Disclosure Avoidance and the 2020 Census Redistricting Data

2020 Census Briefs

By the Population Reference Bureau and
the U.S. Census Bureau's 2020 Census Data Products and Dissemination Team

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This is the first in a series of briefs describing how disclosure avoidance procedures are being applied to 2020 Census data products and the implications of those procedures for data users. This first brief provides key information about disclosure avoidance for the 2020 Census Redistricting Data. More detailed information is available in the U.S. Census Bureau's handbook, "Disclosure Avoidance for the 2020 Census: An Introduction".[1]

WHAT IS DISCLOSURE AVOIDANCE AND WHY IS IT IMPORTANT?

At the Census Bureau, **disclosure avoidance** is defined as a process to protect the confidentiality of respondents' personal information.

The Census Bureau has applied disclosure avoidance procedures to census data products for decades. Why?

To keep your information confidential. The Census Bureau is bound by federal law to protect data provided by or on behalf of respondents and to keep them strictly confidential. We must ensure that information about any specific individual, household, or business is never revealed, even indirectly, through our published statistics. As always, our challenge is to balance society's need for detailed, usable statistics with our responsibility to protect the privacy of the people behind those numbers.

We collect demographic and housing characteristic data on sex, age, Hispanic origin, race, relationship to householder, tenure (i.e., owner- or renter-occupied), vacancy, and group quarters population. The responses to these questions are used to publish statistics and need to be protected through disclosure avoidance. Some questions are only used for data quality assurance (e.g., date of birth) or for census operations (e.g., telephone numbers to contact households who provided incomplete or missing information). These responses are not published.

Differential privacy is the scientific term for a disclosure avoidance framework used to protect the confidentiality of respondents' data in our published data products. It is part of a broader family of disclosure avoidance approaches, known as formal privacy, which precisely quantify the disclosure risk associated with each and every statistic published.

Differentially private disclosure avoidance mechanisms work by treating the data we publish with a controlled amount of statistical noise—small, random additions or subtractions—so that no one can associate the published data with a specific person or household with any certainty. The use of statistical noise to protect confidentiality is not new; the Census Bureau has used similar techniques for decades.

Differential privacy is the best science available to protect 2020 Census respondent confidentiality while minimizing the impact on statistical validity. It is particularly well suited for large, detailed data products like those from a detailed decennial census. And with ever-advancing technology, the threats to disclosure will only grow with time.

[1] U.S. Census Bureau, "Disclosure Avoidance for the 2020 Census: An Introduction," <www.census.gov/library/publications/2021/decennial/2020-census-disclosure-avoidance-handbook.html>.

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Differential privacy offers a significant advantage over the disclosure avoidance methods used in past censuses in that it allows us to tune the balance between confidentiality and accuracy more so than ever before. Where necessary, the mechanism can be adjusted to add less noise to specific statistics, thus making those particular results more accurate. Decisions about how much noise to add and where to add it create a delicate balance between the usefulness of the data and the need to protect confidentiality. If we add less noise to certain results (e.g., number of people aged 37 in a census tract) to improve accuracy, we then must compensate by adding more noise to certain other results to ensure confidentiality.

Given modern-day confidentiality threats, differential privacy is the best science-based approach for 2020 Census results. However, it is just one tool in our disclosure avoidance toolbox. We continue to tailor our methods to each of the data products we release. Where appropriate, we are also strengthening our legacy methods such as swapping, aggregation, and suppression. In every case, we will follow the science to ensure that we are protecting the confidentiality of all responses while still releasing usable, quality statistics from Census Bureau data products.

