

Chapter 2

SAMPLE DESIGN

Leyla Mohadjer, Joseph Waksberg, Huseyin Goksel, and James Green, Westat, Inc.

2.1 OVERVIEW

The National Adult Literacy Survey included the following three components: 1) a national household sample; 2) household samples from 11 states; and 3) a national sample of prison inmates.

The national and state household components were based on a four-stage, stratified area sample with the following stages: (1) the selection of primary sampling units (PSUs) consisting of counties or groups of counties, (2) the selection of segments consisting of census blocks or groups of blocks, (3) the selection of households, and (4) the selection of age-eligible individuals. A single area sample was drawn for the national component, and 11 additional state-level area samples were drawn for the state component (i.e., California, Illinois, Indiana, Iowa, Louisiana, New Jersey, New York, Ohio, Pennsylvania, Texas, and Washington).¹ The national and state samples differed in two important respects. In the national sample, Black and Hispanic individuals were sampled at a higher rate than the remainder of the population to increase their representation in the sample, whereas the state samples used no oversampling. Also, the target population for the national sample consisted of adults age 16 or older, whereas the target population for the state samples consisted of adults ages 16–64.

As noted above, the first stage of sampling for all 12 household samples involved the selection of PSUs, which consist of counties or groups of counties. The PSUs were stratified according to census region, metropolitan status, percentage of Black residents, percentage of Hispanic residents, and, whenever possible, per capita income. The national component used a 101-PSU sample. The national frame of PSUs was used to construct individual state frames for the state components, and a sample of 8 to 12 PSUs was selected within each of the 11 states. All PSUs were selected with a probability proportional to the PSUs' 1990 population.

For the second stage of sampling, segments (census blocks or groups of blocks) within the PSUs were selected with a probability proportional to size, where the measure of size for a segment was a function of the number of year-round housing units within the segment. The oversampling of Black and Hispanic persons for the national component was carried out at the segment level, where segments were classified as high minority (segments with more than 25 percent Black or Hispanic residents) or low minority. The measure of size for high-minority segments was defined as the number of White, non-Hispanic households plus three times the number of Black or Hispanic households. High-minority

¹ A state-level survey was later conducted in Florida, but the data are not included in this report.

segments were therefore oversampled at up to three times the rate of low-minority segments. As for all segments in the state components, the measure of size was simply the number of year-round housing units within the segment. One in seven of the national component segments was selected at random to be included in a “non-incentive” sample (see section 2.3 for more details). Respondents from the remaining segments in the national component received a monetary incentive for participation, as did all respondents in the state components. Data for respondents from the non-incentive segments were not included in the analyses reported by the National Center for Education Statistics, but are available as one of the three principal analysis files (household, prison, and non-incentive data).

For the third stage of sampling, the selection of households within segments, Westat field staff visited all selected segments and prepared lists of all housing units within the boundaries of each segment, as determined by the 1990 census block maps. The lists were used to construct the sampling frame for households. Households were selected with equal probability within each segment, except for White, non-Hispanic households in high-minority segments in the national component. These households were sub-sampled after screening, so that the sampling rates for White, non-Hispanic persons would be about the same in the high-minority segments as in other segments.

For the fourth stage of sampling, a list of age-eligible household members (age 16 or older for the national component, 16–64 for the state component) was constructed for each selected household. One person was selected at random from households with fewer than four eligible members, and two persons were selected at random from households with four or more eligible members. The interviewers were instructed to list the eligible household members in descending order of age. The interviewers then identified the one or two sample household members based on computer-generated sampling messages that had been attached to each questionnaire in advance.

The sample design for the prison component involved two stages of selection. For the first stage of sampling, state or Federal correctional facilities were selected with a probability proportional to size, where the measure of size for a facility was equal to the size of the inmate population. The second stage involved the selection of inmates within each facility. Inmates were selected with a probability inversely proportional to the size of their facility’s inmate population (up to 22 inmates in a facility). Table 2-1 provides the sample sizes for all stages of sampling for the national and state components of the National Adult Literacy Survey.

Section 2.2 provides a review of the four stages of sampling for the national component of the survey. A similar discussion of the state samples is presented in section 2.4. Section 2.5 presents weighted and unweighted response rates for the household component of the survey. Sections 2.3 and 2.6 describe the non-incentive sample design and the prison sample design, respectively.

Table 2-1. Sample sizes for the national and state components of the National Adult Literacy Survey

Component	Number of PSUs	Number of segments*	Number of households ⁺	Number of persons screened	Number of persons interviewed	Number of persons assessed
National and state incentive sample	210	3,733	43,783	30,806	24,944	22,107
National non-incentive sample	101	155	1,838	1,273	930	695
State samples**						
CA	20	405	4,917	3,371	2,665	2,143
IL	14	262	2,914	2,130	1,668	1,504
IN	15	215	2,361	1,755	1,441	1,368
IA	14	187	2,041	1,446	1,246	1,192
LA	10	188	2,270	1,460	1,192	1,087
NJ	16	243	2,790	1,821	1,317	1,111
NY	14	302	3,526	2,139	1,688	1,415
OH	17	246	2,691	1,984	1,568	1,510
PA	14	253	2,950	2,060	1,626	1,532
TX	16	316	3,833	2,681	2,209	1,834
WA	9	182	2,096	1,506	1,244	1,186

• The numbers include segments with at least one dwelling unit selected into the sample.

⁺ The numbers include the missed structures and units (refer to section 2.2.3.3) incorporated into the sample during the data collection.

** Numbers include the national sample cases in each state in addition to the individually selected state sample.

2.2 SAMPLING FOR THE NATIONAL COMPONENT

The target population for the national component of the National Adult Literacy Survey consisted of adults age 16 or older in the 50 states and the District of Columbia who, at the time of the survey (February through August, 1992), resided in private households or college dormitories.

