Documentation for the
2014-2018 Variance Replicate Estimates Tables

Introduction

What are the Variance Replicate Estimates Tables?

The 2014-2018 Variance Replicate Table package provides augmented versions of 112 detailed tables from the American Community Survey (ACS) that are published on thedata.census.gov. For this limited set of tables, in addition to the original published estimates and margins of error (MOE) for each characteristic, the standard errors and eighty variance replicate estimates (Var_Rep) are provided. This additional information makes it possible for data users to compute variances using a methodology similar to the one utilized by the ACS during its production. The benefit of using this set of expanded tables is that it allows advanced data users to calculate MOEs for their own defined characteristics without using approximation formulas. This includes forming their own aggregate estimates across geographies or aggregating categories within a table, as well as ratios, proportions, and percentages. Previously, computing the MOE for such user-derived characteristics was done using approximation formulas that could not account for the covariance between the estimates used in the calculation. The detailed tables selected for this package include a wide range of topics and are the source of many of the estimates in the Data Profile product.
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What is a Variance Replicate Estimate?

The ACS uses a successive differences replication (SDR) variance estimation methodology\(^1\) to derive the MOEs that appear in tables on data.census.gov. This involves computing the official ACS estimate for a characteristic as well as eighty pseudo-estimates. They are called Var_Rep followed by a number ranging from one to eighty. For example, the fourth variance replicate estimate is named Var_Rep4. For the majority of ACS estimates, these values are used to form the variance of the estimate. The formula is provided in the next section. Taking the square root of the variance produces the standard error. The 90% confidence level MOE is equal to the standard error multiplied by 1.645.

A technical description of the full process is located in Chapter 12 of the Design and Methodology report, which may be found at https://www.census.gov/programs-surveys/acs/methodology/design-and-methodology.html. In addition, this methodology is also used to calculate the MOE in the ACS Public Use Microdata Sample (PUMS).

However, there are several special situations where this methodology is not suitable. These situations will be discussed later in this documentation.

Data users should be aware that variance replicate estimates may have negative or zero values, even for characteristics where negative values are not normally found. The variance replicate estimates are solely designed for calculating the SDR variance estimates and MOEs and have no other use and no independent meaning.

Data users also need to be aware that, due to certain limitations, there may be times when a user-derived MOE, following all instructions in this documentation, will not match the published MOE for an estimate on data.census.gov. While this is expected to occur infrequently, the published margin of error is the official value regardless of the value calculated using the variance replicate estimates.

Calculating the Margin of Error Using the Successive Differences Replicate Methodology

As mentioned in the introduction, the variance and standard error of an estimate must be calculated before computing the MOE. The SDR variance is calculated using the official ACS estimate and the eighty variance replicate estimates (Var_Rep1 to Var_Rep80).\(^2\) The variance is the sum of the squared differences between the estimate and each of the eighty variance replicate

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\(^2\) The SDR variance estimation methodology used with the ACS has the advantage that the variance estimate may be computed without consideration of the form of the statistic (i.e. count, mean, ratio, etc.) or the complexity of the sampling and weighting procedures.
estimates, multiplied by 4/80. The MOE is calculated by multiplying the standard error (the square root of the variance) by the factor 1.645 which is associated with a 90 percent confidence level.

\[
\text{Variance} = \frac{4}{80} \sum_{i=1}^{80} (\text{Var}_\text{Rep}_i - \text{Estimate})^2
\]  

(1)

\[
\text{Margin of Error (90\% confidence level)} = 1.645 \times \text{Standard Error} = 1.645 \times \sqrt{\text{Variance}}
\]  

(2)

The factor of 4/80 outside of the summation for the variance is an artifact of using the SDR methodology with eighty variance replicate estimates.

Formula (1) above can be used to calculate the variance for any type of estimate, including, but not limited to, sums (within a table or across geographic areas), percents, and means. A user should calculate their measure using the published estimates and the eighty variance replicate estimates, and use those replicate estimates to calculate the variance of their measure. Two basic examples follow. One is for creating the MOE of a sum and the other for the MOE of a percent.

