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2012 Annual Social and Economic Supplement Microdata File

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SOURCE OF THE DATA

The data in this microdata file are from the 2012 Annual Social and Economic Supplement (ASEC) of the Current Population Survey (CPS). The U.S. Census Bureau conducts the ASEC over a 3-month period in February, March, and April, with most of the data collection occurring in the month of March. The ASEC uses two sets of questions, the basic CPS and a set of supplemental questions. The CPS, sponsored jointly by the Census Bureau and the U.S. Bureau of Labor Statistics, is the country's primary source of labor force statistics for the entire population. The Census Bureau and the Bureau of Labor Statistics also jointly sponsor the ASEC.

Basic CPS. The monthly CPS collects primarily labor force data about the civilian noninstitutionalized population living in the United States. The institutionalized population, which is excluded from the population universe, is composed primarily of the population in correctional institutions and nursing homes (91 percent of the 4.1 million institutionalized people in Census 2000). Interviewers ask questions concerning labor force participation about each member 15 years old and over in sample households. Typically, the week containing the nineteenth of the month is the interview week. The week containing the twelfth is the reference week (i.e., the week about which the labor force questions are asked).

The CPS uses a multistage probability sample based on the results of the decennial census, with coverage in all 50 states and the District of Columbia. The sample is continually updated to account for new residential construction. When files from the most recent decennial census become available, the Census Bureau gradually introduces a new sample design for the CPS.

In April 2004, the Census Bureau began phasing out the 1990 sample[1] and replacing it with the 2000 sample, creating a mixed sampling frame. Two simultaneous changes occurred during this phase-in period. First, primary sampling units (PSUs)[2] selected for only the 2000 design gradually replaced those selected for the 1990 design. This involved 10 percent of the sample. Second, within PSUs selected for both the 1990 and 2000 designs, sample households from the 2000 design gradually replaced sample households from the 1990 design. This involved about 90 percent of the sample. The new sample design was completely implemented by July 2005.

In the first stage of the sampling process, PSUs are selected for sample. The United States is divided into 2,025 PSUs. The PSUs were redefined for this design to correspond to the Office of Management and Budget definitions of Core-Based Statistical Area definitions and to improve efficiency in field operations. These PSUs are grouped into 824 strata. Within each stratum, a single PSU is chosen for the sample, with its probability of selection proportional to its population as of the most recent decennial census. This PSU represents the entire stratum from

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[1]   For detailed information on the 2000 sample redesign, please see reference [1].

[2]   The PSUs correspond to substate areas (i.e., counties or groups of counties) that are geographically contiguous.

which it was selected. In the case of strata consisting of only one PSU, the PSU is chosen with certainty.

Approximately 72,000 housing units were selected for sample from the sampling frame for the basic CPS. Based on eligibility criteria, 12 percent of these housing units were sent directly to computer-assisted telephone interviewing (CATI). The remaining units were assigned to interviewers for computer-assisted personal interviewing (CAPI).[3] Of all housing units in sample, about 59,100 were determined to be eligible for interview. Interviewers obtained interviews at about 53,300 of these units. Noninterviews occur when the occupants are not found at home after repeated calls or are unavailable for some other reason. Table 1 summarizes historical changes in the CPS design.

Table 1. Description of the March Basic CPS and ASEC Sample Cases

[3]   For further information on CATI and CAPI and the eligibility criteria, please see reference [2].

Time period	Number of sample PSUs	Basic CPS housing units eligible		Total (ASEC/ADS[1] + basic CPS) housing units eligible	
		Interviewed	Not interviewed	Interviewed	Not interviewed
2012	824	53,300	5,800	75,100	7,200
2011	824	53,400	5,300	75,900	6,500
2010	824	54,100	4,600	77,000	5,700
2009	824	54,100	4,600	76,200	5,700
2008	824	53,800	5,100	75,900	6,400
2007	824	53,700	5,600	75,500	7,100
2006	824	54,000	5,400	76,000	7,100
2005	754/824 [2]	54,400	5,700	76,500	7,500
2004	754	55,000	5,200	77,700	7,000
2003	754	55,500	4,500	78,300	6,800
2002	754	55,500	4,500	78,300	6,600
2001	754	46,800	3,200	49,600	4,300
2000	754	46,800	3,200	51,000	3,700
1999	754	46,800	3,200	50,800	4,300
1998	754	46,800	3,200	50,400	5,200
1997	754	46,800	3,200	50,300	3,900
1996	754	46,800	3,200	49,700	4,100
1995	792	56,700	3,300	59,200	3,800
1990 to 1994	729	57,400	2,600	59,900	3,100
1989	729	53,600	2,500	56,100	3,000
1986 to 1988	729	57,000	2,500	59,500	3,000
1985	629/729 [3]	57,000	2,500	59,500	3,000
1982 to 1984	629	59,000	2,500	61,500	3,000
1980 to 1981	629	65,500	3,000	68,000	3,500
1977 to 1979	614	55,000	3,000	58,000	3,500
1976	624	46,500	2,500	49,000	3,000
1973 to 1975	461	46,500	2,500	49,000	3,000
1972	449/461 [4]	45,000	2,000	45,000	2,000
1967 to 1971	449	48,000	2,000	48,000	2,000
1963 to 1966	357	33,400	1,200	33,400	1,200
1960 to 1962	333	33,400	1,200	33,400	1,200
1959	330	33,400	1,200	33,400	1,200

1   The ASEC was referred to as the Annual Demographic Survey (ADS) until 2002.
2   The Census Bureau redesigned the CPS following the Census 2000. During phase-in of the new design, housing units from the new and old designs were in the sample.
3   The Census Bureau redesigned the CPS following the 1980 Decennial Census of Population and Housing.
4   The Census Bureau redesigned the CPS following the 1970 Decennial Census of Population and Housing.

The 2012 Annual Social and Economic Supplement. In addition to the basic CPS questions, interviewers asked supplementary questions for the ASEC. They asked these questions of the civilian noninstitutional population and also of military personnel who live in households with at least one other civilian adult. The additional questions covered the following topics:

•   Household and family characteristics

- Marital status
- Geographic mobility
- Foreign-born population
- Income from the previous calendar year
- Poverty
- Work status/occupation
- Health insurance coverage
- Program participation
- Educational attainment

Including the basic CPS sample, approximately 96,700 housing units were in sample for the ASEC. About 82,300 housing units were determined to be eligible for interview, and about 75,100 interviews were obtained (see Table 1).

The additional sample for the ASEC provides more reliable data for Hispanic households, non-Hispanic minority households, and non-Hispanic White households with children 18 years or younger. These households were identified for sample from previous months and the following April. For more information about the households eligible for the ASEC, please refer to reference [2].

Estimation Procedure. This survey's estimation procedure adjusts weighted sample results to agree with independently derived population estimates of the civilian noninstitutionalized population of the United States and each state (including the District of Columbia). These population estimates, used as controls for the CPS, are prepared monthly to agree with the most current set of population estimates that are released as part of the Census Bureau's population estimates and projections program.

The population controls for the nation are distributed by demographic characteristics in two ways:

- Age, sex, and race (White alone, Black alone, and all other groups combined).
- Age, sex, and Hispanic origin.

The population controls for the states are distributed by race (Black alone and all other race groups combined), age (0-15, 16-44, and 45 and over), and sex.

The independent estimates by age, sex, race, and Hispanic origin, and for states by selected age groups and broad race categories, are developed using the basic demographic accounting formula whereby the population from the 2010 Decennial Census data is updated using data on the components of population change (births, deaths, and net international migration) with net internal migration as an additional component in the state population estimates.

The net international migration component in the population estimates includes a combination of the following:

- • Legal migration to the United States.
- • Emigration of foreign-born and native people from the United States.
- • Net movement between the United States and Puerto Rico.
- • Estimates of temporary migration.
- • Estimates of net residual foreign-born population, which include unauthorized migration.

Because the latest available information on these components lags the survey date, it is necessary to make short-term projections of these components to develop the estimate for the survey date.

ACCURACY OF THE ESTIMATES

A sample survey estimate has two types of error: sampling and nonsampling. The accuracy of an estimate depends on both types of error. The nature of the sampling error is known given the survey design; the full extent of the nonsampling error is unknown.

Sampling Error. Since the CPS estimates come from a sample, they may differ from figures from an enumeration of the entire population using the same questionnaires, instructions, and enumerators. For a given estimator, the difference between an estimate based on a sample and the estimate that would result if the sample were to include the entire population is known as sampling error. Standard errors, as calculated by methods described in "Standard Errors and Their Use," are primarily measures of the magnitude of sampling error. However, they may include some nonsampling error.

