Meeting 21st Century Demographic Data Needs—Implementing the American Community Survey

Issued June 2004

Report 7: Comparing Quality Measures: The American Community Survey's Three-Year Averages and Census 2000's Long Form Sample Estimates

USCENSUSBUREAU
Helping You Make Informed Decisions

U.S. Department of Commerce
Economics and Statistics Administration
U.S. CENSUS BUREAU

United States Census 2010

ACKNOWLEDGEMENTS

This report was prepared by **Katie M. Bench**.

Members of the American Community Survey Research and Evaluation Steering Committee who sponsored and reviewed this report include: **Preston J. Waite, Chair**, **William R. Bell**, **Cynthia Z.F. Clark**, **Robert E. Fay, III**, **Nancy M. Gordon**, **Deborah H. Griffin**, **David L. Hubble**, **Ruth Ann Killion**, **John F. Long**, **Elizabeth A. Martin**, **Lawrence S. McGinn**, **Rajendra P. Singh**, **Carol M. Van Horn**, **Daniel H. Weinberg**, and **Tommy Wright**.

Other individuals who contributed to the review and release of this report include: **Gregg J. Diffendal, Michael D. Starsinic, Alfredo Navarro, Susan P. Love, Douglas W. Hillmer, Mark E. Asiala, Nicholas M. Spanos, Donald H. Keathley, Margaret Gill, James B. Treat, Mary Folsom Untch, Andre L. Williams,** and **Rita Jo Petroni**.

Kim D. Ottenstein and **Everett L. Dove** of the Administrative and Customer Services Division, **Walter C. Odom**, Chief, provided publications and printing management, graphics design and composition, and editorial review for print and electronic media. General direction and production management were provided by **James R. Clark**, Assistant Division Chief, and **Susan L. Rappa**, Chief, Publications Services Branch.

Meeting 21st Century Demographic Data Needs—Implementing the American Community Survey

Issued June 2004

Report 7: Comparing Quality Measures: The American Community Survey's Three-Year Averages and Census 2000's Long Form Sample Estimates

U.S. Department of Commerce
Donald L. Evans,
Secretary

Vacant,
Deputy Secretary

Economics and Statistics Administration
Kathleen B. Cooper,
Under Secretary
for Economic Affairs

U.S. CENSUS BUREAU
Charles Louis Kincannon,
Director

SUGGESTED CITATION

U.S. Census Bureau,

Meeting 21st Century Demographic Data Needs—Implementing the American Community Survey

Report 7: Comparing Quality Measures: The American Community Survey's Three-Year Averages and Census 2000's Long Form Sample Estimates

Washington, DC, 2004

ECONOMICS AND STATISTICS ADMINISTRATION

Economics and Statistics Administration

Kathleen B. Cooper,
Under Secretary
for Economic Affairs

U.S. CENSUS BUREAU

Charles Louis Kincannon,
Director

Hermann Habermann,
Deputy Director and Chief Operating Officer

Preston J. Waite,
Associate Director for Decennial Census

Cynthia Z.F. Clark,
Associate Director for Methodology and Standards

CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The Census Bureau initiated the American Community Survey (ACS) development program in 1994 to develop and test the feasibility of producing long form data on a yearly basis, instead of once a decade. In 2001, the Census Bureau initiated the ACS Research and Evaluation Program to answer questions about the usability and reliability of the ACS estimates. This report is an evaluation from that program. The report compares selected quality measures for the 1999 – 2001 ACS three-year average estimates to selected quality measures for the Census 2000 long form estimates.

The ACS data reviewed in this report were collected from 1999 to 2001 in 36 counties across the United States. The 36 counties are not a random sample of counties; they were selected for the ACS demonstration project to represent different types of areas, containing large cities, medium cities, and rural counties. While the estimates examined in this report are three-year average estimates, they are roughly equivalent in terms of their sampling error to the five-year estimates that the ACS will produce when the survey is fully implemented. In order to simulate the sampling error for a five-year average, a greater percentage of the individuals living in these counties in 1999-2001 were included in each year's sample than will be included when the ACS moves to full implementation. The quality measures examined in this report, therefore, may approximate the quality measures for the five-year averages that can be expected using the fully implemented sample size.

We compared the following quality measures:

- Self-Response Rates
- Total Housing Unit Nonresponse Rates
- Occupied Housing Unit Nonresponse Rates
- Summary Item Allocation Rates
- Housing Unit Sample Completeness Rates
- Household Population Sample Completeness Rates

The decennial census and the ACS are very different in methodology, scope, timing, and visibility. The main emphasis of the decennial census is to enumerate the U.S. population and housing; the collection of long form data is secondary. The ACS, in contrast, is designed to collect long form data only. The difference in the purpose of the two operations may be a major reason for the differences we found between the quality measures for the ACS and the Census 2000 long form sample.

This report focuses on how the ACS performed compared to Census 2000 with respect to nonsampling error. Report(s) that analyze and compare ACS and census sampling errors are forthcoming.

Census 2000 long form sample households were more likely to mail back their questionnaires than ACS households (page 11). Self-response rates were higher in the census than in ACS. This means that the proportion of census sample households that mailed back their long form questionnaire is higher than the proportion of ACS households mailing back their ACS questionnaires. This finding is reasonable considering the high visibility and large advertising campaign of Census 2000.

Overall, ACS households were more likely to respond in the ACS than in the Census 2000 long form sample (page 17). The ACS had lower total housing unit and occupied housing unit nonresponse rates than the census sample in a majority of the counties and tracts. This result implies that response rates for nonself-responding households in ACS follow-up operations were higher than those in census follow-up operations. This is not surprising, since the ACS has a more rigorous follow-up campaign than the census has. Additionally, the ACS uses a staff of permanent professional interviewers while the census uses temporary enumerators. The higher census nonresponse rates might mean larger nonresponse errors in census long form sample estimates.

Questionnaires for ACS housing units *(except vacant housing units)* were more likely to contain higher proportions of completed items than did long form questionnaires for Census 2000 sample housing units (page 25). Summary item allocation rates were lower in the ACS *(except for vacant housing units)* than in the census sample. The major contributor to this result is that the ACS is more thorough in collecting data in its nonresponse followup operations than was the census for the long form sample. This result indicates more potential for nonresponse errors in estimates from the census long form sample.

The census and ACS vacant housing unit summary item allocation rates were not directly comparable – because of this, it was not possible to reach definite conclusions regarding vacant housing unit summary item allocation rate comparisons (page 25). The census summary rates reflect only a subset of its long form sample vacant housing unit records (questionnaires), those with two or more completed items. In contrast, the ACS summary rates reflect all of its vacant housing unit questionnaires, including those with zero completed items.

Comparisons of these rates resulted in Census 2000 having higher proportions of completed items on its vacant housing unit long form sample questionnaires than did the questionnaires for ACS vacant housing units. One factor leading to this result is the comparability issue noted above. Another factor leading to this result was that the ACS computer-assisted instrument consistently omitted the *business on property* question during interviews for vacant housing units – this led to an artificially high allocation rate for this item. Without these two factors, the result for vacant housing unit summary item allocation rates would have more closely resembled the result for total and occupied housing units.

Undercoverage was present in both the ACS and Census 2000 long form sample for both housing units and household population; there was more undercoverage of housing units in the Census 2000 sample than in the ACS (page 36). Sample completeness rates measure how well a survey's estimates of household and population totals represent their corresponding household and population universe counts, respectively. Rates greater than 100 indicate over-estimation (overcoverage) of the universe totals; rates less than 100 indicate under-estimation (undercoverage). A rate of 100 indicates that a survey total equals its corresponding universe total. The universe totals for both ACS and the census sample were the Census 2000 100-percent household and population counts. The ACS exhibited housing unit sample completeness rates somewhat closer to 100 than did Census 2000. However, the household population sample completeness rates for both surveys were nearly even. All of the sample completeness rates indicated undercoverage in both the ACS and Census 2000 sample.

These quality measures suggest that the ACS multi-year averages are at least as good as the estimates from the long form. When we also consider the enhanced timeliness of information from the ACS, the superiority of reengineering the 2010 Census over retaining traditional methods is clear. In addition, while further study is needed, it appears that the permanent, on-going nature of the ACS program contributes to lower ACS nonresponse rates, and hence less chance for nonresponse error and bias in the estimates.

1. INTRODUCTION AND BACKGROUND

To reduce the operational complexity of the decennial census and increase the currency of detailed population and housing data, the U.S. Census Bureau has implemented the 2010 Census re-engineering strategy. The American Community Survey (ACS) is one of three program components required to achieve the 2010 Census re-engineering strategic goals. The ACS collects long form data throughout the decade, instead of all at once in the decennial census.

The proposal to replace the census long form sample with the ACS requires an examination of the operational feasibility of the ACS as well as the reliability and usability of ACS data. To help answer these questions, the Census Bureau has conducted and continues to conduct research. In 1994, the Census Bureau began to develop the methods for providing long form-type data each year. Two programs were implemented to develop these methods: the Continuous Measurement program and the Census 2000 Supplementary Survey (C2SS). The Continuous Measurement program began to collect long form data in 1996 in four sites, and has since expanded to 36 counties. The C2SS was conducted as part of Census 2000 to demonstrate the operational feasibility of collecting long form data at the national level at the same time as, but independently from, Census 2000 (Bureau of the Census, 2001). These and other ACS research programs have demonstrated the operational feasibility of the ACS and the reliability of ACS data. Research objectives have continued more recently through the implementation of an ACS Research and Evaluation Program. As part of this research objective, we produced this report to help data users understand how the quality of the 1999 – 2001 ACS three-year average data compares to the Census 2000 long form sample data. These three years were chosen to center the estimate in the census year.

This report compares quality measures for the ACS three-year averages with those for the Census 2000 long form sample for the 36 counties in the Continuous Measurement Program (see Appendix A) and their associated tracts (except for the tracts associated with Fort Bend County, Texas and Harris County, Texas). These counties are not a random sample of counties in the country, but were chosen to represent different types of areas: differing county population sizes, different racial or ethnic groups, highly seasonal populations, migrant workers, American Indian reservations, improving or worsening economic conditions, and various predominant occupations or industry types (Bureau of the Census, ACS Operational Plan, 2003).

1.1 Census 2000 Long Form Sample

Census 2000 collected data using two basic types of questionnaires - the short form, containing the “100 percent” items asked of the entire population, and the long form, containing the “100 percent” items as well as a myriad of detailed housing unit, household, and population items known as sample items. The “100 percent” items were relationship, sex, age, Hispanic origin, race, and tenure for occupied housing units, and vacancy status for vacant housing units. A national average of about one-in six housing units were expected to be enumerated on the long form and make up the Census 2000 sample; the other five-sixths of the addresses were to be enumerated on the short form.

Variable sampling rates were used across the nation in the Census 2000 long form sample. This was done to provide relatively more reliable estimates for small areas and decrease respondent burden in more densely populated areas while maintaining data reliability. There were four different housing unit sampling rates, which varied by census block: 1-in-8, 1-in-6, 1-in-4, and 1-in-2. These rates were assigned based on precensus estimates of the number of occupied housing units in various geographic and statistical entities, such as incorporated places and interim census tracts (Bureau of the Census, Summary File 3 Technical Documentation, 2003).

This comparison project is based on characteristic distributions as estimated by the Census 2000 sample, and additionally on information reflecting overall response to the Census 2000 long form questionnaire. Not all housing units enumerated on long form questionnaires are eligible to be members of the Census 2000 sample. To be eligible for inclusion, long form response records had to meet a set of criteria identifying them as 'sample data defined.' The occupied housing unit or household long form records had to contain at least one person who was both "100 percent" data defined and sample data defined. To satisfy these criteria a person record had to have answers to at least two of the "100 percent" population items and two of the sample population items. No answers to any housing items were required of occupied long form housing units to be considered census sample-eligible. For vacant long form housing units to be placed in the Census 2000 sample they had to have answers to at least two sample housing items.

In addition to estimates based on housing units and the household population, the Census 2000 sample also included data from the group quarters population. These records were removed from the sample for this analysis.

To enumerate the U.S. population, the U.S. Census Bureau distributed and collected forms using three basic methods: mailout/mailback, update/leave, and list/enumerate. These are referred to as Type of Enumeration Areas (TEAs). For mailout/mailback TEAs, questionnaires were delivered to housing units with city style addresses (house number and street name) via the U.S. Postal Service. The householder then completed the questionnaire and returned it via mail. For update/leave TEAs, enumerators left census questionnaires at housing units for the householder to complete and mailback. This occurred in areas with predominantly noncity style addresses. For list/enumerate TEAs, enumerators visited the housing units, listed their addresses, and completed the form while there. This occurred in remote or sparsely populated areas (Bureau of the Census, 2000).

In conjunction with the three basic enumeration methods, a variety of operations were used to collect the "100 percent" and sample items. The Census 2000 long forms were mailed in March 2000 along with the short forms; Nonresponse Followup began in late April 2000, and lasted about nine weeks. During this operation, housing units that had not returned a form by mail were visited multiple times to secure a response. If no response could be obtained from the residents, enumerators obtained as much information as possible from neighbors or other household members – a method known as proxy interviewing. After Nonresponse Followup, the Census Bureau conducted Coverage Improvement Followup and Coverage Edit Followup. Coverage Improvement Followup visited vacant housing units and newly discovered addresses. Coverage Edit Followup identified and resolved count discrepancies. Discrepancies occurred if the number of persons reported for a household did not match the number of persons for whom census information was provided on the form. The Coverage Edit Followup should not be confused with a content edit to followup and obtain answers for blank items on a questionnaire. There was no attempt to followup on items left blank on questionnaires returned by mail (Bureau of the Census, 2001; Bureau of the Census, 2000).

1.2 American Community Survey Three-year Averages

The American Community Survey (ACS) is designed to both collect long form-type data throughout the decade and to release ACS results every year. This is done with continuous, monthly samples, where each sample has a three-month collection cycle. Each collection cycle consists of three phases. In phase 1, questionnaires are mailed to sample housing units; this includes a second mailing of questionnaires to housing units that did not respond to the initial mailing by a certain date[1]. Phase 2 uses computer-assisted telephone interviewing to follow up housing units that did not respond in phase 1 and for whom telephone numbers have been obtained by vendors. Finally, phase 3 of the cycle uses computer-assisted personal interviewing to follow up a one-third subsample of housing units that did not respond in either phase 1 or 2 (Bureau of Census, 2001).

Forms that are returned by mail are processed at the Census Bureau National Processing Center in Jeffersonville, Indiana. The forms returned by mail go through a check-in process, are keyed to capture the data, and then go through an automated review to identify missing but required information and coverage inconsistencies. Mail response records that fail this edit and for which there is a telephone number are contacted during Telephone Edit Followup; this is to obtain answers for missing and inconsistent information as well as to collect the required data for members of households for whom there was no room on the questionnaire (Bureau of the Census, ACS Operational Plan, 2003).

The ACS samples were selected using variable sampling rates, which generally paralleled Census 2000. These variable sampling rates provide relatively more reliable estimates for small areas. For the 1999, 2000, and 2001 ACS, most of the 36 counties were sampled at an annual rate of five percent. The exceptions were the larger counties. Specifically, for Fort Bend and Harris Counties, Texas, the overall housing unit sampling rate was one percent. For Broward County, Florida; Bronx County, New York; Lake County, Illinois; San Francisco County, California; and Franklin County, Ohio, the overall housing unit sampling rate was three percent. The sampling rate within the county varied by the size of the governmental unit in which the housing unit was located (Bureau of the Census, March 2003).

ACS sampling rates paralleled the Census 2000 sampling rates but were not the same - the two operations should have used the same sampling rates. There were two reasons for this. First, the ACS used total housing unit counts to determine sampling rates;

[1] In 1999, 2000, and 2001, ACS mailed questionnaires (applied phase 1) to all geographic areas; this includes areas that Census 2000 enumerated using update/leave and list/enumerate procedures

Census 2000 used estimates of occupied housing units (which was based on 1990 block vacancy rates). This was a source for different differential sampling rates between the ACS and Census 2000 in all 36 counties. Second, Census 2000 used minor civil divisions (MCD) in areas with MCDs to determine the size of governmental units. This was an additional source of different differential sampling rates between the ACS and Census 2000 in areas with MCDs. The result of this difference was that ACS had smaller samples than it should have had in rural areas with high vacancy rates.

The one percent sampling rate in Fort Bend and Harris Counties, Texas yielded small sample sizes at the tract level. Tract estimates based on these small sample sizes are not representative of the five-year averages that will be produced at full ACS implementation levels. The standard errors based on the one percent sampling rate are much larger than the five-year average standard errors will be, and therefore, are not representative of the ACS.

The ACS uses an "Acceptability Index" (AI) to determine whether a housing unit provided enough data to be considered successfully interviewed. The AI index is computed by adding the number of basic items (age, data of birth, Hispanic origin, marital status, race, relationship, and sex) with answers and then dividing this sum by the number of household members. Households with AIs of less that 2.5 are treated as survey noninterviews. Vacant housing units are not subject to this AI requirement.

1.3 Errors in the Data

The ACS and Census 2000 data used for this comparison are based on samples and are therefore subject to errors. There are two main types of errors: sampling error and nonsampling error. This report focuses on how the ACS did compared to Census 2000 with respect to nonsampling error. Report(s) that analyze and compare ACS and census sampling errors are forthcoming.

Nonsampling error is human and processing error that may be introduced during any of the various complex operations used to collect and process data. These errors can be introduced during editing, reviewing, keying, or interviewing operations, and can include: failing to obtain all required information from the respondents, obtaining incorrect or inconsistent information, and recording information incorrectly. Nonsampling error can affect the data in two ways. First, errors that are introduced randomly will increase the variability of the data, which should be reflected in the standard errors. Second, errors that tend to be consistent in one direction will introduce a bias into the survey estimates in that direction (Bureau of the Census, Summary File 3 Technical Documentation, 2003).

The quality measures compared in this analysis help indicate the presence of potential errors and bias. The main error the quality measures deal with is nonresponse bias. Nonresponse to particular questions on a questionnaire or failure to obtain any information for a housing unit allows for the introduction of bias into the data because the characteristics of the nonrespondents have not been observed and may differ from those characteristics reported by respondents. As a result, any imputation or weighting procedure using respondent data may not completely reflect these differences at either the person or housing unit level or on average (Bureau of the Census, Summary File 3 Technical Documentation, 2003).

This report also deals with coverage error. Coverage error consists of undercoverage and overcoverage, both of which can introduce bias into survey estimates. Undercoverage introduces bias when groups of people or housing units with specific characteristics are excluded from a survey's estimates. Overcoverage introduces bias when people or housing units with certain characteristics are included more than once in the computation of a survey's estimates. The sample completeness rates indicate to what extent the ACS and Census 2000 samples represent their corresponding universe populations.

We would have liked to do more to estimate the levels of nonsampling error and bias in the ACS and Census 2000 long form sample estimates. For example, a comparison of ACS or Census 2000 sample data to independent data sources (e.g., administrative record data collected from independent collection operations) might have indicated whether either operation had systematic biases in its estimates. We were limited to the data shown in this report, however.

We compare ACS and Census 2000 estimates (rates) in this report using standard errors. Standard errors are measures of sampling error. Sampling error is the deviation of a sample estimate from the average of estimates from all possible samples. The sample estimates may differ from the figures that would be obtained from interviewing the entire population using the same questionnaires, instructions, and interviewers. The sample estimates will also differ from other samples of the population (Bureau of the Census, Summary File 3 Technical Documentation, 2003).

The standard error of a sample estimate is a measure of the variation among the estimates from all possible samples. It measures the precision with which an estimate from a particular sample approximates the average result of all possible samples (Bureau of the Census, Summary File 3 Technical Documentation, 2003).

2. METHODOLOGY

We computed the quality measures listed below for the 36 counties and their associated tracts (except for the tracts associated with Fort Bend County, Texas and Harris County, Texas). Quality measures are indicators of potential error and bias. We then compared the ACS three-year average quality measures and the Census 2000 sample quality measures for both the counties and the tracts. Section 2.1 describes how we compared the ACS three-year average and Census 2000 sample quality measures. Section 2.2 describes the methods we used to calculate their standard errors. The quality measures are described in detail in section 3.

- Self-Response Rate
- Total Housing Unit Nonrespone Rate
- Occupied Housing Unit Nonresponse Rate
- Summary Item Allocation Rate

- Housing Unit Sample Completeness Rate (county level only)
- Household Population Sample Completeness Rate (county level only)

2.1 Comparisons of the Quality Measures

Since the ACS and Census 2000 sample quality measures are both based on sample data, we expect them to differ. However, we wanted to know if the estimates differ because of sampling error (sampling variability) or nonsampling error. To determine this, we calculated the difference between the two quality measures, and the standard error of this difference. We then used the standard error to determine if the difference was due to sampling error. The difference between the quality measures is the ACS three-year average estimate minus the Census 2000 sample estimate.

If the difference is caused by something other than sampling variability, we refer to the difference as being statistically significant. To determine if the difference between quality measures was statistically significant, we calculated a z-score by dividing the difference by its standard error. We then determined the probability that the computed z-score would yield a value as extreme or more extreme than the value computed if the ACS and Census 2000 sample quality measures were truly equal. We call this probability the p-value, and compare it against some pre-specified level of confidence or alpha value. If the p-value is less than the alpha value, the difference is deemed to be statistically significant because we are not confident that the difference was due to sampling error. If the p-value is greater than the alpha value, the difference is deemed to not be statistically significant because we are confident that it is due to sampling error.

The Census Bureau uses a standard alpha value of 0.10 for determining statistical significance. We need to test for statistical significance because our estimates are based on samples and not the entire population. When we test a tract/county level difference for significance using a 0.10 alpha value, the chance of finding that difference to be statistically significant would be 0.10. However, we tested a large number of tracts/counties, and needed to incorporate a multiplicity allowance to allocate the significance level equally among all the tracts/counties. To do this, we used the Bonferroni multiple comparison procedure to adjust the overall alpha value ($alpha_N$) to a value ($alpha_R$) where the chance of finding one or more significant differences by chance alone, among all the tracts/counties is 0.10. The Bonferoni multiple comparison procedure adjusts $alpha_N$ for multiple comparisons by dividing it by the number of comparisons (m). So, in the Bonferoni equation $alpha_R=alpha_N/m$. For this analysis $alpha_N$ is set to 0.10, and m is set to the number of counties for the county level quality measure comparisons, and the number of tracts for the tract level quality measure comparisons.

For the tract level quality measure comparison, we split the tracts into five different groups, and calculated a separate $alpha_R$ value for each group. So, m is set equal to the number of tracts in the tract group. The tract groups are defined based on county and tract population sizes. Grouping the tracts according to population size helped us see if there were statistically significant differences in nonresponse and coverage between tracts of different population size, and made it easier to graphically display significant tract differences. In addition, we excluded tracts with a population less than 500 from the analysis because the estimates would be based on a small amount of data. The five tract groups are defined as follows.