For redistricting data, the Census Bureau implemented differential privacy through a series of formulas and steps called the TopDown Algorithm (TDA). For more information on TDA, refer to "Disclosure Avoidance for the 2020 Census: An Introduction."[2]

DISCLOSURE AVOIDANCE IS NOT NEW, BUT CHALLENGES HAVE GROWN

Disclosure avoidance has been used since the 1930 Census when the Census Bureau stopped publishing certain tables for small geographic areas to protect respondents' confidential data.[3] Title 13, U.S. Code provides for the confidentiality of census data.[4, 5]

Older disclosure avoidance methods, such as suppression and swapping, were not designed to defend against new types of database reconstruction and reidentification attacks. This vulnerability prompted the Census Bureau's Data Stewardship Executive Policy Committee to review disclosure avoidance procedures for the 2020 Census. To provide confidentiality protections and fit-for-use data, the Disclosure Avoidance System (DAS) had to be modernized.[6]

Differential privacy is a modern disclosure avoidance framework that provides mathematically provable guarantees against a wide range of potential privacy attacks. In addition:

- Differential privacy allows the Census Bureau to track and address potential disclosure risk as it accumulates across each successive data release.
- Unlike prior methods of table suppression or record swapping, differentially private data can be published, analyzed, and combined with other data without any increased risk of disclosure; once the data have been processed, there is no more privacy loss regardless of how the data are used.
- Differential privacy is transparent, unlike prior data protection methods. The programming code, parameter settings, and summaries of the statistical error used by differential privacy are available to the public. In principle, the only information that cannot be released is the exact value of the noise that is added to a given statistic.[7]

IMPLICATIONS FOR DATA USERS: 2020 CENSUS REDISTRICTING DATA

Since apportionment results do not undergo disclosure avoidance, except for aggregation, the 2020 Census Redistricting Data product was the first from the 2020 Census to be protected using differential privacy. Here's what data users need to know before they start using these statistics:

- **DO** add and subtract across person tables (e.g., P1–P5) to calculate counts for other groups. For example, in Clark County, NV, redistricting data table P1 shows a Two or More Races population of 332,095, and redistricting data table P3 shows a voting-age population—aged 18 and older—of

[2] U.S. Census Bureau, "Disclosure Avoidance for the 2020 Census: An Introduction," <www.census.gov/library/publications/2021/decennial/2020-census-disclosure-avoidance-handbook.html>.

[3] U.S. Census Bureau, "A History of Census Privacy Protections," <https://www2.census.gov/library/visualizations/2019/communications/history-privacy-protection.pdf>; and U.S. Census Bureau, "Disclosure Avoidance Techniques Used for the 1970 Through 2010 Decennial Censuses of Population and Housing," <www.census.gov/content/dam/Census/library/working-papers/2018/adrm/Disclosure%20Avoidance%20Techniques%20for%20the%201970-2010%20Censuses.pdf>.

[4] U.S. Census Bureau, "Title 13—Protection of Confidential Information," <www.census.gov/about/policies/privacy/data_stewardship/title_13_-_protection_of_confidential_information.html>.

[5] U.S. Census Bureau, "The Census Bureau's Simulated Reconstruction-Abetted Re-Identification Attack on the 2010 Census," <www.census.gov/data/academy/webinars/2021/disclosure-avoidance-series/simulated-reconstruction-abetted-re-identification-attack-on-the-2010-census.html>.

[6] U.S. Census Bureau, "2020 Census Disclosure Avoidance System Development and Release Timeline," <https://www2.census.gov/programs-surveys/decennial/2020/program-management/data-product-planning/disclosure-avoidance-system/das-development-timeline.pdf>.

[7] The code base can be found at <https://github.com/uscensusbureau>.

219,243 for that group. Subtracting those numbers, 332,095 – 219,243 = 112,852, gives the Two or More Races population under the age of 18 in Clark County, NV.