Nonsampling Error. For a given estimator, the difference between the estimate that would result if the sample were to include the entire population and the true population value being estimated is known as nonsampling error. There are several sources of nonsampling error that may occur during the development or execution of the survey. It can occur because of circumstances created by the interviewer, the respondent, the survey instrument, or the way the data are collected and processed. For example, errors could occur because:

- • The interviewer records the wrong answer, the respondent provides incorrect information, the respondent estimates the requested information, or an unclear survey question is misunderstood by the respondent (measurement error).
- • Some individuals who should have been included in the survey frame were missed (coverage error).
- • Responses are not collected from all those in the sample or the respondent is unwilling to provide information (nonresponse error).
- • Values are estimated imprecisely for missing data (imputation error).
- • Forms may be lost, data may be incorrectly keyed, coded, or recoded, etc. (processing error).

To minimize these errors, the Census Bureau applies quality control procedures during all stages of the production process including the design of the survey, the wording of questions, the review of the work of interviewers and coders, and the statistical review of reports.

Two types of nonsampling error that can be examined to a limited extent are nonresponse and undercoverage.

Nonresponse. The effect of nonresponse cannot be measured directly, but one indication of its potential effect is the nonresponse rate. For the cases eligible for the 2012 ASEC, the basic CPS household-level nonresponse rate was 9.83 percent. The household-level nonresponse rate for the ASEC was an additional 10.4 percent. These two non-response rates lead to a combined supplement nonresponse rate of 19.2 percent.

Coverage. The concept of coverage in the survey sampling process is the extent to which the total population that could be selected for sample "covers" the survey's target population. Missed housing units and missed people within sample households create undercoverage in the CPS. Overall CPS undercoverage for March 2012 is estimated to be about 14.0 percent. CPS coverage varies with age, sex, and race. Generally, coverage is larger for females than for males and larger for non-Blacks than for Blacks. This differential coverage is a general problem for most household-based surveys.

The CPS weighting procedure partially corrects for bias from undercoverage, but biases may still be present when people who are missed by the survey differ from those interviewed in ways other than age, race, sex, Hispanic origin, and state of residence. How this weighting procedure affects other variables in the survey is not precisely known. All of these considerations affect comparisons across different surveys or data sources.

A common measure of survey coverage is the coverage ratio, calculated as the estimated population before poststratification divided by the independent population control. Table 2 shows March 2012 CPS coverage ratios by age and sex for certain race and Hispanic groups. The CPS coverage ratios can exhibit some variability from month to month.

Table 2. CPS Coverage Ratios: March 2012											
Age group	**All people**	**Total**		**White only**		**Black only**		**Residual race**		**Hispanic**	
		Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
0-15	0.86	0.86	0.85	0.89	0.88	0.80	0.78	0.79	0.77	0.80	0.83
16-19	0.84	0.83	0.85	0.86	0.86	0.78	0.79	0.72	0.84	0.80	0.83
20-24	0.72	0.70	0.75	0.71	0.77	0.62	0.69	0.74	0.67	0.66	0.74
25-34	0.83	0.80	0.85	0.83	0.88	0.69	0.76	0.72	0.76	0.72	0.82
35-44	0.88	0.85	0.90	0.88	0.92	0.74	0.79	0.80	0.84	0.81	0.88
45-54	0.88	0.87	0.89	0.88	0.91	0.75	0.82	0.87	0.87	0.80	0.85
55-64	0.90	0.90	0.90	0.91	0.90	0.84	0.90	0.82	0.80	0.87	0.88
65+	0.90	0.91	0.90	0.91	0.90	0.92	0.89	0.83	0.90	0.80	0.78
15+	0.86	0.85	0.87	0.87	0.89	0.76	0.81	0.79	0.81	0.77	0.83
0+	0.86	0.85	0.87	0.87	0.89	0.77	0.80	0.79	0.80	0.78	0.83

Notes: (1) The Residual race group includes cases indicating a single race other than White or Black, and cases indicating two or more races.
　　　　(2) Hispanics may be any race. For a more detailed discussion on the use of parameters for race and ethnicity, please see the "Generalized Variance Parameters" section.

Comparability of Data. Data obtained from the CPS and other sources are not entirely comparable. This results from differences in interviewer training and experience and in differing survey processes. This is an example of nonsampling variability not reflected in the standard errors. Therefore, caution should be used when comparing results from different sources.

Data users should be careful when comparing the data from this microdata file, which reflects Census 2010-based controls, with microdata files from January 2003 through December 2011, which reflect 2000 census-based controls. Ideally, the same population controls should be used when comparing any estimates. In reality, the use of the same population controls is not practical when comparing trend data over a period of 10 to 20 years. Thus, when it is necessary to combine or compare data based on different controls or different designs, data users should be aware that changes in weighting controls or weighting procedures can create small differences between estimates. See the discussion following for information on comparing estimates derived from different controls or different sample designs.

Microdata files from previous years reflect the latest available census-based controls. The most recent change in population controls had relatively little impact on summary measures such as averages, medians, and levels. For example, use of Census 2010-based controls results in about a 0.2 percent increase from the 2000 census-based controls in the civilian noninstitutionalized population and in the number of families and households. However, these differences could be disproportionately greater for certain population subgroups than for the total population.

Users should also exercise caution because of changes caused by the phase-in of the Census 2000 files (see "Basic CPS"). During this time period, CPS data were collected from sample designs based on different censuses. Three features of the new CPS design have the potential of affecting published estimates: (1) the temporary disruption of the rotation pattern from August 2004 through June 2005 for a comparatively small portion of the sample, (2) the change in sample areas, and (3) the introduction of the new Core-Based Statistical Areas (formerly called metropolitan areas). Most of the known effect on estimates during and after the sample redesign was the result of changing from 1990 to 2000 geographic definitions. Research has shown that the national-level estimates of the metropolitan and nonmetropolitan populations should not change appreciably because of the new sample design. However, users should still exercise caution when comparing metropolitan and nonmetropolitan estimates across years with a design change, especially at the state level.

Caution should also be used when comparing Hispanic estimates over time. No independent population control totals for people of Hispanic origin were used before 1985.

A Nonsampling Error Warning. Since the full extent of the nonsampling error is unknown, one should be particularly careful when interpreting results based on small differences between estimates. The Census Bureau recommends that data users incorporate information about nonsampling errors into their analyses, as nonsampling error could impact the conclusions drawn from the results. Caution should also be used when interpreting results based on a relatively small number of cases. Summary measures (such as medians and percentage distributions) probably do not reveal useful information when computed on a subpopulation smaller than 75,000.

For additional information on nonsampling error including the possible impact on CPS data when known, refer to references [2] and [3].

Estimation of Median Incomes. The Census Bureau has changed the methodology for computing median income over time. The Census Bureau has computed medians using either Pareto interpolation or linear interpolation. Currently, we are using linear interpolation to estimate all medians. Pareto interpolation assumes a decreasing density of population within an income interval, whereas linear interpolation assumes a constant density of population within an income interval. The Census Bureau calculated estimates of median income and associated standard errors for 1979 through 1987 using Pareto interpolation if the estimate was larger than $20,000 for people or $40,000 for families and households. This is because the width of the income interval containing the estimate is greater than $2,500.

We calculated estimates of median income and associated standard errors for 1976, 1977, and 1978 using Pareto interpolation if the estimate was larger than $12,000 for people or $18,000 for families and households. This is because the width of the income interval containing the estimate is greater than $1,000. All other estimates of median income and associated standard errors for 1976 through 2011 (2012 ASEC) and almost all of the estimates of median income and associated standard errors for 1975 and earlier were calculated using linear interpolation.

Thus, use caution when comparing median incomes above $12,000 for people or $18,000 for families and households for different years. Median incomes below those levels are more comparable from year to year since they have always been calculated using linear interpolation. For an indication of the comparability of medians calculated using Pareto interpolation with medians calculated using linear interpolation, see reference [5].

Standard Errors and Their Use. The sample estimate and its standard error enable one to construct a confidence interval. A confidence interval is a range about a given estimate that has a specified probability of containing the average result of all possible samples. For example, if all possible samples were surveyed under essentially the same general conditions and using the same sample design, and if an estimate and its standard error were calculated from each sample, then approximately 90 percent of the intervals from 1.645 standard errors below the estimate to 1.645 standard errors above the estimate would include the average result of all possible samples.

