2013 NATIONAL SURVEY ON DRUG USE AND HEALTH

METHODOLOGICAL RESOURCE BOOK SECTION 14: SAMPLING ERROR REPORT

Substance Abuse and Mental Health Services Administration
Center for Behavioral Health Statistics and Quality
Rockville, Maryland

July 2014

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Prepared for the 2013 Methodological Resource Book (Section 14)

Contract No. HHSS283201000003C
RTI Project No. 0212800.001.208.005
Phase II, Deliverable No. 18

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July 2014

Recommended Citation: Center for Behavioral Health Statistics and Quality. (2014). *2013 National Survey on Drug Use and Health: Methodological Resource Book (Section 14, Sampling Error Report)*. Substance Abuse and Mental Health Services Administration, Rockville, MD.

Acknowledgments

This report was prepared for the Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality, by RTI International (a trade name of Research Triangle Institute). Contributors to this report at RTI include Katherine B. Morton, James R. Chromy, Claudia Clark, Margaret Smith, and Valerie Garner.

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1. Introduction

As part of any survey data analysis, a good understanding of the resulting standard errors (SEs) and design effects (DEFFs), corresponding to a key set of outcomes and other variables, is important for a number of reasons: (1) to evaluate how well the sample was designed in light of the target and realized precisions and DEFFs; (2) to obtain confidence intervals (CIs) for cross-sectional estimates (and for change estimates in the case of repeated surveys) and generate significance tests to make inferential statements about the target population; and (3) to be able to incorporate realized DEFFs for future redesigns of the survey.

This report compares the estimated (or realized) precisions of a key set of estimates with the targets for the 2013 National Survey on Drug Use and Health (NSDUH), formerly called the National Household Survey on Drug Abuse (NHSDA). The comparison was made with targets specified by the Substance Abuse and Mental Health Services Administration (SAMHSA) and with the predicted precisions that statisticians from RTI International[1] anticipated during the design of the survey. In addition, tables of realized DEFFs are provided.

This report is organized as follows. Chapter 2 summarizes the 2013 sample design. Chapter 3 describes the calculation of relative standard errors (RSEs) and DEFFs. Chapter 4 presents tables that compare the observed precisions with the expected precisions. Chapter 5 compares median and mean DEFFs. Chapter 6 presents median and mean DEFFs for specific analysis domains. Finally, concluding remarks are provided in Chapter 7.

[1] RTI International is a trade name of Research Triangle Institute.

2. Overview of the 2013 Sample Design

2.1 Target Population

The respondent universe for the 2013 National Survey on Drug Use and Health[2] (NSDUH) was the civilian, noninstitutionalized population aged 12 years or older residing in the United States. Consistent with the NSDUH designs since 1991, the 2013 NSDUH universe included residents of noninstitutional group quarters (e.g., shelters, rooming houses, dormitories, and group homes), residents of Alaska and Hawaii, and civilians residing on military bases. Persons excluded from the 2013 universe included those with no fixed household address (e.g., homeless transients not in shelters) and residents of institutional group quarters, such as jails and hospitals.

2.2 Design Overview

The Substance Abuse and Mental Health Services Administration (SAMHSA) implemented major changes in the way NSDUH would be conducted, beginning in 1999 and continuing through subsequent years. The survey is conducted using computer-assisted interviewing (CAI) methods and provides State estimates based on minimum sample sizes per State. The total targeted sample size of 67,500 is equally allocated across three age groups: persons aged 12 to 17, persons aged 18 to 25, and persons aged 26 or older. This large sample size allows SAMHSA to report more precise demographic subgroup estimates at the national level without needing to oversample specially targeted demographics (such as racial/ethnic groups), as required in the past. This large sample is referred to as the "main sample." The achieved sample for the 2013 sample was 67,838 persons.

Beginning with the 2002 NSDUH and continuing through the 2013 NSDUH, survey respondents were given a $30 incentive payment for participation. As expected, the incentive had the effect of increasing response rates, thereby requiring fewer selected households than previous surveys. In recent years, however, response rates have been slowly declining, which has required the number of selected households to increase.

An additional design change was made in 2002 and continued in 2013. A new pair sampling strategy was implemented that increased the number of adolescent–older adult pairs selected in dwelling units (DUs; Chromy & Penne, 2002), which resulted in an increase in the number of parent-child pairs. However, this change resulted in a moderate decrease in the response rate for older persons.

2.2.1 Five-Year Design

A coordinated sample design was initially developed for the 2005 through 2009 NSDUHs. The 2010 through 2011 and 2012 through 2013 samples are extensions of the 2005 through 2009 sample in which data from the U.S. Census 2000 were used to construct the

[2] This report presents information from the 2013 National Survey on Drug Use and Health (NSDUH). Prior to 2002, the survey was called the National Household Survey on Drug Abuse (NHSDA).

sampling frame and to select the sample across all 9 survey years. Although no overlap was planned with the 1999 through 2004 samples, a coordinated design for 2005 through 2009 and extensions through 2013 facilitated a 50 percent overlap in second-stage units (area segments) within each successive 2-year period from 2005–2006 through 2012–2013. This overlap slightly increased the precision of estimates of year-to-year change due to the expected small but positive correlation. However, the overlap significantly reduced segment listing costs because only half of the segments needed to be relisted for the 2006 through 2013 surveys.

Similar to the 1999 through 2012 surveys, the 2013 design provided for estimates by State in all 50 States plus the District of Columbia. States may, therefore, be viewed as the first level of stratification as well as a reporting variable. Eight States, referred to as the "large" States,[3] had samples designed to yield 3,600 respondents per State. The remaining 43 States[4] had samples designed to yield 900 respondents per State. In all States, the sample sizes were sufficient to support reliable direct estimates or estimates based on small area estimation (SAE) methodology for selected outcomes, while maintaining efficiency for national estimates. All State estimates are typically produced by pooling multiple years of data to increase precision, especially for estimates of change or time.

Within each State, State sampling regions (SSRs) were formed. Based on a composite size measure, States were geographically partitioned into regions of roughly equal population size. In other words, regions were formed such that each area yielded, in expectation, roughly the same number of interviews during each data collection period, thus distributing the workload equally among NSDUH interviewers. The smaller States were partitioned into 12 SSRs, whereas the eight large States were divided into 48 SSRs. Therefore, the partitioning of the United States resulted in the formation of a total of 900 SSRs.

Unlike the 1999 through 2001 NHSDAs and the 2002 through 2004 NSDUHs, the first stage of selection for the 2005 through 2013 NSDUHs was census tracts.[5] This stage was included to contain sample segments within a single census tract to the extent possible.[6] In prior years, segments that crossed census tract boundaries made merging to external data sources difficult.

The first stage of selection began with the construction of an area sample frame that contained one record for each census tract in the United States. If necessary, census tracts were

[3] The large States are California, Florida, Illinois, Michigan, New York, Ohio, Pennsylvania, and Texas.

[4] For reporting and stratification purposes, the District of Columbia is treated the same as a State, and no distinction is made in the discussion.

[5] A census tract is a small, relatively permanent statistical subdivision of a county or equivalent entity that contains between 1,200 and 8,000 people, with an optimum size of 4,000 people (U.S. Census Bureau, Redistricting Data Office, 2009).

[6] Some census tracts had to be aggregated in order to meet the minimum DU requirement.

aggregated within SSRs until each tract[7] had, at a minimum, 150 DUs[8] in urban areas and 100 DUs in rural areas.[9]

Before selecting census tracts, additional implicit stratification was achieved by sorting the first-stage sampling units by a CBSA/SES[10] (core-based statistical area/socioeconomic status) indicator[11] and by the percentage of the population that is non-Hispanic or Latino and white.[12] From this well-ordered sample frame, 48 census tracts per SSR were selected with probabilities proportionate to a composite size measure and with minimum replacement (Chromy, 1979).