- **DO** compare 2020 Census data with data from prior censuses. However, use caution when drawing inferences based on changes observed for very small population groups or geographies (such as blocks), as they will tend to have a higher relative amount of noise to larger population groups and geographies. As with every census, data users should also review guidance regarding methodology changes, such as changes to the questionnaires and geographic boundaries, when making comparisons. For example, data users should use caution when comparing 2010 Census and 2020 Census race data because of improvements to the question design and coding procedures made for the 2020 Census (for more information, refer to "Improved Race and Ethnicity Measures Reveal U.S Population Is Much More Multiracial")[8].
- **DO** compare 2020 Census data with estimates from the American Community Survey (ACS). However, data users should keep in mind the differences between the two sources. The ACS is sent to a sample of U.S. addresses each year, while the decennial census counts every person living in the United States. The ACS and 2020 Census have different residency rules. For information about comparisons, refer to "Understanding and Using American Community Survey Data: What All Data Users Need to Know."[9]
- **DO** remember that some statistics, such as the total number of people in each state, are preserved "as reported" without any noise infusion (refer to the "How Much Noise is There? How Much Bias Is There?" section of this brief).
- **DO** refer to "Understanding Disclosure Avoidance-Related Variability in the 2020 Census Redistricting Data" for information about the range of noise at various geographic levels.[10]
- **DON'T** use data for individual blocks. Instead, aggregate data into larger areas, or use statistical models that combine data from many blocks. Block data are published to permit the analysis of user-constructed geographic areas composed of multiple blocks, for example, new voting districts that consist of collections of blocks within a politically defined geography. For the redistricting data, Census Bureau researchers found that for block groups, a minimum total population between 450 and 499 is sufficient to provide reliable characteristics of various demographic groups, whereas a minimum total population between 200 and 249 provides reliable characteristics for places and minor civil divisions (MCD).[11]

HOW MUCH NOISE IS THERE? HOW MUCH BIAS IS THERE?

When working with any dataset, including data from the decennial census, it is important to consider various sources of error and their effects on the results. Errors may be introduced during data collection—such as erroneous enumerations, omissions, or counting people or households in the wrong block. Errors may also be introduced in data processing, including imputing information for nonresponding households or adding statistical noise to protect confidentiality.

For redistricting data, Census Bureau researchers found that block-level errors introduced by the DAS are comparable in size to those resulting from census operational, measurement, and coverage errors.[12] Their analysis also showed that county-level noise introduced by the DAS is minor relative to these other sources of error. Although the noise introduced by the DAS is similar to, or lower than, error from other sources, it is useful to understand how the DAS affects both noise and bias.

The level of **noise** represents the magnitude of an error, regardless of whether the error is positive or negative. In the DAS, the amount of noise for each statistic is randomly selected from a distribution centered around zero. Values closest to zero (e.g., 0, +1, –1, +2, or –2) are most typical. Larger error values are possible, but the likelihood of their selection decreases the farther away from zero they are in the distribution.

[8] U.S. Census Bureau, "Improved Race and Ethnicity Measures Reveal U.S Population Is Much More Multiracial," <www.census.gov/library/stories/2021/08/improved-race-ethnicity-measures-reveal-united-states-population-much-more-multiracial.html>.

[9] U.S. Census Bureau, "Understanding and Using American Community Survey Data: What All Data Users Need to Know," <www.census.gov/content/dam/Census/library/publications/2020/acs/acs_general_handbook_2020_ch04.pdf>.

[10] U.S. Census Bureau, "Understanding Disclosure Avoidance-Related Variability in the 2020 Census Redistricting Data," <www.census.gov/library/fact-sheets/2022/variability.html>.

[11] Wright, Tommy and Kyle Irimata, "Empirical Study of Two Aspects of The TopDown Algorithm Output for Redistricting: Reliability & Variability (August 5, 2021 Update)," Working paper #2021-02, U.S. Census Bureau, Washington, DC, 2021, <www.census.gov/library/working-papers/2021/adrm/SSS2021-02.html>.

[12] U.S. Census Bureau, "Understanding Disclosure Avoidance-Related Variability in the 2020 Census Redistricting Data," <www.census.gov/library/fact-sheets/2022/variability.html>, and U.S. Census Bureau, "Block-Level Simulation of Non-Sampling Variability in Decennial Census Population Counts," <https://www2.census.gov/adrm/CED/Papers/CY22/2022-01-simulation-studies.pdf>.

