

Instructions for Applying Statistical Testing to ACS Data

The 2004 ACS estimate for the percent of grandparents living with and responsible for grandchildren is 65.1 for Arkansas and 64.8 for Nebraska. The 2003 estimate for Arkansas for the same characteristic is 61.2. When reporting these results, what comparisons can be stated as facts? Can you say “The ACS found a larger percent of grandparents living with and responsible for grandchildren in Arkansas than in Nebraska in 2004”? What about “for Arkansas, the 2004 estimate is higher than the 2003 estimate”? Census policy is to make these statements only if the comparisons are “statistically significant” at the 90 percent confidence level (or to note that the apparent difference is not statistically significant). This means that there is less than a 10 percent chance that the difference between the two estimates would be as large or larger by random chance alone. The determination of statistical significance takes into account the difference between the two estimates as well as the standard errors of both estimates.

Users including ACS estimates in written reports and other documents need to be careful when making comparisons between two (or more) ACS estimates, between an ACS estimate and a fixed value, or between an ACS estimate and a value from another survey or other source. If you want to say

- “Estimate X is bigger than estimate Y.”
- “Estimate X this year is larger than estimate X last year.”
- “Estimate X is smaller than that value in Census 2000.”
- “State Z has the highest value of this characteristic.”

or any similar statement, you need to first do the appropriate statistical test and determine whether the difference is statistically significant.

This document provides some basic instructions for performing the statistical testing , as well as obtaining the ACS standard errors needed to do statistical tests.

Obtaining Standard Errors

Where your standard errors come from, and whether they are readily available or you have to calculate them yourself, depends on where your ACS data is coming from. If the estimate of interest is published on American FactFinder (AFF), then AFF should also be the source of your standard errors. Possible sources for your data, and where to get standard errors:

1. ACS data from published tables on American FactFinder

All ACS estimates from tables on AFF include either 90 percent confidence bounds a 90 percent margin of error. The margin of error is the maximum difference between the estimate and the upper and lower confidence bounds. If confidence bounds are provided, calculate the margin of error first:

Margin of Error = max(upper bound - estimate, estimate - lower bound)

If the margin of error is already available, just use the value without the “+/-“ prefix (i.e., the “absolute value”).

Next:

Standard Error = Margin of Error / 1.65

2. ACS tabulations made especially for you by the Data Products Branch in ACSO

Standard errors are included in tabulation files provided by ACSO.

3. ACS tabulations (of the ACS person-level or housing unit-level data files) that you created

In this case, you should calculate the standard errors directly using available replicate weight files. Recalculate the desired estimates using the ACS sample weight, and at the same time calculate 80 replicate estimates using the “replicate weights”. These replicate estimates are then used to calculate the variance. This is the method used to calculate the ACS standard errors used to create the margins of error and confidence bounds on AFF.

Until an official replicate standard error program is designated, users are urged to contact the ACS Design Branch in DSSD for further assistance in calculating the standard errors if you are creating your ACS estimates this way.

4. ACS public-use microdata sample (PUMS) tabulations

Standard errors for tabulations from the ACS PUMS files should be computed using the parameters and methods described in the 2004 Accuracy of the PUMS documentation, available at <http://www.census.gov/acs/www/Downloads/2004/AccuracyPUMS.pdf> .

NOTE: ACS PUMS design factors *should not* be used to calculate standard errors of full ACS sample estimates, such as those on AFF. Census 2000 design factors *should not* be used to calculate standard errors for *any* ACS estimate.

Obtaining Standard Errors for Derived Estimates

Once you have obtained standard errors for your basic estimates, there may be situations where you create derived estimates, such as percentages or differences, that also require standard errors.

If you're doing your own tabulations and calculating the standard errors using replicate estimates (#3, above), the standard errors for these derived estimates should be computed using replicate estimates as well.

- Sum or Difference of Estimates

$$SE(A + B + K) = SE(A - B - K) = \sqrt{SE(A)^2 + SE(B)^2 + K}$$

- Proportions and Percents

Here we define a proportion as a ratio where the numerator is a subset of the denominator, for example the proportion of persons 25 and over with a high school diploma or higher.

$$\text{Let } P = \frac{A}{B}.$$

$$SE(P) = \frac{1}{B} \sqrt{SE(A)^2 - P^2 \times SE(B)^2}$$

If the value under the square root sign is negative, then instead use

$$SE(P) = \frac{1}{B} \sqrt{SE(A)^2 + P^2 \times SE(B)^2}$$

If $P=1$ then use

$$SE(P) = \frac{SE(A)}{B}$$

If $Q = 100\% \times P$ (a percent instead of a proportion), then $SE(Q) = 100\% \times SE(P)$.

- Means and Other Ratios

If the estimate is a ratio but the numerator is not a subset of the denominator, such as persons per household or per capita income, then

$$SE\left(\frac{A}{B}\right) = \frac{1}{B} \sqrt{SE(A)^2 + \left(\frac{A}{B}\right)^2 \times SE(B)^2}$$

Users may combine these procedures for complicated estimates. For example, if the desired estimate is $P = \frac{A + B + C}{D + E}$, then $SE(A+B+C)$ and $SE(D+E)$ can be estimated first, and then those results used to calculate $SE(P)$.

Users should be cautioned that all methods in this section are approximations. They may be overestimates or underestimates of the estimate's standard error, and may not match direct calculations of standard errors or calculations obtained through other methods.

Instructions for Statistical Testing

Once standard errors have been obtained, doing the statistical test to determine significance is not difficult. For two estimates, A and B, with standard errors SE(A) and SE(B), let

$$Z = \frac{A - B}{\sqrt{(SE(A))^2 + (SE(B))^2}}$$

If $Z < -1.65$ or $Z > 1.65$, then the difference between A and B is significant at the 90 percent confidence level. Otherwise, the difference is not significant.

This method can be used for any types of estimates: counts, percentages, proportions, means, medians, etc. It can be used for comparing across years, or across surveys. If one of the estimates is a fixed value or comes from a source without sampling error (such as the Census 2000 SF1), use zero for the standard error for that estimate in the above equation for Z.

This is the method used in determining statistical significance for the ACS Multi-Year Profiles published on AFF. Note that, especially if you're using method #1 above for obtaining your standard errors, your determination of statistical significance may not match the Multi-Year Profile's result for the same pair of estimates, because the significance tests for the Multi-Year Profiles are made using unrounded standard errors. Standard errors obtained from the rounded confidence bounds and margins of error are unlikely to match the unrounded standard error, and so statistical tests may differ.

Using the rule of thumb of overlapping confidence intervals does not constitute a valid significance test and users are discouraged from using that method.