

Census Accuracy

Key Methods Explained

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KEY TAKEAWAYS

- Inaccuracies in U.S. Decennial Census data undermine fair political representation and the equitable distribution of over \$2 trillion in federal funds each year.
- The Census Bureau uses two methods to check the accuracy of the census: Demographic Analysis (DA) and the Post-Enumeration Survey (PES). These methods provide independent benchmarks that assess census accuracy, each with its own strengths and limitations.
- Understanding DA and the PES helps stakeholders interpret the results of the census and advocate for more fair and accurate data.

The U.S. Decennial Census is the statistical backbone of the United States democratic system. Mandated by the Constitution, the census is the only attempt to count the entirety of the country's population and serves as the basis for allocating political power. The census guides planning for community services, policymaking, the enforcement of civil rights protections, and the distribution of more than \$2 trillion in federal funds to states and localities annually.¹

An accurate census helps ensure fairness in our core democratic institutions, but problems with accuracy persist despite the Census Bureau's best efforts. Crucially, census errors often reflect broader societal inequities, disproportionately and persistently affecting groups such as Black and Hispanic populations, households with low incomes, recent immigrants, and people with disabilities—elevating the census as a civil rights issue.

This is the second brief in a three-part explainer series designed as a user guide on census accuracy for civil rights organizations, advocates, and policymakers. The first brief in this series, "Census Accuracy: Key Concepts Explained," introduces essential terms needed to interpret census accuracy, such as net and gross accuracy and differential undercounts.² The second brief explains the Bureau's evaluation methods, namely Demographic Analysis and the Post-Enumeration Survey. The final brief, "Census Accuracy: Key Trends Explained," provides a summary of key results and trends in accuracy from the 2020 Census and prior censuses.

Overall, this explainer series provides information intended to help stakeholders:

- Advocate for necessary research and reforms to ensure every community is accurately counted.
- Promote robust funding for the census by emphasizing the need for accurate data to help ensure fair political representation and equitable resource distribution.
- Implement measures to mitigate the impact of census inaccuracies.

1. The Two Methods for Measuring Census Accuracy

The Bureau uses two main methods to measure the accuracy of the census: **Demographic Analysis (DA)** and the **Post-Enumeration Survey (PES)**. Both methods provide independent estimates of the population designed to serve as benchmarks for assessing the accuracy of the census.

- **Demographic Analysis (DA):** DA produces population estimates using a method called the “Demographic Accounting Ledger.” This approach calculates changes in population over time by accounting for births, deaths, and international migration.³ The Bureau uses reliable data sources, such as vital records (like birth certificates) and the American Community Survey.⁴ DA allows for national-level comparisons with decennial census data by age, sex, race, and ethnicity. It also provides limited and experimental estimates at state- and county-levels.⁵ DA is grounded in a robust methodology that the agency has refined over decades, providing a strong foundation for evaluating the census.
- **Post-Enumeration Survey (PES):** The PES checks the accuracy of the census by conducting an independent survey of the population. Using a method called “Dual-System Estimation,” the PES matches individual survey responses with census responses.⁶ This matching process allows the Bureau to identify missed individuals and other inaccuracies. Official estimates are available at the national and state levels for the 2020 Census.⁷ To ensure valid results, the PES employs rigorous sampling and data collection techniques.

FIGURE 1. Side-By-Side Summary of DA & PES

	Demographic Analysis	Post-Enumeration Survey
Scope	<ul style="list-style-type: none"> National Level estimates Experimental Results at the State & County Level for Select Groups Excludes all U.S. Territories 	<ul style="list-style-type: none"> National and State Level estimates Excludes Group Quarters, Remote Alaska, & smaller U.S. Territories*
Coverage Error Assessments	<ul style="list-style-type: none"> Net Over- and Undercounts Differential Undercounts 	<ul style="list-style-type: none"> Net Over- and Undercounts Components of Coverage Differential Undercounts
Demographic Detail	<ul style="list-style-type: none"> Race and Ethnicity (limited) Age (single-year) Sex 	<ul style="list-style-type: none"> Race and Ethnicity Age (grouped) Sex Tenure
Available Data	<ul style="list-style-type: none"> 1950 to 2020 Census 	<ul style="list-style-type: none"> 1990 to 2020 Census
Data Sources	<ul style="list-style-type: none"> Vital Records (Birth and Death Certificates) Net International Migration Data Other Records** 	<ul style="list-style-type: none"> Independent survey of a small sample of the nation Sample of census responses
Methodology	<ul style="list-style-type: none"> “Demographic Accounting Ledger” method Compares independent population estimates with census results at the national level 	<ul style="list-style-type: none"> Dual-System Estimates (DSE) method Matches individual survey responses to census records
Measures of Uncertainty	<ul style="list-style-type: none"> Range of Estimates (Low, Middle, High) *** 	<ul style="list-style-type: none"> Standard Error (related to sampling)

Note: *The PES includes Puerto Rico but excludes remaining U.S. territories, i.e., American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and U.S. Virgin Islands. **Additional sources of data include Medicare enrollment records, Defense Manpower Data Center records on armed forces overseas, and data from censuses and surveys from other nations.