Because census tracts generally exceed the minimum DU requirement, one smaller geographic region was selected within each sampled census tract. For this second stage of sampling, each selected census tract was partitioned into compact clusters[13] of DUs by aggregating adjacent census blocks.[14] Consistent with the terminology used in previous NSDUHs, these geographic clusters of blocks are referred to as "segments." A sample DU in NSDUH refers to either a housing unit or a group-quarters listing unit, such as a dormitory room or a shelter bed. Similar to census tracts, segments were formed to contain a minimum of 150 DUs in urban areas and 100 DUs in rural areas. This minimum DU requirement supports the overlapping sample design and any special supplemental samples or field tests that SAMHSA may wish to conduct.

Prior to selection, the segments were sorted in the order they were formed (i.e., geographically), and one segment was selected within each sampled census tract using Chromy's

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[7] For the remainder of the discussion, first-stage sampling units will be referred to as "census tracts" even though each first-stage sampling unit contains one or more census tracts.

[8] DU counts were obtained from the 2000 census data supplemented with revised population counts from Nielsen Claritas.

[9] The basis for the differing minimum DU requirement in urban and rural areas is that it is more difficult to meet the requirement in rural areas, and 100 DUs is sufficient to support one field test and two main study samples.

[10] CBSAs include metropolitan and micropolitan statistical areas as defined by the Office of Management and Budget (2003).

[11] Four categories are defined as (1) CBSA/low SES, (2) CBSA/high SES, (3) non-CBSA/low SES, and (4) non-CBSA/high SES. To define SES, census tract–level median rents and property values obtained from the 2000 Census Summary File 3 were given a rank (1,…,5) based on State and CBSA quintiles. The rent and value ranks then were averaged, weighted by the percentages of renter- and owner-occupied DUs, respectively. If the resulting score fell in the lower 25th percentile by State and CBSA, the area was considered "low SES"; otherwise, it was considered "high SES."

[12] Although the large sample size eliminates the need for the oversampling of specially targeted demographic subgroups as was required prior to the 1999 NHSDA, sorting by a CBSA/SES indicator and by the percentage of the population that is non-Hispanic or Latino and white ensures dispersion of the sample with respect to SES and race/ethnicity. Implicit stratification also has the potential to lower sampling error by reducing the selection of neighboring and possibly similar segments than if the selection was done completely at random.

[13] Although the entire cluster is compact, the final sample of DUs represents a noncompact cluster. Noncompact clusters (selection from a list) differ from compact clusters in that not all units within the cluster are included in the sample. Although compact cluster designs are less costly and more stable, a noncompact cluster design was used because it provides for greater heterogeneity of dwellings within the sample. Also, social interaction (contagion) among neighboring dwellings is sometimes introduced with compact clusters (Kish, 1965).

[14] A census block is a small statistical area bounded by visible features (e.g., streets, roads, streams, and railroad tracks) and nonvisible boundaries (e.g., city, town, and county limits). A block group is a cluster of census blocks within the same census tract and generally contains between 300 and 6,000 people (U.S. Census Bureau, Redistricting Data Office, 2009).

method of sequential random sampling (with probability proportionate to size and minimum replacement) (Chromy, 1979). The 48 selected segments then were randomly assigned to a survey year and quarter of data collection as described in Section 2.4 of the 2013 sample design report (Center for Behavioral Health Statistics and Quality, 2014).

An equal probability subsample of eight segments is used for each NSDUH year. These eight segments are randomly assigned to quarters and to two panels within each quarter. For each survey year after 2005, the first panel segments constitute the overlap sample; that is, they were used in the prior year and were used for the second time in the "current" survey year. The second panel segments constitute the replacement sample and are used for the "current" survey and again the following year, except in 2013 when the second panel segments were used for the 2013 survey only.

2.2.2 Sample Selection at Third and Fourth Stages

Once sample segments for the 2013 NSDUH were selected, specially trained field household listers visited the areas and obtained complete and accurate lists of all eligible DUs within the sample segment boundaries. These lists served as the frames for the third stage of sample selection.

The primary objective of the third stage of sample selection (listing units) was to determine the minimum number of DUs needed in each segment to meet the targeted sample sizes for all age groups. Thus, listing unit sample sizes for the segment were determined using the age group with the largest sampling rate, which we refer to as the "driving" age group. Using 2000 census data adjusted to more recent data from Claritas, Inc., State- and age-specific sampling rates were computed. These rates then were adjusted by the segment's probability of selection; the subsegmentation inflation factor,[15] if any; the probability of selecting a person in the age group (equal to the maximum, or 0.99, for the driving age group); and an adjustment for the "maximum of two" rule.[16] In addition to these factors, historical data from the 2011, 2012, and 2013 NSDUHs were used to compute predicted screening and interviewing response rate adjustments. The final adjusted sampling rate then was multiplied by the actual number of DUs found in the field during counting and listing activities. The product represents the segment's listing unit sample size.

Some constraints were put on the listing unit sample sizes. For example, to ensure adequate samples for supplemental studies, the listing unit sample size could not exceed 100 per segment or half of the actual listing unit count. Similarly, if five unused listing units remained in the segment, a minimum of five listing units per segment were required for cost efficiency.

[15] Segments found to be very large in the field are partitioned into "subsegments." Then, one subsegment is chosen at random with probability proportional to the size to be fielded. In some cases, a second-level subsegmenting was required if the census totals used in the initial subsegmenting were off and the selected subsegment was still too large for listing. The subsegmentation inflation factor accounts for the narrowing down of the segment.

[16] Brewer's Selection Algorithm never allows for greater than two persons per household to be chosen. Thus, sampling rates are adjusted to satisfy this constraint.

Using a random start point and interval-based (systematic) selection, the actual listing units were selected from the segment frame. DUs that were selected from the first panel (overlap) segments in the prior year were not eligible for selection in the "current" year (i.e., two separate samples were selected with the complement of the prior year's sample serving as the DU frame in the "current" year). In 2005, when there was no overlap with the prior year's sample, the same DUs could have been selected over a 2-year period by chance. Persons may be selected in consecutive years if they move and their new residence is selected the year after their original DU was sampled. No mechanism is currently in place for identifying duplicate persons in a given year, but this number should be small given the restriction on DUs that were sampled in the previous year.

After DU selections were made, an interviewer visited each selected DU to obtain a roster of all persons residing in the DU. As in previous years, during the data collection period, if an interviewer encountered any new DU in a segment or found a DU that was missed during the original counting and listing activities, the new or missed dwellings were selected into the 2013 NSDUH using the half-open interval (HOI) selection technique.[17] This selection technique eliminates any frame bias that might be introduced because of errors and/or omissions in the counting and listing activities, and it also eliminates any bias that might be associated with using "old" segment listings.

Using the roster information obtained from an eligible member of the selected DU, 0, 1, or 2 persons were selected for the survey. Sampling rates were preset by age group and State. Roster information was entered directly into the electronic screening instrument, which automatically implemented this fourth stage of selection based on the State and age group sampling parameters.

One benefit of using an electronic screening instrument in NSDUH is the ability to impose a more complicated person-level selection algorithm on the fourth stage of the NSDUH design. Similar to the 1999 through 2012 designs, one feature that was included in the 2013 design was that any two survey-eligible persons within a DU had some chance of being selected (i.e., all survey-eligible pairs of persons had some nonzero chance of being selected). This design feature was of interest to NSDUH researchers because, for example, it allows analysts to examine how the drug use propensity of one individual in a family relates to the drug use propensity of another family members residing in the same DU (e.g., the relationship between parental substance use and substance use by that parent's child).

