

2013 American Housing Survey Sample Design and Weighting

SAMPLE SIZE

The 2013 American Housing Survey (AHS) data are from a sample of housing units interviewed between May and September 2013. The same basic sample of national housing units is interviewed every two years until a new sample is selected. The sample of supplemental metropolitan units follows a longer interviewing cycle. The U.S. Census Bureau updates the sample by adding newly constructed housing units and units discovered through coverage improvement efforts.

For the 2013 AHS, approximately 167,500 sample housing units were selected for interview. This sample includes 98,800 supplemental metropolitan sample units from 25 metropolitan statistical areas (MSAs). Some units that were reduced from the AHS sample in 2007 have been reinstated, and additional expansions to the sample have been made such as the inclusion of approximately 5,100 subsidized housing units and the addition of eight MSAs that have never been interviewed for the American Housing Survey – Metropolitan Sample (AHS-MS).

SAMPLE SELECTION

The Census Bureau has interviewed the current sample of housing units since 1985. First, the United States was divided into areas made up of counties or groups of counties and independent cities known as primary sampling units (PSUs). A sample of these PSUs was selected. Then, a sample of housing units was selected within these PSUs.

Selection of sample areas. The sample for AHS is spread over 394 PSUs. These PSUs cover 878 counties and independent cities with coverage in all 50 states and the District of Columbia.

If there were over 100,000 housing units in a PSU at the time of selection, the PSU is known as a self-representing PSU because it was removed from the probability sampling operation. It was in sample with certainty. The sample from the PSU represents only that PSU. There are 170 self-representing PSUs.

The Census Bureau grouped the remaining PSUs and selected one PSU per group, proportional to the number of housing units in the PSU, to represent all PSUs in the group. These selected PSUs are referred to as nonself-representing PSUs. The sample nonself-representing PSUs for AHS are a subsample of the Current Population Survey's (CPS) sample areas based on the 1980 census.

Selection of sample housing units. The AHS sample consists of the following types of units in the sampled PSUs:

- < Housing units selected from the 1980 census
- < New construction in areas requiring building permits

- < Housing units missed in the 1980 census
- < Other housing units added since the 1980 census
- < Housing units selected from the 2000 census

Housing units selected from the 1980 census. The U.S. Census Bureau picked a systematic sample so every unit had a 1 in 2,148 chance of being included in the AHS.

In areas where addresses are complete (at least 96 percent of units having a house number and street name) and permits are required for new construction, housing units receiving 1980 census long-form questionnaires were sorted by the following items:

- < PSU
- < Central city, urbanized area, urban outside urbanized area, rural
- < Owner, renter, vacant for rent, vacant for sale, other types of vacants
- < Number of rooms
- < Value of housing unit or gross rent
- < Manufactured/mobile home or not a manufactured/mobile home

In areas where addresses are not complete or permits are not required for new construction, land areas were sorted using a formula incorporating the following items:

- < PSU
- < Central city, urbanized area, urban outside urbanized area, rural
- < Median value of housing unit
- < Number of children under 6 years old
- < Number of elderly people
- < Number of owner-occupied housing units
- < Number of manufactured/mobile homes
- < Number of housing units lacking some plumbing
- < Number of owner-occupied housing units whose value is below \$45,000
- < Number of renter-occupied housing units with rent below \$200
- < Number of Black and Hispanic people
- < Number of 1-room housing units

New construction in areas requiring building permits. In areas that require building permits for new construction, the Census Bureau selected a sample of permits. These permits do not cover manufactured/mobile homes or conversion of older buildings (i.e., warehouses) to residential use.

Housing units missed in the 1980 census. The Census Bureau conducted a special study which identified units at addresses missed or inadequately defined in the 1980 census. A sample of these identified units was selected.

Other housing units added since the 1980 census. If extra units are added in buildings or manufactured/mobile home parks where AHS already has sample units, a sample of these extra units was selected. To find when whole buildings are built (in addition to building permits, mentioned above) or are converted from nonresidential to residential use, the Census Bureau listed all residential buildings in a sample of areas around the country, found any additional buildings, and selected a sample of their units.

Housing units selected from the 2000 census. The following adjustments were made to the AHS sample in 2005 by adding certain types of units selected from the 2000 census:

- A new sample of manufactured/mobile homes was selected from the 2000 census in an attempt to improve coverage of manufactured/mobile homes built between 1980 and 2000. These units were selected at the same rate as the 1980-based units. One-half of this sample was included in the 2013 interviewing and, as a result, one-half of the 1980-based sample was not included.
- In an attempt to improve coverage of the elderly, a sample of special living units was selected from the 2000 census. The Census Bureau purchased address lists of special living facilities from two vendors and supplemented these lists with facility addresses from various special living facility websites. These addresses were matched to the 2000 census to identify 2000 census housing units in special living facilities from which the resulting sample of these special living units was drawn. Because the universe was so small, a double sample of units was selected. Before interviewing, the resulting sample was screened to confirm eligibility.

