

Appendix B.

Sample Design and Weighting

SAMPLE AREAS

The 2002 American Housing Survey Metropolitan Sample (AHS-MS) provides information on eight 1970-based metropolitan areas and five 1990-based metropolitan areas interviewed as part of the American Housing Survey (AHS), which was conducted by the U.S. Census Bureau for the Department of Housing and Urban Development.

The eight 1970-based metropolitan areas are:

- Anaheim-Santa Ana, CA
- Buffalo, NY
- Dallas, TX
- Fort Worth-Arlington, TX
- Milwaukee, WI
- Phoenix, AZ
- Riverside-San Bernardino-Ontario, CA
- San Diego, CA

These eight metropolitan areas were last interviewed in 1994.

The five 1990-based metropolitan areas are:

- Charlotte, NC-SC
- Columbus, OH
- Kansas City, MO-KS
- Miami-Fort Lauderdale, FL
- Portland, OR-WA

These five metropolitan areas were last interviewed in 1995.

Most of these metropolitan areas 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:

- Dallas, TX does not include Henderson and Hunt Counties, TX from the 1993 OMB definition for the Dallas, TX PMSA.
- Fort Worth-Arlington, TX does not include Hood and Parker Counties, TX from the 1993 OMB definition for the Fort Worth-Arlington, TX PMSA.
- Phoenix, AZ does not include Pinal County, AZ from the 1993 OMB definition for the Phoenix, AZ MSA.

Interview Schedules

The metropolitan areas selected for AHS-MS are scheduled to be interviewed on a rotating basis once every six years. The Census Bureau collected 2002 AHS-MS data between late February and late September 2002. Initially, the sample in each metropolitan area was uniformly distributed throughout nine panels.

Due to budget constraints, panels were dropped in the following metropolitan areas in 2002:

- In Miami-Fort Lauderdale, all units in five and a half panels
- In Phoenix, all units in three panels
- In all other metropolitan areas, all units in one panel

The cases in the eight remaining panels were assigned to three clusters to be sent out for interview. Cluster 1 was made up of three panels; cluster 2 was made up of four panels; and cluster 3 was made up of one panel. Interviewing for cluster 1 began on February 25, 2002; interviewing for cluster 2 began on May 1; and interviewing for cluster 3 began on July 15. All interviewing was completed by September 30, 2002.

Sample Size

Table B-1 summarizes the interview activity for each of the 2002 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.

Designation of AHS-MS Sample Housing Units

The sample housing units in the areas designated to be interviewed for the 2002 AHS-MS consisted of the following categories which are described in the following sections:

1. All sample housing units that were interviewed in the previous survey.
2. All sample housing units that were Type A noninterviews (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.

Table B-1. Interview Activity for the 2002 American Housing Survey Metropolitan Areas

Metropolitan area	Weighted response rate ¹ (percent)	Eligible units			Ineligible units ³
		Total	Interviewed	Not interviewed ²	
2002 AHS-MS total	92	58,791	54,022	4,769	2,701
Anaheim-Santa Ana, CA	92	4,537	4,178	359	108
Buffalo, NY	93	3,826	3,565	261	277
Charlotte, NC-SC	92	4,736	4,352	384	262
Columbus, OH	91	4,686	4,270	416	201
Dallas, TX	90	4,790	4,283	507	315
Fort Worth-Arlington, TX	90	4,186	3,759	427	284
Kansas City, KS	93	4,493	4,178	315	232
Miami-Fort Lauderdale, FL	94	4,467	4,203	264	200
Milwaukee, WI	92	4,206	3,860	346	195
Phoenix, AZ	93	4,527	4,197	330	162
Portland, OR-WA	92	4,736	4,352	384	112
Riverside-San Bernardino-Ontario, CA	92	5,240	4,816	424	225
San Diego, CA	92	4,361	4,009	352	128

¹The weighted response rate is computed by dividing the number of weighted interviews by the total weighted number of cases eligible for interview and multiplying by 100.

