

Appendix B. Sample Design and Weighting

SAMPLE AREAS

The 2004 American Housing Survey Metropolitan Sample (AHS-MS) provides information on 13 metropolitan areas interviewed as part of the American Housing Survey (AHS), which was conducted by the U.S. Census Bureau for the U.S. Department of Housing and Urban Development.

Table B-1. **AHS-MS Interview Schedule and Sample Base**

MS area	Last interviewed	Sample base
Atlanta, GA MSA	1996	1990
Cleveland, OH PMSA	1996	1990
Denver, CO PMSA	1995	1990
Hartford, CT MSA	1996	1990
Indianapolis, IN MSA	1996	1990
Memphis, TN-AR-MS MSA	1996	1990
New Orleans, LA MSA	1995	1990
Oklahoma City, OK MSA	1996	1990
Pittsburgh, PA MSA	1995	1990
St. Louis, MO-IL MSA	1996	1990
Sacramento, CA PMSA	1996	1990
San Antonio, TX MSA	1995	1990
Seattle-Everett, WA PMSA	1996	1990

Most of these metropolitan areas in Table B-1 are consistent with the 1993 Office of Management and Budget (OMB) definitions of the metropolitan statistical area (MSA), consolidated metropolitan statistical area (CMSA), or primary metropolitan statistical area (PMSA) with the following exceptions:

- The Atlanta, GA MSA does not include Carroll County and Pickens County.
- The Cleveland, OH PMSA does not include Lorain County.
- The New Orleans, LA MSA does not include St. James Parish.

- The St. Louis, MO-IL MSA does not include Sullivan City in Crawford County, MO.

Interview Schedules

The Census Bureau collected 2004 AHS-MS data between May and mid-September 2004.

Due to budget constraints, the sample sizes for each 2004 metropolitan area were reduced. The resulting sample size is shown in Table B-2.

Table B-2. **Sample Size in the American Housing Survey Metropolitan Areas 2004**

2004 AHS metropolitan area	2004 sample size (after reduction)
Atlanta, GA MSA	5,019
Cleveland, OH PMSA	4,639
Denver, CO PMSA	4,776
Hartford, CT MSA	4,663
Indianapolis, IN MSA	4,733
Memphis, TN-AR-MS MSA	4,525
New Orleans, LA MSA	4,323
Oklahoma City, OK MSA	4,679
Pittsburgh, PA MSA	4,651
St. Louis, MO-IL MSA	4,629
Sacramento, CA PMSA	4,615
San Antonio, TX MSA	4,777
Seattle-Everett, WA PMSA	4,654

The sample size equals the sum of eligible and ineligible units shown in Table B-3.

Interview Activity

Table B-3 summarizes the interview activity for each of the 2004 metropolitan areas in this report series. The table provides the weighted response rate, the number of eligible units (comprised of completed interviews and noninterviews), and the number of units visited but ineligible for interview.

Table B-3. **Interview Activity for the 2004 AHS-MS Areas**

Metropolitan area	Weighted response rate (percent)	Eligible units			Ineligible units
		Total	Interviewed	Not interviewed	
2004 AHS-MS total	91	57, 862	52,450	5,412	2,821
Atlanta, GA MSA	93	4,768	4,419	349	251
Cleveland, OH PMSA	89	4,476	3,912	564	163
Denver, CO PMSA	92	4,669	4,241	428	107
Hartford, CT MSA	91	4,474	4,014	460	189
Indianapolis, IN MSA	94	4,524	4,229	295	209
Memphis, TN-AR-MS MSA	91	4,285	3,861	424	240
New Orleans, LA MSA	90	3,924	3,493	431	399
Oklahoma City, OK MSA	94	4,471	4,210	261	208
Pittsburgh, PA MSA	93	4,431	4,081	350	220
St. Louis, MO-IL MSA	95	4,328	4,079	249	301
Sacramento, CA PMSA	89	4,453	3,904	549	162
San Antonio, TX MSA	90	4,570	4,073	497	207
Seattle-Everett, WA PMSA	89	4,489	3,934	555	165

AHS-MS SAMPLE HOUSING UNITS

The sample housing units in the 2004 AHS-MS consisted of the following categories:

1. All sample housing units that were interviewed in the previous survey.
2. All sample housing units that were either Type A non-interviews (that is, units eligible to be interviewed) or Type B noninterviews (that is, units not eligible for interview at the time of the survey but which could become eligible in the future) in the previous survey. For a list of reasons for Type A and Type B noninterviews, see Appendix A for the definition of “Noninterview.”
3. All sample housing units selected from a listing of new residential construction building permits issued since the previous survey. This sample represented the housing units built in permit-issuing areas since the previous survey.
4. All sample housing units that were added since the previous survey in sample blocks from the nonpermit universe. This sample represented the housing built in non-permit-issuing areas since the previous survey.