Note: Unless otherwise specified, the examples provided use 2010-2014 ACS 5-year data.

Example 1: MOEs for Count Characteristics for Combined Estimates

Suppose you wish to calculate the count estimate and MOE for the characteristic of males under the age of fifteen\(^3\). Currently this characteristic is not available in the standard ACS detailed tables on data.census.gov. Several lines within the table for Sex by Age (table ID B01001) will need to be collapsed to form this characteristic. Table 1A shows the first five lines of this table for a hypothetical county in the 2010-2014 variance replicate estimates package. The first two lines give the total population and the total male population. The next three lines (shaded in gray) are the three characteristics which need to be combined for males under the age of 15. This table shows the ACS estimate and four of the eighty variance replicate estimates. Although only four variance replicate estimates are shown, it is implied that all eighty are used in the calculation.

Table 1A: First Five Lines of Sex by Age (Table ID: B01001)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ACS Estimate</th>
<th>Var_Rep1</th>
<th>Var_Rep2</th>
<th>Var_Rep3</th>
<th>…</th>
<th>Var_Rep80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>934,215</td>
<td>934,215</td>
<td>934,215</td>
<td>934,215</td>
<td>...</td>
<td>934,215</td>
</tr>
<tr>
<td>Male</td>
<td>454,762</td>
<td>454,766</td>
<td>454,729</td>
<td>454,765</td>
<td>...</td>
<td>454,727</td>
</tr>
<tr>
<td>Under 5 years</td>
<td>28,230</td>
<td>28,141</td>
<td>29,092</td>
<td>28,265</td>
<td>...</td>
<td>27,962</td>
</tr>
<tr>
<td>5 to 9 years</td>
<td>31,636</td>
<td>31,691</td>
<td>31,602</td>
<td>32,094</td>
<td>...</td>
<td>31,651</td>
</tr>
<tr>
<td>10 to 14 years</td>
<td>34,567</td>
<td>34,555</td>
<td>34,725</td>
<td>34,489</td>
<td>...</td>
<td>34,817</td>
</tr>
</tbody>
</table>

Source: 2010-2014 American Community Survey Variance Replicate Estimates, Table ID B01001

\(^3\) A count estimate is a count of the number of people, households or housing units for a particular characteristic.
Begin the MOE calculation by summing the three age characteristics together for the ACS estimate and for each of the eighty variance replicate estimates to form eighty-one sums of males under the age of 15 (males < 15).

### Table 1B: Forming the Sum of Males Less Than 15

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ACS Estimate</th>
<th>Var_Rep1</th>
<th>Var_Rep2</th>
<th>Var_Rep3</th>
<th>...</th>
<th>Var_Rep80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 5 years</td>
<td>28,230</td>
<td>28,141</td>
<td>29,092</td>
<td>28,265</td>
<td>...</td>
<td>27,962</td>
</tr>
<tr>
<td>5 to 9 years</td>
<td>31,636</td>
<td>31,691</td>
<td>31,602</td>
<td>32,094</td>
<td>...</td>
<td>31,651</td>
</tr>
<tr>
<td>10 to 14 years</td>
<td>34,567</td>
<td>34,555</td>
<td>34,725</td>
<td>34,489</td>
<td>...</td>
<td>34,817</td>
</tr>
<tr>
<td>Sum of Males &lt; 15</td>
<td>94,433</td>
<td>94,387</td>
<td>95,419</td>
<td>94,848</td>
<td>...</td>
<td>94,430</td>
</tr>
</tbody>
</table>

Source: 2010-2014 American Community Survey Variance Replicate Estimates

Take the difference between each of the eighty variance replicate estimates and the ACS estimate and square the result. For example, the difference between the first variance replicate estimate and the ACS Estimate is 94,387 – 94,433 = -46. The difference is then squared which equals 2,116. This is seen in the first line of Table 1C, below.

