 1.23 **Requirement 6:** To audit the ABPEs production process, understand the impact of data issues and support confidence in its approach, ONS needs to build on the principles set out in [its published data quality strategy](#) and implement an end-to-end process that will:
- fully audit and document the process and methods applied at each stage to support cross-production knowledge and capability, and ensure that mechanisms are in place for various teams to discuss, log and audit any decisions or fixes that take place.
 - oversee and assess the quality of the data inputs separately and in stages. This should help ONS develop the quality assurance information published alongside the statistics and support users' understanding of the strengths and limitations of the ABPEs.
 - ensure compliance with Reproducible Analytical Pipelines (RAP) standards.
- 1.24 Revisions will form a routine part of the production of ABPEs, in particular as ONS seeks to produce more-frequent population estimates using the DPM. To manage user expectations, ONS is developing a revisions policy specific to the ABPEs.

- 1.25 **Requirement 7:** To help users understand how to use the ABPEs, ONS should implement and publish a revisions policy, and as part of its development:
- carry out and publish a revisions analysis of the ABPEs to date, including how data input and methods differences may impact the scale of any revisions.
 - clarify how the model will be able to take account of any changes in methods over time as part of producing an ABPEs back series.
 - seek feedback and input from users and key stakeholders about its proposals and involve them in its decision-making.
- 1.26 ONS is at the forefront of developing a population estimation method for official statistics using a Bayesian statistical model. Given the innovative nature of this work, continued collaboration with Bayesian experts will be crucial for the ONS to develop the DPM.
- 1.27 **Requirement 8:** To instil confidence in the ABPEs and ensure that the DPM methods are sound and subject to sufficient independent and external challenge, ONS should:
- continue with its plans to create a sub-group of its Methodological Assurance Review Panel (MARF; the independent panel used by ONS to provide advice and assurance on methods used to produce official statistics).
 - create and implement an expert user group.
 - make it easier for users to find relevant MARF papers to support technical user understanding of the methods used in the DPM.

User understanding and confidence in the proposed new method

- 1.28 Developing the ABPEs is a significant step towards improving population estimates, and users are confident that increased use of administrative data is the right approach. However, users have reported some concern about the differences between the ABPEs and MYEs, the accuracy of the new estimates and how the new method will work without a census. An engagement strategy, specific to the ABPEs, will help ONS to better understand user needs and use this feedback to drive developments. Transparent and open communication with users, particularly about its long-term plans, will help ONS manage user expectations, quality-assure the ABPEs, support public confidence and demonstrate that ONS is a trustworthy organisation that actively listens and responds to users' views.
- 1.29 **Requirement 9:** To maintain public confidence and help shape the future development of the ABPEs and manage user expectations, ONS should:
- develop and implement a user engagement strategy specific to the ABPEs. This strategy should detail specific activities and how users will be involved at various stages of the process. The approaches that have been implemented elsewhere in ONS, for example migration statistics, can serve as a good model for this.
 - use feedback from users to drive developments to the ABPEs whilst also being transparent about where user needs cannot be met, (for example, the availability of breakdowns).

- publish regular updates on its plans for the ABPEs, including how the ABPEs form part of the wider population and migration statistics transformation, including timelines and any interdependencies.
- 1.30 **Requirement 10:** To quality-assure the ABPEs at a local level, and strengthen its relationships with users, ONS should be open to scrutiny from key stakeholders, such as local authorities, and users and respond to any feedback appropriately.
- 1.31 **Requirement 11:** To build trust in the new approach, ONS needs to improve the way that it communicates quality and methodology information and tailor its communication to the differing technical expertise of users of population statistics, including by:
- seeking feedback on its current published quality and methodology information with a broad range of users and working together with other stakeholders across the Analysis Function.
 - helping users navigate to the various publications on the ONS website, for example by implementing a landing page.

Overall judgement

- 1.32 We acknowledge ONS's level of ambition and the progress it has made, as well as the complexity of its work and the valuable staff expertise that has helped to shape and steer the work's development to date. We commend the considerable efforts of ONS staff to deliver this ground-breaking work and support ONS's overall aims, but there is significant work to be done before these statistics fully meet the standards of the Code of Practice for Statistics.
- 1.33 In our view, ONS should improve its governance and develop criteria to be able to benchmark the state of readiness of ABPEs to replace MYEs. More development work is needed to fully test the capabilities of the DPM, quantify the quality of data inputs going into the model and quality-assure the ABPEs to support appropriate use. And this should be done in collaboration with users and methods experts, with ONS encouraging external scrutiny and assurance through improved communication and engagement channels. ONS taking these steps will ensure that users have more confidence in the new method, and therefore the ABPEs.
- 1.34 ONS is working at pace and there is clear ambition to push the capability of the DPM and develop it further to meet more specific user needs (such as small area estimation). Whilst the DPM is an exciting new development for estimating the size of the population, we urge ONS to take time to address our requirements and embed strong foundations for further development to build on.

Next steps

- 1.35 We expect ONS to publish an action plan by October 2024, setting out how it intends to address the eleven requirements, and report back to us publicly every three months on its progress.
- 1.36 We will also consider the scope of the second phase of our assessment. We expect this to focus on the Value pillar of the Code of Practice for Statistics and to cover the coherence and comparability of population estimates across the UK.

2. Introduction

Measuring the population using the current cohort component method

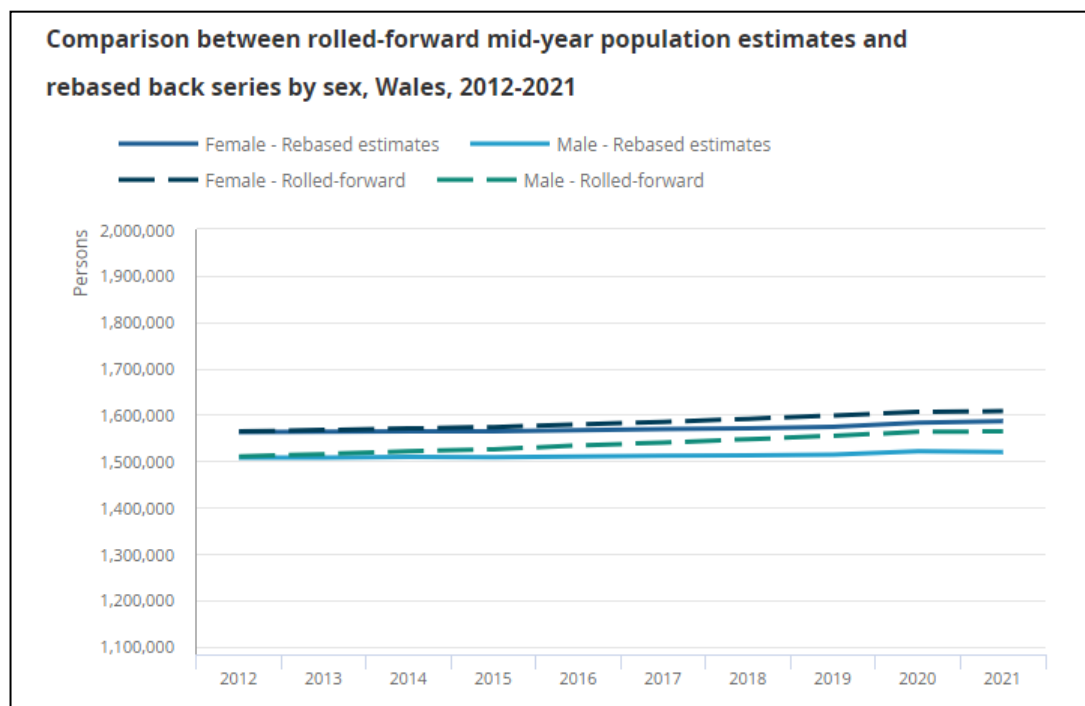
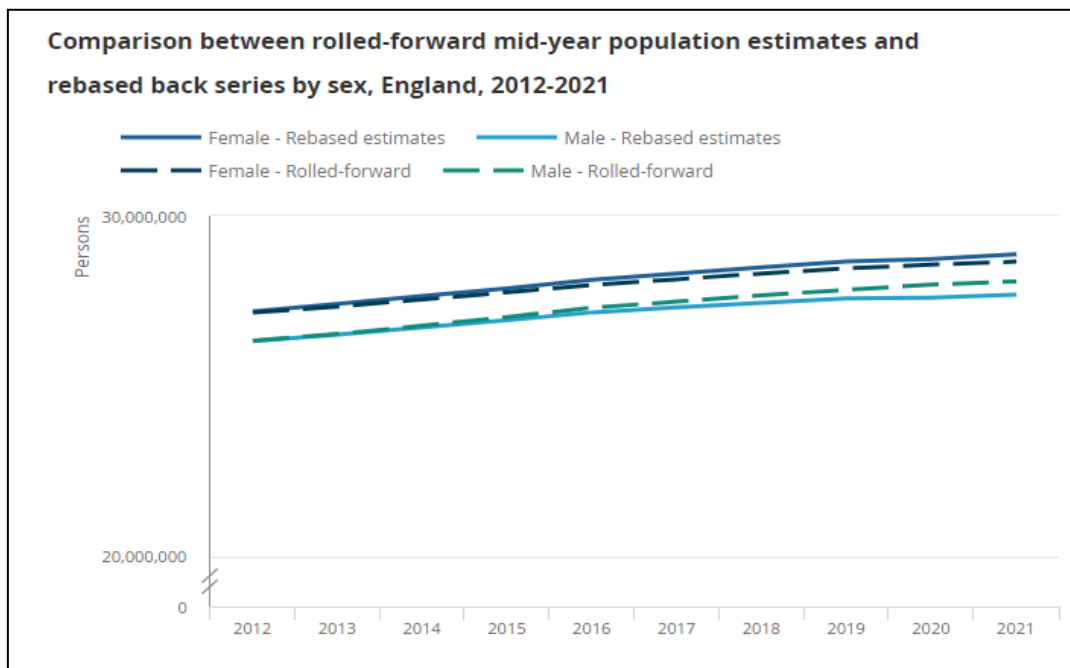
Mid-year estimates

