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A Multidimensional Quality Assessment of the United States 2020 Census

Note by United States Census Bureau*

Summary

In 2020, amidst a global pandemic, the United States (U.S.) conducted its once-a-decade census of population and housing, providing essential data to make informed decisions about the U.S. population. Suspension of in-person data collection and a historic hurricane season, among other challenges to completing the enumeration, resulted in questions about the quality of the 2020 Census counts. Despite the unprecedented challenges faced in conducting the 2020 Census, the end goal remained a complete and accurate count—counting everyone once, only once, and in the right place. Committed to transparency, the U.S. Census Bureau has gone to new lengths to demonstrate the 2020 Census data are fit for their constitutional purpose, for decision making, and for painting a portrait of the U.S. population. This paper describes the robust portfolio of efforts the U.S. Census Bureau implemented—both internally and through engagement with external experts—to assess data quality, share those assessments widely, and begin to use them as input for planning the 2030 Census.

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I. Introduction

1. In 2020, the United States (U.S.) conducted its once a decade census of population and housing. The 2020 Census marked the 24th enumeration of the U.S. population since the first decennial census in 1790. Beyond marking the growth of a nation, the country relies on decennial census data for numerous purposes to make informed decisions about the nation's population. Chief among those, the decennial census serves a constitutional purpose referred to as congressional apportionment, which determines the allocation of seats in the House of Representatives. In addition to reapportionment, the decennial census provides invaluable information about the nation—used by elected leaders, government officials, policymakers, businesses, schools, and researchers to: draw congressional and state legislative districts, school districts, and voting precincts; federally distribute more than \$675 billion annually to states; inform federal, tribal, state, and local government planning decisions; and, inform business and nonprofit organization decisions (e.g., where to locate, size of the market).
2. Given the importance of decennial census data, the goal of each U.S. census of population and housing is always a complete and accurate enumeration—counting everyone once, only once, and in the right place.
3. Even in the best of circumstances, conducting a decennial census is an enormous undertaking and subject to challenges, both predicted and unforeseen. The U.S. 2020 Census was a few days into the collection of self-responses from households when the World Health Organization declared the Covid-19 pandemic. While self-response continued, stay-at-home orders necessitated a suspension of all in-person enumeration resulting in a three-month shift to the schedule. Adding to the challenges posed by the pandemic, in-person enumeration efforts were further hampered by a historic hurricane season, devastating wildfires, dangerous air quality from the wildfires' smoke, and civil unrest with resulting curfews. Not only did these circumstances challenge our ability to conduct the actual data collection operations, but they also impacted the public's ability and willingness to respond to the 2020 Census.
4. Considering the unprecedented challenges faced in conducting the 2020 Census, it is understandable to have questions about the quality and fitness for use of the counts and resulting data for their constitutional purpose, for making decisions, and for painting a portrait of the U.S. population. In keeping with the U.S. Census Bureau's commitment to transparency, the 2020 Census program set forth to analyze and resolve data quality issues and share those results with the public. A 2020 Census Data Quality Executive Governance Group was established in April 2020 to ensure the right focus and resources were dedicated to detecting and addressing data quality issues. During data collection, discussions centered on how time-critical decisions to cope with the pandemic, hurricanes, wildfires, and civil unrest might affect data quality and the identification of actions that could be taken to mitigate any impacts to data quality. During post-collection processing, discussions focused on challenges with processing collected data, remedies, and reviews of early quality indicators. Throughout, the U.S. Census Bureau maintained its commitment to transparency and went to even greater lengths both internally and through engagement with external experts to assess the quality of the 2020 Census results and to share those assessments widely.
5. Data quality is multidimensional—it encompasses completeness, accuracy, reliability, reasonableness, validity, and more—and so, approaching an understanding of data quality from multiple angles produces an insightful and holistic picture of data. The holistic picture of data quality for the 2020 Census is broken down at a high level into two major components: ensuring quality and evaluating quality.

II. Ensuring Quality

6. Steps to achieve the most complete and accurate count possible that is fit for use are part of every step of the census—from designing the census to collecting and processing the data. The 2020 Census design was the culmination of years of research and testing and was shaped by lessons learned from the 2010 Census as well as a rapidly changing environment. It required a flexible design that capitalized on new technologies and data sources while minimizing risk to ensure a high-quality population count. Throughout the decade, the U.S.

Census Bureau conducted extensive research—with both a quantitative and qualitative approach—to understand how people perceived the decennial census and to understand what would motivate the population to respond.