A particular confidence interval may or may not contain the average estimate derived from all possible samples, but one can say with specified confidence that the interval includes the average estimate calculated from all possible samples.

Standard errors may also be used to perform hypothesis testing, a procedure for distinguishing between population parameters using sample estimates. The most common type of hypothesis is that the population parameters are different. An example of this would be comparing the percentage of men who were part-time workers to the percentage of women who were part-time workers.

Tests may be performed at various levels of significance. A significance level is the probability of concluding that the characteristics are different when, in fact, they are the same. For example, to conclude that two characteristics are different at the 0.10 level of significance, the absolute value of the estimated difference between characteristics must be greater than or equal to 1.645 times the standard error of the difference.

The Census Bureau uses 90-percent confidence intervals and 0.10 levels of significance to determine statistical validity. Consult standard statistical textbooks for alternative criteria.

Estimating Standard Errors. The Census Bureau uses replication methods to estimate the standard errors of CPS estimates. These methods primarily measure the magnitude of sampling error. However, they do measure some effects of nonsampling error as well. They do not measure systematic biases in the data associated with nonsampling error. Bias is the average over all possible samples of the differences between the sample estimates and the true value.

There are two ways to calculate standard errors for the CPS ASEC 2012 microdata file. They are:

- Direct estimates created from replicate weighting methods;
- Generalized variance estimates created from generalized variance function parameters a and b.

While replicate weighting methods provide the most accurate variance estimates, this approach requires more computing resources and more expertise on the part of the user. The Generalized Variance Function (GVF) parameters provide a method of balancing accuracy with resource usage as well as a smoothing effect on standard error estimates across time. For more information on calculating direct estimates, see reference [6]. For more information on generalized variance estimates refer to the "Generalized Variance Parameters" section.

Generalized Variance Parameters. While it is possible to compute and present an estimate of the standard error based on the survey data for each estimate in a report, there are a number of reasons why this is not done. A presentation of the individual standard errors would be of limited use, since one could not possibly predict all of the combinations of results that may be of interest to data users. Additionally, data users have access to CPS microdata files, and it is impossible to compute in advance the standard error for every estimate one might obtain from those data sets. Moreover, variance estimates are based on sample data and have variances of their own. Therefore, some methods of stabilizing these estimates of variance, for example, by generalizing or averaging over time, may be used to improve their reliability.

Experience has shown that certain groups of estimates have similar relationships between their variances and expected values. Modeling or generalizing may provide more stable variance estimates by taking advantage of these similarities. The generalized variance function is a simple model that expresses the variance as a function of the expected value of the survey estimate. The parameters of the generalized variance function are estimated using direct replicate variances. These generalized variance parameters provide a relatively easy method to obtain approximate standard errors for numerous characteristics. In this source and accuracy

statement, Table 4 provides the generalized variance parameters for labor force estimates, and Table 5 provides generalized variance parameters for characteristics from the 2012 ASEC supplement. Also, tables are provided that allow the calculation of parameters for prior years and parameters for states and regions. Table 6 provides factors to derive prior year parameters. Tables 7 and 8 contain correlation coefficients for comparing estimates from consecutive years. Tables 9 and 10 provide factors and population controls to derive state and regional parameters.

The basic CPS questionnaire records the race and ethnicity of each respondent. With respect to race, a respondent can be White, Black, Asian, American Indian and Alaskan Native (AIAN), Native Hawaiian and Other Pacific Islander (NHOPI), or combinations of two or more of the preceding. A respondent's ethnicity can be Hispanic or non-Hispanic, regardless of race.

The generalized variance parameters to use in computing standard errors are dependent upon the race/ethnicity group of interest. Table 3 summarizes the relationship between the race/ethnicity group of interest and the generalized variance parameters to use in standard error calculations.

Table 3. Estimation Groups of Interest and Generalized Variance Parameters	
Race/ethnicity group of interest	**Generalized variance parameters to use in standard error calculations**
Total population	Total or White
White alone, White AOIC, or White non-Hispanic population	Total or White
Black alone, Black AOIC, or Black non-Hispanic population	Black
Asian alone, Asian AOIC, or Asian non-Hispanic population	Asian, AIAN, NHOPI
AIAN alone, AIAN AOIC, or AIAN non-Hispanic population	
NHOPI alone, NHOPI AOIC, or NHOPI non-Hispanic population	
Populations from other race groups	Asian, AIAN, NHOPI
Hispanic population	Hispanic
Two or more races – employment/unemployment and educational attainment characteristics	Black
Two or more races – all other characteristics	Asian, AIAN, NHOPI

Notes: (1) AIAN is American Indian and Alaska Native and NHOPI is Native Hawaiian and Other Pacific Islander.
(2) AOIC is an abbreviation for alone or in combination. The AOIC population for a race group of interest includes people reporting only the race group of interest (alone) and people reporting multiple race categories including the race group of interest (in combination).
(3) Hispanics may be any race.
(4) Two or more races refers to the group of cases self-classified as having two or more races.

Standard Errors of Estimated Numbers. The approximate standard error, s_x, of an estimated number from this microdata file can be obtained by using the formula:

$$s_x = \sqrt{ax^2 + bx} \qquad (1)$$

Here *x* is the size of the estimate and *a* and *b* are the parameters in Table 4 or 5 associated with the particular type of characteristic. When calculating standard errors from cross-tabulations involving different characteristics, use the set of parameters for the characteristic that will give the largest standard error.

Illustration 1
Suppose there were 5,780,000 unemployed females in the civilian labor force. Use Formula (1) and the appropriate parameters from Table 4 to get

Illustration 1	
Number of unemployed females in the civilian labor force (*x*)	5,780,000
a parameter (*a*)	-0.000031
b parameter (*b*)	2,782
Standard error	123,000
90-percent confidence interval	5,578,000 to 5,982,000

The standard error is calculated as

$$s_x = \sqrt{-0.000031 \times 5,780,000^2 + 2,782 \times 5,780,000} = 123,000$$

and the 90-percent confidence interval is calculated as 5,780,000 ± 1.645 × 123,000.

A conclusion that the average estimate derived from all possible samples lies within a range computed in this way would be correct for roughly 90 percent of all possible samples.

Illustration 2
Suppose there were 58,949,000 married-couple family households. Use Formula (1) and the appropriate parameters from Table 5 to get

Illustration 2	
Number of married-couple family households (*x*)	58,949,000
a parameter (*a*)	-0.000004
b parameter (*b*)	1,052
Standard error	217,000
90-percent confidence interval	58,592,000 to 59,306,000

The standard error is calculated as

$$s_x = \sqrt{-0.000004 \times 58,949,000^2 + 1,052 \times 58,949,000} = 217,000$$

and the 90-percent confidence interval is calculated as 58,949,000 ± 1.645 × 217,000.

A conclusion that the average estimate derived from all possible samples lies within a range computed in this way would be correct for roughly 90 percent of all possible samples.

Standard Errors of Estimated Percentages. The reliability of an estimated percentage, computed using sample data for both numerator and denominator, depends on both the size of the percentage and its base. Estimated percentages are relatively more reliable than the corresponding estimates of the numerators of the percentages, particularly if the percentages are 50 percent or more. When the numerator and denominator of the percentage are in different categories, use the parameter from Table 4 or 5 as indicated by the numerator.

The approximate standard error, $s_{y,p}$, of an estimated percentage can be obtained by using the formula:

$$s_{y,p} = \sqrt{\frac{b}{y} \, p(100 - p)}$$

(2)

Here y is the total number of people, families, households, or unrelated individuals in the base or denominator of the percentage, p is the percentage $100*x/y$ ($0 \le p \le 100$), and b is the parameter in Table 4 or 5 associated with the characteristic in the numerator of the percentage.

Illustration 3
Suppose there were 203,798,000 out of 234,719,000 adults (aged 18 and older), or 86.8 percent, who graduated from high school. Use Formula (2) and the appropriate parameter from Table 5 to get

Illustration 3	
Percentage of adults who are high school graduates (p)	86.8
Base (y)	234,719,000
b parameter (b)	1,206
Standard error	0.08
90-percent confidence interval	86.7 to 87.0

The standard error is calculated as

$$s_{y,p} = \sqrt{\frac{1,206}{234,719,000} \times 86.8 \times (100 - 86.8)} = 0.08$$

The 90-percent confidence interval of the percentage of adults who graduated from high school is calculated as 86.8 ± 1.645 × 0.08.

