

Appendix B. Sample Design and Weighting

ELIGIBLE UNIVERSE

The universe of interest for the American Housing Survey Metropolitan Sample (AHS-MS) is the residential housing units in the given metropolitan areas that exist at the time the survey is conducted. This excludes group quarters and businesses.

The housing units that were part of the AHS-MS sample are consistent with the 2003 OMB definitions of the Metropolitan Statistical Area (MSA).

In some areas, the following adjustments were made:

- Counties/Minor Civil Divisions (MCDs) were added or dropped so that the definition of each metropolitan area in sample was consistent with the final 2003 OMB definition of the metropolitan area and sample was selected in these added areas.
- The sample in the counties/MCDs in the previous definition that were also in these new definitions (i.e., continuing counties/MCDs) was adjusted to maintain an overall sample size of 4,500 and in some cases it was replaced by new sample for confidentiality reasons.

SAMPLE SIZE

The Census Bureau collected the 2011 American Housing Survey-Metropolitan Sample (AHS-MS) data between July and December 2011. The same basic sample of units is interviewed every few years until a new sample is selected. The U.S. Census Bureau updates the sample by adding newly constructed housing units and units discovered through coverage improvement efforts.

The sample size for each metropolitan area was approximately 3,500 to 5,000 housing units. AHS combined one of the larger metropolitan area samples¹ with its corresponding national sample within the MSA – Los Angeles – while the rest of the MSAs were not combined with their corresponding national sample. Sample sizes by metropolitan area are shown below in Table B-1.

¹ During the weighting process, the cases within the Los Angeles combined metropolitan area were assigned the corresponding national sample weights in lieu of the metro sample weights.

Table B-1. Sample Size in the 2011 American Housing Survey Metropolitan Areas (in housing units)

Metropolitan Area	Basic Sample	Supplemental Sample (from National sample)	Total Sample Size
Anaheim, CA.....	4,011	-	4,011
Atlanta, GA.....	3,578	-	3,578
Birmingham, AL.....	4,387	-	4,387
Buffalo, NY.....	4,149	-	4,149
Charlotte, NC.....	4,100	-	4,100
Cincinnati, OH.....	4,132	-	4,132
Cleveland, OH.....	4,129	-	4,129
Columbus, OH.....	4,157	-	4,157
Dallas, TX.....	3,827	-	3,827
Denver, CO.....	3,777	-	3,777
Fort Worth, TX.....	4,184	-	4,184
Indianapolis, IN.....	4,144	-	4,144
Kansas City, MO.....	3,978	-	3,978
Los Angeles, CA.....	2,708	1,884	4,592
Memphis, TN.....	4,233	-	4,233
Milwaukee, WI.....	4,203	-	4,203
New Orleans, LA.....	4,545	-	4,545
Oakland, CA.....	3,995	-	3,995
Phoenix, AZ.....	3,731	-	3,731
Pittsburgh, PA.....	3,955	-	3,955
Portland, OR.....	4,019	-	4,019
Providence, RI.....	4,368	-	4,368
Riverside, CA.....	3,902	-	3,902
Sacramento, CA.....	4,118	-	4,118
San Diego, CA.....	3,967	-	3,967
San Francisco, CA.....	4,085	-	4,085
San Jose, CA.....	4,153	-	4,153
St. Louis, MO.....	3,917	-	3,917
Virginia Beach, VA.....	4,249	-	4,249

- Represents or rounds to zero.

Table B-2 summarizes the interview activity for each of the 2011 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-2. Interview Activity for the 2011 AHS-MS Areas

Metropolitan area	Unweighted response rate ² (percent)	Weighted response rate ³ (percent)	Eligible units			Ineligible ⁵
			Total	Inter-Viewed	Not inter-viewed ⁴	
Anaheim, CA.....	87.1	87.2	3,941	3,432	509	70
Atlanta, GA.....	86.5	86.5	3,262	2,820	442	316
Birmingham, AL.....	90.7	90.7	3,877	3,515	362	510
Buffalo, NY.....	83.6	83.8	3,762	3,145	617	387
Charlotte, NC.....	87.2	87.2	3,882	3,387	495	218
Cincinnati, OH.....	89.7	89.3	3,918	3,515	403	214
Cleveland, OH.....	83.2	83.1	3,942	3,280	662	187
Columbus, OH.....	86.7	86.9	4,011	3,479	532	146
Dallas, TX.....	86.1	86.1	3,574	3,079	495	253
Denver, CO.....	87.8	87.8	3,664	3,218	446	113
Fort Worth, TX.....	87.9	88.0	3,920	3,445	475	264
Indianapolis, IN.....	89.2	89.3	3,961	3,534	427	183
Kansas City, MO.....	90.4	90.5	3,795	3,432	363	183
Los Angeles, CA.....	85.1	84.7	4,482	3,813	669	110
Memphis, TN.....	88.4	88.5	3,882	3,432	450	351
Milwaukee, WI.....	92.3	92.3	4,023	3,715	308	180
New Orleans, LA.....	89.1	88.8	3,914	3,486	428	631
Oakland, CA.....	83.5	83.5	3,879	3,239	640	116
Phoenix, AZ.....	84.3	84.4	3,508	2,957	551	223
Pittsburgh, PA.....	87.6	87.6	3,685	3,228	457	270
Portland, OR.....	86.3	86.3	3,907	3,370	537	112
Providence, RI.....	87.1	87.2	4,205	3,662	543	163
Riverside, CA.....	88.5	88.4	3,746	3,316	430	156
Sacramento, CA.....	83.5	83.5	3,997	3,337	660	121
San Diego, CA.....	86.7	86.6	3,843	3,332	511	124
San Francisco, CA.....	84.1	84.3	3,911	3,291	620	174
San Jose, CA.....	88.2	88.0	4,027	3,550	477	126
St. Louis, MO.....	88.1	88.2	3,689	3,250	439	228
Virginia Beach, VA.....	86.8	86.8	3,957	3,433	524	292

