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August 16, 2012

MEMORANDUM FOR   Francis Grailand Hall
                    Division Chief, Administrative and Customer Services Division

From: Ruth Ann Killion
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Subject: Survey of Income and Program Participation (SIPP) 2008 Panel:
                    Source and Accuracy Statement for Longitudinal Analysis of
                    Waves 1 to 8 Public Use Files (S&A-15)[1]

Attached is the Source and Accuracy Statement for longitudinal analysis of the eight waves of
the 2008 Survey of Income and Program Participation (SIPP).

Attachment

cc:

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[1]This source and accuracy statement can also be accessed through the U.S. Census Bureau
website at *http://www.census.gov/sipp/source.html*

SOURCE AND ACCURACY STATEMENT FOR THE SURVEY OF INCOME AND PROGRAM PARTICIPATION (SIPP) 2008 PANEL FOR LONGITUDINAL ANALYSIS OF WAVES 1 TO 8 PUBLIC USE FILES [2]

DATA COLLECTION AND ESTIMATION

Source of Data: The data were collected in the 2008 Panel of the Survey of Income and Program Participation (SIPP). The population represented in the 2008 SIPP (the population universe) is the civilian noninstitutionalized population living in the United States. The institutionalized population, which is excluded from the 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).

The 2008 Panel of the SIPP sample is located in 351 Primary Sampling Units (PSUs), each consisting of a county or a group of contiguous counties. Of these 351 PSUs, 123 are self-representing (SR) and 228 are non-self-representing (NSR). SR PSUs have a probability of selection of one. NSR PSUs have a probability of selection of less than one. Within PSUs, housing units (HUs) were systematically selected from the master address file (MAF) used for the 2000 decennial census. To account for HUs built within each of the sample areas after the 2000 census, a sample containing clusters of four HUs was drawn from permits issued for construction of residential HUs up until shortly before the beginning of the panel. In jurisdictions that don't issue building permits or that have incomplete addresses, we systematically sampled expected clusters of four HUs which were then listed by field personnel.

Household were classified into two strata, such that one strata had a higher concentration of low income households than the other. We oversampled the low income stratum by 44 percent to increase the accuracy of estimates for statistics for low income households and program participation. Analysts are strongly encouraged to use the SIPP weights when creating estimates since households are not selected with equal probability.

Sample households within a given panel are divided into four random subsamples of nearly equal size. These subsamples are called rotation groups and one rotation group is interviewed each month. Each household in the sample was scheduled to be interviewed at four-month intervals over a period of roughly five years beginning in September 2008. The reference period for the questions is the four-month period preceding the interview month. The most recent month is designated reference 4, the earliest month is reference month 1. In general, one cycle of four interviews covering the entire sample, using the same questionnaire, is called a wave. Table 1 indicates the reference months corresponding to each interview month for all 16 waves of the 2008 SIPP Panel. For example, Wave 1 rotation group 1 of the 2008 Panel was interviewed in September 2008 and data for the reference months May 2008 through August 2008 were collected.

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[2]For questions or further assistance with the information provided in this document contact: Tracy Mattingly of the Demographic Statistical Methods Division on 301-763-6445 or via the email at Tracy.L.Mattingly@census.gov.

The period covered by the 16 waves of the SIPP 2008 panel consists of 64 interview months (16 interviews) conducted from September 2008 to December 2013. Data for up to 68 reference months are available for persons on the file. Specific months available depend on the person's rotation group and his/her sample entry or exit date. Also note that the availability of data on household composition begins with the first interview month of a rotation group.

In Wave 1, the SIPP 2008 Panel began with a sample of about 65,500 HUs. About 13,500 of these HUs were found to be vacant, demolished, converted to nonresidential use, or otherwise ineligible for the survey. Field Representatives (FRs) were able to obtain interviews for about 42,000 of the eligible HUs. FRs were unable to interview approximately 10,000 eligible HUs in the panel because the occupants: (1) refused to be interviewed; (2) could not be found at home; (3) were temporarily absent; or (4) were otherwise unavailable. Thus, occupants of about 81 percent of all eligible HUs participated in the first interview of the panel.

For subsequent interviews, only original sample people (those in Wave 1 sample households and interviewed in Wave 1) and people living with them were eligible to be interviewed. The SIPP sample includes original sample people if they moved to a new address, unless the new address was more than 100 miles from a SIPP sample area. In this case, FRs attempted telephone interviews.

Since the SIPP follows all original sample members, those members that form new households are also included in the SIPP sample. This expansion of original households can be estimated within the interviewed sample, but is impossible to determine within the non-interviewed sample. Therefore, a growth factor based on the growth in the known sample is used to estimate the unknown expansion of the non-interviewed households.

Growth factors account for the additional nonresponse stemming from the expansion of non-interviewed households. They are used to get a more accurate estimate of the number of non-interviewed HUs at each wave, called sample loss. To calculate sample loss we use Formula (1):

$$Sample\ Loss = \frac{(A_1 \times GF) + A_C + D_C}{I_C + (A_1 \times GF) + A_C + D_C} \tag{1}$$

where A_1 is the number of Type A non-interviewed households in Wave 1, A_c is the number of Type A non-interviewed households in the Current Wave, D_c is the number of Type D non-interviewed households in the current wave, I_c is the number of interviewed households in the current wave, and GF is the growth factor associated with the current wave.

Based on the above equation, the sample loss at each wave of the SIPP 2008 Panel was calculated and tabulated as shown in the table below.

			Type As		Type Ds				Weighted
Wave	**Eligible HUs**	**Interviewed HUs**	**Total**	**Rate**	**Total**	**Rate**	**Growth Factor**	**Sample Loss**	**Response Rate**
1	52,031	42,032	9,999	19.2%				19.2%	80.6 %
2	42,481	39,000	2,921	6.9%	560	1.3%	1.01	25.8%	91.8 %
3	42,779	37,651	4,159	9.7%	969	2.3%	1.02	28.9%	88.1 %
4	43,176	36,195	5,693	13.2%	1,288	3.0%	1.03	32.3%	83.9 %
5	43,422	35,873	6,060	14.0%	1,489	3.4%	1.04	33.3%	82.7 %
6	43,544	34,891	6,894	15.8%	1,759	4.0%	1.04	35.4%	80.1 %
7	43,619	33,827	7,901	18.1%	1,891	4.3%	1.05	37.4%	77.6%
8	43,609	33,417	8,231	18.9%	1,961	4.5%	1.05	38.2%	76.7%

Table A. Sample Loss and Response Rate for SIPP 2008

Wave	**Language Problem**	**Unable to Locate**	**No One Home**	**Temporarily Absent**	**Household Refused**	**Other**
1	1.2%	0.8%	16.6%	3.4%	67.2%	10.9%
2	0.8%		19.2%	5.2%	61.3%	13.4%
3	0.5%		18.6%	5.7%	60.7%	14.5%
4	0.4%		18.4%	3.9%	62.5%	14.7%
5	0.3%		16.6%	3.4%	64.7%	15.1%
6	0.3%		14.8%	3.7%	67.8%	13.3%
7	0.4%		15.3%	2.9%	62.8%	18.7%
8	0.2%		13.7%	2.4%	62.7%	20.9%

Table B. Percent of Type As by Nonresponse Status for SIPP 2008

Note that in Table A the Wave 1 sample loss rate is the same as the Type A rate since growth factors and Type D (movers) are not applicable until Wave 2. Also note that the formula for calculating the weighted response rate is:

$$Weighted\ Response\ Rate = \frac{I_W}{I_W + A_W + D_W} \tag{2}$$

where A_w is the sum of the weights (the inverse of the probabilities of selection) for the Type A non-interviewed households in the current wave, D_w is the sum of the weights for the Type D non-interviewed households in the current wave, and I_w is the sum of the weights for the interviewed households in the current wave.

For the panel (PNL1, PNL2) and calendar year (CY2009, CY2010) weighting procedures, a person was classified as interviewed or non-interviewed based on the following definitions. (NOTE: A person may be classified differently for calculating different weights.) Interviewed sample persons (including children) were defined to be:

1)   those for whom self, proxy, or imputed responses were obtained for each month of the appropriate longitudinal period, or

2)   those for whom self or proxy responses were obtained for the first month of the appropriate longitudinal period and self, proxy, or imputed responses exist for each subsequent month until they were known to have died or moved to an ineligible address (foreign HUs, institutions, or military barracks).

The months for which persons were deceased or residing in an ineligible address were identified on the file. Non-interviewed persons were defined to be those for whom neither self nor proxy responses were obtained for one or more months of the *appropriate longitudinal period* (excluding imputed persons and persons who died or moved to an ineligible address).