Calculate the variance by summing the eighty squared difference terms and then multiply by the factor 4/80. For this example, the sum of all eighty squared differences is 5,446,546. When it is multiplied by 4/80, the result is 272,327.3.

Calculate the 90% confidence level MOE by taking the square root of the variance to form the standard error (521.8499) and then multiply it by 1.645. In this example, the resulting MOE is 858 after rounding to the nearest integer. Note that for MOEs on data.census.gov, rounding is only done once, as the final step. Values shown in the examples in this document are rounded for convenient display, but the unrounded values are used for the calculations.

### Table 1C: Calculating the Margin of Error For Males < 15

<table>
<thead>
<tr>
<th>Variable</th>
<th>Replicate Estimates</th>
<th>ACS Estimates</th>
<th>Difference</th>
<th>Difference Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Var_Rep1</td>
<td>94,387</td>
<td>94,433</td>
<td>-46</td>
<td>2,116</td>
</tr>
<tr>
<td>Var_Rep2</td>
<td>95,419</td>
<td>94,433</td>
<td>986</td>
<td>972,196</td>
</tr>
<tr>
<td>Var_Rep3</td>
<td>94,848</td>
<td>94,433</td>
<td>415</td>
<td>172,225</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Var_Rep80</td>
<td>94,430</td>
<td>94,433</td>
<td>-3</td>
<td>9</td>
</tr>
</tbody>
</table>

Sum of Squared Differences 5,446,546

Variance 272,327.3000

Standard Error 521.8499

Margin of Error 858.4431

Source: 2010-2014 American Community Survey Variance Replicate Estimates

\[
\text{MOE for Males < 15} = 1.645 \times \sqrt{272,327.3} = 1.645 \times 521.8499 = 858.4431
\]

The final result is an estimate of 94,433 for males under the age of 15 with a MOE of 858.
Example 2: MOEs for Percent Characteristic for Combined Geographies

Suppose you wish to calculate the percentage estimate and its MOE for males under the age of 15 for a combined three county area. For this example we will use the estimate of all males as the denominator. This characteristic is not available in any of the standard ACS detailed tables on data.census.gov. The result produced in Example 1 is used as the numerator for this example. Nine estimates are needed to create the estimate for males under the age of 15 (three characteristics by three counties). Similarly, nine estimates are needed for the denominator. Table 2A shows the ACS estimate and four variance replicate estimates for males less than 15 years old for each county. Although only four variance replicate estimates are shown, it is implied that all eighty are used in the calculation. The first line of this table shows the males less than 15 years old results from Example 1. Lines two and three show the males less than 15 years old results for the other two counties.

Begin the MOE calculation by summing the three ACS estimates for males less than 15 years old together for each county. Repeat for each of the eighty variance replicate estimates to form eighty-one total sums. These will be the numerators for our percent estimate and eighty variance replicate estimates.

Table 2A: Forming Sums of Males Under the Age of 15 for a Combined Three County Area (Numerator)

<table>
<thead>
<tr>
<th>Males &lt; 15 years</th>
<th>ACS Estimate</th>
<th>Var_Repl1</th>
<th>Var_Repl2</th>
<th>Var_Repl3</th>
<th>...</th>
<th>Var_Repl80</th>
</tr>
</thead>
<tbody>
<tr>
<td>County 1</td>
<td>94,433</td>
<td>94,387</td>
<td>95,419</td>
<td>94,848</td>
<td>...</td>
<td>94,430</td>
</tr>
<tr>
<td>County 2</td>
<td>21,636</td>
<td>21,691</td>
<td>21,602</td>
<td>22,094</td>
<td>...</td>
<td>21,651</td>
</tr>
<tr>
<td>County 3</td>
<td>4,567</td>
<td>4,555</td>
<td>4,725</td>
<td>4,489</td>
<td>...</td>
<td>4,817</td>
</tr>
<tr>
<td>Sum of Males &lt; 15</td>
<td>120,636</td>
<td>120,633</td>
<td>121,746</td>
<td>121,431</td>
<td>...</td>
<td>120,898</td>
</tr>
</tbody>
</table>

Source: 2010-2014 American Community Survey Variance Replicate Estimates

To form the denominator, the same process needs to be performed on the three county estimates for the total count of males. Table 2B shows the ACS estimate and four variance replicate estimates for total males for each area. Again, although only four variance replicate estimates are shown, it is implied that all eighty are used in the calculation.

