

# The future of population and migration statistics in England and Wales, quality strategy

This report provides information about the quality strategy underpinning the future population and migration statistics system in England and Wales.

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Release date:  
15 July 2024

Next release:  
To be announced

## Notice

### 15 July 2024

This quality strategy has been updated to reflect developments since it was last published in June 2023, including our work on quality standards and methods for quality assessment. We have also updated references to other publications if there has been a new release.

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# 1 . Main points

- The Office for National Statistics (ONS) is developing a future population and migration statistics system for England and Wales, making use of the best available data sources, using robust and innovative methods.
- The system will deliver timely, coherent and accurate statistics, providing new insights to support a better understanding of the population; critical for effective decision making to improve people's lives.
- The system must be supported by a robust quality strategy covering quality at all stages, from data inputs, methods and processes to the resulting statistical outputs.
- The strategy will help ensure that the outputs meet the needs of users, and that users understand the strengths and limitations of the statistics.
- This report provides details about the strategy, including the principles on which it is based, and the framework for assessing and managing quality; it includes the ONS's current work and main areas for future development.
- The strategy will evolve as the ONS advances from research and official statistics in development and seeks accredited official statistics status, influenced by user feedback.

## 2 . Introduction

The Office for National Statistics (ONS) is developing a future population and migration statistics system. The system will draw more strongly on administrative data, using a range of data sources from across government and the public sector. The system will deliver more timely and frequent statistics about the population down to local levels, as shown in our [Overview of population and migration statistics transformation](#).

For more information about the system, read our [The future of population and migration: a statistical design methodology](#).

The future system must be supported by a robust quality strategy. This covers the quality of the data sources (input quality), data processing (process quality, including the quality of methods) and the resulting quality of the final statistical outputs; ensuring they meet user needs (output quality). This report provides information about the strategy and our future plans.

## 3 . The quality principles

Underpinning the quality strategy for the future population and migration statistics system, are the following high-level principles (covering the input, process and output stages):

- statistical outputs are relevant against priority user needs
- the most appropriate data sources are used to deliver the statistical outputs
- strengths and limitations of data sources are understood against their use, quantified, documented and clearly communicated to users
- strengths and limitations of the data sources are accounted for in design decisions, concerning the use of the sources
- changes in quality, through the integration and processing of data, are quantified and reported on
- statistical methods used to deliver the statistical outputs are robust, based on best practice and have been endorsed and quality assured by experts in the field
- statistical outputs are assessed against a set of quality standards, developed through comparisons with other sources, comparisons over time, through consultation with users, and by drawing on expert scrutiny
- users are informed of the quality of the outputs, with published measures of uncertainty, set against the quality standards and with clear information on the strengths and limitations of the statistics
- quality is assessed on a continual basis, to ensure changes in quality are understood, accounted for and reported on through feedback loops, including with data suppliers
- quality is managed across the end-to-end process and throughout the design to identify quality risks and put appropriate mitigations in place
- flexibility exists in the design of our statistics, by avoiding over-reliance on a single data source and ensuring that inputs have complementary sources of known quality, if they are required

## 4 . Quality framework

We define quality to mean that the statistical outputs fit their intended uses, are based on appropriate data and methods, and are not materially misleading ([Code of Practice for Statistics](#)). The quality strategy for the future population and migration statistics system focuses on statistical quality throughout the statistical journey, from data collection to the use of our statistics in decision making.

Understanding and communicating quality is essential to assure and guide users of the Office for National Statistics (ONS) statistical products.

The strategy assesses quality against three stages:

- input quality (the quality of data sources used in the future system)
- process quality (quality through the data processing stage)
- output quality (the quality of the resulting statistics)

The quality assessment at the input quality stage informs whether a source is suitable for its use. The assessment also informs the development of statistical methods and the necessary processing of the source (for example, whether and how it will be integrated with other sources and whether editing or imputation is needed). An understanding of quality at the input and process stages then relates directly to the quality of the statistical outputs. There is a feedback loop across the stages. For example, quality issues identified in the outputs can inform future improvements to the data sources, statistical methods, and data processing.