It is estimated that roughly *134,760*[3] people were initially designated in the sample[4]. Approximately *108,863* people were interviewed in Wave 1; however, we did not interview approximately *25,897* of the sample persons in the panel because the occupants, (1) refused to be interviewed, (2) could not be found at home, (3) were temporarily absent, or (4) were otherwise unavailable. Thus, about 81 percent of all people initially designated in the sample participated in the first interview of the panel.

For CY2009 weighting, the eligible sample cohort includes only people classified as *interviewed* in January 2009, and they are by definition all original (Wave 1) sample people and those joining the sample households at later times during Wave 2. The time span covered for the CY2009 weighting is from January 2009 through December 2009. For CY2010 weighting, the eligible sample cohort includes only people classified as interviewed in January 2010, and they are by definition composed of original sample people and those joining the sample households at later times during Wave 2 to Wave 5. The time span covered for the CY2010 weighting is from January 2010 through December 2010.

The CY2009 weighting classified about 75,150 people as interviewed and had a person nonresponse rate of 22.1%. The CY2010 weighting classified about 68,730 people as interviewed and had a person nonresponse rate of 22.5%.
For the PNL1 and PNL2 weighting, the eligible sample cohorts include only people classified as

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[3]All values given in italics in this paragraph are estimates.

[4]This approximation represents the number of HUs fielded in Wave 1 multiplied by the average number of persons per household in Wave 1.

interviewed in Wave 1 as indicated in Table 1. The time span covered for the PNL1 weighting is from Wave 1 through Wave 5, and the time span covered for the PNL2 weighting is from Wave 1 through Wave 8.

The PNL1 weighting classified about 74,250 people as interviewed and had a person nonresponse rate of 23.1%. The PNL2 weighting classified about 61,040 people as interviewed and had a person nonresponse rate of 25.4%.

Estimation: The SIPP program produces weights for both cross-sectional and longitudinal analysis. What follows is an overview of the longitudinal estimation.

All people classified as interviewed for the longitudinal period of a longitudinal weight (i.e., PNL1 to PNL5 and CY2009 to CY2013) are assigned positive weights for that period, while those classified as non-interviewed or excluded from the weighting process are assigned zero weights. Longitudinal weights are produced at the completion of Waves 5, 8, 11, 14, and 16 (last wave).

- The SIPP 2008 panel weight is produced based on the SIPP survey universe in January 2009. This implies that (a) the controls (benchmark population estimates) for second stage (post stratification) raking for this weight are those of January 2009, and (b) the initial weight (of the SIPP 2008 panel weight) is the non-interview adjusted cross-sectional weight in January 2009, i.e., Reference Month 1 of Wave 3 for Rotation 1, Reference Month 4 of Wave 2 for Rotation 2, Reference Month 3 of Wave 2 for Rotation 3, and Reference Month 2 of Wave 2 for Rotation 4. This weight will cover the time span from May 2008 (corresponding to Reference Month 1 of Wave 1 of Rotation 1) to the last reference month in the last wave of the panel, November 2013.[5]

- Each calendar year weight for the SIPP 2008 Panel is produced based on the SIPP survey universe in January of the reference year. Therefore, (a) the controls for second stage raking for each calendar year weight are those for January of the reference year, (b) the initial weight of each calendar year weight is the non-interview adjusted cross-sectional weight in January of the same reference year, and (c) the time span covered by each calendar year weight is January through December of the same reference year. The first calendar year weight to be produced is 2009, and then followed by the calendar year weights for 2010, 2011, 2012, and 2013, respectively.

Population Controls: The 2008 SIPP estimation procedure adjusts weighted sample results to agree with independently derived population estimates of the civilian noninstitutional population. This attempts to correct for undercoverage and thereby reduces the mean square error of the estimates. The national and state level population controls are obtained directly from the Population Division and are prepared each month to agree with the most current set of

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5 For information on cross-sectional weighting see
<http://www.census.gov/sipp/sourceac/S&A08_W1toW6%28S&A-13%29.pdf>.

population estimates released by the Census Bureau's population estimates and projections program.

The national level controls are distributed by demographic characteristics as follows:

- Age, Sex, and Race (White Alone, Black Alone, and all other groups combined)
- Age, Sex, and Hispanic Origin

The state level controls are distributed by demographic characteristics as follows:

- State by Age and Sex
- State by Hispanic origin
- State by Race (Black Alone, all other groups combined)

The estimates begin with the latest decennial census as the base and incorporate the latest available information on births and deaths along with the latest estimates of net international migration.

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

- legal migration to the U.S.,
- emigration of foreign born and native people from the U.S.,
- net movement between the U.S. and Puerto Rico,
- estimates of temporary migration, and
- estimates of net residual foreign-born population, which include unauthorized migration.

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

Use of Person Weights: *Panel weights* (e.g., PNL1 weights) are computed for sample people who are in sample at Wave 1 and whose monthly data are obtained (either reported or imputed) continuously for every month until they become a survey universe leaver during the longitudinal reference period under consideration. *Calendar year weights* (e.g., CY2009 weights) are computed for sample people who are interviewed (self, proxy, or imputed) in January (control month) and whose monthly data are obtained (either reported or imputed) continuously for every month until they become a survey universe leaver during the longitudinal reference period under consideration. The panel weight can be used to form monthly, quarterly, annual, or multi-year estimates (e.g., the PNL2 weights can be used for estimates at any time spans contained in the period between 2009 through 2010). The calendar year weight can be used to form monthly, quarterly, or annual estimates within a specific calendar year.

> **Example**, using the PNL5 panel weight, one can estimate the number of people receiving TANF from January 2009 up to August 2013 using the data from all four rotations of the

sample (as indicated in Table 1). Note that if one desires to estimate the total number of people receiving TANF from January 2009 up to December 2013 using the data from all four rotations, proper adjustment (e.g., imputation, extrapolation, etc.) must be done to account for the September, October, November, and December 2013 censored data due to panel ending of Rotations 2, 3, and 4 (as indicated in Table 1). Another example, using the CY2010 weight, one can estimate the number of people receiving TANF for the third quarter of 2010.

Users should be forewarned to apply the appropriate weights given on weighting files before attempting to calculate estimates. The weights vary with demographic and time units of analysis (person, family, and household, monthly in 2009, quarterly in 2009, annually between 2009 to 2011, etc.) due to differences in control months, longitudinal reference periods, interview-refusal and unlocated-mover nonresponses, sample reduction effects if there is sample reduction, etc. that are factored in the weighting adjustments. If an analysis/estimate is done for a cohort of people or families or households (in the survey universe) without applying the appropriate weights, the results will be erroneous.

All estimates may be divided into two broad categories: longitudinal and cross-sectional. Longitudinal estimates require that data records for each person be linked across interviews, whereas cross-sectional estimates do not. For example, annual income estimates obtained by summing the 12 monthly income amounts for each person would require linking records and so would be longitudinal estimates. Because there is no linkage between interviews, cross-sectional estimates can combine data from different interviews only at the aggregate level. Longitudinal person weights were developed for longitudinal estimation, but may be used for cross-sectional estimation as well. However, note that wave files with cross-sectional weights are also produced for the SIPP. Because of the larger sample size with positive weights available on the wave files, it is recommended that these files be used for cross-sectional estimation, if possible.

In this section, it is assumed that all four rotation groups are used for estimation.

Some basic types of longitudinal and cross-sectional estimates which can be constructed using longitudinal person weights are described below in terms of estimated numbers. Of course, more complex estimates, such as percentages, averages, ratios, etc., can be constructed from the estimated numbers. Longitudinal person weights can be used to construct the following types of longitudinal estimates:

1.   The number of people who have ever experienced a characteristic during a given time period.

        To construct such an estimate, use the longitudinal person weight for the shortest time period which covers the entire time period of interest. Then sum the weights over all people who possessed the characteristic of interest at some point during the time period of interest. For example, to estimate the number of people who ever received food stamps during the last six months of 2009, use the CY2009 weights, since CY2009 weights cover all 12 months of 2009. The same estimate could be generated using the

panel weights, but there may be fewer positively weighted people than those in the calendar year.

2. The amount of a characteristic accumulated by people during a given time period.

    To construct such an estimate, use the longitudinal person weight for the shortest time period which covers the entire time period of interest. Then compute the product of the weight times the amount of the characteristic and sum this product over all appropriate people. For example, to estimate the aggregate 2009 annual income of people who were employed during all 12 months of the year, use the CY2009 weights. The same estimate could be generated using the panel weights but there may be fewer positively weighted people than those in the calendar year.