SAMPLE SELECTION

Selection of sample housing units. The AHS sample consists of the following types of units in the metropolitan areas.

- Housing units selected from the 1990 (2000) census
- New construction in areas requiring building permits
- Housing units selected from the 2000 census

Units in areas that were part of the previous metropolitan area definition were selected from the 1990 census. Units in areas added to the definition in 2003 were selected from the 2000 census.

Housing units selected from the 1990 (2000) census. The Census Bureau initially grouped the housing units enumerated in the 1990 (2000) census into 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 groups quarters and placing them in a separate frame.

New construction in areas requiring building permits. All housing units that were built after the 1990 (2000) census in areas where construction of new housing units 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

² The unweighted response rate is computed by dividing the unweighted number of interviews by the unweighted total number of cases eligible for interview and multiplying by 100.

³ The weighted response rate is computed by dividing the weighted number of interviews by the weighted total number of cases eligible for interview and multiplying by 100.

⁴ Sample units were classified as noninterviews because (a) no one was at home after repeated visits, (b) the respondent refused to be interviewed, or (c) the interviewer was unable to find the unit.

⁵ Sample units were found to be ineligible because the unit no longer existed or because the unit did not meet the AHS definition of a housing unit.

sample for more than one survey. The Census Bureau selected the AHS-MS sample from the remaining records.

Housing units selected from the 2000 census. The following adjustments were made to the AHS-MS in 2011 by adding certain types of units selected from the 2000 census:

- A sample of subsidized housing units was selected from Census 2000 in an attempt to improve coverage of housing units receiving rent subsidies.
- In 2005, a new sample of manufactured/mobile homes was selected from Census 2000 in an attempt to improve coverage of manufactured/mobile homes built between 1990 and 2000. One-half of this sample was included in the 2005 interviewing and, as a result, one-half of the 1990-based sample was not included.
- In 2005, a sample of assisted living units was selected from Census 2000 in an attempt to improve coverage of the elderly.

Table B-3 presents the percentage of AHS-MS sample selected from each frame by sample design year.

Table B-3. Percentage of 2011 AHS-MS Sample By Frame and Design

2011 AHS metropolitan area	Unit frame		Group quarters frame		Permit frame		Area frame		Total
	1980 or 1990	2000	1980 or 1990	2000	1980 or 1990	2000	1980 or 1990	2000	
Anaheim, CA.....	40.1	1.4	0.1	-	54.2	4.2	-	-	100
Atlanta, GA.....	46.2	9.9	-	-	29.0	14.1	-	0.8	100
Birmingham, AL.....	45.5	16.6	-	-	13.5	6.8	7.2	10.4	100
Buffalo, NY.....	40.5	37.3	1.3	-	17.4	2.6	0.9	-	100
Charlotte, NC.....	49.7	4.7	0.1	-	27.8	16.5	-	1.3	100
Cincinnati, OH.....	22.6	42.8	-	-	9.0	6.4	15.7	3.6	100
Cleveland, OH.....	43.1	36.8	-	-	5.5	3.3	6.9	4.5	100
Columbus, OH.....	49.5	17.6	0.1	-	22.1	4.7	1.9	4.1	100
Dallas, TX.....	22.8	6.1	0.3	-	52.5	12.2	4.4	1.5	100
Denver, CO.....	64.5	3.3	-	-	22.3	9.1	-	0.8	100
Fort Worth, TX.....	24.9	3.5	0.4	-	49.2	12.7	3.8	5.5	100