2.2.3 Creation of Variance Estimation Strata and Replicates

The nature of the stratified, clustered sampling design requires that the design structure be taken into consideration when computing variances of survey estimates. Key nesting variables

[17] In summary, the HOI technique states that, if a DU is selected for the 2013 study and an interviewer observes any new or missed DUs between the selected DU and the DU appearing immediately after the selection on the counting and listing form, all new or missed dwellings falling in this interval will be selected. These added DUs are assigned the same probability of selection as the selected DU. If a large number of new or missed DUs are encountered (greater than 10), a sample of the new or missing DUs will be selected, and the sample weight will be adjusted accordingly. For more information, refer to Section 3.7 in Chapter 3 and Appendix D in Center for Behavioral Health Statistics and Quality (2014).

representing the variance estimation strata and replicates were created to capture explicit stratification and to identify clustering. For the 2005 through 2013 NSDUHs, variance estimation strata are defined at the SSR level, and each SSR is assigned to a different stratum every quarter in pseudo-random fashion. This definition of variance estimation strata has the effect of increasing the number of degrees of freedom for State-level estimates while preserving the number of degrees of freedom for national estimates (900). Each small sample State is in 48 different strata (12 SSRs × 4 quarters); therefore, 48 degrees of freedom are available for State estimates. Similarly, each large sample State is in 192 strata (48 SSRs × 4 quarters) and therefore has 192 degrees of freedom for estimation. Two replicates per year were defined within each variance stratum. Each variance replicate consists of four segments, one for each quarter of data collection. The first replicate consists of those segments that are "phasing out" or will not be used in the next survey year. The second replicate consists of those segments that are "phasing in" or will be fielded again the following year, thus constituting the 50 percent overlap between survey years.

Both census tracts and segments are nested within variance replicates, so the nesting variables cover the variance contributions of both sampling units. Because one segment is selected per sampled census tract, the selection of census tracts at the first stage of selection may reduce variance by controlling the sample distribution and minimizing the chance of selecting neighboring and possibly similar segments within the same census tract. All weighted statistical analyses for which variance estimates are needed should use the stratum and replicate variables to identify nesting. Given the complex nature of the sample design, ignoring the nesting properties in NSDUH may produce standard errors that are too small and could result in false positive test outcomes (i.e., test outcomes that are deemed to be statistically significant when in fact they are not). Variance estimates can be computed using a clustered data analysis software package such as the SUrvey DAta ANalysis program (SUDAAN®; RTI International, 2013; Center for Behavioral Health Statistics and Quality, 2014).

3. Computation of Relative Standard Errors and Design Effects

As mentioned in Chapter 1, there were several objectives for calculating relative standard errors (RSEs) and design effects (DEFFs) for the 2013 National Survey on Drug Use and Health (NSDUH). One objective was to provide a mechanism for comparing the expected precision of the 2013 design with the precision actually obtained. A second objective was to provide users of NSDUH data with a methodology for determining a quick approximation of the precision of estimates obtained from the 2013 survey and to build confidence intervals (CIs) of estimates of level and change. Finally, the magnitudes of the DEFFs are useful for future redesign of the survey.

The RSE of a domain *d* prevalence estimate $\hat{p}_d$ is the standard error (SE) of the estimate divided by the estimate, that is,

$$RSE(\hat{p}_d) = SE(\hat{p}_d) / \hat{p}_d \,. \tag{1}$$

The DEFF for a prevalence estimate is its variance divided by the variance that would be observed if simple random sampling (SRS) had been used:

$$DEFF(d) = \frac{\mathrm{VAR}(\hat{p}_d)}{\mathrm{VAR}_{\mathrm{SRS}}(\hat{p}_d)} \,. \tag{2}$$

Hence, the SE of the estimated prevalence can be approximated as follows:

$$SE(\hat{p}_d) \doteq \left[DEFF(d)\,\hat{p}_d(1-\hat{p}_d)/n_d\right]^{1/2}, \tag{3}$$

where $DEFF(d)$ and n_d are the median (or mean, as the case may be) DEFF and sample size of domain *d*, respectively.

By substituting a prevalence rate of 0.10 into Equations 1 and 3, the RSE becomes

$$RSE(\hat{p}_d = 0.10) = \left[(DEFF(d) * 0.09 / n_d)\right]^{1/2} . \tag{4}$$

This result shows that, for the specified prevalence rate of 0.10, the RSE is purely a function of the DEFF and sample size. In the tables given in this report, RSEs are expressed as percentages (i.e., the right-hand side of Equation 4 is multiplied by 100).

Mean and median DEFFs were used for many of the calculations in this report. DEFFs were calculated based on drug use variables displayed in the 2013 sample design report (Center for Behavioral Health Statistics and Quality, 2014).

As noted previously, the DEFF is the ratio of the design-based variance estimate divided by the variance estimate that would have been obtained from an SRS of the same size. Therefore, the DEFF summarizes the effects of stratification, clustering, and unequal weighting on the variance of a complex sample design. Because clustering and unequal weighting are expected to increase the variance and generally dominate the stratification effect, the DEFF is expected to be greater than 1 in most instances. However, DEFFs were sometimes less than 1 for prevalence rates near 0.

Note that the DEFF is based on the with-replacement (wr) variance estimate as obtained from SUDAAN®, which properly accounts for clustering, stratification, and unequal weighting (RTI International, 2013). In the 1999 sampling error report, DEFF was based on the maximum-of-three rule for computing design-based SEs under the premise that the precision loss anticipated due to clustering and unequal probability sampling offsets any gain due to stratification (i.e., the DEFF should be at least 1). The three SEs correspond to the SUDAAN assumption of wr primary sampling units (PSUs), stratified simple random sample, and simple random sample. Note that, for the 2000 survey onward, it was decided to use only the standard SUDAAN wr SE, based on the PSU for the sake of simpler interpretation, as well as for easier computation of the SE of functions of estimates, such as differences and ratios.

In addition, starting in 2005 and continuing into 2013, the survey has seen the full implementation of a change made to the method of calculation for the SEs of estimated totals. It had been discovered in previous survey years that the original method, multiplying the weighted sample size by the corresponding SE of the mean, had produced underestimation of the SE of some estimated totals that had not been controlled for through the weighting process. As a result, from 2000 to 2003, in order to better reflect variance of the estimates within uncontrolled domains, a subset of the detailed tables reported the SE of the estimated totals directly from the SUDAAN calculation.

However, applying the SEs directly from SUDAAN to only a subset of tables produced inconsistencies between different sets of tables. Therefore, in 2004 and continuing through 2013, the process changed so that the decision about which method of calculation would be used for the SEs of estimated totals was made at the estimate level (e.g., the cell level) rather than at the marginal table level. This way the estimated totals would have consistent values for their variances throughout all reported tables. A specific set of domains used as covariates in the poststratification step of the NSDUH weighting process were designated as the "controlled" domains. The SE reported for these domains would be based on the original method. All other domains would report the SE directly from the SUDAAN calculation. A more detailed discussion on the change in SE reporting can be found in Appendix B, Section B.2.1, of the 2013 summary of national findings (Center for Behavioral Health Statistics and Quality, in press).

DEFFs associated with prevalence estimates below 0.00005 or greater than or equal to 0.99995 (an ad hoc rule representing 0 or 1 in practice) or prevalence estimates exhibiting low precision were not used for determining the medians. To identify estimates with low precision, the suppression rule used in earlier years was applied. Specifically, DEFFs or the corresponding prevalence estimates were not included if the corresponding RSE of $-\ln(\hat{p})$ satisfies

$$RSE[-\ln(\hat{p})] > 0.175 \text{ when } \hat{p} \le 0.5$$

or

$$RSE[-\ln(1-\hat{p})] > 0.175 \text{ when } \hat{p} > 0.5 .$$

A rationale for this rule is that, for a prevalence estimate of 0.10, the minimum required effective sample size (or the sample size under SRS) is around 55 (55.43 to be exact) when the maximum tolerable value of $RSE\left[-\ln(\hat{p})\right] = 0.175.$ This can be derived as follows: under SRS, $RSE(\hat{p})$ is equal to the square root of $\hat{p}(1-\hat{p})/n\hat{p}^2$, and using a first-order Taylor series, $SE\left[-\ln(\hat{p})\right]$ is approximately $SE(\hat{p})/\hat{p}$ (i.e., $RSE(\hat{p})$). Therefore, under SRS, $RSE\left[-\ln(\hat{p})\right]$ is approximately $RSE(\hat{p})/\left[-\ln(\hat{p})\right]$. Then, substituting $\hat{p}$ = 0.10 and $RSE\left[-\ln(\hat{p})\right] = 0.175$ gives n = 55.43 under SRS. For complex designs where $DEFF(\hat{p}) > 1$, this can be interpreted as the minimum required effective sample size. In other words, if $DEFF(\hat{p}) = 2,$ the minimum required sample size is the DEFF times the effective sample size (i.e., 111). The derivation of $RSE\left[-\ln(\hat{p})\right]$ is given below.