Although the distributions are random, the amount of noise relative to the count is larger in small populations than in large populations. For example, adding one person to a block with ten people is a 10 percent change. Adding one person to a block with 100 people is only a 1 percent change. The amount of noise for a given characteristic is very similar across groups regardless of their size.

Because the noise values are selected at random and may be negative, the initial result of adding noise to the data could be a negative number. Since a negative population count is illogical, the DAS adjusts by adding to that count and taking an equivalent amount away from another count—either in a different location or a different subgroup.[13] This adjustment means that small counts—which are more likely to turn negative—often require positive adjustments to become nonnegative.

Bias is whether errors tend to be positive or negative. Because the DAS eliminates negative results but must maintain certain totals—such as the total population in a state, which is the sum of all the substate areas—there are known biases. Small counts have a slight positive bias, meaning their published counts are more likely to be larger than the enumerated count. Larger counts can have a negative bias, meaning their published counts are more likely to be smaller than enumerated.

Simulations based on 2010 Census data provide details about the expected levels of both noise and bias in the 2020 Census Redistricting Data.[14] A selection of results are shown in Table 1 and Figure 1).

Some key findings from the simulations include:

- The average change in block-level total population was around ±5 people, and most block population changes (90 percent) ranged from –11 to +10.
    - Blocks with at least 750 people have larger numerical errors than the smallest blocks. For example, the average error for blocks with total population between 2,250 and 2,749 is 30.3, compared with an average error of 4.6 in blocks with less than 250 people, and 13.5 in blocks with 250–749 people.
    - Although errors are larger, on average, in blocks with more population, the effect is likely to be less noticeable because the relative error is smaller. For example, average error of 30.3 in a block with 2,749 population is 1.1 percent. Average error of 4.6 in a block with 249 people is 1.8 percent.
    - Larger blocks—those with at least 250 people—can have a negative bias, meaning that the reported population may be lower than the enumerated count more often than would be the case for smaller blocks.
- The average change in total population for places and MCDs was less than ±3 people and most (90 percent) ranged from –6 to +6.
    - Among the smallest places/MCDs, of those with a population of 0 to 249, 90 percent had a change in population between –3 and +3.
    - In larger places/MCDs, of those with a population of 3,250 or more, 90 percent had a change in population between –10 and +9.
- The average change in county-level total population was less than ±2 people and most county population changes (90 percent) ranged from –4 to +4.

[13] U.S. Census Bureau "Postprocessing, Consistency, and the Challenges of Negative Numbers," <https://content.govdelivery.com/accounts/USCENSUS/bulletins/2924168>.

[14] Results exclude Puerto Rico. U.S. Census Bureau, "Understanding Disclosure Avoidance-Related Variability in the 2020 Census Redistricting Data," <www.census.gov/library/fact-sheets/2022/variability.html>.