Indianapolis, IN.....	61.9	4.5	0.6	-	23.6	9.2	-	0.3	100
Kansas City, MO.....	56.8	16.1	0.1	-	16.7	7.5	1.1	1.6	100
Los Angeles, CA.....	27.4	62.4	0.2	-	5.7	4.4	-	-	100
Memphis, TN.....	51.4	17.1	0.3	-	19.4	9.5	0.4	1.8	100
Milwaukee, WI.....	31.5	33.0	0.3	-	30.8	4.3	0.4	-	100
New Orleans, LA.....	41.4	37.5	-	-	3.6	5.7	11.8	-	100
Oakland, CA.....	81.8	0.8	0.4	-	11.7	5.4	-	-	100
Phoenix, AZ.....	16.9	7.0	0.2	-	61.3	14.3	-	0.3	100
Pittsburgh, PA.....	61.2	25.8	0.6	-	7.6	2.8	0.2	1.8	100
Portland, OR.....	63.3	3.7	0.1	-	24.0	8.6	-	0.3	100
Providence, RI.....	52.2	36.7	-	-	6.6	4.2	-	0.3	100
Riverside, CA.....	29.1	3.7	0.1	-	54.0	13.1	-	-	100
Sacramento, CA.....	51.9	8.3	0.1	-	20.6	9.3	9.8	0.1	100
San Diego, CA.....	35.2	1.9	0.2	-	57.4	5.3	-	-	100
San Francisco, CA.....	89.2	0.4	0.1	-	6.6	2.7	-	-	100
San Jose, CA.....	77.8	4.5	0.8	-	11.7	4.9	-	0.3	100
St. Louis, MO.....	49.2	28.4	0.3	-	12.0	5.6	1.8	2.7	100
Virginia Beach, VA.....	71.6	3.4	0.1	-	17.2	7.3	-	0.3	100

- Represents or rounds to zero.

ESTIMATION FOR AHS-METRO

Each housing unit in the AHS sample represents itself and many other units. The exact number it represents is its "weight." The weight was calculated in five steps. The purpose of these steps is to minimize both sampling errors and errors from incomplete data.

1. **Basic weight.** The Census Bureau assigned each unit a weight to reflect its probability of selection.
2. **Sample adjustment.** An adjustment was made to account for the addition of the supplemental sample in the 29 metropolitan areas and the subsidized housing units.
3. **Noninterview adjustment.** An adjustment was made for refusals and occupied units where no one was home. The calculations for this adjustment do not include units the Census Bureau could not locate. The adjusted weight was multiplied by the following factor:

$$\frac{\text{Interviewed units} + \text{Units not interviewed}}{\text{Interviewed units}}$$

It was assumed the units missed are similar in some ways to the units interviewed for AHS.

This adjustment was done separately for groups defined by cross-classifying the following data items if prior year data for the indicated items are available:

- Central city/balance
- Frame
- Tenure (i.e., owner or renter)
- Type of unit (i.e., mobile home, special living, non-mobile home or special living)
- Rent
- Value
- Number of rooms

4. **Mobile home ratio estimation.** To adjust for undercoverage of manufactured/mobile homes, the Census Bureau applied the following ratio estimation procedure in each geographic subdivision of the metropolitan area:

$$\frac{\text{Independent estimate of manufactured/mobile homes}}{\text{Sample estimate of manufactured/mobile homes}}$$

The numerator of this ratio was determined using data from the 1980, 1990 and the 2000 censuses; and the 2008, 2009, and 2010 American Community Survey. The Census Bureau estimated the total number of manufactured/mobile homes in the survey year 2011 for the metropolitan areas based on model-based projections calculated from these six years. The denominator was obtained using the existing weight of AHS-MS sample mobile home units (i.e., the product of the basic weight, the sampling adjustment and the Type A noninterview adjustment factor).

5. **Independent total housing unit adjustment.** 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 housing units, the Census Bureau applied the following ratio estimation procedure in all areas:

Independent estimate of the total housing inventory
(excluding mobile homes) for the corresponding
geographic subdivision of the metropolitan area
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 2000 census 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 two 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 manufactured/mobile homes by allocating state manufactured/mobile home shipment data to subcounty areas based on the subcounty area's share of state manufactured/mobile homes in the 2000 census.
4. **Estimated Housing Loss.** The yearly estimates of housing unit loss are based on data derived from the 1997-2003 American Housing Survey national sample (AHS-N).

The following three types of AHS noninterviews were considered to represent permanent loss of a housing unit:

- Type B-16 – Interior exposed to the elements
- Type C-30 – Demolished or disaster loss
- Type C-31 – House or Manufactured/Mobile Home moved

Housing unit loss rates based on these non-interview types were then developed for housing units based on structure type and age of structure.

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/methodology/2011-hu-meth.pdf>.

The denominator was obtained using the product of the basic weight and the weighting factors of AHS-MS sample units, excluding manufactured/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.

Small cells. In each step of weighting, many items were cross-classified; so some cells may have few cases. When a cell was too small (less than 20 cases for the noninterview adjustment or less than 50 cases for the demographic adjustment) or the adjustment factor was too extreme (greater than 2.0 for the noninterview adjustment or outside a range of 0.5 to 2.0 for the demographic adjustment), the Census Bureau combined the cell with one or more other cells that were similar in most respects.