

Appendix B. Sample Design, Telephone Experiments, and Weighting

SAMPLE DESIGN

Introduction

The estimates for each of the seven metropolitan areas in this report series (H171/93) are based on data collected from the 1993 American Housing Survey Metropolitan Sample (AHS-MS) and the American Housing Survey National Sample (AHS-N), which were conducted by the Bureau of the Census acting as collection agent for the Department of Housing and Urban Development.

The sample areas covered for metropolitan areas that remained in the AHS sample after survey year 1983 are consistent with the 1983 Office of Management and Budget (OMB) definitions of a metropolitan statistical area (MSA), consolidated metropolitan statistical area (CMSA), or primary metropolitan statistical area (PMSA). In some instances, a given metropolitan area is a combination of primary metropolitan statistical areas and will be referred to as PMSA's. In addition to adding new areas to some metropolitan samples in order to comply with the 1983 definitional changes, some new metropolitan areas have been added. Thus, each of the 1993 AHS-MS metropolitan areas will fall into one of three categories:

1. Areas of the same geographic area as defined for surveys prior to 1984 (i.e., areas in which the 1970 OMB definition of a standard metropolitan statistical area is the same as the 1983 MSA, PMSA, or CMSA definition, 1970-based area): San Francisco-Oakland, CA PMSA's.

2. Areas consisting of new area in addition to the 1970-based area: Boston, MA-NH CMSA; Detroit, MI PMSA; Minneapolis-St. Paul, MN-WI MSA; and Washington, DC-MD-VA MSA.

3. Areas that are strictly 1980-based: San Jose, CA PMSA and Tampa-St. Petersburg, FL MSA.

The metropolitan areas selected for the 1993 AHS-MS are interviewed on a rotating basis once every 4 years. Initially, each metropolitan area had an expected sample size of 4,250 or 8,500 housing units, uniformly distributed throughout nine panels (panels 4 through 12). Because of budget constraints, the expected sample sizes were reduced to 4,250 in the metropolitan areas with sample sizes of 8,500. For all of the 1993 MSA's interviewing took place from April 1993 through December 1993.

Table A summarizes the interview activity for the 1993 AHS in each of the metropolitan areas. The table provides 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 for the 1993 Survey

The sample housing units designated to be interviewed consisted of the following categories, which are described in the following sections:

Housing units which were in the 1970-based area include the following:

Table A. Description of the American Housing Survey—1993 Metropolitan Sample

Metropolitan statistical area	Units eligible			Units visited, not interviewed ²	National units interviewed
	Total	Interviewed	Not interviewed ¹		
Total	31,957	30,129	1,828	1,753	4,096
Boston, MA-NH CMSA	4,562	4,348	214	252	768
Detroit, MI PMSA	4,217	4,024	193	278	769
Minneapolis-St. Paul, MN-WI MSA	4,623	4,353	270	224	453
San Francisco-Oakland, CA PMSA's	4,625	4,314	311	220	688
San Jose, CA PMSA	4,513	4,294	219	251	248
Tampa-St. Petersburg, FL MSA	4,488	4,280	208	268	475
Washington, DC-MD-VA MSA	4,929	4,516	413	260	695

¹Sample units were visited but occupants were not at home after repeated visits or were unavailable for some other reasons; or, for vacant housing units, no informed respondent could be found.

²Sample 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.

1. All sample housing units that were interviewed in the previous survey. This sample includes housing units that were selected as part of the 1976-1981 Coverage Improvement Program. These coverage improvement cases represented most of the housing units which, until these procedures were implemented, did not have a chance of selection.
2. All sample housing units that were Type A noninterviews (i.e., units eligible to be interviewed) or Type B noninterviews (i.e., units not eligible for interview at the time of the survey but which could become eligible in the future) in the previous survey. (For a list of reasons for Type A noninterviews, see the facsimile of the 1993 AHS questionnaire on page A-28.)
3. 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.
4. 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.
5. In the 1970-based areas of the Boston, MA-NH CMSA; Detroit, MI PMSA; Minneapolis-St. Paul, MN-WI MSA; and Washington, DC-MD-VA MSA, all sample housing units selected from the 1980 Census of Population and Housing.