Subsidized Housing Units. A sample of subsidized housing units was selected from address lists provided by HUD in an attempt to improve coverage of housing units receiving rent subsidies. The Census Bureau received address lists from HUD in 2010. These lists include the Public and Indian Housing Information Center (PIC), Tenant Rental Assistance Certification System (TRACS), and Home Investment Partnership Program (HOME) address lists. The lists were matched to the sample PSUs to enable the Census Bureau to select housing units receiving HUD subsidies.

Supplemental Metropolitan Sample

The Census Bureau initially grouped the housing units enumerated in the 1990 (2000) 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.

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 supplemental metropolitan 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 supplemental metropolitan sample from the remaining records.

The following adjustments were made to the supplemental metropolitan sample in 2005 by adding certain types of units selected from the 2000 census. These units will remain in the 2013 sample:

- * A new sample of manufactured/mobile homes was selected from the 2000 census 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-design sample was not included.
- * In an attempt to improve coverage of the elderly, a sample of special living units was selected from the 2000 census.

NATIONAL ESTIMATION

Each housing unit in the AHS sample represents itself and over 2,000 other units. The exact number it represents is its "weight." The weight was calculated in six steps. The purpose of these steps is to minimize both sampling errors and errors from incomplete data. The result of these steps is also to force consistency with some major categories of data in other Census Bureau surveys, so figures on these categories do not actually depend on the AHS sample, but on the other surveys.

1. *Basic weight.* The Census Bureau assigned each unit a weight to reflect its probability of selection. Generally, this weight is 2,148. Some exceptions are the special living sample units, and the basic weights in the 30 metropolitan areas.
2. *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 earlier 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 is available:

- < Nine census divisions
- < 1990 central city, suburb, or nonmetropolitan
- < 1990 urban or rural
- < Manufactured/mobile home or not a manufactured/mobile home
- < In a special living facility or not in a special living facility (only if the housing unit is not a manufactured/mobile home)
- < Owner/for sale or renter/for rent
- < Number of units in structure*
- < Number of rooms*
- < Occupied, vacant year round, or seasonal/migratory vacant*

(* If known from a previous survey; otherwise, the Census Bureau substituted whether or not units were drawn from building permits for these items.)

For seasonal/migratory vacants and year round vacants other than those for rent or for sale, units were cross-classified only by census region and central city/suburb/nonmetropolitan.

3. *PSU adjustment.* The Census Bureau adjusted for differences that existed in 1990 between the number of 1990 census housing units estimated from the AHS sample of nonself-representing (NSR) PSUs and the 1990 census counts outside the self-representing PSUs. The earlier weight was multiplied by the following factor:

$$\frac{\text{1990 census housing units in all areas that} \\ \text{could have been chosen as nonself-representing PSUs}}{\text{1990 census housing units estimated from the} \\ \text{AHS sample of nonself-representing PSUs}}$$

This adjustment is done separately for groups defined by cross-classifying:

- < Nine census divisions
- < Owner, renter, or vacant
- < 1990 central city, suburb, or nonmetropolitan
- < 1990 urban or rural
- < Hispanic or non-Hispanic householder (only in South and West regions)
- < Black or non-Black householder (only in South region)

4. *New construction adjustment.* The Census Bureau adjusted for known deficiencies in sampling new construction by multiplying the earlier weight by the following factor:

$$\frac{\text{Independent estimate}}{\text{AHS sample estimate}}$$

This adjustment is done separately for groups defined by cross-classifying:

- < Nine census divisions
- < Manufactured/mobile home or not a manufactured/mobile home
- < Number of units in structure
- < Year built (pre-1980 and five-year categories after 1980 as shown in the publication)

Independent estimates are based on the Census Bureau's Survey of Construction and Survey of Manufactured Home Placements. Note that final AHS figures for the categories above are not really based on the AHS sample findings, but on the independent sources.