Table 2B: Forming Sums of Total Males for a Combined Three County Area (Denominator)

<table>
<thead>
<tr>
<th>Total Males</th>
<th>ACS Estimate</th>
<th>Var_Repl1</th>
<th>Var_Repl2</th>
<th>Var_Repl3</th>
<th>...</th>
<th>Var_Repl80</th>
</tr>
</thead>
<tbody>
<tr>
<td>County 1</td>
<td>454,762</td>
<td>454,766</td>
<td>454,729</td>
<td>454,765</td>
<td>...</td>
<td>454,727</td>
</tr>
<tr>
<td>County 2</td>
<td>108,180</td>
<td>108,455</td>
<td>108,010</td>
<td>110,470</td>
<td>...</td>
<td>108,255</td>
</tr>
<tr>
<td>County 3</td>
<td>22,835</td>
<td>22,775</td>
<td>23,625</td>
<td>22,445</td>
<td>...</td>
<td>24,085</td>
</tr>
<tr>
<td>Sum of Total Males</td>
<td>585,777</td>
<td>585,996</td>
<td>586,364</td>
<td>587,680</td>
<td>...</td>
<td>587,067</td>
</tr>
</tbody>
</table>

Source: 2010-2014 American Community Survey Variance Replicate Estimates

To calculate the percent, divide the estimate of males less than 15 years old for the three county area by the estimate of total males for the same area and multiply by 100. Repeat this calculation for each variance replicate estimate.
Table 2C: Calculating the Percent of Males Under the Age of 15 for a Combined Three County Area

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ACS Estimate</th>
<th>Var_Rep1</th>
<th>Var_Rep2</th>
<th>Var_Rep3</th>
<th>...</th>
<th>Var_Rep80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males &lt; 15</td>
<td>120,636</td>
<td>120,633</td>
<td>121,746</td>
<td>121,431</td>
<td>...</td>
<td>120,898</td>
</tr>
<tr>
<td>Total Males</td>
<td>585,777</td>
<td>585,996</td>
<td>586,364</td>
<td>587,680</td>
<td>...</td>
<td>587,067</td>
</tr>
<tr>
<td>Percent</td>
<td>20.5942</td>
<td>20.5860</td>
<td>20.7629</td>
<td>20.6628</td>
<td>...</td>
<td>20.5936</td>
</tr>
</tbody>
</table>

Source: 2010-2014 American Community Survey Variance Replicate Estimates

To calculate the MOE for the percent, we will again use equation 1. This time, use the ACS percent estimate and the eighty variance replicate percent estimates. Take the difference between each of the eighty variance replicate estimates and the ACS estimate and square each difference. For example, the difference between the first variance replicate estimate and the ACS Estimate is 20.5860 – 20.5942 = -0.00821. The squared difference is then equal to 0.0000674. This may be seen in Table 2D below. Note that rounding should only be done on the final result. To calculate the MOE, use the unrounded SE and variance in your calculations.

Calculate the variance by summing the eighty differences squared terms and then multiply by 4/80. For this example, the sum of all eighty squared differences is 0.273793. When multiplied by 4/80, the result is 0.0136896.

Calculate the 90% confidence level MOE by taking the square root of the variance to form the standard error, which is 0.117003. Then multiply it by 1.645. In this example, the result is 0.19247.