The household component used a four-stage, stratified sample design. The first-stage sample was a sample of PSUs (counties or groups of counties) developed by Westat. In developing the sampling frame, the 3,141 counties and independent cities in the 50 states were grouped into 1,404 PSUs, from which a sample of 101 PSUs was selected for the household component. In the second stage of sampling, probability sampling was used to select a sample of 2,064 segments (census blocks or combinations of blocks) from the PSUs chosen during the first stage. The third stage of sampling involved the selection of 24,522 housing units from listings developed within the selected segments by the field listers. In the fourth

stage, age-eligible persons were chosen for interview and assessment from within selected households. The stages of sampling for the national component are described in greater detail in the following sections.

2.2.1 First-Stage Sample

The first-stage sample was a sample of PSUs (counties or groups of counties) developed by Westat.

2.2.1.1 Westat's master sample of PSUs

In selecting the master sample, Westat used the 1990 census Public Law 94-171 (PL94) data tape file as the source of information (total and minority population sizes for each county) for stratification as well as to determine PSU size. The income data were based on the 1988 per capita income reported by the Bureau of Economic Analysis.

In designing the Westat PSU sample, entire metropolitan statistical areas (MSAs) were treated as single PSUs; however, because of their size, the New York, Los Angeles, and Chicago MSAs were divided into three, two, and two PSUs, respectively. In New England, whole-county approximations of MSAs were used. Counties outside of MSAs were grouped to make PSUs (1) large enough to provide a sufficient sample size for most national surveys and (2) as internally heterogeneous as possible but still small enough that an interviewer could conveniently travel across the PSU. A total of 1,404 PSUs were constructed. All PSUs consisted of one or more contiguous counties, or contiguous counties and independent cities, and had minimum population sizes of 15,000. Additionally, all PSUs were completely contained within the boundaries of one of the four census regions.

Master sample PSUs were stratified on the basis of the social and economic characteristics of the population, as reported in the 1990 census. Strata were of roughly equal size; they did not cross regions, and a stratum did not include both metropolitan and non-metropolitan PSUs. The following characteristics were used in stratifying the Westat PSUs (some explicitly and some implicitly, by ordering the PSUs and sampling systematically):

- Region of the country (four census regions);
- Whether or not the PSU was an MSA;
- Percentage of Black residents;
- Percentage of Hispanic residents; and
- Average income.

2.2.1.2 Selecting the sample of PSUs for the national component

The sampling frame for the Westat PSU sample included Hawaii and Alaska, but neither of the Hawaii or Alaska counties were selected for the 100-PSU master sample. Honolulu MSA was added to the sample as the 101st PSU in the national sample. Westat adjusted the weights to correctly account for the inclusion of the Honolulu PSU in the sample.

Table 2-2 shows the distribution of the population in the 101 PSUs selected for the household component of the survey. The measure of size for each PSU was equal to the 1990 population of the PSU.

Twenty-five PSUs were included in the sample with certainty on the basis of their sizes. Then 38 strata of approximately equal size were formed. Two PSUs were selected (without replacement), with probability proportionate to size, from each of the 38 strata. Among the multiple-PSU strata, 26 were MSA strata and 12 were non-MSA strata.

Table 2-2. Proportion of U.S. population in PSUs selected for the national component by stratum type, total 1990 population, Black, and Hispanic

Stratum type	PSU sample	Total 1990		Black		Hispanic	
		Number	%	Number	%	Number	%
Certainty MSA	Total in frame	76,349,843	30.7	12,304,548	40.0	11,769,950	52.7
Non-certainty MSA	Total in frame	116,764,722	47.0	12,823,091	42.8	8,444,362	37.8
	Not in sample	75,474,068	30.4	8,115,899	27.1	5,387,275	24.1
	In 101-PSU sample	41,290,654	16.6	4,707,192	15.7	3,057,087	13.7
Non-certainty non-MSA	Total in frame	55,595,308	22.4	4,858,421	16.2	2,139,747	9.6
	Not in sample	54,058,657	21.7	4,742,122	15.8	2,072,580	9.3
	In 101-PSU sample	1,536,651	0.6	116,299	0.4	67,167	0.3
Grand total		248,709,873	100.0	29,986,060	100.0	22,354,059	100.0

Table 2-3 contains a listing of the 101 PSUs in the national sample (certainty PSUs are in bold).

Table 2-3. National Adult Literacy Survey 101-PSU sample

PSU	County and State	PSU	County and State
101	Boston, MA Essex Middlesex Norfolk Plymouth Suffolk	111	Buffalo, NY Erie
102	Pittsfield, MA Berkshire	112	Bergen/Passaic, NJ Bergen Passaic
103	Springfield, MA Hampden Hampshire	113	Newark, NJ Essex Morris Sussex Union
104	Providence, RI Bristol Kent Providence Washington	114	Monmouth/Ocean, NJ Monmouth Ocean
105	Newport, RI Newport	115	Atlantic City, NJ Atlantic Cape May
106	Nassau/Suffolk, NY Nassau Suffolk	116	Philadelphia, PA/Camden, NJ Burlington, NJ Camden, NJ Gloucester, NJ Bucks, PA Chester, PA Delaware, PA Montgomery, PA Philadelphia, PA
107	Kings/Richmond, NY Kings Richmond	117	Scranton/Wilkes-Barre, PA Columbia Lackawanna Luzerne Monroe Wyoming
108	New York/Queens, NY New York Queens	118	Harrisburg, PA Cumberland Dauphin Lebanon Perry
109	Bronx/Putnam, NY Bronx Putnam Rockland Westchester	119	Pittsburgh, PA Allegheny Fayette Washington Westmoreland
110	Rochester, NY Livingston Monroe Ontario Orleans Wayne		

Certainty PSUs are in bold.

