



# Evaluating the Accuracy of the Decennial Census

A Primer on the Fundamentals of  
Census Accuracy & Coverage Evaluation

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OCTOBER 2020

## Georgetown Center on Poverty and Inequality

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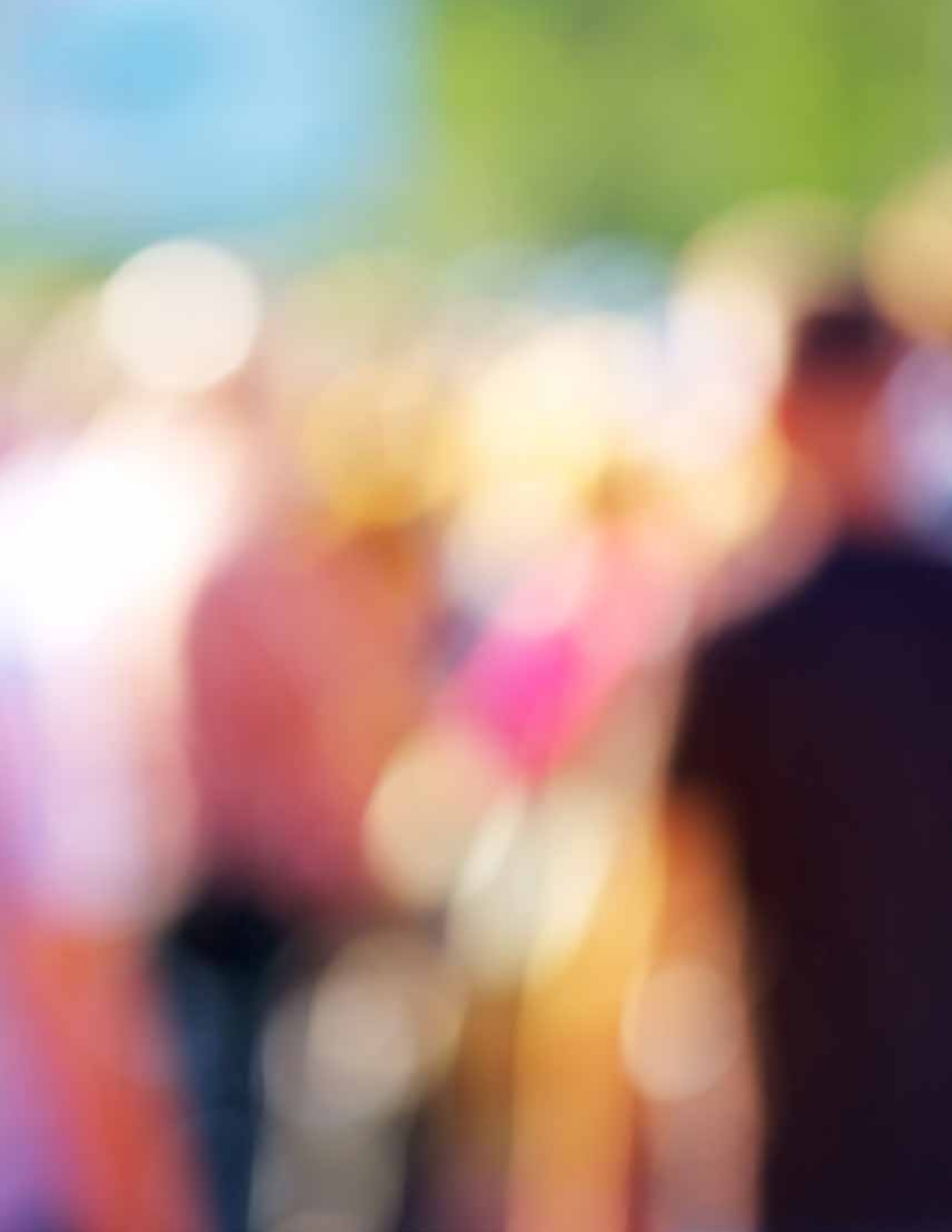
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# Abbreviations, Acronyms, & Initializations

**ACE**—Accuracy and Coverage Evaluation

**DSE**—Dual System Estimates

**CI**—Coverage Improvement

**CCM**—Census Coverage Measurement

**CMS**—Centers for Medicare and Medicaid Services

**COVID-19**—Coronavirus Disease 2019

**DA**—Demographic Analysis

**DSEP**—Data Stewardship Executive Policy Committee

**GAO**—Government Accountability Office

**GOTC**—Get-Out-the-Count

**ISR**—Internet Self-Response

**LGBTQ+**—Lesbian, Gay, Bisexual, Transgender, Queer

**LRS**—Low Response Score

**NRFU**—Nonresponse Followup

**PES**—Post-Enumeration Survey

**PL**—Public Law

**SNAP**—Supplemental Nutrition Assistance Program

**UN**—United Nations



## Executive Summary

In conducting the decennial census, the United States Census Bureau's goal is to count every person "once, only once, and in the right place."<sup>1</sup> However, that is easier said than done. The decennial census is a vast and complex undertaking and plays a crucial role as the backbone of the nation's statistical infrastructure. Every decade, the census determines how many congressional seats in the U.S. House of Representatives are apportioned to states and where the boundaries of legislative, school, and voting precincts are drawn. The census guides how more than \$1 trillion in federal funding are annually distributed and provides the statistics the nation needs to enforce civil rights laws, aids planning and decision-making at all levels of government and in the private sector, and informs efforts to study and formulate solutions for a variety of challenges facing the country. In short, it is imperative that the census be as accurate as possible.

This paper explores approaches and methods for evaluating the accuracy of the census—the extent to which published statistics (and the underlying, internal Census Bureau data) align with reality. For example, one might consider the extent to which the national population count produced through the census reflects the actual number of people living in the U.S. It is important to note that the accuracy of a census is just one component—albeit an incredibly important one—of the overall quality of the census. Quality comprises of additional factors beyond accuracy, such as how timely the publication of census data is and the extent to which census data are available and useful to the broader public.

## Net Undercounts & Differential Undercounts Are Key Measures of Accuracy

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Despite best efforts, the bureau has historically fallen short of counting each person once, only once, and in the right place. Where the bureau successfully enumerates people once and in the right place, these enumerations are called “correct enumerations.” There are two main types of census errors: omissions and erroneous enumerations. The bureau uses the term “omissions” to reflect the number people who should have been counted but were not. Similarly, errors in data collection and processing can result in the bureau erroneously counting people more than once or mistakenly including people in the count who should not be included, such as foreign tourists. Both omissions and erroneous enumerations (including double counts) are referred to as “coverage errors.” When people are not counted through any of the census operations, the bureau is sometimes able to statistically estimate data to represent missing people if they have evidence that they exist. This is referred to as “whole-person imputations”. Whole-person imputations are categorized by the Census Bureau as coverage error.

The total number of omissions, erroneous enumerations, and whole-person imputations is referred to as “gross coverage error.” On the other hand, “net coverage error” is estimated by subtracting the number of omissions from the sum of the erroneous enumerations and whole-person imputations. A positive net error indicates a census undercount, while a negative net error indicates a census overcount. For example, if you have ten omissions, ten erroneous enumerations, and ten whole-person imputations, the net error would indicate an overcount of ten.

Differential undercounts are calculated by comparing the net count of one particular population to that of another population or the nation as a whole. Households with certain demographic characteristics have been omitted in prior decennial censuses at higher rates and tended to have higher net undercounts than other groups—putting them at a disadvantage in terms of political representation and federal funding. Historically undercounted groups include people experiencing homelessness, young children, people with low incomes, people of color, immigrants, LGBTQ+ people, renters, and people displaced by extreme weather events.

## Two Methods Are Primarily Used to Evaluate the Accuracy of the Census

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Demographic Analysis (DA) and Dual System Estimates (DSE) are the two primary methods used by the Census Bureau to evaluate census accuracy. Both methods are intended to provide independent population estimates against which the results of the decennial census can be compared. The Census Bureau will make the 2020 DA and DSE results available in 2020 and 2021 at the earliest, respectively.

DA uses birth and death records, along with net international immigration data, to provide estimates of the expected national census population count by race and origin, age, and sex. The bureau compares the DA estimates with the results of the census to evaluate census accuracy. The DSE method—also referred to as the Post-Enumeration Survey (PES)—relies on a survey of residents living in a sample of geographic areas. The bureau matches and compares the responses of this survey to the responses of the census to measure the accuracy and coverage of the census by various census geographies and demographic and housing characteristics.

Typically, demographers use multiple measures to assess the quality of a census, and a determination about the quality of the census is informed by the context of current events and historical trends. Past results from both DA and DSE show that—despite steady improvements in the accuracy of the overall count for the U.S. population and for different groups—persistent differential undercounts remain.

## Process Measures Provide Timely Indications of the Likely Quality of the Census

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Census process indicators such as self-response rates (that is, households who have responded to the census online, by phone, or by mail) are available on a timelier basis than DA and DSE analyses. These indicators can sometimes provide early evidence of problems in the data collection and data processing phases that might compromise the accuracy of the census. For example, research has found strong correlations between self-response rates and the accuracy of the population count; geographic areas and demographic groups with lower self-response rates have tended to have higher net undercounts and omission rates. For the 2020 Census, the bureau and census stakeholders have used near real-time response rates as an early warning system of potential risks and challenges, using the information to react to challenges before it is too late.



# Introduction

Every decade, the Census Bureau fulfills a constitutional mandate to enumerate, or count, the population of the United States. The decennial census is a vast, complex undertaking and the federal government's largest peacetime operation. It is essential that the census be as fair and accurate as possible, given the range of important applications that rely on decennial census statistics, including political representation, state and federal funding, enforcement of civil rights laws, and decision-making at all levels of government and the private sector.

Despite the best efforts of the Census Bureau, civil society, and other stakeholders, the decennial census misses or miscounts some individuals and households. Groups that the bureau has historically undercounted—such as people with low incomes, people of color, people experiencing homelessness, immigrants, young children, and LGBTQ+ people—are at particular risk of being missed.<sup>2</sup> Undercounts of these groups undermines the fairness and accuracy of the census and puts their communities at a political and economic disadvantage.

It is perhaps more important today than ever before for stakeholders to understand the key approaches and methods for measuring the accuracy of the census. The 2020 Census has faced a myriad of challenges and risks that will likely affect its overall statistical quality. These challenges include chronic underfunding,<sup>3</sup> the eruption of the COVID-19 pandemic that has disrupted crucial census operations,<sup>4</sup> and the Trump Administration's partisan interference in the census, such as the failed attempt to add a citizenship question<sup>5</sup> and the unconstitutional proposal to remove undocumented immigrants from the apportionment count.<sup>6</sup> As nationally recognized census expert Constance Citro noted, "This year's census [the 2020 Census] will encounter greater challenges in completing an accurate enumeration than any census in U.S. history."<sup>7</sup> Given the challenges of the 2020 Census, it will not be surprising to see lower accuracy and quality in the 2020 Census than in the 2010 Census.

“This year’s census will encounter **GREATER CHALLENGES** in completing an accurate enumeration **THAN ANY CENSUS IN U.S. HISTORY**”

– **Constance Citro**

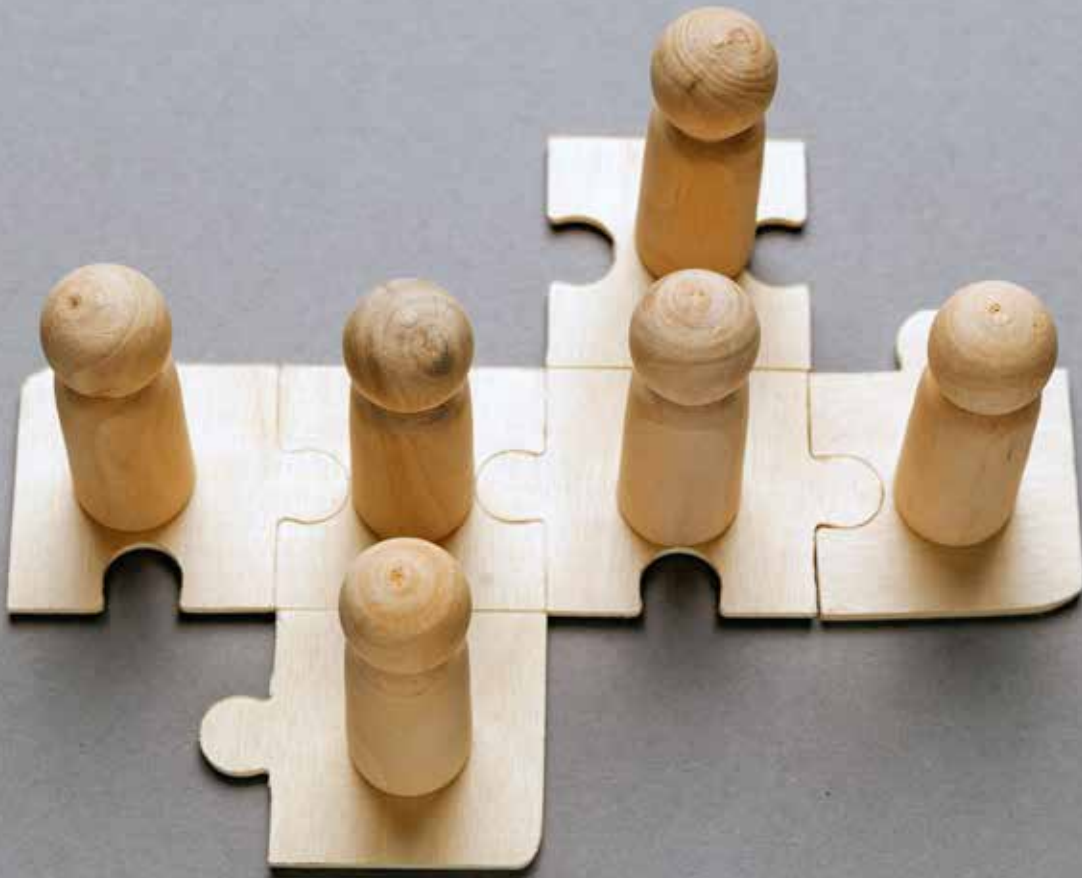
*Senior Scholar, the National Academies of Sciences, Engineering, and Medicine’s Committee on National Statistics*

This paper does not offer a definitive metric or set of metrics to measure the overall success of the 2020 Census. The Census Bureau will likely evaluate success on the basis of a broad range of criteria—including cost, data quality, and the results of process measures (such as productivity rates). Indeed, there is no single measure used by demographers to assess whether a census is a success or failure.