7. The 2020 Census conducted operations and outreach to motivate everyone to respond on their own and to cooperate with census takers in their communities. The U.S. Census Bureau mailed up to seven invitations and reminders, including up to two paper questionnaires to households, and gave the public three options to respond on their own—either online, by phone, or by mail. For the small percent of households (less than 5 per cent) that could not be reached by mail, a census taker dropped off a paper questionnaire or visited to interview the household. The automated census questionnaire was available in 13 languages¹—giving more than 99 per cent of U.S. households the option of responding online or by phone in their language. Help with responding was also available in 59 languages through language guides available in print as well as narrated on video on 2020census.gov. The U.S. Census Bureau expanded its advertising campaign to reach even more people with ads in an additional 33 languages for a total of 47 languages receiving some level of paid media support. The U.S. Census Bureau also expanded the multicultural media vendors that received a combination of paid search, print, or digital advertising, reaching more than 99 per cent of households more than 300 times. More than 400,000 partners encouraged people in their communities to respond. When a response was not received, census takers visited or called to interview households. Special operations to count people living in group quarters (such as college dorms, prisons, or nursing homes), transitory locations, and other types of living situations were also executed.

8. Numerous checks were built into data collection and data processing to ensure data quality. For example, the online questionnaire had prompts built in to help people respond completely and accurately, and when we sent census takers to knock on people's doors, we checked the quality of the census takers' work too. Ensuring quality relied on access to data and expertise to analyze those data. Analyzing data during and after data collection processing contributed to informed decision-making and to developing an understanding of 2020 Census Data Quality.

A. Ensuring Quality During Data Collection

9. With the 2020 Census, more data than ever before were readily available to inform the status of households and decision-making. Not only were data available and used from internal sources, but external sources as well. Several efforts formed the cornerstone to harnessing the power of those data including a Fusion Center, a Decennial Field Quality Monitoring (DFQM) program, and a Real Time Analysis of Data (RTAD) effort.

1. 2020 Census Fusion Center

10. The primary purpose of the Fusion Center was to facilitate information sharing across groups engaged in 2020 Census production operations to ensure situational awareness of cross-cutting issues and to anticipate how those issues might evolve into future problems that could potentially impact other areas of production operations or strategic goals. The Fusion Center was positioned to synthesize a plethora of information and to identify potentially impactful issues for problem solving in a timely manner. Data available to the Fusion Center enabled strategic decisions for each operation and geographic area based on whether it was feasible and safe to deploy staff for field work amidst the Covid-19 pandemic. These data-driven decisions used real-time data from various sources, such as the National Weather Service, Centers for Disease Control and Prevention, and local and tribal governments. This vigilant monitoring effort ensured the health of the public and census staff was not compromised and ensured continuous monitoring of quality during 2020 Census data collection.

¹ [2020 Census Support for Languages](#).

2. Decennial Field Quality Monitoring (DFQM)

11. The Decennial Field Quality Monitoring (DFQM) program was created to allow for the early identification and resolution of potential issues in field data collection operations through regular monitoring and analysis. Staff working at U.S. Census Bureau headquarters, regional census centers, and area census offices monitored activity during various in-person data collection operations, including the largest of the in-person field operations—Non-response Follow-up. Potential issues were identified early and communicated to field management to enable quick root cause analysis, strategies for remediation, and corrective action. The overall goal of the DFQM program was to have potential field data quality problems reported, investigated, and resolved in a timely manner to ensure more accurate and efficient operations. DFQM created and used outlier analysis and associated dashboards, operational control system reports, and ad hoc reports daily. The analysis, communication, and tracking that DFQM executed throughout the operations helped to verify that the data were collected in an appropriate manner and that field staff followed procedures for the primary field operations.

3. Real Time Analysis of Data (RTAD)

12. The purpose of Real Time Analysis of Data (RTAD) was to monitor, over the course of the 2020 Census data collection, select indicators that provided insight into progress as well as potential data quality issues. The RTAD effort was facilitated by the availability of data made possible by extensive use of technology. Metrics were produced on a regular basis—daily or weekly, depending on the metric—and communicated to U.S. Census Bureau leadership, operational teams, or other data monitoring teams such as DFQM, referred to above.

13. RTAD was vital to providing early insights, as well as promoting transparency internally and externally. Prior to the start of data collection, RTAD established self-response rate projections. Realized rates were compared to projections by mode (online, paper, and phone) at various levels of geography. Comparison of the realized rates to projections was key to assessing the impacts of operational delays and changes necessitated because of COVID-19. Daily self-response rates were released publicly to assist partners in evaluating the progression of response to the census in their communities.