²Sample units were visited but occupants were not at home after repeated visits or were unavailable for other reasons.

³Sample units were visited but did not provide information relevant to the housing inventory. This category includes sample units that were found not to be in the sampling frame.

For a list of reasons for Type A and Type B noninterviews, see Appendix A for the definition of “Noninterview.”

- 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.
- All sample housing units that were added since the previous survey in sample segments from the nonpermit universe. This sample represented additions to the housing inventory since the previous survey in nonpermit-issuing areas.

Sample Selection for 1970-Based Metropolitan Areas

The Census Bureau grouped the housing units enumerated in the 1970 Census of Population and Housing in the United States into two frames: the unit/group quarters and the area frame. These frames were defined as follows:

- Housing units in an area where construction of new homes was monitored by building permits were placed in the unit/group quarters frame.
- Housing units in an area that did not issue permits for new construction were placed in the area frame.

In addition to these two frames, all new construction housing units that were built after the 1970 Census in areas that issued building permits were placed into a separate frame, called the permit frame.

Table B-2 presents the percentage of AHS-MS sample drawn from each frame.

Unit/group quarters frame. The Census Bureau selected the major portion of the sample in each of the metropolitan areas from a file that represented the 1970 Census 20-percent sample of housing units enumerated in permit-issuing areas. The occupied housing unit records were stratified by race of the head of household (non-Black/Black), tenure (renter/owner), family size, central city/balance, and family income. The vacant records were stratified into four categories pertaining to central city/balance, and the value or rent associated with the vacant housing units. Whenever a record was selected to be in sample, the housing unit record adjacent to it on the file was also included in sample, resulting in a clustered sample.

The Census Bureau stratified the group quarters and special place records by census tract and census enumeration district (ED) within the central city and within the balance of the metropolitan areas. A sample of special place records that contained an expected four housing units was then selected.

Permit frame. Before February 1984, the Census Bureau sorted the list of permits by the date the permits were issued and then selected clusters of an expected four (usually adjacent) housing units. From February 1984 through April 1994, the list of permits was sorted by the date of issue, State, 1980 central city and balance, county or minor civil division, and permit office. Clusters of an expected four (usually adjacent) housing units were selected and then subsampled so that two of the four housing units originally selected were kept in sample. After April 1994, 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. The Census Bureau selected the remainder of the AHS-MS sample from areas not under the jurisdiction of permit-issuing offices. The first step was the selection of a sample of census enumeration districts. The EDs were stratified by census tract within the central city and within the balance of the metropolitan area and were then divided into segments with an expected size of four housing units. One of these segments within each sample ED was selected and all housing units in existence at the time of interview in these selected segments were eligible for sample.

Sample Selection for the AHS-MS Coverage Improvement Program

The Census Bureau implemented the AHS-MS Coverage Improvement Program to correct the following deficiencies in the AHS-Metropolitan Area sample from the 1970-based unit frame universe and the 1970-based permit frame:

1. New construction from building permits issued prior to January 1970, but completed after April 1, 1970.
2. Mobile homes placed in parks either missed during the 1970 Census or established since the 1970 Census.
3. Housing units missed in the 1970 Census.
4. Housing units converted to residential use that were nonresidential at the time of the 1970 Census.
5. Houses moved onto their present site since the 1970 Census.
6. Mobile homes placed outside parks since the 1970 Census or vacant at the time of the 1970 Census.

For a detailed description of the coverage improvement sample selection process, see reports in the H170 series for the years 1976 through 1981.

AHS-MS Sample Adjustment

In order to meet their needs, the survey sponsor requested changes to the sample design for these 1970-based metropolitan areas. These sample adjustments were initially reflected in 1984 for Buffalo and Milwaukee; in 1985 for Dallas, Fort Worth, and Phoenix; in 1986 for Anaheim and Riverside; and in 1987 for San Diego.