- Group 1 - tracts in small counties (under 100,000 persons) and tract population greater than 500 (207 tracts)
- Group 2 - tracts in medium counties (100,000 - 1,000,000 persons) and tract population between 500 and 4000 (592 tracts)
- Group 3 - tracts in medium counties (100,000 - 1,000,000 persons) and tract population greater than 4000 (580 tracts)
- Group 4 - tracts in large counties (1,000,000+ persons) and tract population between 500 and 4000 (401 tracts)
- Group 5 - tracts in large counties (1,000,000+ persons) and tract population greater than 4000 (470 tracts)

In addition to testing the difference between the ACS three-year average and Census 2000 sample quality measure for each county/tract for statistical significance, we also tested the differences between the average quality measures for statistical significance. That is, we tested the differences between the averages of the county/tract ACS three-year average quality measures and the averages of the county/tract Census 2000 sample quality measures. We tested the differences between the average quality measures using the margin of error. The margin of error plus or minus the value for an estimator is the confidence interval for the estimator. The margin of error is calculated by multiplying the standard error of the difference by the critical z-score value. The critical z-score is the z-score yielded when the resulting p-value is equal to the alpha value. Any z-scores equal to or greater than the critical z-score value are deemed statistically significant. We used a 90-percent confidence interval in our comparisons; this translates into using an alpha value of 0.10. The critical z-score for an $alpha_N$ value of 0.10 is 1.645. So, the margin of errors shown in the tables of this report are equal to 1.645 times the standard error of the difference. Note, since we were only testing the one difference, we did not adjust for multiplicity. Once the margin of error is determined, a confidence interval can be computed. The upper limit of the confidence interval is the difference plus the margin of error. The lower limit of the confidence interval is the difference minus the margin of error. If this interval contains zero, the difference is not statistically significantly different. So, if the margin of error is greater than the absolute value of the difference, the confidence interval will contain zero and the difference will not be statistically significant. If the margin of error is not greater than the absolute value of the difference, the confidence interval will not contain zero, and the difference will be statistically significant.

Even though a difference is statistically significant, the difference may be very small. The small difference may be statistically significant as a result of a large sample size and small standard error. So, a very small difference with a small standard error estimated from a large sample size may be statistically significant even though the difference is of no practical importance.

Note: for the remainder of this report, whenever we use the terms “statistically different,” “statistical difference,” etc., we imply that the difference is (or is not) statistically *significant* at the 90-percent level of confidence.

2.2 Calculation of Standard Errors

The calculation of the standard errors for the Census 2000 sample and ACS three-year averages quality measures are described in this section. Section 2.2.1 describes the calculation of the standard errors of the Census 2000 sample quality measures. They were computed using the Census 2000 published design factors. Section 2.2.2 describes the calculation of the standard errors of the ACS three-year average quality measures. Section 2.2.3 describes the calculation of the standard error of the difference between the ACS three-year average and Census 2000 sample quality measures. For the ACS, the single year estimates were obtained directly via a replication method, and then used to calculate the ACS three-year average standard errors.

2.2.1 Standard Errors for Census 2000 Quality Measures

To estimate standard errors for the Census 2000 quality measures, we applied Census 2000 long form data variance estimation procedures. The standard errors for the Census 2000 self-response rates, housing unit nonresponse rates, and item allocation rates were calculated as described below.

$$SE(\hat{p}) = DF \times \sqrt{\left(\frac{5}{B}\right)\hat{p}(100-\hat{p})}$$

where, B is the base of the percentage or denominator of the rates shown in sections 3.1 through 3.4, and DF is the design factor defined below. For these standard errors, if p was less than 2 percent or greater than 98 percent, then p was set to 2 percent. Also, we set any of the standard errors greater than 70 to 70.

The standard errors for the Census 2000 sample completeness rates were calculated as described below.

$\hat{R}$ = sample completeness rate

$$\hat{R} = \frac{\hat{Y}_1}{\hat{Y}_2} \times 100$$

where $\hat{Y}_2$ is an actual Census 2000 count based on the “100 percent” census enumeration and, therefore, has no standard error; it represents the Census 2000 total housing units for the housing unit sample completeness rate, and the Census 2000 total household population for the household population sample completeness rate. Therefore, $\hat{Y}_2$ was treated as a constant in the sample completeness rate standard errors.

$$SE(\hat{R}) = \left[DF \times \frac{1}{\hat{Y}_2} \sqrt{5\hat{Y}_1 \left(1 - \frac{\hat{Y}_1}{N}\right)} \right] \times 100$$

where N is the size of the publication area or in this case $\hat{Y}_2$, and DF is the design factor.

It should be noted that the formulae for $SE(\hat{p})$ and $SE(\hat{R})$ are derived from the simple random sample variance for a total with a 1-in-6 sampling rate. In addition, the method used to calculate $SE(\hat{R})$ underestimates (overestimates) the standard error if the two items in the rate are negatively (positively) correlated. For more information on the Census 2000 long form variance procedures, see the Summary File 3 Technical Documentation, released in 2003. This can be found on the U.S. Census Bureau web site at http://www.census.gov/prod/cen2000/doc/sf3.pdf .

Design Factors

The design factor used in the Census 2000 long form variance procedure is the ratio of the estimated standard error to the standard error of a simple random sample. This reflects the effects of the actual sample design and the complex ratio estimation procedure used for Census 2000 (Summary File 3 Technical Documentation, 2003). There are published Census 2000 design factors for a wide range of housing unit and population characteristics (Asiala and Haines, 2002). These design factors are available for each state and the United States, and are calculated by the four levels of percent in-sample (observed sampling rate). The characteristics for which design factors are published can be found in the Summary File 3 Technical Documentation. The four levels of percent in sample are:

- Level 1 - less than 15 percent
- Level 2 - 15 percent to less than 25 percent
- Level 3 - 25 percent to less than 35 percent
- Level 4 - 35 percent or more

To calculate the standard errors for the Census 2000 long form quality measures, we first identified the appropriate design factors to use in the equation. The first step was to identify the appropriate percent in-sample level for each of the 36 counties and tracts. The percent in sample for varying geographic levels is available on the Census Bureau web site.

The second step was to select the design factor of the most related housing or population characteristics. There are not directly corresponding published designed factors for all of the quality measures. So, we determined the design factor to use in the standard error calculation by:

- Identifying housing unit/population characteristics with published design factors that correlate to the quality measure.

- Identifying the correlated housing unit/population characteristic with the largest published design factor for each state, and applying this design factor to the quality measure values for the counties and tracts that lie within a state. Using the largest published design factor provided a conservative standard error estimate.

Appendix B contains a list of the quality measures and the housing or population characteristic group whose design factor we used to calculate the standard errors of the quality measures. The national and state design factors can be found in chapter 8 of the Summary File 3 Technical Documentation.

2.2.2 Standard Errors for ACS Quality Measures

For the ACS quality measures, the single year quality measures and standard errors were computed first. That is, the 1999, 2000, and 2001 quality measures with their associated standard errors were computed separately first. Then they were combined to produce the three-year average quality measure and standard error. The standard errors for the single year quality measures were obtained directly via a replication method. The standard errors (SE) for the three-year average quality measures were then computed as follows (Bench, 2003).

Let $Rate_{Year} = \frac{N_{Year}}{D_{Year}} \times 100$, where N stands for numerator and D stands for denominator.

Year = 1999, 2000, or 2001

$N_{3yr} = N_{1999} + N_{2000} + N_{2001}$ and $D_{3yr} = D_{1999} + D_{2000} + D_{2001}$

$$Ratio_{3yr} = \frac{N_{3yr}}{D_{3yr}}, \qquad Rate_{3yr} = \frac{N_{3yr}}{D_{3yr}} \times 100$$

$$\left(SE\left(N_{3yr}\right)\right)^2 = \left(SE\left(N_{1999}\right)\right)^2 + \left(SE\left(N_{2000}\right)\right)^2 + \left(SE\left(N_{2001}\right)\right)^2$$

$$\left(SE\left(D_{3yr}\right)\right)^2 = \left(SE\left(D_{1999}\right)\right)^2 + \left(SE\left(D_{2000}\right)\right)^2 + \left(SE\left(D_{2001}\right)\right)^2$$

$$SE\left(Rate_{3yr}\right) = \left[\frac{1}{D_{3yr}} \sqrt{\left(SE\left(N_{3yr}\right)\right)^2 + \left(Ratio_{3yr}\right)^2 \times \left(SE\left(D_{3yr}\right)\right)^2} \right] \times 100$$

If the standard error of N_{Year} or D_{Year} was calculated as zero using the replication method, we used the approximation below to obtain their standard errors. This would happen if $N_{Year}=0$ or $D_{Year}=0$, and sometimes for nonzero estimates.

Note that the equations for $\left(SE\left(N_{3yr}\right)\right)^2$ and $\left(SE\left(D_{3yr}\right)\right)^2$ do not contain covariance terms – we assumed that any covariance terms would be negligible. The ACS sampling rates in 1999, 2000, and 2001 were small enough so that we could make this assumption.

$$\left(SE\left(D_{Year}\right)\right)^2 = 400 \times AvgWeight_{County}$$

where the average weight is the maximum of the average person and average household final weights for observations in the county for that year.

When any of the single year estimates have been approximated this way, the standard error of the three-year average rate can be quite large.

If the value calculated for $SE(Rate_{3yr})$ was greater than 70, the standard error of the three-year average rate was set to 70. If $D_{3yr} = 0$, meaning there were no observations in the denominator for any of the three years, the standard error for the three year average rate was set to missing.

2.2.3 Standard Errors for the Differences between the ACS and Census 2000 Quality Measures

The standard errors for the differences between the ACS and census quality measures were calculated as follows.

$$SE\left(difference\right) = \sqrt{SE\left(Rate_{ACS3yr}\right)^2 + SE\left(Rate_{Census}\right)^2}$$

where difference = $Rate_{ACS3yr}$ - $Rate_{Census}$

It should be noted that the standard error of the difference does not take into account the covariance between the ACS quality measure and the census quality measure. The effect of not including a covariance term was that we underestimated[2] the values for $SE\left(difference\right)$. This means that some of the rate differences that we found to be statistically significant might not have been so had we used a covariance term in the $SE\left(difference\right)$ equation.

[2] There is a small chance that we overestimated some of the values for $SE\left(difference\right)$, but that would have required a positive correlation between the census and ACS rates – we assumed that all such correlations were negative.

3. ANALYSIS/RESULTS

A description of each quality measure and summary of the results of the ACS three-year average and Census 2000 quality measure comparisons is given in this section. Section 3.1 covers the self-response rate. Section 3.2 covers the total housing unit nonresponse rate and the occupied housing unit nonresponse rate. Section 3.3 covers the item allocation rates, and section 3.4 covers the sample completeness rates.

3.1 Self-Response Rate

To help measure the level of public cooperation with the ACS and Census 2000 long form, we calculated comparable self-response rates for each sample. The self-response rate measures the percent of occupied housing units that mailed back their questionnaire. Self-response rates were calculated for 33 ACS counties[3] and for tracts in 33 ACS counties[4]. The county-level comparison results are presented in section 3.1.1, and the tract-level comparison results are presented in section 3.1.2.

The self-response rate formulae are:

- Census 2000 long form self-response rate

$$= \frac{\sum_{o=1}^{O} S_o W_o}{\sum_{o=1}^{O} W_o} \times 100 \qquad (1)$$

where O = number of Census 2000 sample occupied housing units (including those that were not sample data defined – see below) that were enumerated in mailback TEAs[5]

o = Census 2000 sample occupied housing unit o that was enumerated in a mailback TEA (including not sample data-defined)

S_o = self-response occupied housing unit indicator for housing unit o
= 1 if the housing unit is self-response
= 0 if the housing unit is not self-response

W_o = Census 2000 base weight for Census 2000 sample occupied housing unit o

---

[3] Vilas county, Wisconsin, was excluded because it was not part of Census 2000's mailout/mailback enumeration procedure.

[4] Tracts in Fort Bend County and Harris County were excluded because their sampling rates were low compared to the ACS five-year design-level rates; additionally, we excluded tracts with populations of less than 500 persons because of their small sample sizes; we also excluded the Vilas county tracts.

[5] In mailback TEAs, respondents were asked to return their completed census form by mail. This could have been a mailout/mailback TEA where the census form was delivered to the housing units by the United States Postal Service (USPS), or an update/leave TEA where the form was delivered in person by a census enumerator. Enumerators in list/enumerate TEAs conducted address listings as well as assisted persons in completing their census forms.

- ACS self-response rate

$$= \frac{\sum_{o=1}^{O} S_o W_o}{\sum_{o=1}^{O} W_o} \times 100 \qquad (2)$$

where O = number of ACS sample occupied housing units, including occupied housing units with acceptability indexes < 2.5 (non interviews - see section 1.2)
o = ACS sample occupied housing unit o, including noninterviewed occupied units
S_o = self-response occupied housing unit indicator for housing unit o
= 1 if the housing unit is self-response
= 0 if the housing unit is not self-response
W_o = ACS base weight for ACS sample occupied housing unit o

The numerator and denominator of the Census 2000 rate are weighted by the reciprocal of the sampling fraction used to designate long form housing units for the block in which they were enumerated. This weight is equal to 2, 4, 6 or 8. The weighted block level long form housing units are aggregated to the county/tract level, and the rate computed from the weighted county/tract counts (Bureau of the Census, February 2003). Note, the numerator and denominator of this rate also include noninterviews. Noninterviews are housing units that mailed back a questionnaire *but* did not provide enough information to be considered 'sample data defined' - these housing units were not eligible for inclusion in the Census 2000 sample.

The numerator and denominator of the ACS rate are weighted using base weights, which are the initial ACS sampling weights multiplied by the computer-assisted personal interview subsampling weights (Bureau of the Census, March 2003). Note that the numerator includes the base weighted self-response noninterviewed housing units and the denominator includes all base weighted noninterviewed housing units.

3.1.1 County Comparisons

This section contains the county level quality measures comparison results. In this section we compare the ACS three-year average and Census 2000 long form self-response rate differences for each of the 35 counties (minus Vilas county, WI), and then examine the differences when the values are averaged across all the counties.

Table 1 shows the number of counties with statistical differences between ACS three-year average and Census 2000 long form self-response rates. More specifically, it shows three numbers. First, it shows the number of counties whose self-response rates were not statistically different. Second, it shows the number of counties whose self-response rates were statistically different, with the self-response rates for the ACS three-year averages being larger than the Census 2000 long form estimates. Third, it shows the number of counties whose self-response rates were statistically different with the self-response rate for the Census 2000 long form being larger than the ACS three-year estimate.

While Table 1 shows the results of comparing each of the county differences, Table 2 shows the results of comparing the average of the 35 county self-response rates. The second column in Table 2 shows the average of the 35 county ACS three-year average self-response rates. The third column shows the average of the 35 county Census 2000 long form self-response rates. Column four shows the differences between the ACS and census average self-response rates, where the difference is the ACS average minus the census average. Column five contains the margin of error for the difference of the average.

Table 1. Number of Counties with Statistically Different Self-response Rates [C]

Quality Measure	Number of 35 counties where the ACS and census rates were not statistically different	Number of 35 counties where the ACS rates were statistically higher than the census rates (ACS > census)	Number of 35 counties where the census rates were statistically higher than the ACS rates (census > ACS)
Self-response rate	3	0	32

C – Comparisons are based on a non-random sample of counties

Table 2. Comparison of Self-response Rates: ACS Three-year Averages and Census 2000 Long Form Estimates, County Averages

Quality Measure	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Self-response rate	55.3%	68.1%	-12.8%	± 3.6%

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

Table 1 and Table 2 show that the census usually collected a higher percentage of its sample questionnaires (long form) by self-response methods than did the ACS. Table 1 shows that 32 out of the 35 counties had statistically different rates. Moreover, the self-response rate for the Census 2000 long form was higher than the ACS three-year rate in all of these 32 counties. Table A-1 in Appendix A contains the ACS three-year average and Census 2000 long form self-response rates for each of the 36 counties; the counties are sorted, in ascending order, by their 100 percent count of census housing units. The three counties whose differences are not statistically significant are marked with an "NS" in the table (in the Difference column). Table 2 shows, that on average the self-response rate for the Census 2000 long form was 12.8 percentage points larger than the ACS three-year average estimate. Since the margin of error for the difference is 3.6 percent, the resulting confidence interval would not contain zero. So, the average difference is statistically significant.

Figure C-1 in Appendix C displays the county-level self-response rate differences for the 35 counties through the use of a one-dimensional scatter plot. For this plot, differences between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; counties are on the horizontal axis. We sorted counties for Figure C-1 using the same sort that we used for Table A-1 - by their 100 percent count of census housing units. The sort was in ascending order, from left to right. For example, the difference for the county with the smallest count is the left-most point in Figure C-1 – this point corresponds to the first county listed in Table A-1 (county code 29179 – Reynolds County, MO). Similarly, the difference for the county with the largest count is the right-most point – this point corresponds to the last county listed in Table A-1 (county code 48201 – Harris County, TX).

Figure C-1 shows that the self-response rate for the ACS three-year average was consistently lower than the Census 2000 long form estimate. An "X" on this plot indicates a statistical difference.

The higher census long form self-response rates mean that the success of the census depended less on followup operations than did the success of the ACS. This was an expected result – past experience has consistently indicated that the census will produce mail return rates of between 10 to 20 percentage points higher than other similar operations, even decennial tests. Part of this result is a product of the "census environment," e.g., the census is more 'visible' than the ACS. It is also partially a product of how the ACS and Census 2000 collected data via mail. The ACS mailed its questionnaire to all sample households; on the other hand, Census 2000 used update/leave and list/enumerate procedures instead of mail in areas with non-city style address (rural areas). Census 2000 used questionnaires in languages other than English, especially in Spanish, which would have increased self-response rates in linguistically-isolated areas – the ACS used English questionnaires only. Using these two procedures has the effect of increasing census self-response rates over what they would have been had the questionnaires been mailed to housing units in these areas (Love, 2003).

3.1.2 Tract Comparisons

This section contains the self-response rate comparison for tracts. In this section we compared the ACS three-year average and Census 2000 long form self-response rate differences for the tracts in the 33 counties by tract group, and then compared the differences when the values were averaged across all the counties by tract group.

Table 3 shows the number of tracts with statistical differences between the ACS three-year average and Census 2000 long form self-response rates for each of the five tract groups. More specifically, it shows three numbers. First, it shows the number of tracts for each group whose self-response rates were not statistically different. Second, it shows the number of tracts for each group whose self-response rates were statistically different with the self-response rate for the ACS three-year average being larger than the Census 2000 long form estimate. Third, it shows the number of tracts for each group whose self-response rates were statistically different with the self-response rate for the Census 2000 long form being larger than the ACS three-year average estimate.

While Table 3 shows the results of comparing each tract difference, Table 4 shows the results of comparing the average of the tract self-response rates for each group. The third column in Table 4 shows the average of the ACS three-year average tract self-response rates. The fourth column shows the average of the Census 2000 long form tract self-response rates. Column five shows the differences between the ACS and census average self-response rates, where the difference is the ACS average minus the census average. Column six contains the margin of error for the difference of the average.

Table 3. Number of Tracts with Statistically Different Self-response Rates, by Tract Group [C]

Quality Measure	Tract Group [N]	Number of tracts where the ACS and census rates were not statistically different	Number of tract where the ACS rates were statistically higher than the census rates (ACS > census)	Number of tracts where the census rates were statistically higher than the ACS rates (census > ACS)
Self-response rate	1	149	0	42
	2	578	0	11
	3	556	0	23
	4	387	0	14
	5	396	8	66

N – Note, group 1 contains 191 tracts, group 2 contains 589 tracts, group 3 contains 579 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts. See section 2.1 for tract group definitions.

C – Comparisons are based on a non-random sample of counties

Table 4. Comparison of Self-response Rates: ACS Three-year Averages and Census 2000 Long Form Estimates, Tract Group Averages

Quality Measure	Tract Group [N]	ACS Average	Census Average	Difference [D] of Averages	Margin of Error [C]
Self-response rate	1	54.8%	67.6%	-12.8%	± 2.0%
	2	62.8%	69.5%	-6.7%	± 1.2%
	3	60.3%	68.4%	-8.0%	± 1.1%
	4	48.3%	57.6%	-9.3%	± 1.8%
	5	51.5%	60.7%	-9.2%	± 1.5%

N – Note, group 1 contains 191 tracts, group 2 contains 589 tracts, group 3 contains 579 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts. See section 2.1 for tract group definitions.

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

Some tracts in Census 2000 were enumerated using list/enumerate methods only. Census enumerators conducted personal visit interviews for *all* housing units in these tracts, leaving Census 2000 self-response universes of zero. For group 1, 16 tracts were removed from the self-response rate comparisons; for group 2, three tracts were removed, for group 3, one tract was removed. These removals lowered the number of tracts that were eligible for self-response rate comparisons to 191 in group 1, 589 in group 2, and 579 in group 3.

From Table 3, more than 10 percent of the tracts in groups 1 and 5 have statistical differences. For group 1, 22.0 percent (42 out of 191) of the tract differences are statistically significant; for group 2, 1.9 percent (11 out of 589) of the tract differences are statistically significant; for group 3, 4.0 percent (23 out of 579) of the tract differences are statistically significant; for group 4, 3.5 percent (14 out of 401) of the tract differences are statistically significant; for group 5, 15.7 percent (74 out of 470) of the tract differences are statistically significant. The largest percentage of statistical tract differences occurred in small counties (group 1), and the tracts with large populations in counties with large populations (group 5). In addition, for all of the statistical differences for groups 1, 2, 3, or 4, the Census 2000 long form self-response rates were larger than the ACS three-year average rates. For group 5, for 66 out of the 74 statistical differences, the census self-response rate was larger than the ACS self-response rate.

Table 4 shows that, for all five tract groups, the census, on average, received a higher proportion of its mailout/mailback questionnaires (long form) via self-response than did ACS . The average census self-response rate for each tract group is larger than the corresponding average ACS self-response rate. The margin of error for each of the five groups was less than the absolute value of each difference between the averages. So, the difference between the average is statistically different for all five groups.

Figure D-1 in Appendix D displays tract-level self-response rate differences through the use of a one-dimensional scatter plot. We grouped all of the tract-level differences by tract group. For this plot, differences between the ACS three-year average and Census 2000 long form self-response rate are located on the vertical axis; tracts and tract groups are on the horizontal axis. We sorted tracts within each tract group by their 100 percent count of census housing units. The sorts were in ascending order, from left to right, within each tract group. For example, the difference for the tract with the smallest count is the left-most point within each tract group, while the difference for the tract with the largest count is the right-most point within each tract group. We used a "jittering" process so that we could plot the differences in this way. Within each tract group, the "jittering" process assigned a real number to each tract so as to achieve this sort, where tracts with the smallest counts received the smallest real numbers, etc.