It may be noted that, for a given sample size, the RSE increases as $\hat{p}$ decreases, and for a given $\hat{p}$, it increases as the sample size decreases. The above discussion pertains to $\hat{p} < 0.5$ Although the RSE of $\hat{p}$ is not symmetric about $\hat{p} = 0.5,$ it makes logical sense for precision requirements to be identical for $\hat{p}$ and $1-\hat{p}.$ Therefore, it is convenient to use the convention that the suppression rule for $\hat{p} < 0.5$ also applies for $\hat{p} > 0.5$ by replacing $\hat{p}$ with $1-\hat{p}$.

3.1 Derivation of the $RSE\left[\ln\left(\hat{p}\right)\right]$ Approximation

Define the first-order Taylor series of a function, $f\left(\hat{\theta}\right)$, about a point, θ, as

$$f\left(\hat{\theta}\right) \cong f(\theta) + \left[df\left(\hat{\theta}\right)/d\hat{\theta}\right]_{\hat{\theta}=\theta}\left(\hat{\theta}-\theta\right),$$

then $\left[f\left(\hat{\theta}\right)-f(\theta)\right] \cong \left[df\left(\hat{\theta}\right)\Big/d\hat{\theta}\right]_{\hat{\theta}=\theta}\left(\hat{\theta}-\theta\right)$. If $E\left(\hat{\theta}\right)=\theta$, then

$$Var\left[f\left(\hat{\theta}\right)\right] = E\left[f\left(\hat{\theta}\right)-f(\theta)\right]^2 \cong \left[df\left(\hat{\theta}\right)\Big/d\hat{\theta}\right]^2_{\hat{\theta}=\theta} Var\left(\hat{\theta}\right), \text{ where } Var\left(\hat{\theta}\right) = E\left(\hat{\theta}-\theta\right)^2.$$

Let

$$\hat{\theta} = \hat{p} \quad f(\hat{\theta}) = \ln(\hat{p}) \quad d\ln(\hat{p})/d\hat{p} = 1\Big/\hat{p},$$

then the approximation of the variance would be

$$Var\left[\ln(\hat{p})\right] \cong Var(\hat{p}) \div \hat{p}^2 = \left[RSE(\hat{p})\right]^2,$$

and the approximation of the relative variance could be shown as

$$Rel-Var\left[\ln(\hat{p})\right] \cong \left[RSE(\hat{p})\right]^2 \div \left[\ln(\hat{p})\right]^2 .$$

Taking the square root of both sides of the equation leads to the approximation of $RSE\left[\ln\left(\hat{p}\right)\right]$ as

$$RSE\left[\ln\left(\hat{p}\right)\right] \cong RSE\left(\hat{p}\right) \div \left[-\ln\left(\hat{p}\right)\right].$$

4. Comparison of Observed Precision with Expected Precision

In this chapter, two benchmarks in the 2013 National Survey on Drug Use and Health (NSDUH) are compared with the estimated achieved precision of important outcome measures. One benchmark is derived from requirements specified by the Substance Abuse and Mental Health Services Administration (SAMHSA), and the other is the predicted precision that statisticians at RTI International anticipated during the design of the survey.

Predicted precision requirements for the 2013 designs were specified in terms of targeted relative standard errors (RSEs) and in terms of minimum sample sizes. To obtain the targeted RSEs, historical 2001 data were used, and RSEs were computed for nine outcome measures of interest. RSEs were then standardized to a prevalence of 10 percent as given by Equation 4 in Chapter 3.

The nine key NSDUH outcomes that the sample design optimization for the 2013 NSDUH was based on included recency-of-use estimates, treatment received for alcohol and illicit drug use, and dependence on alcohol and illicit drug use. Specifically, the following outcomes were used for 2013 (variable names on the NSDUH data files are in parentheses):

- cigarette use in the past month (CIGMON),
- alcohol use in the past month (ALCMON),
- any illicit drug use in the past month (SUMMON),
- any illicit drug use other than marijuana in the past month (IEMMON),
- cocaine use in the past month (COCMON),
- dependent on illicit drugs in the past year (DEPNDILL),
- dependent on alcohol in the past year (DEPNDALC) but not dependent on illicit drugs in the past year (DEPNDILL),
- received treatment at any location for illicit drug use in the past year (ILLTRMT), and
- received treatment for alcohol at any location in the past year (ALCTRMT) but did not receive treatment for illicit drugs in the past year (ILLTRMT) at any location.

Table 4.1 at the end of this chapter shows an overall age group comparison of the benchmark and observed design effects (DEFFs) and RSEs based on the nine outcomes from the 2013 sample design report (Center for Behavioral Health Statistics and Quality, 2014). Table 4.2 at the end of this chapter shows a comparison of the projected and observed DEFFs and RSEs for the nine outcomes from the sample design report by overall and age group breakdowns.

4.1 Precision Requirements

Initial requirements for the sample were set as follows:

- minimum sample sizes of 3,600 persons per State in the 8 largest States and 900 persons in the remaining 43 States; and
- equal allocation of the sample across the three age groups: 12 to 17, 18 to 25, and 26 or older within each State.

In addition, for national estimates, the SAMHSA-specified precision requirements were that the expected RSE on a prevalence of 10 percent not exceed the following:

- 3.0 percent for total population statistics; and
- 5.0 percent for statistics in three age group domains: 12 to 17, 18 to 25, and 26 or older.

The large overall sample, along with the presence of sufficient samples in every State, made it possible to get adequate precision for Hispanic or Latino and non-Hispanic or Latino black or African-American populations at the national level without any targeted oversampling of areas of high concentration of these populations or any oversampling through screening for these target populations.

4.2 Observed versus Expected Precision

The tables at the end of this chapter present observed results compared with benchmarks for sample sizes, DEFFs, and associated RSEs. For Table 4.1, the projected RSEs were the averages over the nine outcome variables as given in the beginning of this chapter. Note that, using Equation 4, the RSEs for all the outcome variables were scaled to the generic prevalence of 0.10. The projected DEFF was derived as an average over the DEFFs for the nine variables corresponding to the projected RSEs via Equation 4 for various domains. For the observed RSE, as in previous years' reports, mean DEFFs for the nine outcomes were substituted into Equation 4 to obtain mean RSEs for a prevalence of 0.10. The mean was used here for comparison purposes instead of the median because the mean was used for the purpose of sample allocation. Also, because the DEFF was proportional to the squared RSE or relative variance, it is probably more meaningful to compute projected RSE over all nine outcomes as root mean relative variance rather than mean RSE. However, the difference between the two was only marginal.

All of the nine prevalence estimates contributed to the means in Table 4.1. None were suppressed because of low precision. The observed DEFFs were slightly lower than the projections with the 12 to 17 age group producing decidedly lower results. The observed RSEs fared even better. They were lower than the targets by roughly half in two cases and more than 30 percent in all.

In Table 4.2, the comparison is between the observed and projected precisions for each of the nine outcomes used in sample design optimization. Although the observed mean DEFF values vary quite a bit from the projections, it is important to note that the observed mean RSE

values, the values used in the sample design report, are relatively close to the projected values. Out of 36 observed values, only 2 are larger than their projections by greater than 4 percent, and more than half are below their projections.