- 2.1 Measuring the size of the population accurately is an essential part of understanding different aspects of our lives and communities. It is also inherently challenging. ONS publishes annual [mid-year estimates \(MYEs\)](#) of the population of England, as well as annual population estimates for Wales. The statistics are used extensively by a wide range of users for different uses. They provide insight into the size and location of the population across the UK and feed into a range of other datasets, for example as a denominator in labour market statistics. In turn, MYEs are used to underpin important operational and policy decisions, both at a national and local level.
- 2.2 The annual MYEs are produced from data on four aspects of the population, namely stock, births, deaths, and migration:
 - a) Stock (the size of the population on a given day) is taken from the [census](#). Estimates are rolled forward to 30 June (mid-year), and for consecutive years between censuses.
 - b) Birth data are obtained from birth registrations. ONS publishes [birth statistics for England and Wales](#). ONS also publishes UK birth figures.
 - c) [Death data](#) are obtained from death registrations in constituent countries, similar to birth registrations.
 - d) Migration data include estimates of both [international](#) and [internal](#) migration. An international migrant is defined as a person who changes their country of usual residence for a period of at least one year. Internal migration estimates account for the movement of people within England and Wales and to or from the rest of the UK (cross-border flows).
- 2.3 Finally, adjustments are made to account for special population groups, such as prisoners and armed forces, that are not captured by the internal or international migration estimates.
- 2.4 ONS also collates data from NRS and NISRA to produce population estimates for the UK. Estimates for each of the UK constituent countries are compiled using a common methodological approach with the [aim to be as consistent](#) as possible.

The cohort component method

- 2.5 To produce the MYEs, ONS takes data from the most-recent census, and rolls them forward to 30 June (mid-year) to determine the population stock. ONS then updates the MYEs for population change (also known as population flow) using births, deaths and migration data. This method is referred to as the [cohort component method](#) and accounts for a full-year's population change between 1 July and the subsequent 30 June. However, in census years, the MYEs instead account for the change between the day the census was conducted (for example, 21 March 2021) and mid-year (30 June 2021), a period of three months.

2.6 Between censuses, the estimates tend to drift as the baseline becomes increasingly out of date until they can be rebased again using data from the next census. So the more time that has passed since the last census took place, the less accurate the estimates. For example, in [November 2023](#), ONS rebased its MYEs (2012-2021) once data from Census 2021 for England and Wales became available and revised the back series of components of population change, as depicted in the charts below. In England, this led to an increase in rebased estimates for females and a decrease for males compared to the rolled-forward MYEs. In Wales, rebased estimates decreased the number of both males and females compared to the rolled-forward estimates.



Source: Figures 5 and 8 - [ONS website](#).

- 2.7 This rebasing is standard practice and conducted by ONS as part of the current system to estimate the size of the population, with benchmarking against the census every 10 years. Most of the revisions made have been for net international migration flows as a result of improved methods and data over time.

The proposed new method using the Dynamic Population Model

Globally, ONS is at the forefront of developing official population estimates using a Bayesian statistical model

- 2.8 To make more use of administrative data and technological advances, ONS has developed Admin-Based Population Estimates (ABPEs) for England and Wales using a new method to produce population statistics, namely, [the Dynamic Population Model \(DPM\)](#). The Dynamic Population Model (DPM) is a ground-breaking approach that aims to improve the way that population statistics are produced. It uses a Bayesian demographic accounts approach, developed by Bryant and Graham (2013). We understand that ONS is the only example of a National Statistical Institute using this method to develop official estimates of the population. As a statistical model, the DPM uses a range of data sources to produce a coherent estimate of population counts (stock) and changes (flow) using births, deaths and migration data. In line with ONS's broader ambition to make more use of administrative data, the DPM uses data sources that are supplied by other government departments and public agencies, as detailed in Annex A.
- 2.9 ONS has shown commendable ambition to revolutionise the way that population statistics are produced. We expect that the DPM will influence population estimation methods globally, and we look forward to seeing how ONS's progress in this area evolves and matures over time. Ultimately, ONS intends to replace the MYEs with the ABPEs. The stock data are updated annually using administrative data sources, and the model can produce timelier estimates compared to the current approach.

Admin-based population estimates

- 2.10 ONS has released a series of publications labelled [official statistics in development](#), which use the DPM to generate mid-year population estimates; these are the [ABPEs](#). Estimates of the population in England and Wales are provided by age, sex and local authority. These publications also describe the evolution of ONS's research and developments in methodology and data sources. ONS intends to replace the cohort component method with the DPM as the primary method for producing mid-year estimates. Like the MYEs, the data sources used as inputs use a mid-year date (30 June) for the reference year.