Across the quality stages, the ONS will ensure that the right tools and capabilities are in place and that quality is reviewed on a continual basis, as part of our [ONS Statistical Quality Improvement Strategy](#) and [Data Quality Management Policy](#).

## **Input Quality**

Future population and migration statistics will use a range of data sources. These include administrative data (information collected by government and/or other organisations primarily for administrative purposes, such as, registration, transaction and record keeping), other commercial data (for example, mobile phone data) and survey data, where required. For ONS surveys, the ONS has control over the collection, content and design. However, administrative and commercial data have not been collected for ONS statistical purposes and therefore require other methods of assessment.

### **Administrative and commercial data quality**

The following dimensions are used to assess the quality of administrative data sources and commercial data.

#### **Relevance and integrability**

The extent to which the source meets the intended needs, including how well it covers the population of interest and the required target measures or attributes of the population (age and ethnicity, for example). The extent to which the source can effectively be integrated into the statistics system; including validity (the extent to which the data conform to expected format, type, range) and the presence of high-quality linkage variables, if required.

#### **Time-related dimensions**

Coherence over time (changes in concepts, definitions, and coverage) and timeliness (the period between the date to which the information relates to, and the date the data are available to the ONS).

#### **Accuracy and reliability**

The degree to which data describe what they were intended to measure.

The completeness (levels of missingness and population coverage), uniqueness (degree to which there is no duplication of records).

Plausibility and consistency (values do not conflict with other values within a dataset or across datasets).

#### **Delivery and clarity**

The confidence that data will arrive as and when needed, including the robustness of data sharing agreements, and the relationships with data suppliers.

The completeness and clarity of metadata that describe the data source.

The availability of related data sources to support, complement or substitute, reducing the reliance on any one source.

Information about the administrative data sources used in the research to transform the population and migration statistics system, along with information about their quality is available in our [Data source overviews](#).

An important part of the assessment process is the relationship and communication with data suppliers. This relationship is important to build an in depth understanding of the data sources (clarity) and to ensure the right agreements are in place to secure data as and when needed. Good communication also means that the ONS is consulted on changes to the sources and can feedback on areas for quality improvement.

The ONS uses a variety of communication approaches as part of the quality strategy, including:

- quality working groups with data suppliers
- secondments into government departments
- interviews and shadowing those involved in data collection and processing
- meetings with key areas within supplier departments (data managers, IT specialists, operational teams and data analysts)

The ONS will also draw on the Admin Data Quality Question Bank, which is scheduled to be published in 2024. The question bank includes a tested question set for obtaining quality information about the data from the supplier.

In terms of the methods and approach to assessment, the strategy draws on best practice from the [Office for Statistics Regulation \(OSR\)](#), the Government Statistics and Social Research Services, and international approaches and developments. This includes the use of the [Quality of Administrative Data in Statistics Framework](#), the [Quality Assurance of Administrative Data toolkit](#) and our [cataloguing error in administrative and alternative data sources](#) publication.

We will also continue our research [Exploring the quality of administrative data using qualitative methods](#). This has which has provided useful insight into how different groups of the population interact with administrative data sources.

## Survey data quality

Where surveys may be used, the ONS will continue to draw on the wealth of experience it has in ensuring the collection of high-quality survey data, supported by quality assessment and improvement activities. This includes:

- sampling design
- questionnaire development
- fieldwork practices and training
- validation and quality assurance of data through the data collection stages
- ensuring the design of the surveys is relevant against the user needs for the future population and migration statistics system

## Process quality

Once data are received, they are then integrated with other sources into the statistical system and quality issues are addressed (as identified at the "Input Stage"). Such issues may include concept misalignment between the administrative data sources and the required statistical concepts and definitions, coverage error, and measurement errors.