Table 2-3. 101-PSU sample – Continued

PSU	County and State	PSU	County and State
120	Butler, PA Butler Lawrence	209	Indianapolis, IN Boone Hamilton Hancock Hendricks Johnson Marion Morgan Shelby
201	Steubenville, OH (Weirton,WV) Jefferson		
202	Youngstown/Warren, OH Mahoning Trumbull	210	Gary/Hammond, IN Lake Porter
203	Akron, OH Portage Summit	211	Chicago, IL (CITY) Chicago City
204	Cleveland, OH Cuyahoga Geauga Lake Medina	212	Cook/DuPage/McHenry, IL (Chicago) Cook DuPage McHenry
205	Cincinnati, OH/Dearborn, IN (Covington, KY) Dearborn, IN Clermont, OH Hamilton, OH Warren, OH	213	Aurora/Elgin, IL Kane Kendall
206	Saginaw/Bay City/Midland, MI Bay Midland Saginaw	214	Knox/Mercer, IL Knox Mercer
207	Detroit, MI Lapeer Livingston Macomb Monroe Oakland St. Clair Wayne	215	Peoria, IL Peoria Tazewell Woodford
208	Fountain/Montgomery/Putnam,IN Fountain Montomery Putnam	216	St. Louis, MO/E. St. Louis, IL Clinton, IL Jersey, IL Madison, IL Monroe, IL St.Clair, IL Franklin, MO Jefferson, MO St. Charles, MO St. Louis City, MO St. Louis, MO

Certainty PSUs are in bold.

Table 2-3. 101-PSU sample – Continued

PSU	County and State	PSU	County and State
217	Pike/Ralls, MO Pike Ralls	225	Atchison/Jackson/Jefferson, KS Atchison Jackson Jefferson
218	Howard/Saline, MO Howard Saline	301	Washington, D.C./MD/VA District of Columbia Calvert, MD Charles, MD Frederick, MD Montgomery, MD PrinceGeorges, MD Arlington, VA Fairfax, VA Loudoun, VA PrinceWilliam, VA Stafford, VA Alexandria City, VA Fairfax City, VA Falls Church City, VA Manassas, VA Manassas Park, VA
219	Milwaukee, WI Milwaukee Ozaukee Washington Waukesha	302	Wilmington, DE/Cecil, MD New Castle, DE Cecil, MD
220	Minneapolis/St. Paul, MN/WI Anoka, MN Carver, MN Chisago, MN Dakota, MN Hennepin, MN Isanti, MN Ramsey, MN Scott, MN St.Croix, MN Washington, MN Wright, WI	303	Baltimore,MD AnneArundel Baltimore County Baltimore City Carroll Harford Howard Queen Annes
221	Iowa City, IA Johnson	304	Weirton, WV (Steubenville, OH) Brooke Hancock
222	Monona, IA/Thurston, NE Monona, IA Thurston, NE	305	Charlottesville, VA Albemarle Fluvanna Greene Charlottesville City
223	Hall/Hamilton, NE Hall Hamilton	306	Norfolk/Virginia Beach, VA Gloucester James City York
224	Cheyenne/Rooks, KS Cheyenne Decatur Graham Rawlins Rooks Sheridan		

Certainty PSUs are in bold.

Table 2-3. 101-PSU sample – Continued

PSU	County and State	PSU	County and State
	Chesapeake City Hampton City Newport News City Norfolk City Poquoson Portsmouth City Suffolk City Virginia Beach City Williamsburg City	313	Nashville, TN Cheatham Davidson Dickson Robertson Rutherford Sumner Williamson Wilson
307	Johnson City, TN/Bristol, VA Carter, TN Hawkins, TN Sullivan, TN Unicoi, TN Washington, TN Scott, VA Washington, VA Bristol City, VA	314	Chattanooga, TN/Dade, GA Catoosa, GA Dade, GA Walker, GA Hamilton, TN Marion, TN Sequatchie, TN
308	Covington, KY (Cincinnati, OH) Boone Campbell Kenton	315	Atlanta, GA Barrow Butts Cherokee Clayton Cobb Coweta DeKalb Douglas Fayette Forsyth Fulton Gwinnett Henry Newton Paulding Rockdale Spaulding Walton
309	Fort Knox, KY Breckinridge Grayson Meade		
310	Greensboro/Winston-Salem NC Davidson Davie Forsyth Guilford Randolph Stokes Yadkin		
311	Albemarle, NC Montgomery Stanly	316	Greene/Lincoln, GA Greene Lincoln Oglethorpe Wilkes
312	Fayetteville, NC Cumberland	317	Wheeler/Toombs, GA Montgomery Toombs

Certainty PSUs are in bold.

Table 2-3. 101-PSU sample – Continued

PSU	County and State	PSU	County and State
	Treutlen Wheeler	328	Muskogee/McIntosh, OK McIntosh Muskogee
318	Tallahassee, FL Gadsden Leon	329	Dallas, TX Collin Dallas Denton Ellis Kaufman Rockwall
319	Tampa/St. Petersburg, FL Hernando Hillsborough Pasco Pinellas	330	Anderson TX Anderson
320	Orlando, FL Orange Osceola Seminole	331	Austin, TX Hays Travis Williamson
321	Miami/Ft. Lauderdale, FL Broward Dade	332	San Antonio, TX Bexar Comal Guadalupe
322	Birmingham, AL Blount Jefferson St. Clair Shelby Walker	333	Houston, TX Fort Bend Harris Liberty Montgomery Waller
323	Dothan, AL Dale Houston	334	Big Spring, TX Howard
324	Meridian, MS Lauderdale Newton	401	Seattle, WA King Snohomish
325	Franklin/Madison, AR Franklin Madison	402	Portland, OR Clackamas Multnomah Washington Yamhill
326	Pope, AR Pope	403	Missoula, MT Missoula
327	Shreveport, LA Bossier Caddo		

Certainty PSUs are in bold.

Table 2-3. 101-PSU sample – Continued

PSU	County and State	PSU	County and State
404	Boise City, ID Ada	413	Los Angeles/Long Beach, CA Los Angeles
405	Elmore/Twin Falls, ID Elmore Twin Falls	414	Anaheim/Santa Ana, CA Orange
406	Sacramento, CA El Dorado Placer Sacramento Yolo	415	San Diego, CA San Diego
407	San Francisco/Oakland, CA Alameda Contra Costa Marin San Francisco San Mateo	416	Douglas/Storey/Carson City, NV Douglas Storey Carson City
408	San Jose, CA Santa Clara	417	Las Vegas, NV Clark
409	Merced, CA Merced	418	Phoenix, AZ Maricopa
410	Fresno, CA Fresno	419	Tucson, AZ Pima
411	Riverside/San Bernardino, CA Riverside San Bernardino	420	Cibola/Valencia, NM Cibola Valencia
412	Los Angeles City, CA Los Angeles City	421	Boulder, CO Boulder
		422	Honolulu, HI

Certainty PSUs are in bold.