Standard Errors of Estimated Differences. The standard error of the difference between two sample estimates is approximately equal to

$$s_{x_1 - x_2} = \sqrt{s_{x_1}^2 + s_{x_2}^2 - 2rs_{x_1}s_{x_2}}$$
(3)

where s_{x1} and s_{x2} are the standard errors of the estimates, x_1 and x_2. The estimates can be numbers, percentages, ratios, etc. Tables 7 and 8 contain the correlation coefficient, r, for CPS year-to-year comparisons. The correlations were derived for income, poverty, and health insurance estimates, but they can be used for other types of estimates where the year-to-year correlation between identical households is high. For making other comparisons, assume that r equals zero. Making this assumption will result in accurate estimates of standard errors for the difference between two estimates of the same characteristic in two different areas, or for the difference between separate and uncorrelated characteristics in the same area. However, if there is a high positive (negative) correlation between the two characteristics, the formula will overestimate (underestimate) the true standard error.

Illustration 4
Suppose there were 20,661,000 men over age 24 who were never married and 10,611,000 men over age 24 who were divorced. The apparent difference is 10,050,000. Use Formulas (1) and (3) with $r = 0$ and the appropriate parameters from Table 5 to get

Illustration 4			
	Never married (x_1)	Divorced (x_2)	Difference
Number of males over age 24	20,661,000	10,611,000	10,050,000
a parameter (a)	-0.000009	-0.000009	
b parameter (b)	2,652	2,652	
Standard error	226,000	165,000	280,000
90-percent confidence interval	20,289,000 to 21,033,000	10,340,000 to 10,882,000	9,589,000 to 10,511,000

The standard error of the difference is calculated as

$$s_{x_1 - x_2} = \sqrt{226,000^2 + 165,000^2} = 280,000$$

The 90-percent confidence interval around the difference is calculated as 10,050,000 ± 1.645 × 280,000. Since this interval does not include zero, we can conclude with 90 percent confidence that the number of never married men over age 24 was higher than the number of divorced men over age 24.

Illustration 5
Suppose that the percentage of people without health insurance coverage for 2011 was 15.7 percent out of 308,827,000 people, and the percentage of people without health insurance coverage for 2010 was 16.3 percent out of 306,553,000 people. The apparent difference is 0.6 percent. Use Formulas (2) and (3) and the appropriate parameter, factor, and correlation coefficient from Tables 5, 6, and 7 to get

Illustration 5			
	2010 (x_1)	2011 (x_2)	Difference
Percentage of people without health insurance (p)	16.3	15.7	0.6
Base	306,553,000	308,827,000	
b parameter (b)	2,652*	2,652	
Correlation coefficient (r)	-		0.30
Standard error	0.11	0.11	0.13
90-percent confidence interval	16.1 to 16.5	15.5 to 15.9	0.4 to 0.8

*This parameter is calculated by multiplying the year factor for 2009 from Table 6, 1.0, by the current b parameter.

The standard error of the difference is calculated as

$$s_{x_1 - x_2} = \sqrt{0.11^2 + 0.11^2 - 2 \times 0.30 \times 0.11 \times 0.11} = 0.13$$

and the 90-percent confidence interval around the difference is calculated as $0.6 \pm 1.645 \times 0.13$. Since this interval does not include zero, we can conclude with 90 percent confidence that the percentage of people without health insurance in 2010 is statistically different than the percentage of people without health insurance in 2011.

Standard Errors of Estimated Ratios. Certain estimates may be calculated as the ratio of two numbers. Compute the standard error of a ratio, x/y, using

$$s_{x/y} = \frac{x}{y} \sqrt{\left(\frac{s_x}{x}\right)^2 + \left(\frac{s_y}{y}\right)^2 - 2r \frac{s_x s_y}{xy}} \qquad (4)$$

The standard error of the numerator, s_x, and that of the denominator, s_y, may be calculated using formulas described earlier. In Formula (4), r represents the correlation between the numerator and the denominator of the estimate.

For one type of ratio, the denominator is a count of families or households and the numerator is a count of people in those families or households with a certain characteristic. If there is at least one person with the characteristic in every family or household, use 0.7 as an estimate of r. An example of this type is the average number of children per family with children.

For all other types of ratios, r is assumed to be zero. Examples are the average number of children per family and the family poverty rate. If r is actually positive (negative), then this procedure will provide an overestimate (underestimate) of the standard error of the ratio.

Note: For estimates expressed as the ratio of x per 100 y or x per 1,000 y, multiply Formula (4) by 100 or 1,000, respectively, to obtain the standard error.

Illustration 6
Suppose there were 12,360,000 males working part-time and 20,796,000 females working part-time. The ratio of males working part-time to females working part-time would be 0.594, or 59.4 percent. Use Formulas (1) and (4) with $r = 0$ and the appropriate parameters from Table 4 to get

Illustration 6			
	Males (x)	Females (y)	Ratio
Number who work part-time	12,360,000	20,796,000	0.594
a parameter (a)	-0.000032	-0.000031	-
b parameter (b)	2,971	2,782	-
Standard error	178,000	211,000	0.0105
90-percent confidence interval	12,067,000 to 12,653,000	20,449,000 to 21,143,000	0.577 to 0.611

The standard error is calculated as

$$ s_{x/y} = \frac{12,360,000}{20,796,000} \sqrt{ \left(\frac{178,000}{12,360,000} \right)^2 + \left(\frac{211,000}{20,796,000} \right)^2 } = 0.0105 $$

and the 90-percent confidence interval is calculated as $0.594 \pm 1.645 \times 0.0105$.

Illustration 7
Suppose that the number of families below the poverty level was 9,497,000 and the total number of families was 80,529,000. The ratio of families below the poverty level to the total number of families would be 0.118 or 11.8 percent. Use the appropriate parameters from Table 5 and Formulas (1) and (4) with $r = 0$ to get

Illustration 7			
	In poverty (x)	Total (y)	Ratio (in percent)
Number of families	9,497,000	80,529,000	11.8
a parameter (a)	0.000052	-0.000004	-
b parameter (b)	1,243	1,052	-
Standard error	128,000	238,000	0.16
90-percent confidence Interval	9,286,000 to 9,708,000	80,137,000 to 80,921,000	11.5 to 12.1

The standard error is calculated as

$$ s_{x/y} = \frac{9,497,000}{80,529,000} \sqrt{ \left(\frac{128,000}{9,497,000} \right)^2 + \left(\frac{238,000}{80,529,000} \right)^2 } = 0.0016 = 0.16\% $$

and the 90-percent confidence interval of the percentage is calculated as $11.8 \pm 1.645 \times 0.16$.

Standard Errors of Estimated Medians. The sampling variability of an estimated median depends on the form of the distribution and the size of the base. One can approximate the reliability of an estimated median by determining a confidence interval about it. (See "Standard Errors and Their Use" for a general discussion of confidence intervals.)

Estimate the 68-percent confidence limits of a median based on sample data using the following procedure:

1.   Using Formula (2) and the base of the distribution, calculate the standard error of 50 percent.

2.   Add to and subtract from 50 percent the standard error determined in step 1. These two numbers are the percentage limits corresponding to the 68-percent confidence interval about the estimated median.

3.   Using the distribution of the characteristic, determine upper and lower limits of the 68-percent confidence interval by calculating values corresponding to the two points established in step 2.

   Note: The percentage limits found in step 2 may or may not fall in the same characteristic distribution interval.

   Use the following formula to calculate the upper and lower limits:

$$X_p = \frac{pN - N_1}{N_2 - N_1}(A_2 - A_1) + A_1 \tag{5}$$

   where

   X_p =   estimated upper and lower bounds for the confidence interval $(0 \le p \le 1)$. For purposes of calculating the confidence interval, p takes on the values determined in step 2. Note that X_p estimates the median when $p = 0.50$.

   N =   <u>for distribution of numbers</u>: the total number of units (people, households, etc.) for the characteristic in the distribution.

   =   <u>for distribution of percentages</u>: the value 100.

   p =   the values obtained in Step 2.

   A_1, A_2 =   the lower and upper bounds, respectively, of the interval containing X_p.

   N_1, N_2 =   <u>for distribution of numbers</u>: the estimated number of units

(people, households, etc.) with values of the characteristic less than or equal to A_1 and A_2, respectively.

=   for distribution of percentages: the estimated percentage of units (people, households, etc.) having values of the characteristic less than or equal to A_1 and A_2, respectively.