3. The average number of consecutive months of possession of a characteristic (i.e., the average spell length for a characteristic) during a given time period.

    For example, one could estimate the average length of each spell of receiving food stamps during 2009. Also, one could estimate the average spell of unemployment that elapsed before a person found a new job. To construct such an estimate, first identify the people who possessed the characteristic at some point during the time period of interest. Then create two sums of these persons' appropriate longitudinal weights: (1) sum the product of the weight times the number of months the spell lasted and (2) sum the weights only. Now, the estimated average spell length in months is given by (1) divided by (2). A person who experienced two spells during the time period of interest would be treated as two people and appear twice in sums (1) and (2). An alternate method of calculating the average can be found in the section "Standard Error of a Mean or Aggregate."

4. The number of month-to-month changes in the status of a characteristic (i.e., number of transitions) summed over every set of two consecutive months during the time period of interest.

    To construct such an estimate, sum the appropriate longitudinal person weight each time a change is reported between two consecutive months during the time period of interest. For example, to estimate the number of people who changed from receiving food stamps in July 2009 to not receiving in August 2009, add together the CY2009 weights of each person who had such a change. To estimate the number of changes in monthly salary income during the third quarter of 2009, sum together the estimate of number of people who made a change between July and August, between August and September, and between September and October.

    Note that spell and transition estimates should be used with caution because of the biases that are associated with them. Sample people tend to report the same status of a characteristic for all four months of a reference period. This tendency results in a bias toward reported spell lengths that are multiples of four months. This tendency also

affects transition estimates in that, for many characteristics, the number of characteristics, the number of month-to-month transitions reported between the last month of one reference period and the first month of the next reference period are much greater than the number of reported transitions between any two months within a reference period. Additionally, spells extending before or after the time period of interest are cut off (censored) at the boundaries of the time period. If they are used in estimating average spell length, a downward bias will result.

Also using longitudinal person weights one can construct the following type of cross-sectional estimate:

5.   Monthly estimates of a characteristic averaged over a number of consecutive months.

For example, one could estimate the monthly average number of food stamp recipients over the months July through December 2009. To construct such an estimate, first form an estimate for each month in the time period of interest. Use the longitudinal person weight, summing over all people who possessed the characteristic of interest during the month of interest. Then sum the monthly estimates and divide by the number of months. Either the CY2009 weight or the panel weights can be used for this calculation (but there may be fewer positively weighted people than those in the calendar year).

Adjusting Estimates Which use Less than the Full Sample: When estimates involving months with less than four rotations worth of data are constructed from a wave-panel file or files, factors greater than 1 must be applied. However, when core data from consecutive waves are used together, data from all four rotations may be available, in which case the factors are equal to 1. Note that all wave-panel files contain only core data. In a full panel longitudinal analysis using all wave-panel files, the data for the first and last three reference months are not available for all four rotations due to staggered starting and ending months among the four rotations (as indicated in Table 1).

Among the 16 wave-panel files of the SIPP 2008 Panel, all four rotation groups of data are not available for reference months May 2008 through Jul 2008 on the first (Wave 1) wave-panel file and September 2013 through November 2013 on the last (Wave 16) wave-panel file (see Table 1). If the time period of interest for a given estimate (of person or family or household characteristics) includes these months, the estimate may need to be adjusted in some way to account for the missing rotation groups. For Types 1 to 4 longitudinal estimates (defined earlier under the topic *Use of Person Weights*), this adjustment factor also depends on the duration of the time period under consideration. The simplest duration is monthly one; namely, for monthly estimate, this adjustment factor equals four divided by the number of rotation groups contributing data. For example, if the time period of interest for a given estimate is May 2008, then data will be available only from rotation group 1. Therefore, a factor of 4/1 = 4.0 will be applied. For Type 1 to Type 4 estimates with duration other than monthly one (e.g., quarterly, annually, etc.), their adjustment factors (accounting for their missing rotation) can usually be practically and yet adequately derived using the ratio of 4 to the number of missing rotation

groups as its adjustment factor (without resorting to complicate approaches such as proper imputation and extrapolation to obtain data for the censored months of the missing rotation groups). For example, to estimate the number of people <u>ever</u> unemployed in the 3rd quarter of 2008, since rotation groups 2 and 3 have the data for all/full three months in the third quarter of 2008 (as indicated in Table 1), the estimate can be taken as the estimate from the summation of rotation groups 2 and 3 multiplied by an adjustment factor of 4/2. Note that rotation groups 1 and 4 are ignored because this particular estimate needs <u>full</u> three-month data in the third quarter of 2008 and rotation groups 1 and 4 have no data for all three months in the third quarter of 2008.

Note that if the given estimate is an average of monthly estimates (Type 5), then the number of rotation groups and the factor used will be determined independently for each month in the average and the adjusted monthly estimates will be averaged together in the usual way. For example, to estimate the average number of people unemployed per month in the third quarter of 2013, the July, August, and September data will be multiplied by 4/4, 4/4, and 4/3 respectively before being summed together and divided by three.

ACCURACY OF ESTIMATES

SIPP estimates are based on a sample; they may differ somewhat from the figures that would have been obtained if a complete census had been taken using the same questionnaire, instructions, and enumerators. There are two types of errors possible in an estimate based on a sample survey: sampling and nonsampling. 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. 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. We are able to provide estimates of the magnitude of SIPP sampling error, but this is not true of nonsampling error.

Nonsampling Error: Nonsampling errors can be attributed to many sources:

- inability to obtain information about all cases in the sample
- definitional difficulties
- differences in the interpretation of questions
- inability or unwillingness on the part of the respondents to provide correct information
- errors made in the following: collection such as in recording or coding the data, processing the data, estimating values for missing data
- biases resulting from the differing recall periods caused by the interviewing pattern used and undercoverage.

Quality control and edit procedures were used to reduce errors made by respondents, coders and interviewers. More detailed discussions of the existence and control of nonsampling errors in the

SIPP can be found in the *SIPP Quality Profile, 1998 SIPP Working Paper Number 230, issued May 1999*.

Undercoverage in SIPP results from missed HUs and missed persons within sample HUs. It is known that undercoverage varies with age, race, and sex. Generally, undercoverage is larger for males than for females and larger for Blacks than for non-Blacks. Ratio estimation to independent age-race-sex population controls partially corrects for the bias due to survey undercoverage. However, biases exist in the estimates to the extent that persons in missed households or missed persons in interviewed households have characteristics different from those of interviewed persons in the same age-race-sex group.

A common measure of survey coverage is the coverage ratio, the estimated population before post stratification ratio (second stage) adjustment divided by the independent population control. By definition, a coverage ratio less than one implies undercoverage and a coverage ratio larger the one implies overcoverage. Table C below shows the 2008 SIPP coverage ratios corresponding to control month January 2009 by age-sex-race for PNL1 weights prior to the post stratification ratio adjustment, respectively. The SIPP coverage ratios exhibit some variability from month to month but these are a typical set of coverage ratios. Other Census Bureau household surveys (e.g., the Current Population Survey) experience similar coverage.

Table C. SIPP Average Coverage Ratios for January 2009 for PNL1 Weights Prior to Post Stratification Ratio (Second Stage) Weight Adjustment by Age, Race, and Sex						
Age	White Only		Black Only		Residual	
	Male	Female	Male	Female	Male	Female
<15	0.85	0.85	0.80	0.83	0.97	1.08
15	0.88	0.89	0.80	0.85	1.01	0.98
16-17	0.87	0.85	0.79	0.85	1.04	0.98
18-19	0.81	0.77	0.81	0.83	1.04	0.96
20-21	0.70	0.72	0.68	0.69	1.02	0.97
22-24	0.71	0.75	0.66	0.67	1.01	0.98
25-29	0.73	0.79	0.59	0.75	0.91	0.98
30-34	0.82	0.85	0.65	0.79	0.94	0.97
35-39	0.82	0.85	0.69	0.81	0.88	0.96
40-44	0.82	0.85	0.82	0.85	0.89	0.97
45-49	0.83	0.87	0.77	0.78	1.09	1.12
50-54	0.86	0.92	0.86	0.97	1.10	1.11
55-59	0.88	0.93	0.92	0.98	1.07	1.03
60-61	0.96	1.01	0.94	0.98	1.09	1.00
62-64	0.98	0.97	0.95	1.01	1.05	0.99
65-69	0.96	1.03	1.02	1.01	0.98	0.95
70-74	0.95	0.91	1.00	1.05	0.98	0.97
75-79	0.99	0.97	1.10	0.99	0.96	0.97
80-84	1.02	0.95	1.05	1.00	0.92	0.95
85+	0.85	0.83	1.04	0.94	0.95	1.01

Comparability with Other Estimates: Caution should be exercised when comparing this data with data from other SIPP products or with data from other surveys. The comparability problems are caused by such sources as the seasonal patterns for many characteristics, different nonsampling errors, and different concepts and procedures. Refer to the *SIPP Quality Profile, 1998 SIPP Working Paper Number 230, issued May 1999* for known differences with data from other sources and further discussions.