Table 4.1 Observed Precision Compared with Targeted and Projected Precision, by Age Group: 2013

	Sample Size			Mean Design Effect			Mean Relative Standard Error at $\hat{p}$ = 10 Percent			
Age Group	**Target**	**Observed**	**% Diff**	**Projected**	**Observed**	**% Diff**	**Target**	**Projected**	**Observed[1]**	**% Diff[2]**
Total	67,500	67,838	0.50%	3.35	3.15	-5.9%	3.00	2.10	2.04	-32.1%
12–17	22,500	22,494	-0.03%	1.96	1.68	-14.2%	5.00	2.80	2.59	-48.2%
18–25	22,500	22,214	-1.27%	2.03	2.01	-0.8%	5.00	2.85	2.85	-43.0%
26+	22,500	23,130	2.80%	1.80	1.80	-0.2%	5.00	2.68	2.64	-47.2%

[1]Calculated using Equation 3 with the observed sample size and the mean observed design effect.

[2]Percent relative difference of the observed from the target relative standard error.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2013.

Table 4.2 Observed Precision Compared with Projected Precision, by Age Group and Variable: 2013

Age Group	Drug	Mean Design Effect			Mean Relative Standard Error at $\hat{p}$ = 10 Percent		
		Projected	Observed	% Diff	Projected	Observed[1]	% Diff[2]
Total	CIGMON	4.50	3.75	-16.8%	2.45	2.23	-9.0%
	ALCMON	5.07	4.57	-9.8%	2.60	2.46	-5.3%
	SUMMON	3.06	3.01	-1.6%	2.02	2.00	-1.1%
	IEMMON	2.71	2.89	6.8%	1.90	1.96	3.1%
	COCMON	2.79	2.96	6.0%	1.93	1.98	2.7%
	DEPNDILL	2.32	2.38	2.3%	1.76	1.78	0.9%
	DEPNDALC[3]	3.03	2.88	-4.9%	2.01	1.96	-2.7%
	ILLTRMT	3.00	2.90	-3.3%	2.00	1.96	-1.9%
	ALCTRMT[3]	3.63	3.00	-17.2%	2.20	2.00	-9.3%
12–17	CIGMON	2.10	1.75	-16.6%	2.90	2.65	-8.6%
	ALCMON	2.13	1.88	-11.8%	2.92	2.74	-6.1%
	SUMMON	2.00	1.72	-14.0%	2.83	2.62	-7.3%
	IEMMON	1.90	1.67	-12.5%	2.76	2.58	-6.5%
	COCMON	1.92	1.76	-8.4%	2.77	2.65	-4.3%
	DEPNDILL	1.93	1.62	-16.3%	2.78	2.54	-8.5%
	DEPNDALC[3]	1.84	1.82	-0.8%	2.71	2.70	-0.4%
	ILLTRMT	1.96	1.53	-21.7%	2.80	2.48	-11.5%
	ALCTRMT[3]	1.84	1.37	-25.7%	2.71	2.34	-13.8%
18–25	CIGMON	2.19	2.26	3.0%	2.96	3.02	2.1%
	ALCMON	2.25	2.57	14.0%	3.00	3.22	7.5%
	SUMMON	2.09	2.23	6.6%	2.89	3.00	3.9%
	IEMMON	1.97	1.96	-0.8%	2.81	2.82	0.3%
	COCMON	1.97	1.85	-6.3%	2.81	2.74	-2.6%
	DEPNDILL	2.00	1.99	-0.8%	2.83	2.84	0.3%
	DEPNDALC[3]	1.88	2.15	14.4%	2.74	2.95	7.6%
	ILLTRMT	2.03	1.77	-12.8%	2.85	2.68	-6.0%
	ALCTRMT[3]	1.89	1.37	-27.4%	2.75	2.36	-14.2%
26+	CIGMON	2.02	1.97	-2.1%	2.84	2.77	-2.4%
	ALCMON	2.22	2.38	7.3%	2.98	3.04	2.1%
	SUMMON	1.78	1.84	3.5%	2.67	2.68	0.3%
	IEMMON	1.69	1.81	7.2%	2.60	2.65	2.1%
	COCMON	1.66	1.72	3.3%	2.58	2.59	0.3%
	DEPNDILL	1.63	1.70	4.7%	2.55	2.57	0.9%
	DEPNDALC[3]	1.68	1.60	-4.8%	2.59	2.49	-3.7%
	ILLTRMT	1.74	1.67	-4.0%	2.64	2.55	-3.4%
	ALCTRMT[3]	1.80	1.48	-17.4%	2.68	2.40	-10.4%

[1]Calculated using Equation 3 with the observed sample size and the mean observed design effect.

[2]Percent relative difference from the projected relative standard error.

[3]Results reported for DEPNDALC and ALCTRMT are defined by multiple variables as noted at the beginning of Chapter 4.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2013.

5. Comparison of Median and Mean Design Effects

The mean design effect (DEFF) is more sensitive to outliers and is generally larger than the median. Table 5.1 compares the median and mean of 56 DEFFs for three age groups and over all ages in the 2013 design for the National Survey on Drug Use and Health (NSDUH). Comparisons are also provided for the four race/ethnicity categories, although they were not used as stratification variables when selecting persons within households.

The median and mean DEFF estimates were based on estimates from the following:

- *15 illicit drug use categories:* any illicit drug use, marijuana/hashish, cocaine, crack, inhalants, hallucinogens, LSD, PCP, heroin, nonmedical use of any psychotherapeutics, nonmedical use of stimulants, nonmedical use of sedatives, nonmedical use of tranquilizers, nonmedical use of pain relievers, any illicit drug except marijuana; and
- *3 licit drug use categories:* cigarettes, alcohol, and smokeless tobacco.

Estimates used from these categories included one from each of three recency-of-use classes: ever used, used in past year, and used in past month.

The estimates of past month heavy drinking and binge drinking also were included in the licit drug use category, bringing the total number of estimates used for the mean versus median comparisons to 56. The median and the mean DEFF were calculated from the above estimates for the total population, by age and by race/ethnicity. As seen from Table 5.1, the mean DEFF turned out to be larger than the median DEFF in three of the eight domains. The differences between the mean and median DEFFs fall below 2 percent for the total and age comparison groups. However, for the race/ethnicity comparison groups, the percentage differences vary by up to 9.2 percent for non-Hispanic or Latino other races.

Table 5.1 Comparison of Median and Mean Design Effects of 56 Outcomes: 2013

Outcome	Median Design Effect	Mean Design Effect	Difference (Mean – Median)	Percentage Difference[1]
Total	3.11	3.16	0.05	1.53
Age (Years)				
12–17	1.70	1.68	-0.03	-1.62
18–25	2.07	2.05	-0.02	-0.85
26+	1.85	1.83	-0.01	-0.81
Race/Ethnicity				
White, Not Hispanic or Latino	2.93	2.95	0.02	0.67
Black or African American, Not Hispanic or Latino	3.11	3.25	0.15	4.76
Hispanic or Latino	3.63	3.56	-0.07	-2.03
Other or Multiple, Not Hispanic or Latino	4.19	3.81	-0.39	-9.22

[1]Computed as 100*(Mean – Median)/Median.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2013.

6. Use of Domain-Specific Design Effects for Approximating Standard Error

This chapter presents an approach considered for approximating the standard error (SE) when published 2013 National Survey on Drug Use and Health (NSDUH) SE estimates or computer software is unavailable. The approach considered in this chapter is based on domain-specific median design effects (DEFFs).

Domains were defined by cross-classifications of age and gender, race/ethnicity, population density, geographic division of residence, adult education, current employment, and State.[18] The 56 types of drug and recency categories, provided in Chapter 5, were used for the estimates on which the medians were computed. DEFFs associated with percentage estimates exhibiting low precision, as defined in Chapter 3, were not used. The median DEFFs were computed separately for the three classifications: lifetime illicit drug use (Table 6.1), past year and past month illicit drug use (Table 6.2), and licit drug use (Table 6.3). Note that DEFFs for lifetime use were expected to be quite different from those for past year use and past month use; therefore, it was desirable to keep the two separate. However, this separation was not done for licit drugs because of the small number of drug use variables available for computing the median for each domain (a total of only 11). These tables can be used to calculate an approximate variance estimate for a particular domain as follows:

$$var(\hat{p}_d)_{appx} = DEFF_{d,MED} * \left[\hat{p}_d(1-\hat{p})/n_d\right], \quad (5)$$

where $\hat{p}_d$ is the estimated proportion for domain d, n_d is the sample size for domain d, and $DEFF_{d,MED}$ is the median design effect for domain d.

