

## Appendix B.

### Sample Design and Weighting: 2013

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#### **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), with the following exceptions:

- Included in the Boston NECTAD but not in the 2003 OMB definition for the Boston-Cambridge-Newton, MA-NH MSA are: Mansfield (in Bristol County, MA) and Bolton and Harvard (in Worcester County, MA). Included in OMB's 2003 definition of the Boston-Cambridge-Newton, MA-NH MSA but not in the Boston MSA are: Rockingham County, NH and Stratford County, NH (Rockingham-Stratford Metropolitan Division).
- Included in OMB's 2003 definition of the Chicago-Naperville-Elgin, IL-IN-WI MSA are: Dekalb County, IL and Kane County, IL (Elgin, IL Metropolitan Division); Jasper County, IN; Lake County, IN; Newton County, IN; and Porter County, IN (Gary, IN Metropolitan Division); and Kenosha County, WI (Lake County-Kenosha County, IL-WI Metropolitan Division).
- Included in the Detroit MSA but not in the 2003 OMB definition for the Detroit-Warren-Dearborn, MI MSA is: Monroe County, MI.
- Included in the Hartford MSA but not in the 2003 OMB definition for the Hartford-West Hartford-East Hartford, CT MSA are: Barkhamsted, Harwinton, New Hartford, Plymouth, and Thomaston (in Litchfield County, Ct); Colchester and Lebanon (in New London County, Ct); and Ashford (in Windham County, CT).
- Included in the Houston MSA but not in the 2003 OMB definition for the Houston-The Woodlands-Sugar Land, TX MSA is: San Jacinto County, TX.
- Included in OMB's 2003 definition of the Minneapolis-St. Paul-Bloomington, MN-WI MSA but not in the Minneapolis MSA are: Le Sueur County, MN; Millie Lacs County, MN; and Sibley County, MN.
- OMB's 2003 definition of the New York-Newark-Jersey City, NY-NJ-PA MSA was split

into the New York, NY MSA and Northern New Jersey, NJ MSA.

- Included in OMB's 2003 definition of the New York-Newark-Jersey City, NY-NJ-PA MSA but not in the New York, NY MSA are: Dutchess County, NY (Dutchess County-Putnam County, NY Metropolitan Division); Essex County, NJ, Hunterdon County, NJ, Morris County, NJ, Somerset County, NJ, Sussex County, NJ, Union County, NJ, and Pike County, PA (Newark, NJ-PA Metropolitan Division); Bergen County, NJ, Hudson County, NJ, Middlesex County, NJ, Monmouth County, NJ, Ocean County, NJ, and Passaic County, NJ (New York-Jersey City-White Plains, NY-NJ Metropolitan Division)
- Included in OMB's 2003 definition of the New York-Newark-Jersey City, NY-NJ-PA MSA but not in the Northern New Jersey, NJ MSA are: Dutchess County, NY, Putnam County, NY (Dutchess County-Putnam County, NY Metropolitan Division); Nassau County, NY, Suffolk County, NY (Nassau County-Suffolk County, NY Metropolitan Division); Pike County, PA (Newark, NJ-PA Metropolitan Division); Bronx County, NY, Kings County, NY, New York County, NY, Orange County, NY, Queens County, NY, Richmond County, NY, Rockland County, NY, and Westchester County, NY (New York-Jersey City-White Plains, NY-NJ Metropolitan Division)
- Included in the Northern New Jersey, NJ MSA but not the 2003 OMB definition for the New York-Newark-Jersey City, NY-NJ-PA MSA is: Mercer County, NJ
- The Philadelphia MSA matches the 2003 OMB definition for the Camden, NJ Metropolitan Division and the Montgomery County-Bucks County-Chester County, PA Metropolitan Division
- Included in OMB's 2003 definition of the Rochester, NY MSA but not in the Rochester MSA is: Yates County, NY.
- Included in OMB's 2003 definition of the Washington-Arlington-Alexandria, DC-MD-VA-WV MSA but not in the Washington DC MSA are: Culpeper County, VA and Rappahannock County, VA.
- Included in OMB's 2003 definition of the Nashville-Davidson-Murfreesboro-Franklin, TN MSA but not in the Nashville MSA is: Maury County, TN
- Included in OMB's 2003 definition of the Louisville-Jefferson County, KY-IN MSA but not in the Louisville MSA is: Scott County, IN. Included in Louisville MSA but not the 2003 OMB definition for the Louisville-Jefferson County, KY-IN MSA are: Meade County, KY and Nelson, County, KY

