

Appendix B. Sample Design and Weighting

SAMPLE SIZE

The U.S. Census Bureau collected most of the 2009 AHS-MS data between April and September 2009. The data for the New Orleans, LA MSA was collected between July and October 2009. The same basic sample of units is interviewed every few years until a new sample is selected. The Census Bureau updates the sample by adding newly constructed housing units and units discovered through coverage improvement efforts.

Due to budget constraints, the sample size for each 2009 metropolitan area was reduced from about 4,700 to about 2,500 as is shown in Table B-1. The sample size for New Orleans was much larger due to confidentiality issues pertaining to the central city units.

Table B-1.
Sample Size in the 2009 American Housing Survey Metropolitan Areas

2009 AHS Metropolitan Area	2009 Sample Size
Chicago, IL*	2,558
Detroit, MI*	2,581
New Orleans, LA	6,197
New York, NY*	2,584
Northern New Jersey, NJ*	2,557
Philadelphia, NJ-PA*	2,605
Seattle, WA	2,436

In 2009, new units in the five starred metropolitan areas supplemented the existing national sample in these areas. These metropolitan areas are based on the definitions used in 1985.

The remaining metropolitan areas are consistent with the June 2003 Office of Management and Budget (OMB) definitions of the metropolitan statistical area (MSA), or Metropolitan New England City and Town Area Division (NECTAD) as a result of the following sample adjustments.

- 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 4,700 and in some cases it was replaced by new sample for confidentiality reasons.

Table B-2 summarizes the interview activity for each of the 2009 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 2009 AHS-MS Areas

Metropolitan area	Unweighted response rate ¹ (percent)	Weighted response rate ² (percent)	Eligible Units			Ineligible units ⁴
			Total	Interviewed	Not interviewed ³	
Chicago, IL	88.1	89.5	2,452	2,159	293	106
Detroit, MI	89.4	90.8	2,489	2,225	264	92
New Orleans, LA	86.7	86.6	4,911	4,257	654	1,286
New York, NY	88.7	90.2	2,461	2,184	277	123
Northern New Jersey, NJ	91.2	92.2	2,465	2,249	216	92
Philadelphia, PA	84.5	86.7	2,515	2,126	389	90
Seattle, WA	88.6	88.6	2,330	2,064	266	106

¹The 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.

²The 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.

³Sample units were visited but occupants were not at home after repeated visits or were unavailable for some other reason.

⁴Sample 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.

SAMPLE SELECTION

Selection of sample housing units. The AHS sample consists of the following types of units in the metropolitan areas. 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 Census 2000.

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

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:

- Blocks located in an area that issued permits for new construction were assigned to the unit/group quarters frame.
- 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 sample for more than one survey. The Census Bureau selected the AHS-MS sample from the remaining records.

Housing units selected from Census 2000. The following adjustments were made to the AHS-MS in 2009 by adding certain types of units selected from Census 2000:

- 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 2009 interviewing and, as a result, one-half of the 1990-design sample was not included.
- In an attempt to improve coverage of the elderly, a sample of special living units was selected from Census 2000.

Supplemental Metropolitan Sample. In 1995, the Census Bureau supplemented the national sample in six metropolitan areas (Chicago, Detroit, Los Angeles, New York, Northern New Jersey, and Philadelphia). These metropolitan areas are based on the definitions used in 1985. This supplemental sample was combined with the existing national sample in these areas in order to produce metropolitan-level estimates. This supplemental sample was last used in 2003. A new supplemental sample was used in 2009 for five of the six areas (Los Angeles is scheduled for a later date). The definitions of these areas differ from the 2003 OMB definitions in the following ways:

- The Chicago MSA does not include DeKalb County from the Chicago-Naperville-Joliet, IL Metropolitan Division (MD), Kenosha County, WI, from the Lake County–Kenosha County, IL-WI MD, or any part of the Gary, IN MD.
- The Detroit MSA includes the Monroe, MI MSA.
- The New York MSA includes Orange County, NY, from the Poughkeepsie-Newburgh-Middletown, NY MSA and does not include Bergen, Hudson, and Passaic, NJ Counties from the New York-Wayne-White Plains, NY-NJ MD.

- The Northern New Jersey MSA includes Bergen, Hudson, and Passaic, NJ Counties from the New York-Wayne-White Plains, NY-NJ MD. It does not include Pike County, PA, from the Newark-Union, NJ-PA MD, the Edison, NJ MD or Trenton-Ewing, NJ MSA.
- The Philadelphia MSA does not include the Wilmington, DE-MD-NJ MD.

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

Table B-3.
Percentage of 2009 AHS-MS Sample by Frame and Design

2009 AHS metropolitan area	Unit frame		Group quarters frame		Permit frame			Area frame	Total
	1980 or 1990	2000	1980 or 1990	2000	1980	1990	2000	1980 or 1990 or 2000	
Chicago, IL	45.18	35.93	0.50	–	5.07	5.51	7.81	–	100
Detroit, MI	26.76	60.77	–	0.11	3.03	3.40	5.89	0.04	100
New Orleans, LA	55.30	29.37	0.23	–	–	3.40	3.60	8.10	100
New York, NY	73.11	14.11	0.56	–	4.26	3.25	4.47	0.24	100
Northern New Jersey, NJ	39.17	46.48	–	0.03	4.75	3.71	5.86	–	100
Philadelphia, PA	29.34	58.51	0.29	0.04	3.50	2.61	5.67	0.04	100
Seattle, WA	53.69	19.45	0.29	–	–	15.00	9.76	1.81	100

– Represents or rounds to zero.

ESTIMATION

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 the units remaining after the metropolitan area level reduction implemented in 2009. The actual adjustment varied by area. An additional sample adjustment was implemented to account for the addition of the supplemental sample in the five metropolitan areas.
- 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 is assumed the units missed are similar in some ways to the units interviewed for AHS.

This adjustment is 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, nonmobile 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 all areas:

$$\frac{\text{Independent estimate of manufactured/mobile homes for the corresponding geographic subdivision of the metropolitan area}}{\text{Sample estimate of manufactured/mobile homes for the corresponding geographic subdivision of the metropolitan area}}$$

The numerator of this ratio was determined using data from the 1990 and the 2000 censuses. The Census Bureau estimated the total number of manufactured/mobile homes in the survey year 2009 for the metropolitan areas based on the increase or decrease in the number of manufactured/mobile homes between 1990 and 2000. 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 nonmobile housing units, 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 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 Census 2000.

4. Estimated Housing Loss. The yearly estimates of housing unit loss are based on data derived from the 1997–2003 American Housing Survey National (AHS-N) sample.

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 <www.census.gov/popest/topics/methodology/2009-est-relnotes.pdf> and <www.census.gov/popest/topics/methodology/2009-hurr-spcl-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 is too small (less than 30 cases for the noninterview adjustment or less than 50 cases for the demographic adjustment) or the adjustment factor is too extreme (greater than 1.5 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 are similar in most respects.