Appendix L

HINTS 2007 Sample Design

APPENDIX L

HINTS 2007 SAMPLE DESIGN

The sample design for HINTS 2007 consists of two samples with each sample being selected from a separate sampling frame. One sample will be a list-assisted random digit dialing (RDD) sample selected from all telephone exchanges in the United States, following the design of HINTS 2003 and HINTS 2005. This will result in a nationally representative sample of telephone households. The second sample is new and comprises addresses selected from a list based on United States Postal Service (USPS) administrative records. Questionnaires will be mailed to the address sample, and telephone interviewers will follow up with mail nonrespondents.

During the household screener for the RDD sample, one adult will be sampled within each household and recruited for the extended interview. For the address sample, all adults in the household will be asked to complete a survey. The sample design will yield approximately 7,000 completed interviews: 3,500 from the RDD sample and 3,500 from the address sample.

L.1 RDD sample

A list-assisted RDD sample is a random sample of telephone numbers from all working banks in U.S. telephone exchanges (see for example Tucker, Casady, and Lepkowski, 1993). A *working bank* is a set of 100 telephone numbers (e.g., telephone numbers with area code 301 and first five digits 294-44) with at least one listed residential number.[1]

L.1.1 Size of RDD Sample and Expected Yields

Table L-1 presents expected sample sizes for the RDD sample. A total of 59,020 telephone numbers are to be sampled, with an expected yield of 3,500 completed interviews. A reserve sample of 29,510 telephone numbers will also be sampled and set aside to be used in case expectations are not met

[1] Note that all numbers whether listed as residential or not are part of the sampling frame, as long as they are in working banks.

(i.e., a total of 88,530 telephone numbers will be initially sampled, with 29,510 then set aside as the reserve).

Table L-1. RDD sample's expected completed screeners and completed extended interviews

	RDD sample
Sampled telephone numbers	59,020
Reduction rate due to nonmailable subsampling	91.7%
Residency rate	35.9%
Residential numbers	19,422
Screener response rate	35.0%
Reduction rate due to refusal subsampling	85.8%
Completed screeners	5,833
Extended interview response rate	60.0%
Yield of extended interviews	3,500

NOTE: All figures in the table are rounded, leading to arithmetic inconsistencies (a*b equals c, but rounded a * rounded b is not equal to rounded c).

Our sample design for HINTS 2007 will subsample numbers of two kinds. First, we will sample out 13.2 percent of the nonmailable numbers (numbers for which we have no address information), as discussed in Section L.1.2. This subsampling will deselect a total of 4,917 nonmailable numbers (8.3% of the entire sampled numbers) leaving 54,102 numbers. Then we will further subsample, from each stratum by mailable status, 49.7 percent of the initial screener refusals and noncontacts (numbers for which we obtain a certain form of human contact with nonhostile refusal or noncontact at the first round of screening calls). This subsampling will exclude 4,288 such numbers allowing us to focus only on 50.3 percent of such numbers for conversion. The first type of subsampling was conducted for HINTS 2005 but the second type of subsampling was not. Sections L.1.2 and L.1.3 discuss these two types of subsampling in detail.

L.1.2 Stratification by Mailable Status

We will use stratification by mailable status (see for example Brick, et al., 2002). Numbers that are *mailable* are those for which we have an address. In HINTS 2005,[2] 36.9 percent of the RDD sample was mailable, with 63.1 percent nonmailable. We expect similar percentages in HINTS 2007 (though there may be some change). The mailable numbers have a much higher percentage of residential

[2] We computed the HINTS 2005 mailable rate and response rates from all of the Wave 1 data and a portion of Wave 2 data. We believe this provides the most reliable estimates of various HINTS 2005 rates for purposes of planning the HINTS 2007 RDD sample.

numbers. Additionally, we have seen in HINTS 2005 that we obtain a higher screener response rate among the mailable numbers, especially when we send incentives with an advance letter to the mailable numbers. Computations using HINTS 2005 results show that the cost for each completed extended interview among the nonmailables can be expected to be 1.33 times larger than that for a completed extended interview among the mailables, thereby justifying an explicit stratification by mailable status. The optimal rate for the nonmailable stratum is 86.8 percent of that of the mailable stratum. Table L-2 presents the sample design with this subsampling rate.