Housing units within new areas added to the metropolitan area in 1980 (1980-based area):

1. All housing units selected from the 1980 Census of Population and Housing.
2. All housing units that were selected from a list of new residential construction building permits. This sample represented the housing units built in permit-issuing areas since the 1980 census.
3. All sample housing units that were selected in sample segments added from the nonpermit universe. This sample represents units enumerated in the 1980 census as well as additions to the housing inventory in nonpermit-issuing areas since the 1980 census.

Table B shows the percent of the AHS-MS old construction sample that is 1970-based and 1980-based for each metropolitan area:

Table B. 1970-Based and 1980-Based Sample

Metropolitan area	Percent 1970-based	Percent 1980-based
Boston, MA-NH CMSA	70.1	29.9
Detroit, MI PMSA	91.7	8.3
Minneapolis-St. Paul MN-WI MSA	91.6	8.4
San Francisco-Oakland, CA PMSA's	100.0	0.0
San Jose, CA PMSA	0.0	100.0
Tampa-St. Petersburg, FL MSA	0.0	100.0
Washington, DC-MD-VA MSA	93.3	6.7

1993 AHS-MS Original Sample Selection for the 1970-Based Area Sample of the Metropolitan Areas

The 1993 AHS-MS original sample for the 1970-based area of the metropolitan areas which, in 1970, were 100 percent permit-issuing was selected from two frames:

1. Housing units enumerated in the 1970 Census of Population and Housing in areas under the jurisdiction of permit-issuing areas (the 1970-based permit-issuing universe).
2. Housing units constructed in permit-issuing areas since the 1970 census (the 1970-based new construction universe).

In addition, the sample for those metropolitan areas which were not 100-percent permit-issuing in 1970 included a sample selected from a third frame: housing units located in areas not under the jurisdiction of permit-issuing offices (the 1970-based nonpermit universe).

In 1970, the Boston, MA-NH CMSA; San Francisco-Oakland, CA PMSA's and Washington, DC-MD-VA MSA were the only metropolitan areas that were 100 percent permit-issuing.

Sampling operations, described in the following paragraphs, were performed separately within the central city and balance, using the 1970 OMB definitions of the central city of each metropolitan area for each of the sample frames. The overall sampling rate used to select the sample for each metropolitan area was determined by the size of the sample. Each metropolitan area had a sampling rate about the same for the central city and the balance, since the sample was distributed proportionately between the two, according to the corresponding distribution of total housing units.

Sample from the 1970-based permit-issuing universe.

The major portion of the sample in each of the metropolitan areas was selected from a file that represented the 20-percent sample of housing units enumerated in permit-issuing areas of the metropolitan areas during the 1970 Census of Population and Housing. This file contained records for occupied housing units, vacant housing units, and housing units in certain special places or group quarters. Sampling operations were done separately for the special place and

group quarters records, and for the occupied and vacant housing unit records. Before the sample was selected from the occupied and vacant housing unit records, the records were stratified by race of the head of household (non-Black/Black), and the vacant records were stratified into four categories pertaining to the value or rent associated with the vacant housing units. The occupied housing unit records were further stratified so that each unit was assigned to one of 50 strata according to its tenure (owner/renter), family size, and family income category as illustrated by table C.

Table C. 1970 Housing Unit Strata

Family income	Tenure									
	Owner family size					Renter family size				
	1	2	3	4	5+	1	2	3	4	5+
Under \$3,000										
\$3,000 to \$5,999 ...										
\$6,000 to \$9,999 ...										
\$10,000 to \$14,999 .										
\$15,000 and over ...										

Thus, the occupied housing unit records from the permit-issuing universe were assigned to one of 100 strata for either the central city or for the balance, and the vacant housing unit records were assigned to one of the four vacant strata for either the central city or for the balance of the metropolitan areas. A sample selection procedure was then instituted that would produce one-half of the desired sample. However, whenever a record was selected to be in sample, the housing unit record adjacent to it on the file was also selected to be in sample, thereby insuring the necessary designated sample size.