Important processes include the engineering of data to the required structure and harmonised standards, data validation, linkage, editing and imputation, data modelling and estimation. The aim of the processing is to ensure the production of accurate and timely statistics, through a good understanding of the properties, strengths, and weaknesses of the source data.

## Sound methods

The processing stage must be underpinned by the best available methods and recognised standards for producing statistics from the data sources. The methods that have been and continue to be developed will draw on international best practice and will be reviewed by an external Methodological Assurance Review Panel (MARP). Further information about the methods and MARP can be found on our [Methodology and quality strategy](#) web page.

## Processing and assurance

As data are processed using sound methods, checks are in place to assess changes in data quality as the data go through the production stages. This includes data visualisation techniques. We are also building [Reproducible Analytical Pipelines \(RAPs\)](#) for running our processes and applying our methods to ensure our outputs are reproducible, adaptable and sustainable, using automation and good software engineering practices.

The RAPs also allow consistent, auditable, high-quality assessment and interrogation of specific quality metrics; for example, in checking for invalid data items in different administrative data sources. Automating some aspects of quality assurance in this way reduces the risk of a check being applied incorrectly. The metrics support a process of ongoing review and development to ensure that the processes are working effectively.

Our approach aligns with the [Office for Statistical Regulation best practice](#) and [Government Analysis Function guidance on RAPs](#). It is supported by the [ONS Digital and Technology Strategy \(PDF, 982KB\)](#), which describes how continuous improvement and automation will be at the heart of the ONS service provision. The result is increased efficiency and transparency of processes, which will enhance trust in the resulting analysis for producers and users.

## Data integration and linkage

The future population and migration statistics system integrates multiple data sources, where required. This is to ensure the resulting statistics are as inclusive of the whole population as possible and use the best combination of data available. An important process for integrating data is data linkage. This is particularly challenging for administrative data if there is no common identifier across sources. It is also challenging if there are limited variables available to check the accuracy of matched records, and if there are any quality challenges with the variables used for linkage. For more information see the [UK Statistics Authority, Quality Issues related to linkage of administrative data paper, EAP190 \(PDF, 200KB\)](#).

The ONS assesses the quality of linkage through an understanding of the quality of the variables used to link data together, and an assessment of the linkage process and outputs. This includes estimation of false positives (records that have been linked in error) and false negatives (records that were not linked when they should have been). It also includes comparisons of the distribution of the characteristics of linked and unlinked records (for example, by age, sex and other characteristics) to understand potential biases.

An important framework used by the ONS for linking data is called the Reference Data Management Framework (RDMF). The RDMF enables the ONS to separate the data linkage function (where identifiers such as name and address are used to link datasets) from subsequent data processing (where de-identified linked data is then used). [Our Data Strategy](#) provides further information on the RDMF and how it fits into ONS's plans to develop data capabilities.

An important component of the RDMF is the Demographic Index (DI). The DI integrates education, health, and tax and benefit administrative data to provide a composite data source of the population interacting with administrative data sources. The DI is a building block for the Statistical Population Dataset (SPD) that is fed into the Dynamic Population Model (DPM), to produce admin-based population estimates. The SPD approximates the usually resident population of England and Wales, using integrated administrative data sources. Further information about the SPD and the DPM is provided in [The future of population and migration: a statistical design methodology](#).

As part of the quality strategy, the ONS is developing a range of metrics to understand the statistical quality of the DI, including linkage quality. This work is building on initial research as outlined in the UK Statistical Authority, [Evaluating Statistical Quality in the Demographic Index paper, EAP182 \(PDF, 549KB\)](#). The work is part of a wider validation and assurance (V and A) framework that has been developed for the RDMF. The V and A framework is being reviewed by our Methodological Assurance Review Panel (MARP). Further information is provided in the paper [Methodological evaluation and quality assessment of the Reference Data Management Framework \(RDMF\) overview, EAP205](#), that will be available from the [UK Statistics Authority](#).