Instead, the goal of this paper is to provide an overview of the key concepts and measures that may be used to evaluate one important component of the 2020 Census—its accuracy. Many census stakeholders who are invested in the results and evaluation of the 2020 Census may not be demographers, statisticians, or social scientists. This paper, therefore, outlines some of the fundamental measures and methods for evaluating census accuracy and their relative strengths and weaknesses. This paper also provides key historical context needed for interpreting the results. Process measures and cost measures are explored to a limited extent.

- This paper is divided into four sections: **Sections 1 and 2** provide an overview of the main concepts and methods commonly used to evaluate the accuracy of a census.
  - » **Section 1** covers concepts such as omissions, net undercounts, and differential undercounts.
  - » **Section 2** describes the Census Bureau’s two main methods for measuring the accuracy of the census, Demographic Analysis (DA) and Dual System Estimates (DSE), and notes their relative strengths and weaknesses.
- **Section 3** provides context and highlights historical trends in census enumeration and evaluation.
- **Section 4** focuses on a key process measure—self-response rates—which can provide an early indication of the likely quality of the 2020 Census. Other process indicators include imputation rates and routine quality control measures.

This paper is based in part on the detailed descriptions of census evaluation methods provided in the United Nations report, “Principles and Recommendations for Population and Housing Censuses Revision 3.”<sup>8</sup> The United Nations report provides a list of key measures but does not offer clear guidance for defining an acceptable census or an unacceptably flawed census. This paper also draws from the book, *Methods and Materials of Demography*, by Jacob Siegel and David Swanson,<sup>9</sup> and an article, “Quality and the 2010 Census,” by Howard Hogan (the retired chief demographer of the Census Bureau) and his colleagues,<sup>10</sup> which provides a relatively succinct overview of measures the bureau used to evaluate the 2010 Census.



# 1. Key Concepts in Evaluating the Accuracy of the Census

While the quality of a census is determined by a variety of distinct factors,<sup>11, 12</sup> a major component of quality is accuracy. That is, the extent to which published statistics (or the underlying, internal census data) align with reality,<sup>13</sup> for example, how closely the population count for a small town matches the actual number of people living in that town. Census accuracy depends on census coverage; that is, how well the Census Bureau was able to accurately count everyone who was supposed to be counted, without counting anyone multiple times, and while excluding everyone who was not supposed to be counted.<sup>14</sup> This section defines and explores key measures of census coverage: correct enumerations, omissions, erroneous enumerations, imputations, net coverage, gross coverage, and differential undercounts.

## Correct Enumerations, Erroneous Enumerations, Omissions, & Imputations

At the end of every decade, the Census Bureau produces a count of the nation. However, not all counts of individuals are what the bureau considers “correct enumerations.” Enumerations are correct when the bureau counts people once, only once, and in the right place. In this report, correct enumerations only refer to the number of people in housing units counted through

## BOX 1.

### ACCURACY IS ONE COMPONENT OF CENSUS QUALITY

While this paper focuses on accuracy in its discussion of census data quality, accuracy is just one of many components that define the quality of published statistics. Ultimately, the quality of statistics should be judged by how well the data satisfy the needs of various communities of data users. “Data quality” is therefore also referred to as “fitness-for-use.” Given the numerous and important uses of decennial census statistics, census stakeholders should consider a range of ways of understanding the data quality. The United Nations’ Statistical Division, for example, suggests that the following attributes should be considered when assessing data quality:<sup>15</sup>

- **Relevance:** Published statistics meet the needs of data users and their diverse use-cases while excluding any insignificant or immaterial statistics.
- **Completeness:** Published statistics address the phenomenon they describe as fully as possible, taking into account resource restrictions and respondent burdens.
- **Accuracy:** Published statistics closely align with reality.
- **Comparability:** Published statistics are comparable over time or between places.
- **Timeliness:** The time elapsed between the data release and the event or phenomenon being described is relatively short as to ensure that the information is still of value and can still be acted upon.
- **Coherence:** Data from an individual program and data brought together across statistical programs is logically connected.
- **Punctuality:** Preannounced release dates are followed by the releasing agency.
- **Clarity:** To the extent possible, non-expert users can understand the data.
- **Accessibility:** Users can obtain statistical data with relative ease.
- **Interpretability:** Information is made available to help users understand the sources, definitions, or methods used.
- **Trust:** The public trusts in the statistical authority and its products.

These concepts are distinct, yet interrelated. In some instances, the Census Bureau must prioritize certain aspects of quality over others based on considerations such as the agency’s mandate, legislated requirements, and operational costs. For example, during the 2020 Census enumeration, the Census Bureau has had to address a trade-off between accuracy and punctuality. Due to social distancing recommendations to stem the spread of the COVID-19 pandemic, the Census Bureau has requested to delay reporting deadlines for certain statutorily required data products in order to safely conduct in-person enumeration operations that are critical to a fair and accurate census count.<sup>16</sup> While it may be necessary, the proposed delay will have a cascading effect on the legal and customary timelines in most U.S. states for redrawing legislative and congressional districts.

bureau operations such as self-response and Nonresponse Followup (NRFU). (People residing in group quarters and in remote Alaska are considered to be out-of-scope for purposes of coverage evaluation for DSE.) On the other hand, errors in data collection and processing can result in counting people more than once or mistakenly including people in the count, such as foreign tourists, individuals who died before April 1 of the census year, or fictitious people. The bureau refers to these mistaken *inclusions* in the count as “erroneous enumerations.”

The census count also includes “whole-person imputations.” This refers to people who were not counted directly in the census but who were added to the count by the Census Bureau based on some evidence that they exist.<sup>17</sup> For example, if a housing unit looks occupied but does not return its census form or respond to repeated visits from a Census Bureau enumerator, the Census Bureau may impute an estimated number of people for that housing unit into the census count, along with best guesses about their characteristics. Whole-person imputations are therefore not enumerations.<sup>i</sup>

$$\text{Census Count} = \text{Correct Enumerations} + \text{Erroneous Enumerations} + \text{Whole-Person Imputations}^{18}$$

The **2010 CENSUS** had a net undercount that was near **ZERO PERCENT**. However, there were a little more than **10 MILLION ERRONEOUS ENUMERATIONS**, almost **6 MILLION WHOLE-PERSON IMPUTATIONS**, & about **16 MILLION OMISSIONS**.

There is an important distinction between whole-person imputations and item imputation. Item imputation involves estimating characteristics for people already included in the census.<sup>19</sup> For example, if a census questionnaire is returned with all of the items filled in except sex, the Census Bureau will statistically guess the respondent’s sex on the basis of other information the person has provided about themselves and their household.<sup>20</sup> Item imputations may impact the accuracy of data about specific groups. For example, if a person’s race is incorrectly imputed, it will impact population totals by race.

Omissions refer to the number of individuals who were not enumerated (whether or not they ultimately are represented in the count through whole-person imputation) but should have been counted in the census.<sup>21</sup> The bureau generally calculates omissions by subtracting the number of correct enumerations (not the full census count) from the true population as estimated by Demographic Analysis (DA) or Dual Systems Estimates (DSE). DA and DSE are tools for estimating the true population and are explored in Section 2. Omissions do not include individuals ineligible for enumeration in the census, such as foreign tourists or foreign business travelers.<sup>22</sup>

$$\text{Omissions} = (\text{True Population [DA or DSE]}) - \text{Correct Enumerations}^{23}$$

The bureau effectively treats whole-person imputations as omissions. If the bureau correctly enumerated 290 million people and the estimated true population based on DA or DSE was 300 million, the total number of omissions would be 10 million. Even if 5 million people were added to the census count through whole-person imputation, there would still be 10 million omissions according to the bureau’s definition.

<sup>i</sup> Unlike imputations, proxy responses are considered to be enumerations. If an enumerator is unable to contact members of a household after several attempts, the enumerator may try to get information about the household from proxy respondents such as a neighbor or a landlord. Like other census responses, the Census Bureau may classify a proxy response as a correct enumeration or an erroneous enumeration. Proxy responses may also result in imputations. For example, a neighbor acting as a proxy respondent may know that a housing unit is occupied but may not be aware of how many people live in the unit, possibly resulting in whole-person imputations. Overall, proxy responses provide lower-quality data compared to self-reported data. For example, see Census Bureau, “DSSD 2010 Census Coverage Measurement Memorandum Series #2010-G-01,” 22 May 2012. Available at <https://www2.census.gov/programs-surveys/decennial/2010/technical-documentation/methodology/g-series/g01.pdf>.

## Net Coverage & Gross Coverage Error

The bureau defines “net coverage” as the difference between the true population as estimated for DA or DSE and the census count.<sup>24</sup> When the census count is smaller than the true population there is a net undercount. When the census count is greater, there is a net overcount. Net coverage is among the most widely used measures of census accuracy and is useful for determining whether coverage has improved over time. As will be discussed in Section 3, the census has historically had a net undercount of the population.

$$\text{Net Coverage} = \text{True Population (DA or DSE)} - \text{Census Count}^{25}$$

The bureau also reports the net coverage estimates as a rate or percentage. To calculate this, the bureau divides the net coverage by the true population of the U.S.

$$\text{Percent Net Coverage} = \frac{(\text{True Population (DA or DSE)} - \text{Census Count})}{(\text{True Population (DA or DSE)})} \times 100^{26}$$

Net coverage can also be understood in terms of omissions, erroneous enumerations, and whole-person imputations.<sup>27</sup> If the number of omissions is larger than the combined number of erroneous enumerations and whole-person imputations, there is a net undercount.<sup>28</sup> If the number of erroneous enumerations and whole-person imputations taken together is larger than the number of omissions, there is a net overcount.<sup>29</sup>

Due to how net coverage estimates are calculated, however, the measure can obscure important differences in the underlying scenarios.<sup>30, 31</sup> For example, a net undercount of zero (meaning the true population is equal to the census count) could mean there were no omissions and no erroneous enumerations or whole-person imputations. Alternatively, it could also mean there was a substantial number of omissions canceling out an equal number of erroneous enumerations and whole-person imputations. Though the net undercount is zero either way, these two scenarios provide very different pictures of the accuracy of a census. Therefore, while net coverage is and should be a key measure of accuracy, it is also important to account for omissions, erroneous enumerations, and whole-person imputations separately.<sup>32</sup>

More concretely, the 2010 Census had a net undercount that was near zero percent. However, there were a little more than 10 million erroneous enumerations, almost 6 million whole-person imputations, and about 16 million omissions.<sup>33</sup> In subtracting the number of omissions from the sum of erroneous enumerations and whole-person imputations, the net coverage is near zero. The total number of omissions, erroneous enumerations, and whole-person imputations—referred to as “gross coverage error”—tallies to about 32 million coverage errors; the *gross* coverage can therefore provide a different perspective of census accuracy from the *net* coverage.<sup>34</sup> A calculation of gross coverage error may also exclude whole-person imputations since whole-person imputation can be viewed as a means for producing more accurate counts—rather than a type of coverage error.<sup>35</sup>

Nevertheless, net undercounts are useful for census data use-cases that rely solely on population counts. For example, in the case of congressional apportionment, the measure of net coverage is sufficient. The number of congressional seats a state receives stays the same regardless of whether there were zero omissions and erroneous enumerations or if there were 1,000 omissions and 1,000 erroneous enumerations and whole-person imputations. Only the total net population of a state is used to determine the number of seats each state is allocated in the U.S. House of Representatives.

