

11. MEASURES OF NONSAMPLING ERROR

All survey estimates are subject to both sampling and nonsampling error. In the section on “Understanding Error and Determining Statistical Significance,” the topic of sampling error and the various measures available for understanding the uncertainty in the estimates due to their being based on estimates derived from a sample, rather than from an entire population, are discussed. The margins of error published with American Community Survey (ACS) estimates measure only the effect of sampling error. Other errors that affect the overall accuracy of the survey estimates may occur in the course of collecting and processing the ACS and are referred to collectively as nonsampling errors.

Broadly speaking, nonsampling error refers to any error affecting a survey estimate outside of sampling error. Nonsampling error can occur in complete censuses as well as in sample surveys, and is commonly recognized as including coverage error, unit nonresponse, item nonresponse, response error, and processing error. The U.S. Census Bureau has many procedures in place designed to reduce these sources of nonsampling error and thus improve the quality of the data. More information about these procedures is available in the section on “Improving Data Quality by Reducing Nonsampling Error” on the Census Bureau’s Design and Methodology Report Web page.⁷³

Types of Nonsampling Error

Nonsampling error can result in both random errors and systematic errors. Of greatest concern are systematic errors. Random errors are less critical since they tend to cancel out at higher geographic levels in large samples such as the ACS.

On the other hand, systematic errors tend to accumulate over the entire sample. For example, if there is an error in the questionnaire design that negatively affects the accurate capture of respondents’ answers, processing errors are created. Systematic errors often lead to a bias in the final results. Unlike sampling error and random error resulting from nonsampling error, bias caused by systematic errors cannot be reduced by increasing the sample size.

Coverage error occurs when a housing unit or person does not have a chance of selection in the sample (undercoverage), or when a housing unit or person has more than one chance of selection in the sample or is included in the sample when they should not have been (overcoverage). For example, if the frame used

for the ACS did not allow the selection of newly-constructed housing units; the estimates would suffer from errors because of housing undercoverage.

The final ACS estimates are adjusted for undercoverage and overcoverage by controlling county-level estimates to independent total housing unit controls and to independent population controls by sex, age, race, and Hispanic origin, produced by the Census Bureau’s Population Estimates Program. However, it is important to measure the extent of coverage adjustment by comparing the precontrolled ACS estimates to the final controlled estimates. If the extent of coverage adjustments is large, there is a greater chance that differences in characteristics of undercovered or overcovered housing units or individuals differ from those eligible to be selected. When this occurs, the ACS may not provide an accurate picture of the population before the coverage adjustment, and the population controls may not eliminate or minimize that coverage error. For more information about coverage error visit the Census Bureau’s Coverage Rates Definitions Web page.⁷⁴

However, the process of controlling ACS estimates to the official population estimates may lead to additional errors in the ACS data. The population controls used in the ACS are midyear, point-in-time population estimates based on the decennial census, which has different residence rules than the monthly samples on which ACS estimates are based. See the section on “Residence Rules and Reference Periods” for more information.

Unit nonresponse is the failure to obtain the minimum required information from a housing unit or a resident of group quarters in order for it to be considered a completed interview. Unit nonresponse means that no survey data are available for a particular sampled unit or person. For example, if no one in a sampled housing unit is available during the time frame for data collection, unit nonresponse will result.

It is important to measure unit nonresponse because it has a direct effect on the quality of the data. If the unit nonresponse rate is high, it increases the chance that the final survey estimates may contain bias, even though the ACS estimation methodology includes a nonresponse adjustment intended to control potential unit nonresponse bias. This will happen if the characteristics of nonresponding units differ from the characteristics of responding units. For more information

⁷³ U.S. Census Bureau, “Chapter 15: Improving Data Coverage by Reducing Non-Sampling Error,” American Community Survey Design and Methodology Report, 2014, <www.census.gov/programs-surveys/acs/methodology/design-and-methodology.html>.

⁷⁴ U.S. Census Bureau, American Community Survey (ACS), Coverage Rate Definitions, <www.census.gov/programs-surveys/acs/methodology/sample-size-and-data-quality/coverage-rates-definitions.html>.

about unit nonresponse, visit the Census Bureau's *Response Rates Definitions* Web page.⁷⁵

Item nonresponse occurs when a respondent fails to provide an answer to a required item or when the answer given is inconsistent with other information. With item nonresponse, while some responses to the survey questionnaire for the unit are provided, responses to other questions are not obtained. For example, a respondent may be unwilling to respond to a question about income, resulting in item nonresponse for that question. Another reason for item nonresponse may be a lack of understanding of a particular question by a respondent.