Figure D-1 shows that for each tract group, a majority of the ACS three-year average self-response rates are lower than the Census 2000 long form self-response rates. An "X" on these plots indicates a statistical difference.

The results presented in this section concur with the county-level results – see section 3.1.1 for the analysis of the county-level results.

3.2 Nonresponse Rates: Total and Occupied Housing Units

We calculated total and occupied housing unit nonresponse rates with two goals in mind. One was to measure how successful the ACS and Census 2000 were in obtaining interviews and enumerations, respectively, from their sample housing units. The other goal was to get an indication of levels of potential nonresponse error in the final estimates. These rates were calculated for each of the 36 ACS counties, and for tracts in the 34 ACS tract-level comparison counties[6]. The county-level comparison results are presented in section 3.2.1, and the tract-level comparison results are presented in section 3.2.2.

Toal and occupied housing unit nonresponse rates measure the percent of housing units for which we did not obtain enough information for a given housing unit to be considered an interview (we used the acceptability index to determine whether an ACS housing unit was an interview - see section 1.2). Such nonresponse can introduce bias into the sample estimates because the characteristics of noninterviewed housing units and their residents may differ from the characteristics of interviewed housing units and their residents. The ACS and census processes applied different criteria to determine which housing units provided enough information to be considered interviews. Additionally, the two operations treated noninterviews differently during weighting and estimation: the ACS accounts for noninterviewed housing units by applying noninterview factors whereas the census did not use a noninterview adjustment.

The Census 2000 housing unit nonresponse rates are:

- Total housing unit nonresponse rate

$$= \frac{\left(N_{HU} \quad - \quad \sum_{dd=1}^{DD} W_{dd} \right)}{N_{HU}} \times 100 \qquad (3)$$

where N_{HU} = total number of Census 2000 "100-percent" housing units
DD = total number of Census 2000 sample data-defined housing units
dd = Census 2000 sample data-defined housing unit dd
W_{dd} = Census 2000 base weight for sample data-defined housing unit dd

See section 1.1 for a discussion of sample data-defined housing units.

- Occupied housing unit nonresponse rate

$$= \frac{\left(N_{OHU} \quad - \quad \sum_{odd=1}^{ODD} W_{odd} \right)}{N_{OHU}} \times 100 \qquad (4)$$

where N_{OHU} = number of Census 2000 "100-percent" occupied housing units
ODD = number of Census 2000 sample data-defined occupied housing units

[6] We excluded the tracts in Fort Bend County and Harris County – their sampling rates were low compared to the ACS five-year design-level rates; we also excluded tracts with populations of less than 500 persons because of their small sample sizes.

odd = Census 2000 sample data-defined occupied housing unit odd
W_{odd} = Census 2000 base weight for sample data-defined occupied housing unit odd

See section 1.1 for a discussion of sample data-defined housing units.

The ACS housing unit nonresponse rates are:

- Total housing unit nonresponse rate

$$= \frac{\sum_{ni=1}^{NI} W_{ni}}{\left(\sum_{i=1}^{I} W_i + \sum_{ni=1}^{NI} W_{ni} \right)} \times 100 \qquad (5)$$

where NI = total number of ACS non-interviewed housing units (housing units with an acceptability index < 2.5 – see section 1.2)
ni = ACS non-interviewed housing unit ni
I = total number of ACS interviewed housing units (housing units with an acceptability index ≥ 2.5 – see section 1.2; also includes vacant housing units)
i = ACS interviewed housing unit i
W_{ni} = ACS base weight for non-interviewed housing unit ni
W_i = ACS base weight for interviewed housing unit i

- Occupied housing unit nonresponse rate

$$= \frac{\sum_{oni=1}^{ONI} W_{oni}}{\left(\sum_{oi=1}^{OI} W_{oi} + \sum_{oni=1}^{ONI} W_{oni} \right)} \times 100 \qquad (6)$$

where ONI = number of ACS occupied non-interviewed housing units (housing units with an acceptability index < 2.5 – see section 1.2)
oni = ACS occupied non-interviewed housing unit oni
OI = number of ACS occupied interviewed housing units (housing units with an acceptability index ≥ 2.5 – see section 1.2)
oi = ACS occupied interviewed housing unit oi
W_{oni} = ACS base weight for occupied non-interviewed housing unit oni
W_{oi} = ACS base weight for occupied interviewed housing unit oi

The numerator of the census formulae represents the shortage in the Census 2000 sample of housing units. Two factors caused this shortage. One factor is that there were too few enumerations using long form questionnaires; the other factor is that response records for long forms are not always sample data-defined (section 1.1). Therefore, the Census 2000 nonresponse rates are percents of total enumerated housing units. Each long form sample data-defined housing unit is weighted by the reciprocal of the sample fraction used to designate long form housing units for the block in which it was enumerated - this weight is equal to 2, 4, 6, or 8 (Bureau of the Census, February 2003)

The ACS base weights are the initial ACS sampling weights multiplied by the computer-assisted personal interview subsampling weights (Bureau of the Census, March 2003).

3.2.1 County Comparisons

This section contains the nonresponse rate comparisons for total and occupied housing units for counties. In this section we compare the ACS three-year average and Census 2000 housing unit nonresponse rate differences for each of the 36 counties, and then compare the differences when the values were averaged across all the counties.

Table 5 shows the number of counties with statistical differences between the ACS three-year average and Census 2000 total and occupied housing unit nonresponse rates. Table 6 shows the results of comparing the average of the 36 county rates.

Table 5. Number of Counties with Statistically Different Nonresponse Rates for Total and Occupied Housing Units [C]

Quality Measure	Number of 36 Counties where the ACS and census rates were not statistically different	Number of 36 Counties where the ACS rates were statistically higher than the census rates (ACS > census)	Number of 36 Counties where the census rates were statistically higher than the ACS rates (census > ACS)
Total housing unit nonresponse rate	9	1	26
Occupied housing unit nonresponse rate	13	1	22

C – Comparisons are based on a non-random sample of counties

Table 6. Comparison of Nonresponse Rates for Total and Occupied Housing Units: ACS Three-year Averages and Census 2000 Sample Estimates, County Averages

Quality Measure	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Total housing unit nonresponse rate	4.4%	9.7%	-5.3%	± 1.5%
Occupied housing unit nonresponse rate	5.2%	8.7%	-3.5%	± 1.3%

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

Table 5 and Table 6 show that the ACS usually had less housing unit nonresponse than the Census 2000 sample. The lower housing unit nonresponse rates for the ACS suggest that the ACS collected more information during follow-up operations than the census. Table 5 shows that 27 out of the 36 counties had statistically different housing unit nonresponse rates, and 23 out of 36 had statistically different occupied housing unit nonresponse rates. For 26 counties with statistically different housing unit nonresponse rates, the housing unit nonresponse rate for the Census 2000 sample was larger than the ACS three-year average estimate. For 22 counties with statistically different occupied housing unit nonresponse rates, the occupied housing unit nonresponse rate for the Census 2000 sample was larger than the ACS three-year average estimate. Table A-2 in Appendix A contains the ACS three-year average and Census 2000 sample housing unit nonresponse rates for each of the 36 counties. The counties whose differences are not statistically significant are marked with an "NS" in the table (in the Difference column). We sorted the counties in Table A-2 by their 100 percent count of census housing units.

Table 6 shows that, on average, the Census 2000 sample total housing unit nonresponse rate was 5.3 percentage points larger than the ACS three-year average rate. Since the margin of error for the difference is 1.5 percent, the resulting confidence interval does not contain zero. So, the average total housing unit nonresponse rate difference is statistically significant. For the occupied housing unit nonresponse rate, the Census 2000 sample rate was 3.5 percentage points larger than the ACS three-year average rate. The margin of error for the occupied housing unit nonresponse rate is 1.3 percent. So, the average occupied housing unit nonresponse rate is also statistically different.

Figures C-2 and C-3 in Appendix C display the county-level total housing unit nonresponse rate and occupied housing unit nonresponse rate differences, respectively, for all 36 counties through the use of one-dimensional scatter plots. For these plots, differences between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; counties are on the horizontal axis. We sorted counties for both figures using the same sort that we used for Table A-2 - by their 100 percent count of census housing units. The sorts were in ascending order, from left to right. For example, the difference for the county with the smallest count is the left-most point in the plots – these points correspond to the first county listed in Table A-2 (county code 29179 – Reynolds County, MO). Similarly, the difference for the county with the largest count is the right-most point – these points correspond to the last county listed in Table A-2 (county code 48201 – Harris County, TX).

Figure C-2 shows that the majority of the total housing unit nonresponse rates for the ACS three-year averages were lower than the Census 2000 sample estimates. An "X" on this plot indicates a statistical difference.

Figure C-3 also shows that the majority of the occupied housing unit nonresponse rates for the ACS three-year averages were lower than the Census 2000 sample estimates. An "X" on this plot indicates a statistical difference.

The larger Census 2000 sample housing unit nonresponse rates are not unexpected. This is due to differences between the census and ACS. The main emphasis of the decennial census is to enumerate the U.S. population, and only secondarily to collect long form sample data. In contrast, the sole focus for the ACS is collecting long form data. Census 2000 used temporary enumerators to collect census data while the ACS uses permanent, professional interviewers using computer-assisted interviewing instruments to collect its data. The census did not attempt to obtain answers for blank items on mail-returned questionnaires; the ACS makes this attempt using telephone followup. Census 2000 has to follow up on all non-responding housing units in the country in a tight time frame, making it difficult for the census to obtain complete long form information, especially if it is necessary to obtain information from neighbors. The ACS, on the other hand, conducts a personal visit followup on a one-third sub-sample of housing units that have not been interviewed by mail or by computer-assisted telephone interview followup. These differences between the census and ACS could contribute to the differences in the housing unit nonresponse rates. These differences are an indication of higher nonresponse error in the Census 2000 sample than in the ACS.

3.2.2 Tract Comparisons

This section contains the nonresponse rate comparisons for total and occupied housing units for tracts. We compare the ACS three-year average and Census 2000 sample nonresponse rate differences for the tracts in the 34 counties by tract group. Then we compare the differences when the values are averaged across all the tracts in a group.

Table 7 shows the number of tracts with statistical differences between the ACS three-year average and Census 2000 sample housing unit nonresponse rates for each of the five tract groups. Table 8 shows the results of comparing the average of the tract rates for each group.

Table 7. Number of Tracts with Statistically Different Nonresponse Rates for Total and Occupied Housing Units, by Tract Group [C]

Quality Measure	Tract Group[N]	Number of tracts where the ACS and census rates were not statistically different	Number of tracts where the ACS rates were statistically higher than the census rates (ACS > census)	Number of tracts where the census rates were statistically higher than the ACS rates (census > ACS)
Total housing unit nonresponse rate	1	162	3	42
	2	569	0	23
	3	510	1	69
	4	388	0	13
	5	392	0	78
Occupied housing unit nonresponse rate	1	193	0	14
	2	580	0	12
	3	533	2	45
	4	392	0	9
	5	398	0	72

N – Note, group 1 contains 207 tracts, group 2 contains 592 tracts, group 3 contains 580 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts. See section 2.1 for tract group definitions.

C – Comparisons are based on a non-random sample of counties

Table 8. Comparison of Nonresponse Rates for Total and Occupied Housing Units: ACS Three-year Averages and Census 2000 Sample Estimates, Tract Group Averages

Quality Measure	Tract Group[N]	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Total housing unit nonresponse rate	1	4.3%	10.7%	-6.4%	± 1.0%
	2	4.6%	9.4%	-4.8%	± 0.6%
	3	4.4%	8.9%	-4.5%	± 0.4%
	4	5.9%	15.7%	-9.9%	± 1.0%
	5	4.9%	11.8%	-6.9%	± 0.7%
Occupied housing unit nonresponse rate	1	5.4%	9.3%	-3.9%	± 0.8%
	2	5.0%	8.8%	-3.8%	± 0.5%
	3	4.7%	8.5%	-3.8%	± 0.4%
	4	6.5%	15.6%	-9.1%	± 1.0%
	5	5.4%	12.4%	-7.0%	± 0.7%

N – Note, group 1 contains 207 tracts, group 2 contains 592 tracts, group 3 contains 580 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts. See section 2.1 for tract group definitions.

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

Table 7 shows that more than 10 percent of the total occupied housing unit nonresponse rate differences in groups 1, 3, and 5 are statistically significant. For group 1, 22.0 percent (45 out of 207) of the tract differences are statistically significant; for group 2, 3.9 percent (23 out of 592) of the tract differences are statistically significant; for group 3, 12.1 percent (70 out of 580) of the tract differences are statistically significant; for group 4, 3.2 percent (13 out of 401) of the tract differences are statistically significant; for group 5, 16.6 percent (78 out of 470) of the tract differences are statistically significant. The most statistically significant differences are between tracts in small counties (group 1), tracts with large populations in medium counties (group 3), and tracts with large populations in counties with large populations (group 5). In addition, the census total housing unit nonresponse rates were higher than the ACS rates in all tracts with statistical differences in groups 2, 4, and 5. For group 1, the census total housing unit nonresponse rate was higher than the ACS rate in 42 of the 45 tracts with statistical differences. For group 3, the census total housing unit nonresponse rate was higher than the ACS rate for 69 of the 70 tracts with statistical differences.

Table 7 also shows that for occupied housing unit nonresponse rates, the only group with more than 10 percent of its tracts having statistically different rates is group 5. For group 1, 6.8 percent (14 out of 207) of the tract differences are statistically significant; for group 2, 2.0 percent (12 out of 592) of the tract differences are statistically significant; for group 3, 8.1 percent (47 out of 580) of the tract differences are statistically significant; for group 4, 2.2 percent (9 out of 401) of the tract differences are statistically significant; for group 5, 15.3 percent (72 out of 470) of the tract differences are statistically significant. The most statistically significant differences occur for the tracts with large populations in counties with large populations (group 5). In addition, the Census 2000 sample occupied housing unit nonresponse rates were higher than the ACS rates in all tracts with statistically different rates in groups 1, 2, 4, and 5. For group 3, the census occupied housing unit nonresponse rate was higher than the ACS rate in 45 of the 47 tracts with statistical differences.

In Table 8, the margins of error were less than the absolute values of the differences (of averages) for every tract group in both quality measure categories. In addition, all of the differences are negative. These two results mean that the ACS had statistically lower average total and occupied housing unit nonresponse rates in each tract group. In turn, this indicates that, in general, the ACS successfully interviewed a higher proportion of the housing units in its sample (using the acceptability index – see section 1.2) than the census enumerated in its sample (using sample defined data – see section 1.1) for a given tract.

Figures D-2 and D-3 in Appendix D display tract-level total housing unit and occupied housing unit nonresponse rate differences, respectively, through the use of one-dimensional scatter plots. We grouped all of the tract-level differences by tract group. For these plots, differences between the ACS three-year average and Census 2000 sample quality measures are located on the vertical axis; tracts and tract groups are on the horizontal axis. We sorted tracts within each tract group by their 100 percent count of census housing units. The sorts were in ascending order, from left to right, within each tract group. For example, the difference for the tract with the smallest count is the left-most point within each tract group, while the difference for the tract with the largest count is the right-most point within each tract group. We used a “jittering” process so that we could plot the differences in this way. Within each tract group, the “jittering” process assigned a real number to each tract so as to achieve this sort, where the tracts with the smallest counts received the smallest real numbers, etc.

The results in Figures D-2 and D-3 illustrate the results in Tables 7 and 8. Figure D-2 shows that a majority of the total housing unit nonresponse rates for the ACS three-year averages are lower than the Census 2000 sample estimates. Figure D-3 shows that, for each tract group, a majority of the occupied housing unit nonresponse rates for the ACS three-year averages are lower than the Census 2000 sample estimates. An “X” on these plots indicates a statistical difference.

The results in this section were anticipated due to the differences in the ACS and Census 2000 – see the discussion in section 3.2.1.

3.3 Summary Item Allocation Rates

Each response in the Census 2000 sample and ACS contains questions (items) for which an answer is required (required item). Item nonresponse occurs when a required item is either left blank or contains an unusable answer. Items can be left blank for a variety of reasons, e.g., a respondent may not know the answer to a question, a respondent does not understand the skip patterns on a questionnaire, or a respondent may view a question as too personal. Unusable answers include responses to items that are either illegible or inconsistent with answers to other items on a questionnaire. Required items with blank or unusable responses (nonresponse items) can affect the quality of the final survey estimates

Nonresponse items in both the ACS and Census 2000 received allocations. An allocation is the assignment of a usable value to a nonresponse item, e.g., an imputation. Both the ACS and census used "nearest neighbor" hot deck imputation methods to supply values for nonresponse items. Allocations took place for both person and housing unit nonresponse items. If the true values of the nonresponse items differ from the allocated values, then the resulting data can be biased.

There were 54 population (person-level) items, 29 occupied housing unit items, and 12 vacant housing unit items that appeared on both the ACS and census long form questionnaires for which allocations were made. The questions associated with these items may not have always been identical on the two questionnaires, but they were comparable (e.g., the two questionnaires asked the same question with minor wording differences).

We computed summary item allocation rates for the analysis in this section. These summary rates are measures of overall allocation – they are averages of the corresponding individual item allocations rates. Each individual item allocation rate is the weighted proportion of allocations for a given item, times 100. The allocation rate formulae are below. Note that we used each formula for both Census 2000 and the ACS three-year averages.

- Summary population item allocation rate

$$= \frac{\sum_{i=1}^{54} \left[\frac{\sum_{p=1}^{P} A_{i,p} W_{i,p}}{\sum_{p=1}^{P} W_{i,p}} \times 100 \right]}{54} \qquad (7)$$

where P = number of Census 2000 or ACS sample persons
p = Census 2000 or ACS sample person p
i = population item i
A_i = item allocation indicator for item i
= 1 if an item was allocated
= 0 if an item was not allocated
W_p = final person weight (Census 2000 or ACS sample) for person p

- Summary occupied housing unit item summary allocation rate

$$= \frac{\sum_{i=1}^{29} \left[\frac{\sum_{o=1}^{O} A_{i,o} W_{i,o}}{\sum_{o=1}^{O} W_{i,o}} \times 100 \right]}{29} \qquad (8)$$

where O = number of Census 2000 or ACS sample occupied housing units

o = Census 2000 or ACS sample occupied housing unit o

i = occupied housing unit item i

A_i = item allocation indicator for item i

= 1 if an item was allocated

= 0 if an item was not allocated

W_o = final housing unit weight (Census 2000 or ACS sample) for occupied housing unit o

- Summary vacant housing unit item summary allocation rate

$$= \frac{\sum_{i=1}^{12} \left[\frac{\sum_{v=1}^{V} A_{i,v} W_{i,v}}{\sum_{v=1}^{V} W_{i,v}} \times 100 \right]}{12} \qquad (9)$$

where V = number of Census 2000 or ACS sample vacant housing units

v = Census 2000 or ACS sample vacant housing unit v

i = vacant housing unit item i

A_i = item allocation indicator for item i

= 1 if an item was allocated

= 0 if an item was not allocated

W_v = final housing unit weight (Census 2000 or ACS sample) for vacant housing unit v

- Summary population & occupied housing unit item summary allocation rate

$$= \frac{\sum_{i=1}^{54} \left[\frac{\sum_{p=1}^{P} A_{i,p} W_{i,p}}{\sum_{p=1}^{P} W_{i,p}} \times 100 \right] + \sum_{i=1}^{29} \left[\frac{\sum_{o=1}^{O} A_{i,o} W_{i,o}}{\sum_{o=1}^{O} W_{i,o}} \times 100 \right]}{54 + 29} \qquad (10)$$

See equations (7) and (8) above for variable definitions.

The census versions of these formulae reflect sample data-defined person and housing unit records, only (see section 1.1). This is because only sample data-defined records went through the census item allocation processes. The ACS versions for these formulae reflect records with acceptability indexes greater than or equal to 2.5 (see section 1.2). The exception is for equation (9) – all ACS vacant housing unit records went through its item allocation process.

See Bureau of the Census, February 2003 for descriptions of the census versions of the weights (W_p, W_o, and W_v). See Bureau of the Census, March 2003 for descriptions of the ACS versions of W_p, W_o, and W_v.

Summary item allocation rates are provided for each of the 36 ACS counties, and for tracts in the 34 ACS tract-level comparison counties[7]. At the county level, the summary item allocation rates are also broken out by response mode. They are not broken out by response mode at the tract level because of small sample sizes at the tract level. The county-level comparison results are presented in section 3.3.1, and the tract-level comparison results are presented in section 3.3.2.

The response modes are self-response or interviewer-response. Self-response means that the household data came from a mail return, and interviewer-response means that an interviewer or enumerator obtained the data with the use of a follow-up form or instrument. For Census 2000, the follow-up operations were Nonresponse Followup and Coverage Improvement Followup. For the ACS, the follow-up operations were computer-assisted telephone interviewing and computer-assisted personal interviewing.

Summary item allocation rates provide overall measures of item nonresponse and summarize the population and housing item allocation rates. They show overall patterns in the data. However, they also obscure differences among the individual items.

3.3.1 County Comparisons

This section contains the summary item allocation rate comparison results for the counties. In this section we compare the ACS three-year average and Census 2000 sample summary item allocation rate differences for each of the 36 counties, and then compare the differences when the values are averaged across all the counties.

Table 9 shows the number of counties with statistical differences between item allocation rates for the ACS three-year average and Census 2000 sample. Table 10 shows the results of comparing the summary item allocation rates averaged across the 36 counties.

[7] We excluded the tracts in Fort Bend County and Harris County – their sampling rates were low compared to the ACS five-year design-level rates; we also excluded tracts with populations of less than 500 persons because of their small sample sizes.