*** The range of estimates is only available starting with the 2010 Census.

Source: Jensen, Eric B., et al. “Methodology for the 2020 Demographic Analysis Estimates.” U.S. Census Bureau, 15 December 2020. Available at https://www2.census.gov/programs-surveys/popest/technical-documentation/methodology/2020da_methodology.pdf; Groves, Robert. “How do we Conduct a Post-Enumeration Survey?” U.S. census Bureau, 17 May 2012. Available at <https://www.census.gov/newsroom/blogs/director/2012/05/how-do-we-conduct-a-post-enumeration-survey.html>;

2. DA & PES Work Together to Create a Picture of Census Accuracy

Using both Demographic Analysis (DA) and the Post-Enumeration Survey (PES) helps the Census Bureau cross-check results, giving a fuller picture of census accuracy. The two methods provide insights into census quality that are broadly consistent but not identical.⁸

I. COMPARING THE TYPE & DETAIL OF INFORMATION PROVIDED

The two methods differ in the types of information they provide and the populations they cover. The DA provides a historical view of census accuracy, allowing us to understand long-term trends and how they have changed since the 1960 Census. However, DA lacks specific sub-national estimates and detailed breakdowns of coverage. On the other hand, the PES offers more detailed insights into census quality, providing breakdowns by components of coverage and additional characteristics down to the state level. However, the Bureau has used PES as an official measure for a shorter time, with results available starting with the 1990 Census.

Demographic Analysis

- **Long History of Use.** The Bureau has used DA since 1960 to evaluate census accuracy.⁹ Historical DA files are available for censuses dating back to the 1940 Census.¹⁰
- **Limited Subnational Estimates.** DA produces strong, reliable national estimates but offers limited state- and county-level data. For the 2020 Census, the Bureau produced experimental subnational estimates for young children (i.e., population aged 0 to 4).^{11,12}
- **Limited Estimates by Race and Ethnicity.** Historically, the Census Bureau has traditionally only released DA-based estimates for Black and residual “non-Black” population groups.¹³ More recently, DA estimates include analyses by Hispanic origin, but these are only available for younger-age groups. 2020 DA estimates are available for the age group 0 to 29.¹⁴
- **No Components of Coverage.** DA reports net undercounts and overcounts but does not provide detailed breakdowns of errors, such as omissions or duplications, limiting its ability to assess specific census coverage issues.
- **Population Universe Includes the 50 States and D.C.** The DA method only covers populations residing in the 50 states and the District of Columbia (D.C.), including household and group quarters populations. Current DA estimates exclude U.S. territories, including Puerto Rico.

Post-Enumeration Survey

- **Shorter History of Use.** The Census Bureau has used the PES as an official measure starting with the 1990 Census, providing less historical data than the DA.¹⁵ Earlier iterations of the PES can be traced back to the 1950 Census.¹⁶
- **Availability of State-Level Estimates.** The 2020 PES data provided national- and state-level estimates. Though the 2010 PES provided coverage estimates for large counties and places, the Bureau did not produce sub-state results for the 2020 PES.¹⁷
- **Detailed Estimates by Race and Ethnicity.** The 2020 PES provided estimates by all major race and ethnicity census categories, including breakdowns of American Indian and Alaska Native (AI/AN) estimates by geographic categories (i.e., populations living “On Reservation” and “American Indian Areas Off Reservation.”)
- **Availability of Estimates by Tenure.** The PES is the only source of coverage estimates by housing tenure (i.e., whether the household is owner- or renter-occupied).

- **Provides Components of Coverage.** The PES method provides estimates of components of coverage errors such as erroneous enumerations (e.g., people counted more than once) and omissions (people missed in the census).¹⁸ Components of coverage provide a more detailed picture of census coverage. For example, Asian populations were overcounted in the 2020 Census. However, looking at net accuracy alone hides the fact that Asian populations experienced notable rates of omissions.
- **Excludes Group Quarters.** The Census Bureau produces PES estimates for the 50 states, D.C., and Puerto Rico. However, these estimates only refer to the household population in these areas and exclude people living in Group Quarters.
- **Excludes Remote Alaska and Smaller U.S. Territories.** The PES does not include households living in remote areas of Alaska and the smaller U.S. territories, such as the U.S. Virgin Islands and Guam.