## Differential Undercounts

People with certain characteristics are more likely to be omitted in a census. The groups who have historically been missed in the census include people with low incomes, people of color, people experiencing homelessness, immigrants, young children, and LGBTQ+ people.<sup>36</sup> Historically, these groups experience higher omission rates and net undercounts in comparison to other groups. Differences in the net coverage rates between two groups (or a group and the nation as a whole) is known as “differential undercounts.”<sup>37</sup> Differential undercounts are among the most important measures of census accuracy and are traditionally evaluated in terms of the geographic, demographic, and housing characteristics collected in the decennial census.<sup>38</sup>

Differential undercounts are particularly damaging to the fairness of the census. If all groups were undercounted at the same rate, the Census Bureau or data users could arguably apply the same adjustment factor for all groups.<sup>39</sup> However, adjusting for differential undercounts can be difficult. The impact of differential undercounts is that groups and communities that are undercounted in the census are denied their fair share of political power and federal funding.<sup>40</sup> Unfortunately, it is often the groups most in need of federal resources that are undercounted at the highest rates.<sup>41, 42</sup>

### BOX 2.

#### MODERN DISCLOSURE AVOIDANCE SYSTEMS INTRODUCE CAREFULLY CALIBRATED ERROR TO PROTECT THE CONFIDENTIALITY OF RESPONDENTS

As a steward of the data it collects, the Census Bureau is tasked with deciding how to best produce meaningful statistics while ensuring that published statistics do not disclose—or allow others to discover—confidential information about individual respondents.<sup>43</sup> A fundamental challenge the bureau faces is a trade-off between confidentiality and data utility, including accuracy: the more statistics the bureau publishes, and the closer those statistics match the underlying, internal census data, the greater the risk to the confidentiality of individual respondents.<sup>44</sup> To uphold a legal obligation to protect the confidentiality of its respondents, the bureau has historically employed a variety of data processing techniques to limit the granularity of published statistics and to carefully introduce errors into statistics in order to protect confidentiality while still preserving the statistical accuracy.<sup>45</sup> The bureau refers to this process as “disclosure avoidance.”

For the 2020 Census, the Census Bureau has been modernizing its disclosure avoidance system by implementing a formal privacy method called “differential privacy.” In theory, the use of differential privacy will allow the bureau to provide robust and measurable confidentiality protections amid the evolving threats to confidentiality posed by the growing abundance of personal information available online and from commercial providers, along with advances in computer science and statistical techniques.<sup>46</sup> The Census Bureau’s Data Stewardship Executive Policy (DSEP) committee have the responsibility of setting the policy for how much confidentiality-protecting error to introduce into published statistics. DSEP will make this final policy decision before the bureau produces the first Public Law (PL) 94-171 redistricting data files in February 2021. (As of August 2020, the Census Bureau is required to deliver the PL 94-171 files to U.S. states by April 1, 2021.)<sup>47</sup> However, errors in data collection and processing—including omissions and erroneous enumerations—also contribute to a lack of precision in published statistics.<sup>48</sup>



## 2. Primary Methods for Estimating Census Coverage: Demographic Analysis & Dual System Estimates

**T**he Census Bureau uses two main methods for measuring census accuracy: Demographic Analysis (DA) and Dual System Estimates (DSE). Both methods provide independent population estimates in order to provide a valid comparison point to the census for the evaluation of census coverage. There are some notable differences between the methods, however, and the respective strengths and weaknesses are important to understand.

DA uses birth and death records, along with net international migration data, to provide an estimate of the expected census population counts by race and origin,<sup>ii</sup> age, and sex.<sup>49</sup> The DSE method compares census results to the results of a Post-Enumeration Survey (PES), which is conducted towards the end of census data collection.

The nomenclature can be confusing here. The terms Dual System Estimates (DSE) and Post-Enumeration Survey (PES) are often used interchangeably.<sup>50</sup> Moreover, the DSE or PES approach has been given a different name in each of the past three decennial censuses. In 2010, the operation was called Census Coverage Measurement (CCM), in the 2000 Census it was called Accuracy and Coverage Evaluation (ACE), and in the 1990 Census it was called the Post-Enumeration Survey (PES).<sup>51</sup> Sometimes the DSE or PES approach is simply called the “survey method.”<sup>52</sup> The DSE operation in the 2020 Census will be called PES, as it was in the 1990 Census.<sup>53</sup>

ii The Census Bureau treats race and origin as two separate and distinct concepts. Regardless of race, households responding to the 2020 Census have the option to identify as a person of Hispanic, Latinx, or Spanish origin. This category includes individuals who identify with one or more nationalities or groups originating in Cuba, Mexico, Spain, Puerto Rico, South or Central America, or another Hispanic, Latinx, or Spanish origin. See “About: About Hispanic Origin.” Census Bureau, retrieved July 02, 2020. Available at <https://www.census.gov/topics/population/hispanic-origin/about.html>.

**FIGURE 1.** Measures of Census Accuracy Have Relative Strengths & Limitations

Strengths & Limitations of Census 2020 DA & DSE Methodologies for Assessing Census Accuracy

STRENGTHS	LIMITATIONS
<b>DEMOGRAPHIC ANALYSIS (DA)</b>	
Long history of use	Data are only available nationally (except for young children)
Underlying data and methods are robust	Data only available for a few race and origin groups; information on race collected from birth and death certificates are not always comparable with categorizations of race in the census
Simplicity of method	Only net figures are available
	No measure of uncertainty
<b>DUAL SYSTEM ESTIMATES (DSE)</b>	
Consistent questions and concepts between the census and the PES survey	Relies on memory of individuals
Produces estimates of coverage errors	Matching records between the PES survey and the census can be a problem
Produces data for populations by race and origin as well as by tenure	Correlation bias can be a problem
Subnational estimates available	Estimates contain sampling error
Includes standard measures of uncertainty	

Source: Georgetown Center on Poverty & Inequality, 2020.

## Strengths & Limitations of Demographic Analysis

The Census Bureau has used DA to evaluate the coverage of every census since the 1950 census.<sup>54,55</sup> DA largely relies on federal and state administrative records for births, deaths, and net international immigration to provide an independent estimate of the expected census population counts by race, age, and sex.<sup>56</sup> Administrative records refer to information collected by government agencies for the purposes of administering programs and providing services, such as tax and medical records; however, the term can be more broadly used to include “third party data,” or records that are collected and maintained by commercial entities.

### STRENGTHS

The underlying data and methodology for DA are simple and robust. As the bureau has relied on DA as an integral part of the decennial program, the bureau has conducted extensive research and invited external reviews of the DA methodology and its components.<sup>57</sup> For example, researchers at the bureau and a group of subject matter experts on DA have met periodically in the years leading up to the 2020 Census to review the agency’s detailed plans for DA in the 2020 Census.

Because it has been used for each census since 1950, DA estimates can provide insights into trends over time. According to a Census Bureau working paper, “The national DA estimates have become the accepted benchmark for tracking historical trends in net Census undercounts and for assessing coverage differences by age, sex, and race.”<sup>58</sup>

## LIMITATIONS

There are several important limitations of DA, including a lack of subnational estimates, limited race and ethnicity data, the absence of information about omissions and erroneous enumerations, and the absence of measures of uncertainty.<sup>59</sup>

### Limited Subnational Estimates

Coverage estimates from DA are generally only available at the national level. DA is based on a basic demographic equation: births, minus deaths, plus net international migration, equals the population size. Because DA only uses data on net international migration to capture movement into and out of the U.S., it is difficult for the bureau to calculate coverage estimates for subnational geographic units—such as states and counties. The population of children aged zero to nine years is an exception. Subnational analysis can be done for the population aged zero to nine because the Census Bureau’s population estimates for this group are primarily based on birth certificate records between official census years.<sup>60, 61, 62, 63, 64</sup>

### Limited Race & Ethnicity Data

For much of the duration of the DA program, the Census Bureau released estimates for only two racial categories: Black and non-Black. This is because Black has historically been the only racial group to be coded relatively consistently in birth and death certificates.<sup>65</sup> Therefore, the bureau could only produce DA estimates for individuals identified as Black and labeled the residual category as non-Black.

Census race categories include **“SOME OTHER RACE”** which is not included on birth and death certificates

Historically, the comparison between Black and non-Black populations has been the main paradigm through which the bureau and stakeholders examined net and differential undercounts in the census. However, the demographic composition of the non-Black population has changed over time and has changed particularly dramatically in recent decades.<sup>66</sup> In 2010, the Census Bureau began including DA estimates for populations of Hispanic or Latinx origin.<sup>67</sup> However, these estimates were only for populations under age 20 because birth and death certificates have only identified individuals of Hispanic and Latinx origin in a consistent manner since 1990.<sup>68</sup>

The usefulness of DA is further complicated by the differences between the race categories used by the Census Bureau and those reported on birth certificates. For example, the Census race categories include “some other race” which is not included on birth and death certificates. In order to use DA estimates for calculating net undercounts by race and ethnicity, one must wait for the bureau’s “modified race categories” file that reconciles the race categories in birth and death certificates with those used in the census.<sup>69</sup> (For the 2010 Census, the bureau published the “modified race data” in July 2012.)<sup>70</sup>

## No Information about Omissions & Erroneous Enumerations

DA estimates supply net undercount and overcount figures when compared to census counts. However, net undercounts and overcounts alone do not provide a full assessment of a quality of a census. They can obscure information about omissions and erroneous enumerations. A net undercount of zero could, for example, be the result of two very different scenarios: either no one was missed (omissions) or double counted and mistakenly included (erroneous enumerations)—or, the substantial undercount of a certain group is canceled out by the equal overcount of another group. This second scenario puts the undercounted group at a disadvantage. While overall the net undercount may be the same, these two example scenarios provide very different pictures of the accuracy and fairness of the decennial census.

## No Measures of Uncertainty

The DA methodology lacks any measures of uncertainty for the estimates, such as standard errors associated with estimates based on sample surveys. However, it should be noted that in the December 2010 DA release, the Census Bureau released five different series of estimates based on five sets of assumptions about births, deaths, and net international migration to reflect some of the uncertainty regarding the DA estimates.

The DA population estimates in the 2010 Census ranged from 305.7 million for the low series to 312.7 million for the high series which amounts to a difference of a little more than 2 percent. The middle series estimate (308.5 million) was almost exactly the same as the census count. When the Census Bureau updated the 2010 DA in 2012 based on more recent data and methodological improvements, the bureau provided data only for the middle series estimate.<sup>71</sup>

### BOX 3.

#### PLANS FOR 2020 CENSUS DEMOGRAPHIC ANALYSIS

The Census Bureau typically releases the DA estimates in December of every census year.<sup>72</sup> The bureau publishes the DA estimates before the release of any of decennial census data products in order to reinforce the fact that the DA estimates are calculated independently from the decennial census counts.<sup>73</sup> However, since DA estimates only provide statistics on the expected population of the United States, the public will need to wait until 2020 Census results are released in 2021 in order to determine potential net undercounts and overcounts.<sup>74</sup>

The 2020 DA estimates will include population statistics with age, sex, and limited race and origin categories.<sup>75</sup> Data for the “race alone or in combination” and “race alone” categories will only be available for the population under age 40. Additionally, for the first time, experimental DA estimates for the 2020 Census will include full race and origin detail for the population ages 0 to 17.<sup>76</sup> The 2020 DA method will also produce estimates for the net undercount of young children for states and large counties, but that data will not be available until 2022.<sup>78</sup>

Finding the correct census data for comparison is not easy. For example, one cannot legitimately compare the statistics for Black people (or for people of other racial groups) in the official decennial census files to the DA estimates.<sup>79</sup> One must wait until the Census Bureau produces a special file, known as the modified race file, where people who marked as “some other race” are re-assigned to one of the major race categories.<sup>80</sup> As of August 2020, it is not clear when that file will be released by the Census Bureau.

## Strengths & Limitations of Dual System Estimates

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The Dual System Estimates (DSE) method compares census results to the results of a Post-Enumeration Survey (PES) which is conducted as the census data collection operations come to a close. For the PES, the bureau conducts an independent enumeration of the population using a sample of blocks. (The 2020 Census PES will have a sample of around 180,000 housing units.)<sup>81</sup> The results of the PES are compared to an internal census data file to determine the number and characteristics of people who were counted accurately, omitted, or included erroneously (mostly those who were double-counted).

### STRENGTHS

The DSE method has several advantages. The Census Bureau controls all the data collection for DSE (unlike DA which depends on data collected and compiled by other agencies, such as the National Center for Health Statistics). Therefore, the questions and terms used in the PES can be made identical to those used in the census.<sup>82</sup> Importantly, questions about race and ethnicity can be asked the same way in the census and the PES.<sup>83</sup>

Another major advantage of the DSE method is that it provides estimates of different components of coverage errors such as erroneous enumerations and omissions.<sup>84</sup> This provides a much richer picture of census coverage than simply looking at net undercounts and net overcounts. In fact, the DSE method is the only source of data on omissions, which is fundamental to understanding census accuracy.

DSE data can also provide subnational estimates, although the extent to which these estimates are accurate enough for use depends in part on sample size. These subnational estimates are for the total population only and not, for example, for subpopulations by race and origin. In the 2010 CCM, the Census Bureau produced state net undercount estimates but none of the states had a net undercount that was statistically significantly different from zero.<sup>85</sup> This is likely related, at least in part, to a relatively small sample in some states. While sampling error—error caused by observing a sample rather than the entire population—is itself a limitation, the ability to measure the sampling error is an important strength.