14. RTAD also compared mail delivery dates to targeted mail delivery dates, monitored areas with no response, produced break-off rates of self-respondents, and compared demographic distributions to population benchmarks. RTAD staff regularly responded to external inquiries regarding self-response patterns to ensure external stakeholders had an accurate understanding to use in their data quality analysis.

B. Ensuring Quality During Post-Data Collection Processing

15. Once all data were collected, a window of time opened within which data were processed, tabulated, and reviewed for reasonableness. The data review ensured processing occurred as designed. The data review uncovered occurrences when processing did not occur as designed—referred to as anomalies. Anomalies found in processing are not errors in the census but could turn into errors if not resolved. Finding anomalies is a signal that the quality checks on the census are working. Most of the anomalies were typical and similar to those encountered in prior decennial censuses, such as basic errors in processing code and errors in data handoffs. Others were novel to planned improvements for the 2020 Census, and some were related to difficulties collecting data during the pandemic.

16. With the primary goal of an accurate count, response data were meticulously reviewed, comparing population totals against other data sources, such as the 2010 Census, 2020 population estimates, and the American Community Survey. And as data were reviewed, outlier analysis was conducted—looking for numbers that did not fit what might reasonably be expected. As outliers were identified, deeper analysis was conducted to determine if further remediation was necessary, and when deemed necessary, to determine the corrective course of action. Examining outliers is a normal part of data processing and quality checks for any census or survey.

III. Evaluating Quality

17. Even with all the quality checks and analysis conducted during data collection, the question became, did the circumstances under which the 2020 Census was conducted impact the fitness for use of the data? No singular number could definitively quantify the quality of the census. Each assessment, each piece of information, when considered along with other analysis and pieces of information, painted the picture about the quality of the 2020 Census and how the U.S. Census Bureau and the public would know the results are adequate for their constitutional purpose and many other uses. A variety of techniques are used to evaluate the quality of a decennial census. These techniques fall into two major categories: assessments of how well the 2020 Census was conducted and comparisons of 2020 Census results to other ways of measuring the population.

A. Assessments of how well the 2020 Census was conducted

18. Assessment of how well the U.S. Census Bureau conducted the 2020 Census took several forms. The U.S. Census Bureau, itself, thoroughly reviewed census operations and examined operational metrics on how census responses were collected. The U.S. Census Bureau also asked outside experts to independently review the processes, procedures, and data from the 2020 Census.

1. Operational Quality Metrics

19. For the first time in the U.S. Census Bureau's history, operational data quality metrics were released on the same day as the first decennial census results. These metrics are data points related to how the decennial census operations went. For example, operational data quality metrics examined the final status of addresses in the decennial census and how that status was determined—offering insight into how responses were collected from the different census operations—such as occupied addresses resolved via self-response by mode (online, by phone, or by mail) or addresses resolved in the Non-response Follow-up operation (household interview, proxy interview, or administrative records).

20. No singular number can definitively quantify the quality of the 2020 Census. However, looking at operational metrics and comparing them across geographies and with past censuses gave insight into the quality of the data. For example, from past research we know that the highest quality information usually comes from a person within the household. As a result, understanding the percentage that was self-response (a response submitted online, by phone or by mail by a member of the household) is important. Similarly, understanding the percentage of population counts collected by talking to proxy respondents, or “proxies,” such as neighbors or building managers, is also important.

21. With each census, the U.S. Census Bureau has produced similar operational metrics to those released for the 2020 Census. However, for the 2020 Census, the operational metrics were released sooner than with past censuses, and the metrics were released at the state-level in addition to the national level.

22. Differences when comparing metrics across decades were expected. “Different” didn't necessarily mean better or worse. Many differences were the result of changes to the way the 2020 Census was conducted compared with the 2010 Census. That included, for example, implementing an online response option.

23. With each decennial census, there are changes to the way the census is conducted—taking advantage of advances in technology, considering environmental factors, and considering how the world has changed over the decade—all with the aim of conducting a complete and accurate census as efficiently as possible. Observing a difference in operational metrics when comparing the 2020 Census to the 2010 Census is another data point for consideration in the breadth of quality assessments of the 2020 Census. The 2020 Census

operational quality metrics, data visualizations, and downloadable tables are available on a 2020 Census Data Quality webpage.²

2. Conducting a series of planned assessments and evaluations of the 2020 Census operations

24. With each decennial census, the U.S. Census Bureau completes a series of operational assessments and evaluations. The 2020 Census Assessments and Evaluations were designed to document and evaluate the 2020 Census programs and operations. Results from the 2020 Census assessments and evaluations serve as the background or basis from which the 2030 Census will be designed, tested, and implemented. As part of each decennial census since 1950, the U.S. Census Bureau incorporated a testing, evaluation, and experimental program to evaluate the current census and to facilitate planning for the next decennial census.