II. COMPARING METHODOLOGIES & DATA SOURCES

Measuring the accuracy of the U.S. Census is a significant challenge. Measuring the true size and characteristics of a population will always involve degrees of error and uncertainty due to the complexities of data collection, limitations of statistical methodologies, and the dynamic nature of population change. To serve as reliable benchmarks, DA and PES rely on methods that are sufficiently independent and different from the decennial census, minimizing the potential for biases.

Demographic Analysis:

- **Underlying Data and Methods Are Robust.** The DA methodology is simple and robust.¹⁹ The DA methodology allows the Bureau to draw from several different data sources, ranging from administrative records to censuses conducted in other countries.
- **Inconsistent Definitions of Race.** Since the Bureau does not control data collection for all data sources, methodological issues may arise. For example, information on race and ethnicity collected from birth and death certificates are not always comparable with categorizations of race and ethnicity in the census.
- **No Traditional Measures of Uncertainty.** The DA methodology lacks traditional measures of uncertainty for the estimates, such as confidence intervals which help data users to interpret the reliability of estimates. However, since the 2010 Census, the Bureau has produced a range of population estimates—a Low, Middle, and High series in the 2020 Census—to reflect underlying uncertainties in the data and methodology.

Post-Enumeration Survey:

- **Potential Biases Due to Sampling and Data Collection Techniques.** The Post-Enumeration Survey (PES) methodology is robust but relies on complex data collection²⁰ and matching produces that are susceptible to error, such as recall bias, matching errors, and correlation bias.
 - » “Recall bias” may occur due to reliance on respondents’ ability to recall who and how many people resided in a household on Census Day (April 1). Memory can be flawed, especially when interviews take place several months after Census Day.²¹
 - » “Matching errors” occur when inconsistencies in respondents’ names or insufficient information hinder the accurate pairing of PES data with census records.²²

- » “Correlation bias” happens when the same individuals missed in the census are also likely to be missed in the PES. This correlation bias occurs, in part, because the PES follows data collection methods similar to those used in the census. For example, the same barriers to participation—like distrust of government or language barriers—can affect both the census and PES. If there is substantial correlation bias, the result can be an underestimation of the net undercount of the population.²³
- **Consistent Questions and Terms.** The Census Bureau controls all the data collection for PES and the Census. Therefore, the questions and terms used in the PES can be made identical to those used in the census.²⁴
- **Provides Measures of Standard Error.** The PES provides measures of uncertainty, namely the standard error associated with sampling. This measure of uncertainty allows the Bureau to assess the statistical significance of coverage estimates. Understanding statistical significance is important because it indicates whether the results are reliable. It helps data users know whether observed differences in coverage are meaningful (or simply due to sampling variability).

Conclusion

The results of the PES and DA are largely consistent, but the two methods both have their own strengths and weaknesses. Understanding how these methods work can help readers ascertain which statistic from which method is best for their needs. DA provides broad historical data and draws on methods and data sources that are largely independent and distinct from the decennial census. However, DA falls short in offering detailed subnational estimates and specific coverage components. On the other hand, the PES identifies specific errors like omissions and duplicates, providing detailed estimates by characteristics such as race, ethnicity, and tenure. Despite its granular insights, PES may encounter correlation bias and respondent recall bias, an issue DA avoids due to its reliance on administrative rather than survey-based data.

Appendix: Glossary of Terms

This glossary provides brief definitions of terms related to census accuracy. Please refer to Brief 1 for a more comprehensive discussion of these concepts.

- **Components of Coverage:** Categories of census accuracy, including correct enumerations, erroneous enumerations, omissions, and whole-person imputations.
- **Differential Undercount:** The difference in undercount rates between different population groups, often highlighting racial, ethnic, or geographic disparities in census accuracy.
- **Erroneous Enumerations:** People who were counted incorrectly, including duplicates, fictional individuals, or those who should not have been counted.
- **Group Quarters:** Places where people live or stay in a group living arrangement, such as dormitories, nursing homes, or prisons. These are treated separately from private households for census purposes.
- **Net Coverage:** The difference between the census count and an independent benchmark, such as the Demographic Analysis (DA) or Post-Enumeration Survey (PES). It reflects whether there was a net overcount or undercount of the population.
- **Net Overcount:** Occurs when the census count exceeds an independent benchmark estimate, indicating that more people were counted than should have been.
- **Net Undercount:** Occurs when the census count falls short of an independent benchmark estimate, meaning that fewer people were counted than actually exist.
- **Omissions:** Individuals who should have been counted in the census but were missed, contributing to an undercount.
- **Whole-Person Imputations:** People added to the census count through statistical methods when data was not available, typically used when a housing unit appears occupied but does not respond to census enumerators.