### LIMITATIONS

There are several important limitations of the DSE method. These include recall bias that results from a reliance on people's memory, errors in the matching procedure, correlation bias, and sampling error.

#### Reliance on People's Memory

The method relies on the memory of respondents. The bureau conducts in-person interviews with a sample of census respondents, typically several months after April 1 of the census year. During these interviews, the bureau worker asks the respondent where they were living and to list all members of their household as of April 1 of the census year. For some households and some individuals this is a challenge. As a researcher at the Census Bureau noted in 2007, "Respondents interviewed months after April 1 may find it difficult to recall accurately when a move occurred."<sup>86</sup> This phenomenon is commonly referred to as "recall bias." In a Census Bureau study of the 2010 Census, the bureau found potential evidence of recall bias.<sup>87</sup> Since the end of the data collection period has been moved further away from April 1—from July 31 to September 30<sup>88</sup>—recall bias may be a bigger problem in 2020 than it was in 2010.

## Matching Procedure

To tell if an individual was counted correctly in the census, people in the PES must be matched to those in internal census records.<sup>89</sup> This can pose a challenge because people do not always provide their names consistently, and the other information used to match people is missing in some cases.<sup>90</sup> For example, a person might be listed as John Jones in the census and Johnathan Jones Jr. in the PES. Deciding if these two entries are a match is not always straightforward.<sup>91</sup> Often, but not always, the Census Bureau has additional information like an address and birthdate to help with matching. Nonetheless, the matching procedure inherently allows for error.<sup>92</sup>

The limited information for some people included in the census can also be an obstacle to matching.<sup>93</sup> For example, as a last resort, an enumerator may contact a neighbor to find out about people living in a household that has not self-responded.<sup>94</sup> The neighbor may say there are two adults and a young child living there, without providing names or ages. This is called a “proxy response.”<sup>95</sup> These people are included in the census, but there is not enough information about them in the census records to allow matching to the PES records.<sup>96</sup> Some people may have been included in the census but appear to have been missed because there was not enough information to match the PES records to the census records.<sup>97</sup>

## Correlation Bias

If there is substantial  
**CORRELATION BIAS**,  
the result can be an  
underestimation of the  
net **UNDERCOUNT IN  
POPULATION**

“Correlation bias” refers to the fact that the same people who are likely to be missed in the census are also likely to be missed in the PES.<sup>98</sup> This violates the independence assumption of the DSE methodology. That is, the likelihood of being missed in the first “capture” (i.e. the census) is independent of the likelihood of being missed in the second “capture” or the “recapture” (i.e. the PES).<sup>99</sup> In reality, the likelihood of being missed in the census is related to the likelihood of being missed in the PES. This correlation bias occurs, in part, because the PES follows similar data collection methods as the census.<sup>100</sup>

If there is substantial correlation bias, the result can be an underestimation of the net undercount in population. In other words, if a group of people are likely to be missed in both the census and the PES, the undercount estimate for that group will be biased downward. The issue of correlation bias in the DSE approach has been discussed by several researchers.<sup>101, 102, 103</sup> In the 2010 DSE estimates, the Census Bureau made adjustments for correlation bias for Black men but not for other groups at greater risk of being missed (such as Latinx men or young children).<sup>104</sup>

## Sampling Error

PES estimates are based on a sample, and thus involve sampling error. Since the PES surveys a sample of the population and not the entire population, there is a level of uncertainty about how closely the results from the sample reflect the characteristics of the population it is meant to represent. The careful calculation of sampling error in the PES allows the bureau to determine, for example, where a small net undercount for a group is, in fact, statistically different than zero (i.e. no undercount).

In general, the smaller the sample size for a group, the larger the sampling error. Because the DSE is based on a carefully drawn sample, the coverage estimates include standard measures of uncertainty. As noted in the prior section, this could be seen as both a strength and a weakness. The fact that the estimates have errors is a weakness, but the ability to measure the size of those errors is a strength.

## BOX 4.

### USE OF ADMINISTRATIVE RECORDS TO ASSESS 2020 CENSUS ACCURACY

There is an opportunity to more fully utilize administrative records for assessing the accuracy of the 2020 Census. For more than two decades the Census Bureau has been collecting data on individuals from a broad range of administrative records. The Census Bureau has listed several dozen administrative records files that could be used to improve the efficiency of census operations and the quality of the enumeration,<sup>105</sup> including the Social Security Numident file, the CMS Medicare Enrollment data base, and data from the Supplemental Nutrition Assistance Program (SNAP). The Census Bureau could use the enhanced administrative records file to get one more measure of census accuracy.

Following the 2010 census, the Census Bureau compared the information from administrative records to the results from the census.<sup>106</sup> That exercise only involved examining how well the data from administrative records matched the data from the census. In 2015, O'Hare reported that about 20 percent of children ages 0 to 2 counted in the census could not be found in the administrative records file and match rates between administrative records and census records for young children were lower than any other age group.<sup>107</sup> Later in the decade, Census Bureau researchers used administrative records data to assess the characteristics of young children who were in the administrative records but could not be found in the census records—a sign of being undercounted.<sup>108</sup> The researchers found that about 19.8 percent of children ages 0 to 4 in the administrative records could not be matched to a record in the 2010 Census.<sup>109</sup> To be clear, it is possible that some of the children that could not be matched were actually counted in the 2010 Census, but their records did not contain enough detailed information to allow a match.



### 3. Evaluating the Accuracy of Past Censuses

While the nation first conducted the decennial census in 1790, the formal evaluations of the census only began in the mid-20<sup>th</sup> century.<sup>110</sup> These formal evaluations show that the bureau has steadily improved the overall accuracy of the census over time. This is a significant achievement, especially given the historical decline in self-response rates to censuses and the operational complexity of counting an increasingly diverse and mobile population.<sup>111</sup> However, notable challenges remain. While the overall accuracy of the census has improved for the population overall and subpopulations, the bureau has struggled to close a persistent coverage gap between different groups. This coverage gap undermines the fairness of the census, since undercounted populations miss out on their fair share of political representation and federal funding. This effect is compounded when the same groups are persistently undercounted (e.g. people of color, people with low incomes, young children, and immigrants). The historical context is important to understand; an examination of past censuses can provide readers with a standard by which to compare the coverage estimates for the 2020 Census.

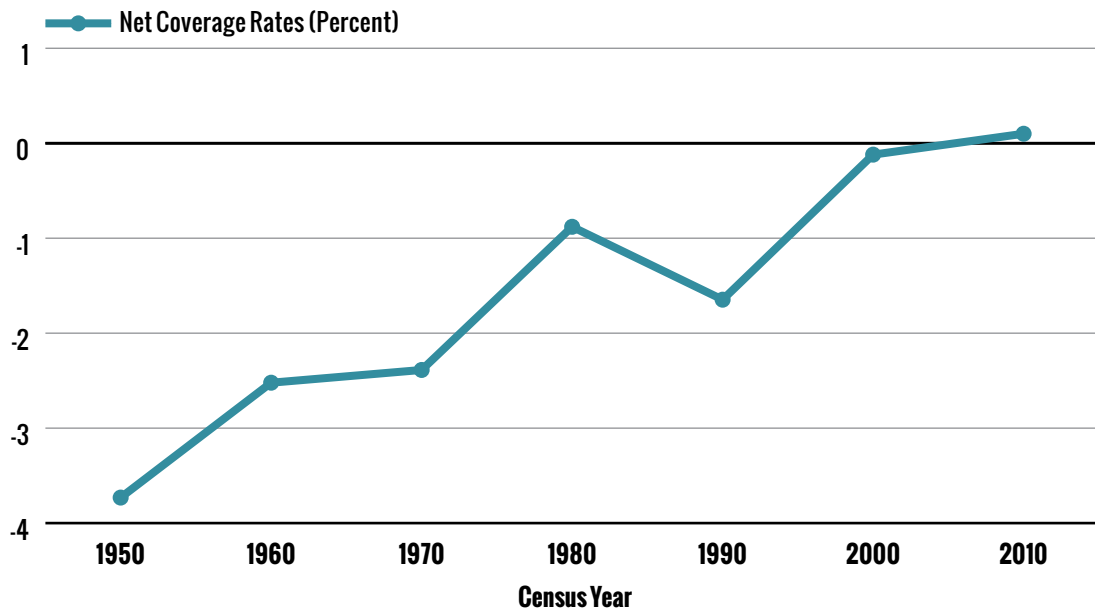
## DA & DSE Show Improvements in Census Coverage Over Time

The decennial census has never achieved its ideal of counting every person, once and only once, and in the right place.<sup>112</sup> Each census is an immensely complex and challenging undertaking and the census will likely always be imperfect in some way. However, evaluations of past censuses do show a positive trend with the net coverage of the census having steadily improved over time.<sup>113</sup>

The bureau has used DA estimates since 1940 and those results can help us understand historical trends. The 1940 Census recorded a 3.7 percent net undercount and, other than a dip with the 1990 Census, the overall positive trend continued: the net coverage for the total population was near zero for the 2000 and 2010 Censuses. There was a net undercount of 0.1 percent in 2000 and a net overcount of 0.1 percent in 2010.

**FIGURE 2. Census Net Coverage Rates Have Generally Improved in Recent Decades**

Percent Net Coverage Rates from DA, 1950 – 2010



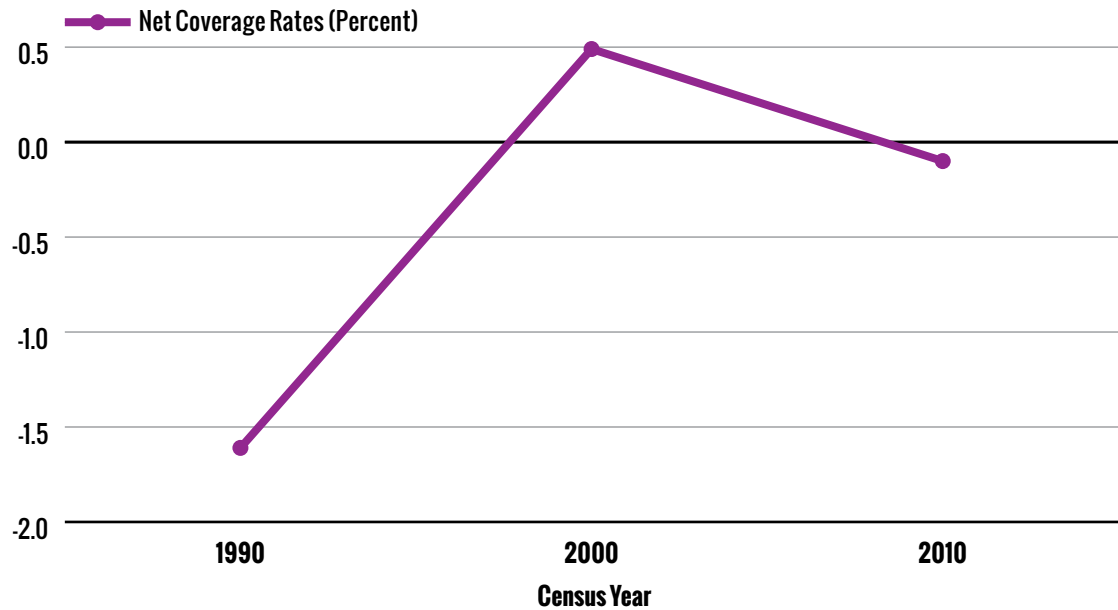
**Note:** Negative coverage rates indicate a net undercount.

**Source:** Georgetown Center on Poverty & Inequality, 2020. 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, 5 March 2014. Available at <https://www.census.gov/srd/papers/pdf/ssm2014-03.pdf>.

DSE estimates also provide evidence of this positive trend, though data are only available going back to the 1990 Census. DSE indicates an improvement in coverage rates from a net undercount of 1.61 percent in the 1990 Census to a net overcount of 0.49 in the 2000 Census followed by a slight net undercount of 0.1 percent in the 2010 Census.

**FIGURE 3. Census Net Undercount Rates From DSE Provide Consistent Evidence of Improving Coverage**

Percent Net Coverage Rates from DSE, 1990 – 2010



**Note:** Negative net coverage rates indicate an undercount. People residing in group quarters and in remote Alaska are considered to be out-of-scope for purposes of coverage evaluation.

**Source:** Georgetown Center on Poverty & Inequality, 2020. Authors' analysis of data from Hogan, Howard, et al. "Quality and the 2010 Census." *Population Research and Policy Review* 32: 637-662: 5 April 2013. Table 1. Available at <https://link.springer.com/article/10.1007/s11113-013-9278-5?shared-article-renderer>.

Since DA and DSE use independent methods to produce population estimates, it is not surprising that the estimates do not align exactly for each census. Rather, it is important to note that both methods provide fairly consistent results and show the same overall trend. That is, a large reduction in the net undercount from the 1990 Census to 2000 Census and gradual progress towards a net coverage error of zero percent.