Sampling Variability: Standard errors indicate the magnitude of the sampling error. They also partially measure the effect of some nonsampling errors in response and enumeration, but do not measure any systematic biases in the data. The standard errors for the most part measure the variations that occurred by chance because a sample rather than the entire population was surveyed.

USES AND COMPUTATION OF STANDARD ERRORS

Confidence Intervals: The sample estimate and its standard error enable one to construct confidence intervals, ranges that would include the average result of all possible samples with a known probability. For example, if all possible samples were selected, each of these being surveyed under essentially the same conditions and using the same sample design, and if an estimate and its standard error were calculated from each sample, then:

1.   Approximately 68 percent of the intervals from one standard error below the estimate to one standard error above the estimate would include the average result of all possible samples.

2.   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.

3.   Approximately 95 percent of the intervals from two standard errors below the estimate to two standard errors above the estimate would include the average result of all possible samples.

The average estimate derived from all possible samples is or is not contained in any particular computed interval. However, for a particular sample, we can say with a specified confidence that the average estimate derived from all possible samples is included in the confidence interval.

Hypothesis Testing: Standard errors may also be used for hypothesis testing, a procedure for distinguishing between population characteristics using sample estimates. The most common types of hypotheses tested are: H_0: the population characteristics are identical versus H_1: they are different. Tests may be performed at various levels of significance, where a level of significance

is the probability of concluding that the characteristics are different when, in fact, they are identical.

To perform the most common test, compute the difference X_A-X_B, where X_A and X_B are sample estimates of the characteristics of interest. A later section explains how to derive an estimate of the standard error of the difference X_A-X_B. Let that standard error be S_{DIFF}. If X_A-X_B is between $-1.645 \times S_{DIFF}$ and $+1.645 \times S_{DIFF}$, no conclusion about the characteristics is justified at the 10 percent significance level. If, on the other hand, X_A-X_B is smaller than $-1.645 \times S_{DIFF}$ or larger than $+1.645 \times S_{DIFF}$, the observed difference is significant at the 10 percent level. In this event, it is commonly accepted practice to say that the characteristics are different. We recommend that users report only those differences that are significant at the 10 percent level or better. Of course, sometimes this conclusion will be wrong. When the characteristics are the same, there is a 10 percent chance of concluding that they are different.

Note that as more tests are performed, more erroneous significant differences will occur. For example, at the 10 percent significance level, if 100 independent hypothesis tests are performed in which there are no real differences, it is likely that about 10 erroneous differences will occur. Therefore, the significance of any single test should be interpreted cautiously. A Bonferroni correction can be done to account for this potential problem that consists of dividing your stated level of confidence by the number of tests you are performing. This correction results in a conservative test of significance.

Note Concerning Small Estimates and Small Differences: Because of the large standard errors involved, there is little chance that estimates will reveal useful information when computed on a base smaller than 75,000. Also, nonsampling error in one or more of the small number of cases providing the estimate can cause large relative error in that particular estimate. Care must be taken in the interpretation of small differences since even a small amount of nonsampling error can cause a borderline difference to appear significant or not, thus distorting a seemingly valid hypothesis test.

Calculating Standard Errors for SIPP Estimates: There are three main ways we calculate the Standard Errors (SEs) for SIPP Estimates. They are as follows:
- Direct estimates using replicate weighting methods;
- Generalized variance function parameters (denoted as *a* and *b*); and
- Simplified tables of SEs based on the *a* and *b* parameters.

While the replicate weight 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 smoothing effect on SE estimates across time. SIPP uses the Replicate Weighting Method to produce GVF parameters (see K. Wolter, *Introduction to Variance Estimation*, Chapter 5 for more information). The GVF parameters are used to create the simplified tables of SEs.

Standard Error Parameters and Tables and Their Use: Most SIPP estimates have greater standard errors than those obtained through a simple random sample because of its two-stage cluster sample design. To derive standard errors that would be applicable to a wide variety of estimates and could be prepared at a moderate cost, a number of approximations were required.

Estimates with similar standard error behavior were grouped together and two parameters (denoted by *a* and *b*) were developed to approximate the standard error behavior of each group of estimates. Because the actual standard error behavior was not identical for all estimates within a group, the standard errors computed from these parameters provide an indication of the order of magnitude of the standard error for any specific estimate. These *a* and *b* parameters vary by characteristic and by demographic subgroup to which the estimate applies. Tables 2a to 2d provide base *a* and *b* parameters associated with the longitudinal estimates created using the CY2009, CY2010, PNL1, and PNL2 weights on the 2008 SIPP wave-panel files. Table 3 provides additional factors needed for adjusting the base *a* and *b* parameters to account for the missing data of reference months of any rotation groups in a longitudinal or cross-sectional estimate under consideration.   In addition, we also provide Table 5 that gives correlations between quarterly and yearly averages of cross-sectional estimates. These correlations are used in the formula for the standard error of a difference [Formula (14)].

These factors are needed for two reasons: the monthly estimates are correlated and averaging over a greater number of monthly estimates will produce an average with a smaller standard error.

The creation of appropriate *a* and *b* parameters for the previously discussed types of estimates are described below. Again, it is assumed that all four rotation groups are used in estimation. If not, refer to the section "Adjusting Standard Errors of Estimates Which Use Less Than the Full Sample."

1. The number of people who have ever experienced a characteristic during a given time period.

   The appropriate *a* and *b* parameters are taken directly from Tables 2a to 2d. The choice of parameter depends on the weights used, on the characteristic of interest, and on the demographic subgroup of interest.

2. Amount of a characteristic accumulated by people during a given time period.

   The appropriate *b* parameters are also taken directly from Tables 2a to 2d.

3. The average number of consecutive months of possession of a characteristic per spell (i.e., the average spell length for a characteristic) during a given time period.

   Start with the appropriate base *a* and *b* parameters from Tables 2a to 2d. The parameters are then inflated by an additional factor, g, to account for people who experience multiple spells during the time period of interest. This factor is computed by:

$$g = \frac{\sum_{i=1}^{n} m_i^2}{\sum_{i=1}^{n} m_i}, \tag{5}$$

where there are n people with at least one spell and m_i is the number of spells experienced by person i during the time period of interest.

4. The number of month-to-month changes in the status of a characteristic (i.e., number of transitions) summed over every set of two consecutive months during the time period of interest.

    Obtain a set of adjusted *a* and *b* parameters exactly as just described in 3, then multiply these parameters by an additional factor. Use 1.0 if the time period of interest is two months and 2.0 for a longer time period. (The factor of 2.0 is based on the conservative assumption that each spell produces two transitions within the time period of interest.)

5. Monthly estimates of a characteristic averaged over a number of consecutive months.

    Appropriate base *a* and *b* parameters are taken from Tables 2a to 2d. If more than one longitudinal weight has been used in the monthly average, then there is a choice of parameters from Tables 2a to 2d. Choose the table which gives the largest parameter.

Adjusting Standard Error Parameters for Estimates which Use Less Than Full Sample: If some rotation groups are unavailable to contribute data to a given estimate, then the estimate and its standard error need to be adjusted. The adjustment of the estimate is described in a previous section. The standard error of a longitudinal estimate (Types 1 to 4) is adjusted by multiplying the appropriate *a* and *b* parameters by a factor equal to 4 divided by the number of rotation groups contributing data to the estimate.

For the standard error of a cross-sectional estimate which covers only one month (monthly estimates) with monthly data missing for one or more rotation groups, the factor used for adjusting the base *a* and *b* to account for the missing monthly data is provided in Table 3. For example, if the monthly data available for a monthly estimate are only from two rotation groups, then the adjusted/appropriate *a* and *b* parameters are 2 × the base *a* and *b* parameters. Similarly, Table 3 also provides the adjustment factors for the base *a* and *b* parameters for standard error calculation of quarterly estimates. For example, suppose in a quarterly estimate only ten-monthly data are available instead of 12-monthly data (full sample data) and all the available six-monthly data are suitable to be used for the estimate, then the adjusted/appropriate *a* and *b* parameters are 1.0494 × the base *a* and *b* parameters.

Standard Errors of Estimated Numbers: The approximate standard error, s_x, of an estimated number of persons may be obtained by using the formula:

$$s_x = \sqrt{ax^2 + bx}$$ (6)

Here x is the size of the estimate and a and b are the parameters associated with the particular type of characteristic being estimated. Note that this method should not be applied to dollar values.