The quality of the DI and the SPD is also being explored through linkage to the Census 2021 and Census Coverage Survey. You can find out more in the publication, [A linkage project between the 2021 Census and Census Coverage Survey to the Demographic Index: Rationale and Research Questions, EAP192 \(PDF, 523KB\)](#). This provides important quality information about differences between the population captured in the 2021 Census and the population in the DI and SPD, as found in our [Understanding quality of linked administrative data sources in England and Wales, using the 2021 Census - Demographic Index linkage article](#). This information will support improvements to data linkage and the methods used to produce the SPD.

Administrative data are also linked longitudinally as part of our research, including for statistics on internal and international migration. We have an [error framework for longitudinal administrative sources](#), which will be used to understand the quality of longitudinally linked administrative data.

It is important that our linkage methods are inclusive, without introducing biases for groups of the population for which accurate linkage is more challenging. We will therefore continue our work to develop linkage methods for more complex population groups, building on the work of our [Refugee Integration Outcomes \(RIO\) data linkage pilot](#) that uses innovative approaches to link data for refugees.

## Processes for dealing with missingness and making decisions between sources

It is important to account for missingness in the data sources to improve accuracy. This may be achieved through the application of imputation methods in the processing stage. The methods will be assessed against quality standards to ensure they are improving accuracy, preserving the distributions of the true data values, and delivering results that are plausible and consistent. The ONS is working to overcome the challenges of missingness and conflicting records, which includes our research from the [Methods for producing multivariate population statistics using administrative and survey sources paper](#), EAP186 (PDF, 353).

We are also exploring new methods for comparing data sources to make decisions about the best way to use datasets in combination. This includes estimating error, where there are multiple data sources each including a variable which measures the same (or a nearly identical) concept.

We have published some of our trials on our methods. These publications cover techniques such as [structural equation modelling \(SEM\)](#) and [multiple imputation latent class \(MILC\) modelling](#). These techniques can take account of error and factor uncertainty into final estimates. We have also published work on assessing quality in terms of representativeness in administrative data through trialling an initial application of [representativity indicators \(R-indicators\) and distance metrics](#).

We are also trialling methods such as latent class modelling (LCM) and Dempster Shafer Theory (DST). LCM is a modelling method that can be used to estimate the amount of error in categorical variables across input datasets. DST quantifies uncertainty in the accuracy of values and variables produced by rule-based methods. Both methods can be run without the Census and without a gold standard comparison dataset.

## Output Quality

It is important that the statistical outputs from the future population and migration statistics system meet user needs, are well understood, and that users understand the strengths and limitations of the statistics. The European Statistics System (ESS) output quality dimensions are used as part of the strategy to assess output quality.

### Relevance

The degree to which the statistical outputs meet current and emerging user needs.

### Accuracy and reliability

The closeness between an estimated result and the unknown true value, and how reliable these are over time and geography.

### Timeliness and punctuality

The lapse of time between publication and the period to which the data refer, and the time lag between actual and planned publication dates.

### Accessibility and clarity

The ease with which the data user can access and understand the data they are interested in.

### Coherence and comparability

The degree to which data can be compared over time, region and domain. The degree to which data that are derived from different sources or methods, but refer to the same phenomenon, are similar.

## Relevance

The ONS is engaging with users to ensure that the future population and migration statistics system meets their needs. This includes using the insights gathered from the 2023 [user consultation](#) on the proposed system, together with insights from wider engagement work, to shape our work programmes. The ONS will report back to users on the outcomes of the 2023 consultation in due course.

We will also continue to work across the user community through a variety of forums to develop and refine our understanding of user needs, and to invite feedback on our programme of research and statistical outputs.