Table 2D: Calculating the Margin of Error for Percent of Males Under the Age of 15 for a Combined Three County Area

<table>
<thead>
<tr>
<th>Variable</th>
<th>Replicate Estimate</th>
<th>ACS Estimate</th>
<th>Difference</th>
<th>Difference Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Var_Rep1</td>
<td>20.5860</td>
<td>20.5942</td>
<td>-0.00821</td>
<td>0.0000674</td>
</tr>
<tr>
<td>Var_Rep2</td>
<td>20.7629</td>
<td>20.5942</td>
<td>0.16869</td>
<td>0.0288455</td>
</tr>
<tr>
<td>Var_Rep3</td>
<td>20.6628</td>
<td>20.5942</td>
<td>0.06859</td>
<td>0.0047047</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Var_Rep80</td>
<td>20.5936</td>
<td>20.5942</td>
<td>-0.00062</td>
<td>0.0000039</td>
</tr>
</tbody>
</table>

| Sum of Difference Squared | 0.2737930 |
| Variance                  | 0.0136896 |
| Standard Error            | 0.1170028 |
| Margin of Error           | 0.1924696 |

Source: 2010-2014 American Community Survey Variance Replicate Estimates

\[
\text{Margin of Error} = 1.645 \times \sqrt{0.0136896} = 1.645 \times 0.117003 = 0.19247
\]
Users can round the estimate and the MOE to the desired number of decimal place. If rounded to the hundredth decimal place, the final result for the percent males under the age of 15 for the combined three-county area is 20.6% with a MOE of 0.2%.  

**MOEs for Zero Counts and Percent Estimates of Zero or 100 Percent**

The standard replicate variance formula does not provide an acceptable value when a count estimate is zero, or a percent estimate is zero percent or 100 percent. For these three cases, all variance replicate estimates will be the same as the production estimate, and the resulting variance from the variance replicate estimates will be zero. In each case, the estimate should have sampling error, as persons or housing units not selected in sample may have the given characteristic.

For zero count, zero percent, and 100 percent estimates, the ACS uses models to provide reasonable margins of error for these estimates. Formulas for these special cases are provided below.

**Margins of Error for Zero Count Estimates**

The margin of error for a zero count estimate is based on two values, the average weight and the k-value.

\[
\text{MOE}(0 \text{ count}) = 1.645 \times \sqrt{\text{average weight} \times \text{k-value}} \tag{3}
\]

The average weight is the maximum of the average person weight and average housing unit weight, and is calculated for the nation, the 50 states, the District of Columbia and Puerto Rico. Average weight values for the 2014-2018 ACS 5-year data may be found in the parameter file located at [https://www.census.gov/programs-surveys/acs/technical-documentation/variance-tables.html](https://www.census.gov/programs-surveys/acs/technical-documentation/variance-tables.html). There is a pdf and CSV version available. If the geographic area lies entirely within a state, then use that state’s average weight in the formula. Otherwise, use the national average weight.

The k-value is assigned based on the total population size of the geographic area. Similar to the average weight file, there is a file that denotes the k-values. The file also included the population thresholds to use in selecting the correct k-value. Note that the total population estimate should be used to determine a k-value for a particular geography.

Data users should be aware that the actual k-value and average weight are created using internal files which are not available to the public. Therefore, the published MOE may differ from the calculated MOE using the values and methods presented in this document.

---

4 ACS rounds to one decimal place for both percentage estimates and their MOEs for published data on data.census.gov. In addition, if the MOE rounds to zero, the ACS tables display the MOE as 0.1.
Chapter 12 of the Design and Methodology report\(^5\) has a brief discussion of the derivation of this methodology.

**Example 3: Calculating the MOE for a Zero Count Estimate**

Suppose your zero estimate is for a geographic area in the state of Maryland with a total population of 25,000. Looking to the 2010-2014 ACS 5-year average weight values, we see that the k-value is 14. In addition, the average weight for Maryland is 13.\(^6\)

\[
\text{MOE}(0) = 1.645 \times \sqrt{\text{average weight} \times \text{k-value}} \\
= 1.645 \times \sqrt{13 \times 14} \\
= 1.645 \times \sqrt{182} = 22
\]