4.   Divide the difference between the two points determined in step 3 by 2 to obtain the standard error of the median.

Note: Median incomes and their standard errors calculated as below may differ from those in published tables and reports showing income, since narrower income intervals were used in those calculations.

Illustration 8
Suppose there were 121,084,000 households in 2012, and their income was distributed in the following way:

Illustration 8			
Income level	Number of households	Cumulative number of households	Cumulative percent of households
Under $5,000	4,261,000	4,261,000	3.52%
$5,000 to $9,999	4,973,000	9,234,000	7.63%
$10,000 to $14,999	7,126,000	16,360,000	13.51%
$15,000 to $24,999	13,978,000	30,338,000	25.06%
$25,000 to $34,999	13,258,000	43,596,000	36.00%
$35,000 to $49,999	16,876,000	60,472,000	49.94%
$50,000 to $74,999	21,293,000	81,765,000	67.53%
$75,000 to $99,999	13,898,000	95,663,000	79.01%
$100,000 and over	25,421,000	121,084,000	100.00%

1.   Using Formula (2) with $b = 1,140$, the standard error of 50 percent on a base of 121,084,000 is about 0.15 percent.

2.   To obtain a 68-percent confidence interval on an estimated median, add to and subtract from 50 percent the standard error found in step 1. This yields percentage limits of 49.85 and 50.15.

3.   The lower and upper limits for the interval in which the percentage limits falls are $35,000 and $50,000, respectively.

Then the estimated numbers of households with an income less than or equal to $35,000 and $50,000 are 43,596,000 and 60,472,000, respectively.

Using Formula (5), the lower limit for the confidence interval of the median is found to be about

$$X_{0.4985} = \frac{0.4985 \times 121,084,000 - 43,596,000}{60,472,000 - 43,596,000}(50,000 - 35,000) + 35,000 = 49,901$$

Similarly, the upper limit is found to be about

$$X_{0.5015} = \frac{0.5015 \times 121,084,000 - 43,596,000}{60,472,000 - 43,596,000}(50,000 - 35,000) + 35,000 = 50,224$$

Thus, a 68-percent confidence interval for the median income for households is from $49,901 to $50,224.

4. The standard error of the median is, therefore,

$$\frac{50,224 - 49,901}{2} = 161.5$$

Standard Errors of Averages for Grouped Data. The formula used to estimate the standard error of an average for grouped data is

$$s_{\bar{x}} = \sqrt{\frac{b}{y}(S^2)} \tag{6}$$

In this formula, *y* is the size of the base of the distribution and *b* is the parameter from Table 4 or 5. The variance, *S²*, is given by the following formula:

$$S^2 = \sum_{i=1}^{c} p_i \bar{x}_i^2 - \bar{x}^2 \tag{7}$$

where $\bar{x}$, the average of the distribution, is estimated by

$$\bar{x} = \sum_{i=1}^{c} p_i \bar{x}_i \tag{8}$$

where

  c = the number of groups; *i* indicates a specific group, thus taking on values 1 through *c*.

  p_i = estimated proportion of households, families, or people whose values for the characteristic being considered fall in group *i*.

  $\bar{x}_i$ = $(Z_{Li} + Z_{Ui})/2$ where Z_{Li} and Z_{Ui} are the lower and upper interval boundaries, respectively, for group *i*. $\bar{x}_i$ is assumed to be the most representative value for the characteristic of households, families, or people in group *i*. If group *c* is open-

ended, i.e., no upper interval boundary exists, use a group approximate average value of

$$\overline{x}_c = \frac{3}{2} Z_{Lc} \tag{9}$$

Illustration 9

Suppose that there were 9,497,000 families in poverty and that the distribution of the income deficit (the difference between their family income and poverty threshold) for all families in poverty was

Income deficit	Number of families in poverty	Percentage of families in poverty (p_i)	Average income deficit ($\overline{x}_i$)
Under $1000	659,000	6.9	500
$1000 to $2,499	925,000	9.7	2,250
$2,500 to $4,999	1,497,000	15.8	5,000
$5,000 to $7,499	1,215,000	12.8	8,750
$7,500 to $9,999	1,040,000	11.0	12,500
$10,000 to $12,499	957,000	10.1	16,250
$12,500 to $14,999	914,000	9.6	20,000
$15,000 and over	2,289,000	24.1	22,500
Total	9,496,000*	100.0	

*There may be a difference due to rounding

Using Formula (8),

$$\overline{x} = (0.069 \times 500) + (0.097 \times 2,250) + (0.158 \times 5,000) + (0.128 \times 8,750) + (0.11 \times 12,500) + (0.101 \times 16,250)$$
$$+ (0.096 \times 20,000) + (0.241 \times 22,500) = 12,522$$

and Formula (7),

$$S^2 = (0.069 \times 500^2) + (0.097 \times 2,250^2) + (0.158 \times 5,000^2) + (0.128 \times 8,750^2) + (0.11 \times 12,500^2)$$
$$+ (0.101 \times 16,250^2) + (0.096 \times 20,000^2) + (0.241 \times 22,500^2) - 12,522^2 = 61,722,000$$

Use the appropriate parameter from Table 5 and Formula (6) to get

Illustration 9	
Average income deficit for families in poverty ($\overline{x}$)	$12,522
Variance (S^2)	61,722,000
Base (y)	9,497,000
b parameter (b)	1,243
Standard error	$90
90-percent confidence interval	$12,374 to $12,670

The standard error is calculated as

$$s_{\bar{x}} = \sqrt{\frac{1,243}{9,497,000}(61,722,000)} = 90$$

and the 90-percent confidence interval is calculated as $12,522 ± 1.645 × $90.

<u>Standard Errors of Estimated Per Capita Deficits</u>. Certain average values in reports associated with the ASEC data represent the per capita deficit for households of a certain class. The average per capita deficit is approximately equal to

$$x = \frac{hm}{p} \tag{10}$$

where

h = number of households in the class.

m = average deficit for households in the class.

p = number of people in households in the class.

x = average per capita deficit of people in households in the class.

To approximate standard errors for these averages, use the formula

$$s_x = \frac{hm}{p} \sqrt{\left(\frac{s_m}{m}\right)^2 + \left(\frac{s_p}{p}\right)^2 + \left(\frac{s_h}{h}\right)^2 - 2r\left(\frac{s_p}{p}\right)\left(\frac{s_h}{h}\right)} \tag{11}$$

In Formula (11), r represents the correlation between p and h.

For one type of average, the class represents households containing a fixed number of people. For example, h could be the number of 3-person households. In this case, there is an exact correlation between the number of people in households and the number of households. Therefore, $r = 1$ for such households. For other types of averages, the class represents households of other demographic types, for example, households in distinct regions, households in which the householder is of a certain age group, and owner-occupied and tenant-occupied households. In this and other cases in which the correlation between p and h is not perfect, use 0.7 as an estimate of r.

<u>Illustration 10</u>
Suppose there were 33,126,000 people living in families in poverty, and 9,497,000 families in poverty, with an average deficit income for families in poverty of $12,522 with a standard error

of $90 (from Illustration 9). Use Formulas (1), (10), and (11) and the appropriate parameters from Table 5 and $r = 0.7$ to get

Illustration 10				
	Number (h)	Number of people (p)	Average income deficit (m)	Average per capita deficit (x)
Value for families in poverty	9,497,000	33,126,000	$12,522	$3,590
a parameter (a)	+0.000052	-0.000017	-	-
b parameter (b)	1,243	5,282	-	-
Correlation (r)	-	-	-	0.7
Standard Error	128,000	395,000	$90	$44
90-percent confidence interval	9,286,000 to 9,708,000	32,476,000 to 33,776,000	$12,374 to $12,670	$3,518 to $3,662

The estimate of the average per capita deficit is calculated as

$$x = \frac{9,497,000 \times 12,522}{33,126,000} = 3,590$$

and the standard error is calculated as

$$s_x = \frac{9,497,000 \times 12,522}{33,126,000} \sqrt{\left(\frac{90}{12,522}\right)^2 + \left(\frac{395,000}{33,126,000}\right)^2 + \left(\frac{128,000}{9,497,000}\right)^2 - 2 \times 0.7 \times \left(\frac{395,000}{33,126,000}\right) \times \left(\frac{128,000}{9,497,000}\right)} = 44$$

The 90-percent confidence interval is calculated as $3,590 \pm 1.645 \times \$44$.

Accuracy of State Estimates. The redesign of the CPS following the 1980 census provided an opportunity to increase efficiency and accuracy of state data. All strata are now defined within state boundaries. The sample is allocated among the states to produce state and national estimates with the required accuracy while keeping total sample size to a minimum. Improved accuracy of state data was achieved with about the same sample size as in the 1970 design.

