

CHAPTER 5. WEIGHT CALCULATIONS

Weights are needed to produce valid population-level estimates. Several stages of nonresponse adjustment and poststratification are done to reduce sampling error and bias. For the 2001 NHTS, two sets of weights have been provided: 1) The full sample, including add-on samples for selected areas as well as the national sample; and 2) The national sample only. For the second set of weights, all add-on sample cases have weights set equal to zero. Different weights are required for households, persons, and travel days. Discussion of which weight to use when is contained in Chapter 7, Section D.

The public use dataset contains person and household weights for:

- Useable households in which person interviews were completed with at least 50 percent of adults in the household (69,817 households in the national and add-on samples, 26,038 households in the national sample) and
- 100 percent households in which person interviews were completed with all adults in the household (60,520 households in the national and add-on samples, 22,178 households in the national sample).

Although it is also possible to tabulate data for other categories of households, the weights provided in the data are appropriate for only the 100 percent and useable households. These other categories of households of interest are:

- Households in which extended interviews (person interviews) were completed with at least one adult in the household (72,004 households in the national and add-on samples, 26,995 households in the national sample), and
- Households for which there was a completed household interview (106,598 households in the national and add-on samples, 36,810 households in the national sample), whether or not there were any completed extended interviews in the household.

5-A. HOUSEHOLD WEIGHTS

5-A.1. INITIAL HOUSEHOLD WEIGHT

The baseweight is the reciprocal of the known probability of selection of a telephone number. The first adjustment to the baseweight is for nonresponse in attempting to complete the household interview. A special adjustment is needed prior to the nonresponse adjustment because it is not possible to determine whether some telephone numbers are residential or not. This occurs when there are only ring-no-answers on repeated calls, and when repeated calls only reach an answering machine. Residency rates for these two situations were determined by fitting survival analysis equations to survey results. This method takes advantage of the fact that telephone numbers reach a final status after a variable number of attempts. To apply this method, it is necessary to make extra attempts for a small sample of telephone numbers. The results of these extra attempts are used to fit an equation for the proportion of numbers that are residential after a given number of attempts. The equation is then used to predict the proportion of undetermined numbers that are residential.¹

In the nonresponse adjustment, cells were formed, with a separate nonresponse adjustment factor applied for each cell. Characteristics of telephone exchanges, such as percentage of listed households by race or by tenure, were examined to determine where response rates differed. A categorical search algorithm called CHAID² was used to determine which variables and categories had the largest differences in response rates. The variables for which response rates differed significantly are given in Appendix H, Weighted Response Rates and Variables Used to Define Nonresponse Adjustment Cells. These differ for the full sample weighting and for the national sample weighting, and so two sets are given in Appendix H.

The next weight adjustment is for interviewed households that have more than one residential telephone line. Such households have a higher probability of selection and thus received a reduced weight.

¹ Brick, J. M., Montaquila, J., Scheuren, F. (2002). "Estimating residency rates for undetermined telephone numbers", *Public Opinion Quarterly*, Vol. 66, pp. 18-39.

² Kass, G. (1980). "An exploratory technique for investigating large quantities of categorical data", *Applied Statistics*, vol. 29, pp. 119-127.

The weight consisting of the product of the baseweight, the household nonresponse adjustment, and the multiple phone adjustment is called the "initial household weight." This weight is the starting point for all of the different weights.

5-A.2. USEABLE HOUSEHOLD WEIGHT

For the "useable household weight," a nonresponse adjustment was applied to the initial household weight. Information on characteristics collected in the household interview, as well as the information available on all telephone numbers, was available for determining nonresponse adjustment cells. As in the initial household weight, nonresponse adjustment, CHAID was used to determine the best definition of cells. Variables used in the nonresponse adjustment are given in Appendix H.

The next step for the useable household weight was to control survey estimates to independent controls for various demographic categories, in a process called raking. The source for these controls was the 2000 Census. Census estimates were adjusted for growth between 2000 and 2001 when the majority of data collection on the NHTS was conducted, using estimates from the Census Bureau's Current Population Survey. The variables and the control totals are provided in Table 1 in Appendix F, along with the average adjustment factor for each category, for both the full sample and for the national sample. Weights were first adjusted to assure agreement on the first raking dimension, then weights were adjusted for the second raking dimension, then for the third, etc. Then the process was repeated, again assuring agreement with each of the raking dimensions. The process continued to be repeated, with iterative controlling to each variable, until simultaneously close agreement for each variable was obtained. In addition to variables for which Census data was used, it was desired to ensure equal contributions for each of the seven days of the week and to obtain appropriate contributions by month in which the travel day occurred (varying only by the number of days in the month). We paired months (January and February, March and April, etc.) and controlled estimates by day of week crossed with paired months, creating 42 control categories. These categories were used along with the Census sets in the raking process. We also used controls for MSA center-city, MSA non-center-city and non MSA crossed by individual month.