Table 1.
Accuracy Profile for Total Population by Type of Geography: 2010

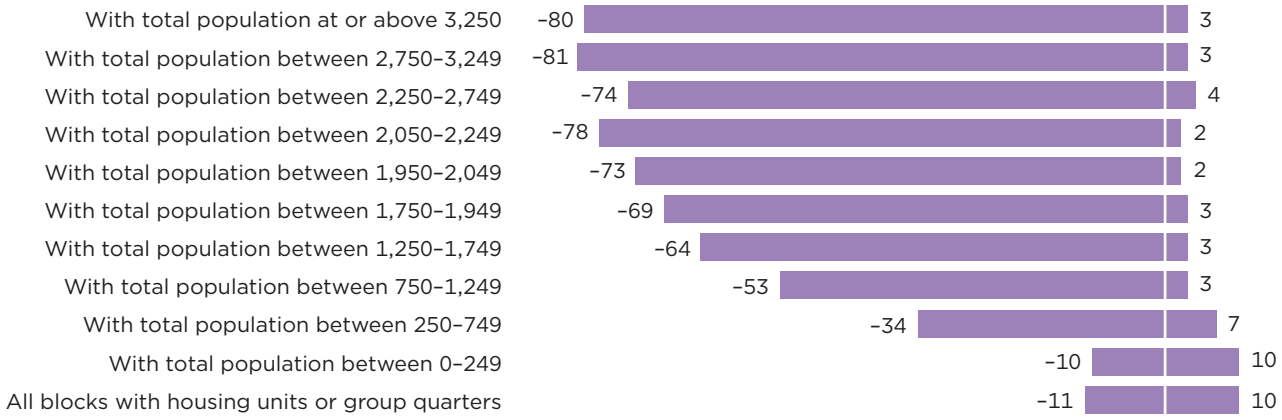
Geography	Mean absolute error (number of people)	Error: middle 90 percent (number of people)	
		Minus	Plus
Blocks[1]	4.89	–11	10
Places and minor civil divisions (MCDs)	2.73	–6	6
Counties	1.75	–4	4

[1] Blocks with housing units or group quarters.
Source: U.S. Census Bureau, Population Division, calculations from 2010 Demonstration Privacy-Protected Microdata File 2021-06-08.

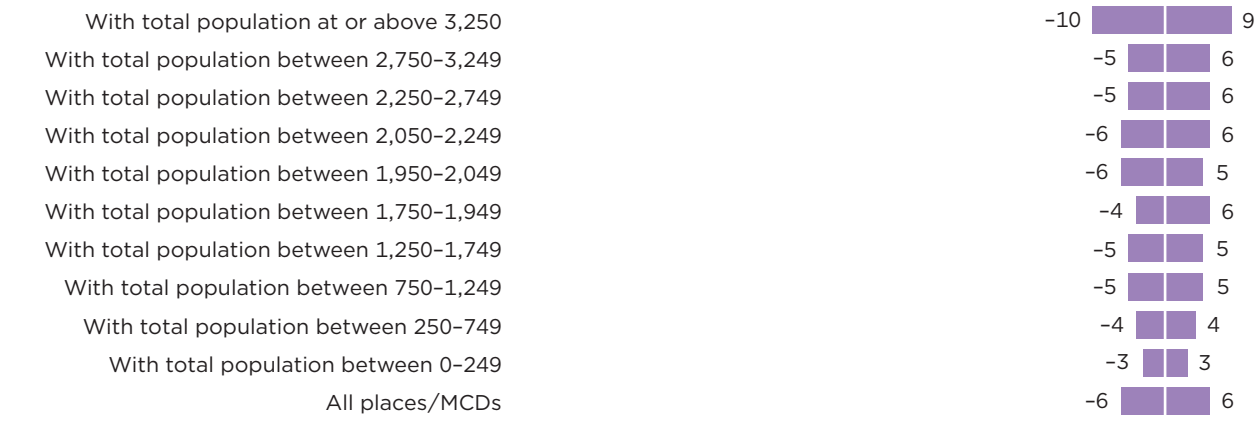
Figure 1.

Accuracy Profile for Total Population in Blocks, Places, and Minor Civil Divisions (MCDs), and Counties by Size of Population (Excluding Puerto Rico): 2010