Since the CPS is designed to produce both state and national estimates, the proportion of the total population sampled and the sampling rates differ among the states. In general, the smaller the population of the state the larger the sampling proportion. For example, in Vermont approximately 1 in every 250 households is sampled each month. In New York the sample is about 1 in every 2,000 households. Nevertheless, the size of the sample in New York is four times larger than in Vermont because New York has a larger population.

Note: The Census Bureau recommends the use of 3-year averages to compare estimates across states and 2-year averages to evaluate changes in state estimates over time. See "Standard Errors of Data for Combined Years" and "Standard Errors of Differences of 2-Year Averages." The Census Bureau also recommends the American Community Survey microdata file as the preferred source for income and poverty state data in years 2006 (2005 estimates) to the present.

Standard Errors for State Estimates. The standard error for a state may be obtained by determining new state-level *a* and *b* parameters and then using these adjusted parameters in the standard error formulas mentioned previously. To determine a new state-level *b* parameter (b_{state}), multiply the *b* parameter from Table 4 or 5 by the state factor from Table 9. To determine a new state-level *a* parameter (a_{state}), use the following:

(1) If the *a* parameter from Table 4 or 5 is positive, multiply it by the state factor from Table 9.

(2) If the *a* parameter in Table 4 or 5 is negative, calculate the new state-level *a* parameter as follows:

$$a_{state} = \frac{-\, b_{state}}{POP_{state}} \tag{12}$$

where *POP$_{state}$* is the state population found in Table 9.

Illustration 11
Suppose there were 15,027,000 people living in New York state who were born in the United States. Use Formulas (1) and (12) and the appropriate parameter, factor, and population from Tables 5 and 9 to get

Illustration 11	
Number of people in NY who were born in the U.S. (*x*)	15,027,000
b parameter (*b*)	2,652
New York state factor	1.17
State population	19,360,790
State a parameter (a_{state})	-0.000160
State b parameter (b_{state})	3,103
Standard error	102,000

Obtain the state-level *b* parameter by multiplying the *b* parameter, 2,652, by the state factor, 1.17. This gives b_{state} = 2,652 × 1.17 = 3,103. Obtain the needed state-level *a* parameter by

$$a_{state} = \frac{-\, 3,103}{19,360,790} = -\, 0.000160$$

The standard error of the estimate of the number of people in New York state who were born in the United States can then be found by using Formula (1) and the new state-level *a* and *b* parameters, -0.000160 and 3,103, respectively. The standard error is given by

$$s_x = \sqrt{-\, 0.000160 \times 15,027,000^2 + 3,103 \times 15,027,000} = 102,000$$

Standard Errors of Regional Estimates. To compute standard errors for regional estimates, follow the steps for computing standard errors for state estimates found in "Standard Errors for State Estimates" using the regional factors and populations found in Table 10.

Illustration 12

Suppose there were 18,380,000 of 114,936,000 people, or 16.0 percent, living in poverty in the South. Use Formulas (2) and (12) and the appropriate parameter, factor, and population from Tables 5 and 10 to get

Illustration 12	
Poverty rate in the South (p)	16.0
Base (y)	114,936,000
b parameter (b)	5,282
South regional factor	1.08
Regional b parameter (b_{region})	5,705
Standard error	0.26
90-percent confidence interval	15.6 to 16.4

Obtain the region-level b parameter by multiplying the b parameter, 5,282, by the South regional factor, 1.08. This gives $b_{region} = 5{,}282 \times 1.08 = 5{,}705$.

The standard error of the estimate of the poverty rate for people living in the South can then be found by using Formula (2) and the new region-level b parameter, 5,705. The standard error is given by

$$s_{y,p} = \sqrt{\frac{5{,}705}{114{,}936{,}000} \times 16.0 \times (100 - 16.0)} = 0.26$$

and the 90-percent confidence interval of the poverty rate for people living in the South is calculated as $16.0 \pm 1.645 \times 0.26$.

Standard Errors of Groups of States. The standard error calculation for a group of states is similar to the standard error calculation for a single state. First, calculate a new state group factor for the group of states. Then, determine new state group a and b parameters. Finally, use these adjusted parameters in the standard error formulas mentioned previously.

Use the following formula to determine a new state group factor:

$$\text{state group factor} = \frac{\sum_{i=1}^{n} POP_i \times \text{state factor}_i}{\sum_{i=1}^{n} POP_i} \tag{13}$$

where POP_i and $state\ factor_i$ are the population and factor for state i from Table 9. To obtain a new state group b parameter ($b_{state\ group}$), multiply the b parameter from Table 4 or 5 by the state factor obtained by Formula (13). To determine a new state group a parameter ($a_{state\ group}$), use the following:

(1)   If the *a* parameter from Table 4 or 5 is positive, multiply it by the state group factor determined by Formula (13).

(2)   If the a parameter in Table 4 or 5 is negative, calculate the new state group a parameter as follows:

$$a_{\text{state group}} = \frac{-b_{\text{state group}}}{\sum_{i=1}^{n} POP_i}$$ (14)

Illustration 13
Suppose the state group factor for the state group Illinois-Indiana-Michigan was required. The appropriate factor would be

$$\text{state group factor} = \frac{12,706,857 \times 1.13 + 6,440,007 \times 1.08 + 9,768,568 \times 1.09}{12,706,857 + 6,440,007 + 9,768,568} = 1.11$$

Standard Errors of Data for Combined Years. Sometimes estimates for multiple years are combined to improve precision. For example, suppose $\overline{x}$ is an average derived from *n* consecutive years' data, i.e., $\overline{x} = \sum_{i=1}^{n} \frac{x_i}{n}$, where the x_i are the estimates for the individual years. Use the formulas described previously to estimate the standard error, s_{x_i}, of each year's estimate. Then the standard error of $\overline{x}$ is

$$s_{\overline{x}} = \frac{s_x}{n}$$ (15)

where

$$s_x = \sqrt{\sum_{i=1}^{n} s_{x_i}^2 + 2r\sum_{i=1}^{n-1} s_{x_i} s_{x_{i+1}}}$$ (16)

and s_{x_i} are the standard errors of the estimates x_i. Tables 7 and 8 contain the correlation coefficients, *r*, for the correlation between consecutive years *i* and *i*+1. Correlation between nonconsecutive years is zero. The correlations were derived for income and poverty estimates, but they can be used for other types of estimates where the year-to-year correlation between identical households is high.

The Census Bureau recommends the use of 3-year average estimates for certain small population subgroups[4] (see also "Accuracy of State Estimates.") Two-year moving averages are

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[4] Estimates of characteristics of the American Indian and Alaska Native (AIAN) and Native Hawaiian and Other Pacific Islander (NHOPI) populations based on a single-year sample would be unreliable due to the small size of the sample that can be drawn from either population. Accordingly, such estimates are based on multiyear averages.

recommended for these small population subgroups for comparisons across adjacent years (see "Standard Errors of Differences of 2-Year Averages.")

Illustration 14
Suppose the 2009-2011 3-year average percentage of the AIAN population without health insurance was 27.9. Suppose the percentages and bases for 2009, 2010, and 2011 were 29.1, 27.2, and 27.4 percent and 2,681,000, 3,093,000, and 3,216,000 respectively. Use the appropriate parameters, factors, and correlation coefficients from Tables 5, 6, and 7 and Formulas (2), (15), and (16) to get

Illustration 14				
	2009	2010	2011	2009-2011 avg
Percentage of AIAN without health insurance (p)	29.1	27.2	27.4	27.9
Base (y)	2,681,000	3,093,000	3,216,000	-
b parameter (b)	3,809*	3,809*	3,809	-
Correlation (r)	-	-	-	0.30, 0.30
Standard error	1.71	1.56	1.53	1.09
90-percent confidence interval	26.3 to 31.9	24.6 to 29.8	24.9 to 29.9	26.1 to 29.7

*These parameters are calculated by multiplying the year factors from Table 6 by the current parameter.

The standard error of the 3-year average is calculated as

$$s_{\bar{x}} = \frac{3.28}{3} = 1.09$$

where

$$s_x = \sqrt{1.71^2 + 1.56^2 + 1.53^2 + (2 \times 0.30 \times 1.71 \times 1.56) + (2 \times 0.30 \times 1.56 \times 1.53)} = 3.28$$

The 90-percent confidence interval for the 3-year average percentage of the AIAN population without health insurance is $27.9 \pm 1.645 \times 1.09$.