Before the sample was selected from the group quarters and special place records, the records were stratified 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 was then selected by a procedure that produced one-quarter of the desired sample size. However, at the time of the survey, the housing units at each of the special places were listed and subsampled at a rate which produced an expected four sample units, thereby insuring the necessary designated sample size.

Sample from the 1970-based new construction universe. The second frame from which the metropolitan area sample was selected was a list of new construction building permits issued since 1970 (i.e., the new construction universe). The sample selection from the list of new construction building permits was an independent operation within the metropolitan area. Under clerical selection procedures, the list of permits was stratified by the date the permits were issued, and clusters of an expected four (usually adjacent) housing units were formed. These clusters were then sampled for inclusion at the overall sampling

rate. In February 1984, the new construction sampling operation for the 1970-based and 1980-based areas were combined into one computerized system. The universe sampled in the computerized system will be referred to in the estimation section as the 1980-based permit universe. Under these procedures, prior to sample selection the list of permits was stratified 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 formed. These clusters were then sampled for inclusion at twice the overall sampling rate. The housing units within each of the clusters were then subsampled so that two of the four housing units originally selected were kept in sample.

Sample from the 1970-based nonpermit universe. For those metropolitan areas that were not 100-percent permit-issuing, the remainder of the AHS-MS sample was selected from a frame consisting of areas not under the jurisdiction of permit-issuing offices (i.e., the nonpermit universe). The first step in the sampling operation for the nonpermit universe was the selection of a sample of census enumeration districts. Prior to this sample selection, the ED's were stratified by census tract within the central city and within the balance of the metropolitan area. The probability of selection of an ED was proportionate to the following:

$$\frac{\text{Number of housing units in 1970 census ED} + \frac{\text{Group quarters population in 1970 census ED}}{3}}{4}$$

The sample ED's were then divided into segments (i.e., small land areas with well-defined boundaries having an expected size of four, or a multiple of four, housing units). At the time of the survey, those segments that did not have an expected size of four were further subdivided to produce an expected four sample housing units. The next step was the selection of one of these segments within each sample ED. All housing units in existence at the time of interview in these selected segments were eligible for sample. Thus, housing units enumerated in the 1970 census as well as housing units built since the 1970 census were included.

Sample Selection for the AHS-MS Coverage Improvement Program

The AHS-MS Coverage Improvement Program was undertaken to correct certain deficiencies in the AHS-Metropolitan Area sample from the 1970-based permit-issuing universe and the 1970-based new construction universe within the 1970-based area. The coverage deficiencies included the following types of units:

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 that have been 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 H-170 series for the years 1976 through 1981.

1985 AHS-MS Sample Reduction and Sample Reinstatement

The 1985 AHS-MS sample reduction dropped units from sample, whereas the 1985 AHS-MS sample reinstatement added enumerated units that were previously dropped from sample. The universes involved were (a) the 1970-based permit-issuing universe, (b) the 1970-based new construction universe, and (c) the 1970-based nonpermit universe.

Sample reduction and reinstatement involved dropping or adding (a) individual housing units from the permit-issuing universe, (b) whole clusters from the new construction universe, and (c) whole segments from the nonpermit universe.

The reduction/reinstatement was implemented to achieve two criteria:

1. A sample size of 8,500 or 4,250 in each metropolitan area.
2. A sample having an equal number of owners and renters.

To achieve these results, each unit was classified according to the original panel number (the original sample was divided into 12 panels, with one-twelfth of the sample being in each panel) and 1985 tenure (each housing unit was given a 1985 tenure based on the previous year's tenure status). In order to simplify field procedures, panels 1 through 3 (i.e., a random one-fourth of the original sample) were dropped from sample whenever possible. More sample reductions were implemented separately for each 1985 tenure group (using different selection rates across the remaining panels).