Illustration

Suppose the SIPP estimate of the number of people ever receiving Social Security during the first three months of 2009 is 38,122,000. [This estimate is obtained using the 2009 calendar year (CY2009) weight.] The appropriate **a** and **b** parameters to use in calculating a standard error for the estimate are obtained from Table 2a. They are a = -0.00002279, b=5,434, respectively. Using Formula (6), the approximate standard error is

$$\sqrt{(-0.00002279)(38,122,000)^2 + (5,434)(38,122,000)} = 417,175 \; persons$$

The 90-percent confidence interval as shown by the data is from 37,435,747 to 38,808,253. Therefore, 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 samples. Similarly, the 95-percent confidence interval as shown by the data is from 37,304,337 to 38,939,663 and we could conclude with 95-percent confidence that the average estimate derived from all possible samples lies within this interval.

Standard Error of a Mean: A mean is defined here to be the average quantity of some item (other than people, families, or households) per person. For example, it could be the annual household income of females age 25 to 34. The standard error of a mean can be approximated by Formula (7) below. Because of the approximations used in developing Formula (7), an estimate of the standard error of the mean obtained from this formula will generally underestimate the true standard error. The formula used to estimate the standard error of a mean x is

$$s_{\bar{x}} = \sqrt{\left(\frac{b}{y}\right)s^2}$$ (7)

where y is the size of the base, s^2 is the estimated population variance of the item and b is the parameter associated with the particular type of item.

The population variance s^2 may be estimated by one of two methods. In both methods, we assume x_i is the value of the item for unit "i." (Unit may be person, family, or household). To use

the first method, the range of values for the item is divided into "c" intervals. The lower and upper boundaries of interval j are Z_{j-1} and Z_j, respectively. Each unit is placed into one of "c" groups such that $Z_{j-1} < x_i < Z_j$.

The estimated population mean, x, and variance, s^2, are given by the formulas:

$$\bar{x} = \sum_{j=1}^{c} p_j m_j$$

$$s^2 = \sum_{j=1}^{c} p_j m_j^2 - \bar{x}^2, \tag{8}$$

where p_j is the estimated proportion of units in group j, and $m_j = (Z_{j-1} + Z)/2$. The most representative value of the item in group j is assumed to be m_j. If group "c" is open-ended, or there exists no upper interval boundary, then an approximate value for m_c is

$$m_c = \frac{3}{2} Z_{c-1}. \tag{9}$$

In the second method, the estimated population mean, x, and variance, s^2, are given by the formulas

$$\bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$$

$$s^2 = \frac{\sum_{i=1}^{n} w_i x_i^2}{\sum_{i=1}^{n} w_i} - \bar{x}^2, \tag{10}$$

where there are n units with the item of interest and w_i is the final weight for unit "I" (note that $\sum w_i = y$).

Illustration of Method 1

Suppose that the 2009 distribution of annual incomes is given in Table 4 for people aged 25 to 34 who were employed for all 12 months of 2009.

$$\bar{x} = \frac{370}{23,527}(2,500) + \frac{302}{23,527}(6,250) + ... + \frac{2,138}{23,527}(105,000) = \$38,704.$$

Using Formula (8) and the mean annual cash income of $38,704 the estimated population variance, s^2, is

$$s^2 = \frac{370}{23,527}(2,500)^2 + \frac{302}{23,527}(6,250)^2 + ... + \frac{2,138}{23,527}(105,000)^2 - (38,704)^2 = 649,457,303.$$

The appropriate **b** parameter from Table 2a is 5,434. Now, using Formula (7), the estimated standard error of the mean is

$$s_{\bar{x}} = \sqrt{\frac{5,434}{23,527,377}(649,457,303)} = \$387$$

Illustration of Method 2

Suppose that we are interested in estimating the average length of spells of food stamp recipiency during the calendar year 2009 for a given subpopulation. Also, suppose there are only 10 sample people in the subpopulation who were food stamp recipients. (This example is a hypothetical situation used for illustrative purposes only; actually, 10 sample cases would be too few for a reliable estimate and their weights could be substantially different from those given.) The number of consecutive months of food stamp recipiency during 2009 and the CY2009 weights are given in the table below for each sample person:

Sample Person	Spell Length in Months	CY2009 Weight
1	4, 3	5,300
2	5	7,100
3	9	4,900
4	3, 3, 2	6,500
5	12	9,200
6	12	5,900
7	4, 1	7,600
8	7	4,200
9	6	5,500
10	4	5,700

Using formula (10), the average spell of food stamp recipiency is estimated to be:

$$\bar{x} = \frac{(5300)(4) + (5300)(3) + ... + (5700)(4)}{5300 + 5300 + ...5700} = 5.4$$

The standard error will be computed by Formula (7). First, the estimated population variance can be obtained by Formula (10):

$$s^2 = \frac{(5300)(4)^2 + (5300)(3)^2 + ... + (5700)(4)^2}{5300 + 5300 + ... + 5700} - (5.4)^2$$

$$= 12.4 \ (months)^2$$

Next, the base **b** parameter of 5,732 is taken from Table 2a and multiplied by the factor computed from Formula (5):

$$g = \frac{2^2 + 1 + 1 + 3^2 + 1 + 1 + 2^2 + 1 + 1 + 1}{2 + 1 + 1 + 3 + 1 + 1 + 2 + 1 + 1 + 1}$$

$$= 1.71$$

Therefore, the final **b** parameter is $1.71 \times 5{,}732 = 9{,}802$, and the standard error of the mean from Formula (7) is:

$$s_{\bar{x}} = \sqrt{\frac{9{,}802}{87{,}800}(12.4)} = 1.18 \ months$$

Standard error of an Aggregate: An aggregate is defined to be the total quantity of an item summed over all the units in a group. The standard error of an aggregate can be approximated using Formula (11).

As with the estimate of the standard error of a mean, the estimate of the standard error of an aggregate will generally underestimate the true standard error. Let y be the size of the base, s^2 be the estimated population variance of the item obtained using Formula (8) or Formula (10) and b be the parameter associated with the particular type of item. The standard error of an aggregate is:

$$s_x = \sqrt{b * y * s^2} \tag{11}$$

Standard Errors of Estimated Percentages: The reliability of an estimated percentage, computed using sample data for both numerator and denominator, depends upon both the size of the percentage and the size of the total upon which the percentage is based. 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, e.g., the percent of people employed is more reliable than the estimated number of people employed. When the numerator and denominator of the percentage have different parameters, use the parameter (and appropriate

factor) of the numerator. If proportions are presented instead of percentages, note that the standard error of a proportion is equal to the standard error of the corresponding percentage divided by 100.

There are two types of percentages commonly estimated. The first is the percentage of people sharing a particular characteristic such as the percent of people owning their own home. The second type is the percentage of money or some similar concept held by a particular group of people or held in a particular form. Examples are the percent of total wealth held by people with high income and the percent of total income received by people on welfare.

For the percentage of people, the approximate standard error, $s_{(x,p)}$, of the estimated percentage p may be approximated by the formula

$$s_{(x,p)} = \sqrt{\frac{b}{x}(p)(100-p)} \ percent. \tag{12}$$

Here x is the size of the subclass of social units which is the base of the percentage, p is the percentage $(0 < p < 100)$, and b is the parameter associated with the characteristic in the numerator.

Illustration

Suppose that using the first panel weight (PNL1), it was estimated that 59,355,000 males were employed in July 2009 and an estimated 2.4 percent of them became unemployed in August 2009. The base "b" parameter is 5,552 (from Table 2b). Using Formula (12) and the appropriate "b" parameter, the approximate standard error is

$$\sqrt{\frac{5,552}{59,355,000}(2.4)(100-2.4)} = 0.15 \ percent.$$

Consequently, the 90-percent confidence interval as shown by these data is from 2.15 to 2.65 percent.

For percentages of money, a more complicated formula is required. A percentage of money will usually be estimated in one of two ways. It may be the ratio of two aggregates:

$$p_I = 100(x_A / x_N) \tag{13}$$

or it may be the ratio of two means with an adjustment for different bases:

$$p_I = 100(\hat{p}_A \bar{x}_A / \bar{x}_N) \tag{14}$$

Where x_A and x_N are aggregate money figures, $\bar{x}_A$ and $\bar{x}_N$ are mean money figures, and $\hat{p}_A$ is the estimated number in group A divided by the estimated number in group N.