Table 9. Number of Counties with Statistically Different Summary Item Allocation Rates [C]

Quality Measure	Number of counties where the ACS and census rates were not statistically different	Number of counties where the ACS rates were statistically higher than the census rates (ACS > census)	Number of counties where the census rates were statistically higher than the ACS rates (census > ACS)
Summary population item allocation rates			
Total	2	0	34
Self-response	17	0	19
Interviewer-response	3	0	33
Summary housing unit item allocation rates			
Total occupied housing unit	0	0	36
Vacant housing unit	24	10	2
Self-response occupied housing unit	2	0	34
Interviewer-response occupied housing unit	1	0	35
Summary population and occupied housing unit item allocation rates			
Total	0	0	36
Self-response	5	0	31
Interviewer-response	1	0	35

C – Comparisons are based on a non-random sample of counties

Table 10. Comparison of Summary Item Allocation Rates: ACS Three-year Averages and Census 2000 Sample Estimates, County Averages

Quality Measure	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Summary population item allocation rates				
Total	6.5%	11.2%	-4.7%	± 0.6%
Self-response	8.9%	10.2%	-1.3%	± 0.8%
Interviewer-response	4.2%	14.0%	-9.8%	± 1.1%
Summary housing unit item allocation rates				
Total occupied housing units	7.7%	15.8%	-8.0%	± 0.8%
Vacant housing units	23.2%	19.8%	3.4%	± 2.8%
Self-response occupied housing unit	7.5%	15.0%	-7.5%	± 1.0%
Interviewer-response occupied housing units	8.8%	18.9%	-10.1%	± 1.3%
Summary population and occupied housing unit item allocation rates				
Total	6.9%	12.8%	-5.9%	± 0.6%
Self-response	8.5%	11.9%	-3.5%	± 0.9%
Interviewer-response	5.8%	15.7%	-10.0%	± 1.1%

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

Table 9 and Table 10 show that, except for the summary total vacant housing unit item allocation rates, the ACS had statistically lower item allocation rates.

Table 9 shows that, for most of the quality measures, over 80 percent of the 36 counties exhibited statistically higher Census 2000 summary item allocation rates. There were two exceptions. One exception was for summary population item allocation rates, self-response mode; almost half of the counties (17 of 36) showed no statistical differences between the ACS and Census 2000 rates. The second exception was for summary housing unit item allocation rates for vacant housing units - two-thirds of the counties (24 of 36) exhibited no statistical differences between ACS and Census 2000 summary housing unit item allocation rates. Additionally, 10 of the remaining 12 counties exhibited statistically higher ACS summary vacant housing unit item allocation rates. Tables A-3 through A-6 in Appendix A contain the summary item allocation rates for the ACS three-year averages and Census 2000 sample for each of the 36 counties. Population rates are in Table A-4; occupied housing unit rates are in Table A-5; vacant housing unit rates are in Table A-5; population and occupied housing unit rates are in Table A-6. In each of these tables, the counties whose differences are not statistically significant are marked with an "NS" in the Difference columns. The counties in all three tables are sorted, in ascending order, by their 100 percent count of census housing units.

Table 10 shows that for all of the summary item allocation rates, except the average summary vacant housing unit item allocation rate, the census average rate is higher than the ACS average rates. For the average summary vacant housing unit item allocation rates, the ACS average rate is higher than the census average rate. In addition, none of the margin of errors are greater than the absolute values of the differences. So, all of the average differences are statistically different.

Figures C-4, C-5, and C-6 in Appendix C display the county-level summary population item allocation rate differences, summary housing unit item allocation rate differences, and summary population and occupied housing unit item allocation rate differences, respectively, for all 36 counties. The figures display these differences through the use of one-dimensional scatter plots. For these plots, differences between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; counties by quality measure are on the horizontal axis. We sorted counties within each quality measure using the same sort with which we sorted counties in Tables A-3 through A-6 - by their 100 percent count of census housing units. The sorts were in ascending order, from left to right. For example, the difference for the county with the smallest count is the left-most point in each quality measure in each graph – these points correspond to the first county listed in Tables A-3 through A-6 (county code 29179 – Reynolds County, MO). Similarly, the difference for the county with the largest count is the right-most point in each quality measure in each graph – these points correspond to the last county listed in Tables A-3 through A-6 (county code 48201 – Harris County, TX).

Figures C-4, C-5, and C-6 show that, except for the summary vacant housing unit item allocation rates, the census rates are almost always higher than the ACS rates. An “X” on these plots identifies a statistical difference.

The results presented in Table 9, Table 10, Appendix A and Appendix C show that for population and occupied housing unit items, the ACS had less item nonresponse as measured by the item allocation rates. For the vacant housing unit items, the census had less item nonresponse.

The larger Census 2000 sample summary item allocation rates could have been expected (except for vacant housing units – see below). The main focus of the ACS is to collect “long form” data; this was a secondary goal in the census. Specifically, the major contributor to these results is that the ACS was more thorough in collecting data in its followup operations than was Census 2000. Another factor is that the ACS uses a permanent, professional staff of interviewers with computer-assisted interviewing instruments while Census 2000 used temporary, relatively inexperienced enumerators using paper questionnaires.

Larger ACS summary item allocation rates for vacant housing units might have been a reasonable expectation as well. This was in part because of the census including only sample data-defined (section 1.1) vacant housing unit records in its sample and, therefore, its allocation process; the census vacant housing unit summary item allocation rates do not take non-sample data-defined units into account. In contrast, the ACS included all of its vacant housing unit records in its sample and allocation process; the ACS vacant housing unit summary item allocation rates take *all* ACS vacant units into account. Additionally, an error in the computer-assisted instrument for the ACS omitted the *business on property* item from the vacant housing unit interview – this negatively affected the ACS summary vacant housing unit item allocation rates as well. If the census allocation rates had been based on all vacant housing unit long form response records, and if the ACS had discovered the instrument error in time, we might have observed similar results for vacant housing unit allocation rates as we did for the rates for the other categories in this section. See Love, 2004 for further discussion.

3.3.2 Tract Comparisons

This section contains the tract level summary item allocation rate comparison results. In this section we compare the ACS three-year average and Census 2000 sample summary item allocation rate differences for the tracts in the 34 counties by tract group, and then compare the differences when the values are averaged across all counties by tract group. We only compared the total summary item allocation rates for the tracts. We did not compare the self-response or interviewer-response summary item allocation rates because of small sample sizes.

Table 11 shows the number of tracts with statistical differences between the ACS three-year average and Census 2000 sample summary item allocation rates for each of the five tract groups. Table 12 shows the results of comparing the average of the tract summary item allocation rates for each group.

Table 11. Number of Tracts with Statistically Different Summary Item Allocation Rates, by Tract Group [C]

Quality Measure	Tract Group[N]	Number of tracts where the ACS and census rates were not statistically different	Number of tracts where the ACS rates were statistically higher than the census rates (ACS > census)	Number of tracts where the census rates were statistically higher than the ACS rates (census > ACS)
Summary total population item allocation rate	1	174	0	33
	2	504	0	88
	3	453	0	127
	4	310	0	91
	5	327	0	143
Summary total occupied housing unit item allocation rate	1	145	0	62
	2	558	0	34
	3	474	0	106
	4	380	0	21
	5	415	0	55
Summary vacant housing unit item allocation rate	1	201	1	2
	2	507	1	1
	3	545	1	0
	4	348	3	0
	5	449	0	2
Summary total population and occupied housing unit item allocation rate	1	128	0	79
	2	463	0	129
	3	374	0	206
	4	269	0	132
	5	275	0	195

N – Note, group 1 contains 207 tracts, group 2 contains 592 tracts, group 3 contains 580 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts. For vacant housing units, group 1 contains 204 tracts, group 2 contains 509 tracts, group 3 contains 546 tracts, group 4 contains 351 tracts, and group 5 contains 451 tracts. See section 2.1 for tract group definitions.

C – Comparisons are based on a non-random sample of counties

Table 12. Comparison of Summary Item Allocation Rates: ACS Three-year Averages and Census 2000 Sample Estimates, Tract Group Averages

Quality Measure	Tract Group[N]	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Summary total population item allocation rate	1	6.9%	11.7%	-4.8%	0.5%
	2	6.5%	10.6%	-4.1%	0.3%
	3	6.6%	10.9%	-4.3%	0.3%
	4	7.4%	13.8%	-6.4%	0.5%
	5	7.1%	12.3%	-5.2%	0.4%
Summary total occupied housing unit item allocation rate	1	7.7%	15.7%	-8.0%	0.5%
	2	6.7%	13.3%	-6.6%	0.3%
	3	7.3%	14.1%	-6.8%	0.3%
	4	7.5%	16.9%	-9.4%	0.6%
	5	7.4%	15.9%	-8.5%	0.5%
Summary vacant housing unit item allocation rate	1	22.0%	20.3%	1.7%	[NS] 1.8%
	2	15.7%	14.3%	1.4%	1.2%
	3	16.2%	13.9%	2.3%	1.1%
	4	14.9%	15.6%	-0.7%	[NS] 1.5%
	5	13.0%	14.8%	-1.7%	1.0%
Summary total population and occupied housing unit item allocation rate	1	7.2%	13.1%	-5.9%	0.5%
	2	6.5%	11.5%	-5.0%	0.3%
	3	6.9%	12.0%	-5.2%	0.3%
	4	7.4%	14.9%	-7.4%	0.5%
	5	7.2%	13.5%	-6.4%	0.4%

N – Note, group 1 contains 207 tracts, group2 contains 592 tracts, group 3 contains 580 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts. For vacant housing units, group 1 contains 204 tracts, group 2 contains 509 tracts, group 3 contains 546 tracts, group 4 contains 351 tracts, and group 5 contains 451 tracts. See section 2.1 for tract group definitions.

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

NS – The ACS three-year average and Census 2000 sample quality measure are not statistically different for this tract group

Some tracts were excluded from the summary vacant housing unit item allocation rate comparison. There are no summary vacant housing unit item allocation rates for the Census 2000 sample in these tracts because the denominator or universe of the census rate is zero. For these tracts, the ACS had at least one vacant housing unit in one of the three years. For group 2, 16 tracts were removed from the comparison; for group 4, 14 tracts were removed.

Table 11 shows that for the summary population item allocation rates, summary occupied housing unit item allocation rates, and the summary population and occupied housing unit item allocation rates, tracts in each group had ACS and Census 2000 rates that were either not statistically different or had statistically higher Census 2000 rates. The proportion of tracts in each group with statistically higher Census 2000 rates ranged from 5.2 percent (summary total occupied housing unit item allocation rate, tract group 4) to 41.5 percent (summary total population and occupied housing unit item allocation rate, tract group 5). In addition, Table 12 shows that all of the average Census 2000 summary item allocation rates for these tract groups are statistically larger than the average ACS three-year average rates.

For the summary vacant housing unit item allocation rates, Table 11 shows that almost all of the tracts within all five groups exhibited no statistical differences between the ACS and Census 2000 rates. Of the tracts with statistical differences, six exhibited higher ACS rates while five exhibited higher Census 2000 rates. Table 12 shows no statistical differences between the average ACS and Census 2000 summary vacant housing unit item allocation rates for tract groups 1 and 4. Table 12 also shows that the average ACS rates are statistically higher for tract groups 2 and 3 while the average Census 2000 rates are statistically higher for tract group 5.

Figures D-4, D-5, D-6, and D-7 in Appendix D display tract-level summary item allocation rate differences through the use of one-dimensional scatter plots. We grouped all of the tract-level differences by tract group. For these plots, differences between the ACS three-year average and Census 2000 sample quality measures are located on the vertical axis; tracts and tract groups are on the horizontal axis. We sorted tracts within each tract group by their 100 percent count of census housing units. The sorts were in ascending order, from left to right, within each tract group. For example, the difference for the tract with the smallest count is the left-most point within each tract group, while the difference for the tract with the largest count is the right-most point within each tract group. We used a "jittering" process so that we could plot the differences in this way. Within each tract group, the "jittering" process assigned a real number to each tract so as to achieve this sort, where the tracts with the smallest counts received the smallest real numbers, etc. Statistical differences are indicated by an "X" on all four plots.

Figure D-4 displays the tract-level summary population item allocation rate differences, by tract group. It shows that, for each group, for a majority of the summary population item allocation rates, the ACS three-year averages are lower than the Census 2000 sample estimates.

Figure D-5 displays the tract-level summary occupied housing unit item allocation rate differences, by tract group. It shows that, for each group, for a majority of the summary occupied housing unit item allocation rates, the ACS 3-year averages are lower than the Census 2000 sample estimates.

Figure D-6 displays the tract-level summary vacant housing unit item allocation rate differences, by tract group. The differences for the five groups are approximately centered on zero.

Figure D-7 displays the tract-level summary population and occupied housing unit item allocation rate differences, by tract group. It shows that, for each group, for a majority of the summary population and occupied housing unit item allocation rates, the ACS 3-year averages are lower than the Census 2000 sample estimates.

The results presented in Table 11, Table 12, and Appendix D show that the ACS had lower levels of item nonresponse than the census for occupied housing unit and population items. These results correspond to the results at the county level (section 3.3.1 above). This could be a sign of potentially higher item nonresponse error for census occupied housing unit and population item estimates.

For vacant housing units, the overwhelming majority of tract-level comparisons showed no statistical differences in ACS versus census item allocation rates (Table 11). Only three of the five tract groups (Table 12) showed statistical differences in item allocation rates, two with ACS having higher rates, one with Census 2000 having higher rates. As for the county-level rates, had Census 2000 retained all of its long-form vacant housing units in sample (instead of just the sample data-defined vacant housing units) *and* had ACS discovered the instrument error in time (section 3.3.1., Love 2004), then we might have observed statistically higher Census 2000 item allocation tract-level summary item allocation rates.

3.4 Sample Completeness Rates

We calculated sample completeness rates to measure how well the ACS and Census 2000 sample represented their target area's population or housing. These rates are 100 times the ratio of the survey's estimate of population or housing units to the target area's count of population or housing units, respectively. The formulae for these rates are shown below.

Census 2000 Sample Completeness Rates:

- Housing unit

$$= \frac{\sum_{hdd=1}^{HDD} W_{hdd}}{N_{CensusHU}} \times 100 \qquad (11)$$

where HDD = number of Census 2000 sample data-defined housing units
hdd = Census 2000 sample data-defined housing unit hdd
W_{hdd} = Census 2000 base weight for sample data-defined housing unit hdd
$N_{CensusHU}$ = total number of Census 2000 "100-percent" housing units

- Household population

$$= \frac{\sum_{pdd=1}^{PDD} W_{pdd}}{N_{CensusP}} \times 100 \qquad (12)$$

where PDD = Census 2000 sample data-defined household population (number of Census 2000 sample data-defined persons)
pdd = Census 2000 sample data-defined person pdd
W_{pdd} = Census 2000 base weight for sample data-defined person pdd
$N_{CensusP}$ = Census 2000 "100-percent" household population (total number of Census 2000 "100-percent" persons)

ACS three-year Average Sample Completeness Rates:

- Housing unit

$$= \frac{\sum_{h=1}^{H} W_h}{\sum_{year=1999}^{2001} HUC_{year}} \times 100 \qquad (13)$$

where H = number of ACS housing units
h = ACS housing unit h
W_h = ACS base weight for housing unit h
HUC_{year} = ACS housing unit control for year $year \in \{1999, 2000, 2001\}$
where HUC_{1999} = Census 2000 "100-percent" housing count projected backward to form an intercensal housing unit estimate for 1999
HUC_{2000} = ACS 2000 total housing unit estimate controlled to a Census 2000 "100-percent" total housing unit count
HUC_{2001} = Census 2000 "100-percent" housing count projected forwards to form an intercensal housing unit estimate for 2001

- Household population

$$= \frac{\sum_{p=1}^{P} W_p}{\sum_{year=1999}^{2001} PC_{year}} \times 100 \qquad (14)$$

where P = ACS population (number of ACS persons)
h = ACS person p
W_p = ACS base weight for person p
PC_{year} = ACS population control for year *year* $\in$ {1999, 2000, 2001}
where PC_{1999} = Census 2000 "100-percent" population count projected backward to form an intercensal population estimate for 1999
PC_{2000} = ACS 2000 total population estimate controlled to a Census 2000 "100-percent" total population count
PC_{2001} = Census 2000 "100-percent" population count projected forwards to form an intercensal population estimate for 2001

The Census 2000 weights (W_{hdd} and W_{pdd}) are the reciprocal of the sampling fraction used to designate long form housing units for the block in which they were enumerated - this weight is equal to 2, 4, 6 or 8 (Bureau of the Census, February 2003).

The ACS base weights are the initial ACS sampling weights multiplied by the computer-assisted personal interview subsampling weights (Bureau of the Census, March 2003).

We computed these rates for each of the 36 ACS counties. We did not compute these rates at the tract level, however – the controls in the denominators for the ACS rates (equations (13) and (14)) were computed at the county level, only. The county-level comparison results are presented below.

These rates measure nonresponse and coverage errors. Survey nonresponse and undercoverage can introduce bias if they result in certain groups of people or housing units with specific characteristics being excluded from the sample estimates. Survey overcoverage can result in bias if those included in the survey more than once share specific characteristics to a higher degree than those included in the survey only once. A rate of 100 is desired – it indicates that there was neither undercoverage nor overcoverage. A rate greater than 100 represents overcoverage of the target area by the survey, and a rate less than 100 represents undercoverage of the target area by the survey.

County Comparisons

This section contains the county level sample completeness comparison results. In this section we compare the ACS three-year average and Census 2000 housing unit sample completeness rates and the household population sample completeness rates. We first compare the differences for each of the 36 counties, and then compare the differences when the values are averaged across all the counties.

Table 13 shows the number of counties with statistically different ACS three-year average and Census 2000 sample completeness rates. Table 14 shows the results of comparing the average of the 36 county housing unit sample completeness rates and household population sample completeness rates.

Table 13. Number of Counties with Statistically Different Sample Completeness Rates [C]

Quality Measure	Number of counties where the ACS and census rates were not statistically different	Number of counties where the ACS rates were statistically higher than the census rates (ACS > census)	Number of counties where the census rates were statistically higher than the ACS rates (census > ACS)
Housing unit sample completeness rate	11	21	4
Household population sample completeness rate	22	8	6

C – Comparisons are based on a non-random sample of counties

Table 14. Comparison of Sample Completeness Rates: ACS Three-year Averages and Census 2000 Sample Estimates, County Averages

Quality Measure	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Housing unit sample completeness rate	92.9	90.3	2.6	± 2.1
Household population sample completeness rate	90.4	91.1	-0.7	[NS] ± 2.1

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

NS – the ACS and Census averages are not statistically different for this quality measure.

Table 13, Table 14, and Table A-7[8] together show that the ACS sample represents more of its target housing unit population than does the census sample. Table 13 shows that 25 out of the 36 county housing unit sample completeness rates were statistically different. For 21 counties with statistically different housing unit sample completeness rates, the ACS three-year average housing unit sample completeness rate was larger and, as shown in Table A-7, closer to 100 than the Census 2000 sample estimate; the four statistically larger census housing unit sample completeness rates are closer to 100 than the ACS rates. The housing unit sample completeness rates are all less than 100 except for the ACS rate for two counties (Rockland county, NY, and Ohio county, WV). Table 14 shows that, on average, the housing unit sample completeness rate for the ACS three-year average was larger and closer to 100 than the Census 2000. Since the margin of error for the difference is smaller than the difference itself (2.1 versus 2.6), the resulting confidence interval would not contain zero. In turn, the difference of the averages is statistically significant.

Figures C-7 and C-8 in Appendix C display the housing unit sample completeness rate and household population sample completeness rate differences, respectively, for all 36 counties through the use of one-dimensional scatter plots. For these plots, differences

[8] The counties in Table A-7 are sorted, in ascending order, by their 100 percent count of census housing units.

between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; counties are on the horizontal axis. We sorted counties in these two figures using the same sort that we used for Table A-7 - their 100 percent count of census housing units. The sorts were in ascending order, from left to right. For example, the difference for the county with the smallest count is the left-most point in the plots – these points correspond to the first listed county in Table A-7 (county code 29179 – Reynolds County, MO). Similarly, the difference for the county with the largest count is the right-most point – these points correspond to the last county listed in Table A-7 – county code 48201 – Harris County, TX). An “X” on these plots identifies a statistical difference.

Figure C-7 shows that the majority of counties have higher ACS housing unit sample completeness rates than census sample completeness rates. In addition, for the counties with the largest number of census housing units, the ACS housing unit sample completeness rates are statistically higher than the census housing unit sample completeness rates.

Table 13, Table 14, and Table A-7 also show that the ACS sample and census sample represent their target area’s household population about equally well. Table 13 shows that only 14 out of the 36 county sample completeness rates for household population were statistically different. For eight of these fourteen counties, the ACS three-year average sample completeness rate was higher and as shown in Table A-7 closer to 100; for the other six counties, the Census 2000 sample completeness rate was higher and closer to 100. The household population sample completeness rates are all less than 100 except for the ACS rate for one county (Vilas county, WI). Table 14 shows that the average household population sample completeness rates were not statistically different.

Figure C-8 shows that the household population sample completeness rate differences are spread nearly evenly about zero. In addition, as the number of census housing units in the counties increases, the differences seem to get lower.

The results presented in Table 13, Table 14, Table A-7, Figure C-7, and Figure C-8, show that, in general, the ACS had housing unit sample completeness rates slightly closer to 100 than the census sample, but their household population sample completeness rates were about equally close to 100. The sample completeness rates measure nonresponse error and coverage error, and a rate of 100 is optimal. So, the difference in the housing unit sample completeness rates could signal that the census has somewhat higher coverage error rates.

4. CONCLUSIONS

Overall, we observed statistical differences between the quality measures for the ACS three-year averages and the Census 2000 sample estimates. The results show that, although the census had higher levels of self-response (responses through the mail), the ACS generally obtained more responses and more complete information from respondents during follow-up operations. As a whole, a higher proportion of households responded in the ACS (that is, the ACS had a generally lower housing unit nonresponse rate). The ACS tended to obtain more complete information (that is, the ACS tended to have lower summary item allocation rates) for sample housing units than the census. The ACS exhibited better coverage of its target area's housing units than did the census (that is, the ACS had housing unit sample completeness rates closer to 100 than did the census), but the two surveys covered their target area's population about equally well (that is, the two surveys' population sample completeness ratios were comparable). These results seem to be explained by the operational and methodological differences between the ACS and the census.

We observed the overall statistical differences at the county level, also. For the self-response rate (mail returns), most of the counties had statistically higher Census 2000 long form rates - this indicated that the census performed better than the ACS with respect to this quality measure. However, for the total and occupied housing unit nonresponse rates and summary item allocation rates, a majority (if not all) of the counties had statistically lower ACS three-year average rates - this indicated that the ACS performed better than the census for these quality measures. For the sample completeness rates, the number of counties with statistical differences and the number of counties without statistical differences is about even.

For the most part, we observed the same statistical differences noted above at the tract level. The census seemed to collect a higher proportion of forms through the mail in tracts for all five tract groups. The ACS, on the other hand, obtained more information for housing units that did not respond through the mail for tracts in all five tract groups. The ACS also tended to obtain more information for housing units in tracts in all five tract groups, as well.