## **Improving timeliness and punctuality of data supplies**

The ONS is working in collaboration with data suppliers to improve the timeliness and reliability of data supplies. This includes the automation of processes; the implementation of communication mechanisms, which ensure timely notification and consultation on any changes to a supply, and the development of data sharing agreements. This work is improving the timeliness and punctuality of data supplies, which supports the delivery of timely population statistics.

## **Improving accuracy, timeliness and coherence**

The ONS research into the use of administrative and other data sources to produce population and migration statistics is demonstrating our ability to deliver more frequent, timely, inclusive and responsive statistics.

For example, the development of our Dynamic Population Model (DPM) has illustrated how we can draw strength from multiple data sources to deliver more timely and coherent population estimates. The DPM has also illustrated the ability to sustain better levels of accuracy compared with the mid-year population estimates produced from the current system.

Information about our research, including statistics on the population and migration, housing and households, and our work on longitudinal analysis and outcomes is available on our [Research outputs using administrative data page](#).

## **Assessing accuracy and quality standards**

To assess the accuracy of the statistics from the future system, it is important to understand two things. Firstly, what is the statistical quality of the estimates from our current system that users are accustomed to? Secondly, how do we develop methods to quantify the statistical quality of the outputs from the future system, so that users can understand their quality against the current system?

## **Development of quality standards**

To support the first question, a set of quality standards for population size estimates is essential. These quality standards will refer to the level of statistical quality that we are aiming to achieve from the future system, based on user needs. We consider quality in terms of variance (how precise an estimate is) and bias (whether we are systematically under or over-estimating our values). We have based these standards on those achieved by Census 2021 and the mid-year estimates (MYE) based system. We looked at the statistical quality of outputs across the decade between 2011 Census and the year before Census 2021, to understand both the high statistical quality of census outputs and the decline in quality as we move further away from census base year.

Our standard for assessing the current, 10-yearly census-based system is therefore based on the quality estimated for the MYE 2016, as that reflects the quality standard mid-way between the two censuses.

Further information on the quality standards can be found in the [UK Statistics Authority Bias and variance quality standards for 2023 recommendation, EAP189 \(PDF, 223KB\)](#).

In setting initial quality standards for the accuracy of local authority population estimates by age and sex, we will be applying the following principles:

- the quality standards will be reviewed regularly as our statistics develop
- the required standard should be both initially achievable and ambitious
- the majority of user needs should be met, particularly the needs of local government (so the data are useful for policy planning purposes)
- the standards should recognise the high quality of the Census every 10 years to date, but also the “drift” of population estimates between censuses

We will be testing these standards with users to ensure that our future outputs result in statistics that are fit for the majority of uses to which they will be put. In addition, we will be regularly engaging with users to identify areas for potential improvement.

Our future work will include expanding these quality standards for population estimates to cover other statistics about the characteristics of the population.

### **Accessing accuracy: development of uncertainty measures**

We are developing methods to quantify the statistical quality of the outputs under the future system. This will allow users to understand the quality of the outputs and will provide important information on whether the quality standards are being achieved.

We have made good progress with the methods, which have been used to produce measures of uncertainty for our international migration statistics. These are presented in our [Quantifying uncertainty in headline international migration](#) working series methodology.

We have also developed a method for calculating measures of uncertainty for the admin-based population estimates from the DPM at local authority level. Information about the method is provided in our [Dynamic population model, improvements to data sources and methodology for local authorities, England and Wales: 2021 to 2022 article](#).

More recent results and the latest developments are presented in the [Dynamic population model, improvements to data sources and methodology: local authorities in England and Wales, mid-2021 to mid-2023 article](#). We are working to extend the method to produce uncertainty measures at different levels of aggregation. For example, for population estimates by sex and age groupings.

Producing measures of uncertainty for admin-based population and migration estimates is a new and innovative area. We are therefore continuing our research into different methods, working with experts in the field and with our Methodology Assurance Review Panel (MARP).