**Margins of Error for Zero Percent or 100 Percent Estimates**

There is a different formula used for zero and 100 percent estimates. The average weight is also used in the formula, but the k-value is not. First, define \(p^*\), using the average weight and the denominator of the percent estimate:

\[
p^* = \frac{2.3 \times \text{average weight}}{\text{denominator}}; \quad \text{If } p^* > 0.5, \text{ then use } p^* = 0.5 \text{ instead.} \quad (4)
\]

\[
\text{MOE}(0\% \text{ or 100\%}) = 100\% \times 1.645 \times \sqrt{p^* \times (1 - p^*)} \times \frac{\text{average weight}}{\text{denominator}} \quad (5)
\]

**Example 4: Calculating the MOE for a 100 Percent Estimate**

This example demonstrates how to calculate the MOE for a 100 percent estimate. Suppose the estimate is in the state of New Mexico and the denominator is 6,000. Looking to the 2010-2014 ACS 5-year average weight values, we see that the average weight for New Mexico is 13.\(^7\)

\[
p^* = \frac{2.3 \times \text{average weight}}{\text{denominator}} \[
= \frac{2.3 \times 13}{6,000} = 0.00498
\]

---

\(^5\) The Design and Methodology document is located here: [https://www.census.gov/programs-surveys/acs/methodology/design-and-methodology.html](https://www.census.gov/programs-surveys/acs/methodology/design-and-methodology.html).

\(^6\) The 2010-2014 ACS 5-year average weights can be found in Appendix A of the 2014 Variance Replicate Tables Documentation: [https://www.census.gov/programs-surveys/acs/technical-documentation/variance-tables.html](https://www.census.gov/programs-surveys/acs/technical-documentation/variance-tables.html).
A zero percent estimate in the same geographic area and with the same denominator would have the same margin of error, \( \text{MOE}(0\%) = 0.5\% \).

**Example 5: Alternate Method for Calculating the MOE for a Zero Count Estimate**

When summing zero count estimates and using approximation methods to calculate the sum’s margin of error, we have recommended using the largest MOE of the zero estimates in the approximation formula. The approximation formula may be found in the Instructions for Applying Statistical Testing document, located at: [https://www.census.gov/programs-surveys/acs/technical-documentation/code-lists.html](https://www.census.gov/programs-surveys/acs/technical-documentation/code-lists.html). This avoided the issue of the approximate MOE becoming unusable when many zero estimates were included in a sum. Data users may still use this method if they wish because the MOE for zero estimates is model-based.

Table 3 shows an example of three zero estimates and their sum.

**Table 3: Sum of Zero Count Estimates for a Combined Three Tract Area**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ACS Estimate</th>
<th>Var_Rep1</th>
<th>Var_Rep2</th>
<th>Var_Rep3</th>
<th>...</th>
<th>Var_Rep80</th>
<th>Published MOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tract 1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Tract 2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Tract 3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Sum of Tracts</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Source: 2010-2014 American Community Survey Variance Replicate Estimates

As previously mentioned, the MOE cannot be zero because the zero estimate may actually be non-zero when the full population is examined. For this example, instead of using the average weight and k-value, simply examine the published MOEs. Assign the zero estimate for the sum a MOE of 13 as that is the largest published MOE for the three estimates. Note that this method may underestimate the MOE as compared with the average weight and k-value method.

**Controlled Estimates and Other Estimates Where All Variance Replicate Estimates Are Equal**

Users of ACS data are likely aware that some ACS estimates are controlled to be equal to the official Population Estimates. The population estimates are the official intercensal estimates...
produced by the Census Bureau. Controlled ACS estimates can occur for only a limited number of demographic characteristics such as totals by age and sex. ACS estimates which are controlled are assigned a MOE of five asterisks (*****) on data.census.gov. Because they are forced to match a fixed value, they are assumed to have no sampling error. That is, the MOE is zero. In the variance replicate estimate files, the variable called CME will have a value of five asterisks (******).