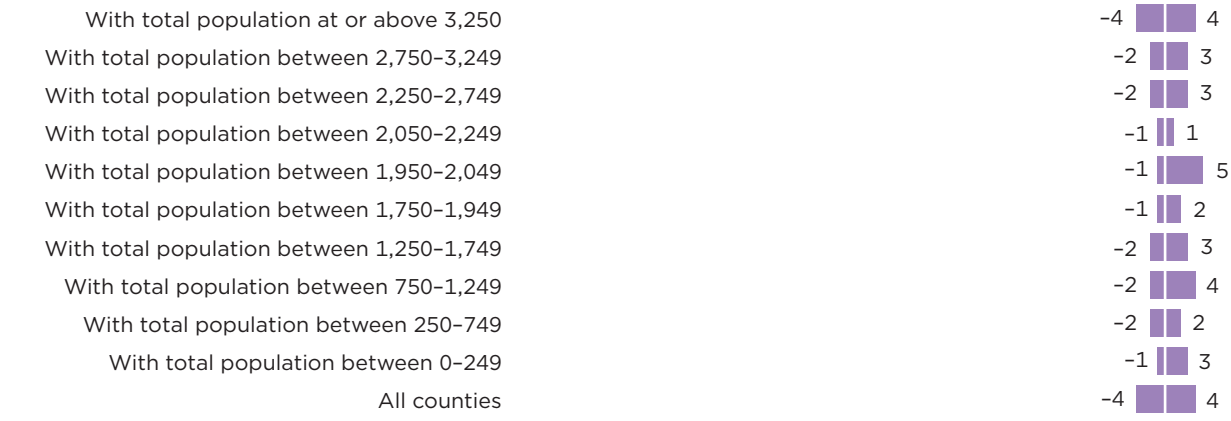
Range of Changes in Total Population for Middle 90 Percent of Blocks[1] by Size



Range of Changes in Total Population for Middle 90 Percent of Places/MCDs by Size



Range of Changes in Total Population for Middle 90 Percent of Counties by Size



[1] Blocks with housing units or group quarters population.

Source: U.S. Census Bureau, calculations from 2010 Demonstration Privacy-Protected Microdata File 2021-06-08.

- Among the smallest counties, of those with a population of 0 to 249, 90 percent had a change in population between –1 and +3.
- In larger counties, of those with a population of 3,250 or more, 90 percent had a change in population between –4 and +4.

HOW MUCH NOISE IS IN MY DATA?

To get a sense of how much noise or bias is in a given count, data users can refer to the "Detailed Summary Metrics" from the production settings demonstration data released on June 6, 2021.[15] The metrics are presented in a spreadsheet that includes a set of tables showing various measures of noise and bias for different characteristics and geographies—such as blocks, tracts, counties, incorporated places, and school districts—by size of geography. Data users can refer to these metrics to understand approximate noise for a geography and characteristic of interest.

For example, if someone wanted to know how much noise there might be in the total population count for an elementary school district of 7,000 people, they could look for "Table 1.g: Total Population for School District Size Categories" (an excerpt is shown in Table 2). In this table, the mean absolute error (MAE) column reflects average noise. A larger MAE value means more noise. A district of 7,000 people would fall within size category 5,000 to 9,000. The MAE column shows that the noise for a school district of that size is, on average, 18.28 people. As a percentage of the area's total population, the mean absolute percent error (MAPE) column shows that the added noise changes the total population count by 0.26 percent on average.

Mean algebraic percent error (MALPE) reflects bias. A negative MALPE means that reported counts are, on average, lower than enumerated. A positive MALPE means that reported counts tend to be higher than enumerated. For a school district with 5,000 to 9,000 people, there is minimal negative bias in the noisy count (–0.01 percent).

The MAE in total population across all elementary school districts is 22.74. The smallest districts—those with total population less than 1,000—have an average error of 14.46 and positive bias of 2.19 percent. The largest districts (those with population of 100,000 or more) have an average error of 103.41 and slight negative bias of 0.04 percent. As noted in Table 2, smaller districts are more likely to have large errors relative to the size of their populations. The MAPE for the smallest districts is 4.90 percent, compared with a MAPE value of 0.08 percent in the largest districts.

[15] To download the Excel file containing production setting metrics for 2020 Census Redistricting Data, visit <https://www2.census.gov/programs-surveys/decennial/2020/program-management/data-product-planning/2010-demonstration-data-products/01-Redistricting_File--PL_94-171/2021-06-08_ppmf_Production_Settings/2021-06-08-data-metrics-tables_production-settings.xlsx>.