2.2.2 Second-Stage Sample—Selecting Census Blocks (Segments)

Within each PSU, area segments consisting of census blocks (or combinations of two or more adjacent census blocks) were selected with probability proportionate to size. A total of 2,064 segments were chosen, an average of 21 per PSU. The frame for defining and sampling segments was the 1990 PL94 data.

The sample design requirements called for an average cluster size of about seven interviews (i.e., an average of about seven completed background interviews per segment). The sample of housing units within each segment was designed to account for attrition. Attrition was expected because, according to figures obtained from the 1990 census, approximately 10 percent of the housing units were probably vacant. Additionally, we expected a 10 percent screener refusal rate and a 15 percent background

questionnaire refusal rate. The sample of housing units selected within each segment was thus made equal to 11. In addition, a reserve sample of approximately 5 percent of the size of the main sample was selected and set aside in case of shortfalls due to unexpectedly high vacancy and nonresponse rates.

2.2.2.1 Measures of size and sampling rates

Standard texts on sampling discuss measure of size in multistage designs for household surveys only in univariate situations. In effect, they describe how the total population can be used as the measure of size when sampling areas with probability proportionate to size, followed by sampling within each area at a rate proportionate to the reciprocal of the measure of size. A sample selected in this way has two desirable properties: (1) it is a self-weighting sample (i.e., all households are selected at the same rate), and (2) the interviewer workloads are approximately the same in all areas. The second property provides operational efficiency and results in lower variances than designs with variable workloads.

The national sample design modified and adapted the theory for multivariate situations by establishing a measure of size that produced constant workloads among segments and, at the same time, produced constant (but separate) sampling rates for minorities and non-minorities within each of two strata. The following is a description of the derivation of measures of size for this survey.

One of the requirements of the national design was to sample Black and Hispanic adults at a higher rate than the remainder of the population. Segments where 25 percent or more of the population consisted of Black and Hispanic adults were oversampled at a rate up to three times that of the remainder of the segments.

The housing unit counts served as the measure of size for the low-minority segments (segments with less than 25 percent Black or Hispanic households). In high-minority segments, the measure of size was equal to the number of White, non-Hispanic households plus three times the number of Black and Hispanic households. In low-minority segments, the measure of size of a segment was equal to the number of households in the segment.

$$MOS_{2ij} = H_{Oij} + H_{Mij} \quad (1)$$

where

- MOS_{2ij} = measure of size for the ij^{th} segment in the low-minority stratum.
- H_{Oij} = number of “other” (i.e., non-minority) households in the j^{th} segment in the i^{th} PSU; and
- H_{Mij} = number of minority (Black plus Hispanic) households in the j^{th} segment in the i^{th} PSU;

In high-minority segments, the measure of size was equal to

$$MOS_{1ij} = H_{Oij} + 3H_{Mij},$$

where

$$MOS_{1ij} = \text{measure of size of the } ij^{\text{th}} \text{ segment in the high-minority stratum (the minority stratum is defined as segments in which the Black plus Hispanic population is 25 percent or more of the total population).}$$

The sampling interval, I, was computed as

$$I = \frac{\sum_{1_{ij}} MOS_{1ij}/P_i + \sum_{2_{ij}} MOS_{2ij}/P_i}{2064} \quad (2)$$

where

$$P_i = \text{probability of selection of the } i^{\text{th}} \text{ PSU.}$$

The segment selection probability in the i^{th} PSU was thus $\frac{MOS_{1ij}}{IP_i}$ for high-minority segments and $\frac{MOS_{2ij}}{IP_i}$

for low-minority segments. It should be noted that the overall segment selection probability was independent of P_i .

2.2.2.2 Minimum segment size

The screening sampling rate within a segment was $11/MOS_{2ij}$ (in low-minority segments) and $33/MOS_{1ij}$ (in high-minority segments). Thus, in the low-minority stratum

$$H_{Oij} + H_{Mij} \geq 11. \quad (3)$$

In the high-minority stratum

$$H_{Oij} + 3H_{Mij} \geq 33. \quad (4)$$

or

$$H_{Oij}/3 + H_{Mij} \geq 11. \quad (5)$$

The actual segment sizes had to be 11 households in low-minority areas, 11 households in high-minority areas with 33 percent minorities, and 22 households in segments with 25 percent minorities.

2.2.2.3 Segment sample selection

The first step in sampling segments was to extract block data from the PL94 file for the 101 PSUs in the sample. In the next step, blocks containing fewer than the minimum number of housing units required to select the third-stage sample were combined with other adjacent or nearby blocks to form the segments that served as second-stage sample units. Segments were sorted within each PSU according to the proportion of Black and Hispanic residents.² A systematic sample of segments was then selected with probability proportional to size. The systematic selection provided implicit stratification according to the proportion of minority residents in the segments. The sample of 2,064 segments included 869 high-minority and 1,195 low-minority segments.

2.2.2.4 TIGER maps

The National Adult Literacy Survey was one of the first sample surveys nationwide to use the Bureau of the Census's Topologically Integrated Geographical Encoding and Referencing (TIGER) System file for the production of segment maps. Segment maps are essential features of an area sample; they define and describe the sample segments, permitting field interviewers to locate the areas and list the housing units within the segments. In the past, segment maps were produced by hand, with clerks outlining the segments manually on maps purchased from the Census Bureau. This operation was slow, costly, and somewhat error-prone. The maps were of diverse sizes, resulting in problems of filing and storage. Street names were difficult to read on many of the maps.