- Included in the Richmond MSA but not in the 2003 OMB definition for the Richmond, VA MSA are: Cumberland County, VA, King and Queen County, VA, and Louisa County, VA

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 2013 American Housing Survey-Metropolitan Sample (AHS-MS) data between May and September 2013. 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 the five largest metropolitan area samples<sup>1</sup> with their corresponding national sample within the MSA – namely, the Chicago, Detroit, New York, Northern New Jersey, and Philadelphia MSAs – 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.

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<sup>1</sup> During the weighting process, the cases within the five combined metropolitan areas were assigned the corresponding national sample weights in lieu of the metro sample weights.

**Table B-1. Sample Size in the 2013 American Housing Survey Metropolitan Areas (in housing units)**

<b>Metropolitan Area</b>	<b>Basic Sample</b>	<b>Supplemental Sample (from National sample)</b>	<b>Total Sample Size</b>
Baltimore, MD.....	4,065	-	4,065
Boston, MA.....	4,134	-	4,134
Chicago, IL.....	2,878	1,850	4,728
Detroit, MI.....	3,547	1,111	4,658
Hartford, CT.....	4,440	-	4,440
Houston, TX.....	3,631	-	3,631
Miami, FL.....	3,558	-	3,558
Minneapolis, MN.....	3,990	-	3,990
New York, NY.....	2,169	2,680	4,849
Northern NJ.....	3,268	1,527	4,795
Oklahoma City, OK.....	5,061	-	5,061
Philadelphia, PA.....	3,691	967	4,658
Rochester, NY.....	4,726	-	4,726
San Antonio, TX.....	5,056	-	5,056
Seattle, WA.....	3,939	-	3,939
Tampa, FL.....	3,814	-	3,814
Washington, DC.....	3,567	-	3,567
Orlando, FL.....	4,129	-	4,129
Las Vegas, NV.....	4,121	-	4,121
Nashville, TN.....	4,166	-	4,166
Austin, TX.....	4,185	-	4,185
Jacksonville, FL.....	4,223	-	4,223
Louisville, KY.....	4,197	-	4,197
Richmond, VA.....	4,242	-	4,242
Tucson, AZ.....	4,313	-	4,313

- Represents or rounds to zero.

Table B-2 summarizes the interview activity for each of the 2013 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 2013 AHS-MS Areas**

Metropolitan area	Unweighted response rate <sup>2</sup> (percent)	Weighted response rate <sup>3</sup> (percent)	Eligible units			Ineligible <sup>5</sup>
			Total	Inter-viewed	Not inter-viewed <sup>4</sup>	
Baltimore, MD.....	91.2	91.3	3,856	3,518	338	209
Boston, MA.....	77.6	77.6	3,971	3,082	889	163
Chicago, IL.....	85.6	85.2	4,543	3,885	658	185
Detroit, MI.....	89.0	88.8	4,465	3,978	487	193
Hartford, CT.....	85.7	85.9	4,270	3,659	612	170
Houston, TX.....	90.6	90.7	3,454	3,129	325	177
Miami, FL.....	91.9	91.9	3,439	3,160	279	119
Minneapolis, MN.....	85.3	85.5	3,869	3,302	567	121
New York, NY.....	83.9	83.3	4,645	3,895	750	204
Northern NJ.....	80.6	80.3	4,616	3,720	896	179
Oklahoma City, OK.....	87.2	87.3	4,630	4,038	592	431
Philadelphia, PA.....	84.6	84.5	4,499	3,806	693	159
Rochester, NY.....	83.6	83.7	4,373	3,657	716	353
San Antonio, TX.....	86.5	86.6	4,713	4,079	634	343
Seattle, WA.....	85.4	85.5	3,823	3,263	560	116
Tampa, FL.....	87.6	87.7	3,597	3,152	445	217
Washington, DC.....	86.1	86.1	3,472	2,991	481	95
Orlando, FL.....	95.3	95.3	4,003	3,813	190	126
Las Vegas, NV.....	86.8	86.8	4,017	3,485	532	104
Nashville, TN.....	86.6	86.6	4,037	3,496	541	129
Austin, TX.....	83.8	83.8	4,052	3,397	655	133

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> 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.