The sample adjustments achieved two criteria:

1. A sample size of 4,250 in each metropolitan area.
2. A sample having an equal number of owners and renters

Sample Selection for the 1990-Based Metropolitan Areas

The Census Bureau initially grouped the housing units enumerated in the 1990 Census of Population and Housing into census blocks and divided these blocks into two frames; the unit/group quarters frame and the area frame, as follows:

1. Blocks located in an area that issued permits for new construction were placed in 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 groups quarters and placing them in a separate frame. In addition, to coordinate with another Census Bureau survey a subset of census blocks in the unit frame which contained sample units selected by this other survey was moved to the area frame.

All new construction 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 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-2 presents the percentage of AHS-MS sample drawn from each frame.

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.

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.

Table B-2. **Percentage of 2002 AHS-MS Sample by Frame**

2002 AHS metropolitan areas	Unit frame	Group quarters frame	Permit frame	Area frame
Anaheim-Santa Ana, CA	45.8	0.7	53.6	-
Buffalo, NY	78.3	1.9	18.5	1.4
Charlotte, NC-SC	55.0	0.2	29.5	15.4
Columbus, OH	71.8	0.4	23.1	4.6
Dallas, TX	34.8	1.0	56.1	8.1
Fort Worth-Arlington, TX	37.2	0.8	53.8	8.2
Kansas City, MO-KS	71.8	0.2	18.5	9.5
Miami-Fort Lauderdale, FL	78.3	0.2	16.8	4.7
Milwaukee, WI	66.2	1.6	32.2	-
Phoenix, AZ	26.9	0.4	72.8	-
Portland, OR-WA	70.7	0.1	24.8	4.5
Riverside-San Bernardino-Ontario, CA	40.8	0.6	58.6	-
San Diego, CA	42.3	0.9	56.9	-

- Means not applicable.

Area frame. The Census Bureau sorted census blocks by central city and balance and 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 four and a systematic sample of blocks was selected. The sample blocks were listed and clusters of expected four units were sampled. In blocks that issued building permits, nonmobile home housing units built since the 1990 Census were screened out since these units are covered by the building permit system.

To reduce field listing costs, a subset of the blocks from the unit frame (that was moved to the area frame to coordinate with another survey) were matched to the census and the 1990 Census list of housing units in this subset of 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 2002 AHS-MS produced estimates of housing inventory characteristics at the time of the interview based on the sample in the metropolitan areas.

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 sample units for which occupants:

- Were not home
- Refused to be interviewed
- Were unavailable for some other reason

The calculations for this adjustment included occupied units. The Census Bureau computed the Type A noninterview adjustment separately for the following:

1. All occupied housing units with data used in the adjustment 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 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 rent.

2. All occupied housing units with data used in the adjustment not available from the data from a previous survey.

The occupied housing units with incomplete or no 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 (1970-, 1980-, or 1990-based). 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 within each cell which was 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:

$$\frac{\text{Census count of housing units from the unit frame in 1990 (1970) in the corresponding cell}}{\text{AHS-MS sample estimate of housing units in the unit frame in 1990 (1970) in the corresponding cell}}$$

For each 1990-based (1970-based) metropolitan area, the numerators of the factors were obtained from the 1990 (1970) Census of Population and Housing.

The denominators of these factors come from weighted estimates of all the AHS-MS housing units in existence at the time of the 1990 (1970) Census from the unit frame, using the product of the basic weight and the Type A non-interview adjustment factor available at the time of calculation.

Mobile home ratio estimation. To adjust for undercoverage of mobile homes, the Census Bureau, assuming the same undercoverage of mobile homes experienced in the last enumeration, applied the undercoverage factors from 1994 for the eight 1970-based metropolitan areas and from 1995 for the five 1990-based metropolitan areas. For more details on the calculation of these undercoverage factors, refer to Current Housing Reports, Series H170/94 and H170/95 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 nonmobile 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 making adjustments to the Census 2000 data to account for residential new construction as well as losses to the housing inventory. These estimates were generated at the county level and combined to form geographic subdivisions. For a more detailed description of the determination of these numbers, see <http://eire.census.gov/popest/topics/methodology/hu-meth.php>. 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.