The Census Bureau produced a system known as the TIGER file for the implementation of the 1990 census. The TIGER file digitized all intersections of geographic boundaries used in the 1990 census, including individual blocks. This information can be used to computer generate maps of selected blocks, combinations of blocks, or any other type of geography referred to in the census. Before the National Adult Literacy Survey began, Westat purchased a copy of the TIGER file and software to generate maps from the file and then developed additional software to facilitate its use for sample survey purposes. In the completely automated sampling process, sample blocks were selected from census summary tapes, and the block identifications were automatically fed into the TIGER file, which in turn generated the segment maps. This method of map production cost considerably less than the old method, was more accurate, and was much faster to implement. Because Westat developed much of the software, other useful features were included in the segment maps. For example, the maps were uniform in size, had sufficient detail to permit

² A serpentine sort executes multiple sorts within a stratum such that bordering sample units are the most similar with respect to the sort variables. This is accomplished by reversing the sort order within the segment groups.

street names to be read, had convenient map numbers automatically inserted, included small-scale maps of larger areas, showed segment locations within broader areas, and included certain data (based on the 1990 census) for quality control.

2.2.2.5 Listing sample segments

Westat field staff visited each sample segment and prepared a list of all housing units within the boundaries of the segment. (A total of 142 large segments from the national sample were subdivided before listing, with one part, or “chunk,” selected at random for listing.) Table 2-4 provides the distribution of segments in the national sample, by segment size. As noted earlier in this section, segments consisted of census blocks or combinations of two or more adjacent blocks that could be accessed without crossing over census tract boundaries. Therefore, if the segments did not contain enough households to reach the minimum size established for that type of segment (see section 2.2.2.2), the measure of size was considered to be equal to the minimum measure of size.

Table 2-4. Distribution of segments in the national sample, by segment size*

Dwelling units	Frequency	Percent	Cumulative frequency	Cumulative percent
0-19	8	0.4	8	0.4
20-29	1	0.0	9	0.4
30-39	12	0.6	21	1.0
40-49	35	1.7	56	2.7
50-59	100	4.8	156	7.6
60-69	282	13.7	438	21.2
70-79	264	12.8	702	34.0
80-89	196	9.5	898	43.5
90-99	129	6.2	1,027	49.8
100-119	211	10.2	1,238	60.0
120-149	208	10.1	1,446	70.1
150-199	186	9.0	1,632	79.1
200-249	102	4.9	1,734	84.0
250-299	103	5.0	1,837	89.0
300-399	168	8.1	2,005	97.1
400-499	51	2.5	2,056	99.6
500-699	7	0.3	2,063	100.0
700-799	1	0.0	2,064	100.0

* The frequencies reported in this table are the actual numbers of dwelling units listed in the selected segments. Large segments were subdivided and one section was selected at random for listing.

2.2.3 Third-Stage Sample—Selecting Housing Units

The third stage of sampling for the national component involved sampling households within the selected segments. After selection, households were screened to determine whether they included any eligible respondents. In the low-minority segments, any household with at least one person age 16 or older was included in the sample. In the high-minority segments, all minority households with at least one person age 16 or older were retained in the sample, but only one-third of nonminority households (with at least one person age 16 or older) were included in the sample.

2.2.3.1 Within-segment sampling rate

The sampling rates within the low-minority segments were set to produce an average of 11 housing units per segment. In high-minority segments, the average was about 14 housing units. White, non-Hispanic households in high-minority segments were sub-sampled at a rate of about one-third, so that White, non-Hispanic adults from high-minority segments had the same overall sampling rate as those residing in low-minority segments. The within-segment sampling rate (i.e., the household sampling rate) in low-minority segments was

$$r_{2ij} = \frac{11}{MOS_{2ij}} \quad (6)$$

In high-minority segments, the sampling rate was

$$r_{1ij} = \frac{33}{MOS_{2ij}} \text{ for minority households} \quad (7)$$

$$r_{2ij} = \frac{11}{MOS_{1ij}} \text{ for other households.} \quad (8)$$

If the number of housing units in the selected segments was the same in 1992 as in 1990, the number of selected households that remained in the sample for interview would be constant across all segments; that is, if in low-minority segments the number of households in segment ij was equal to $H_{Oij} + H_{Mij} = MOS_{2ij}$, the sample size was equal to

$$\frac{11}{MOS_{2ij}} \times (H_{Oij} + H_{Mij}) = 11. \quad (9)$$

In high-minority segments, the sample size was equal to

$$n_o = \frac{11}{MOS_{lij}} \times H_{Oij} = \frac{11 H_{Oij}}{H_{Oij} + 3H_{Mij}} \quad (10)$$

$$n_M = \frac{33}{MOS_{lij}} \times H_{Mij} = \frac{33 H_{Mij}}{H_{Oij} + 3H_{Mij}}$$

$$n_o + n_M = \frac{11 (H_{Oij} + 3H_{Mij})}{H_{Oij} + 3H_{Mij}} = 11$$

where

n_o is the number of non-minority households selected in a high-minority segment;

n_M is the number of minority households selected in a high minority segment.

The segment sizes would thus be constant, equal to 11.

However, segment sizes for the screening sample varied in the high-minority stratum. The screening sample in each segment was the rate at which minorities were selected. The sampling yield for the screening sample was thus MOS

$$\frac{33}{MOS_{lij}} (H_{Oij} + H_{Mij}) = \frac{33}{H_{Oij} + 3H_{Mij}} (H_{Oij} + H_{Mij}) \quad (11)$$

$$= 11 \left[\frac{H_{Oij} + 3H_{Mij}}{H_{Oij} + 3H_{Mij}} + \frac{2H_{Oij}}{H_{Oij} + 3H_{Mij}} \right]$$

$$= 11 \left[1 + \frac{2H_{Oij}}{H_{Oij} + 3H_{Mij}} \right]$$

$$= 11 \left(1 + \frac{\frac{2H_{Oij}}{MOS_{lij}}}{\frac{H_{Oij}}{MOS} + \frac{3H_{mij}}{MOS_{lij}}} \right)$$

Since the cut-off point for the high-minority strata was 25 percent minorities, the proportion of minorities in a segment from a high-minority stratum ranged from 25 percent to 100 percent. Putting those values in the formula above gives a range for the screening sample of 11 to 22 households.

In the national sample, 24,522 households were selected. The following table provides the distribution of the selected households by census region.