These quality measures suggest that the ACS multi-year averages are at least as good as the estimates from the long form. When we also consider the enhanced timeliness of information from the ACS, the superiority of reengineering the 2010 Census over retaining traditional methods is clear. In addition, while further study is needed, it appears that the permanent, on-going nature of the ACS program contributes to lower ACS nonresponse rates, and hence less chance for nonresponse error and bias in the estimates.

5. REFERENCES

Asiala, Mark and Dawn Haines, *Census 2000 long Form – Data Groupings for Generalized Design Factors*, DSSD CENSUS PROCEDURES AND OPERATIONS MEMORANDUM SERIES #LL-11, Bureau of the Census, September 16, 2002.

Bench, Katie, *Census 2000 Sample Data and ACS three-year Averages Quality Measures Comparison Documentation*, Bureau of the Census, May 23, 2003.

Bureau of the Census, *Summary File 3 Technical Documentation, 2000 Census of Population and Housing*, http://www.census.gov/prod/cen2000/doc/sf3.pdf, February 2003.

Bureau of the Census, *American Community Survey Operational Plan*, Release 1, March 2003.

Bureau of the Census, *Meeting 21st Century Demographic Data Needs—Implementing American Community Survey*, Report1: Demonstrating Operational Feasibility, July 2001.

Bureau of the Census, *Census 2000 Operational Plan*, http://www.census.gov/dmd/www/pdf/Operational2000.pdf, December 2000.

Love, Susan P., *Comparison of Item Allocation Levels for Comparable Census 2000 Sample and Census 2000 Supplementary Survey Items, by Data Collection Mode,* February 5, 2004

Love, Susan P. and Griffin, Deborah H., *A Closer Look at the Quality of Small Area Estimates from the American Community Survey,* presented at the 2003 Joint Statistical Meeting in San Francisco, CA.

Appendix A
County Level Quality Measures

This section contains Tables A-1 through A-7. Each table contains ACS and Census 2000 county-level rates and their differences. The tables also show if a difference was statistically significant. The tables contain:

Table	Contents
A-1	Self-response rates
A-2	Nonresponse rates
A-3	Summary item allocation rates – population
A-4	Summary item allocation rates – occupied housing units
A-5	Summary item allocation rates – vacant housing units
A-6	Summary item allocation rates – population and occupied housing units
A-7	Sample completeness rates

Each table was sorted by the county-level 100 percent count of census housing units, in ascending order. For example, Reynolds County, MO, the first county listed in each table, had the smallest 100 percent count of census housing units among the 36 counties. This sort matches the sort used in the figures in Appendix C.

Table A-1. Comparison of Self-Response Rates: ACS Three-Year Averages and Census 2000 Sample Estimates, by County

County	County Code	Self-Response Rates		
		ACS	Census	Difference
Reynolds County, MO	29179	38.2	71.9	-33.7
Iron County, MO	29093	48.4	70.2	-21.8
Zapata County, TX	48505	25.7	62.5	-36.8
Fulton County, PA	42057	57.4	75.0	-17.6
Washington County, MO	29221	40.8	66.1	-25.3
De Soto Parish, LA	22031	49.3	62.8	-13.5
Upson County, GA	13293	56.0	69.7	-13.7
Lake County, MT	30047	52.4	74.6	-22.2
Miami County, IN	18103	59.8	70.6	-10.8
Petersburg City, VA	51730	52.1	62.8	-10.7
Starr County, TX	48427	21.7	54.0	-32.3
Ohio County, WV	54069	69.1	72.6	NS -3.5
Vilas County, WI	55125	56.6	N/A	
Oneida County, WI	55085	71.6	78.0	NS -6.4
Calvert County, MD	24009	63.0	71.5	-8.5
Madison County, MS	28089	54.5	71.6	-17.1
Otero County, NM	35035	59.3	65.0	-5.7
Jefferson County, AR	05069	50.6	67.6	-17.0
Flathead County, MT	30029	60.1	72.9	-12.8
Sevier County, TN	47155	58.7	65.2	-6.5
Black Hawk County, IA	19013	69.6	76.6	-7.0
Schuylkill County, PA	42107	69.5	77.3	-7.8
Yakima County, WA	53077	58.4	65.8	-7.4
Rockland County, NY	36087	57.6	65.3	-7.7
Fort Bend County, TX	48157	56.7	66.9	NS -10.2
Tulare County, CA	06107	50.1	63.4	-13.3
Hampden County, MA	25013	61.9	69.1	-7.2
Douglas County, NE	31055	67.2	72.5	-5.3
Lake County, IL	17097	65.3	72.0	-6.7
Multnomah County, OR	41051	65.0	70.4	-5.4
San Francisco County, CA	06075	57.9	65.7	-7.8
Pima County, AZ	04019	62.1	69.7	-7.6
Franklin County, OH	39049	64.2	69.3	-5.1
Bronx Borough, NY	36005	36.0	52.9	-16.9
Broward County, FL	12011	56.4	60.9	-4.5
Harris County, TX	48201	47.9	60.6	-12.7

NS – The ACS three-year average and Census 2000 sample self-response rates are not statistically different for this county.
N/A – not applicable to Census 2000

Table A-2. Comparison of Total and Occupied Housing Unit Nonresponse Rates: ACS Three Averages and Census 2000 Sample Estimates, by County

County	County Code	Total Housing Units			Occupied Housing Units		
		ACS	Census	Difference	ACS	Census	Difference
Reynolds County, MO	29179	2.9	1.4	NS 1.5	4.1	2.6	NS 1.5
Iron County, MO	29093	3.8	4.4	NS 1.5	4.6	4.5	NS 0.1
Zapata County, TX	48505	6.8	13.0	-6.2	10.0	11.6	NS -1.6
Fulton County, PA	42057	3.9	4.6	NS -0.7	4.7	4.8	NS -0.1
Washington County, MO	29221	4.4	1.8	2.6	5.3	1.3	4.0
De Soto Parish, LA	22031	6.5	6.7	NS -0.2	7.5	7.8	NS -0.3
Upson County, GA	13293	3.2	8.9	-5.7	3.5	7.1	-3.6
Lake County, MT	30047	6.0	12.2	-6.2	7.7	9.2	NS -1.5
Miami County, IN	18103	4.3	21.4	-17.1	4.8	17.1	-12.3
Petersburg City, VA	51730	2.4	19.1	-16.7	2.9	13.8	-10.9
Starr County, TX	48427	6.0	11.9	-5.9	7.4	10.1	NS -2.7
Ohio County, WV	54069	3.4	4.7	NS -1.3	3.8	3.9	NS -0.1
Vilas County, WI	55125	5.5	18.4	-12.9	10.7	14.2	-3.5
Oneida County, WI	55085	3.9	19.3	-15.4	5.9	12.2	-6.3
Calvert County, MD	24009	2.9	5.2	-2.3	3.2	4.8	-1.6
Madison County, MS	28089	4.3	12.5	-8.2	4.7	11.3	-6.6
Otero County, NM	35035	4.8	7.2	-2.4	6.0	9.8	-3.8
Jefferson County, AR	05069	4.4	17.2	-12.7	5.0	14.3	9.3
Flathead County, MT	30029	3.8	3.7	NS 0.1	4.4	4.4	NS 0.0
Sevier County, TN	47155	4.9	6.2	NS -1.3	5.9	5.6	NS 0.3
Black Hawk County, IA	19013	3.5	9.4	-5.9	3.7	7.9	-4.2
Schuylkill County, PA	42107	3.8	5.6	-1.8	4.3	5.3	NS -1.0
Yakima County, WA	53077	3.7	10.6	-6.9	3.9	9.5	-5.6
Rockland County, NY	36087	3.5	5.5	-2.0	3.6	5.2	-1.6
Fort Bend County, TX	48157	4.8	6.1	NS -1.3	5.0	6.2	NS -1.2
Tulare County, CA	06107	3.6	11.4	-7.8	3.9	10.1	-6.2
Hampden County, MA	25013	5.0	11.3	-6.3	5.4	10.0	-4.6
Douglas County, NE	31055	3.9	6.6	-2.7	4.2	5.9	-1.7
Lake County, IL	17097	3.9	6.8	-2.9	4.1	6.4	-2.3
Multnomah County, OR	41051	3.6	5.0	-1.4	3.8	5.1	-1.3
San Francisco County, CA	06075	6.0	12.4	-6.4	6.4	12.0	-5.6
Pima County, AZ	04019	5.7	11.7	-6.0	6.3	11.4	-5.1
Franklin County, OH	39049	1.9	5.8	-3.9	2.1	5.9	-3.8
Bronx Borough, NY	36005	9.7	22.2	-12.5	10.5	21.0	-10.5
Broward County, FL	12011	3.9	9.5	-5.6	4.5	11.7	-7.2
Harris County, TX	48201	4.2	10.1	NS -5.9	4.6	10.2	NS -5.6

NS – The ACS three-year average and Census 2000 sample nonresponse rates are not statistically different for this county.

Table A-3. Comparison of Summary Allocation Rates for Population Items: ACS Three Averages and Census 2000 Sample Estimates, by County

County	County Code	Total			Self-Response			Interviewer-Response		
		ACS	Census	Difference	ACS	Census	Difference	ACS	Census	Difference
Reynolds County, MO	29179	6.1	13.6	-7.5	11.3	12.8	NS -1.5	3.7	16.7	-13.0
Iron County, MO	29093	6.9	11.8	-4.9	11.0	11.0	NS 0.0	3.7	13.5	-9.8
Zapata County, TX	48505	4.2	13.8	-9.6	8.8	17.3	-8.5	2.8	7.6	-4.8
Fulton County, PA	42057	7.6	10.2	NS -2.6	9.6	9.9	NS -0.3	5.0	11.7	NS -6.7
Washington County, MO	29221	6.4	12.0	-5.6	10.3	11.2	NS -0.9	3.5	13.7	-10.2
De Soto Parish, LA	22031	7.6	13.0	-5.4	12.1	13.6	NS -1.5	3.0	11.5	-8.5
Upson County, GA	13293	8.1	11.7	-3.6	11.1	12.3	NS -1.2	4.7	11.0	-6.3
Lake County, MT	30047	6.3	7.6	-1.3	7.7	8.1	NS -0.4	4.8	7.5	NS -2.7
Miami County, IN	18103	5.9	12.9	-7.0	7.9	10.8	-2.9	3.2	23.7	-20.5
Petersburg City, VA	51730	7.3	13.9	-6.6	11.5	13.7	-2.2	3.2	14.6	-11.4
Starr County, TX	48427	3.9	9.1	-5.2	12.5	12.1	NS 0.4	1.7	8.1	-6.4
Ohio County, WV	54069	7.6	10.3	-2.7	8.1	9.5	NS -1.4	6.3	12.3	-6.0
Vilas County, WI	55125	6.5	10.5	-4.0	7.8	5.1	NS 2.7	4.9	10.5	-5.6
Oneida County, WI	55085	6.6	8.4	NS -1.8	8.0	8.7	NS -0.7	3.3	8.2	NS -4.9
Calvert County, MD	24009	5.4	8.9	-3.5	6.6	8.2	-1.6	3.6	11.2	-7.6
Madison County, MS	28089	6.0	13.0	-7.0	8.0	10.0	-2.0	3.9	25.9	-22.0
Otero County, NM	35035	6.2	9.5	-3.3	8.4	7.9	NS 0.5	3.1	12.8	-9.7
Jefferson County, AR	05069	7.4	13.8	-6.4	11.4	11.6	NS -0.2	3.5	20.1	-16.6
Flathead County, MT	30029	6.8	11.6	-4.8	9.0	9.5	NS -0.5	3.9	17.9	-14.0
Sevier County, TN	47155	6.7	11.1	-4.4	8.8	9.5	NS -0.7	3.9	14.2	-10.3
Black Hawk County, IA	19013	6.0	9.6	-3.6	7.5	8.0	NS -0.5	3.9	15.8	-11.9
Schuylkill County, PA	42107	5.9	10.0	-4.1	7.1	8.9	-1.8	3.2	14.2	-11.0
Yakima County, WA	53077	7.6	10.7	-3.1	8.9	10.5	-1.6	6.6	11.1	-4.5
Rockland County, NY	36087	6.8	10.8	-4.0	8.1	9.7	-1.6	5.3	13.1	-7.8
Fort Bend County, TX	48157	5.7	10.8	-5.1	7.1	9.2	-2.1	4.1	14.6	-10.5
Tulare County, CA	06107	7.1	13.2	-6.1	9.8	12.0	-2.2	4.9	15.7	-10.8
Hampden County, MA	25013	6.7	11.7	-5.0	8.4	10.6	-2.2	4.3	14.6	-10.3
Douglas County, NE	31055	5.6	9.3	-3.7	7.2	7.6	NS -0.4	3.2	14.8	-11.6
Lake County, IL	17097	6.1	10.3	-4.2	7.1	8.5	-1.4	4.8	15.3	-10.5
Multnomah County, OR	41051	6.0	9.2	-3.2	7.0	7.7	-0.7	4.9	13.0	-8.1
San Francisco County, CA	06075	7.5	12.3	-4.8	8.8	10.3	-1.5	6.0	17.6	-11.6
Pima County, AZ	04019	6.2	9.9	-3.7	7.5	8.4	-0.9	4.5	13.8	-9.3
Franklin County, OH	39049	5.0	9.4	-4.4	6.3	7.5	-1.2	3.2	14.2	-11.0
Bronx Borough, NY	36005	8.5	16.3	-7.8	13.7	15.8	-2.1	5.5	17.4	-11.9
Broward County, FL	12011	6.9	11.1	-4.2	8.7	9.8	-1.1	5.1	13.2	-8.1
Harris County, TX	48201	6.2	12.1	-5.9	8.6	11.3	-2.7	4.3	13.7	-9.4

NS – The ACS three-year average and Census 2000 sample summary population allocation rates are not statistically different for this county

Table A-4. Comparison of Summary Allocation Rates for Occupied Housing Unit Items: ACS Three Averages and Census 2000 Sample Estimates, by County

County	County Code	Total			Self-Response			Interviewer-Response		
		ACS	Census	Difference	ACS	Census	Difference	ACS	Census	Difference
Reynolds County, MO	29179	9.2	19.2	-10.0	9.0	18.8	-9.8	10.2	21.5	-11.3
Iron County, MO	29093	7.6	16.0	-8.4	7.0	15.4	-8.4	8.6	17.1	-8.5
Zapata County, TX	48505	6.0	18.8	-12.8	7.5	21.4	NS -13.9	5.7	12.9	-7.2
Fulton County, PA	42057	7.7	15.8	-8.1	7.0	15.5	-8.5	8.8	17.1	-8.3
Washington County, MO	29221	7.2	17.3	-10.1	6.5	17.4	-10.9	8.0	17.8	-9.8
De Soto Parish, LA	22031	10.0	19.3	-9.3	9.6	19.1	-9.5	10.7	20.9	-10.2
Upson County, GA	13293	7.1	16.4	-9.3	7.4	17.0	-9.6	6.8	15.0	-8.2
Lake County, MT	30047	7.2	11.4	-4.2	6.3	12.9	-6.6	8.6	11.1	NS -2.5
Miami County, IN	18103	7.6	16.8	-9.2	7.4	15.0	-7.6	8.0	26.8	-18.8
Petersburg City, VA	51730	9.0	17.7	-8.7	9.0	16.6	-7.6	10.5	21.4	-10.9
Starr County, TX	48427	6.3	17.8	-11.5	9.6	23.6	-14.0	5.6	14.2	-8.6
Ohio County, WV	54069	7.4	15.4	-8.0	6.5	14.6	-8.1	10.4	18.4	-8.0
Vilas County, WI	55125	7.1	13.3	-6.2	7.4	7.3	NS 0.1	7.2	13.2	-6.0
Oneida County, WI	55085	7.1	11.4	-4.3	7.2	13.1	-5.9	7.0	10.9	-3.9
Calvert County, MD	24009	6.0	12.2	-6.2	6.0	11.4	-5.4	6.7	15.0	-8.3
Madison County, MS	28089	7.4	17.1	-9.7	7.2	14.0	-6.8	8.8	31.2	-22.4
Otero County, NM	35035	7.5	14.0	-6.5	7.3	12.3	-5.0	8.3	18.8	-10.5
Jefferson County, AR	05069	8.9	18.2	-9.3	8.9	16.2	-7.3	9.4	25.8	-16.4
Flathead County, MT	30029	6.9	14.9	-8.0	7.4	13.2	-5.8	6.6	20.5	-13.9
Sevier County, TN	47155	8.4	15.6	-7.2	7.6	14.8	-7.2	10.0	17.8	-7.8
Black Hawk County, IA	19013	7.3	13.5	-6.2	6.6	12.2	-5.6	9.9	20.3	-10.4
Schuylkill County, PA	42107	7.0	15.9	-8.9	7.1	15.1	-8.0	7.6	19.8	-12.2
Yakima County, WA	53077	9.6	15.9	-6.3	7.9	15.6	-7.7	12.6	17.2	-4.6
Rockland County, NY	36087	8.2	15.6	-7.4	6.8	14.1	-7.3	11.0	19.3	-8.3
Fort Bend County, TX	48157	7.7	15.5	-7.8	6.8	13.7	-6.9	9.9	20.3	-10.4
Tulare County, CA	06107	9.5	17.5	-8.0	8.1	15.9	-7.8	11.7	21.8	-10.1
Hampden County, MA	25013	7.9	16.2	-8.3	7.2	15.3	-8.1	9.5	19.5	-10.0
Douglas County, NE	31055	6.5	12.7	-6.2	6.2	11.4	-5.2	7.8	17.8	-10.0
Lake County, IL	17097	6.6	13.7	-7.1	6.4	12.0	-5.6	7.4	19.7	-12.3
Multnomah County, OR	41051	6.6	11.8	-5.2	6.2	10.8	-4.6	8.0	15.4	-7.4
San Francisco County, CA	06075	9.5	17.2	-7.7	9.4	15.7	-6.3	9.8	22.4	-12.6
Pima County, AZ	04019	7.4	13.5	-6.1	6.9	12.3	-5.4	9.0	18.1	-9.1
Franklin County, OH	39049	6.5	12.7	-6.2	6.1	11.2	-5.1	7.7	17.9	-10.2
Bronx Borough, NY	36005	11.1	25.1	-14.0	13.1	24.1	-11.0	9.7	27.7	-18.0
Broward County, FL	12011	7.6	15.0	-7.4	7.6	14.8	-7.2	8.0	15.9	-7.9
Harris County, TX	48201	7.9	16.6	-8.7	7.3	15.9	-8.6	9.4	19.0	-9.6

NS – The ACS three-year average and Census 2000 sample summary allocation rates for occupied housing units are not statistically different for this county.

Table A-5. Comparison of Summary Allocation Rates for Vacant Housing Unit Items: ACS Three Averages and Census 2000 Sample Estimates, by County

County	County Code	Vacant Housing Units		
		ACS	Census	Difference
Reynolds County, MO	29179	21.0	26.0	NS -5.0
Iron County, MO	29093	34.8	12.9	21.9
Zapata County, TX	48505	31.3	25.1	NS 6.2
Fulton County, PA	42057	25.4	19.1	NS 6.3
Washington County, MO	29221	40.2	21.8	18.4
De Soto Parish, LA	22031	24.8	16.5	NS 8.3
Upson County, GA	13293	12.7	20.7	NS -8.0
Lake County, MT	30047	24.7	21.0	NS 3.7
Miami County, IN	18103	21.3	23.1	NS -1.8
Petersburg City, VA	51730	20.0	23.0	NS -3.0
Starr County, TX	48427	22.9	22.9	NS 0.0
Ohio County, WV	54069	38.8	18.1	20.7
Vilas County, WI	55125	31.5	43.2	-11.7
Oneida County, WI	55085	26.8	34.5	NS -7.7
Calvert County, MD	24009	19.9	16.7	NS 3.2
Madison County, MS	28089	15.5	20.5	NS -5.0
Otero County, NM	35035	14.7	21.8	-7.1
Jefferson County, AR	05069	28.4	24.5	NS 3.9
Flathead County, MT	30029	16.1	14.4	NS 1.7
Sevier County, TN	47155	21.1	18.1	NS 3.0
Black Hawk County, IA	19013	32.0	21.5	10.5
Schuylkill County, PA	42107	31.2	20.9	10.3
Yakima County, WA	53077	21.6	21.7	NS -0.1
Rockland County, NY	36087	38.0	16.3	21.7
Fort Bend County, TX	48157	18.8	13.2	NS 5.6
Tulare County, CA	06107	28.6	21.4	7.2
Hampden County, MA	25013	20.2	18.7	NS 1.5
Douglas County, NE	31055	13.5	15.5	NS -2.0
Lake County, IL	17097	16.8	14.5	NS 2.3
Multnomah County, OR	41051	15.5	9.5	6.0
San Francisco County, CA	06075	15.6	16.1	NS -0.5
Pima County, AZ	04019	14.7	14.4	NS 0.3
Franklin County, OH	39049	16.7	10.6	6.1
Bronx Borough, NY	36005	26.7	27.0	NS -0.3
Broward County, FL	12011	13.5	13.6	NS -0.1
Harris County, TX	48201	19.3	12.1	7.2

NS – The ACS three-year average and Census 2000 sample summary allocation rates for vacant housing units are not statistically different for this county.