Handling Controlled Estimates

If a data user sums two or more controlled estimates together, the sum will be controlled. Any percent or ratio estimate where both the numerator and denominator are entirely made up of controlled estimates will be controlled as well. The estimate and the eighty variance replicate estimates for a controlled estimate are often the same value. However, this is not always the case. Table 4 shows the estimate and eighty variance replicate estimates for the total population of the United States.

Table 4: Total Population for the United States

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ACS Estimate</th>
<th>Var_Rep1</th>
<th>Var_Rep2</th>
<th>…</th>
<th>Var_Rep80</th>
<th>Published MOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Population</td>
<td>314,107,084</td>
<td>314,107,058</td>
<td>314,107,058</td>
<td>…</td>
<td>314,107,058</td>
<td>*****</td>
</tr>
</tbody>
</table>

Source: 2010-2014 American Community Survey Variance Replicate Estimates, Table ID B01003

Although the variance replicate estimates are all identical, the ACS estimate is different from them. Differences like these arise due to the complex ACS weighting, and is sometimes due to rounding the ACS weights to whole numbers.  

Non-Controlled Estimates

Sometimes a data user sums estimates within a table or across geographies and the results is a published, controlled estimate on data.census.gov. If the data user knows the published estimate is controlled, then the sum is also controlled. However, if a data user combines two or more estimates to form an estimate which is not published on data.census.gov and the calculated MOE is zero, assume that the estimate is not controlled and calculate the MOE using the methods specified earlier in this document in equations 3, 4 or 5, as if the estimate were zero.

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8 The Population Estimates may be found at [https://www.census.gov/programs-surveys/popest.html](https://www.census.gov/programs-surveys/popest.html).

9 Controlled estimates only occur for counties, areas that are equivalent to a county, or areas that are combinations of complete counties. Estimates of subgroups of the total population are controlled only if they are combinations of specific age ranges, sex, and Hispanic origin. No estimate involving a race group is ever controlled. The total population in housing units, in group quarters, and for certain group quarters types may also be controlled for states, areas that are equivalent to a state, or areas that are combinations of states.

10 For more information on the ACS weighting process, see Chapter 11 of the ACS Design & Methodology report. [https://www.census.gov/programs-surveys/acs/methodology/design-and-methodology.html](https://www.census.gov/programs-surveys/acs/methodology/design-and-methodology.html).
Example 6: Calculating the MOEs for Non-Controlled Estimates

This example demonstrates how to calculate the MOE for an estimate which is not controlled, but has a calculated MOE of zero. Table 5 shows two county estimates for the population of 18 and 19 years of age. In both cases, the estimates are not controlled. They each have a calculated MOE of zero, but a published MOE which is not zero. Suppose the data user wants to sum these estimates for an estimate for the combined area. The sum will have a calculated MOE of zero like the original estimates and, like them, a non-zero MOE must be assigned. In this case, the MOE is calculated using the same methodology for zero estimates.

Table 5: Forming the Sum of Estimates with Calculated MOEs of Zero

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ACS Estimate</th>
<th>Var_Repl1</th>
<th>Var_Repl2</th>
<th>Var_Repl3</th>
<th>...</th>
<th>Var_Repl80</th>
<th>Published MOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autauga County, Alabama, Age 18 and 19</td>
<td>725</td>
<td>725</td>
<td>725</td>
<td>725</td>
<td>...</td>
<td>725</td>
<td>27</td>
</tr>
<tr>
<td>Butler County, Alabama, Age 18 and 19</td>
<td>231</td>
<td>231</td>
<td>231</td>
<td>231</td>
<td>...</td>
<td>231</td>
<td>21</td>
</tr>
<tr>
<td>Sum of the Two Counties, Age 18 and 19</td>
<td>956</td>
<td>956</td>
<td>956</td>
<td>956</td>
<td>...</td>
<td>956</td>
<td></td>
</tr>
</tbody>
</table>

Source: 2010-2014 American Community Survey Variance Replicate Estimates, Table ID B01001

The estimates are from Alabama and therefore the result is entirely in Alabama as well. The 2010-2014 ACS 5-year average weight for Alabama is 12. To determine the k-value, we use the table for Total Population (Table ID: B01003) and find that the total population for Autauga County is 55,136. The total population for Butler County is 20,523. The combined total population is therefore 55,136 + 20,523 or 75,659. The table for the k-value parameter indicates that any geography with a population over 50,000 should use a k-value of 22.