Standard Errors of Differences of 2-Year Averages. Comparing two non-overlapping 2-year averages also improves precision for comparisons across years. Use the formulas described previously to estimate the standard error, s_{xi}, of each year's estimate, x_i, and the standard error, $s_{\bar{x}_{i,i+1}}$, of each average, $\overline{x}_{i,i+1}$. Then the standard error of the difference of the two non-overlapping 2-year averages, $\overline{x}_{1,2} - \overline{x}_{3,4}$, is

$$s_{\bar{x}_{1,2} - \bar{x}_{3,4}} = \sqrt{s^2_{\bar{x}_{1,2}} + s^2_{\bar{x}_{3,4}} - \frac{1}{2} r s_{x_2} s_{x_3}} \qquad (17)$$

Illustration 15

Suppose that you want to calculate the standard error of the difference between the 2008, 2009 and 2010, 2011 averages of the percent of people in California without health insurance. Use the following information along with Tables 5, 6, 9 and Formula (2) to get

	2008	2009	2010	2011
Percentage of people in CA without health insurance (p)	18.6	20.0	19.4	19.7
Base (y)	36,691,000	36,749,000	37,292,000	37,634,000
b parameter (b)	2,652[1]	2,652[1]	2,652[1]	2,652
California state factor	1.25	1.25	1.25	1.25
State b parameter (b_{state})	3,315	3,315	3,315	3,315
Standard error[2]	0.37	0.38	0.37	0.37

[1]These parameters are calculated by multiplying the year factors from Table 6 by the current parameter.
[2]See "Standard Errors of State Estimates" for instructions and illustrations on calculating state standard errors.

Use this information, Formulas (15), (16), and (17), and the appropriate correlation coefficient from Table 7 to get

Illustration 15				
	2008, 2009	2009, 2010	2010, 2011	avg(2010, 2011) -avg(2008, 2009)
Average percent of people in CA without health insurance ($\overline{x}$)	19.3	-	19.6	0.3
Correlation coefficient (r)	0.30	0.30	0.30	-
Standard error	0.30*	-	0.30*	0.40
90-percent confidence interval	18.8 to 19.8	-	19.1 to 20.1	-0.4 to 1.0

*See "Standard Errors of Data for Combined Years" for instructions and illustrations on calculating these standard errors.

The standard error of the difference of the two 2-year averages is calculated as

$$s_{x_{1,2} - x_{3,4}} = \sqrt{0.30^2 + 0.30^2 - \frac{1}{2} \times 0.30 \times 0.38 \times 0.37} = 0.40$$

and the 90-percent confidence interval around the difference of the 2-year averages is calculated as $0.3 \pm 1.645 \times 0.40$. Since this interval includes zero, we cannot conclude with 90 percent confidence that the 2009-2010 average percent of people in California without health insurance was higher than the 2007-2008 average percent of people in California without health insurance.

<u>Standard Errors of Quarterly or Yearly Averages</u>. For information on calculating standard errors for labor force data from the CPS which involve quarterly or yearly averages, please see the "Explanatory Notes and Estimates of Error: Household Data" section in *Employment and Earnings*, a monthly report published by the U.S. Bureau of Labor Statistics.

<u>Technical Assistance</u>. If you require assistance or additional information, please contact the Demographic Statistical Methods Division via e-mail at <u>dsmd.source.and.accuracy@census.gov</u>.

Table 4. Parameters for Computation of Standard Errors for Labor Force Characteristics: March 2012		
Characteristic	a	b
Total or White		
Civilian labor force, employed	-0.000016	3,068
Not in labor force	-0.000009	1,833
Unemployed	-0.000016	3,096
Civilian labor force, employed, not in labor force, and unemployed		
Men	-0.000032	2,971
Women	-0.000031	2,782
Both sexes, 16 to 19 years	-0.000022	3,096
Black		
Civilian labor force, employed, not in labor force, and unemployed	-0.000151	3,455
Men	-0.000311	3,357
Women	-0.000252	3,062
Both sexes, 16 to 19 years	-0.001632	3,455
Hispanic, may be of any race		
Civilian labor force, employed, not in labor force, and unemployed	-0.000141	3,455
Men	-0.000253	3,357
Women	-0.000266	3,062
Both sexes, 16 to 19 years	-0.001528	3,455
Asian, American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander		
Civilian labor force, employed, not in labor force, and unemployed	-0.000346	3,198
Men	-0.000729	3,198
Women	-0.000659	3,198
Both sexes, 16 to 19 years	-0.004146	3,198

NOTES: (1) These parameters are to be applied to basic CPS monthly labor force estimates.

(2) The Total or White, Black, and Asian, AIAN, NHOPI parameters are to be used for both alone and in combination race group estimates.

(3) For nonmetropolitan characteristics, multiply the a and b parameters by 1.5. If the characteristic of interest is total state population, not subtotaled by race or ethnicity, the a and b parameters are zero.

(4) For foreign-born and noncitizen characteristics for Total and White, the a and b parameters should be multiplied by 1.3. No adjustment is necessary for foreign-born and noncitizen characteristics for Black, Hispanic, and Asian, AIAN, NHOPI parameters.

(5) For the groups self-classified as having two or more races, use the Asian, AIAN, NHOPI parameters for all employment characteristics.

Table 5. Parameters for Computation of Standard Errors for People and Families: 2012 ASEC								
Characteristics	Total or White		Black		Asian, AIAN, & NHOPI		Hispanic	
	a	b	a	b	a	b	a	b
PEOPLE								
Educational attainment	-0.000005	1,206	-0.000027	1,364	-0.000055	1,101	-0.000025	922
Employment	-0.000016	3,068	-0.000151	3,455	-0.000346	3,198	-0.000141	3,455
People by family income	-0.000010	2,494	-0.000057	2,855	-0.000143	2,855	-0.000078	2,855
Income characteristics								
Total	-0.000005	1,249	-0.000029	1,430	-0.000071	1,430	-0.000039	1,430
Male	-0.000011	1,249	-0.000062	1,430	-0.000151	1,430	-0.000078	1,430
Female	-0.000010	1,249	-0.000053	1,430	-0.000136	1,430	-0.000079	1,430
Age								
15 to 24	-0.000029	1,249	-0.000127	1,430	-0.000304	1,430	-0.000105	1,430
25 to 44	-0.000016	1,249	-0.000076	1,430	-0.000175	1,430	-0.000090	1,430
45 to 64	-0.000015	1,249	-0.000092	1,430	-0.000246	1,430	-0.000153	1,430
65 and over	-0.000030	1,249	-0.000247	1,430	-0.000654	1,430	-0.000471	1,430
Health insurance	-0.000010	2,652	-0.000119	3,809	-0.000284	3,809	-0.000104	3,809
Marital status, household and family								
Some household members	-0.000009	2,652	-0.000057	3,809	-0.000138	3,809	-0.000073	3,809
All household members	-0.000010	3,222	-0.000084	5,617	-0.000204	5,617	-0.000108	5,617
Mobility (movers)								
Educational attainment, labor force,								
Marital status, HH, family, and income	-0.000005	1,460	-0.000022	1,460	-0.000053	1,460	-0.000028	1,460
US, county, state, region, or MSA	-0.000013	3,965	-0.000059	3,965	-0.000144	3,965	-0.000076	3,965
Below poverty								
Total	-0.000017	5,282	-0.000079	5,282	-0.000101	5,282	-0.000101	5,282
Male	-0.000035	5,282	-0.000166	5,282	-0.000201	5,282	-0.000201	5,282
Female	-0.000034	5,282	-0.000149	5,282	-0.000204	5,282	-0.000204	5,282
Age								
Under 15	-0.000066	4,072	-0.000243	4,072	-0.000258	4,072	-0.000258	4,072
Under 18	-0.000049	4,072	-0.000187	4,072	-0.000440	4,072	-0.000210	4,072
15 and over	-0.000021	5,282	-0.000103	5,282	-0.000253	5,282	-0.000126	5,282
15 to 24	-0.000046	1,998	-0.000177	1,998	-0.000425	1,998	-0.000146	1,998
25 to 44	-0.000025	1,998	-0.000107	1,998	-0.000245	1,998	-0.000125	1,998
45 to 64	-0.000024	1,998	-0.000129	1,998	-0.000344	1,998	-0.000214	1,998
65 and over	-0.000048	1,998	-0.000346	1,998	-0.000913	1,998	-0.000658	1,998
Unemployment	-0.000016	3,096	-0.000151	3,455	-0.000346	3,198	-0.000141	3,455
FAMILIES, HOUSEHOLDS, OR UNRELATED INDIVIDUALS								
Income	-0.000005	1,140	-0.000025	1,245	-0.000062	1,245	-0.000034	1,245
Marital status, HH and family, educational								
attainment, population by age/sex	-0.000004	1,052	-0.000019	952	-0.000048	952	-0.000026	952
Poverty	0.000052	1,243	0.000052	1,243	0.000052	1,243	0.000052	1,243

NOTES: (1) These parameters are to be applied to the 2012 Annual Social and Economic Supplement data.
(2) AIAN, NHOPI are American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander, respectively.
(3) Hispanics may be any race. For a more detailed discussion on the use of parameters for race and ethnicity, please see the "Generalized Variance Parameters" section.