25. Operational assessments are designed to document final volumes, rates, and costs for individual operations or processes using data from production files and activities and information collected from debriefings and lessons learned. They generally do not include evaluative analyses. Operational assessments report planned versus actual variances as related to budget, schedule, and workloads (production and training). Depending on the operation, the assessment may include frequency distributions and standard demographic or address tables.

26. Evaluations are studies designed to analyze, interpret, and synthesize the effectiveness of census components and their impact on data quality and coverage using data collected from census operations, processes, systems, and auxiliary data collections.

27. Results from the 2020 Census assessments and evaluations will be published in a series of reports beginning mid-2022. Additional information about the 2020 Census assessments and evaluations can be found on the U.S. Census Bureau's website.³

3. Working with respected members of the scientific and statistical community to provide independent, external assessments of the census

28. Asking outside experts to review decennial census results is standard operating procedure at the U.S. Census Bureau. It underscores the commitment to quality and transparency. With the 2020 Census, however, the U.S. Census Bureau provided the public an unprecedented exclusive view at the 2020 Census to provide additional confidence in assessing the fitness of the 2020 Census data. Three highly respected groups were engaged to provide an external and independent assessment of the decennial census:

(a) JASON

29. JASON is an independent group of scientists and engineers with expertise in a variety of technical areas leveraged to perform studies for government sponsors. JASON has completed multiple studies for the U.S. Census Bureau, covering various aspects of the 2020 Census and other U.S. Census Bureau operations. The JASON study did not examine 2020 Census data. Rather, its goal was to identify strengths and weaknesses in the plans for data quality assessments and metrics, and to inform the efforts to communicate important aspects of data quality that could accompany release of 2020 Census data products.

(b) The American Statistical Association (ASA) Quality Indicators Task Force

30. The ASA has long shown an interest in the decennial census, and it includes experts who know census work well. The ASA was given access to internal operational and response data from the 2020 Census to help understand the accuracy and coverage of the 2020 Census enumeration.

² [2020 Census: Operational Quality Metrics](#).

³ [2020 Census Evaluations and Experiments \(EAE\)](#).

(c) National Academy of Sciences (NAS) Committee on National Statistics

31. The NAS has worked with the U.S. Census Bureau each decade, and it too includes many experts familiar with the work of the U.S. Census Bureau. Over the decades, the Committee on National Statistics (CNSTAT) has established panels to assess each decennial census and to suggest parameters for the research and planning of the subsequent censuses. Similar to the ASA, the NAS was also given access to internal operational and response data.

32. These three groups tackled different aspects of assessing the U.S. Census Bureau's work. Their reports will advise the U.S. Census Bureau on improving future censuses and will help the public understand the quality of the 2020 Census data. Additional information on U.S. Census Bureau engagement with outside experts can be found on the U.S. Census Bureau's website.⁴

B. Comparison of census results to other ways of measuring the population.

33. Comparing the 2020 Census results to other sources of data enabled us to analyze differences. Differences could be the result of errors either in the census or in the other data sources. Some differences are simply the result of different ways of collecting or generating the data. The key is to determine if a difference is expected or plausible. The conclusion depends largely on differences in the data and the specific benchmark under consideration. A coverage measurement program is essential for measuring the effectiveness of any census, including the 2020 Census, in terms of data quality. It is necessary to produce coverage measures to determine if the goals for the 2020 Census were met and to determine how future censuses can be improved.

1. Comparing Census results to Demographic Analysis estimates and other population benchmarks

34. Demographic Analysis (DA) is a method used to evaluate the quality of the decennial census. Current and historical vital records, data on international migration, and Medicare records are used to produce national estimates of the population on April 1 by age, sex, select race categories, and (for people age 30 and under) Hispanic origin. The DA population estimates are independent of the decennial census. The results are used to produce estimates of net coverage error, which are calculated as the percent difference between the census counts and the DA population estimates. The independence of the DA estimates makes them a particularly appropriate tool for evaluating the decennial census, and in fact, this is the purpose for which the DA estimates program was designed. Demographic Analysis results can be found on the U.S. Census Bureau's website.⁵

35. Each year, the U.S. Census Bureau produces official estimates of the population for many levels of geography. For the nation, states, and counties, estimates are also produced by demographic characteristics: age, sex, race, and Hispanic origin. It is a longstanding practice to compare the results of the decennial census against the official estimates of the population. Comparisons of decennial census counts to the population estimates can be an informative exercise, particularly when considering how the census and estimates differ from one another over the decades. Additional information about population estimates can be found on the U.S. Census Bureau's website.⁶

2. Conducting a Post-Enumeration Survey to measure how many people and housing units may have been missed or counted erroneously in the census

36. Although extensive efforts are undertaken to accurately count everyone in a decennial census, sometimes people are missed or duplicated. Census errors can result in a smaller or

⁴ [2020 Census Data Quality](#).