Table 2.
Basic Demographic Accuracy Profile for School Districts by Size of District: 2010

School district size	Number of units	Mean absolute error	Mean absolute percent error	Mean algebraic percent error
All elementary school districts	**2,304**	**22.74**	**1.57**	**0.53**
Elementary school districts with total population less than 1,000	555	14.46	4.90	2.19
Elementary school districts with total population 1,000 to 4,999.	897	16.63	0.80	0.03
Elementary school districts with total population 5,000 to 9,999.	322	18.28	0.26	–0.01
Elementary school districts with total population 10,000 to 49,999	425	39.10	0.20	–0.03
Elementary school districts with total population 50,000 to 99,999	78	53.08	0.08	Z
Elementary school districts with total population of 100,000 or more	27	103.41	0.08	–0.04

Z Rounds to zero.
Source: U.S. Census Bureau, "Developing the DAS: Demonstration Data and Progress Metrics, Detailed Summary Metrics for Production Settings 2021–06–08," <www.census.gov/programs-surveys/decennial-census/decade/2020/planning-management/process/disclosure-avoidance/2020-das-development.html>.

For information about noise for other geographies and topics, refer to the "Detailed Summary Metrics for Production Settings 2021-06-08."[16]

IMPLAUSIBLE AND IMPOSSIBLE RESULTS

Noise infusion will result in some implausible results, especially for the smallest populations and geographies. These are manifestations of the uncertainty that is at the heart of how the DAS was implemented to protect confidential data. For example, an area, such as a block, may have data showing:

- Only one occupied housing unit but dozens of people (implying that those dozens of people live in the same household).
- Resident children under the age of 18, but no adults.
- People living in households in an area with only vacant housing units.
- More occupied housing units than people to occupy those units.

These results are often associated with geographic units having very small populations. For example, as shown in Table 3, 6.8 percent of blocks with people living in households have zero occupied housing units. But only about 0.1 percent of block groups and tracts—and zero counties—have this kind of implausibility.

As data are aggregated to larger geographic areas with greater population counts, the implausible results are less frequent and accuracy increases. For many use cases, such as detailed housing or household population analysis, block-level data may be too noisy. Block groups, census tracts, counties, or other larger geographies may be better choices as units of analysis. Data users are encouraged to combine block-level data into geographic areas with larger populations.

WHICH DATA POINTS ARE PRESERVED "AS REPORTED" WITHOUT ANY NOISE INFUSION?

The redistricting data files include certain "invariants"—data that are kept exactly as enumerated with no noise added. Invariant statistics for the 2020 Census Redistricting Data are:

- Total number of people in each state, the District of Columbia, and Puerto Rico.
- Total number of housing units (but not population counts) in each census block, and all other geographic levels.
- Number of occupied group quarters facilities (but not population counts) in each census block by the following types:
  - Correctional facilities for adults.
  - Juvenile facilities.

[16] U.S. Census Bureau, "Developing the DAS: Demonstration Data and Progress Metrics, Detailed Summary Metrics for Production Settings 2021-06-08," <www.census.gov/programs-surveys/decennial-census/decade/2020/planning-management/process/disclosure-avoidance/2020-das-development.html>.

Table 3.
Implausible Results by Geographic Summary Level: 2020 Census

Inconsistency	Blocks affected		Block groups affected		Tracts affected		Counties affected	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Zero occupied housing units but more than zero household population	392,921	6.80	223	0.09	90	0.11	Z	Z
Zero household population but more than zero occupied housing units	91,415	1.70	30	0.01	17	0.02	Z	Z
Households outnumber household population	220,954	4.10	60	0.03	29	0.03	Z	Z
Everyone in area under age 18 (excludes areas with group quarters population)[1]	101,127	1.80	27	0.02	17	0.05	Z	Z

Z Represents or rounds to zero.
[1] Share of areas that have no group quarters population.
Source: U.S. Census Bureau, 2020 Census Redistricting (Public Law 94-171) Summary File.