## Coverage of Subpopulations Has Improved

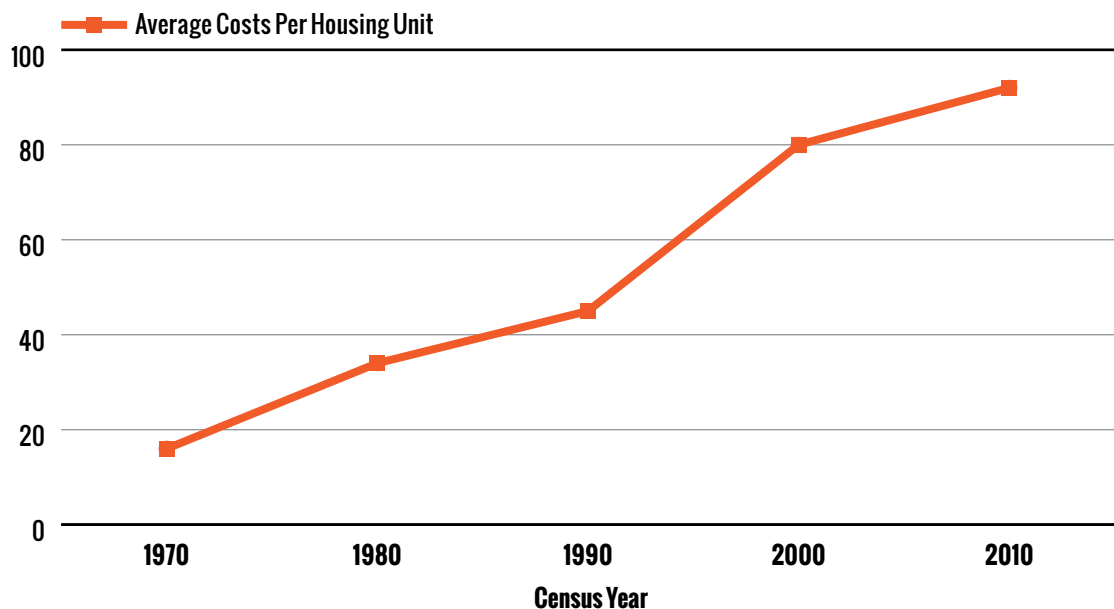
The positive historical trend in the net coverage of the total U.S. population is mirrored in the improving net coverage of many subpopulations. For example, the DA estimates show an improvement in coverage of the Black population from a net undercount of 7.5 percent in the 1950 Census to a net undercount of 2.5 percent in the 2010 Census. The residual non-Black population saw improvements from an undercount of 3.8 percent in the 1950 Census to an overcount of 0.3 percent in the 2000 Census that increased slightly in the 2010 Census. (See Figure 5.)

While data are not available for the comparable period of time, a similar trend of improving census coverage can also be seen in the net undercount for people of Hispanic or Latinx origin in the 2010 Census (see Figure 6). The undercount of people of Hispanic or Latinx origin was 5 percent in the 1990 Census and 1.5 percent in the 2010 Census. While the population of people who indicate Hispanic or Latinx origin is treated as homogenous with respect to the bureau's undercount estimates, subgroups within the population likely have different coverage rates.<sup>114</sup>

There appears to be no commonly accepted explanation for the improvement in the census coverage of Black and Hispanic or Latinx populations between 1990 and 2010. It is possible the improvement is in part related to expanded outreach activities such as the Census Partnership Program and paid advertising which started in the 2000 Census. Changes between 1990 and 2010 in the way data on race have been collected and the increased spending on the census per household over this period may have also contributed to the improvement.

#### FIGURE 4. Per Housing Unit Cost of the Decennial Census Has Increased Nearly Six-Fold in Recent Decades

Average Cost Per Enumerated Housing Unit in 2020 U.S. Dollars, 1970 - 2010



**Note:** Dollar figures are adjusted to 2020 U.S. dollars. The bureau calculated the per housing unit cost using the total number of enumerated households. This calculation does not include group quarters.

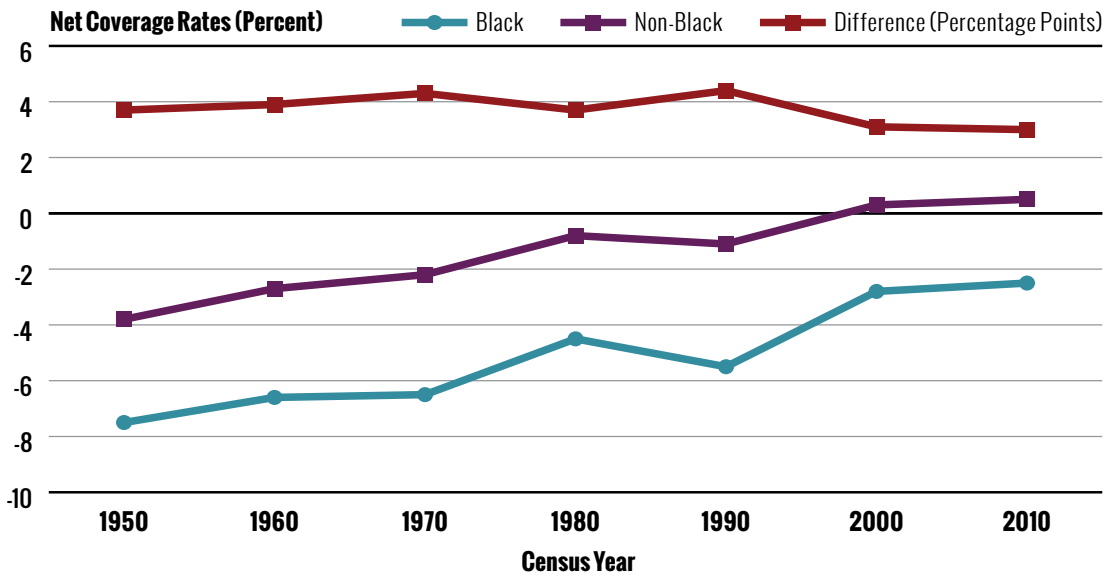
**Source:** Georgetown Center on Poverty & Inequality, 2020. "2020 Census: Further Actions Needed to Reduce Key Risks to a Successful Enumeration." U.S. Government Accountability Office, GAO-19-431T, 30 April 2019. Figure 1. Available at <https://www.gao.gov/assets/700/698794.pdf>.

## Coverage Gaps Persist Between Groups Despite Improvements

Despite substantial improvement in the coverage of subpopulations by race and origin, significant and persistent coverage gaps (referred to as differential undercounts) between groups remain. The differential undercount between the Black population and the residual non-Black population was 3.4 percentage points in 1940 and 3.0 percentage points in 2010. (See Figure 5.) Similarly, the differential undercount between people of Hispanic or Latinx origin and White people who are not of Hispanic or Latinx origin was 3.4 in 1990 and 2.4 in 2010. Of the past three censuses, The gap was at its narrowest in 2000. (See Figure 6.)

**FIGURE 5. Despite Overall Improvements in Accuracy, Coverage Gaps Remain Between Black & Non-Black Populations**

Percentage Net Undercount Rates, by Race, from DA, 1950 – 2010

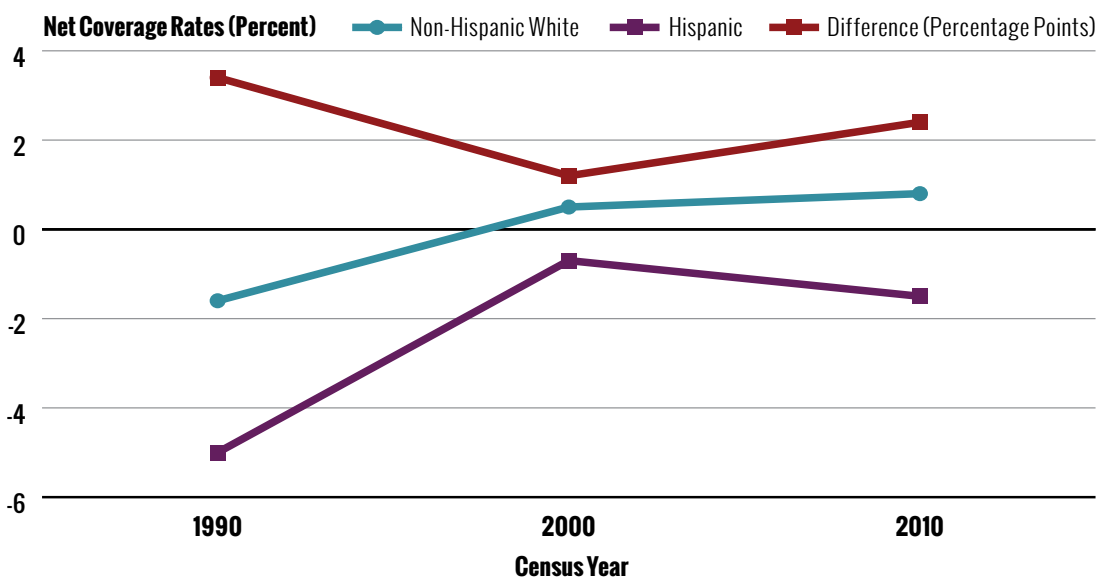


**Note:** Differential undercount calculated by subtracting the total population of the residual non-Black group minus the total population of Black people. Negative numbers indicate an undercount.

**Sources:** Georgetown Center on Poverty & Inequality, 2020. Authors' analysis of data from "Envisioning the 2020 Census." National Research Council, 2010. Available at <https://www.nap.edu/catalog/12865/envisioning-the-2020-census>.

**FIGURE 6. Persistent Coverage Gaps Remain Between Non-Hispanic or non-Latinx Whites & Those Who Indicate Hispanic or Latinx Origin Despite Overall Improvements In Census Coverage**

Percent Net Undercounts Rates, by Hispanic or Latinx origin, from DSE, 1990 – 2010



**Note:** Negative coverage rates indicate a net undercount of the population. People residing in group quarters and in remote Alaska are considered to be out-of-scope for purposes of coverage evaluation. People residing in group quarters and in remote Alaska are considered to be out-of-scope for purposes of coverage evaluation.

**Source:** Georgetown Center on Poverty & Inequality, 2020. Mule, Thomas. "Census Coverage Measurement Estimation Report." U.S. Census Bureau, 22 May 2012. Table 7. Available at [https://www.census.gov/coverage\\_measurement/pdfs/g01.pdf](https://www.census.gov/coverage_measurement/pdfs/g01.pdf).

The 2010 Census illustrates the persistency of these differential undercounts. Though top experts (such as the then Deputy U.S. Commerce Secretary Rebecca Blank) characterized the 2010 Census as “extremely accurate,”<sup>115</sup> the 2010 Census omitted the population of Black people at a rate of 9.3 percent and undercounted the population by 2.1 percent—the highest omissions and net undercounts for any group by race and origin.

Similarly, American Indian and Alaska Native, and Native Hawaiian or Pacific Islander populations (alone or in combination) and people of Hispanic or Latinx origin have higher omissions rates and greater undercount rates compared to the Non-Hispanic White Alone population. In general, groups who have higher omissions rates also have higher net undercount rates. By comparison, the population of White (alone and non-Hispanic/Latinx) people had an omissions rate of 3.8 percent and was the only group who was overcounted in the census. (See Figure 7.)

**FIGURE 7. Latinx & Black People Were Most Missed in the 2010 Census**

2010 Census Net Undercount Rates & Omission Rates, by Race and Origin

RACE AND HISPANIC ORIGIN	NET UNDERCOUNT RATE	OMISSIONS RATE
<b>Total</b>	<b>0</b>	<b>5.3</b>
<b>Non-Hispanic White Alone</b>	<b>0.8</b>	<b>3.8</b>
<b>Black Alone or in Combination *</b>	<b>-2.1</b>	<b>9.3</b>
<b>Asian Alone or in Combination *</b>	<b>0</b>	<b>5.3</b>
<b>American Indian and Alaska Native Alone or in Combination*</b>	<b>-0.2</b>	<b>7.6</b>
<b>Native Hawaiian or Pacific Islanders Alone or in Combination *</b>	<b>-1</b>	<b>7.9</b>
<b>Hispanic Origin *</b>	<b>-1.5</b>	<b>7.7</b>

**Note:** Negative figures reflect net undercounts. (\*) Includes Latinx people and people of Hispanic origin who selected this race. Latinx people and people of Hispanic origin are also included in the Hispanic Origin category. People residing in group quarters and in remote Alaska are considered to be out-of-scope for purposes of coverage evaluation.