Information on item nonresponse allows users to judge the completeness of the data on which the survey estimates are based. Final estimates can be adversely impacted when item nonresponse is high, because bias can be introduced if the actual characteristics of the people who do not respond to a question differ from those people who do respond to it. The ACS estimation methodology includes imputations for item nonresponse, intended to reduce the potential for item nonresponse bias. For more information about item nonresponse, visit the Census Bureau's *Item Allocation Rates Definitions* Web page.⁷⁶

Response error occurs when data are reported or recorded incorrectly. Response errors may be due to the respondent, the interviewer, the questionnaire, or the survey process itself. For example, if an interviewer conducting a telephone interview incorrectly records a respondent's answer, response error results. In the same way, if the respondent fails to provide a correct response to a question, response error results. Another potential source of response error is a survey process that allows proxy responses to be obtained, wherein a knowledgeable person within the household provides responses for another person within the household who is unavailable for the interview. Even more error prone is allowing neighbors to respond.

Processing error can occur during the preparation of the final data files. For example, errors may occur if data entry of questionnaire information is incomplete or inaccurate. Coding of responses incorrectly also results in processing error. Critical reviews of edits and tabulations by subject matter experts are conducted to keep errors of this kind to a minimum.

⁷⁵ U.S. Census Bureau, American Community Survey (ACS), *Response Rate Definitions*, <www.census.gov/programs-surveys/acs/methodology/sample-size-and-data-quality/response-rates-definitions.html>.

⁷⁶ U.S. Census Bureau, American Community Survey (ACS), *Item Allocation Rates Definitions*, <www.census.gov/programs-surveys/acs/methodology/sample-size-and-data-quality/item-allocation-rates-definitions.html>.

ACS Quality Measures

Nonsampling error is extremely difficult, if not impossible, to measure directly. However, the Census Bureau has developed a number of indirect measures of nonsampling error to help inform users of the quality of the ACS estimates: sample size, coverage rates, unit response rates and nonresponse rates by reason, and item allocation rates. These measures are available on the Census Bureau's *Sample Size and Data Quality* Web page.⁷⁷

Sample size measures for the ACS summarize information for the housing unit and group quarters (GQ) samples. The measures available at the state level are:⁷⁸

- Housing Units
 - Number of initial addresses selected.
 - Number of final survey interviews.
- Group Quarters People (beginning with the 2006 ACS)
 - Number of initial persons selected.
 - Number of final survey interviews.

Sample size measures may be useful in special circumstances when determining whether to use 1-year or 5-year estimates in conjunction with estimates of the population of interest. While the coefficient of variation (CV) can be used to determine usability, as explained in the section on "Understanding Error and Determining Statistical Significance," there may be some situations where the CV is small but the user has reason to believe the sample size for a subgroup is very small and the robustness of the estimate is in question.

Coverage rates measure the ratio of ACS population or housing estimates of geographic areas or groups to the independent estimates for those areas or groups, multiplied by 100. National coverage rates are available for the total population by six race/ethnicity categories and the GQ population. Coverage rates are also available for housing units and total population by sex at both the state and national level. Low coverage rates are an indication of greater potential for coverage error in the estimates.

Unit response and nonresponse rates for housing units are available at the county, state, and national

⁷⁷ U.S. Census Bureau, American Community Survey, *Sample Size and Data Quality*, <www.census.gov/acs/www/methodology/sample-size-and-data-quality/>.

⁷⁸ The sample size measures for housing units (number of initial addresses selected and number of final survey interviews) and for persons in group quarters cannot be used to calculate response rates. For the housing unit sample, the number of initial addresses selected includes addresses that were determined not to identify housing units, as well as initial addresses that are subsequently subsampled out in preparation for personal visit Nonresponse Followup. Similarly, the initial sample of people in group quarters represents the expected sample size within selected group quarters prior to visiting and sampling of residents.

level by reason for nonresponse: refusal, unable to locate, no one home, temporarily absent, language problem, insufficient data, maximum contact attempts reached, and other.

A low unit response rate is an indication that there is potential for bias in the survey estimates.

Missing data for a particular question or item is called **item nonresponse**. **Item allocation** involves the use of statistical procedures to impute the values for these missing data. **Item allocation rates**—the proportions of responses allocated for an item in a given geographic area—are determined by the content edits performed on the individual raw responses and closely correspond to item nonresponse rates. Overall housing unit and person characteristic allocation rates are available at the state and national levels, which combine many different characteristics. Allocation rates for individual items are published at the state and national levels. Allocation rates for other summary levels may be calculated from the B99 series of Detailed Tables in data.census.gov.

Item allocation rates differ by state, so data users are advised to examine the allocation rates for characteristics of interest before drawing conclusions from the published estimates.

Additional Background Information

Sample Size and Data Quality

www.census.gov/acs/www/methodology/sample-size-and-data-quality/

The quality measures provided on this Web page illustrate the steps the Census Bureau takes to ensure that ACS data are accurate and reliable.

Design and Methodology Report

www.census.gov/programs-surveys/acs/methodology/design-and-methodology.html

The 2014 Design and Methodology Report contains descriptions of the basic design of the ACS and details of the full set of methods and procedures.