Census region	Number of households
Northeast	4,676
Midwest	5,051
South	9,340
West	5,455
Total	24,522

2.2.3.2 Overall probabilities of selection

The overall probability of selection of households in low-minority segments was

$$P_2 = P_i \frac{MOS_{2ij}}{IP_i} \frac{11}{MOS_{2ij}} = \frac{11}{I} \quad (12)$$

In high-minority segments, the overall probability of selection for nonminority households was equal to

$$P_{2i} = P_i \frac{MOS_{1ij}}{IP_i} \frac{33}{MOS_{1ij}} \frac{1}{3} = \frac{11}{I} \quad (13)$$

where I is the sampling interval.

For minority households in high-minority segments, the overall probability was

$$P_{1i} = P_i \frac{MOS_{1ij}}{IP_i} \frac{33}{MOS_{1ij}} = \frac{33}{I} \quad (14)$$

2.2.3.3 Procedures for selecting missed structures and missed dwelling units

Entire structures may have been omitted from the initial segment listing, either because the lister made an error or because the structure was constructed in the interval between listing and interviewing.

Additionally, listers may have missed dwelling units within a listed structure because they were instructed not to inquire about the number of units in most residential buildings in order to reduce listing costs.

Instead, listers were told to list a structure that looked like a one-family residence as a one-family

residence. However, a smaller number of buildings that looked like one-family residences may have been converted to multi-family residences. To compensate for this problem and identify missed households, Westat instructed interviewers to conduct two quality control procedures at the time of data collection. These procedures are described below.

Missed Structure Procedure. If the first dwelling unit on the completed listing sheet was selected for the sample, a segment canvass to search for missed structures was conducted. If any missed structures were found, the dwelling units within each missed structure were selected if the number of units within the structure was less than or equal to 10. If the number of units was greater than 10, 10 dwelling units were selected at random.

Missed Dwelling Unit Procedure. If the first (or only) dwelling unit on the completed listing sheet was selected for the sample, the interviewer inquired at the sample unit about any additional units in the building. If any missed dwelling units were found, then all missed units were selected if the number of missed dwelling units within the structure was less than or equal to 10. If the number of missed dwelling units within the structure was greater than 10, all missed units were listed and a sample was selected from the listing.

The increase in the total number of assessments and the effects of differential weights were considered when determining the probabilities with which to select these dwelling units. The overall goal was to control the increase in the total number of assessments within a segment so that no more than (approximately) double the number of persons originally expected were selected in a segment.

2.2.4 Fourth-Stage Sample—Selecting Persons Age 16 or Older

A list of household members was obtained during the screener interview conducted at each sample household. Interviewers listed the household members in descending order of age. A computer-generated sampling message attached in advance to each questionnaire contained instructions on which household members to choose for an interview. The following table illustrates a typical sampling message:

Number of eligible persons in household	Choose the following person for interview
1	First
2	Second
3	Second
4	First and third
5	First and fifth
6	Third and sixth
Etc.	

Because the sampling messages varied from household to household, each household member had the same chance of selection within each size of household group. One adult was sampled randomly from households with fewer than four eligible persons. In households with four or more eligible persons, two adults were selected. The selection of two adults in households with four or more eligible persons prevented a substantial increase in variances due to high weights resulting from the selection of one person in households with large numbers of eligible persons.

Because non-Black, non-Hispanic persons were undersampled in segments designated as high minority, each individual was classified into a race/ethnicity class during the screening interview so that the subsampling procedure for non-Black, non-Hispanic persons could be implemented. Because most U.S. households contain persons of the same race/ethnicity group, a race/ethnicity category was also assigned to each household and the subsampling procedure was carried out based on the race/ethnicity of the household. The household classification was based on the race/ethnicity of the person designated as the head of household, defined as the person who owns or rents the dwelling unit. If the screener respondent could not identify a head of household, the race/ethnicity of the first person listed on the household roster was used as the race/ethnicity of the household. This procedure made the sample screening and selection less complicated and reduced the chance of sample selection errors during the data collection.

The subsampling of nonminority households in high-minority segments was carried out using a sampling message that was attached to the questionnaires for a randomly selected two-thirds of the households in high-minority segments.

2.3 THE NON-INCENTIVE SAMPLE

At the request of the Office of Management and Budget, a subsample of segments was selected to produce about 1,000 completed interviews with respondents who were not offered the \$20 incentive. A field test experiment carried out before the main survey showed lower response rates for the non-incentive group than for those who received incentives. The lower response rates were taken into account when selecting the segment sample for the non-incentive experiment.

A subsample of 155 segments was selected randomly from the 2,064 segments in the national sample, including 65 high- and 90 low-minority segments. This subsample contained 1,812 households and was expected to yield approximately 1,000 completed interviews with respondents who received no incentives.

The role of incentives is discussed in more detail in Chapter 10 of this report.

2.4 SAMPLING FOR THE STATE LITERACY SURVEYS

The National Adult Literacy Survey provided an opportunity for state officials to request that supplementary adult literacy surveys be conducted within their states, to provide state-level estimates of adult literacy skills that are reliable, valid, and comparable to national estimates. A sample of about 1,000

interviewed persons was used to supplement the national sample in each of the 11 states participating in the program. This sample size was estimated to be sufficient to provide adequate precision for most anticipated analyses.

Participants in the state component were selected through a process nearly identical to that used for the national component, where the units at each stage of sample selection represented a particular state rather than the entire United States. The two principal differences between the sample designs for the national and the state surveys were that (1) Black and Hispanic adults were not oversampled in the state surveys and (2) the respondent universe consisted of adults ages 16–64 (vs. adults age 16 and older for the national survey).

2.4.1 Sample of PSUs

The first-stage primary sampling units, or PSUs, for a state consisted of geographic clusters of one or more adjacent counties within the state. With a few exceptions, the PSUs were identical to those used in the national sample. The exceptions were the national PSUs that crossed state boundaries, which were subdivided for the state sample. Each PSU was assigned to a stratum (i.e., groups of PSUs with similar characteristics) and one PSU was selected within each stratum. The following characteristics were used to stratify the PSUs: whether the PSU was within an MSA as defined for the 1990 census; the percentage of the population in the PSU who were Black and/or Hispanic; and the population size of the PSU. Per capita income was also used wherever possible. In some states, the number of strata that could be created precluded the effective use of all four stratifying characteristics.