The residency rates and mailable percentages are from HINTS 2005. The differential screener response rates (36.0% for the mailable stratum and 28.8% for the nonmailable stratum) reflect the difference in response rates (7.2 percentage points) that we saw in HINTS 2005 and other recent Westat RDD studies between the nonmailable stratum and the mailable stratum with $2 incentive.

The same extended-interview response rates for the mailable and nonmailable strata reflects our HINTS 2005 observation that there was no difference in extended interview response rates between the mailable stratum with the $2 advance letter incentive and the nonmailable stratum.

L.1.3 Subsampling of Refusals

We will also apply *refusal subsampling* (e.g., Brick, et al., 2005). Numbers that are *screener refusal or noncontact* are those for which we obtain either human contact with nonhostile refusal or nonhuman contacts during the first round of the screener calling attempt. Based on HINTS 2005 data, we anticipate 25 percent and 44.4 percent of residential numbers will be cooperative and refusal-noncontact numbers, respectively, in the first round of the screening calls. From about 8,618 screener refusal and noncontact numbers, we will select 50.3 percent of them (4,342 numbers) for carrying out refusal conversion. Table L-2 shows the sample design with this subsampling rate. We anticipate a total of 5,833 screener completes with 4,856 initial screener completes and 978 additional screener completes that are either initially refused or noncontact.

Table L-2. Proposed mailable stratification and refusal subsampling sample design

	Mailable	Mailable percentage of total	Non-mailable	Non-mailable percentage of total	Total
Original numbers	21,766	36.9%	37,254	63.1%	59,020
Subsampling rate	100.0%		86.8%		
Sampled telephone numbers	21,766	40.2%	32,337	59.8%	54,102
Residency rate	77.2%		8.1%		35.9%
Residential numbers	16,783	86.5%	2,619	13.5%	19,422
Screener response rate	36.0%		28.8%		35.0%
Initial response rate	26.0%		18.6%		25.0%
Initial refusal rate	44.7%		42.6%		44.4%
Refusal conversion rate	22.9%		19.9%		22.5%
Refusal subsampling rate	50.3%		50.3%		50.3%
Completes with initial cooperation	4,369	90.0%	486	10.0%	4,856
Completes with initial refusal	866	88.5%	112	11.5%	978
Screener completes	5,235	89.7%	5980	10.3%	5,833
Extended interview response rate	60.0%		60.0%		60.0%
Overall response rate	21.6%		17.3%		21.0%
Yield of extended interviews	3,141	89.7%	359	10.3%	3,500
Effective sample size*					2,692

* Effective sample size was figured with assuming design effect of 1.3.

L.1.4 Effective Sample Size for Domains of Interest

In HINTS 2005, the number of completed RDD extended interviews was 5,493.[3] For HINTS 2007 the expected number of completed RDD extended interviews is 3,500. The HINTS 2007 RDD sample is smaller than previously because there will also be a HINTS 2007 address sample. Table M-3 presents Current Population Survey (March 2005 supplement) estimates of adults within the domains of interest, with expected sample sizes proportional to these estimates. The effective sample sizes (the sample size of a simple random sample with the same precision) are smaller by a factor of 1.3: we expect

[3] In HINTS 2005, we have 5,586 extended interview completes, including 93 web-extended interview completes.

a design effect[4] of 1.3, which allows for adult selection within households (generating variable weights for adults for differing size households) that generally has a design effect of 1.2, mailable-nonmailable subsampling (see Section L.1.2), screener refusal subsampling (see Section L.1.3), and nonresponse weighting adjustments.

Table L-3. RDD sample's expected completed extended interviews by race

	Adults in U.S. population (in 1,000s)	Percentage of adults	Expected completes	Expected effective sample size
Hispanic	27,509	12.66	399	341
Non-Hispanic black	24,916	11.46	407	309
Non-Hispanic white and other race	164,910	75.88	2,694	2,043
Total	217,334	100.00	3,500	2,692

L.2 Address Sample

The address sample will be a stratified sample selected from a list of addresses. Questionnaires will be mailed to the address sample, and all adults at each sampled address will be asked to complete a separate questionnaire. Telephone interviewers will follow up those mail nonrespondents for which it is possible to reverse match telephone numbers to addresses. Telephone followup interviews will use the RDD calling protocol and interview instruments, in which only one adult will be sampled and interviewed (see Appendixes I and J).