Sample Selection

The Census Bureau initially grouped the housing units enumerated in the 1990 Census of Population and Housing into census blocks and assigned these blocks to either the unit/group quarters frame or the area frame, as follows:

1. Blocks located in an area that issued permits for new construction were assigned to the unit/group quarters frame.
2. All other blocks were assigned to the area frame.

The unit/group quarters frame was then split into the unit frame and the group quarters frame by removing all group quarters and placing them in a separate frame. In addition, to coordinate the National Health Interview Survey, (NHIS), the census blocks in the unit frame that contained sample units selected by NHIS were moved to the area frame.

All housing units that were built after the 1990 census in areas where construction of new homes was monitored by building permits were placed into a separate frame, called the permit frame.

Sampling operations for all frames were performed separately within a designated group of counties in each state. Prior to the AHS-MS sample selection, records selected by other Census Bureau surveys were removed from each of the frames to avoid having the same housing unit in sample for more than one survey. The Census Bureau selected the AHS-MS sample from the remaining records. Table B-4 presents the percentage of AHS-MS sample drawn from each frame.

Table B-4. **Percentage of 2004 AHS-MS Sample By Frame**

2004 AHS metropolitan area	Unit frame	Group quarters frame	Permit frame	Area frame
Atlanta, GA MSA	56.5	...	36.3	7.2
Cleveland, OH PMSA	79.7	...	7.2	13.1
Denver, CO PMSA	71.7	0.1	25.7	2.5
Hartford, CT MSA	82.1	0.6	11.1	6.2
Indianapolis, IN MSA	66.3	0.5	25.6	7.6
Memphis, TN-AR-MS MSA	67.4	0.6	23.0	9.0
New Orleans, LA MSA	76.1	0.3	5.1	18.5
Oklahoma City, OK MSA	71.0	0.1	14.2	14.7
Pittsburgh, PA MSA	72.8	0.5	8.9	17.8
St. Louis, MO-IL MSA	74.0	0.6	14.4	11.0
Sacramento, CA PMSA	59.5	0.1	24.1	16.3
San Antonio, TX MSA	68.3	0.5	18.2	13.0
Seattle-Everett, WA PMSA	72.1	0.3	22.5	5.1

... Not applicable.

Unit frame. The Census Bureau stratified the 1990 census housing units by the central city and balance of the metropolitan area, by the rent or value of the unit, and by the number of rooms. A systematic sample of housing units was then selected across these strata.

Group quarters frame. In the first stage, the Census Bureau systematically sampled census blocks with a probability proportional to the group quarters measure of size. Based upon a block's measure of size, clusters expected to yield four housing units were then sampled in the second stage. Field representatives monitored these group quarters and sampled housing units that came into existence after April 1, 1990, based on specific listing instructions.

Permit frame. The Census Bureau selected sample units in the permit frame from a list of new construction building permits issued in each metropolitan area. Prior to sample selection, the list of permits was sorted by 1990 central city and balance of the metropolitan area, permit office, and the date the permit was issued. Clusters of approximate size four were selected and then were sampled down to one unit. If the original clusters were larger than four, the units were sampled at 1 in 4.

Area frame. Remainder of the AHS-MS sample was selected in blocks that had more than 4 percent of the homes with inadequate street addresses or where newly constructed units do not require building permits. The first step was sorting census blocks by central city and balance, and then by the percentage of renter-occupied housing units in the block. Each block was assigned a measure of size equivalent to total housing units in the block divided by 4 and a systematic sample of blocks was selected. The sample blocks were listed and an expected four units were sampled from the lists. In blocks covered by building permit offices, non-mobile home housing units built since the 1990 census were screened out since these units are covered by the permit frame.

To reduce field listing costs, the unit frame blocks that were moved to the area frame to coordinate with NHIS

were matched to the census and the 1990 census list of housing units in these blocks was created. These housing units were sorted by address within census block and a systematic sample of housing units (yielding approximately four units per block) was then selected from this sample of blocks. New construction since the 1990 census was captured in the permit frame since new construction in these blocks was covered by the building permit system.

Estimation

The survey produced estimates of housing inventory characteristics at the midpoint of the interview period based on the sample in the metropolitan area. The sample housing units were weighted according to a multiple-stage ratio estimation procedure. Before implementing the ratio estimation procedure, the basic weight (that is, the inverse of the probability of selection) for each interviewed sample housing unit was adjusted to account for Type A noninterviews.

Type A noninterview adjustment. Type A noninterviews are occupied sample units for which occupants:

- were not home.
- refused to be interviewed.
- were unavailable for some other reason.