The approximate SE estimate for $\hat{p}_d$, $SE(\hat{p}_d)_{appx}$, is the square root of $\text{var}(\hat{p}_d)appx$.

These tables provide the median DEFFs for the 8 large States and the median of the 43 State medians for the remaining States. Results for the smaller States are provided for reference only. Although these DEFFs were of the same order as those for the larger States (because the sample design was the same for all States), the above approximate formula is not recommended for use with smaller States because of the instability of the prevalence estimates. The small area estimation (SAE) methodology was used, as in the case of NSDUH reports since 1999, to improve the precision of the State estimates. To get an idea of the magnitude of the 2013 drug-specific DEFFs used in computing the median DEFF over the drugs, Table 6.4 lists the 56 individual DEFFs for each of the age groups and the national total.

[18] The demographic variables for county type and race underwent minor revisions in 2003 and remained revised for 2013. The Office of Management and Budget, whose definitions are used to determine county type, changed the way "metropolitan" was defined. Counties may have moved between levels of county type specifically because of this change. For race, there is no longer a response in the questionnaire that allows respondents to choose a "main race." Instead main race was imputed for multiple race respondents.

Table 6.1 Median Design Effects of Lifetime Illicit Drug Use, by Age Group, Gender, and Demographic Characteristic: 2013

Demographic Characteristic	Age Group			Gender		Total
	12–17	18–25	26+	Male	Female	
Total	1.78	2.05	1.99	3.66	3.77	4.00
Gender						
Male	1.82	1.92	1.76	N/A	N/A	3.66
Female	1.62	1.87	2.03	N/A	N/A	3.77
Age (Years)						
12–17	N/A	N/A	N/A	1.82	1.62	1.78
18–25	N/A	N/A	N/A	1.92	1.87	2.05
26+	N/A	N/A	N/A	1.76	2.03	1.99
Race/Ethnicity						
White, Not Hispanic or Latino	1.69	1.98	1.97	3.41	3.42	3.79
Black or African American, Not Hispanic or Latino	1.82	1.57	2.12	4.48	4.16	3.95
Hispanic or Latino	1.84	2.05	2.15	4.24	3.71	4.33
Other or Multiple, Not Hispanic or Latino	1.39	2.33	2.36	5.75	3.54	5.04
Population Density						
Large Metropolitan	1.39	1.82	1.79	3.18	3.47	3.51
Small Metropolitan	1.94	2.03	2.08	4.05	3.52	4.17
Nonmetropolitan	2.16	2.02	2.34	4.47	4.26	4.38
Census Division						
New England	1.61	2.87	2.29	4.52	4.48	4.86
Middle Atlantic	1.33	1.79	1.59	3.50	3.05	3.28
East North Central	1.29	1.71	1.56	2.67	2.70	2.95
West North Central	1.87	1.84	2.47	4.27	4.84	4.92
South Atlantic	1.64	1.97	2.22	3.67	4.21	4.37
East South Central	1.27	1.52	1.33	2.63	2.84	2.71
West South Central	1.24	1.32	1.41	2.39	2.10	2.58
Mountain	2.33	2.35	2.64	4.44	4.42	5.23
Pacific	1.35	1.90	1.79	3.58	3.07	3.66
County Type[1]						
Large Metropolitan	1.40	1.83	1.79	3.21	3.51	3.56
Small Metropolitan I	1.88	1.90	2.00	3.79	3.02	4.25
Small Metropolitan II	1.94	2.04	2.10	4.08	3.68	4.39
Nonmetropolitan I	2.11	2.07	2.43	4.73	4.00	4.70
Nonmetropolitan II	1.85	2.21	2.40	4.53	4.37	4.86
Nonmetropolitan III	1.92	2.05	2.05	4.42	2.97	4.01
Adult Education[2]						
Less Than High School	N/A	1.72	1.65	2.67	2.45	2.62
High School Graduate	N/A	1.93	1.82	2.75	2.91	2.81
Some College	N/A	1.95	1.98	3.25	3.03	3.22
College Graduate	N/A	1.86	2.29	2.78	2.73	2.85
Current Employment[3]						
Full Time	N/A	1.99	2.00	2.46	2.75	2.74
Part Time	N/A	1.90	2.10	3.90	3.64	3.77
Unemployed	N/A	1.94	1.84	2.91	3.61	3.07
Other[4]	N/A	1.90	1.74	2.69	2.48	2.60

Table 6.1 Median Design Effects of Lifetime Illicit Drug Use, by Age Group, Gender, and Demographic Characteristic: 2013 (continued)

Demographic Characteristic	Age Group			Gender		Total
	12–17	18–25	26+	Male	Female	
State						
California	1.13	1.43	1.46	2.82	2.66	2.91
Florida	1.11	1.31	1.67	3.03	2.67	3.28
Illinois	1.04	1.60	1.18	2.21	1.99	2.29
Michigan	1.25	1.31	1.43	2.71	2.51	2.79
New York	1.16	1.62	1.33	2.91	3.03	2.76
Ohio	1.09	1.20	1.49	2.82	2.51	2.99
Pennsylvania	1.06	1.34	1.46	2.75	2.23	2.74
Texas	1.02	1.18	1.32	2.15	1.96	2.31
Other[5]	1.17	1.29	1.47	2.64	2.38	2.90

N/A = not applicable.

Note: These design effects apply to the following drugs: any illicit drug use, marijuana/hashish, cocaine, crack, inhalants, hallucinogens, LSD, PCP, heroin, nonmedical use of any psychotherapeutics, nonmedical use of stimulants, nonmedical use of sedatives, nonmedical use of tranquilizers, nonmedical use of pain relievers, and any illicit drug except marijuana.

[1]Data on County Type are defined as follows:

Large Metropolitan: counties in metro areas with a population ≥ 1 million.

Small Metropolitan I: counties in metro areas with a population between 250,000 and 1 million.

Small Metropolitan II: counties in metro areas with a population < 250,000.

Nonmetropolitan I: urban populations not part of metro areas ≥ 20,000.

Nonmetropolitan II: urban populations not part of metro areas between 2,500 and 19,999.

Nonmetropolitan III: completely rural.

[2]Data on adult education are not applicable for persons aged 12 to 17.

[3]Data on current employment are not applicable for persons aged 12 to 17.

[4]Retired, disabled, homemaker, student, or "other."

[5]Median of the median design effects for the 43 States.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2013.

Table 6.2 Median Design Effects of Past Year and Past Month Illicit Drug Use, by Age Group, Gender, and Demographic Characteristic: 2013