Table A-6. Comparison of Summary Allocation Rates for Population and Occupied Housing Unit Items: ACS Three Averages and Census 2000 Sample Estimates, by County

County	County Code	Total			Self-Response			Interviewer-Response		
		ACS	Census	Difference	ACS	Census	Difference	ACS	Census	Difference
Reynolds County, MO	29179	7.2	15.5	-8.3	10.5	14.9	NS -4.4	5.9	18.4	-12.5
Iron County, MO	29093	7.1	13.3	-6.2	9.6	12.5	NS -2.9	5.4	14.8	-9.4
Zapata County, TX	48505	4.9	15.6	-10.7	8.4	18.8	-10.4	3.8	9.4	-5.6
Fulton County, PA	42057	7.6	12.1	-4.5	8.7	11.8	NS -3.1	6.4	13.6	-7.2
Washington County, MO	29221	6.6	13.9	-7.3	9.0	13.3	-4.3	5.1	15.1	-10.0
De Soto Parish, LA	22031	8.4	15.2	-6.8	11.3	15.5	-4.2	5.7	14.8	-9.1
Upson County, GA	13293	7.8	13.4	-5.6	9.8	13.9	-4.1	5.5	12.4	-6.9
Lake County, MT	30047	6.6	8.9	-2.3	7.2	9.8	-2.6	6.1	8.8	NS -2.7
Miami County, IN	18103	6.5	14.3	-7.8	7.8	12.3	-4.5	4.9	24.8	-19.9
Petersburg City, VA	51730	7.9	15.2	-7.3	10.6	14.7	-4.1	5.7	17.0	-11.3
Starr County, TX	48427	4.7	12.1	-7.4	11.5	16.1	-4.6	3.0	10.2	-7.2
Ohio County, WV	54069	7.6	12.1	-4.5	7.5	11.3	-3.8	7.7	14.4	-6.7
Vilas County, WI	55125	6.7	11.5	-4.8	7.6	5.9	NS 1.7	5.7	11.5	-5.8
Oneida County, WI	55085	6.8	9.5	-2.7	7.7	10.2	NS -2.5	4.6	9.2	-4.6
Calvert County, MD	24009	5.6	10.1	-4.5	6.4	9.3	-2.9	4.6	12.5	-7.9
Madison County, MS	28089	6.5	14.4	-7.9	7.7	11.4	-3.7	5.6	27.8	-22.2
Otero County, NM	35035	6.5	11.1	-4.6	8.0	9.4	-1.4	4.9	14.9	-10.0
Jefferson County, AR	05069	7.9	15.3	-7.4	10.5	13.2	-2.7	5.5	22.1	-16.6
Flathead County, MT	30029	6.9	12.8	-5.9	8.4	10.8	-2.4	4.9	18.8	-13.9
Sevier County, TN	47155	7.3	12.7	-5.4	8.4	11.4	-3.0	6.0	15.5	-9.5
Black Hawk County, IA	19013	6.5	11.0	-4.5	7.2	9.5	-2.3	6.0	17.4	-11.4
Schuylkill County, PA	42107	6.3	12.0	-5.7	7.1	11.1	-4.0	4.8	16.1	-11.3
Yakima County, WA	53077	8.3	12.5	-4.2	8.6	12.3	-3.7	8.7	13.2	-4.5
Rockland County, NY	36087	7.3	12.4	-5.1	7.6	11.3	-3.7	7.3	15.3	-8.0
Fort Bend County, TX	48157	6.4	12.5	-6.1	7.0	10.7	-3.7	6.1	16.6	-10.5
Tulare County, CA	06107	7.9	14.7	-6.8	9.2	13.3	-4.1	7.3	17.9	-10.6
Hampden County, MA	25013	7.1	13.3	-6.2	8.0	12.3	-4.3	6.1	16.3	-10.2
Douglas County, NE	31055	6.0	10.5	-4.5	6.9	8.9	-2.0	4.8	15.8	-11.0
Lake County, IL	17097	6.3	11.5	-5.2	6.9	9.7	-2.8	5.7	16.4	-10.7
Multnomah County, OR	41051	6.2	10.1	-3.9	6.7	8.8	-2.1	6.0	13.9	-7.9
San Francisco County, CA	06075	8.2	14.0	-5.8	9.0	12.2	-3.2	7.3	19.3	-12.0
Pima County, AZ	04019	6.6	11.1	-4.5	7.3	9.8	-2.5	6.1	15.3	-9.2
Franklin County, OH	39049	5.5	10.6	-5.1	6.2	8.8	-2.6	4.8	15.5	-10.7
Bronx Borough, NY	36005	9.4	19.4	-10.0	13.5	18.7	-5.2	7.0	21.0	-14.0
Broward County, FL	12011	7.2	12.4	-5.2	8.3	11.6	-3.3	6.1	14.1	-8.0
Harris County, TX	48201	6.8	13.7	-6.9	8.1	12.9	-4.8	6.1	15.5	-9.4

NS – The ACS three-year average and Census 2000 sample summary allocation rates for population and occupied housing units are not statistically different for this county.

Table A-7. Comparison of Housing Unit and Household Population Sample Completeness Rates: ACS Three Averages and Census 2000 Sample Estimates, by County

County	County Code	Housing Unit Rates			Household Population Rates		
		ACS	Census	Difference	ACS	Census	Difference
Reynolds County, MO	29179	91.8	98.6	NS -6.8	86.6	98.1	NS -11.5
Iron County, MO	29093	93.0	95.6	NS -2.6	91.2	96.5	NS -5.3
Zapata County, TX	48505	74.4	87.0	-12.6	73.6	86.9	NS -13.3
Fulton County, PA	42057	94.0	95.4	NS -1.4	94.9	94.4	NS 0.5
Washington County, MO	29221	88.6	98.2	-9.6	84.0	98.6	-14.6
De Soto Parish, LA	22031	87.1	93.3	NS -6.2	83.1	94.9	-11.8
Upson County, GA	13293	95.9	91.1	NS 4.8	89.8	92.5	NS -2.7
Lake County, MT	30047	89.5	87.8	NS 1.7	87.5	88.5	NS -1.0
Miami County, IN	18103	95.4	78.6	16.8	96.2	81.9	14.3
Petersburg City, VA	51730	99.1	80.9	18.2	92.1	82.9	9.2
Starr County, TX	48427	86.9	88.1	NS -1.2	78.5	90.6	-12.1
Ohio County, WV	54069	100.2	95.3	4.9	99.5	96.5	NS 3.0
Vilas County, WI	55125	87.3	81.6	5.7	106.5	86.4	20.1
Oneida County, WI	55085	87.3	80.7	6.6	96.1	87.4	8.7
Calvert County, MD	24009	93.2	94.8	NS -1.6	91.6	95.2	NS -3.6
Madison County, MS	28089	95.4	87.5	7.9	90.4	89.7	NS 0.7
Otero County, NM	35035	85.3	92.8	-7.5	82.9	89.5	-6.6
Jefferson County, AR	05069	93.5	82.9	10.6	88.1	84.9	NS 3.2
Flathead County, MT	30029	94.8	96.3	NS -1.5	93.7	95.1	NS -1.4
Sevier County, TN	47155	83.4	93.8	-10.4	88.2	94.1	-5.9
Black Hawk County, IA	19013	96.4	90.6	5.8	93.5	92.9	NS 0.6
Schuylkill County, PA	42107	95.0	94.4	NS 0.6	93.7	95.6	NS -1.9
Yakima County, WA	53077	94.4	89.4	5.0	89.2	88.9	NS 0.3
Rockland County, NY	36087	101.2	94.5	6.7	97.1	94.6	NS 2.5
Fort Bend County, TX	48157	90.6	93.9	NS -3.3	84.4	93.4	-9.0
Tulare County, CA	06107	94.5	88.7	5.8	88.4	89.4	NS -1.0
Hampden County, MA	25013	96.0	88.7	7.3	92.8	90.1	2.7
Douglas County, NE	31055	95.5	93.4	2.1	93.8	93.7	NS 0.1
Lake County, IL	17097	98.1	93.2	4.9	94.0	93.8	NS 0.2
Multnomah County, OR	41051	96.3	95.0	1.3	93.9	94.4	NS -0.5
San Francisco County, CA	06075	92.9	87.6	5.3	88.3	88.0	NS 0.3
Pima County, AZ	04019	94.7	88.3	6.4	91.0	88.5	2.5
Franklin County, OH	39049	97.6	94.2	3.4	94.6	94.2	NS 0.4
Bronx Borough, NY	36005	92.0	77.8	14.2	83.4	79.8	3.6
Broward County, FL	12011	97.8	90.5	7.3	92.9	88.6	4.3
Harris County, TX	48201	94.6	89.9	4.7	90.7	90.1	NS 0.6

NS – The ACS three-year average and Census 2000 sample completeness rates are not statistically different for this county.

Appendix B
Design Factor Sources for the Census Quality Measure Standard Errors

For the self-response rates, housing unit nonresponse rates, and housing unit completeness rate, the largest design factor (see Summary File 3 Technical Documentation, released in 2003 at http://www.census.gov/prod/cen2000/doc/sf3.pdf) from the following housing unit characteristics was used to calculate the census standard errors.

- Race of householder
- Age of householder
- Type of residence

For the population completeness rate, the largest design factor from the following population characteristics were used to calculate the census standard errors.

- Race
- Age
- Household type and relationship
- Family type

For the item allocation rates, the following table lists the items for which an allocation rate was calculated, and the population/housing characteristic group which most relates to that item. The design factor for the population/housing characteristic group listed was applied to the item allocation rate standard errors. The bold housing unit allocation rate items are vacant housing unit items.

Table B-1. Design Factor Sources for the Census 2000 Sample Item Allocation Rate Standard Errors

Group Number	Design Factor Population/Housing Characteristic Group	Allocation Rate Item
Population Characteristics and Groups		
P1	Age	Age
P6	Household type and relationship	Relationship
P2	Sex	Sex
P3	Race	Race
P4	Hispanic or Latino	Hispanic
P5	Marital Status	Marital Status
P15	School enrollment	School enrollment
		Grade attending
P14	Educational attainment	Educational attainment
P13	Language spoken at home and ability to speak English	Non-English language
		Language spoken
		English ability
P9	Place of birth	Place of birth
P10	Citizenship status	Citizenship
P12	Year of entry	Year of entry
P11	Residence in 1995	Mobility status
		Migration – state

Group Number	Design Factor Population/Housing Characteristic Group	Allocation Rate Item
		Migration – county
		Migration – place
P7	Disabled and employment disability	Vision or hearing difficulty
		Physical difficulty
		Mental difficulty
		Self-care difficulty
		Difficulty going out
		Difficulty working at a job
P37	Grandparent status and responsibility for grandchild	Grandparent living at home
		Responsible for grandchildren
		Months responsible for grandchildren
P36	Military service and veteran status	Served in armed forces
		Periods of military service
		Years of active duty
P20	Employment status	Employment status
P26	Place of work	Place of work - state
		Place of work - county
		Place of work - place
P27	Means of transportation to work	Transportation to work
P29	Time leaving home to go to work	Time of departure
P30	Private vehicle occupancy	Carpool size
P28	Travel time to work	Commuting time
P24	Usual hours worked per week and weeks worked in 1999	When last worked
		Weeks worked last year
		Hours worked each week
P21	Industry	Industry
P22	Occupation	Occupation
P23	Class of worker	Class of worker
P31	Type of Income in 1999	Wages & salary income
		Self-employment income
		Interest, dividend, etc. income
		Social security/railroad retirement
		Supplemental security income
		Public assistance
		Retirement income
		Other income
		All income allocated
Housing Unit Characteristics and Groups		
H5	Tenure	Tenure
		Year moved in
H4	Units in structure	**Units in structure/building size**
H10	Year structure built	**Year built**
H11	Rooms, bedrooms	**Rooms**
		Bedrooms

Group Number	Design Factor Population/Housing Characteristic Group	Allocation Rate Item
H13	Plumbing facilities	**Complete plumbing**
H12	Kitchen facilities	**Complete kitchen**
		Telephone
H14	House heating fuel	Heating fuel
		Electricity cost
		Gas cost
		Water and sewer cost
		Other fuel cost
H16	Vehicles available	Number of vehicles
H22	Type of residence	**Business on property**
		Lot size
		Agricultural sales
H8	Gross rent	**Monthly rent**
		Meals in rent
H19	Mortgage status and selected monthly owner costs	Mortgage
		Mortgage payments
		Payment includes property taxes
		Payment includes insurance
		Second mortgage payment
		Yearly real estate taxes
		Yearly property insurance
		Total cost on mobile home
H7	Value	**Value**
H6	Occupancy status	**Vacancy status**

Appendix C
Quality Measures Scatter Plots for Counties

This Appendix contains one dimensional scatter plots of the county-level differences between the quality measures for the ACS three-year averages and Census 2000 sample estimates.

Differences between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; counties and, in Figures C-4, C-5, and C-6, quality measures, are on the horizontal axis. We sorted counties using the same sort with which we sorted the counties in the tables in appendix A - by their 100 percent count of census housing units (for Figures C-4, C-5, and C-6, we sorted counties within each quality measure). The sorts were in ascending order, from left to right. For example, the second point in Figure C-2 (going left to right) corresponds to Iron County, MO (county code 29093) in Table A-1. Similarly, the 31st point in Figure C-1 corresponds to San Francisco County, CA (county code 06075).

An "X" on the scatter plots indicates a county with a statistical differences; circles indicate counties whose differences are not statistically different. A difference is defined to be the ACS three-year average quality measure minus the Census 2000 sample quality measure. These graphs were produced in SAS using data from the Quality Measures Comparison Files.

Figure C-1. Scatter Plot of Differences in Self-Response Rates, by County

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

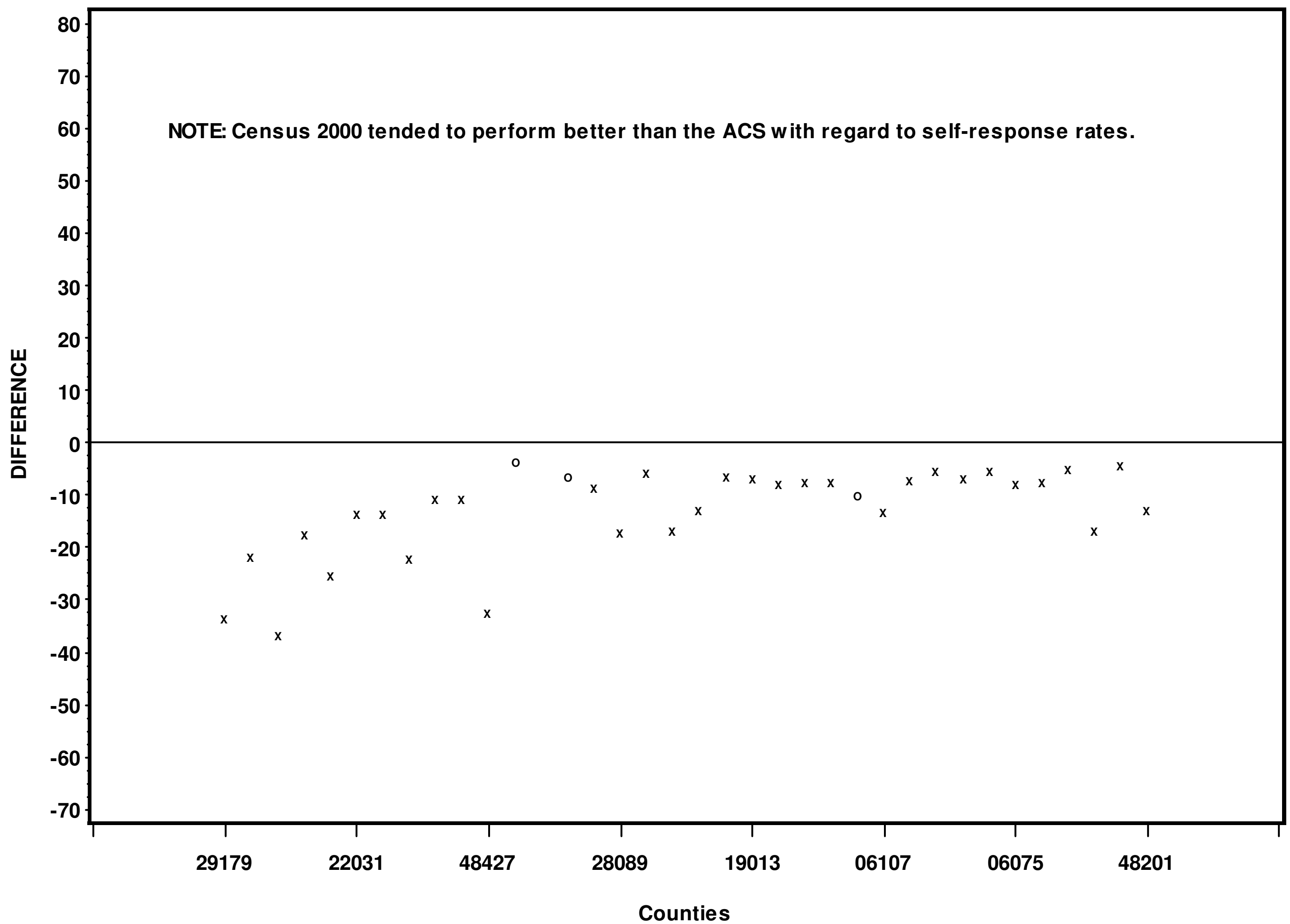


Figure C-2. Scatter Plot of Differences in Total Housing Unit Nonresponse Rates, by County

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

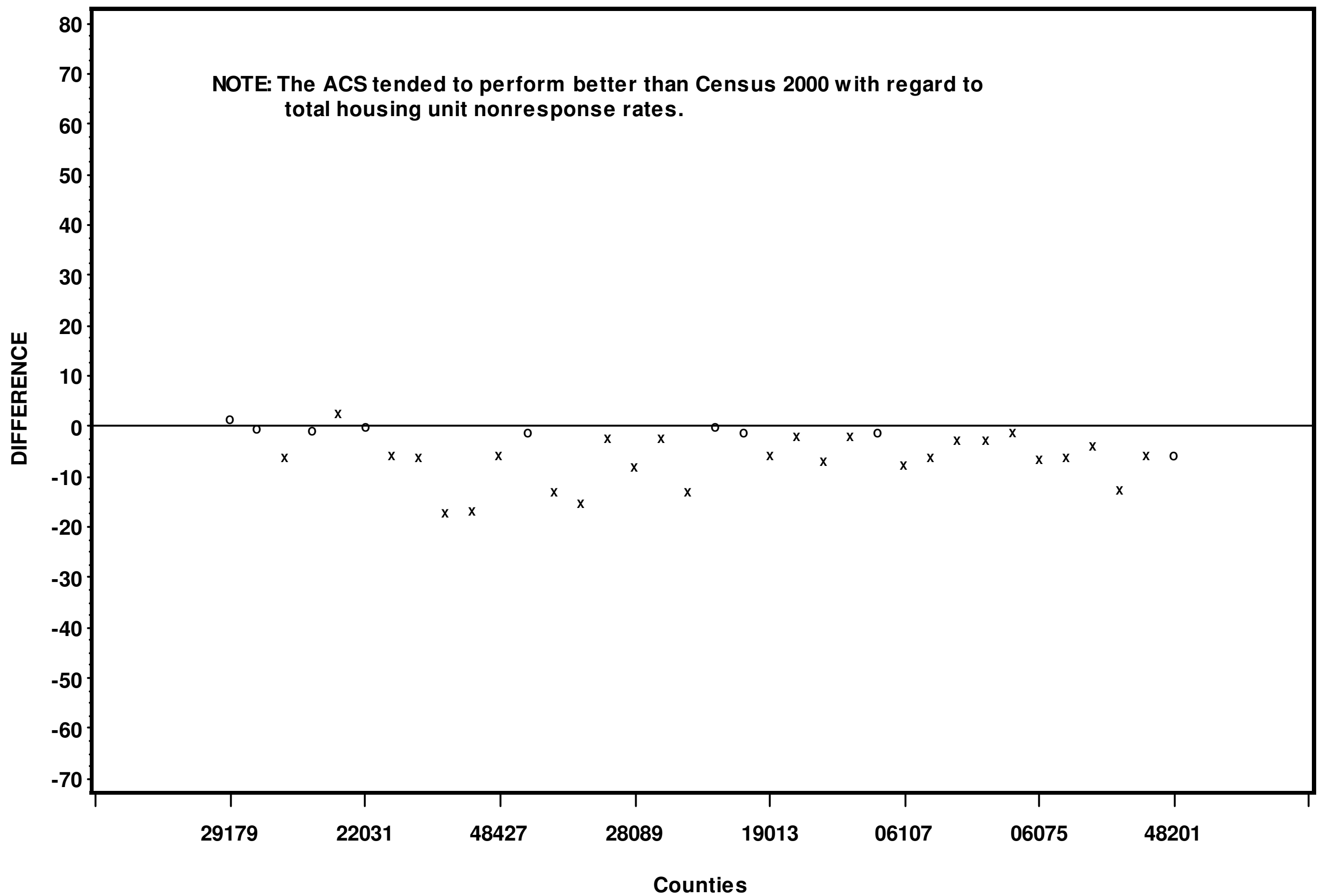


Figure C-3. Scatter Plot of Differences in Occupied Housing Unit Nonresponse Rates, by County

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

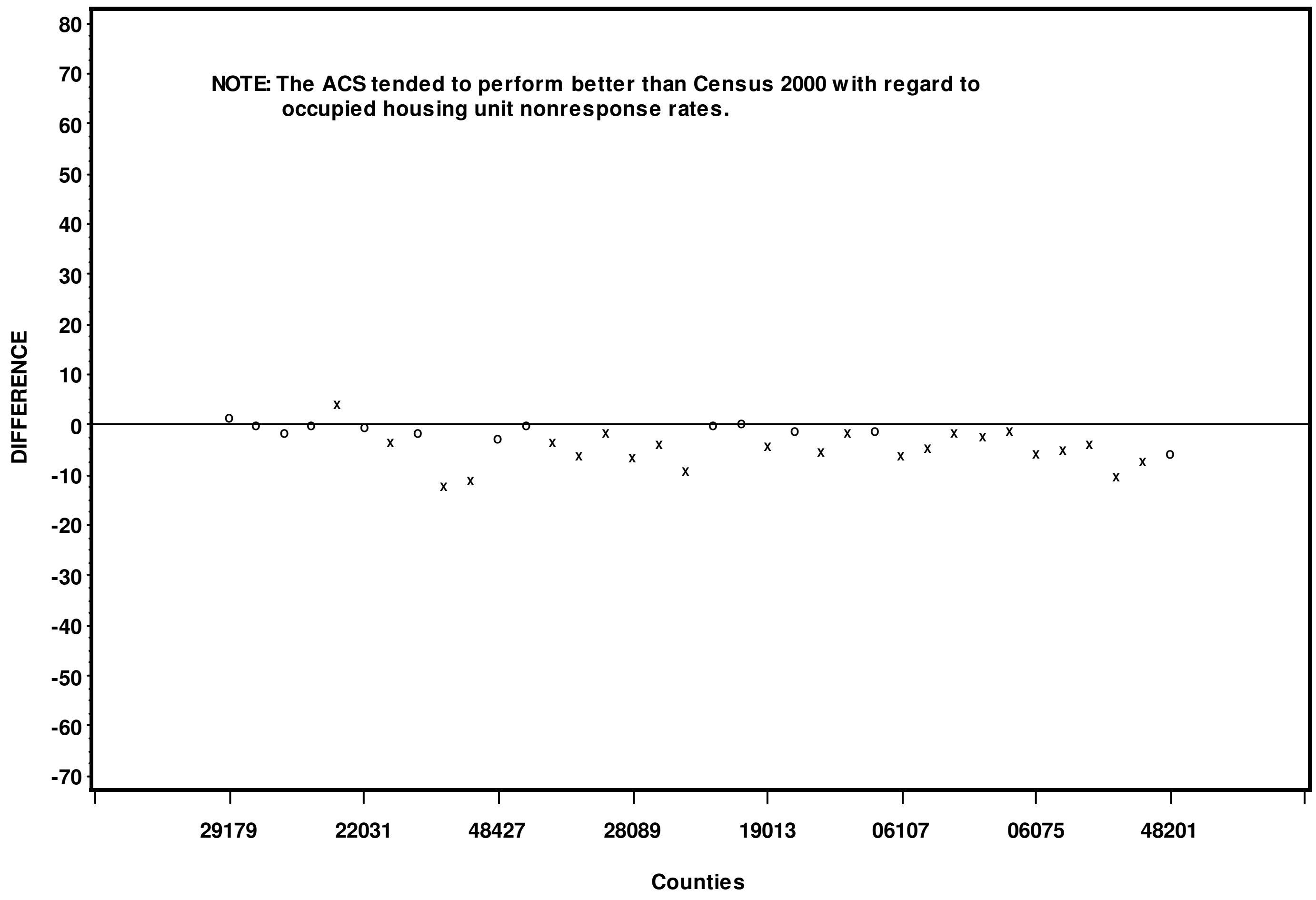


Figure C-4. Scatter Plot of Differences in Summary Allocation Rates for Population Items, by County