AHS-MS Sample Selection for the 1980-Based Area Sample of the Metropolitan Areas

The sample for new areas added to the 1970-based metropolitan areas, and metropolitan areas in sample for the first time that, in 1980, were 100-percent permit-issuing, was selected from two frames:

1. Housing units enumerated in the 1980 Census of Population and Housing in areas under the jurisdiction of permit-issuing areas (the 1980-based permit-issuing universe).
2. Housing units constructed in permit-issuing areas since the 1980 census (1980-based new construction universe).

In addition, the sample for those metropolitan areas that were not 100-percent permit-issuing in 1980 included a sample from a third frame: housing units not under the jurisdiction of permit-issuing offices (1980-based nonpermit universe).

In 1980, the Boston, MA-NH CMSA; Minneapolis-St. Paul MN-WI MSA; and Washington, DC-MD-VA MSA were the only metropolitan areas that added new areas that were not 100-percent permit-issuing.

To satisfy confidentiality requirements in the Boston, MA-NH CMSA; and Washington, DC-MD-VA MSA, it was necessary to supplement the existing sample within the 1970-based area. The additional housing units were selected separately for each metropolitan area from the 1980-based permit-issuing universe.

Sample from the 1980-based permit-issuing universe.

The major portion of the sample in each metropolitan area was selected from a file that represented all the housing units enumerated in permit-issuing areas during the 1980 Census of Population and Housing. This file contained records for occupied housing units, vacant housing units, and housing units in group quarters. Sampling operations were done separately for noninstitutionalized group quarters and for all other housing units in permit-issuing areas. In addition, in order that an equal number of owner and renter housing units were selected in each metropolitan area, a selection rate that differed by tenure group was used. Before the sample was selected, the housing units that were not classified as group quarters were stratified into 60 categories by tenure, contract rent, value, and number of rooms as illustrated by table D.

Table D. 1980 Housing Unit Strata

Contract rent and value	Number of rooms		
	1 to 3	4 to 5	6 or more
RENTER			
Contract rent.....			
Less than \$100.....			
\$100 to \$149.....			
\$150 to \$199.....			
\$200 to \$249.....			
\$250 to \$299.....			
\$300 to \$349.....			
\$350 to \$399.....			
\$400 or more.....			
Not available.....			
OWNER			
Value.....			
Less than \$20,000.....			
\$20,000 to \$29,999.....			
\$30,000 to \$34,999.....			
\$35,000 to \$39,999.....			
\$40,000 to \$49,999.....			
\$50,000 to \$64,999.....			
\$65,000 to \$79,999.....			
\$80,000 to \$99,999.....			
\$100,000 to \$149,999.....			
\$150,000 or more.....			
Not available.....			

The group quarters housing units were grouped into two strata: (1) institutionalized group quarters and (2) noninstitutionalized group quarters.

The following sample selection procedures were then implemented separately within the central city and balance of each metropolitan area. For the Boston, MA-NH CMSA and Washington, DC-MD-VA, the sample selections were implemented separately by the 1970-based and 1980-based areas. All units were sorted by the 1980 central city and balance, stratum, State, district office, ED, and census serial number. The sample selection procedure was then implemented separately for: (a) institutionalized group quarters and nongroup quarters housing units and (b) noninstitutionalized group quarters.

Individual housing units were selected for the nongroup quarters while each institutionalized group quarters had one chance of selection. Before the sample selection for the noninstitutionalized group quarters was implemented, the following measure of size was calculated for each record:

$$\frac{(1/4) \times (\text{Total group quarters population})}{2.75}$$

The noninstitutionalized group quarters were then selected proportionate to the measure of size.

Sample selection from the 1980-based new construction universe. The second frame from which the metropolitan area sample was selected was a list of new construction building permits issued since 1980 (i.e., the new construction universe). The sample selection from the

list of new construction building permits was an independent operation within each metropolitan area. This operation was described in the discussion of the 1970-based new construction universe.