A final step was to “trim” very large weights. Inordinately large weights tend to substantially increase sampling errors. By not allowing weights to get too large, sampling errors are reduced although there is some loss in the bias reduction due to nonresponse adjustment and raking. Trimming is only for the purpose of reducing large weights, not for editing data in any way. There were 89 weights that were trimmed because they were more than 4.0 times the mean weight for the full sample weighting. In addition, there were some households that were sampled from one jurisdiction in New York or Wisconsin or from outside these states, but turned out to be located in a different jurisdiction that was sampled at a higher rate. The 42 households that had weights more than 8.0 times the mean of the jurisdiction in which they were located had their weights trimmed. After trimming large weights, the raking process was then repeated so that survey estimates would still agree with the control total.

5-A.3. HUNDRED PERCENT REPORTED HOUSEHOLD WEIGHT

The weighting process for the useable household weight was also used for the "100% reported household weight." The nonresponse adjustment had to be done separately for each weight, because there are households that are considered as respondents for useable households (i.e., 50% or more of household adults interviewed) that are nonrespondents for 100% reported households. The variables used in the nonresponse adjustment differ slightly among the weights. The variables used for the 100% reported households are also given in Appendix H.

Raking was then performed separately for each weight. The average adjustment factors for each category in the raking are provided in Appendix F, Control Totals and Adjustment Factors. The final step was again to "trim" very large weights and to then repeat the raking process after trimming. There were 176 full sample weights that needed trimming. In addition, there were 37 weights trimmed because of very large weights due to the household being located in a different jurisdiction than where it was sampled.

5-B. PERSON WEIGHTS

5-B.1. USEABLE HOUSEHOLDS PERSON WEIGHT

The starting point for person weights for useable households is the initial household weight.

A nonresponse adjustment was done similar to the adjustment for the useable household weight. CHAID was again used to determine the best definition of cells. Variables used in the nonresponse adjustment are given in Appendix H. The next step for this person weight was to control survey estimates to control totals from the 2000 Census. Table 2 in Appendix F has the average adjustment factors for each category used in this weighting step. A final step was to “trim” the weights for persons who have extremely large weights (more than 4 times the mean weight). There were 427 full sample weights that needed trimming. In addition, there were 85 weights trimmed because of very large weights due to the household being located in a different jurisdiction from where it was sampled. The process for controlling to Census totals was then repeated so that survey estimates would agree with control totals after trimming.

5-B.2. HUNDRED PERCENT REPORTED HOUSEHOLDS PERSON WEIGHT

The weighting process for the useable households person weight was also used for the 100% reported households' person weight. The set of variables used for the nonresponse adjustment for this weight is the same as for useable households' person weights. Raking and trimming were then performed. There were 731 full sample person weights that required trimming for 100% reported households. There are a large number of weights that require trimming because of the relatively high nonresponse rates and our ability to form cells that varied greatly in their nonresponse rates. The range of nonresponse rates among cells is good in that it permits reduction in the bias due to nonresponse, but it also leads to large adjustment factors for some cells and the subsequent need for weight trimming. The average adjustment factors for each category in the raking are provided in Appendix F. In addition, there were 71 weights trimmed because of very large weights due to the household being located in a different jurisdiction from where it was sampled.

5-C. PERSON TRIP WEIGHTS FOR TRAVEL DAY DATA

Travel day person trip weights are simple functions of the person weights in section 5-B, modified only for the purpose of producing annual estimates of the number of trips. The "useable households travel day person trip weight" is simply equal to the final useable household person weight multiplied by 365. The 100%-reported-household travel day person trip weight is similarly calculated from the corresponding person weight.

5-D. TRAVEL PERIOD WEIGHTS

5-D.1. HOUSEHOLD TRIP WEIGHTS FOR TRAVEL PERIOD

Travel period household weights are simple functions of the household weights described in section 5-A, modified only for the purpose of producing annual estimates of the number of household trips. The "useable households travel period household weight" is simply equal to the final useable household weight multiplied by $365/28$. The 100-percent-reported-households travel period household weight is similarly calculated from the corresponding household weight.

5-D.2. PERSON TRIP WEIGHTS FOR TRAVEL PERIOD

Travel period person weights are simple functions of the person weights described in section 5-B, modified only for the purpose of producing annual estimates of the number of person trips. The "useable households travel period person weight" is simply equal to the final useable household person weight multiplied by $365/28$. The 100-percent-reported-households travel period person weight is similarly calculated from the corresponding person weight.

5-E. DISTRIBUTION OF NUMBER OF TRAVEL PERIOD TRIPS

The data in this file cannot be used in a simple manner to produce realistic distributions of households or persons by number of annual trips. The survey provides the number of trips taken in a 28-day period. Thus, for example, if a person reports taking two long distance trips in the 28-day travel period, we have no direct knowledge of how many trips the person takes in a year. A simple estimate of number of annual trips is $2 * 365 / 28 = 26$, but of course it is quite likely that the person will have taken fewer trips than this in a year. Similarly, if a person reports taking zero long distance trips in the 28-day travel period, a simple estimate of number of annual trips is also zero, but of course it is quite possible that the person will have taken a few trips during the year.