## Quality assurance of the outputs (supporting coherence and comparability)

In addition to the checks carried out in the processing stage, we use several approaches to quality assure the population statistics. This includes comparisons with other alternative sources, including the Census 2021 and survey data. It also includes the monitoring of trends in the components and for key demographic indicators, such as, mortality, childbearing, migration and sex ratios. We have developed a dashboard that allows real-time assessment and visualisation of trends, which is monitored by data experts and demographers.

The dashboard allows us to visualise and compare recent and historic patterns, so that we can identify unexpected changes in the data. We are also exploring new and innovative “signal” data to include in the dashboard that provides further intelligence about population change at local level, including mobile phone usage and energy consumption, such as, electricity or gas data. This information not only supports quality assurance of the results, but the sources may also prove valuable for inclusion into our models for population estimates in the future.

We also draw on expert review of the methods and estimates, and local area intelligence, including our work with local authorities. This has been invaluable in developing the DPM and understanding what other data sources might support the quality assurance or development of our outputs. For this purpose we have launched a local population statistics insight feedback framework, as described in our [Receiving user insights on local population levels and change, England and Wales: August 2022 article](#). The framework enables users of population statistics to provide feedback at local authority level and suggest sources for us to better understand the quality of our estimates.

We will approach selected local authorities with particular local characteristics or challenges (for example, highly mobile populations) as we develop admin-based population estimates. This will enable us to learn more about the quality of those estimates for measuring specific groups of the population, and to quality assure those estimates with other local sources of information.

## Accessibility and clarity

The ONS will work with users to ensure our statistics can be easily accessed; users can retrieve the information they need quickly and in the format they require. To achieve this, we will build on the accessibility and successful outputs tools used for Census 2021 data, which includes creating a custom dataset, as shown in our [New ways to access Census 2021 data news and insight page](#).

We will continue to publish information on the data sources, methods and processes, as our work progresses, to ensure users understand how our statistics have been produced and their quality. We will listen to and take on user feedback to continue to improve our approaches and the way we communicate information.

## Disclosure control

All outputs from the Office for National Statistics (ONS) are subject to the Data Protection Act 2018 and the Statistics and Registration Services Act 2007, and so must not contain information that identifies an individual, household, or business. Our responsibility to protect confidentiality is also made clear in the [UK Statistics Authority's Code of Practice for Statistics](#). For more information, read our [Disclosure control proposal for Future Population and Migration Statistics methodology](#).

## 5 . Future plans

The Office for National Statistics (ONS) will continue to work on developing a quality-driven, statistical framework for combining data sources to produce population statistics. This includes the work to further assess the quality of individual and linked administrative datasets that are used as part of the Dynamic Population Model (DPM) framework for producing admin-based population statistics. Our work will draw on international best practice and developments.

We will continue to develop methods to quantify the statistical uncertainty of the new outputs, including our work to set out quality standards for population and characteristics statistics. These standards need to be both achievable and ambitious as our uses of administrative data and methods mature.

We will continue to publish quality information about the data sources, our processing and the resulting statistical outputs, so that users understand the quality of the statistics. Our [Long-term international migration: quality assuring administrative data methodology](#) provides quality information about the data sources used for our admin-based, long-term international migration estimates.

The previous release of the quality strategy referenced future work on the quality of the Statistical Population Dataset (SPD). This work is progressing as we explore methods to understand and adjust for coverage error in the SPD (where people have been missed from the target population or included in error). Further information on the coverage adjustment work is provided in [The future of population and migration: a statistical design methodology](#).

We will continue to engage with users, including through our local authority engagement, to build on the insight gathered from the [UK Statistics Authority Consultation on the future of population and migration statistics in England and Wales](#). User feedback will support the continued development of the quality strategy.

We will further develop the structures around quality management as we move from research towards producing accredited National Statistics under the future population and migration system.

## 6 . Cite this methodology

Office for National Statistics (ONS), released 15 July 2024, ONS website, Methodology, [The future of population and migration statistics in England and Wales, a quality strategy](#).