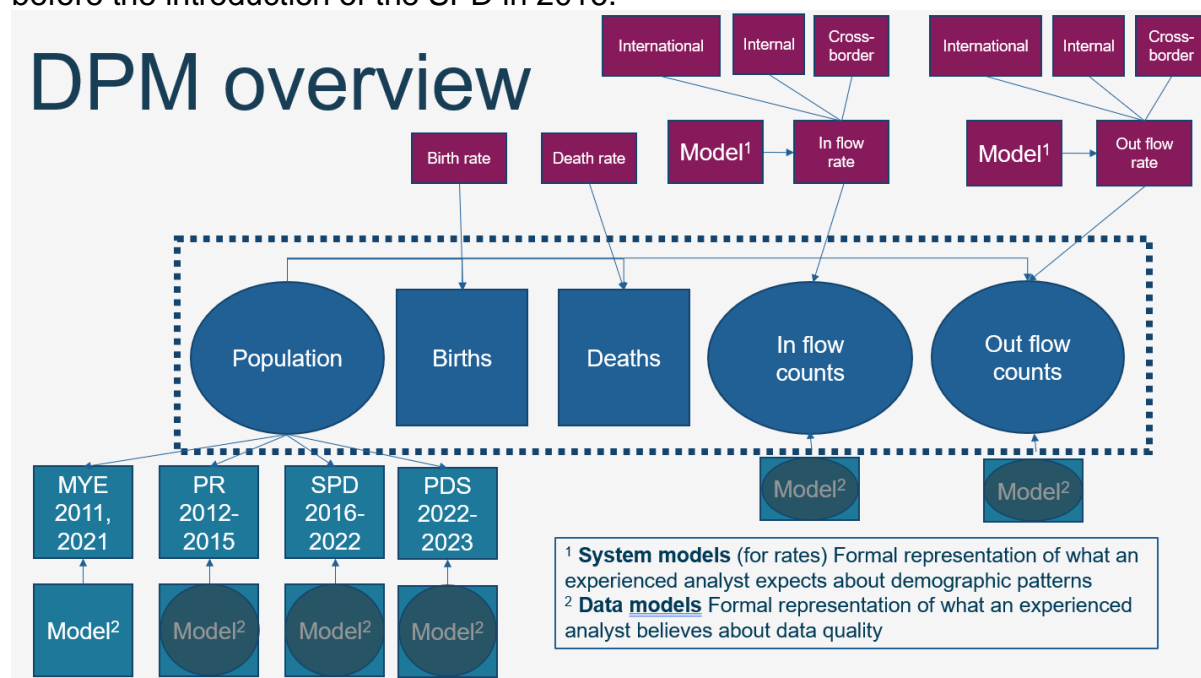
The DPM and data inputs

- 2.11 Based on theory outlined in ['Bayesian Demographic Estimation and Forecasting' \(J.Bryant, J.L.Zhang, 2020\)](#), ONS, in collaboration with academic experts, has researched and developed the DPM to produce estimates of the population in England and Wales. The model aims to produce a demographic account using a Bayesian statistical model and create a coherent set of population estimates; it is designed to allow flexibility in managing changeable data inputs and overcome potential data flaws (such as inaccuracies and missingness). The DPM requires an unbiased stock measure over time and a deep understanding of the quality of the data inputs to produce robust estimates with credible intervals.
- 2.12 In Bayesian inference, a probability distribution (posterior) is produced that summarises the uncertainty of the unknown variable of interest (in this case, ABPEs

by age-sex-LA-year) conditional on observed population counts that are measured with error. Bayesian modelling requires a joint probability model of the data and the unknown quantities, and necessarily rests on many assumptions – these need to be transparently communicated, and their influence on uncertainty should be explored.

The Statistical Population Dataset: stock data

- 2.13 The [Statistical Population Dataset](#) (SPD), which is based on linked administrative data, is the main stock measure and an approximation of the usual resident population of England and Wales. The stock data are updated annually using more-recent administrative data sources, therefore, in principle, reducing the likelihood of any rolled-forward errors and potential drift over time, as currently seen in the MYEs.
- 2.14 The SPD is created from the Demographic Index (DI), a composite data source built from a range of admin data sources using cuts of data. The stock data used in the DPM change over time, as shown in the chart below. Census-based MYEs (rolled forward to 30 June) were used as the stock for the census years 2011 and 2021. NHS Patient Register (PR) data were used as the stock between 2012 and 2015, before the introduction of the SPD in 2016.



Source: unpublished chart provided by ONS, 2024

- 2.15 The SPD is subject to limitations and bias. It is subject to under-coverage, with some people missing on administrative records, or not showing any signs of activity on their records that indicate their presence. It is also subject to over-coverage with some people being counted as present in England and Wales despite having moved to a different location. Therefore, a benchmark is needed to adjust the SPD to overcome bias caused by over-coverage and under-coverage. Currently, coverage ratios are derived from Census-based MYEs 2011 and 2021 data.

Births, deaths and migration data

- 2.16 Changes in the population for provisional and updated ABPEs are caused by births, deaths and migration (which includes international migration, internal migration and migration to or from England and Wales to other countries within the UK). Understanding the quality and the source of any uncertainty in the data inputs is a

crucial part of the Bayesian approach. In terms of data input for the DPM, ONS considers births and deaths data to be the most accurate, given that they are sourced from registrations data.

- 2.17 On the other hand, migration, which accounts for the largest proportion of population change, is the component with the most uncertainty. Long-term international migration (LTIM) estimates, which are currently labelled as official statistics in development, are undergoing transformation following the move away from the [International Passenger Survey \(IPS\)](#) as a data source. ONS had planned to move away from the IPS due to quality issues exacerbated by the COVID-19 pandemic because of the difficulty of collecting face-to-face data and led to the IPS's suspension in March 2020. At present, three main data sources are used to produce migration estimates for different groups of migrants:
- a) Home Office Borders and Immigration (HOBI) data for non-EU nationals
 - b) Department for Work and Pensions' Registration and Population Interaction Database (RAPID) for EU nationals
 - c) the IPS for British Nationals
- 2.18 Measuring how people move within the UK, also known as internal migration, is inherently challenging. To determine how people move within countries, ONS estimates internal migration using GP registration data from the [Personal Demographics Service \(PDS\)](#) and [Higher Education Student Agency \(HESA\)](#) data. Cross-border moves between England and Wales, and Scotland and Northern Ireland, are agreed with NRS and NISRA.

Wider population and migration statistics transformation

- 2.19 ONS ran a [consultation on the Future of Population and Migration Statistics in England and Wales from June to October 2023](#). The consultation was designed to provide ONS with information on how people currently use population and migration statistics and gather user feedback on ONS's proposals for the future development of these statistics. ONS published a [consultation update in December 2023](#) which detailed who responded to the consultation, how ONS engaged with users of population and migration statistics and how ONS carried out its analysis of responses. The user responses gathered during the consultation will inform a recommendation from the UK Statistics Authority to the UK Government on the advice of the National Statistician. It will be important for ONS to address the needs of the Welsh Government as a primary stakeholder, as it develops its plans for the transformation of population and migration statistics in England and Wales. We are pleased to hear that ONS is engaging with the Welsh Government to keep it informed of its plans, and we expect this positive practice to continue.
- 2.20 At present, the future of the census, as considered in the ONS Future of Population and Migration Statistics (FPMS) programme, is uncertain. Irrespective of decisions about the census, for the purpose of this assessment, we focus on the extent to which the ABPEs meet the professional standards set out in the [Code of Practice for Statistics](#) as a statistical output. Our judgements are based on how the statistics are currently compiled, quality-assured and presented.

3. Findings

Benchmarking the state of readiness of ABPEs to replace MYEs

This section outlines our findings related to the [Trustworthiness pillar](#) of the Code of Practice, namely the confidence in the people and organisations that produce statistics and data (in this case, the Office for National Statistics).

We consider how ONS plans to transition from the current MYEs to the ABPEs and how well this is supported through its governance and capability.

To maintain public confidence in its population statistics, ONS needs to understand the current dependencies between the ABPEs and MYEs to help inform its decision about when the ABPEs will replace the MYEs

- 3.1 To demonstrate the evolution and improvement of the methods used in the DPM, ONS has published a series of [outputs comparing the ABPEs with the MYEs](#) in an open and transparent way. Census data are used in the production of ABPEs in several ways, including as a population stock for 2021 and 2011 to provide the coverage adjustment for the Statistical Population Dataset (SPD), and in the production of rate denominators for birth, death and migration rates. As census data are also a key input for the MYEs, this creates a challenge for understanding how comparable the ABPEs are with the MYEs in the absence of census data.
- 3.2 The work to develop the ABPEs forms part of the wider population transformation taking place within ONS as it considers the future of the census. In February 2023, [ONS presented the ABPEs, with a reference date of 30 June 2021, in four different ways](#):
 - an ABPE best estimate (this represents ONS's best estimate derived from the DPM and uses the best available data, including Census 2021)
 - an ABPE future estimate (this is indicative of what can be expected from population estimates derived from the DPM in the future, assuming there is no longer a census. It includes a proxy for a coverage adjustment method to adjust for bias in the SPD and does not directly include the Census 2021 estimate)
 - an ABPE basic estimate (this does not include Census 2021 or a robust coverage adjustment method)
 - the unadjusted SPD (before it is included in the DPM and without a coverage adjustment method)
- 3.3 As expected, where census data are used (such as for the ABPE best estimate), the total population estimate for England and Wales is much closer to the Census 2021-based MYEs, whereas both the ABPE basic and unadjusted SPD estimates are less comparable to the Census 2021-based MYEs. Therefore, the evidence around the quality of the ABPEs is not conclusive, as the ABPEs are dependent on the input data used. The analysis uses a quality standard set out in the evaluation criteria of the [Beyond 2011](#) programme, a project looking at the alternatives to running a UK Census in 2021 to measure the quality of ABPEs at a local authority level (the quality standard is that estimates at local authority level are within 3.8% positive or negative of 2011 Census estimates). ONS has told us that it is updating

its quality standards in light of Census 2021, starting with a minimum accuracy standard for ABPEs of age and sex by local authority.