Demographic Characteristic	Age Group			Gender		Total
	12–17	18–25	26+	Male	Female	
Total	1.64	2.04	1.64	2.46	2.65	2.61
Gender						
Male	1.77	2.00	1.51	N/A	N/A	2.46
Female	1.54	1.92	1.71	N/A	N/A	2.65
Age (Years)						
12–17	N/A	N/A	N/A	1.77	1.54	1.64
18–25	N/A	N/A	N/A	2.00	1.92	2.04
26+	N/A	N/A	N/A	1.51	1.71	1.64
Race/Ethnicity						
White, Not Hispanic or Latino	1.64	2.03	1.62	2.18	2.61	2.37
Black or African American, Not Hispanic or Latino	1.85	1.52	1.53	2.56	2.37	2.62
Hispanic or Latino	1.64	2.01	1.78	2.52	2.52	2.74
Other or Multiple, Not Hispanic or Latino	1.56	1.95	1.31	2.41	1.01	1.92
Population Density						
Large Metropolitan	1.41	1.81	1.40	2.07	2.27	2.15
Small Metropolitan	1.78	2.17	1.80	2.59	2.45	2.68
Nonmetropolitan	1.51	1.70	1.83	3.00	2.01	3.09
Census Division						
New England	1.49	2.53	1.69	2.67	2.84	3.02
Middle Atlantic	1.47	1.49	1.00	1.57	1.57	1.57
East North Central	1.31	1.55	1.21	1.88	1.70	1.91
West North Central	1.57	2.02	1.25	1.71	1.49	1.88
South Atlantic	1.47	1.85	2.00	2.14	3.65	2.93
East South Central	1.27	1.32	1.00	1.50	1.43	1.59
West South Central	1.14	1.37	1.06	1.47	1.28	1.51
Mountain	2.02	2.57	1.83	2.95	2.44	3.03
Pacific	1.40	2.05	1.31	2.03	1.76	2.17
County Type[1]						
Large Metropolitan	1.44	1.83	1.41	2.07	2.30	2.17
Small Metropolitan I	1.71	1.83	1.72	2.53	2.50	2.45
Small Metropolitan II	1.80	2.01	1.52	2.22	2.03	2.28
Nonmetropolitan I	1.74	2.17	1.24	2.08	1.38	1.94
Nonmetropolitan II	1.43	2.25	1.75	2.38	1.46	2.77
Nonmetropolitan III	1.92	1.45	1.55	3.08	2.14	2.59
Adult Education[2]						
Less Than High School	N/A	1.76	1.47	1.84	1.91	1.94
High School Graduate	N/A	2.00	1.24	1.83	1.62	1.62
Some College	N/A	1.94	1.74	2.01	2.58	2.33
College Graduate	N/A	1.97	1.92	1.71	2.13	2.08
Current Employment[3]						
Full Time	N/A	2.00	1.54	1.63	1.85	1.74
Part Time	N/A	1.95	2.10	2.20	3.16	2.88
Unemployed	N/A	1.91	1.57	2.15	2.37	2.34
Other[4]	N/A	1.79	1.37	1.91	1.41	1.83

Table 6.2 Median Design Effects of Past Year and Past Month Illicit Drug Use, by Age Group, Gender, and Demographic Characteristic: 2013 (continued)

Demographic Characteristic	Age Group			Gender		Total
	12–17	18–25	26+	Male	Female	
State						
California	1.17	1.56	1.05	1.65	1.37	1.71
Florida	1.05	1.36	1.21	1.83	1.36	1.88
Illinois	1.01	1.51	1.00	1.38	1.26	1.42
Michigan	1.15	1.15	1.18	2.04	1.32	1.73
New York	1.34	1.43	1.00	1.46	1.75	1.62
Ohio	1.09	1.16	1.00	1.28	1.34	1.40
Pennsylvania	1.06	1.36	1.03	1.66	1.11	1.55
Texas	1.00	1.18	1.02	1.06	1.14	1.35
Other[5]	1.09	1.29	1.01	1.29	1.04	1.38

N/A = not applicable.

Note: These design effects apply to the following drugs: any illicit drug use, marijuana/hashish, cocaine, crack, inhalants, hallucinogens, LSD, PCP, heroin, nonmedical use of any psychotherapeutics, nonmedical use of stimulants, nonmedical use of sedatives, nonmedical use of tranquilizers, nonmedical use of pain relievers, and any illicit drug except marijuana.

[1]Data on County Type are defined as follows:

Large Metropolitan: counties in metro areas with a population ≥ 1 million.

Small Metropolitan I: counties in metro areas with a population between 250,000 and 1 million.

Small Metropolitan II: counties in metro areas with a population < 250,000.

Nonmetropolitan I: urban populations not part of metro areas ≥ 20,000.

Nonmetropolitan II: urban populations not part of metro areas between 2,500 and 19,999.

Nonmetropolitan III: completely rural.

[2]Data on adult education are not applicable for persons aged 12 to 17.

[3]Data on current employment are not applicable for persons aged 12 to 17.

[4]Retired, disabled, homemaker, student, or "other."

[5]Median of the median design effects for the 43 States.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2013.

Table 6.3 Median Design Effects of Lifetime, Past Year, and Past Month Licit Drug Use Estimates, by Age Group, Gender, and Demographic Characteristic: 2013

Demographic Characteristic	Age Group			Gender		Total
	12–17	18–25	26+	Male	Female	
Total	1.88	2.24	1.92	3.39	3.28	3.60
Gender						
Male	1.85	2.08	1.80	N/A	N/A	3.39
Female	1.89	1.94	2.04	N/A	N/A	3.28
Age (Years)						
12–17	N/A	N/A	N/A	1.85	1.89	1.88
18–25	N/A	N/A	N/A	2.08	1.94	2.24
26+	N/A	N/A	N/A	1.80	2.04	1.92
Race/Ethnicity						
White, Not Hispanic or Latino	1.80	1.93	1.86	3.09	3.07	3.46
Black or African American, Not Hispanic or Latino	1.71	1.65	2.08	3.92	3.87	3.89
Hispanic or Latino	1.97	1.97	2.05	3.97	3.81	3.99
Other or Multiple, Not Hispanic or Latino	2.06	2.47	2.25	5.44	3.12	4.65
Population Density						
Large Metropolitan	1.65	2.12	1.76	3.00	2.97	3.41
Small Metropolitan	2.00	2.23	2.16	3.62	3.81	4.07
Nonmetropolitan	2.16	1.98	2.38	4.61	3.42	4.09
Census Division						
New England	2.50	2.91	2.13	3.96	3.69	4.16
Middle Atlantic	1.58	1.68	1.73	3.04	2.94	3.27
East North Central	1.54	1.87	1.59	2.81	2.63	2.82
West North Central	1.89	2.05	2.11	3.49	3.36	3.57
South Atlantic	2.03	2.22	2.37	3.77	3.80	4.07
East South Central	1.13	1.58	1.72	2.99	3.03	2.95
West South Central	1.45	1.55	1.47	2.61	2.35	2.77
Mountain	2.15	2.39	2.76	4.29	4.76	4.86
Pacific	1.70	2.23	1.70	2.93	2.66	3.02
County Type[1]						
Large Metropolitan	1.66	2.11	1.79	3.07	3.00	3.46
Small Metropolitan I	1.92	2.21	2.00	3.49	3.65	3.72
Small Metropolitan II	2.03	2.37	2.29	3.69	4.31	4.31
Nonmetropolitan I	1.84	2.26	2.02	3.46	4.74	3.76
Nonmetropolitan II	2.03	2.05	2.14	4.89	3.88	4.22
Nonmetropolitan III	1.99	2.38	2.08	3.74	3.37	3.79
Adult Education[2]						
Less Than High School	N/A	1.78	2.08	3.05	2.97	3.00
High School Graduate	N/A	2.01	1.91	2.89	2.78	2.93
Some College	N/A	1.92	1.83	2.70	2.95	2.71
College Graduate	N/A	2.00	1.92	2.39	2.03	2.37
Current Employment[3]						
Full Time	N/A	2.10	1.94	2.41	2.48	2.55
Part Time	N/A	1.96	2.01	2.93	3.13	3.21
Unemployed	N/A	1.83	1.99	3.05	3.15	3.23
Other[4]	N/A	2.16	1.66	2.48	2.73	2.46

Table 6.3 Median Design Effects of Lifetime, Past Year, and Past Month Licit Drug Use Estimates, by Age Group, Gender, and Demographic Characteristic: 2013 (continued)

Demographic Characteristic	Age Group			Gender		Total
	12–17	18–25	26+	Male	Female	
State						
California	1.25	1.70	1.36	2.32	2.25	2.38
Florida	1.44	1.46	1.49	2.55	2.40	2.78
Illinois	1.20	1.40	1.34	2.35	2.04	2.53
Michigan	1.32	1.56	1.50	2.33	2.23	2.65
New York	1.31	1.58	1.49	2.72	2.55	2.88
Ohio	1.25	1.35	1.47	2.59	2.13	2.74
Pennsylvania	1.19	1.35	1.36	2.35	2.07	2.40
Texas	1.31	1.44	1.32	2.27	2.11	2.43
Other[5]	1.27	1.54	1.42	2.52	2.24	2.64

N/A = not applicable.