L.2.1 Sampling Frame for Address Sample

The sampling frame for the address sample will be a database of addresses used by Marketing Systems Group (MSG) to provide random samples of addresses. Our decision to use this database as a sampling frame is the result of an evaluation study conducted by Link and colleagues. (2005). This study compared five address vendors in terms of the coverage of their lists for a six-state area. Three vendors had high levels of undercoverage in one or more of the six states. Of the remaining two vendors, only MSG could provide sampling services for a single-stage sample of addresses. The use

[4] *Design effect* is defined as the ratio of the actual sample variance to the variance of a simple random sample with the same sample size. See for example Kish (1965, p. 162).

of the other vendor would have required two stages of sampling—first the sampling of carrier routes and then the sampling of individual addresses. Compared with a single-stage design, a two-stage design for selecting addresses is more costly and provides less precision for a given sample size.

The MSG address database is updated bimonthly from the USPS's Computerized Delivery Sequence (CDS) File. Licensed by the U.S. Postal Service to qualified address vendors, the CDS is an electronic data product that provides and updates addresses by carrier route (USPS, 2006). Address vendors must initially qualify for the CDS information for a given five-digit ZIP Code area by having at least 90 percent but not more than 110 percent of the all the addresses in the ZIP Code area. Once a vendor has qualified for a five-digit ZIP Code area, CDS information is made available bimonthly via electronic media.

The CDS contains current information on all mailing addresses serviced by the U.S. Postal Service, with the exception of general delivery. CDS information is available for the following types of addresses:

- **Address Type 1.** Addresses that currently receive or have received mail delivery.
- **Address Type 2.** Addresses on city routes to which carriers do not deliver because of alternative delivery arrangements, e.g. to post office boxes. (Referred to as *throwbacks*, these addresses can be included in or excluded from MSG-provided samples of addresses.)
- **Address Type 3.** Addresses on city routes vacant longer than 90 days and that are likely to be long-term vacancies, that are not considered seasonal. (Referred to as *vacants*, these addresses can also be included in or excluded from MSG-provided samples of addresses.)
- **Address Type 4.** Addresses delivered seasonally. (No CDS information is available, however, on the dates of the mailing season. Referred to as *seasonals*, these addresses can also be included in or excluded from MSG-provided samples of addresses.)

The availability of bimonthly CDS data allows address vendors to frequently update their address lists. Another address vendor that uses CDS data for updating is Advo, Inc. Staab and Iannachione (2003) evaluated the coverage for the Advo mailing list in 2002. They compared the number of addresses on the Advo mailing list (excluding vacant and seasonal addresses) to census household projections generated by Claritas, Inc., for 29,000 local areas. They found that for local areas containing 10,000 or more households, the totals number of residential city-style addresses exceeded the number of households. For areas containing fewer than 10,000 households, the total number of residential city-style

addresses was only 86.3 percent of the total number of households. However, if post office boxes and rural route addresses were also included, the total number of addresses exceeded the total number of households for local areas containing fewer than 10,000 households.

Link and colleagues (2005) evaluated the coverage of the MSG address list for the six states of California, Illinois, New Jersey, North Carolina, Texas, and Washington. For each of the counties in this six-state study area, they compared the number of addresses on the MSG list as of April 1, 2005, to the U.S. Census Bureau's estimated number of households for July 1, 2003. They tabulated the number of counties in which there was a high level of undercoverage that they defined as the number of addresses on the MSG list for the county as less than the number of households in the county by at least 10 percent. They found that in counties where less than 25 percent of the population lives in an urban area that nearly 90 percent of the counties had a high level of undercoverage; whereas in counties where 75 percent or more of the population lives in an urban area, only 4.3 percent of the counties had a high level of undercoverage.