5. *Demographic adjustment.* Comparability among the surveys was ensured by multiplying the earlier weight by the following factor:

$$\frac{\text{Independent estimate}}{\text{AHS sample estimate}}$$

This adjustment is done in two steps for occupied units. First, the factors were computed and applied for the Hispanic or non-Hispanic groups defined by cross-classifying:

- < Nine census divisions
- < Owner or renter
- < Hispanic or non-Hispanic householder
- < Husband-wife, other male householder, or other female householder
- < Age of householder

Next, the demographic adjustment is repeated with the same cells, except classified by the Black or non-Black groups, rather than the Hispanic or non-Hispanic groups. Vacant for sale, vacant for rent, other year round vacant, and seasonal/migratory vacant units were cross-classified only by the four census regions and 2000 central city, suburb, or nonmetropolitan area.

The percentage of occupied and vacant units was based on the AHS itself. The distribution within occupied and vacant units are from the Census Bureau's Current Population Survey for occupied units and from the Housing Vacancy Survey for vacant units. The grand total number of all housing units in the United States is based on the

2000 census adjusted to account for new and lost units. Note that final AHS figures for the categories above are not really based on the AHS sample findings, but on the independent sources.

Repetitions. The new construction and demographic adjustments were repeated to help match both sets of independent estimates simultaneously. These adjustments were repeated until every cell's factor is between 0.98 and 1.02 or the change in each factor from one repetition to the next is less than 0.015.

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. Cells for the PSU adjustment or the new construction adjustment were not combined.

SUPPLEMENTAL METROPOLITAN SAMPLE

SAMPLE AREA

The 2013 American Housing Survey's supplemental metropolitan sample provides information on 25 metropolitan areas interviewed as part of the AHS. The data from these 25 areas will be used in creating the national estimates as well as metro level estimates.

In all of the historic AHS-MS metropolitan areas, the supplemental sample units include units selected from the 1980, 1990, and 2000 censuses and any new construction since the censuses.

These metropolitan areas are consistent with the June 2003 Office of Management and Budget (OMB) definitions of the metropolitan statistical area (MSA) as a result of the following sample adjustments:

1. 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.
2. The sample in the counties/MCDs in the previous definitions that were also in these new definitions (i.e., continuing counties/MCDs) were adjusted to maintain an overall sample size of approximately 4,500 and in some cases it was replaced by new sample for confidentiality reasons.

In order to improve coverage for the eight new MSAs, the Census Bureau sampled units from the July 2012 Master Address File for all counties in these MSAs, as given in the June 2003 OMB definitions. Prior to sample selection, units already included in the AHS-N were removed from

the frame. Once the frame was created, units were grouped using the following items for each MSA:

- County
- New construction from the 2010 census / 2010 census units
- Tenure (Owner, Renter, Vacant)
- Mobile homes
- Single / Multi-unit dwellings

SAMPLE SIZE

The supplemental sample of 25 metropolitan areas includes about 98,800 units. When aggregated with the 17,200 AHS-N cases in the AHS-MS areas, this yields approximately 4,500 from each of most MSAs.

Sample Housing Units

1. The sample from continuing counties consists of the following:
 - * Interviews in the previous survey
 - * 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.
 - * New construction 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
 - * Housing units added since the previous survey in sample blocks from the nonpermit universe. This sample represented the housing built in nonpermit-issuing areas since the previous survey
 - * 2000 census manufactured/mobile homes
 - * 2000 census special living units
 - * 2000 census housing units replacing current sample housing units for confidentiality reasons
2. The sample from new counties consists of the following:
 - * 2000 census housing units

- * New construction housing units selected from a listing of new residential construction building permits issued since the 2000 census. This sample represented the housing units built in permit-issuing areas since the 2000 census.
- * Housing units added since the 2000 census in sample blocks from the nonpermit universe. This sample represented the housing built in nonpermit-issuing areas since the 2000 census.

ESTIMATION FOR SUPPLEMENTAL METROPOLITAN SAMPLE

Each housing unit in the AHS sample represents itself and other units. The exact number it represents is its "weight." The weight was calculated in several steps.

1. *Basic weight.* The Census Bureau assigned each unit a weight to reflect its probability of selection.
2. *Sample adjustment.* An adjustment is made to the units remaining after the reduction.
3. *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 performed the Type A noninterview adjustment by cross-classifying occupied housing units into various categories or cells on the basis of the following data items:

- * 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

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

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

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:

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

The numerator of this ratio was determined using data from the 1980 census, the 1990 census, and the 2000 census. The denominator was obtained using the existing weight of supplemental metropolitan sample mobile home units (i.e., the product of the basic weight and the Type A noninterview adjustment factor).

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

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

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

- a. *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.
- b. *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).
- c. *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.
- d. *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.

- e. *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/2005_hu_meth.pdf. The denominator was obtained using the product of the basic weight and the weighting factors of supplemental metropolitan 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.