(4) The Total or White, Black, and Asian, AIAN, NHOPI parameters are to be used for both alone and in-combination race group estimates.
(5) For nonmetropolitan characteristics, multiply the *a* and *b* parameters by 1.5. If the characteristic of interest is total state population, not subtotaled by race or ancestry, the *a* and *b* parameters are zero.
(6) For foreign-born and noncitizen characteristics for Total and White, the *a* and *b* parameters should be multiplied by 1.3. No adjustment is necessary for foreign-born and noncitizen characteristics for Black, Asian, AIAN, NHOPI, and Hispanic.
(7) For the group self-classified as having two or more races, use the Asian, AIAN, NHOPI parameters for all characteristics except employment, unemployment, and educational attainment, in which case use Black parameters.
(8) To obtain parameters prior to 2012, multiply the parameter from this table by the appropriate year factor in Table 6.

Table 6. CPS Year Factors: ASEC 1947 to 2011				
Data Collection Period	Total or White	Black		Hispanic
	a and b	a and b	a*	a and b
2003 – 2011	1.00	1.00	1.00	1.00
2001 (expanded) – 2002	1.00	1.00	1.53	1.00
1996 – 2001 (basic)	1.97	1.97	3.00	1.97
1990 – 1995	1.82	1.82	2.78	1.82
1989	2.02	2.02	3.09	2.12
1985 – 1988	1.70	1.70	2.60	1.70
1982 – 1984	1.70	1.70	2.60	2.38
1973 – 1981	1.52	1.52	2.32	2.13
1967 – 1972	1.52	1.52	2.32	3.58
1957 – 1966	2.28	2.28	3.48	5.38
1947 – 1956	3.42	3.42	5.22	8.07

NOTES: (1) Blacks have separate factors for the *a* and *b* parameter factors due to the new race definitions and how they affected the population control totals.
(2) Use the asterisked factor to get *a* parameters for all estimates of the Black population except those for Black families, households, and unrelated individuals in poverty.
(3) For races not listed, use the factor for Total or White.
(4) Hispanics may be any race. For a more detailed discussion on the use of parameters for race and ethnicity, please see the "Generalized Variance Parameters" section.

Table 7. CPS Year-to-Year Correlation Coefficients for Income and Health Insurance Characteristics: 1961 to 2012				
Characteristics	1961-2001 (basic) or 2001 (expanded)-2012		2000 (basic)-2001 (expanded)	
	People	Families	People	Families
Total	**0.30**	**0.35**	**0.19**	**0.22**
White	0.30	0.35	0.20	0.23
Black	0.30	0.35	0.15	0.18
Other	0.30	0.35	0.15	0.17
Hispanic	0.45	0.55	0.36	0.28

NOTES: (1) Correlation coefficients are not available for income data before 1961.
(2) Hispanics may be any race. For a more detailed discussion on the use of parameters for race and ethnicity, please see the "Generalized Variance Parameters" section.
(3) These correlation coefficients are for comparisons of consecutive years. For comparisons of nonconsecutive years, assume the correlation is zero.
(4) For households and unrelated individuals, use the correlation coefficient for families

Table 8. CPS Year-to-Year Correlation Coefficients for Poverty Characteristics: 1971 to 2012										
Characteristics	1973-84, 1985-2001 (basic) or 2001 (expanded)-2012		2000 (basic)-2001 (expanded)		1984-1985		1972-1973		1971-1972	
	People	Families	People	Families	People	Families	People	Families	People	Families
Total	**0.45**	**0.35**	**0.29**	**0.22**	**0.39**	**0.30**	**0.15**	**0.14**	**0.31**	**0.28**
White	0.35	0.30	0.23	0.20	0.30	0.26	0.14	0.13	0.28	0.25
Black	0.45	0.35	0.23	0.18	0.39	0.30	0.17	0.16	0.35	0.32
Other	0.45	0.35	0.22	0.17	0.30	0.30	0.17	0.16	0.35	0.32
Hispanic	0.65	0.55	0.52	0.40	0.56	0.47	0.17	0.16	0.35	0.32

NOTES: (1) Correlation coefficients are not available for income data before 1961.
(2) Hispanics may be any race. For a more detailed discussion on the use of parameters for race and ethnicity, please see the "Generalized Variance Parameters" section.
(3) These correlation coefficients are for comparisons of consecutive years. For comparisons of nonconsecutive years, assume the correlation is zero.
(4) For households and unrelated individuals, use the correlation coefficient for families

Table 9. Factors and Populations for State Standard Errors and Parameters: 2012 ASEC					
State	Factor	Population	State	Factor	Population
Alabama	1.05	4,737,614	Montana	0.24	987,084
Alaska	0.18	700,819	Nebraska	0.46	1,822,856

Arizona	1.23	6,409,104	Nevada	0.67	2,694,189
Arkansas	0.68	2,897,161	New Hampshire	0.34	1,303,900
California	1.25	37,354,295	New Jersey	1.12	8,732,350
Colorado	1.20	5,059,821	New Mexico	0.58	2,053,475
Connecticut	0.88	3,530,747	New York	1.17	19,273,788
Delaware	0.22	896,127	North Carolina	1.11	9,498,785
District of Columbia	0.18	616,907	North Dakota	0.16	674,395
Florida	1.12	18,882,314	Ohio	1.09	11,387,518
Georgia	1.08	9,647,954	Oklahoma	0.91	3,727,075
Hawaii	0.29	1,328,729	Oregon	1.01	3,851,906
Idaho	0.36	1,571,879	Pennsylvania	1.09	12,578,773
Illinois	1.13	12,706,857	Rhode Island	0.30	1,034,691
Indiana	1.08	6,440,007	South Carolina	1.06	4,597,571
Iowa	0.77	3,031,088	South Dakota	0.17	811,158
Kansas	0.73	2,820,579	Tennessee	1.08	6,327,692
Kentucky	1.05	4,291,249	Texas	1.28	25,445,297
Louisiana	1.05	4,488,870	Utah	0.54	2,815,196
Maine	0.39	1,315,546	Vermont	0.18	620,243
Maryland	1.13	5,759,971	Virginia	1.08	7,923,718
Massachusetts	1.06	6,532,220	Washington	1.15	6,765,074
Michigan	1.09	9,768,568	West Virginia	0.39	1,828,964
Minnesota	1.07	5,307,542	Wisconsin	1.10	5,651,923
Mississippi	0.71	2,914,814	Wyoming	0.15	560,087
Missouri	1.11	5,913,019			

NOTES: (1) The state population counts in this table are for the 0+ population.

(2) For foreign-born and noncitizen characteristics for Total and White, the *a* and *b* parameters should be multiplied by 1.3. No adjustment is necessary for foreign-born and noncitizen characteristics for Black, Asian, AIAN, NHOPI, and Hispanic.

Table 10. Factors and Populations for Regional Standard Errors and Parameters: 2012 ASEC		
Region	Factor	Population
Midwest	1.03	66,335,510
Northeast	1.05	54,922,258
South	1.08	114,482,083
West	1.10	72,151,658

NOTES: (1) The state population counts in this table are for the 0+ population.

(2) For foreign-born and noncitizen characteristics for Total and White, the *a* and *b* parameters should be multiplied by 1.3. No adjustment is necessary for foreign-born and noncitizen characteristics for Black, Asian, AIAN, NHOPI, and Hispanic.

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[6]   U.S. Census Bureau, July 15, 2009, "Estimating ASEC Variances with Replicate Weights Part I: Instructions for Using the ASEC Public Use Replicate Weight File to Create ASEC Variance Estimates." (http://www.bls.census.gov/cps_ftp.html#cpsmarch)