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

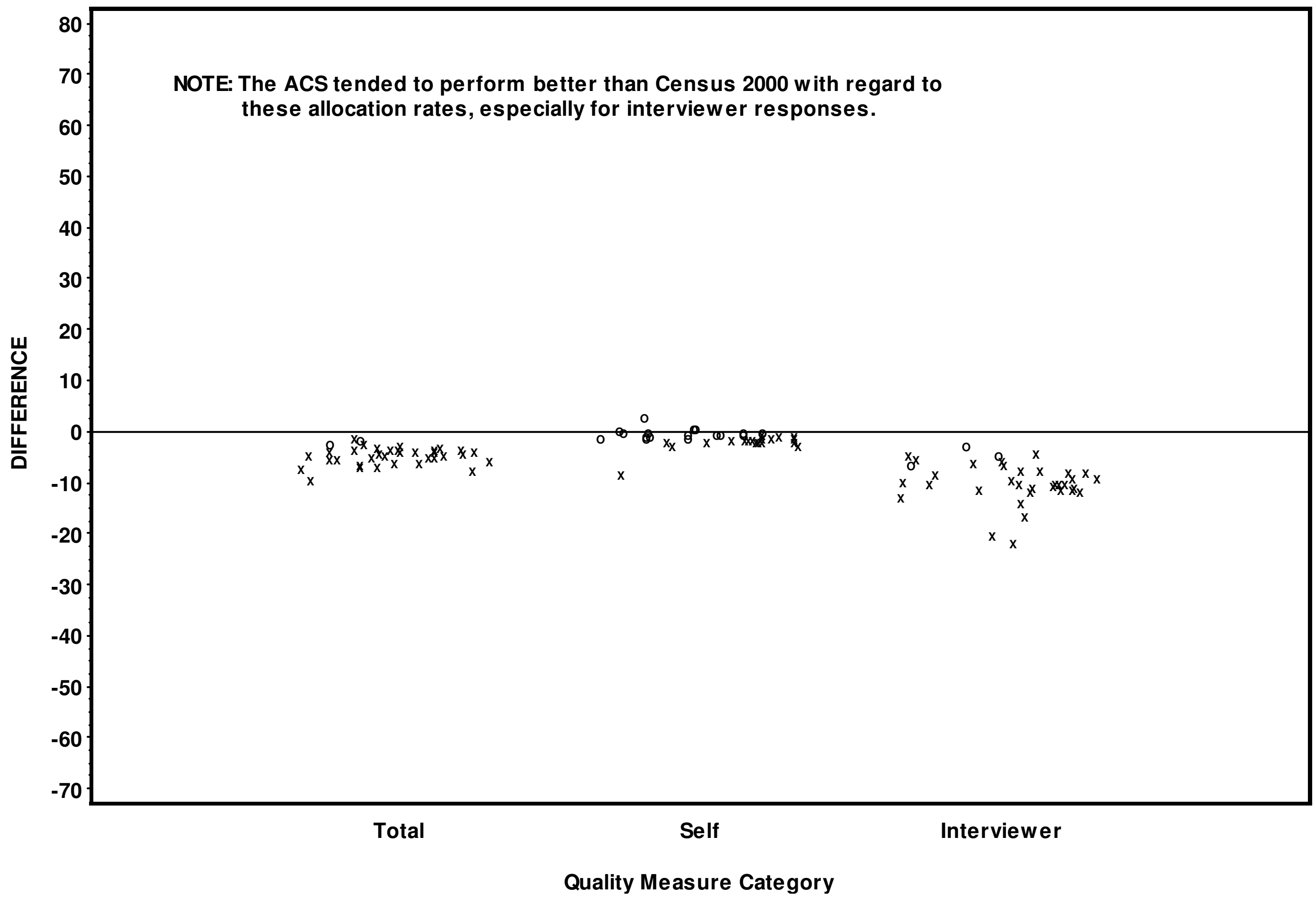


Figure C-5. Scatter Plot of Differences in Summary Allocation Rates for Housing Unit Items, by County

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

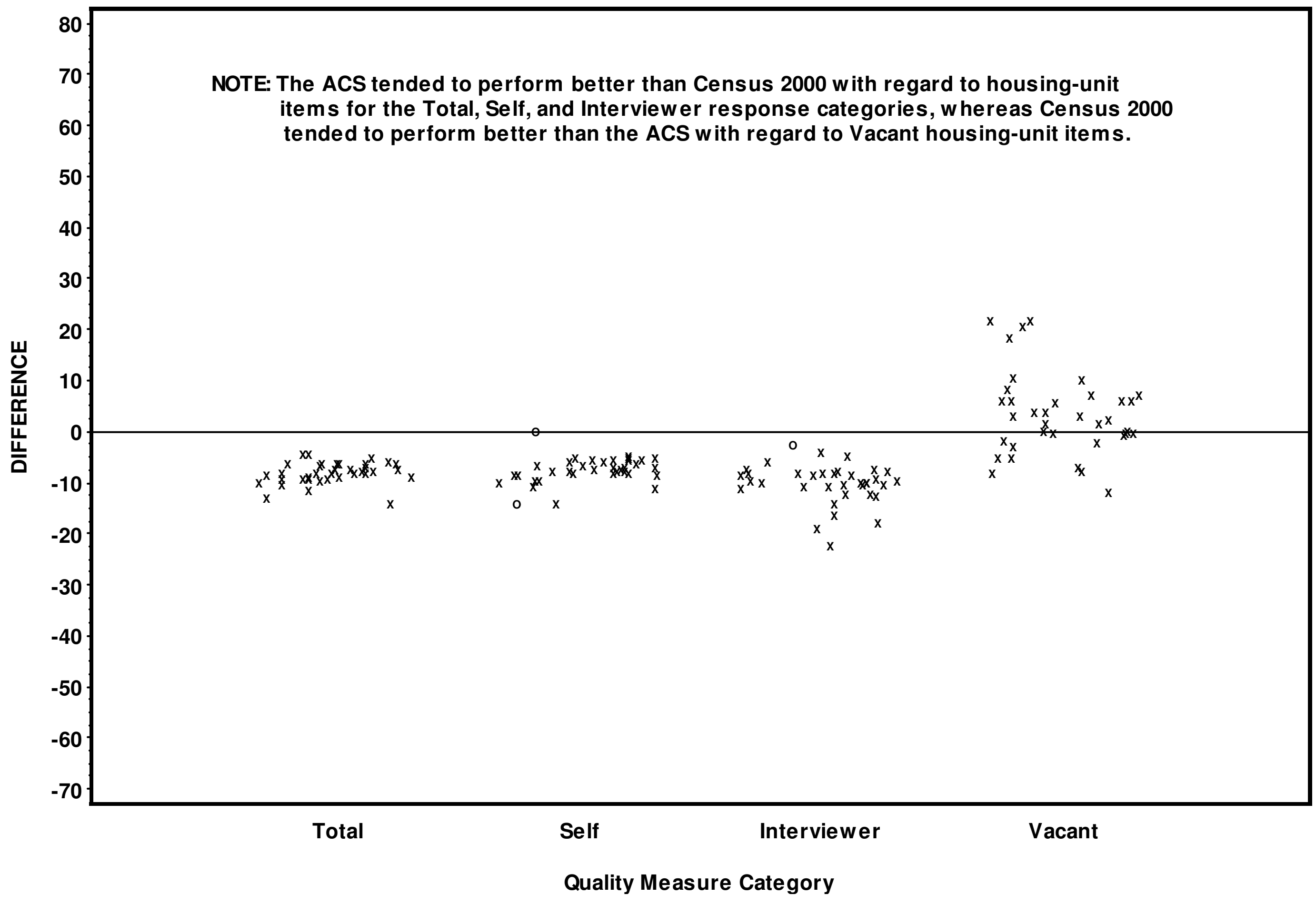


Figure C-6. Scatter Plot of Differences in Summary Allocation Rates for Population and Occupied Housing Unit Items, by County

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

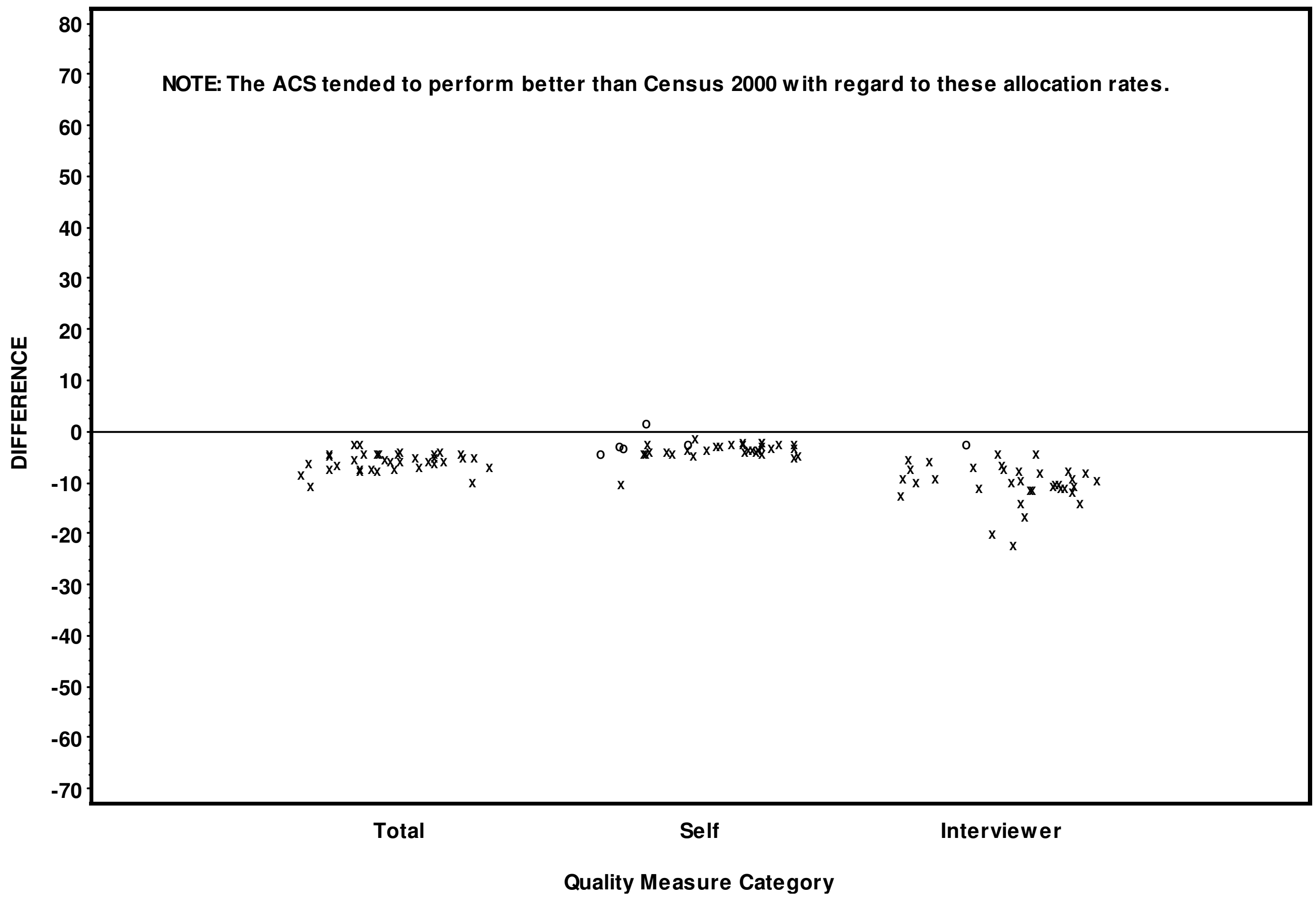


Figure C-7. Scatter Plot of Differences in Housing Unit Sample Completeness Rates, by County

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

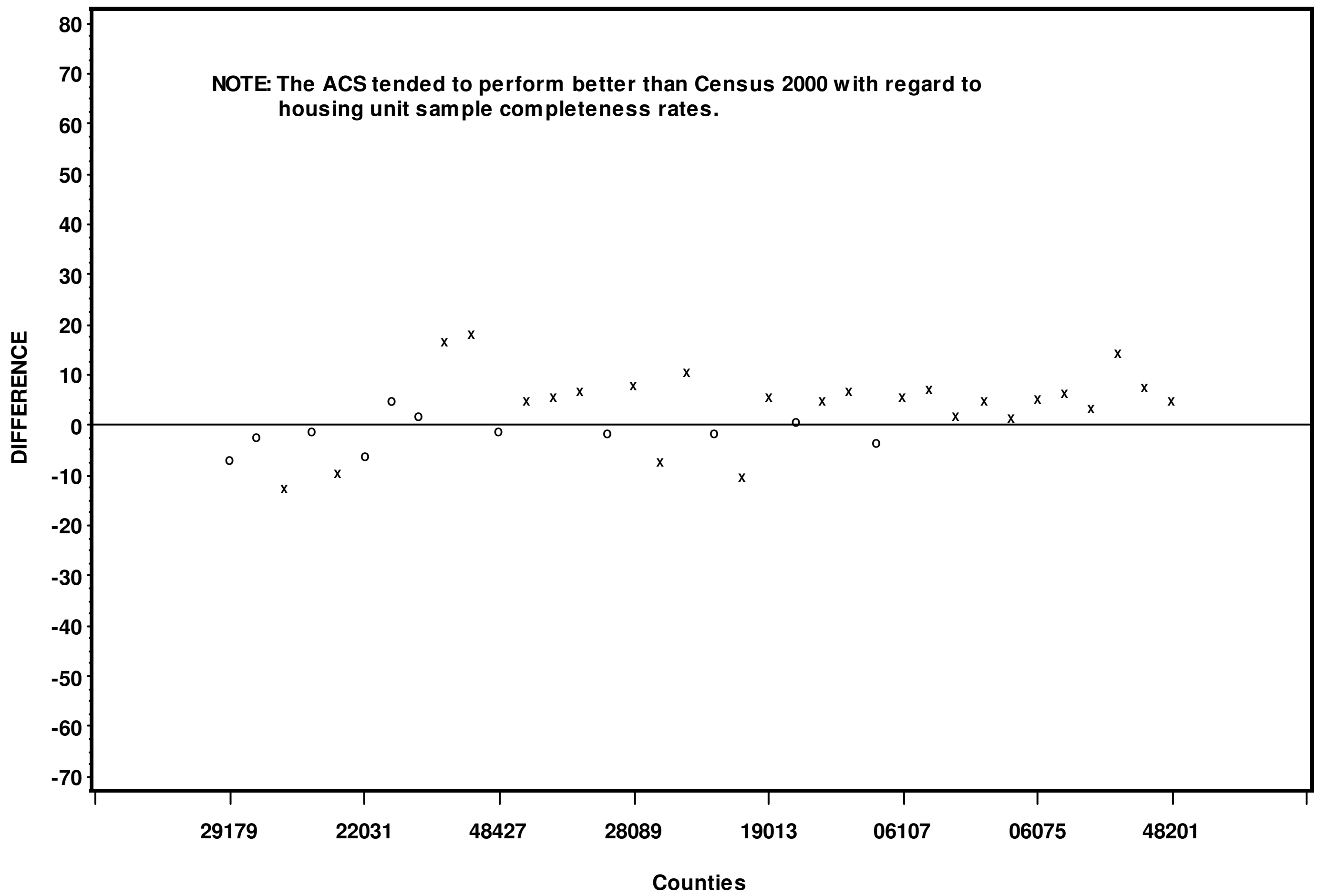
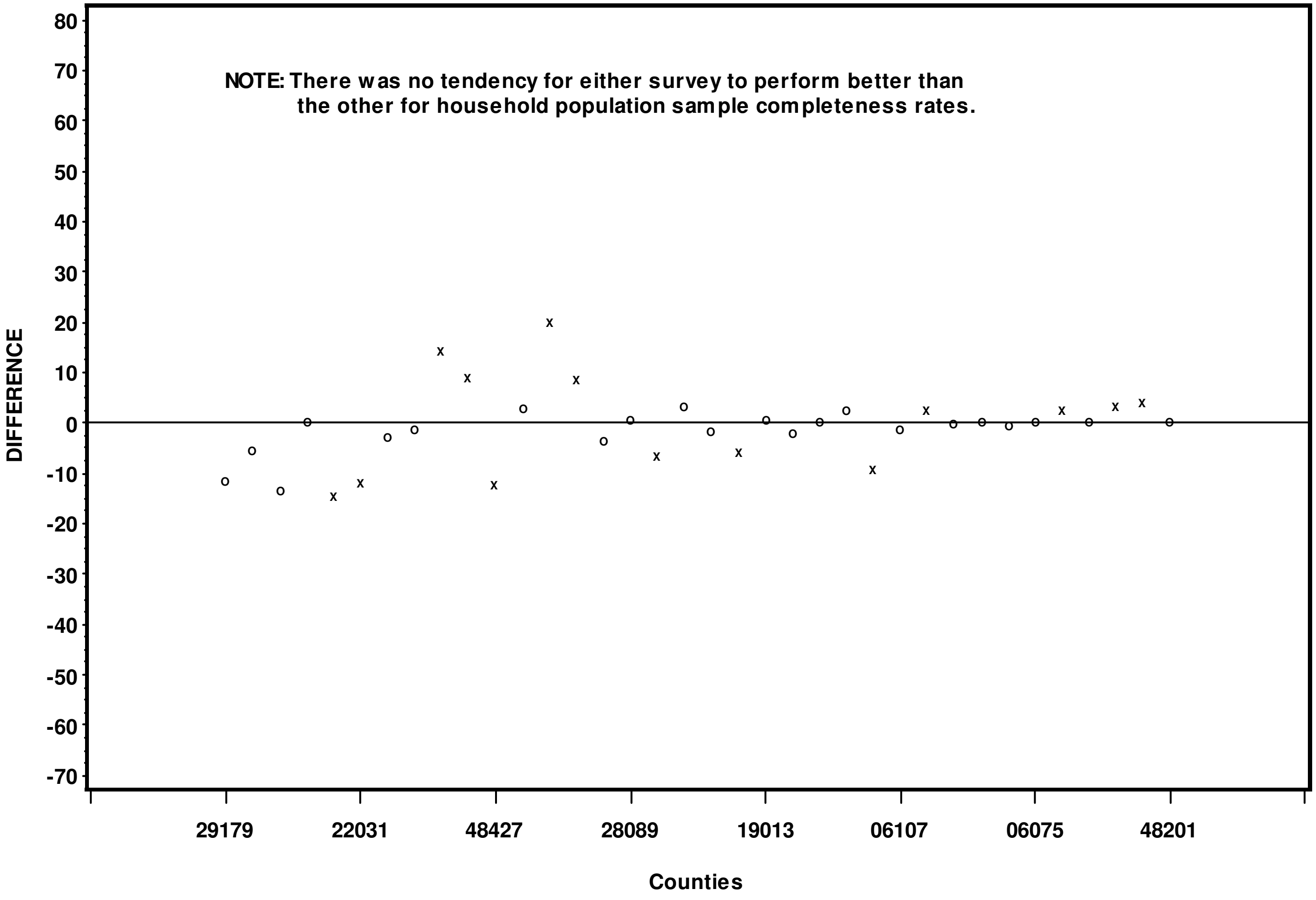


Figure C-8. Scatter Plot of Differences in Household Population Sample Completeness Rates, by County

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant



Appendix D
Quality Measures Scatter Plots for Tracts

This Appendix contains one dimensional scatter plots of the tract-level differences between the quality measures for the ACS three-year averages and Census 2000 sample estimates. We grouped all of the tract-level differences in each graph by tract group. So, there are five sets of one-dimensional scatter plots in each graph, one set of plots for each tract group. Each graph represents one quality measure.

Differences between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; tracts and tract groups are on the horizontal axis. We sorted tracts within each tract group by their 100 percent count of census housing units. The sorts were in ascending order, from left to right, within each tract group. For example, the difference for the tract with the smallest count is the left-most point within each tract group, while the difference for the tract with the largest count is the right-most point within each tract group. We used a "jittering" process so that we could plot the differences in this way. Within each tract group, the "jittering" process assigned a real number to each tract so as to achieve this sort, where the tracts with the smallest counts received the smallest real numbers, etc.

The tract groups are:

- Group 1 - tracts in small counties (under 100,000 persons) and tract population greater than 500 (207 tracts)
- Group 2 - tracts in medium counties (100,000 - 1,000,000 persons) and tract population between 500 and 4000 (592 tracts)
- Group 3 - tracts in medium counties (100,000 - 1,000,000 persons) and tract population greater than 4000 (580 tracts)
- Group 4 - tracts in large counties (1,000,000+ persons) and tract population between 500 and 4000 (401 tracts)
- Group 5 - tracts in large counties (1,000,000+ persons) and tract population greater than 4000 (470 tracts)

An "X" on the scatter plots indicates tracts with statistical differences; a circle indicates tracts whose differences are not statistically different. The difference is defined to be the ACS three-year average quality measure minus the Census 2000 sample quality measure. These graphs were produced in SAS using data from the Quality Measures Comparison Files.

