Percent Changes

The purpose of this documentation is to provide data users with a basic understanding of the estimation methodology and the accuracy of the ACS data for multi-year percent changes.

Multi-year percent change tables and profiles will be tabulated using the geography from the end of each year of data collection (eg., data collected in 1998 will use 1998 geography, data collected in 1997 will use 1997 geography, etc.). The one exception to this rule is that the 1996 data used 1997 geography.

PERCENT CHANGE

There are two different percent change products:

1. Previous year to the current year. Examples would be 1996 to 1997 or 1997 to 1998.
2. Initial year to the current year. An example would be 1996 to 1998.

For this documentation, initial year refers to the first year (Either previous or initial year) in the percent change and final year refers to last year (or current year) in the percent change.

Computing the Percent Change

$$\%CHG = \frac{EST_{\text{final year}} - EST_{\text{initial year}}}{EST_{\text{initial year}}} * 100$$

Exceptions to the above formula:

1. If the estimate for the initial year ($EST_{\text{initial year}}$) is less than zero then the %CHG estimate should have the opposite sign.

2. If the estimate for the initial year is equal to 0 then the %CHG estimate was given a value of "- -" and the standard error a value of "***".

Computing the Initial Year to Final Year Percent Change Standard Error

First you need to calculate the standard errors for the initial year and final year estimates. The procedures for calculating the standard errors for individual years can be found in the Accuracy of the Data documents for the appropriate years.

Now that we have standard errors for both the initial year and final year estimates, we can calculate standard errors for the percent change from initial year to final year.

The standard error for the percent change is calculated as follows:

$$\text{SE(\%CHG)} = \left|\frac{EST_{\text{final year}}}{EST_{\text{initial year}}}\right| * \sqrt{\frac{SE^2_{\text{final year}}}{EST^2_{\text{final year}}} + \frac{SE^2_{\text{initial year}}}{EST^2_{\text{initial year}}}} * 100$$

Exceptions to the above formula:

1. If the estimate for the final year is equal to zero then the standard error was given a value of "****".

2. If both the initial year and final year standard errors are zero due to the estimates being controlled, then the standard error was given a value of "*****".

3. If the standard error for either the initial year or final year would be assigned a value of "*" (too few sample observations to compute a stable estimate of the standard error), then the standard error was given a value of "*".

Computing the Initial Year to Final Year Percent Change Upper and Lower Bounds

If the standard error for percent change is "*", "***", "****", or "*****", then the values of the lower and upper bounds were assigned the same number of *'s as the standard error, and the value of significance was assigned "- -".

For all other estimates the lower and upper bounds for the %chg estimate were calculated as follows:

lower bound (lb) = %chg - 1.65 * se(%chg)

upper bound (ub) = %chg + 1.65 * se(%chg)

To determine significance, use the following algorithm:

If either lb or ub is equal to zero, then the percent change is not statistically significant.

If both lb and ub have the same sign (that is both are positive or both are negative), then the percent change is statistically significant.

If lb and ub have different signs (that is one is positive and one is negative), then the percent change is not statistically significant.

Examples

We will present some examples to demonstrate the use of the formulas.

Example 1

Our first example is of a 1996 to 1998 percent change. In this example, 1996 is the initial year and 1998 is the final year for our formulas. We are interested in estimating the percent change for aggregate travel time to work (in minutes) for Multnomah County, OR. This is summary table P38. Since there are no formulas for determining standard errors for aggregates, we must use the standard errors provided in the summary tables. For 1996 we use the 1996 data in 1997 geography summary tables, and obtain an estimate of 6,429,326 and a standard error of 36,768. For 1998 we obtain an estimate of 6,613,917 and an *upper bound* of 6,751,753. We can use the upper bound to obtain the standard error, thus the standard error = (upper bound - estimate) / 1.65.

standard error for 1998 = (6,751,753 - 6,613,917) / 1.65 = 83,536.9697 = 83,537.

$$\%CHG = \frac{6,613,917 - 6,429,326}{6,429,326} * 100 = 2.9\%$$

Since we have the standard errors for the 1996 and 1998 estimates, we can obtain the standard error of the percent change estimate.

$$SE(\%CHG) = \left|\frac{6,613,917}{6,429,326}\right| * \sqrt{\frac{83,537^2}{6,613,917^2} + \frac{36,768^2}{6,429,326^2}} * 100 = 1.4$$

To calculate the lower and upper bounds of the 90 percent confidence interval around 2.9% using the standard error (1.4), simply multiply by 1.65, then add and subtract the product from 2.9. Thus the 90 percent confidence interval is: [2.9 - 1.65(1.4)] to [2.9 + 1.65(1.4)] or 0.6% to 5.2%. Since both the lower and upper bounds are positive, the percent change is statistically significant.

Example 2

Our second example is of a 1997 to 1998 percent change. In this example, 1997 is the initial year and 1998 is the final year for our formulas. We are interested in estimating the percent change for 3 person households for Portland, OR. This is one of the estimates in summary table P12. For 1997 the estimate is 30,276, and for 1998 we obtain an estimate of 29,716.

$$\%CHG = \frac{29,716 - 30,276}{30,276} * 100 = -1.8\%$$

Next, we need to calculate the standard errors for the 1997 and 1998 estimates using the design factor approach (see Accuracy Documents for each year for full details). For 1997 we need the site level count of housing units, which we get from summary table H1 for Multnomah County, OR to be 275,165. For 1998 we need Portland's count of housing units, which is 230,716. We also need the design factors for the two years. For 1997 the design factor for Household Size is 1.2, and for 1998 it is 1.3. Now we can calculate the single year standard errors.

$$\text{standard error for 1997} = 1.2 * \sqrt{\frac{97}{3} * 30{,}276 * \left(1 - \frac{30{,}276}{275{,}165}\right)} \;=\; 1{,}120$$

$$\text{standard error for 1998} = 1.3 * \sqrt{\frac{97}{3} * 29{,}716 * \left(1 - \frac{29{,}716}{230{,}716}\right)} \;=\; 1{,}189$$

Now that we have the standard errors for the 1997 and 1998 estimates, we can obtain the standard error of the percent change estimate.

$$\text{SE(\%CHG)} = \left|\frac{29{,}716}{30{,}276}\right| * \sqrt{\frac{1{,}189^2}{29{,}716^2} + \frac{1{,}120^2}{30{,}276^2}} * 100 \;=\; 5.3$$

To calculate the lower and upper bounds of the 90 percent confidence interval around -1.8% using the standard error (5.3), simply multiply by 1.65, then add and subtract the product from -1.8. Thus the 90 percent confidence interval is: [-1.8 - 1.65(5.3)] to [-1.8 + 1.65(5.3)] or -10.5% to 6.9%. Since the lower bound is negative and the upper bound is positive, the percent change is not statistically significant.

Generalized variances are used wherever applicable for both the initial year and final year for percent changes. In calculating standard errors for 1996 estimates, the exact value of 85/15 was used, not the rounded value of 5.7 given in the formulas for generalized variances following Tables A and B in the Accuracy of the Data 1996.