- Nursing facilities/skilled-nursing facilities.
- Other institutional facilities.
- College/university student housing.
- Military quarters.
- Other noninstitutional facilities.

HOW HAS DATA USER FEEDBACK INFORMED THE PLANNING PROCESS?

The Census Bureau received invaluable external stakeholder feedback on the DAS that informed our efforts and decision-making. Feedback was received via the 2020 DAS email <2020DAS@census.gov>, advisory meetings, tribal consultations, and comments provided during presentations at conferences and the "Disclosure Avoidance Webinar Series."[17] Data user feedback was also incorporated in a series of demonstration products to test whether the noise-infused data were fit for use.[18] The Census Bureau and external data users identified several issues with preliminary versions of the DAS that needed additional attention before it could be applied to the 2020 Census data, including:

- Small populations tended to gain population, whereas larger populations tended to lose population.
- Limitations of the noise-infused data for emergency planning operations for tract-level data.
- Issues for populations living in American Indian, Alaska Native, and Native Hawaiian areas as defined by Census Bureau geography.
- Problems with the accuracy of census data for certain geographic areas that do not follow the Census Bureau's standard geographic hierarchy.[19]
- Identification of extreme outliers.
- Distortions in the data that effectively moved individuals from high- to low-density populations (e.g., from cities to rural areas or from larger race groups to smaller race groups).

The Census Bureau used this feedback to make improvements to the DAS and adjust privacy settings to improve overall accuracy in the 2010 demonstration data for geographic areas and other characteristics, but never to favor a particular subpopulation over another. As a result of this work, the Census Bureau was able to greatly reduce many of these limitations.

Advanced data users may download the demonstration data that was generated by applying the 2020 DAS to the 2010 Census data using the production settings run. An alternative option is the "Detailed Summary Metrics" as previously mentioned.[20]

WHERE CAN I LEARN MORE?

- Disclosure Avoidance: Latest Frequently Asked Questions <www.census.gov/programs-surveys/decennial-census/decade/2020/planning-management/process/disclosure-avoidance/2020-das-updates/2020-das-faqs.html>
- 2020 Decennial Census: Processing the Count: Disclosure Avoidance Modernization <www.census.gov/programs-surveys/decennial-census/decade/2020/planning-management/process/disclosure-avoidance.html>
- Disclosure Avoidance Webinar Series <www.census.gov/data/academy/webinars/series/disclosure-avoidance.2021.List_882320526.html#list-tab-List_882320526>
- Disclosure Avoidance for the 2020 Census: An Introduction <www.census.gov/library/publications/2021/decennial/2020-census-disclosure-avoidance-handbook.html>

You can also subscribe to the Census Bureau's "2020 Census Data Products Newsletter" for timely updates and contact us at <2020DAS@census.gov> if you have questions.[21]

[17] To view any webinar in the series, visit <www.census.gov/data/academy/webinars/2021/disclosure-avoidance-series.html>.

[18] U.S. Census Bureau, "Developing the DAS: Demonstration Data and Progress Metrics, Detailed Summary Metrics for Production Settings 2021-06-08," <www.census.gov/programs-surveys/decennial-census/decade/2020/planning-management/process/disclosure-avoidance/2020-das-development.html>.

[19] Committee on National Statistics, workshop on "2020 Census Data Products: Data Needs and Privacy Considerations," <https://sites.nationalacademies.org/DBASSE/CNSTAT/DBASSE_196518>.

[20] To download the Excel file containing production setting metrics for 2020 Census Redistricting Data, visit <https://www2.census.gov/programs-surveys/decennial/2020/program-management/data-product-planning/2010-demonstration-data-products/01-Redistricting_File--PL_94-171/2021-06-08_ppmf_Production_Settings/2021-06-08-data-metrics-tables_production-settings.xlsx>.

[21] U.S. Census Bureau, "Decennial Census: Data Products and Operational Updates," <https://public.govdelivery.com/accounts/USCENSUS/signup/15409>.