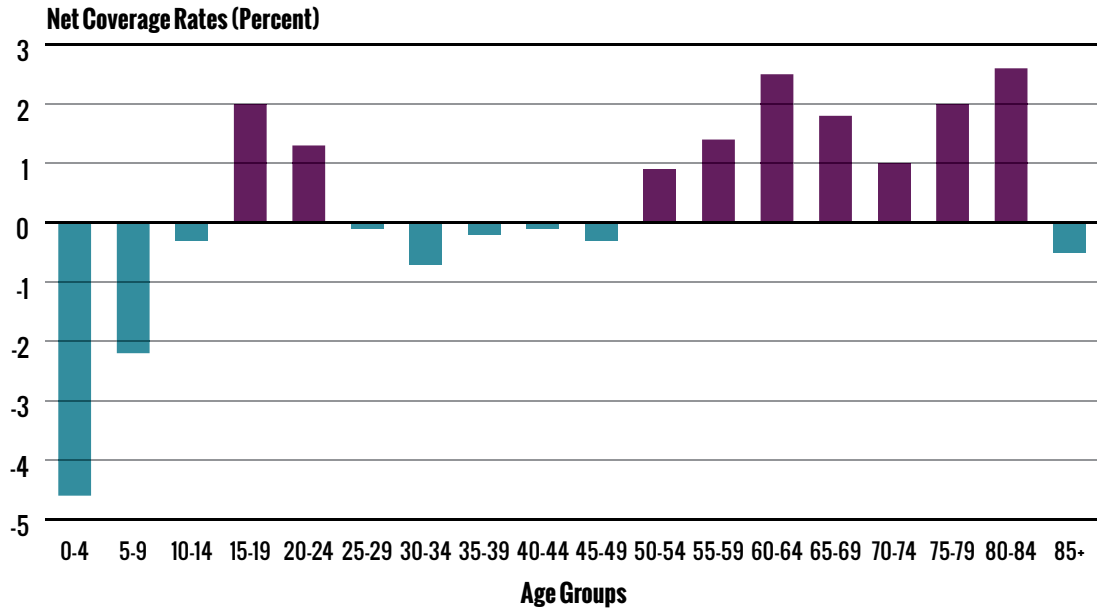
**Source:** Georgetown Center on Poverty & Inequality, 2020. U.S. Census Bureau (2012), “2010 Census Coverage Measurement Estimation Report: Summary of Estimates of Coverage for Persons in the United States,” DSSD 2010 CENSUS Coverage Measurement Memorandum Series #2010-G-01. Available at [https://www.census.gov/coverage\\_measurement/pdfs/g01.pdf](https://www.census.gov/coverage_measurement/pdfs/g01.pdf).

Populations with other demographic and housing characteristics were also differentially undercounted in the 2010 Census.<sup>iii</sup> For example, DA estimates for different age groups show that the 2010 Census undercounted young children (ages 0 to 4) by 4.6 percent and adults aged 25 to 29 by 0.1 percent. Recall that the DA net coverage results for the 2010 Census showed a slight net overcount of 0.1 percent for the entire population. Adults older than 50 were generally overcounted (with the exception of adults aged 85 and older).

iii This report focuses on differential undercounts related to race and origin and briefly discusses differential undercounts by age and geography. While the bureau also publishes coverage estimates by sex, geography, and household tenure, this report does not discuss these estimates. For an in-depth discussion, see O’Hare, William P., Differential Undercounts in the U.S. Census, 14 February 2019. <https://link.springer.com/content/pdf/10.1007%2F978-3-030-10973-8.pdf>

**Figure 8. Young Children Are Significantly Undercounted In the Census**

Percent Net Undercount Rates, by Age, from DA, 2010



**Note:** The coverage measurements excludes counts of persons living in group quarters and person in remote Alaska. Negative net coverage rates indicate a net undercount.

**Source:** Georgetown Center on Poverty & Inequality, 2020. O'Hare, William P. "Census Coverage Differentials by Age," in *Differential Undercounts in the U.S. Census*. Springer, 14 February 2019. Available at [https://link.springer.com/chapter/10.1007/978-3-030-10973-8\\_5](https://link.springer.com/chapter/10.1007/978-3-030-10973-8_5).

Generally, groups who show a high net undercount in the DA data also show high net undercounts in the DSE data, with the exception of young children. The 2010 net undercount rates from DA and from DSE illustrate this (see Figure 9). DA results show an estimated 4.6 percent net undercount for ages 0 to 4 while DSE shows a 0.7 percent undercount for this age group. There is a similar discrepancy in the results for the population ages 5 to 9, but the difference is not as large. The difference is attributed to correlation bias in the DSE method.<sup>116</sup> There are discrepancies between DSE and DA estimates for other groups which are statistically significant. However, those discrepancies are not as large as those seen for young children. This suggests that other than for young children, the two methods produce relatively consistent results.

### FIGURE 9. DA & DSE Results Are Fairly Consistent for Age Groups Other Than Young Children

Comparison of DA & DSE Coverage Measurements, By Age & Sex Groups, 2010

AGE AND SEX	DA	DSE	DIFFERENCE (DA-DSE)
All ages	-0.1	0	-0.1
0 to 9	3.4	0.2	3.2*
0 to 4	4.6	0.7	3.9*
5 to 9	2.2	-0.3	2.5*
10 to 17	-0.5	-1	0.5*
Males: 18 to 29	-0.4	1.2	-1.6*
Females: 18 to 29	-1.5	-0.3	-1.2*
Males: 30 to 49	2.3	3.6	-1.3*
Females: 30 to 49	-1.7	-0.4	-1.3*
Males: 50 and older	-0.5	-0.3	-0.1
Females: 50 and older	-2.4	-2.4	0.1

**Note:** Negative numbers indicate a net overcount. The asterisk indicates statistically significant difference between DA and DSE estimates at the 0.10 level. People residing in group quarters and in remote Alaska are considered to be out-of-scope for purposes of coverage evaluation.

**Source:** Georgetown Center on Poverty & Inequality, 2020. O'Hare et al. "Comparing the U.S. Decennial Census Coverage Estimates for Children from Demographic Analysis and Coverage Measurement Surveys." *Population Research and Policy Review* 35: 685-704, May 2016. Available at <https://link.springer.com/article/10.1007/s11113-016-9397-x/tables/1>.



## 4. Anticipating the Likely Quality of Census Data Using Process Indicators

**D**A and DSE provide measures of census accuracy, but the omissions, net undercounts, and differential undercount estimates they provide will not be available for the 2020 Census until late 2020 and 2021, respectively, at the earliest. Census process indicators, however, are available on a timelier basis and can sometimes provide early evidence about problems in the data collection process that might compromise the accuracy of the census.

The Census Bureau has used many process indicators to assess the efficiency, cost, and quality of census operations over the years. These include the following:

- Self-response rates
- Nonresponse Followup (NRFU) rates
- Whole-person imputation rates
- Item imputation rates
- Percent of cases sent for coverage improvement (CI)
- Percent of cases sent for CI where respondents were reached
- Percent of cases that were included in the census erroneously
- Percent of cases (people and households) that were from Administrative Records

While there is no consensus on which process measures provide the best assessment of overall accuracy, self-response rates are one the most widely used and readily available process measures.

## Self-Response Rates & Census Accuracy

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Self-response rates typically refer to the percentage of households who have responded to the decennial census before the Nonresponse Followup (NRFU) operation begins. For the 2020 Census, the bureau has provided self-response rates on a regular basis to the public and these rates are available at the national level down to the census tract level (a geographic unit of about 4,000 people).<sup>117</sup>

The real-time census response rates can act as an early warning system of potential risks and challenges, providing opportunities for the bureau and census stakeholders to react before it is too late. This is because strong correlations exist between self-response rates and the likely accuracy of a census.<sup>118, 119, 120</sup> If, for example, real-time data show a certain area lagging significantly more than expected in their self-response rates, Get-Out-the-Count (GOTC) organizations could use this information to target their outreach strategies and resources to that area. The bureau has also utilized self-response rates from past censuses to develop a Low Response Score (LRS), which is the agency's primary metric for identifying which geographic areas are likely to be difficult to enumerate.<sup>121</sup>

## 2020 Census Self-Response Rates in Context

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As of September 30, 2020, the 2020 Census self-response rate was 66.6 percent. The self-response for the 2020 Census has surpassed the rate for the 2010 Census (66.5 percent). Based on a historical trend of declining public participation in government surveys and census, the bureau had projected a final self-response rate of 60.5 percent for the 2020 Census. The notably higher than expected self-response rate is—in part—due to the extended self-response operation which was initially scheduled to end on July 31, 2020.<sup>122</sup>

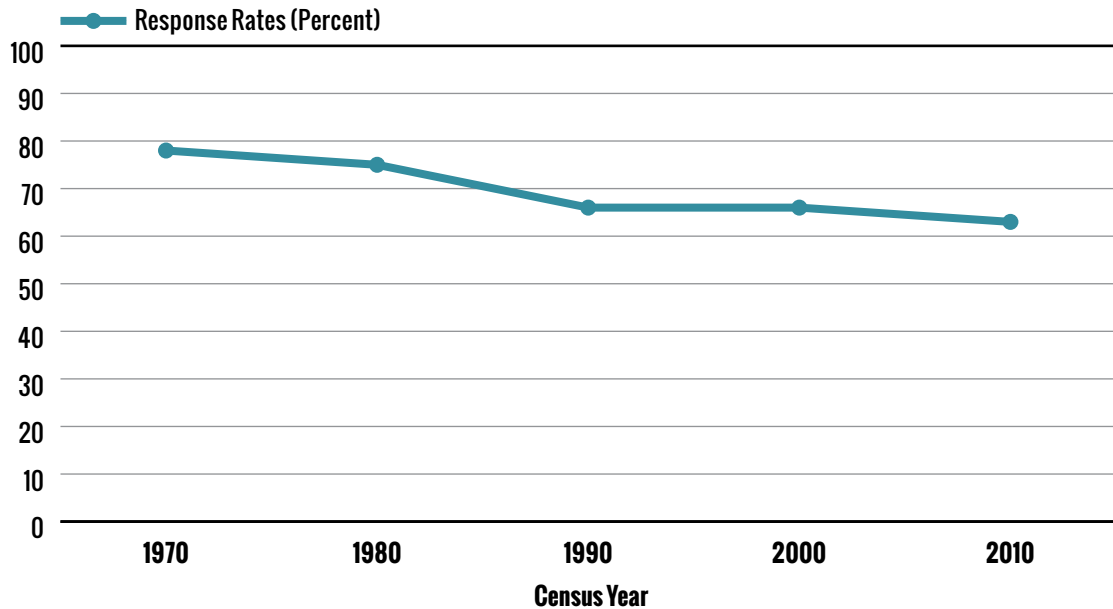
While the overall 2020 Census self-response rate has surpassed the predicted final self-response rate, there is significant variation by geography and social, economic, and cultural characteristics. Analysis by the Center of Urban Research at the City University of New York shows that areas with higher self-response rates tend to have fewer people in poverty, fewer people of color, and fewer people with limited English proficiency and who are foreign-born.<sup>123</sup>

Overall, geographic areas identified as Hard-to-Count in the 2010 Census appear to have lower self-response rates in the 2020 Census than those not identified as what the Census Bureau calls “Hard-to-Count areas.”<sup>124</sup> These differences can be observed at the state level. As of September 30, 2020, the state with the highest self-response rate (that is, Minnesota) had a rate of 74.9 percent while the state with the lowest self-response rate (that is, Alaska) had a rate of 54.3 percent.<sup>125</sup> Significant differences in self-response rates exist within states.

Figure 10, below, shows the self-response rates to the decennial census from 1970 to 2010 at the point in the census-taking process when the Census Bureau calculated the NRFU workload. Self-response rates to the decennial census have steadily declined over the decades.

**FIGURE 10. Census Response Rates Have Declined Over Time**

Census Mail Response Rates, 1970 to 2010



**Note:** Prior to the 2020 Census, the bureau used mail response rates as a measure of self-response rates. The mail response rates in this figure are the rates calculated at the point in the census-taking process when the Census Bureau calculated the Nonresponse Followup workload. They are not the final mail response rates for each census.

**Source:** “2020 Census: Further Actions Needed to Reduce Key Risks to a Successful Enumeration.” U.S. Government Accountability Office, GAO-19-431T, 30 April 2019. Figure 1. Available at <https://www.gao.gov/assets/700/698794.pdf>.

From 1970 to 2010, virtually all households received a paper census form in the mail. As a result, the bureau historically used two self-response rates: return rates and response rates. The Mail Return Rate is only calculated on occupied housing units, but the Mail Response Rate is calculated on all housing units—occupied or not. The final Mail Return Rate in the 2010 Census was 79.3 percent and the Mail Response Rate in the 2010 Census was 66.5 percent as of September 7, 2010.<sup>126</sup> As the internet self-response portal is the primary method for self-response for the 2020 Census, the Mail Return Rate and Mail Response Rate are no longer used.



## Conclusion

**T**he 2020 Census faces extraordinary challenges that impact its fairness and accuracy. Even prior to the COVID-19 pandemic, researchers at the Urban Institute estimated that the 2020 Census could be less accurate than the 2010 Census and characterized by higher net undercounts.<sup>127</sup> The pandemic has increased the risk for undercounts as measures to stem the spread have disrupted and delayed in-person operations designed to help enumerate communities which have been historically undercounted, such as people experiencing homelessness. The pandemic has also disrupted outreach activities stakeholders had planned to help support a fair and accurate census.

The **2020 CENSUS** could be **LESS ACCURATE** than the 2010 Census & characterized by **HIGHER NET UNDERCOUNTS**

As states have begun to loosen physical distancing requirements, critical in-person operations have resumed on a state-by-state basis. DSE may provide a better understanding of the extent to which the bureau's phased approach of resuming field operations may have affected the accuracy of the census of one area relative to another. However, delayed PES in-person interviews could increase the risk for recall bias.