⁵ [Demographic Analysis \(DA\) \(census.gov\)](#).

⁶ [Population and Housing Unit Estimates \(census.gov\)](#).

larger population count than the actual number of people. The U.S. Census Bureau uses the post enumeration survey to independently statistically estimate the population.

37. The U.S. Census Bureau has used post-enumeration surveys with dual-system estimation to measure coverage in the decennial censuses of population and housing since 1980. The post-enumeration survey creates an alternative estimate of the number of people in the United States by independently surveying a sample of the population. Then, a case-by-case matching of individuals in the post-enumeration survey with individuals in the decennial census is executed. The comparison of the decennial census counts to the post-enumeration survey estimate enables calculation of the net proportion of people in the estimated population who may have been missed, duplicated, or counted by mistake in the decennial census.

38. Results from the post-enumeration survey provide two types of results: net coverage error and components of coverage. Net coverage error is the difference between the decennial census count and the post-enumeration survey estimate of the actual number of people in the United States. Components of coverage are created by breaking final decennial census counts into the three groups: correct enumerations, erroneous enumerations, and whole-person imputations.

39. The post-enumeration survey results will help estimate how well the 2020 Census covered—or counted—the population. The survey, along with other ways of evaluating quality, provides a measure of overall census quality and helps us identify ways to improve the next census. Results from the 2020 Census Post-Enumeration Survey can be found on the U.S. Census Bureau’s website.⁷

IV. A Look to the 2030 Census

40. The challenges faced by the U.S. Census Bureau in conducting the 2020 Census were unprecedented, so too was the degree of transparency within which the U.S. Census Bureau operated and communicated about the status and data quality of 2020 Census results. For the 2030 Census, the design will strive for greater access to data than ever before. During day-to-day data collection activities, decision-makers must have accurate data not only on production cost and progress, but also on data quality, respondent characteristics, and possible data anomalies.

41. As we look to the future and further modernize the design, we plan to incorporate the quality checks previously applied at the end of decennial census processing much earlier in the data collection and processing phase. The same quality checks applied at the end of 2020 Census processing and many more can be built into the 2030 Census collection and processing systems and executed frequently, in near real-time. Building the data and quality checks within the system itself helps to enable adequate consideration and testing of those metrics. Real-time analysis will allow U.S. Census Bureau staff to execute data queries and visualize the data to facilitate both data quality review and quality monitoring. The data review and quality monitoring will inform decision-making when corrective actions are necessary.

42. While the long-established commitment to transparency carries forward, stakeholder expectations have been raised given the unprecedented availability of data issued by the U.S. Census Bureau about the 2020 Census. The public expects insight into the status of data collection earlier, frequently, and at lower levels of geography. To meet stakeholder expectations, the planning for the 2030 Census will consider solutions to meet those expectations while protecting the privacy and confidentiality of all respondents. A complete and accurate census—counting everyone once, only once, and in the right place—will remain the primary goal for the 2030 Census, as it has for past censuses.

⁷ [Post-Enumeration Surveys \(census.gov\)](https://www.census.gov/post-enumeration-surveys).

V. Conclusions

43. The U.S. Census Bureau has a long-established commitment to transparency about the production of statistics. To increase transparency, we shared information about the quality of the 2020 Census results as they were known. A 2020 Census data quality webpage provides access to downloadable tables of operational quality metrics, data visualizations, news releases, blog posts, videos, reference maps, fact sheets, and more.

44. Despite the challenge of conducting the 2020 Census during a global pandemic, the U.S. Census Bureau remained flexible, practical, and persistent in completing an accurate count of its population. Numerous quality checks were built into collecting the data, robust processes for monitoring data collection informed real-time decision-making, the most comprehensive post-data collection review in recent decennial census history was conducted, and extensive post-data collection assessments were implemented. While no decennial census is perfect and there is no singular number that can definitively quantify the quality of the 2020 Census, each check, each metric, and each assessment supported the evaluation of the quality of the 2020 Census. Combined, these measures enabled the public to draw conclusions about the accuracy of the 2020 Census counts and their fitness for their constitutional purpose, for making decisions, and for painting a portrait of the U.S. population. Lessons learned from the 2020 Census will inform planning and design for the 2030 Census.