The Census Bureau computed the Type A noninterview adjustment separately for the following:

1. All occupied housing units with data available from a previous survey.

The adjustment for these units was calculated separately for owners in the central city, for owners in the balance, for renters in the central city, and for renters in the balance of the metropolitan area. All owner-occupied housing units were categorized into cells by

the number of rooms and the value. All renter-occupied housing units were categorized into cells by the number of rooms and the unit's contract rent.

2. All occupied housing units without data from a previous survey.

The occupied housing units with incomplete or none of the required data from a previous survey were divided into two groups by central city and balance. Within central city and balance, the housing units were subdivided by frame. Finally, the housing units were split on tenure status (owner/renter) at the time of the interview.

Within a given cell, the Type A noninterview adjustment factor was equal to the following ratio:

$$\frac{\text{Weighted count of interviewed housing units} + \text{Weighted count of Type A noninterviewed housing units}}{\text{Weighted count of interviewed housing units}}$$

Ratio estimation procedure for the unit frame. The Census Bureau computed a unit-frame ratio-estimation factor separately for the cells that were formed by combining strata used in the sample selection of the unit frame. This procedure corrected the probabilities of selection in each of the sample strata. Prior to the AHS-MS sample selection, housing units already selected for other Census Bureau surveys were deleted from the unit frame. The same probability of selection was then applied to the remaining units to select the AHS-MS sample. Since the proportion of housing units deleted from each of the unit frame strata was not necessarily equal as was assumed, some variation between strata in the actual probability of selection was introduced during the sample selection. The unit-frame ratio-estimation factor for each cell was equivalent to:

$$\frac{\text{1990 census count of housing units from the unit frame in the corresponding cell}}{\text{AHS-MS sample estimate of housing units from the unit frame in 1990 in the corresponding cell}}$$

The denominators of these factors were the weighted estimates of all the AHS-MS housing units in existence at the time of the 1990 census from the unit frame, using the product of the basic weight and the Type A noninterview adjustment factor.

Mobile home ratio estimation. To adjust for undercoverage of mobile homes, the Census Bureau assumed the same undercoverage of mobile homes experienced in the last enumeration and applied the undercoverage factors from 1995 for the four appropriate metropolitan areas and from 1996 for the nine appropriate metropolitan areas. For more details on the calculation of these undercoverage factors, refer to Current Housing Reports, Series H170/95 and H170/96 for the appropriate metropolitan areas.

Independent total housing unit ratio estimation. For the ratio estimation procedure described below, each metropolitan area was subdivided into geographic areas consisting of individual counties or a combination of counties.

To lower the undercoverage of non-mobile homes, the Census Bureau applied the following ratio estimation procedure in all areas:

$$\frac{\text{Independent estimate of the total housing inventory (excluding mobile homes) for the corresponding geographic subdivision of the metropolitan area}}{\text{Sample estimate of the total housing inventory (excluding mobile homes) for the corresponding geographic subdivision of the metropolitan area}}$$

The numerator of this ratio was determined by a model consisting of the following components:

1. Census 2000 Housing Units. The Census 2000 counts of housing units are updated each year through the Geographic Update System to Support Intercensal Estimates to reflect boundary updates from the Boundary and Annexation Survey, Count Question Resolution actions, and administrative revisions.
2. Estimated Residential Construction since April 1, 2000. This component is calculated through a formula involving counts of new residential construction in non-permit issuing areas since April 1, 2000, plus counts of residential building permits that resulted in the construction of new units times a factor of 0.98 (since 2 percent of all building permits never result in the actual construction of a housing unit).
3. Estimated New Mobile Home Placements. The Census Bureau derives estimates for mobile homes by allocating state mobile home shipment data to subcounty areas based on the subcounty area's share of state mobile homes in Census 2000.
4. Estimated Housing Loss. The yearly estimates of housing unit loss are based on data derived from the 1993 Components of Inventory Change Survey and 1990 census data. The following four types of housing units were identified to be at a greater risk of loss:
 - Mobile homes
 - Older units constructed before 1939
 - Vacant for seasonal or recreational use
 - Boarded up
5. Final State and County Housing Unit Estimates. The housing unit estimates at the subcounty level are summed to obtain county level housing unit estimates, which are then summed to produce state level housing unit estimates.

For a more detailed description of the determination of these numbers, see <http://www.census.gov/popest/topics/methodology/2003_hu_meth.pdf>. The denominator was obtained using the product of the basic weight and the weighting factors of AHS-MS sample units, excluding mobile homes.

The computed ratio estimation factors were then applied to all appropriate housing units in the corresponding geographic area of each metropolitan area, and the resulting product was used as the final weight for tabulation purposes.

The ratio estimation procedure reduced the sampling error for most statistics below what would have been obtained by simply weighting the results of the sample by the inverse of the probability of selection. Since the housing population of the sample differed somewhat by chance from the metropolitan area as a whole, one can expect that the sample housing population, or different portions of it, is brought into agreement with known good estimates of the metropolitan area housing population.