Given these and other challenges, being prepared to measure the quality of data produced in the 2020 Census is critical. Making that assessment is not straightforward or simple. The information and context provided in this paper can prepare stakeholders for that task and provide a foundation for more detailed and in-depth analysis as data from the 2020 Census become available.

# Endnotes

- 1 Jarmin, Ron. "Counting Everyone Once, Only Once and in the Right Place." U.S. Census Bureau, 5 November 2018. Available at [https://www.census.gov/newsroom/blogs/director/2018/11/counting\\_everyoneon.html](https://www.census.gov/newsroom/blogs/director/2018/11/counting_everyoneon.html)
- 2 Khan, Sophie, and Casey Goldvale. "Hard to Count Communities in the 2020 Census." Georgetown Law Center on Poverty & Inequality: Economic Security and Opportunity Initiative, 2018. Available at <https://www.georgetownpoverty.org/issues/democracy/census-2/hard-to-count/>.
- 3 Elliot, Diana, and Charmaine Runes. "An Underfunded 2020 Census Puts an Accurate Count at Risk." 18 March 2019. Urban Institute. Available at <https://www.urban.org/urban-wire/underfunded-2020-census-puts-accurate-count-risk>.
- 4 "2020 Census Operational Adjustments Due to COVID-19." US Census Bureau, 16 June 2020. Available at <https://2020census.gov/content/dam/2020census/materials/news/2020-census%20operational-adjustments-long%20version.pdf>.
- 5 Karpman, Michael, Stephen Zuckerman, and Dulce Gonzalez. "On Eve of 2020 Census, Many People in Hard-to-Count Groups Remain Concerned about Participating." Urban Institute, 20 February 2020. Available at <https://www.urban.org/research/publication/eve-2020-census-many-people-hard-count-groups-remain-concerned-about-participating>.
- 6 Lo Wang, Hansi. "Trump Sued Over Attempt To Omit Unauthorized Immigrants From A Key Census Count, 24 July 2020. Available at <https://www.npr.org/2020/07/24/894322040/trump-sued-for-attempt-to-omit-unauthorized-immigrants-from-a-key-census-count>.
- 7 Citro, Constance. "The 2020 Census: Counting Under Adversity." Issues in Science and Technology, 6 April 2020. Available at <https://issues.org/the-2020-census-counting-under-adversity/>.
- 8 "Principles and Recommendations for Population and Housing Censuses, Revision 3." United Nations, 2017. Available at [https://unstats.un.org/unsd/demographic-social/Standards-and-Methods/files/Principles\\_and\\_Recommendations/Population-and-Housing-Censuses/Series\\_M67rev3-E.pdf](https://unstats.un.org/unsd/demographic-social/Standards-and-Methods/files/Principles_and_Recommendations/Population-and-Housing-Censuses/Series_M67rev3-E.pdf).
- 9 Siegel, Jacob, and David Swanson. The Methods and Materials of Demographic, 2nd Edition. London: Elsevier Academic Press, 2004.
- 10 Hogan, Howard, et al. "Quality of the 2010 Census." *Population Research and Public Policy*, 32(5): 637-662, October 2013. Available at <https://link.springer.com/article/10.1007/s11113-013-9278-5#Sec4>
- 11 de Vries, Willem. "Dimensions of Statistical Quality: A Discussion Note." United Nations Statistics Division, 22 August 2002. Available at <https://unstats.un.org/unsd/accsub/2002docs/sa-02-6add1.pdf>.
- 12 "Principles and Recommendations for Population and Housing Censuses, Revision 3." United Nations Statistics Division, 2017. Available at [https://unstats.un.org/unsd/demographic-social/Standards-and-Methods/files/Principles\\_and\\_Recommendations/Population-and-Housing-Censuses/Series\\_M67rev3-E.pdf](https://unstats.un.org/unsd/demographic-social/Standards-and-Methods/files/Principles_and_Recommendations/Population-and-Housing-Censuses/Series_M67rev3-E.pdf).
- 13 de Vries. "Dimensions of Statistical Quality: A Discussion Note." 2002.
- 14 O'Hare, William P. "Who Is Missing? Undercounts and Omissions in the U.S. Census." *Differential Undercounts in the U.S. Census*, 14 February 2019. Available at [https://link.springer.com/chapter/10.1007/978-3-030-10973-8\\_1](https://link.springer.com/chapter/10.1007/978-3-030-10973-8_1).
- 15 "Principles and Recommendations for Population and Housing Censuses, Revision 3." United Nations, 2017.
- 16 "Census Bureau Statement on Coronavirus and the 2020 Census." US Census Bureau, 11 March 2020. Available at <https://www.census.gov/newsroom/press-releases/2020/statement-coronavirus.html>.
- 17 O'Hare, William P. "Potential Explanations for Why People Are Missed in the U.S. Census." *Differential Undercounts in the U.S. Census*, 2019. Available at [https://link.springer.com/chapter/10.1007/978-3-030-10973-8\\_13](https://link.springer.com/chapter/10.1007/978-3-030-10973-8_13).
- 18 U.S. Census Bureau. "Investigating the 2010 Undercount of Young Children — A New Look at 2010 Census Omissions by Age." 26 July 2016. Available at <https://www2.census.gov/programs-surveys/decennial/2020/program-management/memo-series/2020-report-2010-undercount-children-omissions.pdf>.
- 19 O'Hare. "Potential Explanations for Why People Are Missed in the U.S. Census." 2019.
- 20 Keller, Andrew. "Imputation Research for the 2020 Census." U.S. Census Bureau, 2016. Available at <https://www.census.gov/content/dam/Census/library/working-papers/2015/dec/DSSD-WP2015-03.pdf>.
- 21 O'Hare. "Who Is Missing? Undercounts and Omissions in the U.S. Census." 2019.
- 22 "2010 Census Coverage Measurement Estimation Report: Summary of Estimates of Coverage for Persons in the United States DSSD 2010 Census Coverage Measurement Memorandum Series #2010-G-01." U.S. Census Bureau, May 2012. Available at [https://www.census.gov/coverage\\_measurement/pdfs/g01.pdf](https://www.census.gov/coverage_measurement/pdfs/g01.pdf)
- 23 "Investigating the 2010 Undercount of Young Children – A New Look at 2010 Census Omissions by Age." U.S. Census Bureau. 2016.
- 24 Ibid.
- 25 Ibid.
- 26 Census Bureau. "DSSD 2010 Census Coverage Measurement Memorandum Series #2010-G-01." 22 May 2012. Available at <https://www2.census.gov/programs-surveys/decennial/2010/technical-documentation/methodology/g-series/g01.pdf>.
- 27 O'Hare. "Who Is Missing? Undercounts and Omissions in the U.S. Census." 2019.
- 28 Ibid.
- 29 Ibid.
- 30 Groves, Robert . "Quality in a Census, Some Overview Thoughts." Census Director Blog, U.S. Census Bureau, 9 September 2010. Available at <https://www.census.gov/newsroom/blogs/director/2010/09/quality-in-a-census-some-overview-thoughts.html>.
- 31 O'Hare. "Who Is Missing? Undercounts and Omissions in the U.S. Census." 2019.
- 32 Groves. "Quality in a Census, Some Overview Thoughts." 2010.
- 33 "2010 Census Coverage Measurement Estimation Report: Summary of Estimates of Coverage for Persons in the United States DSSD 2010 Census Coverage Measurement Memorandum Series #2010-G-01." U.S. Census Bureau. 2012.
- 34 O'Hare. "Who Is Missing? Undercounts and Omissions in the U.S. Census." 2019.
- 35 National Research Council. "Research and Plans for Coverage Measurement in the 2010 Census: Interim Assessment." 2007. Available at <https://www.nap.edu/catalog/11941/research-and-plans-for-coverage-measurement-in-the-2010-census>.
- 36 Khan, Sophie, and Casey Goldvale. "Hard to Count Communities in the 2020 Census." 2018.
- 37 O'Hare. "Who Is Missing? Undercounts and Omissions in the U.S. Census." 2019.
- 38 For example, "Investigating the 2010 Undercount of Young Children - A Comparison of Characteristics by Age." U.S. Census Bureau Decennial Statistics Division, 18 January 2017. Available at [https://www2.census.gov/programs-surveys/decennial/2020/program-management/final-analysis-reports/2020-2017\\_02-UndercountofYoungChildrenReport.pdf](https://www2.census.gov/programs-surveys/decennial/2020/program-management/final-analysis-reports/2020-2017_02-UndercountofYoungChildrenReport.pdf).
- 39 O'Hare. "Who Is Missing? Undercounts and Omissions in the U.S. Census." 2019.
- 40 "Census Accuracy and the Undercount: Why It Matters, How it's measured." Funders Census Initiative 2020. Available at <https://funderscommittee.org/wp-content/uploads/2017/01/FCI2020-FactSheet-Census-Accuracy-Undercount-Fall2016.pdf>.

- 41 Ibid.
- 42 Runes, Charmaine. "Following a long history, the 2020 Census risks undercounting the black population." Urban Institute, 26 February 2019. Available <https://www.urban.org/urban-wire/following-long-history-2020-census-risks-undercounting-black-population>.
- 43 Lee, Jae June, and Cara Brumfield. "Differential Privacy in the 2020 Census." Georgetown Center on Poverty and Inequality Economic Security and Opportunity Initiative. Available at November 2019. Available at <https://www.georgetownpoverty.org/wp-content/uploads/2019/11/GCPI-ESOI-Differential-Privacy-in-the-2020-Census-20191107.pdf>.
- 44 Ibid.
- 45 "Innovations in Federal Statistics: Combining Data Sources While Protecting Privacy." National Academies of Sciences, Engineering, and Medicine, 2017. Available at [https://www.ncbi.nlm.nih.gov/books/NBK425875/pdf/Bookshelf\\_NBK425875.pdf](https://www.ncbi.nlm.nih.gov/books/NBK425875/pdf/Bookshelf_NBK425875.pdf).
- 46 boyd, danah. "Balancing Data Utility and Confidentiality in the 2020 US Census: A Living Document." Data & Society, 10 December 2019. Available at [https://datasociety.net/wp-content/uploads/2019/12/DS\\_Differential\\_Privacy\\_L.pdf](https://datasociety.net/wp-content/uploads/2019/12/DS_Differential_Privacy_L.pdf).
- 47 "What is the timeline for finalizing the Disclosure Avoidance System?" Disclosure Avoidance: Latest Frequently Asked Questions, U.S. Census Bureau. Available at <https://ask.census.gov/prweb/PRServletCustom?pyActivity=pyMobileSnapStart&ArticleID=KCP-5888>.
- 48 boyd. "Balancing Data Utility and Confidentiality in the 2020 US Census: A Living Document." 2019.
- 49 "Demographic Analysis." U.S. Census Bureau. Available at <https://www.census.gov/programs-surveys/popest/technical-documentation/research/demographic-analysis.html>.
- 50 O'Hare. "Who Is Missing? Undercounts and Omissions in the U.S. Census." 2019.
- 51 "Coverage Measurement." U.S. Census Bureau. Available at <https://www.census.gov/programs-surveys/decennial-census/about/coverage-measurement.html>.
- 52 O'Hare, William P. "Methodology Used to Measure Census Coverage." Differential Undercounts in the U.S. Census, 2019. Available at [https://doi.org/10.1007/978-3-030-10973-8\\_3](https://doi.org/10.1007/978-3-030-10973-8_3).
- 53 "2020 Census Decision to Change the Name of the Coverage Measurement Survey to the Post-Enumeration Survey." U.S. Census Bureau, 14 September 2017. Available at [https://www2.census.gov/programs-surveys/decennial/2020/program-management/memo-series/2020-memo-2017\\_17.pdf](https://www2.census.gov/programs-surveys/decennial/2020/program-management/memo-series/2020-memo-2017_17.pdf).
- 54 Robinson, J. Gregory. "Accuracy and Coverage Evaluation: Demographic Analysis Results." DSSD Census 2000 Procedures and Operations Memorandum Series B-4, 2 March 2001. Available at <https://www.census.gov/dmd/www/pdf/Fr4.pdf>.
- 55 Passel, Jeffrey S. "Demographic Analysis: An Evaluation." Section 4 in U.S. Census Monitoring Board, Presidential Members. Final Report to Congress. Washington, D.C., September 2001. Available at [https://govinfo.library.unt.edu/cmb/cmbp/reports/final\\_report/default.asp.htm](https://govinfo.library.unt.edu/cmb/cmbp/reports/final_report/default.asp.htm); <https://www.census.gov/dmd/www/pdf/Fr4.pdf>.
- 56 "Demographic Analysis." U.S. Census Bureau.
- 57 Robinson, J. Gregory. "The Coverage of Population in Census 2000 Base on Demographic Analysis: The History Behind the Numbers." U.S. Census Bureau Population Division, 8 January 2010. Available at <https://www.census.gov/content/dam/Census/library/working-papers/2011/demo/POP-twps0091.pdf>.
- 58 Ibid.
- 59 O'Hare. "Methodology Used to Measure Census Coverage." 2019.
- 60 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 online at <http://www.census.gov/srd/papers/pdf/ssm2014-03.pdf>.
- 61 Mayol-Garcia, Yerris, and J. Gregory Robinson. "Census 2010 counts compared to the 2010 population estimates by demographic characteristics." October 2011 Southern Demographic Association Conference, Tallahassee FL.
- 62 Arjun L. Adlakha, 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 online at <https://www.census.gov/content/dam/Census/library/working-papers/2003/dec/o-20.pdf>.
- 63 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, 26-28 April 2018, Denver, Co. Available at <https://paa.confex.com/paa/2018/meetingapp.cgi/Paper/21374>.
- 64 O'Hare. "Historical Examination of Net Coverage Error for Children in the U.S. Decennial Census: 1950 to 2010." 2014.
- 65 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>.
- 66 Perez, Anthony Daniel, and Charles Hirschman. "The Changing Racial and Ethnic Composition of the US Population: Emerging American Identities." Population and development review, 35(1): 1-51, 9 June 2010. Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2882688/>.
- 67 Devine, Jason, et al. "The Development and Sensitivity Analysis of the 2010 Demographic Analysis Estimates." U.S. Census Bureau, February 2012. Available at <https://www.census.gov/content/dam/Census/library/working-papers/2012/demo/POP-twps0093.pdf>.
- 68 Ibid.
- 69 Census Bureau. "Modified Race Data." revised 8 February 2017. Available at <https://www.census.gov/programs-surveys/popest/technical-documentation/research/modified-race-data.html>.
- 70 U.S. Census Bureau. "2010 Census Data Product Descriptions." Revised 19 June 2013. Available at [https://www.census.gov/2010census/news/pdf/data\\_products\\_2010\\_census2.pdf](https://www.census.gov/2010census/news/pdf/data_products_2010_census2.pdf).
- 71 "Demographic Analysis." U.S. Census Bureau.
- 72 Jensen, Eric. "The 2020 Demographic Analysis Program." Powerpoint presented at the September 2019 Scientific Advisory Committee Meeting. Available at <https://www2.census.gov/cac/sac/meetings/2019-09/2020-demographic-analysis-program.pdf?#>.
- 73 "2020 Census Detailed Operational Plan for: 30. Evaluations and Experiments Operation." U.S. Census Bureau, 23 September 2019. Available at <https://www.census.gov/programs-surveys/decennial-census/2020-census/planning-management/planning-docs/EAE-detailed-op-plan.html>.
- 74 Ibid.
- 75 "Demographic Analysis." U.S. Census Bureau.
- 76 O'Hare. "Methodology Used to Measure Census Coverage." 2019.
- 77 "2020 Census Operational Plan, Version 3.0." U.S. Census Bureau, September 2017. Available at <https://www2.census.gov/programs-surveys/decennial/2020/program-management/planning-docs/2020-oper-plan3.pdf>.
- 78 Ibid.
- 79 O'Hare. "Methodology Used to Measure Census Coverage." 2019.
- 80 Ibid.
- 81 "2020 Census Detailed Operational Plan for Post-Enumeration Survey (PES) Operations – Including : 27. CMDE, 28. CMM, and 29. CMFO." U.S. Census Bureau, 16 April 2020. Available at <https://www2.census.gov/programs-surveys/decennial/2020/program-management/planning-docs/PES-detailed-operational-plan.pdf>.
- 82 O'Hare. "Who Is Missing? Undercounts and Omissions in the U.S. Census." 2019.
- 83 Ibid.
- 84 O'Hare. "Methodology Used to Measure Census Coverage." 2019.
- 85 "2010 Census Coverage Measurement Estimation Report: Net Coverage for the Household Population in the United States." U.S. Census Bureau, May 2012. Available at [https://www.census.gov/coverage\\_measurement/pdfs/q03.pdf](https://www.census.gov/coverage_measurement/pdfs/q03.pdf).