Thus, the margin of error is:

\[ \text{MOE}(956) = 1.645 \times \sqrt{\text{average weight} \times k\text{-value}} \]
\[ = 1.645 \times \sqrt{12 \times 22} = 27 \]

Percent or Ratio Estimates with One or More Undefined Variance Replicate Estimates

Another special case may arise for percentages or ratios. In this case, the percent or ratio is defined, but one or more of the variance replicate estimates of the percent or ratio is undefined.

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11 The 2010-2014 ACS 5-year average weights can be found in Appendix A of the 2014 Variance Replicate Tables Documentation: [https://www.census.gov/programs-surveys/acs/technical-documentation/variance-tables.html](https://www.census.gov/programs-surveys/acs/technical-documentation/variance-tables.html).
because the denominator is zero. In these cases, substitute a value of zero for the percent or ratio variance replicates that are undefined.

**Example 7: Calculating a Variance Replicate Estimate with a Denominator of Zero for a Percent or Ratio**

For example, if the second variance replicate estimate for the numerator of your percent estimate is 35 and the denominator is zero, as seen in Table 6. Assign a value of zero for the second replicate percent estimate when calculating the squared difference for that variance replicate estimate.

**Table 6: Assigning a Value to an Undefined Variance Replicate Percent**

<table>
<thead>
<tr>
<th>Replicate</th>
<th>Numerator</th>
<th>Denominator</th>
<th>Percent</th>
<th>ACS Est</th>
<th>Difference</th>
<th>Difference Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Var_Rep1</td>
<td>30</td>
<td>50</td>
<td>60.0</td>
<td>80.0</td>
<td>-20.0</td>
<td>400.0</td>
</tr>
<tr>
<td>Var_Rep2</td>
<td>35</td>
<td>0</td>
<td>N/A</td>
<td>80.0</td>
<td>-80.0</td>
<td>6,400.0</td>
</tr>
</tbody>
</table>

**File Notes**

**Note on File Layout**

The data for the variance replicate estimate tables are in comma separated value (CSV) files. CSV files may be imported into a wide range of statistical programs, such as SAS, SPSS, STATA, and R. Excel will also also open CSV files.

Data users who import the data into SAS may encounter an issue where the last variable in the file is not read in correctly. This may be due to the end-of-line character on the CSV file. Beginning in SAS 9.2, the INFILE statement TERMSTR= CRLF may be used to correct this issue.

Below is example SAS code which demonstrates this.

```sas
%macro import_vre_data(path=,table_id=);
data vre_data;
INFILE "&path./&table_id..csv"
   DELIMITER = "," MISSOVER DSD LRECL=32767 FIRSTOBS=4 TERMSTR=CRLF ;
   INFORMAT tblid $12. geoid $40. name $1000. order 8. title $400. estimate 8. moe 8.
   cme $20. se 8. %do i = 1 %to 80; Var_Rep&i. 8. %end; ;
   se 8. %do j = 1 %to 80; Var_Rep&j. 8. %end; ;
   INPUT tblid $ geoid $ name $ order title $ estimate moe cme $ se
   %do k = 1 %to 80; Var_Rep&k. %end; ;
run;
%mend;
%import_vre_data(path=<specify location of file>,table_id=<Table ID, e.g. B01001>);
```
Note on File Size and Excel

Data users should be aware that issues may arise when opening large files in Excel due to the file exceeding the row limit (1,048,576 for Office 2010), causing Excel to truncate the data. Not all files will have this issue. Data users may need to use other programs to examine the data in these large files.

If you need any additional information or have more questions, please e-mail acso.users.support@census.gov.

If you have questions or comments about the American Community Survey, you may submit a question online at https://ask.census.gov/.

References