<sup>5</sup> 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.

Jacksonville, FL.....	95.6	95.6	4,104	3,923	181	119
Louisville, KY.....	86.8	86.8	4,087	3,546	541	110
Richmond, VA.....	87.7	87.7	4,136	3,629	507	106
Tucson, AZ.....	86.0	86.0	4,173	3,587	586	140

## 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 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 2013 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.

**Split Sample Modules.** In 2013, five rotating topical modules were included in the survey: “Doubled-Up Households”, “Disaster Planning”, “Public Transportation”, “Neighborhood Observation” and “Collective Efficacy”.

The entire sample was given the Doubled-Up Households module.

To facilitate including the other four topical modules, the AHS used a split-sample approach. The entire sample was randomly split in half. The first half of the sample was asked questions from the Disaster Planning and Public Transportation topical modules. The second half was asked questions from the Neighborhood Observation and Collective Efficacy topical modules.

Traditionally, the AHS weight applies to all variables in the survey. However, the split-sample format required the creation of two new weights such that:

- One weight is applicable to all characteristics except those pertaining to the four split-sample topical modules mentioned above,
- A second weight is applicable to the Disaster Planning and Public Transportation topical modules,
- A third weight is applicable to Neighborhood Observation and Collective Efficacy topical modules.

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

**Table B-3. Percentage of 2013 AHS-MS Sample By Frame and Design**

2013 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	
Baltimore, MD.....	74.0	6.9	0.4	-	14.6	3.8	0.3	-	100
Boston, MA.....	77.7	12.7	0.4	-	6.4	2.8	-	-	100
Chicago, IL.....	24.3	63.3	0.3	-	6.5	5.4	-	0.1	100
Detroit, MI.....	13.5	78.8	-	-	3.8	3.9	-	-	100
Hartford, CT.....	73.2	12.0	0.6	-	9.5	4.6	-	-	100
Houston, TX.....	50.4	14.2	0.2	-	16.6	14.8	2.5	1.3	100
Miami, FL.....	60.1	19.0	0.1	-	13.4	7.3	-	0.1	100
Minneapolis, MN.....	70.5	2.1	0.2	-	20.7	6.5	-	-	100
New York, NY.....	41.3	51.6	0.5	-	3.5	3.0	-	-	100
Northern NJ.....	19.5	71.4	-	-	4.6	4.4	-	0.1	100
Oklahoma City, OK.....	60.4	8.2	0.4	-	11.9	10.4	1.4	7.3	100
Philadelphia, PA.....	13.2	80.2	-	-	2.4	4.0	-	0.2	100
Rochester, NY.....	78.2	4.1	0.7	-	11.3	4.4	1.3	0.1	100
San Antonio, TX.....	52.8	9.5	0.3	-	14.0	13.7	3.7	6.0	100
Seattle, WA.....	60.4	11.6	0.2	-	17.5	9.1	0.3	0.9	100
Tampa, FL.....	69.8	4.0	0.5	-	17.9	7.9	-	-	100
Washington, DC.....	68.7	4.2	0.4	-	19.5	7.1	-	0.2	100
Orlando, FL.....	-	100.0	-	-	-	-	-	-	100
Las Vegas, NV.....	-	100.0	-	-	-	-	-	-	100
Nashville, TN.....	-	100.0	-	-	-	-	-	-	100
Austin, TX.....	-	100.0	-	-	-	-	-	-	100
Jacksonville, FL.....	-	100.0	-	-	-	-	-	-	100
Louisville, KY.....	-	100.0	-	-	-	-	-	-	100
Richmond, VA.....	-	100.0	-	-	-	-	-	-	100
Tucson, AZ.....	-	100.0	-	-	-	-	-	-	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 25 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 2013 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:

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

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

1. **Census 2000 Housing Units.** The 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/2013-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.