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Any errors of fact or interpretation remain the authors'.

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Endnotes

- 1 In fiscal year 2021, federal agencies distributed more than \$2.8 trillion through 353 federal programs based on decennial census data (in part or in whole). For more details, see Ceci A. Villa Ross. "Uses of Decennial Census Programs Data in Federal Funds Distribution: Fiscal Year 2021." U.S. Census Bureau, released June 2023. Available at <https://www2.census.gov/library/working-papers/2023/decennial/census-data-federal-funds-fy-2021.pdf>
- 2 Though not covered in this brief, "operational metrics"—such as self-response rates—provide insights into census data collection and processing operations. These metrics help understand data quality, though they are not themselves direct measures of census quality. For further discussion, see O'Hare, William P., and Jae June Lee, "Who Responded in the 2020 Census? Variation in Tract-Level Self-Response Rates in the 2020 U.S. Census." Georgetown Center on Poverty and Inequality, 13 April 2021. Available at <https://www.georgetownpoverty.org/issues/who-responded-in-the-2020-census/>; and "Assessing the 2020 Census." Teresa A. Sullivan and Daniel L. Cork, Editors. National Academies of Sciences, Engineering, and Medicine, 2023. Available at <https://nap.nationalacademies.org/catalog/27150/assessing-the-2020-census-final-report>.
- 3 Jensen, Eric, et al. "Methodology for the 2020 Demographic Analysis Estimates." U.S. Census Bureau, 15 December 2020. Available at https://www2.census.gov/programs-surveys/popest/technical-documentation/methodology/2020da_methodology.pdf
- 4 Jensen, Eric, et al. "Methodology for the 2020 Demographic Analysis Estimates." U.S. Census Bureau, 15 December 2020. Available at https://www2.census.gov/programs-surveys/popest/technical-documentation/methodology/2020da_methodology.pdf
- 5 "State and County Demographic Analysis Tables: 2020." U.S. Census Bureau, last revised 8 April 2024. Available at <https://www.census.gov/data/tables/2020/demo/popest/2020-state-county-da-tables.html>.
- 6 Groves, Robert. "How do we Conduct a Post-Enumeration Survey?" U.S. census Bureau, 17 May 2012. Available at <https://www.census.gov/newsroom/blogs/director/2012/05/how-do-we-conduct-a-post-enumeration-survey.html>
- 7 "Post-Enumeration Surveys." Census Bureau, last revised 12 March 2024. <https://www.census.gov/programs-surveys/decennial-census/about/coverage-measurement/pes.html>.
- 8 O'Hare, W. P., Robinson, J.G., West, K., and Mule, T., (2016). "Comparing the U.S. Decennial Census Coverage Estimates for Children from the Demographic Analysis and Coverage Measurement Surveys," Population Research and Policy Review, Vol. 35, Issue 5, pages 685-704.
- 9 Medina, Lauren, Sewell Demetric, and Eric Jensen. "Testing the Hypothesis of Similar Errors: Evaluating 80 Years of Demographic Analysis Estimates." Census Bureau, 26 April 2018. Available at https://www2.census.gov/programs-surveys/popest/technical-documentation/research/demographic-analysis/HSE_final.pdf.
- 10 Medina, Lauren, Sewell Demetric, and Eric Jensen. "Testing the Hypothesis of Similar Errors: Evaluating 80 Years of Demographic Analysis Estimates." Census Bureau, 26 April 2018. Available at https://www2.census.gov/programs-surveys/popest/technical-documentation/research/demographic-analysis/HSE_final.pdf.
- 11 "State and County Demographic Analysis Tables: 2020." U.S. Census Bureau, last revised 8 April 2024. Available at <https://www.census.gov/data/tables/2020/demo/popest/2020-state-county-da-tables.html>.