To ensure appropriate oversight is in place, ONS should strengthen its governance structure and develop criteria to support any decisions around the transition from MYEs to ABPEs

- 3.4 The work to develop and deliver ABPEs is complex and progressing at pace, with many different teams across ONS working hard in their roles. While each individual team recognises its specific contribution, there is no clear governance to bring the aims of the work together to ensure consistency and working in a joined-up way.
- 3.5 As mentioned previously, the development of the ABPEs forms part of the wider population transformation taking place within ONS. The FPMS programme is ambitious, and like many major programmes, faces practical delivery constraints. As the programme spans multiple ONS teams, decision-making responsibilities need to be clear to ensure that appropriate oversight and governance are in place for the ABPEs. Such governance should appropriately consider how any developments are prioritised and resourced to meet programme deliverables, in line with any intended timescales. ONS should build on its [recently published plans for population and migration statistics](#), taking into account any findings from the FPMS consultation. Alongside this, ONS should help users understand how the ABPEs, as the proposed method for measuring the population in the future, fit within these plans.
- 3.6 The ABPEs are currently published as official statistics in development. Final decisions around the ABPEs are made by the National Statistician. However, there is some uncertainty around how the decision to make the ABPEs the official population estimates will be made for England and Wales, and how this decision will be communicated both within and outside of ONS and to key stakeholders including the Welsh Government. ONS has developed success criteria for the FPMS programme as a whole, but no criteria for determining when ABPEs will become the official estimates of the population. Without clearly defined criteria, there is a risk that user confidence will be undermined.
- 3.7 **Requirement 1:** To maintain public confidence in its population statistics, ONS needs to understand the current dependencies between the ABPEs and MYEs. Together with key stakeholders, such as the Welsh Government, ONS should also develop and publish criteria to support its decision about when the ABPEs will replace the MYEs. The criteria should include statistical quality, operational readiness, planned evaluation and assurance processes and contingency plans, and be usefully applied to the ABPEs and MYEs.
- 3.8 ONS's National Accounts are overseen by a coordination division, which plays a central role in coordinating timelines for system and data deliveries and statistical release timetables. Implementing a similar infrastructure for the ABPE teams would support the sustainable delivery of these estimates, so it is good to hear that ONS is reorganising its team structure with the aim of better supporting the production of the ABPEs.
- 3.9 The responsibility of producing ABPEs within ONS currently sits within the Population and Migration Research Division (PMRD). The PMRD team continues to research and develop the new method for population estimation. In the long term, ONS is planning to hand over the responsibility of the ABPEs to its Demography Division, which is responsible for producing population statistical outputs, including

the MYEs. The plans for this transition, including timings, are crucial, as ONS needs to ensure that staff have a suitable level of expertise, knowledge and skills to embed a sustainable production process and have increased organisation resilience beyond the current handful of people who have expert knowledge. These plans remain under development.

- 3.10 As ONS develops these plans, it will be important that it ensures that they cover the end-to-end process, considering a range of scenarios that are at risk of change, including technical or data issues, staff turnover/capability issues, sustainability or improvements that are made to the methods and also the outputs. Given the computational challenges that ONS experienced at the start of the project and the complexity of Bayesian computational methods, it needs to ensure that there is capacity to support the DPM work. Therefore, we expect ONS to have an approved detailed plan that can be implemented at an appropriate time and before this transition is made to support this work operationally, drawing on principles outlined in the [National Audit Office good practice guide](#) to overcome challenges in managing risks.

To support the sustainable delivery of ABPEs, ONS needs to manage risks around funding and staff capability

- 3.11 The DPM production and development work is a complex, challenging, and pioneering effort in UK official statistics. It is being undertaken by teams who are working incredibly hard, and under considerable pressure. In addition to the complexity of this work, ONS also faces a challenge in terms of its financial position. Staff working on the ABPEs and developing the DPM are in roles that are funded by the wider FPMS programme. The programme is dependent on funding decisions made in the Spending Review and there is some uncertainty around its funding for this year and future financial years. Consequently, retaining and recruiting staff in the long term has been difficult. Any changes in the levels of funding could also impact the future delivery of the ABPEs.
- 3.12 The ONS team producing and developing the ABPEs is relatively small, with only a handful of people in ONS having a comprehensive understanding of how the DPM works. Estimating the population using a Bayesian demographic account, an internally consistent set of demographic stocks and flows, is challenging work. As far as we are aware, no other National Statistical Institutes have implemented this method, which limits the opportunities for ONS to learn from others' experience.
- 3.13 **Requirement 2:** To ensure that there is sufficient oversight and leadership of the production of ABPEs in a way that is joined-up across ONS, and support the ongoing development of ABPEs, ONS should strengthen its governance structure. Work here should include establishing clearly defined decision-making responsibilities to manage any risks associated with funding, capability and prioritisation across the ABPEs production process.

Understanding the suitability and quality assurance of the data and methods

This section outlines our findings related to the [Quality pillar](#) of the Code of Practice; namely the data and methods that produce assured statistics.

Given the complexity of the methods used in the DPM, we commissioned an independent review from Professor Arkadiusz Wiśniowski which contains additional recommendations and suggestions for further work.

Requirement 3: To improve and quality assure the methods used in the DPM in a way that supports public confidence in the ABPEs, ONS should publish a response by October 2024 detailing how it plans to address the recommendations and suggestions in Professor Wiśniowski's report. In particular, the essential recommendations (R1-R7). Any recommendations that ONS decides not to take forward should be clearly explained within the response, setting out how it has considered the recommendation.

R1.	<p>To provide a comprehensive and detailed methods guide that will ensure that the Dynamic Population Model (DPM) is reproducible. The guide should describe in detail:</p> <ul style="list-style-type: none"> a. data inputs, b. modelling framework, c. assumptions regarding population components, d. computational methods, e. model testing, and f. analysis of the outputs. <p>The methods guide should contain versioning similar to the versioning of the Statistical Population Dataset (SPD).</p>
R2.	<p>To provide in the documentation (R1) a clear differentiation between bias and accuracy (or precision) of the data inputs and assess each data input in terms of bias and accuracy. The assessment should inform the DPM. Such a distinction is essential for the DPM to produce reliable (i.e. unbiased and accurate) population estimates.</p>
R3.	<p>To quantify in the documentation (R1) the assumptions in the model, e.g., for precision this could be done by providing coefficients of variation around the mean, rather than stating that one source is more precise than the other. The current version of the DPM relies on informative priors and such quantification is required as an input to the model. It will ensure that the various assumptions can be tested and their impact on ABPEs assessed.</p>
R4.	<p>To test and document the impact of using a coverage benchmark in the DPM (Option 1: correct in the data inputs, Option 2: Correct in the DPM via model parameters). The documentation should contain a description which option has been implemented.</p>
R5.	<p>To analyse the sensitivity of the ABPEs to a variety of prior distributions assumed for the accuracy (precision) of each of the data inputs. Special attention should be paid to precision of migration (currently internal,</p>

	cross-border and international migration being jointly modelled as in- and out-flows to and from LAs). Sensitivity analysis should be carried out for the prior distributions for the coverage adjustment parameters. These analyses will inform if the ABPEs are robust to the assumptions about data quality and help identify extreme situations where the DPM may require further research.
R6.	To continue developing a quality assurance processes at each stage of producing ABPEs, i.e. starting with producing data inputs, assessment of their bias and accuracy, quantification in terms of data-corrections and/or model parameters, as well as robustness and sensitivity analyses of the DPM and ABPEs. This is to ensure the sustainability of the DPM if data inputs change or new sources are introduced in the future.
R7.	To provide a statement that accompanies the DPM-based ABPEs on the potential sources of uncertainty or bias that are unaccounted for and, where possible, an assessment of their importance in a given situation, e.g. when considering estimates for age groups or LAs.