Sample from the 1980-based nonpermit universe. For those metropolitan areas that were not 100-percent permit-issuing, the remainder of the AHS-MS sample was selected from a frame consisting of areas not under the jurisdiction of permit-issuing offices (i.e., the 1980-based nonpermit universe). The first step in the sampling operation for the nonpermit universe was the selection of a sample of census ED's within these areas (using the overall sampling rate). Prior to this sample selection, the ED's were sorted by State, district office and enumeration district number. The probability of selection of an ED was proportionate to the following:

$$\frac{\text{Number of housing units in 1980 census ED} \times \text{Noninstitutionalized group quarters population in 1980 census ED}}{2.75}$$

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The sample ED's were then divided into segments (i.e., small land areas with well-defined boundaries having an expected size of four, or a multiple of four, housing units). At the time of the survey, those segments that did not have an expected size of four housing units were further subdivided to produce an expected four sample housing units. Following the division, a segment from each sample ED was selected. All housing units in existence at the time of interview in these selected segments were eligible for sample. Thus, housing units enumerated in the 1980 census as well as housing units built since the 1980 census are included.

1989 AHS-MS Sample Reduction and Sample Reinstatement

(The following paragraph pertains to all 1993 MSA's except San Jose.) When these metropolitan areas were interviewed in 1985, 3 of the 6 had an expected sample size of 8,500 distributed throughout panels 4 through 12; panels 11 and 12 were dropped before interviewing was completed in these large metropolitan areas, further reducing the sample size. The remaining three metropolitan areas had an expected sample size of 4,250 in 1985; in these areas, one or both of panels 11 and 12 were also dropped.

In addition, for the large metropolitan areas, the sample size was reduced from 8,500 to 4,250 by randomly selecting half of the original panels 4 through 12 to be dropped. Furthermore, there was some reassignment of units between

panels 9 and 10 and panels 11 and 12 so that all the units interviewed in 1989 also had a prior interview. In addition, panels 11 and 12 were later dropped in 1989 because of budgetary concerns.

1988 AHS-MS Sample Reduction and Sample Reinstatement

(The following paragraph pertains only to the San José, CA PMSA.) Each 1988 metropolitan area had an expected sample size of 4,250 housing units uniformly distributed throughout nine panels (panels 4-12). Due to budget constraints, panel 4 was dropped from sample in all metropolitan areas, and interviewing took place from May 1988 to December 1988. As a result, the expected sample sizes were lower than the original goal of 4,250 sample units.

1993 AHS-MS Sample Reduction and Sample Reinstatement

For the current survey year, 3 of the 7 metropolitan areas had an expected sample size of 8,500; the remaining areas had an expected sample size of 4,250. Because of budget constraints, the sample sizes for the three large metropolitan areas were reduced from 8,500 to 4,250.

Panels 11 and 12 were reinstated in the Boston, MA-NH CMSA; the Detroit, MI PMSA; the Minneapolis-St. Paul, MN-WI MSA; the San Francisco-Oakland, CA PMSA's; the Tampa-St. Petersburg, FL MSA and the Washington, DC-MD-VA MSA in 1993. Panel 4 was reinstated in the San Jose, CA PMSA in 1993.

TELEPHONE INTERVIEWING

In 1993, AHS-MS used a maximum telephone interviewing data collection mode for panels 6,8,10, and 12. This means that when housing units in panels 6,8,10, and 12 met certain eligibility criteria they were interviewed by telephone. These criteria included having a telephone; having an interview in the last survey year (1988 or 1989) and having the same household as in the last survey year. This was done to evaluate potential differences between data collected by the traditional personal visit (used in panels 4,5,7,9, and 11 in 1993) and data collected by telephone interview. These telephone interview data are included in the estimates in the data tables of this publication.

We plan to evaluate the telephone data further. Depending on our evaluations, telephone interviewing may become a permanent feature of AHS-MS.

AHS-NATIONAL SAMPLE SELECTION

The United States was divided into areas made up of counties and independent cities called primary sampling units (PSU's). These PSU's were grouped into strata of one or more PSU's; one PSU was selected from each stratum to represent all PSU's in that stratum.