In either case, we estimate the standard error as

$$s_I = \sqrt{\left(\frac{\hat{p}_A\bar{x}_A}{\bar{x}_N}\right)^2\left[\left(\frac{s_P}{\hat{p}_A}\right)^2+\left(\frac{s_A}{\bar{x}_A}\right)^2+\left(\frac{s_B}{\bar{x}_N}\right)^2\right]}, \qquad (15)$$

where s_p is the standard error of $\hat{p}_A$, s_A is the standard error of $\bar{x}_A$ and s_B is the standard error of $\bar{x}_N$. To calculate s_P, use Formula (12). The standard errors of $\bar{x}_N$ and $\bar{x}_A$ may be calculated using Formula (7).

It should be noted that there is frequently some correlation between $\hat{p}_A, \bar{x}_N,$ and $\bar{x}_A$. Depending on the magnitude and sign of the correlations, the standard error will be over or underestimated.

Illustration

Suppose that in October 2009 an estimated 8.8% of males 16 years and over were black, the mean monthly earnings of these black males was $1288, the mean monthly earnings of all males 16 years and over was $1911, and the corresponding standard errors are 0.28%, $36, and $27. Then, the percent of male earnings made by blacks in October 2009 is:

$$p_M = .088\left(\frac{1288}{1911}\right)\times 100$$

$$= 5.9\%$$

Using Formula (15), the approximate standard error is:

$$s_M = \sqrt{\left(\frac{(.088)(1288)}{1911}\right)^2\left[\left(\frac{.0028}{.0880}\right)^2+\left(\frac{36}{1288}\right)^2+\left(\frac{27}{1911}\right)^2\right]}$$

$$= 0.26\%$$

Standard Error of a Difference: The standard error of a difference between two sample estimates is approximately equal to

$$s_{(x-y)} = \sqrt{s_x{}^2 + s_y{}^2 - r\,s_x\,s_y}, \qquad (16)$$

where s_x and s_y are the standard errors of the estimates x and y.

The estimates can be numbers, percent, ratios, etc. The correlation between x and y is represented by r. Some correlations are given in Table 5. The above formula assumes that the correlation coefficient between the characteristics estimated by x and y is non-zero. If no correlations have been provided for a given set of x and y estimates, assume $r = 0$. However, if the correlation is really positive (negative), then this assumption will tend to cause overestimates (underestimates) of the true standard error.

Illustration

Suppose that SIPP estimates show the number of people age 35-44 years with annual cash income of $50,000 to $59,999 was 3,186,000 in 2009 and the number of people age 25-34 years with annual cash income of $50,000 to $59,999 in the same time period was 2,619,000. Then, using parameters from Table 2a and Formula (6), the standard errors of these numbers are approximately 130,696 and 118,640, respectively. The difference in sample estimates is 567,000 and using Formula (9), the approximate standard error of the difference is

$$\sqrt{(130,696)^2 + (118,640)^2} = 176,513.$$

Suppose that it is desired to test at the 10 percent significance level whether the number of people with annual cash income of $50,000 to $59,999 was different for people age 35-44 years than for people age 25-34 years. To perform the test, compare the difference of 567,000 to the product $1.645 * 176,513 = 290,364$. Since the difference is larger than 1.645 times the standard error of the difference, the data show that the two age groups are significantly different at the 10 percent significance level.

Standard Error of a Median: The median quantity of some item such as income for a given group of people is that quantity such that at least half the group have as much or more, and at least half the group have as much or less. The sampling variability of an estimated median depends upon the form of the distribution of the item as well as the size of the group. To calculate standard errors on medians, the procedure described below may be used.

The median, like the mean, can be estimated using either data which have been grouped into intervals or ungrouped data. If grouped data are used, the median is estimated using Formulas (17) or (18) with p = 0.5. If ungrouped data are used, the data records are ordered based on the value of the characteristic, then the estimated median is the value of the characteristic such that the weighted estimate of 50 percent of the subpopulation falls at or below that value and 50 percent is at or above that value. Note that the method of standard error computation which is presented here requires the use of grouped data. Therefore, it should be easier to compute the median by grouping the data and using Formulas (17) or (18).

An approximate method for measuring the reliability of an estimated median is to determine a confidence interval about it. (See the section on sampling variability for a general discussion of

confidence intervals.) The following procedure may be used to estimate the 68-percent confidence limits and hence the standard error of a median based on sample data.

- Determine, using Formula (12), the standard error of an estimate of 50 percent of the group.

- Add to and subtract from 50 percent the standard error determined in step 1.

- Using the distribution of the item within the group, calculate the quantity of the item such that the percent of the group with more of the item is equal to the smaller percentage found in step 2. This quantity will be the upper limit for the 68-percent confidence interval. In a similar fashion, calculate the quantity of the item such that the percent of the group with more of the item is equal to the larger percentage found in step 2. This quantity will be the lower limit for the 68-percent confidence interval.

- Divide the difference between the two quantities determined in step 3 by two to obtain the standard error of the median.

To perform step 3, it will be necessary to interpolate. Different methods of interpolation may be used. The most common are simple linear interpolation and Pareto interpolation. The appropriateness of the method depends on the form of the distribution around the median. If density is declining in the area, then we recommend Pareto interpolation. If density is fairly constant in the area, then we recommend linear interpolation. Note, however, that Pareto interpolation can never be used if the interval contains zero or negative measures of the item of interest. Interpolation is used as follows. The quantity of the item such that p percent have more of the item is

$$X_{pN} = A_1 * \exp\left[\left(Ln\left(\frac{pN}{N_1}\right) \middle/ Ln\left(\frac{N_2}{N_1}\right)\right) \quad Ln\left(\frac{A_2}{A_1}\right)\right]. \tag{17}$$

if Pareto Interpolation is indicated and

$$X_{pN} = \left[\frac{pN - N_1}{N_2 - N_1}(A_2 - A_1) + A_1\right] \tag{18}$$

if linear interpolation is indicated, where

N is the size of the group,

A_1 and A_2 are the lower and upper bounds, respectively, of the interval in which X_{pN} falls,

N_1 and N_2 are the estimated number of group members owning more than A_1 and A_2, respectively,

exp   refers to the exponential function, and

Ln   refers to the natural logarithm function.

Illustration

To illustrate the calculations for the sampling error on a median, we return to Table 4. The median annual income for this group is $32,200. The size of the group is 23,527,000.

1.   Using Formula (12), the standard error of 50 percent on a base of 23,527,000 is about 0.71 percentage points.

2.   Following step 2, the two percentages of interest are 49.29 and 50.71.

3.   By examining Table 4, we see that the percentage 49.29 falls in the income interval from 30,000 to 39,999. (Since 54.7% receive more than $30,000 per month, the dollar value corresponding to 49.29 must be between $30,000 and $39,999). Thus, $A_1=\$30,000$, $A_2=\$39,999$, $N_1=18,377,000$, and $N_2=12,881,000$.

In this case, we decided to use Pareto interpolation. Therefore, the upper bound of a 68% confidence interval for the median is

$$\$30,000 \ \exp\left[\left(Ln\left(\frac{(.4929)(23,527,000)}{18,377,000}\right)\Big/ Ln\left(\frac{12,881,000}{18,377,000}\right)\right) \ Ln\left(\frac{39,999}{30,000}\right)\right] = \$43,549.$$

Also by examining Table 4, we see that 50.71 falls in the same income interval. Thus, A_1, A_2, N_1, and N_2 are the same. We also use Pareto interpolation for this case. So the lower bound of a 68% confidence interval for the median is

$$\$30,000 \ \exp\left[\left(Ln\left(\frac{(.5071)(23,527,000)}{18,377,000}\right)\Big/ Ln\left(\frac{12,881,000}{18,377,000}\right)\right) \ Ln\left(\frac{39,999}{30,000}\right)\right] = \$42,560.$$

Thus, the 68-percent confidence interval on the estimated median is from $42,560 to $43,549. An approximate standard error is

$$\frac{\$43{,}549 - \$42{,}560}{2} = \$494.50.$$

Standard Errors of Ratios of Means and Medians: The standard error for a ratio of means or medians is approximated by:

$$s_{\left(\frac{x}{y}\right)} = \sqrt{\left(\frac{x}{y}\right)^2 \left[\left(\frac{s_y}{y}\right)^2 + \left(\frac{s_x}{y}\right)^2\right]} \tag{19}$$

where x and y are the means or medians, and s_x and s_y are their associated standard errors.

Formula (19) assumes that the means are not correlated. If the correlation between the population means estimated by x and y are actually positive (negative), then this procedure will tend to produce overestimates (underestimates) of the true standard error for the ratio of means.