We have ordered our findings in line with the flow of data in the production of ABPEs. We start with the data inputs, and then look at how ONS quality-assures the data and methods. Finally, we consider how ONS communicates quality information to support user understanding and appropriate use of the ABPEs.

Given the fundamental value of population statistics and their reliance on administrative data, data sharing across government needs to be improved

3.14 The DPM relies on access to data sources (as outlined in Annex A) that are supplied by other government departments and public agencies, with securely governed and sustainable data sharing representing a fundamental part of compiling the ABPEs. Our 2023 [Data Sharing and Linkage for the Public Good report](#) highlighted remaining challenges that hinder the benefits and value of data sharing and linkage. Government departments regularly use population data and therefore should recognise their role in facilitating data sharing to support ONS’s ambition to maximise the value and insight that administrative data can offer.

3.15 The [recent Public Administration and Constitutional Affairs Committee report](#) on the UK’s evidence base highlights the long-standing barriers to sharing data for statistical and research purposes. In the context of ABPEs, it is vital that ONS have continued and increased access to relevant data sources in order to produce these statistics, meet user needs and support the efficient use of public funds. We would welcome any cross-government commitment to support ONS with this.

ONS’s mature data supplier relationships, governance and its Data Pipeline Maturity Framework help ONS to manage risks around its data supply

3.16 ONS has many mature relationships with data suppliers and associated data sharing agreements that exist as part of the current production of MYEs and meeting the requirements of the wider FPMS programme. These strong relationships help ONS to regularly provide feedback on any data quality issues to data suppliers so that improvements can be made and any obstacles in data supply overcome. Strong governance is in place around the data supply for ABPEs to support escalation of any issues, as needed.

- 3.17 Recent delays with the Higher Education Student Record data provided by [Jisc](#) (under the Higher Education Statistics Agency brand), used within the SPD and migration datasets, have led to unexpected further work and pressure to the ABPEs production timetable. This delay highlights the interdependent nature of wider population and migration statistics, and the potential system-wide implications of a single delay or issue. ONS thus needs to consider the dependencies of data sources across the population statistics landscape and continue to use its data supplier relationships and its established governance mechanisms to escalate and deal with any future issues.
- 3.18 The ONS team that oversees and manages the data supply for the production of ABPEs is confident in the ability of its recently developed Data Pipeline Maturity Framework to assess the maturity of the data sources supplied to ONS. This is a good approach that will help ONS manage risks and put contingencies in place for any issues with data deliveries specific to the ABPEs.
- 3.19 The DPM is designed to be able to adapt to changes in data inputs. To support the sustainability of population estimates production and make use of a changing and evolving data landscape, newly identified and existing data sources can be incorporated into the model. For example, data from the [Driver and Vehicle Licensing Agency \(DVLA\)](#) have recently been identified as a potential source, and so ONS is seeking to collaborate with DVLA to understand how these data could potentially be used in the DPM. It is not clear, however, whether ONS has enough resource (both human and computational) to incorporate new data sources.

ONS's understanding of the quality and sensitivity of the data inputs is fundamental to ensuring that the model does not produce biased population estimates

- 3.20 Whilst the DPM can adapt to changes in data availability, the quality of the data sources will affect its performance – highlighting the crucial need for ONS to fully understand the quality of the input data and embed knowledge around any uncertainties into the model itself. As Professor Wiśniowski mentioned in his report, without benchmarks to correct for biases in administrative data, the DPM may produce biased and/or uncertain ABPEs. We saw a positive example of the DPM's ability to overcome input data issues in 2023, when the annual MYEs were delayed from June to November. This delay was due to data quality issues with the internal migration component. Despite this set-back for the MYEs, [in June 2023](#), the ABPEs were updated for all local authorities in England and Wales and the quality issues were accounted for within the credible intervals.
- 3.21 Coverage of special population groups, such as those that frequently move (for example students and foreign armed forces), or those that have atypical interactions with government services, such as those residing in communal establishments (prisons, care homes etc) is particularly challenging to measure. ONS makes adjustments to the MYEs to account for this. At present, ONS has published little information about how special populations are accounted for within the DPM. ONS has told us that with the planned inclusion of Ministry of Justice (MoJ) prison data in the SPD coverage of prison populations for the next release will be improved. However, ONS recognises it needs to do more to improve coverage of special populations more generally. Until these improvements have been made, ONS should update the published quality information that sits alongside the ABPEs to help users understand any coverage limitations.

- 3.22 It is unclear how ONS plans to evaluate the possible impact of changes in government policy on the quality of admin data sources that are used within the DPM. For example, the number of new GP registrations increased during the COVID-19 pandemic as part of the vaccination roll out, and the place in which some people registered differed from their permanent area of residence (as in the case of many students, for example).
- 3.23 In Bayesian demographic accounts, knowledge on the plausibility of demographic trends and the data models is dependent on having consistent and high-quality data. Therefore, how the DPM deals with volatile data (particularly those collected before and after the pandemic) and what impact this has on embedded assumptions are unclear. It is also unclear how and when ONS will review and update the model's assumptions – this poses a risk to data quality as the accuracy of data sources changes over time. ONS should test the DPM in extreme situations where sudden changes in data quality may be encountered, as recommended by Professor Wiśniowski.
- 3.24 **Requirement 4:** To maximise the capability of the DPM and the quality of the ABPEs, ONS should:
- address the practical implications of incorporating new data sources into the DPM over time and ensure it is appropriately resourced.
 - continue with its plans to conduct sensitivity analysis to explore how the model's performance is affected by the availability and quality of different data sources.
 - review and test the capability of the DPM, at suitable intervals, to account for the integration of any novel and volatile/changeable data sources that are included in the model over time.
 - implement regular fully audited assumption checking and validation to support reproducibility and to help keep the model sustainable.

As the main stock measure used in the DPM, it is important for ONS to conduct further work to understand the source of any bias in the Statistical Population Dataset and identify a long-term solution to benchmark its quality

- 3.25 The SPD, a linked dataset, is the main stock measure used in the DPM. The SPD is created from the Demographic Index (DI), a composite data source built from a range of admin data sources using cuts of data. Methods for assuring the quality of the DI are not yet in place, with little publicly available information explaining the data transfer process and any risk of errors associated with this. ONS [identified and proposed metrics](#) to measure the quality of the DI in 2022. Our understanding is that the metrics have not yet been implemented, with insufficient programme funding cited as one of the reasons why this has not been done. Quantifying error arising in the DI (from linkage error or other data source issues) is an important metric to inform how SPD quality is measured.
- 3.26 To better understand the quality of the SPD, ONS conducted an analysis comparing both [aggregate](#) and [individual records](#) from the SPD version 4.0 and Census 2021. Whilst at an aggregate level the SPD is broadly similar to Census 2021 estimates, there are patterns of over-coverage (where SPD estimates are higher than Census 2021 estimates) and under-coverage (where SPD estimates are lower than Census 2021 estimates). Differences are by age, sex and geographically at national levels (with under-coverage for Wales – the SPD estimates are 5.2% lower than the

Census 2021 estimates) and local authority levels. The differences between the estimates for Wales and England may be linked to the inclusion of [Hospital Episode Statistics \(HES\)](#), the [Emergency Care Data Set \(ECDS\)](#), and the [Individualised Learner Record \(ILR\)](#), which only cover England. ONS has told us that it plans to include Welsh equivalents of these data sources in the next iteration of the SPD.