We plan to include a question on the mail questionnaire about the different ways respondents receive mail. The responses to this question will be used in the calculation of sampling weights to adjust for the duplication of households in the sampling frame. We also plan to investigate weighting adjustments to reduce the effects on survey estimates of the sampling frame's undercoverage of rural areas.

L.2.2 Selection of Main-Survey Address Sample

The sampling unit for the address sample will be an individual address. We plan to subject to sampling all residential addresses on the MSG database, including post office boxes, throwbacks, vacant addresses, and seasonal addresses. Following the selection of the address sample, we will use the AUTOMATCH computer program to compare the address sample with the addresses of telephone numbers assigned to the mailable stratum of the RDD sample. Addresses in both the address sample and the RDD sample will **not** be contacted by RDD telephone interviewers. (Telephone numbers assigned to the nonmailable stratum will not have addresses, so they cannot be tested for membership in the address sample.) Envelopes containing mailed questionnaires will be marked "Do Not Forward" so that address changes will not provide multiple opportunities for a household to be selected for the address sample.

The address sample will have two strata: one containing a high concentration of minority adults and the other containing a low concentration. Each address on the MSG database will be assigned to one of the two minority strata by an algorithm based on linking each address to a geographic **assignment area** for which MSG has demographic data by race and ethnicity. One possibility for the stratification algorithm is to use ZIP+4 Codes to link addresses to census block groups, for which MSG has Claritas-provided demographic data. Another possibility is to use ZIP Codes to link addresses to telephone exchanges, for which MSG also has associated Claritas-provided demographic data. The development of the stratification algorithm will be done in consultation with MSG data-product experts. For planning purposes, we are using telephone exchanges as assignment areas and defining the high-minority stratum as those addresses in ZIP Codes linked to telephone exchanges in which the black or Hispanic population proportion is 16 percent or greater.

An equal-probability sample of addresses will be selected from each sampling stratum. The high-minority stratum will be oversampled by 50 percent to increase the yield of blacks and Hispanics. For example, if 50 percent of all the addresses in the sampling frame were assigned to the high-minority stratum, the oversampling of the high-minority stratum would assign to the high-minority stratum 75 percent of the sample, rather than the population percentage of 50 percent.

Unlike the RDD sample, all adults in the household at a sampled address will be asked to complete a questionnaire. Hence, the mail sample is a stratified cluster sample, in which the household is the cluster. Our decision to not subsample the adults in sampled households is the result of an evaluation study conducted by Battaglia and colleagues (2005). This study compared three respondent-selection methods for household mail surveys: (1) any adult in the household, (2) the adult in the household having the next birthday, and (3) all adults in the household. The study found that the next birthday and all-adults methods yielded household-level completion rates that were comparable with the any-adult method, the method that the researchers assumed to have the least respondent burden. Another finding from this study was that differences in response rates by gender and age were less for the all-adults methods than for the next birthday and all-adults method.

Because we will be using the all-adults method to select respondents, two types of household-level nonresponse must be considered. One type of nonresponding household will be *within-household* nonrespondent—that is, a household in which some but not all adults in the household, complete the mail questionnaire. To handle this situation the mail questionnaire will include a question about the number of adults living in the household. The responses to this question, plus the number of

adults in the household that do respond, will be used to calculate a within-household sampling weight to be applied to the data provided by the household's respondents. The other type of nonresponding household will be an *entire-household* nonrespondent. A sample of entire-household nonrespondents will receive telephone followup using the RDD data collection protocol. Only one adult will be interviewed in the cooperating address sample of households assigned to telephone followup.

The target number of completed mail questionnaires is 3,500, and the target number of completed RDD questionnaires resulting from telephone followup is 457. Table L-4 contains the number of sampled addresses needed to obtain these targets and the planning assumptions we used to determine these results.