One PSU was selected from each stratum with a probability proportional to the PSU’s 1990 population. The number of sample PSUs per state varied from 8 to 12, with smaller numbers of PSUs in states with one or more very large PSUs that were chosen with certainty.

2.4.2 Sample of Segments

The second-stage sampling units consisted of census blocks or groups of blocks within the selected PSUs. Adjacent blocks were combined whenever necessary to ensure that each segment had a minimum of 20 housing units per segment. In each state, 167 segments were selected across the PSUs. The selection was systematic and with probability proportional to size, where the measure of size was the number of year-round housing units within the segment.

The sampling interval for the selection of segments, I , was computed as

$$I = \frac{\sum_{ij} \text{MOS}_{2ij}/P_i}{167} \quad (15)$$

where

MOS_{2ij} = the measure of size for the j^{th} segment in the i^{th} PSU
(note that this is equivalent to the low-minority segment measure of size
in the national component) and

P_i = probability of selection of the i^{th} PSU.

The PL94 data tapes from the 1990 census were used to define the segments within each PSU. Segments were stratified according to the percentage of minority (Black and Hispanic) residents before selection.

2.4.3 Sample of Housing Units

The third stage of sampling involved the selection of households within segments. Westat field staff visited the 167 selected segments and prepared a list of all housing units within the boundaries of each segment. Segment boundaries were determined by the 1990 census block maps (i.e., the TIGER maps). The segment listings were sent to Westat, where a sample of about 11 housing units was selected per segment. Interviewers visited these housing units, determined which were occupied, and obtained a roster of household members. The same quality control procedures as in the national sample were used to compensate for missed structures and missed dwelling units within listed structures.

2.4.4 Sample of Persons

One or two adults ages 16–64 were selected from the list of household members obtained during the household screening. The selection procedure was similar to the one used in the national sample. One person was selected at random from households with fewer than four eligible members; two persons were selected from households with four or more eligible persons. Interviewers listed the eligible household members in descending age order. The interviewers then identified the one or two household members for interview based on computer-generated sampling messages that had been attached to each questionnaire in advance.

2.5 WEIGHTED AND UNWEIGHTED RESPONSE RATES

Unweighted response rates are indicators of how well the survey operations were carried out. They are useful during the survey as part of the quality control process and at the completion of field work as a measure of success. However, weighted response rates are more appropriate in examining the potential effect of nonresponse on statistics. Because the literacy estimates are based on weighted data, weighted response rates are better clues to potential data quality problems. Table 2-5 provides the weighted and unweighted response rates for the survey. Note that for the National Adult Literacy Survey the weighted and unweighted response rates are almost identical. Chapter 3 includes a detailed discussion of the weighting procedures used in the National Adult Literacy Survey.

Table 2-5. Screener, background questionnaire, and exercise booklet response rates for the National Adult Literacy Survey, by respondent characteristics for all sample types

Survey component and subgroup	Unweighted (%)	Weighted (%)*
Screener	89.1	--
Background questionnaire		
All respondents	81.0	80.5
Age		
16-24	85.0	85.5
25-44	82.8	82.3
45-64	78.7	78.1
65+	77.4	74.9
Sex		
Male	77.9	77.9
Female	83.5	82.7
Race/ethnicity		
Hispanic	81.7	82.3
Black, non-Hispanic	84.6	84.0
White and other	80.2	79.9
Exercise booklet		
All respondents	95.9	95.9
Age		
16-24	98.2	98.6
25-44	96.7	96.7
45-64	94.6	94.5
65+	89.0	
Sex		
Male	95.7	95.6
Female	96.0	96.2
Race/ethnicity		
Hispanic	95.0	95.4
Black, non-Hispanic	94.3	94.8
White and other	96.3	96.1
Education level		
Some or no high school	94.0	93.9
High school graduate/GED**	95.4	95.3
Some college or vocational education	96.7	97.0
College graduate or advanced degree	97.1	97.0

* The weighted response rates were calculated by applying the sampling weight to each individual to account for his/her probability of selection into the sample. Weighted response rates were computed only for screened households (the probability of selection is not known for persons in households that were not screened).

** GED = General Educational Development certificate

2.6 SAMPLING FOR THE PRISON SURVEY

For the survey of the prison population, background interviews were completed with 1,147 persons. The survey used a two-stage sample design. The first-stage unit, or PSU, was a state or Federal adult correctional facility selected with probability proportional to size, where the measure of size was the size of the inmate population. The second-stage unit was an inmate within a sample facility. Inmates were selected with a probability inversely proportional to the facility's population size, so that the product of the first- and second-stage selection probabilities would be constant. The selection rates were designed to produce an average of about 12 assessments per facility. In practice, this number varied because of differences between the anticipated and actual sizes of the inmate populations.

Although the sample design was intended to provide a constant overall probability of selection across all inmates, inmate selection probabilities were lowered in a few facilities because of operational constraints. In facilities with high rates of population growth, the sample size to yield a constant selection probability exceeded the maximum allowable number of interviews (22). Because the sample sizes in these facilities had to be truncated to 22, the overall selection probabilities were lower. Sections 2.6.1 and 2.6.2 describe the procedures for selecting correctional facilities and inmates, respectively.

2.6.1 Sample of Correctional Facilities

In the first stage of sampling, a sample of Federal and state adult correctional facilities was selected. The correctional units in multi-location facilities were sub-sampled, and one correctional unit was selected from each multi-location facility. It was estimated that, with a sample of approximately 15 inmates from each facility, a maximum of 96 facilities would be necessary to produce the required number of completed background interviews (1,000). This estimate was based on the assumptions that approximately 80 of 96 facilities (83 percent) would cooperate and that, on average, interviews would be completed with approximately 12 to 13 inmates in each of the cooperating facilities. However, early successes in gaining the cooperation of selected facilities indicated that response rates much higher than the anticipated 83 percent were likely. Therefore, a random subsample of eight facilities was deselected and set aside as a reserve sample. Of the 88 facilities selected for data collection, 87 (one of which was discovered to be two facilities) agreed to cooperate, and one facility was determined to be ineligible. The gain of one facility offset the loss of one facility due to ineligibility, making the number of eligible facilities 88. Therefore, it was not necessary to use the reserve sample.