- 3.27 Differences between the Census 2021 and the SPD counts likely reflect a combination of true population change and the differing features of the census and SPD. Census 2021 was carried out when England and Wales were under more COVID-19 restrictions than at the reference date for the SPD (June 2021). The way that people interacted with public services during the pandemic was atypical, and therefore reliance on administrative data sources collected during the pandemic needs to be quality-assured against survey data sources. The variability of estimates derived from the SPD compared to Census 2021 records on a disaggregated level, for populations with varying characteristics in different areas, points to a need for ONS to benchmark the SPD and capture any issues that may affect the quality of the ABPEs, including bias from over-coverage and under-coverage. Currently coverage ratios are derived from Census-based MYEs 2011 and 2021 data. Considering the UK Statistics Authority's wider recommendation on the future of population and migration statistics, and building on [its work](#) to date, ONS needs to develop an alternative approach for coverage adjustment of the SPD in the long term. We expect ONS to implement the recommendations highlighted in Professor Wiśniowski's report to work towards overcoming this issue.

To ensure the appropriate use of the ABPEs, ONS needs to ensure its methodology and quality documentation for the SPD are up to date and include an explanation of any strengths and limitations

- 3.28 Based on published material to date, it is difficult to understand how the stock data (and other data sources) change over time and how this affects the quality between 'provisional' and 'updated' ABPEs. [Provisional mid-2023 ABPEs](#) use SPD version 4.1 and population stock data from the Personal Demographics Service (PDS) yet there is no detailed quality information specific to SPD version 4.1, beyond a description of what data sources are used in its compilation. ONS should support the use of data by clearly communicating what data inputs are used over time, as this may affect the quality of the ABPEs.
- 3.29 The SPD is produced by linking data from various administrative data sources, meaning that data will come from different sources for different, and occasionally the same, people. ONS has not fully evaluated the impact of different approaches and definitions being used in the collection of data across all admin sources, or communicated this to users to ensure appropriate interpretation. Our [published guidance](#) on collecting and reporting data about sex and gender identity in official statistics highlights the need for producers to have a strong understanding of their data and statistics to be able to explain their strengths and limitations.
- 3.30 The complexities of creating a population stock measure using linked administrative data sources highlight how important it is that ONS accurately measure and report relevant quality information to help users understand any potential bias (for example, definitions, coverage issues and linkage errors) in the source data, and the extent of any impact on the statistics. ONS needs to address and prioritise improving its communication of quality with users.
- 3.31 **Requirement 5:** To maximise appropriate use of the ABPEs, and avoid inappropriate use of these statistics, ONS should:

- better understand the source of any bias in the SPD and introduce documented quality metrics for the DI that quantify errors (in particular, linkage errors) and any associated uncertainty, that may propagate into the SPD, and subsequently, the DPM.
- publish information on the DI, including on how it is created, reviewed, updated and quality-assured.
- communicate and present, in a simple way, how the stock data (and other data inputs to the model) change over time, as this may affect the quality of the ABPEs and how it compares to that of other population estimates, such as the MYEs.
- ensure its published quality information includes explanation of any strengths and limitations, and reflects the latest data inputs used, for example, updating to the latest version of the SPD.

ONS's intention to develop uncertainty measures for migration data is fundamental to understanding the quality of the ABPEs

- 3.32 As described previously in the 'Introduction to the proposed new methods using the Dynamic Population Model' section, migration data account for the largest proportion of population change and are the component with the most uncertainty. Four of the recommendations from [OSR's 2022 Review of Migration Statistics](#) remain outstanding and these are relevant to the development of ABPEs. In particular, ONS's current work to investigate all sources of uncertainty within LTIM estimates and the results of this should be published and considered in the wider context of ABPEs.
- 3.33 In order to understand the uncertainty of the ABPEs, ONS needs to investigate all sources of uncertainty and develop reliable measures for LTIM data, as recommended by Professor Wiśniowski. We expect ONS to prioritise this as part of addressing the outstanding requirements from our review of its migration statistics.
- 3.34 ONS is working on plans to improve estimation of internal migration and is working with the Scottish Government, NRS and NISRA to determine how it should approach cross-border flows to improve measuring internal migration. Data quality issues in some of the data used for the internal migration components caused a delay in publication, with the official MYEs for 2022 being published in November 2023. Whilst the flexibility of the DPM allowed the 2022 ABPEs to be published as planned in June 2023, these data quality issues point to a broader issue with the quality of migration data and the importance for ONS to ensure the DPM assumptions are appropriately updated.

Implementing Reproducible Analytical Pipeline (RAP) standards and using the principles outlined in its published data quality strategy will strengthen the quality assurance process for the ABPEs

- 3.35 ONS carries out a series of quality assurance checks on the input data for the DPM, and a real-time dashboard is in place to help identify any data anomalies or issues with the supply of administrative data. ONS uses its strong relationships with data suppliers and its internal forum for data quality management to understand any identified data issues and take action.
- 3.36 Given the variety and number of teams involved in producing these statistics, there is ambiguity in what the needs are for ABPEs and how errors are managed. There is no detailed process map nor fully documented quality assurance approach

covering the end-to-end process. Appropriate research and quality metrics for clustering, linkage error, coverage and managing errors are not yet well established across the whole process, and there is siloed working across some of the teams. More clarity and documentation around how quality is described and assessed at each stage of the process is needed to fully audit the data flow and to help individual teams understand what impact any data issues may lead to as part of the wider production process.

- 3.37 ONS points to various published [Quality Assurance of Administrative Data \(QAAD\) reports](#) to support its level of assurance and confidence in the quality of individual data inputs, for example long-term international migration, births and deaths. Most data quality reports exist as part of the production of the MYEs and were last updated in 2016 or 2017. More recently, ONS developed [Quantitative Quality Indicators](#) (QQI) to describe its assessment of the quality of inputs used to compile the SPD version 4.0. Quantifying the quality of administrative data is crucial for the outputs of the DPM. Also, improving the definitions used to differentiate between bias and accuracy, in line with Professor Wiśniowski's findings will help to ensure that the DPM produces reliable population estimates. We have encouraged the team to seek advice and expertise from the [Government Data Quality Hub](#) in considering what quality information, including that captured by the QQI, is needed to support appropriate ongoing use of the statistics.
- 3.38 [Reproducible Analytical Pipelines](#) (RAP) are automated statistical and analytical processes that increase the efficiency, reproducibility, auditability and quality assurance of the statistics. The ABPEs production pipeline does not yet meet RAP standards. The publication of the programming code using an open software platform such as [GitHub](#) would support transparency, as well as encourage peer scrutiny and challenge. We are encouraged to hear that once the code has undergone further internal development, ONS intends to publish it in an open and transparent way. The ONS Methodology and Quality team is also supporting the ABPEs team to building capability and ensuring that the production code is produced in a reproducible way that is safe and sustainable.
- 3.39 We welcome a review that ONS has started which will cover coding, quality assurance and capability, as well as a review of the methods, with the overall aim being to help the DPM move from a research phase into a production phase. Given the relevance of this review to the scope of our assessment and the areas where we are seeking further assurance, we look forward to seeing its outcome later this year.
- 3.40 **Requirement 6:** To audit the ABPEs production process, understand the impact of data issues and support confidence in its approach, ONS needs to build on the principles set out in [its published data quality strategy](#) and implement an end-to-end process that will:
- fully audit and document the process and methods applied at each stage to support cross-production knowledge and capability, and ensure that mechanisms are in place for various teams to discuss, log and audit any decisions or fixes that take place.
 - oversee and assess the quality of the data inputs separately and in stages. This should help ONS develop the quality assurance information published alongside the statistics and support users' understanding of the strengths and limitations of the ABPEs.

- ensure compliance with Reproducible Analytical Pipeline (RAP) standards.