- 12 For further discussion, see O'Hare, William P. "Historical Examination of Net Coverage Error for Children in the U.S. Decennial Census: 1950 to 2010." U.S. Census Bureau, 2014. Available at <http://www.census.gov/srd/papers/pdf/ssm2014-03.pdf>. Mayol-Garcia, Yeris, and J. Gregory Robinson. "Census 2010 counts compared to the 2010 population estimates by demographic characteristics." October 2011 Southern Demographic Association Conference, Tallahassee FL; Adlakha, Arjun L., et al. "Assessment of Consistency of Decennial Census Data with Demographic Benchmarks at the Subnational Level." Decennial Census 2000 Evaluation 0.20 Final Report, 2003. Available at <https://www.census.gov/content/dam/Census/library/working-papers/2003/dec/o-20.pdf>; King, Heather, David Ihrke, and Eric Jensen. "Subnational Estimates of Net Coverage Error for the Population Aged 0 to 4 in the 2010 Census." 2018 Population Association of American Conference, Denver Colorado April 26-28, 2018. Available at <https://paa.confex.com/paa/2018/meetingapp.cgi/Paper/21374>.
- 13 Devine, Jason, et al. "The Use of Vital Statistics in the 2010 Demographic Analysis Estimates." U.S. Census Bureau, 8 January 2010. Available at <https://www.census.gov/population/www/documentation/twps0088/twps0088.pdf>.
- 14 2020 DA estimates are available for the age group 0 to 29. See Jensen, Eric, et al. "Methodology for the 2020 Demographic Analysis Estimates." U.S. Census Bureau, 15 December 2020. Available at https://www2.census.gov/programs-surveys/popest/technical-documentation/methodology/2020da_methodology.pdf
- 15 "Post-Enumeration Surveys: 1980." Census Bureau, last revised 12 March 2024. Available at <https://www.census.gov/programs-surveys/decennial-census/about/coverage-measurement/pes.1980.html#list-tab-400924250>.
- 16 Anderson, Margo. The American Census: A Social History (2nd Edition). Yale University Press: New Haven, 2015.
- 17 "The Post-Enumeration Survey: Measuring Coverage Error." U.S. Census Bureau, December 2021. Available at: <https://www.census.gov/newsroom/blogs/random-samplings/2021/12/post-enumeration-measuring-coverage-error.html>; Jensen, Eric, and Scott Konicki. "Recommendations Regarding the Use of the 2020 Post-Enumeration Survey Coverage Results in the Vintage 2023 Population Estimates." Census Bureau, 18 December 2023. Available at <https://www.census.gov/newsroom/blogs/random-samplings/2023/12/recommendations-2020-pes-coverage-results-in-vintage-2023-pop-estimates.html>.
- 18 O'Hare, William P. "Methodology Used to Measure Census Coverage." Differential Undercounts in the U.S. Census, Springer Briefs in Population Studies, 2019. Available at https://doi.org/10.1007/978-3-030-10973-8_3.
- 19 Robinson, J. Gregory. "The Coverage of Population in Census 2000 Based on Demographic Analysis: The History Behind the Numbers." U.S. Census Bureau Population Division, January 8, 2010. Available at <https://www.census.gov/content/dam/Census/library/working-papers/2011/demo/POP-twps0091.pdf>.
- 20 For example, see National Academy of Science, Engineering and Medicine (2023). Assessing the 2020 Census :Final Report , Washington, DC., National Academy Press, <https://doi/10.17226/27150>
- 21 For further discussion, see O'Hare, William P., Cara Brumfield, and Jae June J. Lee. "Evaluating the Accuracy of the Decennial Census: A Primer on the Fundamentals of Census Accuracy and Coverage Evaluation." Georgetown Center on Poverty and Inequality, last updated November 2020. Available at <http://www.georgetownpoverty.org/wp-content/uploads/2020/11/EvaluatingAccuracyDecennialCensus-Nov2020.pdf>.
- 22 For further discussion, see O'Hare, William P., Cara Brumfield, and Jae June J. Lee. "Evaluating the Accuracy of the Decennial Census: A Primer on the Fundamentals of Census Accuracy and Coverage Evaluation." Georgetown Center on Poverty and Inequality, last updated November 2020. Available at <http://www.georgetownpoverty.org/wp-content/uploads/2020/11/EvaluatingAccuracyDecennialCensus-Nov2020.pdf>.

- 23 For further discussion, see O'Hare, William P., Cara Brumfield, and Jae June J. Lee. "Evaluating the Accuracy of the Decennial Census: A Primer on the Fundamentals of Census Accuracy and Coverage Evaluation." Georgetown Center on Poverty and Inequality, last updated November 2020. Available at <http://www.georgetownpoverty.org/wp-content/uploads/2020/11/EvaluatingAccuracyDecennialCensus-Nov2020.pdf>.
- 24 O'Hare, William P. "Who Is Missing? Undercounts and Omissions in the U.S. Census." Differential Undercounts in the U.S. Census, SpringerBriefs in Population Studies, pp. 1-12, 2019. Available at https://doi.org/10.1007/978-3-030-10973-8_1.