2.6.1.1 Sampling frame and selection of correctional facilities

The sampling frame for the correctional facilities was based on the 1990 census of Federal and state prisons. The data in the frame were updated to mid-1991. State adult correctional and Federal adult correctional facilities were extracted from the census file.³

³The youth offender facilities is a category under the state adult prisons.

The sample of correctional facilities was drawn from the correctional facilities frame. The facilities in the frame were stratified on the basis of their characteristics using implicit stratification. That is, the facilities were placed in a sort order according to these characteristics and were selected systematically.

The following variables were used in the sort:

- 1) State or Federal;
- 2) Region: Northeast, Midwest, South, West;
- 3) Sex of inmates: male only, both sexes, female only; and
- 4) Type of facility:
 - a) For state facilities, the categories in the sort order were maximum and closed security; medium security; minimum security; classification, diagnostic, and reception center; medical facility and hospital; work-release/prerelease; and youthful offender facility.
 - b) For Federal facilities, the categories in the sort order were U.S. penitentiary, Federal correctional institution, federal prison camp, metropolitan correctional center, federal detention center, metropolitan detention center, federal medical center, community correctional center, and other.

The facilities were sorted first according to whether they were federal or state facilities; then by region, inmate gender composition within region, and type of facility within inmate gender composition; and, finally, by the size of the facility's inmate population within type of facility. A serpentine sort order was used for the last three variables. That is, the direction of the sort for inmate gender composition alternated between region categories, and the direction of the sort for type of facility alternated between inmate gender composition categories.

From this sorted list, the sample of facilities was drawn by taking a systematic sample with probabilities proportional to the number of inmates in the facility. The number of inmates in a facility was taken as its measure of size. The reserve sample of eight facilities was drawn by taking a systematic sample, with equal probabilities of selection, from the 96 sample facilities.

Table 2-6 shows the numbers of correctional facilities in the sample (excluding the reserve units), as well as facilities and inmates in the sampling frame, by stratification variables.

Table 2-6. Number of facilities and inmates included in the survey of the prison population, by stratification variables*

Stratification variable	Sample		Sampling frame			
	Facilities		Facilities		Inmates	
	Number	%	Number	%	Number	%
Facility Type						
Total	88	100.0	1,345	100.0	712,141	100.0
State	81	92.0	1,250	92.9	654,646	91.9
Federal	7	8.0	95	7.1	57,495	8.1
State Facilities						
Total	81	100.0	1,250	100.0	654,646	100.0
Region						
Northeast	14	17.3	195	15.6	117,221	17.9
Midwest	18	22.2	264	21.1	141,988	21.7
South	30	37.0	546	43.7	249,705	38.1
West	19	23.5	245	19.6	145,732	22.3
Facility type						
Maximum security	24	29.6	186	14.9	197,230	30.1
Medium security	37	45.7	392	31.4	298,380	45.6
Minimum security	10	12.3	334	26.7	83,909	12.8
Classification, Diagnostic, and Reception center	4	4.9	43	3.4	32,896	5.0
Medical facility	1	1.2	3	0.2	7,653	1.2
Work-release	3	3.7	265	21.2	20,505	3.1
Pre-release center						
Youthful offender Facility	2	2.5	27	2.2	14,073	2.1
Sex of inmates						
Male only	73	90.1	1,027	82.2	584,539	89.3
Both sexes	5	6.2	117	9.4	43,183	6.6
Female only	3	3.7	106	8.5	26,924	4.1
Federal facilities						
Total	7	100.0	95	100.0	57,495	100.0
Region						
Northeast	1	14.3	13	13.7	8,339	14.5
Midwest	1	14.3	15	15.8	10,913	19.0
South	3	42.8	50	52.6	27,964	48.6
West	2	28.6	17	17.9	10,279	17.9

Table 2-6. Number of facilities and inmates included in the survey of the prison population, by stratification variables* – continued

Stratification variable	Sample		Sampling frame			
	Facilities		Facilities		Inmates	
	Number	%	Number	%	Number	%
Facility type						
U.S. penitentiary	1	14.3	6	6.3	7,360	12.8
Federal correctional Institution	3	42.9	32	33.7	29,865	51.9
Federal prison camp	3	42.8	34	35.8	11,373	19.8
Metropolitan correctional center	0	0.0	4	4.2	3,400	5.9
Federal detention center	0	0.0	6	6.3	1,648	2.9
Metropolitan detention center	0	0.0	1	1.0	867	1.5
Federal medical center	0	0.0	2	2.1	1,679	2.9
Community correctional center	0	0.0	7	7.4	787	1.4
Other	0	0.0	3	3.2	516	0.9
Sex of Inmates						
Male	6	85.7	72	75.8	47,281	82.2
Both sexes	1	14.3	19	20.0	8,808	15.3
Female	0	0.0	4	4.2	1,406	2.5

*Excludes reserve sample.

2.6.2 Selection of Inmates Within Facilities

An upper bound of 22 inmates per facility was used to determine the inmate sample sizes for the correctional facilities. This upper bound was dictated by the practical limits on interviewing a large number of inmates per facility. First, the expected inmate sample sizes for cooperating facilities were computed under a self-weighting design to yield a total of 1,500 inmates. If a facility's expected sample size exceeded 22, it was truncated to 22, and the sample sizes for the other facilities were inflated to yield a total expected inmate sample of 1,500. This iterative process continued until there was no facility with an expected inmate sample size greater than 22, and the expected inmate sample sizes summed to 1,500 over all cooperating facilities.

Because of the uncertainty concerning inmate response rates and their availability for interview, the sample of facilities was randomly divided into two waves. The first wave included 30 percent of the facilities. The outcomes of wave 1 (in terms of response rates and inmate availability) were used to set the sampling rates for wave 2.

The selection of inmates was conducted within each facility using a list of names obtained from facility administrators. The interviewers received forms to complete and instructions that they were required to follow when sampling inmates from the lists.