As the DPM is a new method, ONS's collaboration with experts is important to ensure that the methods are sound

- 3.41 Given the specialist knowledge of Bayesian statistical analysis needed to develop the DPM, ONS has been collaborating with experts in this field from the University of Southampton as well as a Bayesian demographer from New Zealand. There is no national or international consensus on the methods used in the DPM. Therefore, external collaboration with academic experts continues to be crucial to putting the Bayesian theory into practice. On paper, the theory underpinning the DPM is well grounded. The [Methodological Assurance Review Panel \(MARP\)](#), which was formed by the National Statistician to provide advice and assurance on methods used to produce official statistics, provides independent assurance on the overall statistical design and methods being developed for the ABPEs. The panel comprises mainly academics whose expertise covers various aspects of statistics. Papers submitted to MARP are published on the UKSA website. However, they are not clearly linked to the publications, which would help technical users better understand the methods.
- 3.42 Recognising the niche area of expertise required to fully understand the practical application of Bayesian methods in the DPM, we support ONS's plans to introduce an additional sub-group of MARP. Members of the sub-group should be independent of the development of the methods to introduce the extra scrutiny and challenge needed to appropriately interrogate the methods. A rigorous approach will ensure that users have confidence in how ONS develops the methods going forward.
- 3.43 Since [the introduction of the DPM in 2022](#), ONS has continued to develop and make changes to the methods used in the DPM; for example, to improve the speed of the estimation process, the method was changed in December 2023. However, to understand at a high level how the methods have evolved over time, users would need to read five statistical publications and three accompanying methodology reports. Moreover, these publications are hard to navigate and understand, given the volume and changeability of the data sources used and the intricacies of the methods applied.
- 3.44 ONS has shared with us a list of priorities and developments for the methods (for example hierarchical models). There are no specific timescales for these developments or information about their impact on the model's performance. Without more transparent documentation it is difficult to follow the model's development and performance.
- 3.45 **Requirement 7:** To instil confidence in the ABPEs and ensure that the DPM methods are sound and subject to sufficient independent and external challenge, ONS should:
- continue with its plans to create MARP sub-group.
 - create and implement an expert user group.
 - make it easier for users to find relevant MARP papers to support technical user understanding of the methods used in the DPM.

To support user understanding, and appropriate use, of the ABPEs, ONS needs to implement a revisions policy

- 3.46 One of the strengths of the DPM is its ability to produce provisional timely estimates of the population. With revisions expected to be a normal part of publishing the ABPEs in the future, it is good to hear that ONS is planning to develop and implement a revisions policy for these statistics. This is a significant shift away from rebasing current population estimates every 10 years using the census, to a more frequent revision schedule.
- 3.47 The methods used to produce provisional estimates are dependent on the availability of data sources. For example, due to a lag with HESA data, the methods used to estimate internal migration differ from those used for the updated estimates. As shown in the table below, the only comparison between provisional and updated ABPEs that ONS has made to date was published in 2021 and 2022. Relatively small revisions were made for those two years.

Comparison of updated ABPEs with provisional estimates

Table 1: The updated ABPEs for England and Wales are very similar to provisional ABPEs
First provisional and updated ABPEs for mid-year 2021 and 2022, England and Wales

Mid-year	Provisional ABPE	Updated ABPE	% difference
2021	59,648,423	59,620,119	-0.05%
2022	60,134,268	60,236,396	0.17%

Source: ABPE provisional and updated estimates from the Office for National Statistics

Source: ONS's [ABPEs published June 2023](#)

- 3.48 Changes to the methods used in the input data, such as with LTIM, will affect the consistency of time series. Within the DPM, it is unclear how Bayesian modelling and estimation will be able to identify and distinguish any changes in methods applied to input data to help users make sense of and understand the reasons underpinning changes in population trends.
- 3.49 In order to develop a population statistics revisions policy, ONS must understand its data and how they are used by different users. To meet user needs, ONS will need to consider the demands for both timeliness and consistency as well as the potential impact of revisions on other statistical publications where population estimates are used as a denominator or in survey weights. At the moment, the lack of a revisions policy for population estimates represents a significant gap. A revisions policy would support transparency and help users understand what will be published and when.
- 3.50 We recognise that there may be practical challenges to implementing a comprehensive revisions policy, and so would encourage the ONS team to apply the practices used in producing estimates of Gross Domestic Product (GDP) to ensure best-practice principles are followed. The team should also consider the findings outlined in [our review on revisions of GDP estimates](#).

- 3.51 During our engagement, users welcomed the move to ABPEs highlighting the potential for timelier estimates, as well as the possibility to address the issue of drift in population estimates between censuses. However, others raised concerns about the clarity of revisions and the importance of understanding at what point the estimates are fit to use to support decision-making.
- 3.52 **Requirement 8:** To help users understand how to use the ABPEs, ONS should implement and publish a revisions policy, and as part of its development:
- carry out and publish a revisions analysis of the ABPEs to date, including how data input and methods differences may impact the scale of any revisions.
 - clarify how the model will be able to take account of any changes in methods over time as part of producing an ABPEs back series.
 - seek feedback and input from users and key stakeholders about its proposals and involve them in its decision-making.

User understanding and confidence in the proposed new method

This section outlines our findings related to the [Value pillar](#) of the Code of Practice, namely statistics that support society's need for information.

We highlight the importance of ONS's engagement with users to understand their needs, manage their expectations and be responsive to feedback to help shape the development of ABPEs going forward. Tailored communication would support user understanding and build trust in the new method.

To shape the future development of the ABPEs ONS needs to create and implement a user engagement strategy and communicate its long-term plans for the ABPEs to manage user expectations

- 3.53 The ABPE team points to the [FPMS consultation](#) as its primary public engagement with users and stakeholders, in addition to a number of DPM-specific events that targeted expert users. The team told us it is awaiting feedback from the consultation, which will help it to understand users' needs, particularly around quality. The team acknowledges that the consultation was very broad and asked users about their needs for all population estimates, whereas the DPM is focused on population estimates by age and sex.
- 3.54 In working to meet user needs, ONS also needs to understand the similarities and differences between the ABPEs and MYEs. As an example, the DPM does not currently split migration into internal and international components for publication. At present, ABPEs provide breakdowns of births, deaths and net migration only (which includes international migration and migration between England and Wales and other parts of the UK), whereas the MYEs are able to provide these same breakdowns and are the only source of information on international migration in Wales. We understand that ONS intends to provide this further breakdown in due course, which is fundamental to meeting Welsh users' needs, in addition to those of users requiring estimates of internal migration.
- 3.55 Having an open and effective dialogue with users and stakeholders is vital in demonstrating that ONS is a trustworthy organisation that actively listens and responds to users' views. Therefore, it is good to see, as highlighted in [its recent update article on transformation of population and migrations statistics](#), that ONS intends to gather feedback from users, in particular local authorities, on the ABPEs

in autumn 2024. We encourage the team to build on these plans to develop a broader strategy to understand users' needs, including their need for breakdowns of components such as internal migration. This strategy will help to shape and steer the development of the ABPEs going forward.

- 3.56 As the outcome of the [FPMS consultation](#) is yet to be published, it is not clear to users what ONS's long-term intention is for ABPEs as a statistical output, and the ability of the DPM to produce outputs in line with this intention. This sentiment was echoed in our conversations with users, with some seeing ABPEs as a replacement to the census while others see it as a way of measuring the population. For example, ABPEs currently cover the population by age, sex and local authority (in essence, they replicate the current annual MYEs), but it is unclear whether ABPEs will be developed in future to provide more-granular breakdowns to meet users' needs for information such as data on [small area estimation](#) (geographical breakdowns lower than local authority in England and Wales) and characteristics such as ethnicity.
- 3.57 **Requirement 9:** To maintain public confidence and help shape the future development of the ABPEs and manage user expectations, ONS should:
- develop and implement a user engagement strategy specific to the ABPEs. This strategy should detail specific activities and how users will be involved at various stages of the process. The approaches that have been implemented elsewhere in ONS, for example migration statistics, can serve as a good model for this.
 - use feedback from users to drive developments to the ABPEs whilst also being transparent about where user needs cannot be met (for example, the availability of breakdowns).
 - publish regular updates on its plans for the ABPEs, including how the ABPEs form part of the wider population and migration statistics transformation, including timelines and any interdependencies.