Note: These design effects apply to the following substances: cigarettes, alcohol, binge drinking, heavy drinking, and smokeless tobacco.

[1]Data on County Type are defined as follows:

Large Metropolitan: counties in metro areas with a population ≥ 1 million.

Small Metropolitan I: counties in metro areas with a population between 250,000 and 1 million.

Small Metropolitan II: counties in metro areas with a population < 250,000.

Nonmetropolitan I: urban populations not part of metro areas ≥ 20,000.

Nonmetropolitan II: urban populations not part of metro areas between 2,500 and 19,999.

Nonmetropolitan III: completely rural.

[2]Data on adult education are not applicable for persons aged 12 to 17.

[3]Data on current employment are not applicable for persons aged 12 to 17.

[4]Retired, disabled, homemaker, student, or "other."

[5]Median of the median design effects for the 43 States.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2013.

Table 6.4 Design Effects, by Age Group, for the Outcomes Used in the Medians in Tables 6.1, 6.2, and 6.3: 2013

Outcome	Age Group			Total
	12–17	18–25	26+	
Illicit Drugs, Lifetime Recency				
Any Illicit Drug	1.93	2.12	2.16	4.06
Marijuana	1.97	2.12	2.21	4.14
Cocaine	1.51	2.10	1.86	3.85
Crack	1.19	1.84	1.85	4.00
Inhalants	1.92	1.90	1.85	3.60
Hallucinogens	1.58	2.25	1.90	3.83
LSD	1.47	2.00	1.85	3.87
PCP	1.34	1.79	2.26	4.91
Heroin	1.80	2.05	2.17	4.31
Nonmedical Use of Psychotherapeutics	1.81	2.08	1.99	3.83
Nonmedical Use of Stimulants	1.64	2.07	1.74	3.39
Nonmedical Use of Sedatives	1.52	1.99	2.42	5.07
Nonmedical Use of Tranquilizers	1.78	2.04	2.09	4.01
Nonmedical Use of Pain Relievers	1.79	1.96	1.88	3.45
Any Illicit Drug except Marijuana	1.86	2.12	2.01	4.02
Illicit Drugs, Past Year Recency				
Any Illicit Drug	1.90	2.20	2.02	3.39
Marijuana	1.91	2.27	1.82	2.99
Cocaine	1.52	2.23	1.36	2.24
Crack	1.14	1.68	1.22	2.45
Inhalants	1.64	2.28	1.63	1.86
Hallucinogens	1.62	2.30	2.24	2.48
LSD	1.45	2.33	1.91	1.52
PCP	1.38	1.05	1.13	1.25
Heroin	1.64	1.87	1.10	1.87
Nonmedical Use of Psychotherapeutics	1.69	2.06	1.84	3.12
Nonmedical Use of Stimulants	1.55	1.97	1.66	2.37
Nonmedical Use of Sedatives	1.55	1.97	1.73	2.85
Nonmedical Use of Tranquilizers	1.47	2.07	1.60	2.66
Nonmedical Use of Pain Relievers	1.70	2.17	1.70	2.86
Any Illicit Drug except Marijuana	1.74	2.15	1.87	3.10

Table 6.4 Design Effects, by Age Group, for the Outcomes Used in the Medians in Tables 6.1, 6.2, and 6.3: 2013 (continued)

Outcome	Age Group			Total
	12–17	18–25	26+	
Illicit Drugs, Past Month Recency				
Any Illicit Drug	1.72	2.23	1.84	3.01
Marijuana	1.76	2.16	1.75	2.76
Cocaine	1.76	1.85	1.72	2.96
Crack	1.00	2.54	1.33	2.78
Inhalants	1.69	2.04	1.46	2.11
Hallucinogens	1.70	2.41	3.08	3.40
LSD	1.72	1.96	1.52	1.56
PCP	1.38	1.00	1.13	1.81
Heroin	1.63	1.78	1.00	1.62
Nonmedical Use of Psychotherapeutics	1.73	1.92	1.61	2.66
Nonmedical Use of Stimulants	1.40	1.90	1.61	2.56
Nonmedical Use of Sedatives	1.52	1.58	2.68	4.59
Nonmedical Use of Tranquilizers	1.41	1.73	1.27	2.24
Nonmedical Use of Pain Relievers	1.76	2.03	1.50	2.47
Any Illicit Drug except Marijuana	1.67	1.96	1.81	2.89
Licit Drugs, Lifetime Recency				
Alcohol	2.01	2.51	2.75	4.19
Cigarettes	1.88	2.17	2.17	3.90
Smokeless Tobacco	2.21	2.12	1.85	3.59
Licit Drugs, Past Year Recency				
Alcohol	1.94	2.57	2.42	4.47
Cigarettes	1.78	2.24	1.92	3.59
Smokeless Tobacco	2.21	1.94	1.53	2.54
Licit Drugs, Past Month Recency				
Alcohol	1.88	2.57	2.38	4.57
Cigarettes	1.75	2.26	1.97	3.75
Smokeless Tobacco	1.79	1.68	1.55	2.73
Binge Drinking	1.84	2.59	1.90	3.60
Heavy Drinking	1.69	2.08	1.74	3.20

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2013.

7. Conclusions

As stated in Chapter 1, it is important to have a good understanding of the resulting standard errors (SEs) and design effects (DEFFs) corresponding to a set of key outcome variables and other variables as part of any survey data analysis. One reason for this is to evaluate how well the sample was designed in light of the target and observed precisions, and the DEFFs. The 2013 National Survey on Drug Use and Health (NSDUH) met its precision goals for all four target domains defined by three age groups (12 to 17, 18 to 25, 26 or older, and total [i.e., 12 or older]).

Another important reason for the examination of SEs and DEFFs is to obtain quick estimates of SEs for any user-specified outcome variable through some form of modeling. Although SEs of several prevalence estimates are available from published analysis reports on the survey, SEs of other estimates of interest by a user may not be available in the published tables. If the user has access to the primary data source (i.e., micro data), the SE can be computed using commercially available software, such as SUDAAN®. If the user has access to the Substance Abuse and Mental Health Services Administration's (SAMHSA's) Web site containing detailed tables (http://www.samhsa.gov/data/), then SEs are also included and should be used. Online NSDUH data analysis tools at http://www.icpsr.umich.edu/icpsrweb/content/SAMHDA/index.html include the capability to produce appropriate SEs and should be used. Otherwise, if a user only has access to a secondary data source without information on SEs, then, in this case, it is useful to have a provision for computing quick and approximate SEs. If the secondary data source contains information about median DEFFs (over a set of drug use variables) for selected demographic domains, such as age and race/ethnicity, a rough approximate SE can be obtained easily using the formula (Equation 5) for variance as a function of DEFF, domain sample size, and the prevalence estimate. The formula is

$$var(\hat{p}_d)_{appx} = DEFF_{d,MED} * [\hat{p}_d(1-\hat{p}_d)/n_d].$$

Note that the use of a known median DEFF in place of a variable-specific unknown DEFF provides a simple type of modeling. One also could use mean DEFF instead of median DEFF. This report contains tables showing median and mean DEFFs for a number of domains. The differences are generally small. The above way of modeling SEs, via median DEFF, is not applicable if the available median DEFF does not correspond to the domain of interest.

In summary, the user may obtain SE estimates for the 2013 NSDUH for drug recency outcomes from the following sources in recommended order:

1. commercially available variance estimation software packages, such as SUDAAN;
2. published SEs from reports using data from the 2013 NSDUH (available at http://www.samhsa.gov/data/ or upon request from the Center for Behavioral Health Statistics and Quality at SAMHSA);

3. median domain DEFFs appearing in Tables 6.1, 6.2, and 6.3 and application of Equation 5 in Chapter 6 for drug recency of use; and

4. online data analysis system in the Substance Abuse and Mental Health Data Archive, available at http://www.icpsr.umich.edu/icpsrweb/content/SAMHDA/index.html, provided that the stratum and primary sampling unit variables are specified.

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