Figure D-1. Scatter Plot of Differences in Self-Response Rates, by Tract

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

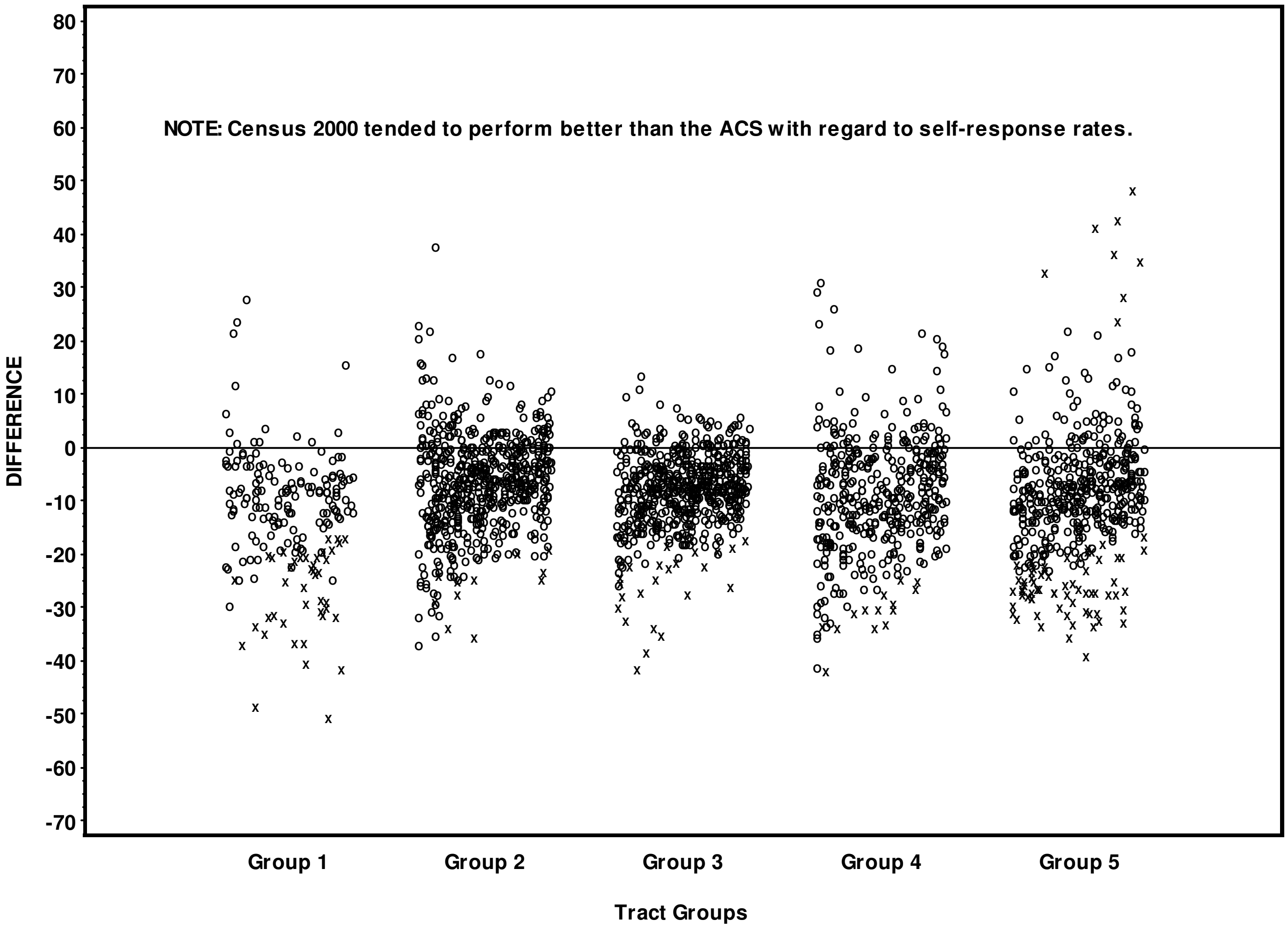


Figure D-2. Scatter Plot of Differences in Total Housing Unit Nonresponse Rates, by Tract

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

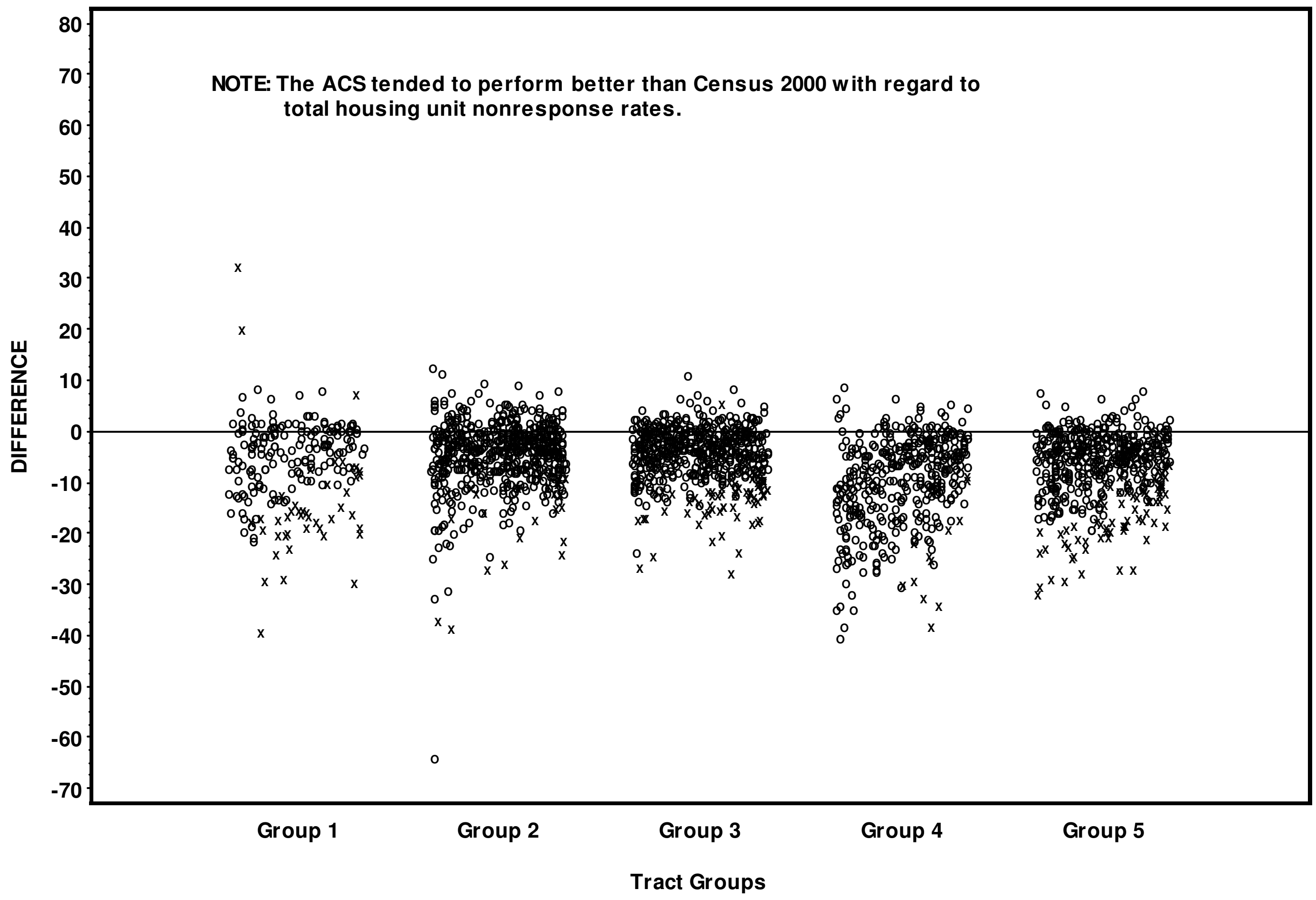


Figure D-3. Scatter Plot of Differences in Occupied Housing Unit Nonresponse Rates, by Tract

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

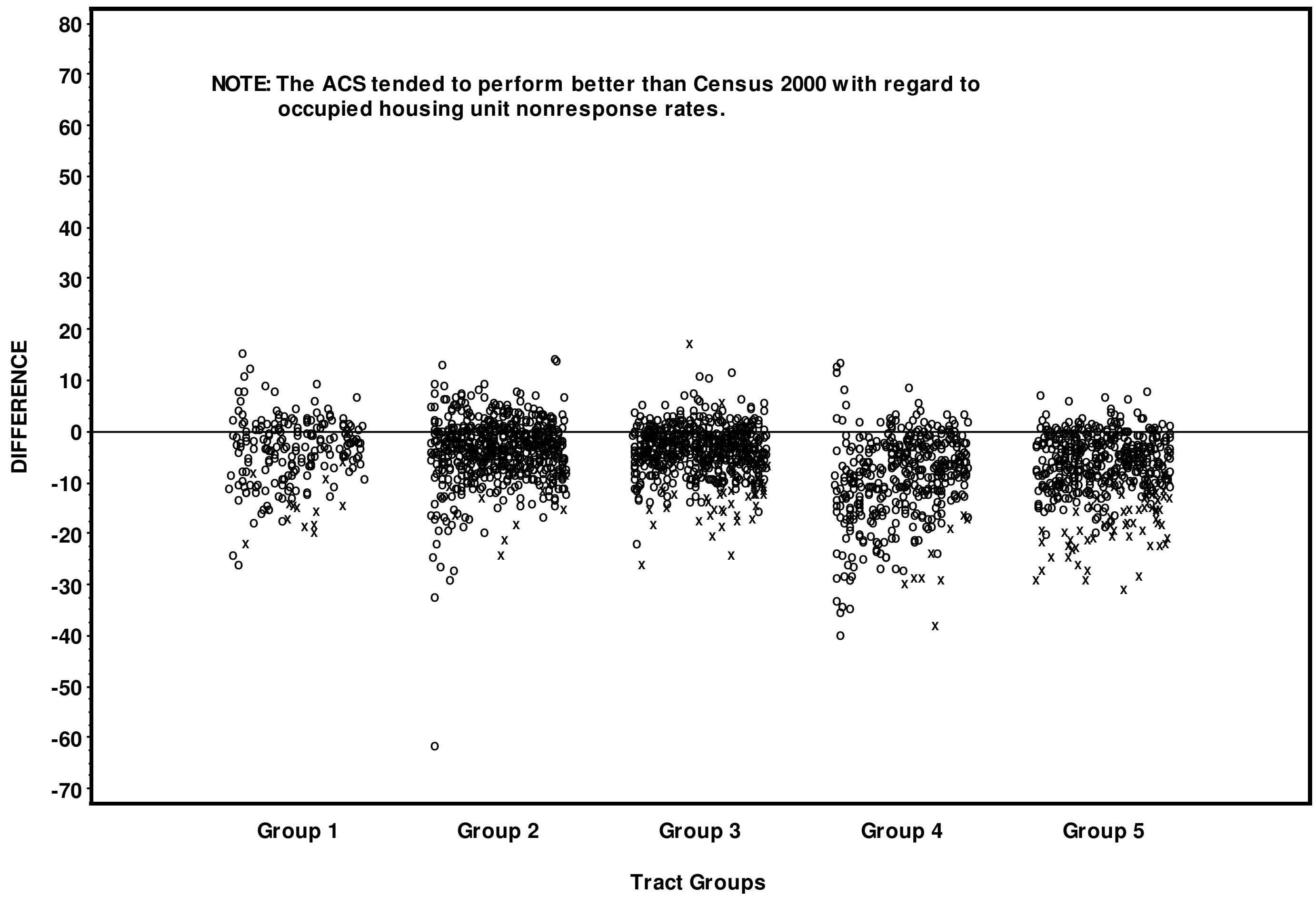


Figure D-4. Scatter Plot of Differences in Summary Allocation Rates for Population Items, by Tract

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

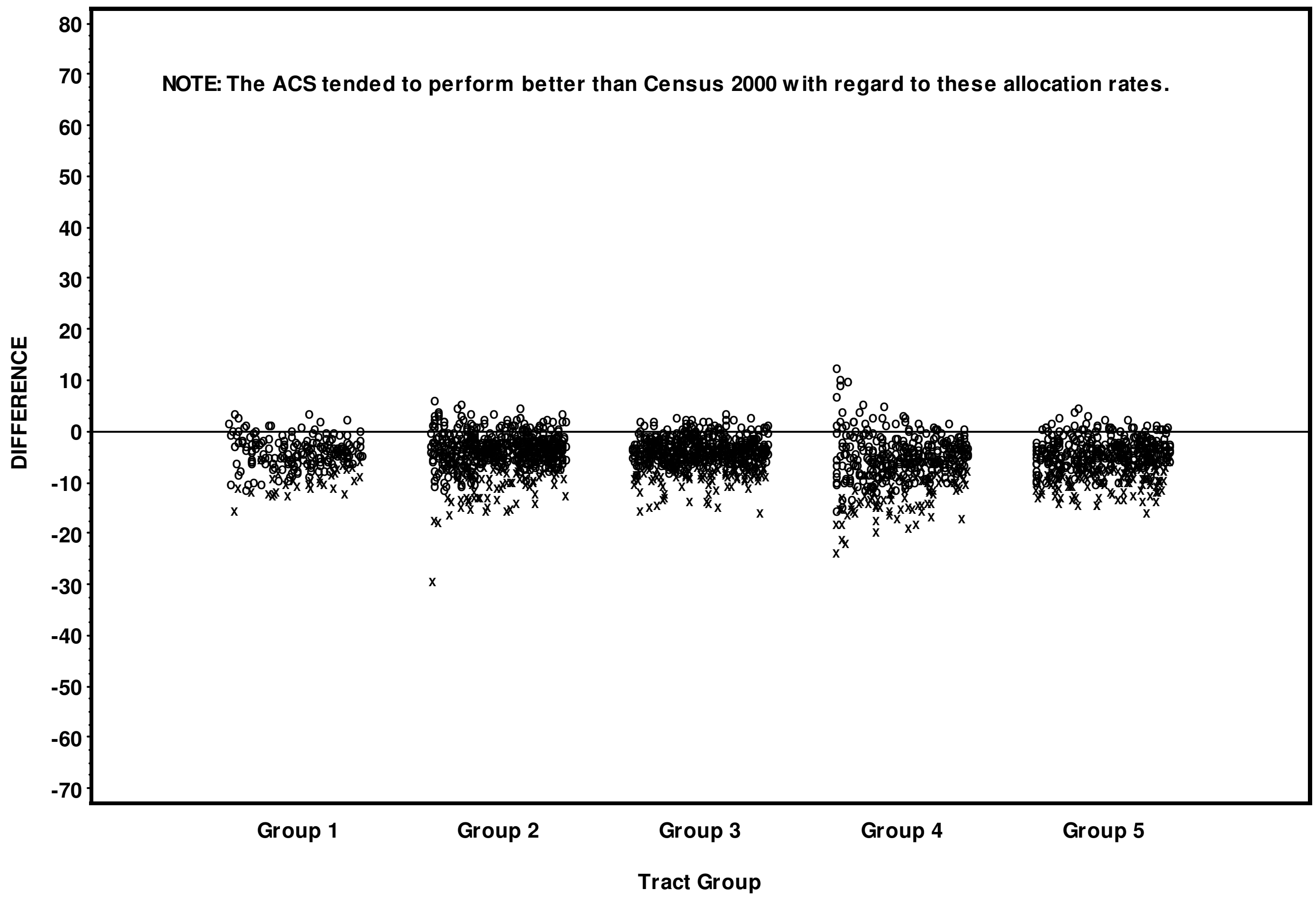


Figure D-5. Scatter Plot of Differences in Summary Allocation Rates for Occupied Housing Unit Items, by Tract

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

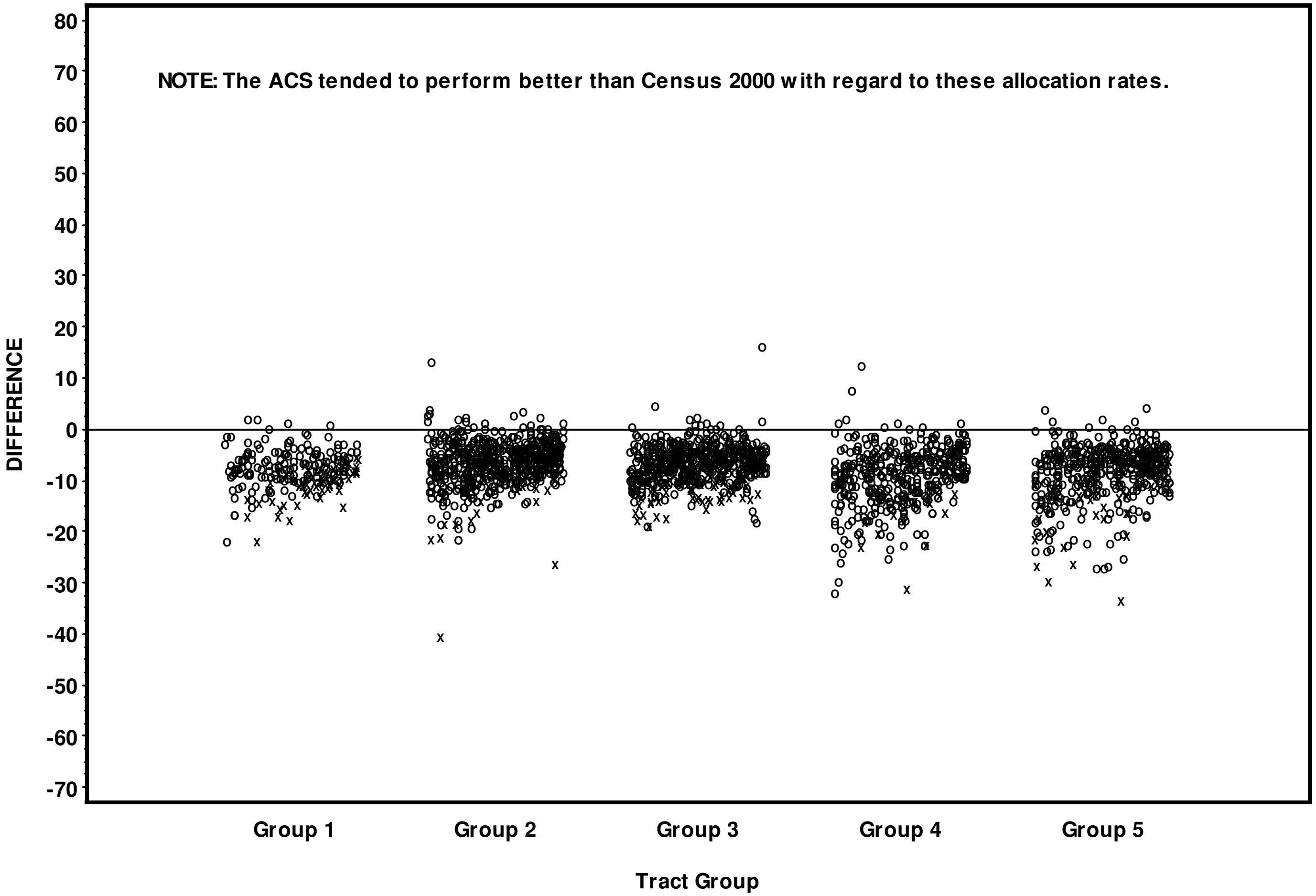


Figure D-6. Scatter Plot of Differences in Summary Allocation Rates for Vacant Housing Unit Items, by Tract

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant

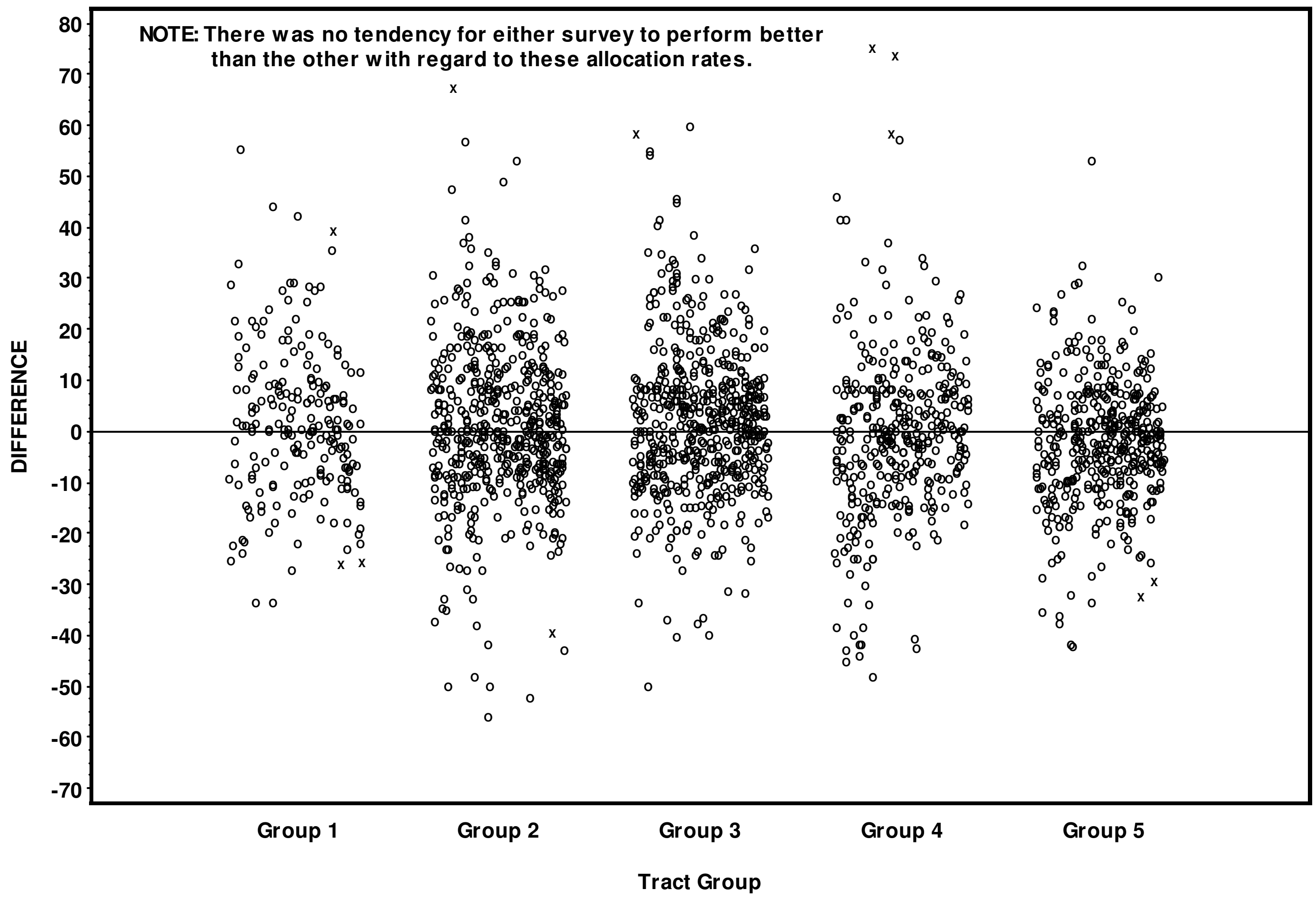


Figure D-7. Scatter Plot of Differences in Summary Allocation Rates for Population and Occupied Housing Unit Items, by Tract

Difference = ACS quality measure - Census quality measure
X represents a statistically significant difference
O represents a difference that's not statistically significant