- 86 Martin, Elizabeth. "Strength of Attachment: Survey Coverage of People with Tenuous Ties to Residences." *Demography*, 44(2): 437-440, May 2007. Available at <https://link.springer.com/article/10.1353/dem.2007.0014>.
- 87 Linse, Kyra, et al. "The 2010 Census Coverage Measurement Recall Bias Study." U.S. Census Bureau, Decennial Statistical Studies Division, 27 August 2012. Available at <https://www2.census.gov/programs-surveys/decennial/2010/program-management/5-review/cpex/2010-cpex-232.pdf>.
- 88 "2020 Census: Recent Decision to Compress Census Timeframes Poses Additional Risk to an Accurate Count." U.S. Government Accountability Office, August 2020. Available at <https://www.gao.gov/assets/710/709015.pdf>.
- 89 O'Hare. "Methodology Used to Measure Census Coverage." 2019.
- 90 Ibid.
- 91 Ibid.
- 92 Ibid.
- 93 Ibid.
- 94 Ibid.
- 95 O'Hare. "Potential Explanations for Why People Are Missed in the U.S. Census." 2019.
- 96 O'Hare. "Methodology Used to Measure Census Coverage." 2019.
- 97 Ibid.
- 98 Watcher, Kenneth W. and David A. Freedman. "The Fifth Cell: Correlation Bias in the U.S. Census Adjustment." Technical Report Number 570. Department of Statistics, University of California, Berkeley, December 1999. Available at <https://statistics.berkeley.edu/sites/default/files/tech-reports/570.pdf>.
- 99 O'Hare. "Methodology Used to Measure Census Coverage." 2019.
- 100 Martin. "Strength of Attachment: Survey Coverage of People with Tenuous Ties to Residences." 2007.
- 101 Watcher and Freedman. "The Fifth Cell: Correlation Bias in the U.S. Census Adjustment." 1999.
- 102 Shores, Roger. "Accuracy and Coverage Evaluation Revision II Adjustment for Correlation Bias, U.S. Bureau of Census, December 2002.
- 103 Shores, Roger and Robert Sands. "Correlation Bias Estimation in the Accuracy and Coverage Evaluation Revision II." U.S. Census Bureau, 2003. Available at <http://www.asasrms.org/Proceedings/y2003/Files/JSM2003-000815.pdf>.
- 104 "2010 Census Coverage Measurement Estimation Report: Net Coverage for the Household Population in the United States." U.S. Census Bureau. 2012.
- 105 Deaver, Karen. "Intended Administrative Data Use in the 2020 Census." U.S. Census Bureau, 8 April 2019. Available at <https://www2.census.gov/programs-surveys/decennial/2020/program-management/planning-docs/administrative-data-use-2020-census.pdf>.
- 106 Rastogi, Sonya and Amy O'Hara. "2010 Match Study." U.S. Census Bureau, 16 November 2012. Available at [https://www.census.gov/content/dam/Census/library/publications/2012/dec/2010\\_cpex\\_247.pdf](https://www.census.gov/content/dam/Census/library/publications/2012/dec/2010_cpex_247.pdf).
- 107 O'Hare, William P. "What Do We Know About the Presence of Young Children in Administrative Records." Proceedings of the Federal Conference on Statistical Methodology, December 2015. Available at [https://nces.ed.gov/FCSM/pdf/G1\\_OHare\\_2015FCSM.pdf](https://nces.ed.gov/FCSM/pdf/G1_OHare_2015FCSM.pdf).
- 108 Fernandez, Leticia, Rachel Shattuck, and James Noon. "The Use of Administrative Records and the American Community Survey to Study the Characteristics of Undercounted Young Children in the 2010 Census." Center for Administrative Records Research and Applications, CARRA Working Paper Series, 25 May 2018. Available at <https://www.census.gov/library/working-papers/2018/adrm/carra-wp-2018-05.html>.
- 109 Ibid.
- 110 "Measuring America: The Decennial Censuses From 1790 to 2000." U.S. Census Bureau, September 2002. Available at [https://www2.census.gov/library/publications/2002/dec/pol\\_02-ma.pdf](https://www2.census.gov/library/publications/2002/dec/pol_02-ma.pdf).
- 111 "2020 Census Operational Plan, Version 4.0." U.S. Census Bureau, December 2018. Available at <https://www.census.gov/programs-surveys/decennial-census/2020-census/planning-management/planning-docs/operational-plan.html>.
- 112 Groves. "Quality in a Census, Some Overview Thoughts." 2010.
- 113 O'Hare. "Historical Examination of Net Coverage Error for Children in the U.S. Decennial Census: 1950 to 2010." 2014.
- 114 O'Hare. "Who Is Missing? Undercounts and Omissions in the U.S. Census." 2019.
- 115 Blank, Rebecca. "Statement by Deputy U.S. Commerce Secretary Rebecca Blank on Release of the Data Measuring Census Accuracy," U.S. Department of Commerce, 22 May 2012. Available at <https://2010-2014.commerce.gov/news/press-releases/2012/05/22/statement-deputy-us-commerce-secretary-rebecca-blank-release-data-mea.html>.
- 116 O'Hare, William P., et al. "Comparing the U.S. Decennial Census Coverage Estimates for Children from the Demographic Analysis and Coverage Measurement Surveys." *Population Research and Policy Review*, 35(5): 685-704. Available at [https://www.researchgate.net/publication/303505526\\_Comparing\\_the\\_US\\_Decennial\\_Census\\_Coverage\\_Estimates\\_for\\_Children\\_from\\_Demographic\\_Analysis\\_and\\_Coverage\\_Measurement\\_Surveys](https://www.researchgate.net/publication/303505526_Comparing_the_US_Decennial_Census_Coverage_Estimates_for_Children_from_Demographic_Analysis_and_Coverage_Measurement_Surveys).
- 117 "Glossary: Census Tract." U.S. Census Bureau. Available at [https://www.census.gov/programs-surveys/geography/about/glossary.html#par\\_textimage\\_13](https://www.census.gov/programs-surveys/geography/about/glossary.html#par_textimage_13).
- 118 "2010 Census Coverage Measurement Estimation Report: Summary of Estimates of Coverage for Persons in the United States DSSD 2010 Census Coverage Measurement Memorandum Series #2010-G-01." U.S. Census Bureau. 2012.
- 119 O'Hare, William P. Expert Witness report, in STATE OF NEW YORK et al. v. UNITED STATES DEPARTMENT OF COMMERCE, et al., 2018.
- 120 O'Hare, William P. Expert Witness report, in LA UNION DEL PUEBLO, ET.AL. V. ROSS, ET AL. Case no. 18-cv-011570, 2019.
- 121 Kephart, Kathleen. "Identifying Hard-to-Survey Populations Using Low Response Scores by Census Tract." U.S. Census Bureau, 14 May 2016. Available at <https://www.census.gov/newsroom/blogs/research-matters/2016/05/identifying-hard-to-survey-populations-using-low-response-scores-by-census-tract.html>.
- 122 "2020 Census: COVID-19 Presents Delays and Risks to Census Count." U.S. Government Accountability Office, GAO-20-551R, June 2020. Available at <https://www.gao.gov/assets/710/707456.pdf>.
- 123 Romalewski, Steven, and Terri Ann Lowenthal. "2020 CENSUS: Weeks 8 & 9: Self-Response Analysis Summary." CUNY Center for Urban Research, 21 May 2020. [https://www.gc.cuny.edu/CUNY\\_GC/media/CUNY-Graduate-Center/PDF/Centers/Center%20for%20Urban%20Research/Resources/Weeks-8-9-Self-Response-Analysis-Summary-05-22-20.pdf](https://www.gc.cuny.edu/CUNY_GC/media/CUNY-Graduate-Center/PDF/Centers/Center%20for%20Urban%20Research/Resources/Weeks-8-9-Self-Response-Analysis-Summary-05-22-20.pdf).
- 124 "Census Self-Response Rates Mapped and Analyzed: 2000, 2010, and (soon) 2020." CUNY Center for Urban Research, 16 March 2020. Available at [https://www.gc.cuny.edu/Page-Elements/Academics-Research-Centers-Initiatives/Centers-and-Institutes/Center-for-Urban-Research/CUR-research-initiatives/Census-Self-Response-Rates-Mapped-and-Analyzed-2000-2010-and-\(soon\)-2020](https://www.gc.cuny.edu/Page-Elements/Academics-Research-Centers-Initiatives/Centers-and-Institutes/Center-for-Urban-Research/CUR-research-initiatives/Census-Self-Response-Rates-Mapped-and-Analyzed-2000-2010-and-(soon)-2020).
- 125 "2020 Census Housing Unit Enumeration Progress by State." US Census Bureau, 1 October 2020. Available at <https://2020census.gov/content/dam/2020census/news/daily-nrfu-rates/nrfu-rates-report-10-01.pdf>.
- 126 Letourneau, Earl. "Mail Response/Return Rates Assessment." U.S. Census Bureau, 30 May. 2012. Available at [https://www.census.gov/content/dam/Census/library/publications/2012/dec/2010\\_cpex\\_198.pdf](https://www.census.gov/content/dam/Census/library/publications/2012/dec/2010_cpex_198.pdf).
- 127 Elliott, Diana, et al. "Assessing Miscounts in the 2020 Census." Urban Institute, 2019. Available at [https://www.urban.org/sites/default/files/publication/100324/assessing\\_miscounts\\_in\\_the\\_2020\\_census.pdf](https://www.urban.org/sites/default/files/publication/100324/assessing_miscounts_in_the_2020_census.pdf).