To support the development of the ABPEs, and help assure quality at a local level, ONS needs to be more responsive to scrutiny

- 3.58 The ABPE are estimates and therefore subject to uncertainty. ONS uses credible intervals for breakdowns by age, sex and local authority to quantify the degree of uncertainty. At an aggregate level, the [December 2023](#) ABPEs are very similar to official MYEs, at 0.1% lower than the Census 2021-based MYEs. Differences do vary by local authority, with the largest differences generally found in cities and more-urban local authorities. Aggregate comparisons can mask a range of differences at more-granular breakdowns, for example for particular age groups, highlighting the benefit of engaging with users to scrutinise and test evidence at a local level, especially for those estimates of specific population groups.
- 3.59 Measuring student populations is challenging in terms of capturing both internal and international student migration patterns. In 2021, as part of [our review of population estimates and projections produced by ONS](#), we found that in some smaller cities with a large student population, the estimates appeared to be potentially higher than local evidence suggested. Many of our recommendations within the report pointed to a need for ONS to collaborate with others to learn from best practice, for example expert demographers who produce their own estimates on a more localised level. These findings remain relevant for the ABPEs. Any insights offered or queries raised by population demographers and other expert users such as local authorities

need to be fully investigated with curiosity and rigour to fully understand the causes of any potential discrepancies with other data insights or sources. Accurately capturing difficult to measure populations, such as students, also highlights the need for ONS to reconcile its population estimates with other available data sources (for example, the Annual Population Survey) that may provide more assurance at lower-level geographies.

- 3.60 The users we spoke to reported confidence that the ABPEs are likely – in the long run – to meet their needs and would be higher quality than the current method of producing MYEs. However, some users reported that whilst ONS was open to receiving feedback, they were not informed about how ONS responded to their concerns about the accuracy of the ABPEs. ONS should be open to this kind of scrutiny from users to benefit the ongoing development of the model itself, and to have appropriate processes in place to ensure that these queries are responded to (even if it was decided that no further action was necessary).
- 3.61 Shared best practice and learning with the ONS National Accounts production teams may be helpful here, given its quality assurance through ‘curiosity meetings’ which involve internal and external stakeholders. We expect that ONS’s plans to engage with local authorities in the future, and the support from communications teams, mean that ONS can be more proactive with this feedback in future.
- 3.62 **Requirement 10:** To quality assure the ABPEs at a local level, and strengthen its relationships with users, ONS should be open to scrutiny from key stakeholders, such as local authorities, and users and respond to any feedback appropriately.

To build trust in the DPM, ONS needs to improve and tailor the communication of its methods

- 3.63 Recognising the complexity of the methods used in the DPM, ONS published a [short video](#) explaining to users at a high-level how the DPM works and why it is being developed. For technical users, ONS published a [detailed paper](#) and hosted a series of workshops and webinars to aid understanding of the methods used. The navigation between the research and documentation surrounding the development of ABPEs, published to date, could be improved. Users explained to us that a centralised landing page with links to all of the documentation in chronological order would help them to follow and understand the developments that are taking place.
- 3.64 Our engagement with users indicates that they appreciate the increased use of administrative data to produce these estimates, but do not understand the new method. We heard this from a wide range of users, including methodological and demography experts and local authorities’. Users told us that some of the published material was not understood and did not provide enough detail on the DPM. Experts who had spent considerable time trying to understand the methods also reported struggling to fully grasp how the DPM works, including stakeholders in devolved administrations. Academics told us there was a middle ground that wasn’t being met in terms of communicating information about the DPM to non-technical, but engaged, users. For example, there was a gap between the high-level information and the [more-detailed methodological and academic studies documentation](#). Users were also concerned about how the new approach could work without a census and felt that ONS has not provided sufficient assurance on this.
- 3.65 ONS acknowledges that the DPM is complex and uses innovative methods, and as such, it is challenging to explain the method to audiences with varying technical expertise. It also recognises that this is an area where it needs to do further work.

Further, ONS accepts that there has been some inconsistency in the language and naming of developments, which has confused some users. ONS has stated that it plans to address some of these issues, for example by publishing a plain-English technical volume and journal articles. It has also introduced a new role with oversight of the narrative and statistical design so that it can improve coherence across its outputs. We would encourage ONS to collaborate more widely across the [Analysis Function](#) to seek best practice and advice, for example with the [Government Data Quality Hub](#) and [Data Science Campus](#), on how to communicate complex statistical methods in a way that supports understanding.

- 3.66 Our findings that ONS needs to engage more with users, be more responsive to scrutiny, and better communicate its methods, resonate strongly with the findings from our [Review of Population Estimates and Projections](#), published in 2021. Given we have stated very similar recommendations before to ONS, it is disappointing that lessons do not appear to have been learnt from this previous work.
- 3.67 **Requirement 11:** To build trust in the new approach, ONS needs to improve the way that it communicates quality and methodology information and tailor its communication to the differing technical expertise of users of population statistics, including by:
- seeking feedback on its current published quality and methodology information with a broad range of users and working together with other stakeholders across the Analysis Function.
 - helping users navigate to the various publications on the ONS website; for example by implementing a landing page.

Annex A: ABPEs data inputs

- **NHS Personal Demographics Service (PDS) (NHS England)** – the national electronic database of NHS patient demographic data, such as name, address date of birth and NHS number in England, Wales, the Isle of Man, or UK defence medical services. (SPD v4.1, v4.0) (LTIM and internal migration)
- **English School Census (ESC) (Department for Education) and Welsh School Census (WSC) (Welsh Government)** – statutory data collected on all pupils attending state-funded schools in England and Wales. (SPD v4.1, v4.0)
- **Individualised Learner Record (ILR) (Education and Skills Funding Agency)** – data collected by learning producers in the Further Education (FE) and Skills sector in England. (SPD v4.1, SPD v4.0)
- **Higher Education Student Record (HESA) data (Jisc)** – data collected about students enrolled at publicly funded Higher Education providers, including international students residing in England and Wales. (SPD v4.1, SPD v4.0) (LTIM – EU nationals and internal migration)
- **NHS Hospital Episode Statistics (HES) (NHS England)** – records details of all attendances, appointments and admissions to NHS hospitals in England. (SPD v4.1, SPD v4.0)
- **Emergency Care Datasets (ECDS) (NHS England)** – national dataset for urgency and emergency care provided by all hospitals with A&E departments in England. (SPD v4.1, SPD v4.0)
- **Death registrations (General Register Office)** – according to the [Births and Deaths Registration Act 1953](#), a death should be registered within five days unless it is referred to a coroner for investigation. (SPD v4.1, SPD v4.0)
- **ONS Census Address frame (Office for National Statistics)** – list of residential addresses in England and Wales used for Census 2021 collection. (SPD v4.1)
- **Birth registrations (General Register Office)** – under the [Births and Deaths Registration Act 1874](#), it is a legal requirement for parents to register the birth within 42 days in England and Wales.
- **Census 2021 England and Wales data (Office for National Statistics)** – providing data of all people and households in England and Wales. (Stock measure for 2021 and coverage adjustment for SPD)
- **Benefit and Income Datasets (BIDs) (Department for Work and Pensions and HM Revenue and Customs)** – captures information on anyone in the UK in receipt of a benefit, tax credit or state pension, as well as individuals who pay tax through the Pay As You Earn Real Time Information (PAYE RTI) system. Consists of seven different datasets; Universal Credit (UC), Single Housing Benefit Extract (SHBE), Personal Independence Payments (PIP), National Benefits Database (NBD), P14 (derived from PAY RTI), Tax Credits (TC) and Child Benefit (CB). (SPD v4.0)
- **Customer Information System (CIS) (Department for Work and Pensions)** – contains demographic information on everyone who has a National Insurance number (NINo) in the UK. (SPD v4.0)

- **Home Office Borders and Immigration data (HOBI) (Home Office)** – used to produce migration estimates of non-EU nationals (excluding British nationals). (LTIM)
- **Registration and Population Interaction Database (RAPID) (Department for Work and Pensions)** – used to produce migration estimates of EU nationals. (LTIM)
- **International Passenger Survey (IPS) (Office for National Statistics)** – used to produce migration estimates of British nationals. (LTIM).