Table L-4. Address sample expected completions and telephone followup calls

	Total	High-minority stratum	Low-minority stratum
Number of sampled addresses	6,944	5,208	1,736
All-mailings household response rate	25%	25%	25%
Number of households responding to mail survey	1,736	1,302	434
Average number of adults per household	2.52	2.52	2.52
Within-household response rate	80%	80%	80%
Number of completed mail questionnaires	3,500	2,625	875
Number of households not responding to mail survey	5,208	3,906	1,302
Subsampling rate for telephone followup	70%	70%	70%
Number of households assigned to telephone followup	3,657	2,743	914
Screener response rate for telephone followup	25%	25%	25%
Extended response rate for telephone followup	50%	50%	50%
Number of completed telephone followup questionnaires	457	343	114
Number of completed mail + followup questionnaires	3,957	2,968	989
Design effect	1.6	1.20	1.20
Effective sample size	2,473	2,473	824

L.2.3 Effective Sample Sizes by Domain of Interest

For HINTS 2007, the expected number of completed mail questionnaires is 3,500 and the expected number of completed telephone followup interviews is 457. The third to last row of Table L-4

contains the expected number of completed mailed questionnaires and telephone followup interviews by stratum (using telephone exchanges as assignment areas). The effective sample sizes in the last row of Table L-4 are smaller by a factor of 1.2. We expect an approximate design effect of 1.2 for the completed mailed questionnaires (due to within-household correlation and weighting adjustments for within-household nonresponse) and also for telephone followup (due to the selection of one adult within households that generates variable weights for adults for differing size households). Table L-5 contains estimates of the address sample's effective sample sizes by strata and analysis domains of interest.

Table L-5. Address-sample's effective sample sizes by stratum and analysis domains of interest

Stratum	Analysis domain	Proportion of population (%)	Proportion of stratum (%)	Expected completes	Effective sample size
Total	Hispanic	11.9		651	520
	Non-Hispanic black	12.2		665	528
	White and other race	75.9		2,641	1,425
	All	100.0		3,957	2,473
High minority	Hispanic	10.5	21.0	624	520
	Non-Hispanic black	10.6	21.4	634	528
	White and other race	28.7	57.6	1,711	1,425
	All	49.8	100.0	2,968	2,473
Low minority	Hispanic	1.4	2.8	27	23
	Non-Hispanic black	1.6	3.2	32	26
	White and other race	47.2	94.0	930	775
	All	50.2	100.0	989	824

L.3 Calculation of Weights for Composite Estimates

Domains are subsets of samples defined by respondent-provided data. Domain statistics estimate parameters for corresponding subpopulations. For example, data from respondents that indicate they are Hispanic are used to estimate parameters for the Hispanic subpopulation. We plan to include on the mail questionnaire a question about whether or not the respondent's household has one or more land-line telephone numbers that answers to conduct household telephone calls. The responses to this question and the mode of data collection define the following three *estimation domains*:

- **Noncallable Domain.** Address-sample respondents who complete the mail questionnaire and indicate their household does not have one or more land-line telephone numbers.

- **Address-Sample Overlap Domain.** Address-sample respondents who (1) complete a mail questionnaire and indicate that their household does have one or more land-line telephone numbers or (2) provide data via telephone followup.

- **RDD-Sample Domain.** RDD-sample respondents.

We will use the estimation domains to calculate weights for *composite estimates*—i.e., estimates based on data from both the RDD sample and the address sample. A composite estimate for a population totals combines estimated totals from the three estimation domains as follows:

$$\hat{T}_{composite} = \hat{T}_{NC}^{(address)} + \alpha\hat{T}_{overlap}^{(address)} + (1-\alpha)\hat{T}_{RDD}^{(RDD)},$$

where

$\hat{T}_{composite}$ = the composite estimate of a population total,

$\hat{T}_{NC}^{(address)}$ = the estimated total for the noncallable domain, calculated from address-sample data,

$\hat{T}_{overlap}^{(address)}$ = the estimated total for the address-sample overlap domain, calculated from address-sample data,

$\hat{T}_{RDD}^{(RDD)}$ = the estimated total for the RDD domain, calculated from RDD-sample data, and

α, called the *mixing parameter*, satisfies $0 < \alpha < 1$ and is chosen to minimize the variance of resulting composite estimates.