Standard Errors Using SAS or SPSS: Standard errors and their associated variance, calculated by SAS or SPSS statistical software package, do not accurately reflect the SIPP's complex sample design. Erroneous conclusions will result if these standard errors are used directly. We provide adjustment factors by characteristics that should be used to correctly compensate for likely under-estimates. The factors called Design effect (DEFF) available in Table 2 must be applied to SAS or SPSS generated variances. The square root of DEFF can be directly applied to similarly generated standard errors. These factors approximate design effects which adjust statistical measures for sample designs more complex than simple random sample.

Table 1 - SIPP Panel 2008 Reference Months (Horizontal) for Each Interview Month (Vertical)

Column groups by year/quarter: 2008 (2nd Quar: May–Jun; 3rd Quarter: Jul–Sep; 4th Quarter: Oct–Dec); 2009–2012 (1st Q: Jan–Mar; 2nd Q: Apr–Jun; 3rd Q: Jul–Sep; 4th Q: Oct–Dec); 2013 (1st Q: Jan–Mar; 2nd Q: Apr–Jun; 3rd Q: Jul–Sep; 4th Q: Oct–Nov). Month columns labeled with year suffix for clarity.

Month of Interview	Wave/ Rotation	May08	Jun08	Jul08	Aug08	Sep08	Oct08	Nov08	Dec08	Jan09	Feb09	Mar09	Apr09	May09	Jun09	Jul09	Aug09	Sep09	Oct09	Nov09	Dec09	Jan10	Feb10	Mar10	Apr10	May10	Jun10	Jul10	Aug10	Sep10	Oct10	Nov10	Dec10	Jan11	Feb11	Mar11	Apr11	May11	Jun11	Jul11	Aug11	Sep11	Oct11	Nov11	Dec11	Jan12	Feb12	Mar12	Apr12	May12	Jun12	Jul12	Aug12	Sep12	Oct12	Nov12	Dec12	Jan13	Feb13	Mar13	Apr13	May13	Jun13	Jul13	Aug13	Sep13	Oct13	Nov13
Sep 08	1/1	1	2	3	4																																																															
Oct	1/2		1	2	3	4																																																														
Nov	1/3			1	2	3	4																																																													
Dec	1/4				1	2	3	4																																																													
Jan 09	2/1					1	2	3	4																																																											
Feb	2/2						1	2	3	4																																																										
Mar	2/3							1	2	3	4																																																									
Apr	2/4								1	2	3	4																																																							
May	3/1									1	2	3	4																																																						
Jun	3/2										1	2	3	4																																																				
July	3/3											1	2	3	4																																																			
Aug	3/4												1	2	3	4																																																	
Sep	4/1													1	2	3	4																																																
Oct	4/2														1	2	3	4																																															
Nov	4/3															1	2	3	4																																													
Dec	4/4																1	2	3	4																																												
Jan 10	5/1																	1	2	3	4																																										
Feb	5/2																		1	2	3	4																																									
Mar	5/3																			1	2	3	4																																							
Apr	5/4																				1	2	3	4																																						
May	6/1																					1	2	3	4																																					
Jun	6/2																						1	2	3	4																																				
July	6/3																							1	2	3	4																																		
Aug	6/4																								1	2	3	4																																
Sep	7/1																									1	2	3	4																															
Oct	7/2																										1	2	3	4																													
Nov	7/3																											1	2	3	4																											
Dec	7/4																												1	2	3	4																										
Jan 11	8/1																													1	2	3	4																									
Feb	8/2																														1	2	3	4																							
Mar	8/3																															1	2	3	4																						
Apr	8/4																																1	2	3	4																					
May	9/1																																	1	2	3	4																				
Jun	9/2																																		1	2	3	4																			
July	9/3																																			1	2	3	4																		
Aug	9/4																																				1	2	3	4																	
Sep	10/1																																					1	2	3	4																
Oct	10/2																																						1	2	3	4															
Nov	10/3																																							1	2	3	4														
Dec	10/4																																								1	2	3	4													
Jan 12	11/1																																									1	2	3	4												
Feb	11/2																																										1	2	3	4											
Mar	11/3																																											1	2	3	4										
Apr	11/4																																												1	2	3	4									
May	12/1																																													1	2	3	4								
Jun	12/2																																														1	2	3	4							
July	12/3																																															1	2	3	4						
Aug	12/4																																																1	2	3	4					
Sep	13/1																																																	1	2	3	4				
Oct	13/2																																																		1	2	3	4			
Nov	13/3																																																			1	2	3	4		
Dec	13/4																																																				1	2	3	4	
Jan 13	14/1																																																					1	2	3	4											
Feb	14/2																																																						1	2	3	4										
Mar	14/3																																																							1	2	3	4									
Apr	14/4																																																								1	2	3	4								
May	15/1																																																									1	2	3	4							
Jun	15/2																																																										1	2	3	4						
July	15/3																																																											1	2	3	4					
Aug	15/4																																																												1	2	3	4				
Sep	16/1																																																													1	2	3	4			
Oct	16/2																																																														1	2	3	4		
Nov	16/3																																																															1	2	3	4	
Dec	16/4																																																																1	2	3	4

Table 2a - SIPP Generalized Variance Function Parameters for Calendar Year Estimates (Associated with the Survey Universe in January 2009) in Time Periods Covered by the Calendar Year 2009 Using the 2009 Calendar Year Weight (the CY2009 Weight)

Domain	Parameters		DEFF[6]
	a	b	
Poverty and Program Participation, Persons 15+			
Total	-0.00002404	5,732	2.88
Male	-0.00004969	5,732	2.88
Female	-0.00004657	5,732	2.88
Income and Labor Force Participation, Persons 15+			
Total	-0.00002279	5,434	2.73
Male	-0.00004711	5,434	2.73
Female	-0.00004415	5,434	2.73
Other, Persons 15+			
Total (or White)	-0.00001912	5,705	2.87
Male	-0.00003907	5,705	2.87
Female	-0.00003744	5,705	2.87
Black, Persons 15+			
Total	-0.00015920	5,998	3.02
Male	-0.00034302	5,998	3.02
Female	-0.00029709	5,998	3.02
Hispanic, Persons 15+			
Total	-0.00015192	7,070	3.55
Male	-0.00029711	7,070	3.55
Female	-0.00031089	7,070	3.55
Households, Persons 15+			
Total (or White)	-0.00003940	4,650	2.34
Black	-0.00031722	4,650	2.34
Hispanic	-0.00033825	4,650	2.34

Notes on Domain Usage for Table 2a:

Poverty and Program Participation Use these parameters for estimates concerning poverty rates, welfare program participation (e.g., foodstamp, SSI, TANF), and other programs for adults with low incomes.

Income and Labor Force These parameters are for estimates concerning income, sources of income, labor force participation, economic well being other than poverty, employment related estimates (e.g., occupation, hours worked a week), and other income, job, or employment related estimates.

Other Persons Use the "Other Persons" parameters for estimates of total (or white) persons aged 0+ in the labor force, and all other characteristics not specified in this table, for the total or white population.

Black/Hispanic Persons Use these parameters for estimates of Black and Hispanic persons 0+.

Households Use these parameters for all household level estimates.

6 DEFF=B/SAMPLE INTERVAL, WHERE SAMPLE INTERVAL=1,989

Table 2b - SIPP Generalized Variance Function Parameters for Calendar Year Estimates (Associated with the Survey Universe in January 2010) in Time Periods Covered by the Calendar Year 2010 Using the 2010 Calendar Year Weight (the CY2010 Weight)

Domain	Parameters		DEFF[6]
	a	b	
Poverty and Program Participation, Persons 15+			
Total	-0.00002692	6,476	3.26
Male	-0.00005558	6,476	3.26
Female	-0.00005222	6,476	3.26
Income and Labor Force Participation, Persons 15+			
Total	-0.00002537	6,103	3.07
Male	-0.00005238	6,103	3.07
Female	-0.00004921	6,103	3.07
Other, Persons 15+			
Total (or White)	0.00001923	5,794	2.91
Male	0.00003926	5,794	2.91
Female	0.00003769	5,794	2.91
Black, Persons 15+			
Total	0.00016271	6,210	3.12
Male	0.00035104	6,210	3.12
Female	0.00030329	6,210	3.12
Hispanic, Persons 15+			
Total	-0.00015180	7,325	3.68
Male	-0.00029592	7,325	3.68
Female	-0.00031167	7,325	3.68
Households, Persons 15+			
Total (or White)	-0.00004352	5,151	2.59
Black	-0.00034595	5,151	2.59
Hispanic	-0.00037239	5,151	2.59

Notes on Domain Usage for Table 2b:

Poverty and Program Participation	Use these parameters for estimates concerning poverty rates, welfare program participation (e.g., foodstamp, SSI, TANF), and other programs for adults with low incomes.
Income and Labor Force	These parameters are for estimates concerning income, sources of income, labor force participation, economic well being other than poverty, employment related estimates (e.g., occupation, hours worked a week), and other income, job, or employment related estimates.
Other Persons	Use the "Other Persons" parameters for estimates of total (or white) persons aged 0+ in the labor force, and all other characteristics not specified in this table, for the total or white population.
Black/Hispanic Persons	Use these parameters for estimates of Black and Hispanic persons 0+.
Households	Use these parameters for all household level estimates.
6	DEFF=B/SAMPLE INTERVAL, WHERE SAMPLE INTERVAL=1,989

Table 2c - SIPP Generalized Function Variance Parameters for Panel Estimates (Associated with the Survey Universe in January 2009) in Time Periods Covered by Wave 1 through Wave 5 Using the First PNL1 Weight

Domain	Parameters		DEFF[6]
	a	b	
Poverty and Program Participation, Persons 15+			
Total	-0.00002445	5,830	2.93
Male	-0.00005052	5,830	2.93
Female	-0.00004736	5,830	2.93
Income and Labor Force Participation, Persons 15+			
Total	-0.00002328	5,552	2.79
Male	-0.00004812	5,552	2.79
Female	-0.00004511	5,552	2.79
Other, Persons 15+			
Total (or White)	-0.00001945	5,805	2.92
Male	-0.00003974	5,805	2.92
Female	-0.00003809	5,805	2.92
Black, Persons 15+			
Total	-0.00016278	6,134	3.08
Male	-0.00035066	6,134	3.08
Female	-0.00030380	6,134	3.08
Hispanic, Persons 15+			
Total	-0.00015386	7,160	3.60
Male	-0.00030095	7,160	3.60
Female	-0.00031480	7,160	3.60
Households, Persons 15+			
Total (or White)	-0.00003985	4,704	2.37
Black	-0.00032092	4,704	2.37
Hispanic	-0.00034206	4,704	2.37

Notes on Domain Usage for Table 2c:

Poverty and Program Participation	Use these parameters for estimates concerning poverty rates, welfare program participation (e.g., foodstamp, SSI, TANF), and other programs for adults with low incomes.
Income and Labor Force	These parameters are for estimates concerning income, sources of income, labor force participation, economic well being other than poverty, employment related estimates (e.g., occupation, hours worked a week), and other income, job, or employment related estimates.
Other Persons	Use the "Other Persons" parameters for estimates of total (or white) persons aged 0+ in the labor force, and all other characteristics not specified in this table, for the total or white population.
Black/Hispanic Persons	Use these parameters for estimates of Black and Hispanic persons 0+.
Households	Use these parameters for all household level estimates.
6	DEFF=B/SAMPLE INTERVAL, WHERE SAMPLE INTERVAL=1,989

Table 2d - SIPP Generalized Function Variance Parameters for Panel Estimates (Associated with the Survey Universe in January 2009) in Time Periods Covered by Wave 1 through Wave 8 Using the PNL2 Weight

Domain	Parameters		DEFF[6]
	a	b	
Poverty and Program Participation, Persons 15+			
Total	-0.00003119	7,398	3.72
Male	-0.00006476	7,398	3.72
Female	-0.00006015	7,398	3.72
Income and Labor Force Participation, Persons 15+			
Total	-0.00002872	6,813	3.43
Male	-0.00005964	6,813	3.43
Female	-0.00005539	6,813	3.43
Other, Persons 15+			
Total (or White)	-0.00002498	7,308	3.67
Male	-0.00005127	7,308	3.67
Female	-0.00004872	7,308	3.67
Black, Persons 15+			
Total	-0.00021809	8,039	4.04
Male	-0.00047349	8,039	4.04
Female	-0.00040432	8,039	4.04
Hispanic, Persons 15+			
Total	-0.00019543	8,849	4.45
Male	-0.00038611	8,849	4.45
Female	-0.00039571	8,849	4.45
Households, Persons 15+			
Total (or White)	-0.00004890	5,812	2.92
Black	-0.00039317	5,812	2.92
Hispanic	-0.00042222	5,812	2.92

Notes on Domain Usage for Table 2d:

Poverty and Program Participation	Use these parameters for estimates concerning poverty rates, welfare program participation (e.g., foodstamp, SSI, TANF), and other programs for adults with low incomes.
Income and Labor Force	These parameters are for estimates concerning income, sources of income, labor force participation, economic well being other than poverty, employment related estimates (e.g., occupation, hours worked a week), and other income, job, or employment related estimates.
Other Persons	Use the "Other Persons" parameters for estimates of total (or white) persons aged 0+ in the labor force, and all other characteristics not specified in this table, for the total or white population.
Black/Hispanic Persons	Use these parameters for estimates of Black and Hispanic persons 0+.
Households	Use these parameters for all household level estimates.
6	DEFF=B/SAMPLE INTERVAL, WHERE SAMPLE INTERVAL=1,989

Table 3 - Adjustment Factors to Be Applied to the *a* and *b* Base Parameters to Obtain Appropriate *a* and *b* Parameters for Monthly and Quarterly Estimates with Monthly Data Unavailable or Available but Not Usable from One or More Rotation Groups.

Table 3. Factors to be Used When Using Less Than Full Sample	
Number of Available Rotation Months[7]	**Factor**
Monthly Estimate[8]	
1	4.0000
2	2.0000
3	1.3333
4	1.0000
Quarterly Estimate[9]	
6	1.8519
8	1.4074
9	1.2222
10	1.0494
11	1.0370
12	1.0000

[7] The number of available rotation months for a given estimate is the sum of the number of rotations available for each month of the estimates.

[8] Adjustment factors for monthly estimates are equal to 4 divided by the number of rotation groups contributing data to the estimate

[9] Adjustment factors for quarterly estimates are calculated as follows:
Assume:
    1. No change within rotation (i.e., no change in value for a variable across months).
    2. Rotations are independent.
    3. All sigmas are equal.
The monthly factor for each month are equal to 4 divided by the number of rotation groups contributing data to the estimate. Therefore, the variance of the estimate for the full sample is: $36\sigma^2$. The variance of the estimate for less than a full sample is: the sum of the squared monthly factors for each rotation month*σ^2. The adjustment factor for the quarterly estimate is: (the sum of the squared monthly factors for each rotation month*σ^2) / ($36\sigma^2$).

Table 4 - Hypothetical Distribution of Annual Income Among People 25 to 34 Years Old

Intervals of Annual Cash Income	Total	under $5000	$5000 to $7499	$7500 to $9999	$10000 to $12,499	$12,500 to $14,999	$15,000 to $17,499	$17,500 to $19,999	$20,000 to $29,999	$30,000 to $39,999	$40,000 to $49,999	$50,000 to $59,999	$60,000 to $69,999	$70,000 and over
Mid-intervals of Annual Cash Income		2,500	6250	8750	11,250	13,750	16,250	18,750	25,000	35,000	45,000	55,000	65,000	105,000
Thousands in interval	23,527	370	302	447	685	935	1,113	1,298	5,496	4,596	3,121	1,902	1,124	2,138
Cumulative with at least as much as lower bound of interval		23,527	23,158	22,856	22,409	21,724	20,789	19,675	18,377	12,881	8,285	5,164	3,262	2,138
Percent with at least as much as lower bound of interval		100.0	98.4	97.1	95.2	92.3	88.4	83.6	78.1	54.7	35.2	21.9	13.9	9.1

Table 5 - Correlations between Estimates of the Same Characteristic at Two Points of Time. Both Estimates must be Monthly Estimates Averaged over Quarters or Years

	Quarterly Estimates				Calendar Year Estimates
	Consecutive Quarters	1 Quarter Apart	2 Quarters Apart	3 Quarters Apart	2008 to 2013

INDIVIDUALS

A. Both Estimates Created Using The Same Weight, Either 5 Wave, 8 Wave, 11 Wave, 14 Wave, or 16 Wave Weights

Income

Social Security or Private Pensions	0.97	0.86	0.75		
Other	0.72	0.63	0.54		

B. One Estimate Created Using An Annual Weight While The Other Estimate Is Created Using a Different Annual Weight

Income

Social Security or Private Pensions	0.81	0.72	0.63	0.55	0.70
Other	0.60	0.53	0.45	0.37	0.49

C. Both Estimates Created Using The 16 Wave (or Panel) Weight

Income

Social Security or Private Pensions	0.97	0.86	0.75	0.65	0.83
Other	0.72	0.63	0.54	0.46	0.58