We will calculate composite weights so that composite estimates of totals can be calculated as weighted sums of the data from both the RDD sample and the address sample and composite estimates of means and proportions can be calculated as weighted totals divided by sums of composite weights. A four-step procedure will be used to calculate weights, with the results of each step denoted as follows:

w_s = sample-specific base weights
w_s' = sample-specific nonresponse-adjusted weights
w_c' = composite nonresponse-adjusted weights
w_c'' = composite calibration weights

The sample-specific base weight, w_s, for a respondent is the reciprocal of its probability of being included in a particular sample (i.e., RDD sample or address sample). The RDD-sample base weight for a respondent will be adjusted for multiple selection opportunities if the respondent's household has two or more land-line telephone numbers that it answers. Similarly, the address-sample base weight for a respondent will be adjusted for multiple selection opportunities if the respondent's household receives mail at two or more addresses, such as home delivery to a street address and a post office box. The sample-specific, nonresponse-adjusted weight, w_s', will be calculated by multiplying w_s by sample-specific, nonresponse adjustment factors calculated from counts of sampled units and responding units within nonresponse adjustment cells. The composite nonresponse-adjusted weight, w_c', will be calculated as follows:

- In the noncallable domain, $w_c' = w_s'$ (where w_s' is for the address sample).
- In the address-sample overlap domain, $w_c' = \alpha\, w_s'$ (where $0 < \alpha < 1$ and w_s' is for the address sample).
- In the RDD-sample domain, $w_c' = (1-\alpha)\, w_s'$ (where $0 < \alpha < 1$ and w_s' is for the RDD sample).

If we find that it is possible to assign RDD-sample respondents to their corresponding address-sample strata (e.g., if ZIP Code areas are assignment areas, and it is possible to link telephone exchanges to ZIP Code areas), then the value of α used for the high-minority stratum can differ from the value used for the low-minority stratum. If this is not possible, however, then the same value of α will be used for all respondents. The composite calibration weights, w_c'', will be calculated by modifying the nonresponse-adjusted calibration weights so they aggregate to control totals computed from the Current Population Survey, which has a much larger sample size than HINTS 2007.

Table L-6 contains the effective sample sizes by stratum for RDD-sample estimates, address-sample estimates, and composite estimates. For the composite estimates, Table L-7 contains the maximum standard errors of estimated proportions in the race/ethnicity domains of interest and the half-widths of the associated 95-percent confidence intervals.

Table L-6. Effective sample sizes for composite estimates by stratum

	High-minority stratum	Low-minority stratum
Proportion of adults with landline telephones*	93%	91%
Telephone-sample effective sample size	1,346	1,346
Address-sample effective sample size	2,473	824
Effective sample size for composite estimates for various mixing parameters:		
0.40	3,127	1,971
0.45	3,346	1,927
0.50	3,534	1,855
0.55	3,674	1,761
0.60	3,752	1,652
0.65	3,761	1,536
0.70	3,698	1,417

* Based on Blumberg, S.J., Luke, J.V., and Cynamon, M.L. (2006). Telephone coverage and health survey estimates: Evaluating the need for concern about wireless substitution. *American Journal of Public Health,* 96, 926-931.

Table L-7. Maximum standard errors and half-widths of associated 95-percent confidence intervals for composite estimates of proportions in race/ethnicity domains of interest

	Hispanics (%)	Non-Hispanic blacks (%)	Non-Hispanic whites and other races (%)	All adults (%)
Maximum standard error of estimated domain proportions for various mixing parameters*:				
0.40	1.90	1.87	0.85	0.89
0.45	1.85	1.83	0.85	0.86
0.50	1.82	1.80	0.85	0.84
0.55	1.80	1.78	0.87	0.82
0.60	1.80	1.78	0.89	0.82
0.65	1.81	1.80	0.91	0.82
0.70	1.84	1.83	0.95	0.82
Half-width of 95-percent of confidence intervals about estimated domain proportions for various mixing parameters:				
0.40	3.72	3.67	1.66	1.75
0.45	3.62	3.58	1.66	1.69
0.50	3.56	3.52	1.67	1.65
0.55	3.52	3.49	1.70	1.62
0.60	3.52	3.49	1.74	1.60
0.65	3.55	3.52	1.79	1.60
0.70	3.61	3.58	1.85	1.61

* Standard error when estimating stratum proportions equal to 50 percent.

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