Selection from the 1980 census. Sample units were selected from the 1980 census units in these PSU's at an overall sampling rate of 1 in 2,148. The procedure for sampling of housing units, in a given area, depended on (a) the completeness of addresses and (b) the degree of monitoring of new construction by permits.

In areas where addresses were mostly complete and new construction was monitored by permits, a sample was selected from a list of housing units that received long-form questionnaires in the 1980 census.

In areas where at least 4 percent of the addresses were incomplete or inadequate, or where new construction was not monitored by building permits (mostly rural areas), a sample of 1980 "long-form questionnaire" census units was selected in several steps:

1. The areas were grouped and a sample of areas was chosen.
2. A segment was selected within each sample area.
3. A sample of housing units that received 1980 census long forms was selected within the segment.

Selection of new construction housing units in permit-issuing areas. The sample of permit new construction was selected from issued building permits such that the units were expected to be completed after April 1, 1980. The sampling procedure was similar to that of AHS-MS; however, the subsampling rate used was 1 in 4.

Selection of other added units and new construction in nonpermit-issuing areas. These types of housing units added to the inventory since the 1980 census were represented using two methods:

1. Within-structure additions are units in structures that contained at least one units enumerated in the 1980 census.
2. Whole-structure additions include units in structures that contained no units enumerated in the 1980 census.

Additional information concerning the 1993 AHS-National survey is available in the Current Housing Report series H150/93.

ESTIMATION

The 1993 AHS-Metropolitan Area sample produced estimates pertaining to characteristics of the housing inventory at the time of the interview (i.e., the 1993 housing inventory). The combined estimates used information from both the AHS-MS and AHS-National samples (i.e., the combined sample estimates).

In addition, the 1993 AHS-MS produced estimates of the characteristics of units that were lost from the housing inventory since the 1988 or 1989 survey. These estimates, referred to as building loss estimates, only used information from the AHS-MS sample.

CURRENT HOUSING INVENTORY ESTIMATES

AHS-MS Weighting. Before performing estimation procedures using the combined sample, the AHS-MS sample housing units were weighted according to a one-step ratio estimation procedure. Before the implementation of the ratio estimation procedure, the basic weight (i.e., the inverse of the probability of selection) for each interviewed sample housing unit was adjusted to account for Type M and Type A noninterviews.

Type M noninterview adjustment. The Type M noninterviews are sample units which were dropped due to selection by another survey or because of permit unavailability. These noninterviews occur in (a) the 1980-based permit-issuing area universe, (b) the 1980-based nonpermit-issuing area universe, and (c) the 1980-based new construction universe.

The adjustment was done separately for the above universes for the central city and balance for each metropolitan area. The adjustment was equal to the following:

$$\frac{\text{AHS-MS sample estimate of 1980 housing units in the cell} + \text{Weighted count of Type M noninterviewed housing units}}{\text{AHS-MS sample estimate of 1980 housing units in the cell}}$$

Type A noninterview adjustment. Type A noninterviews are sample units for which (a) occupants were not home, (b) occupants refused to be interviewed, or (c) occupants were unavailable for some other reason.

The adjustment was done on occupied units and was computed separately for the following:

1. Units in the 1980-based permit-issuing area universe.
2. New construction.
3. All other housing units (this includes the 1970-based permit-issuing universe, the 1970-based and 1980-based nonpermit-issuing universes and the 1970-based new construction housing units built prior to the last survey).

For units in the 1980-based permit-issuing universe, a Type A noninterview adjustment factor was computed separately, for each of the 62 strata used in the sample selection process, by 1980 central city and balance. For new construction units a Type A noninterview adjustment factor was computed separately for each of the central city

and balance. For all other units, a Type A noninterview adjustment factor was calculated separately by tenure and 1970 central city and balance for each of the following:

1. Twenty-four noninterview cells for sample housing units from the permit-issuing universe (each cell was derived from one or more of the 50 different strata used in the 1970-based permit-issuing universe, illustrated earlier).
2. One noninterview cell for new construction housing units.
3. One noninterview cell for mobile homes or trailers from the nonpermit-issuing universe.
4. One noninterview cell for units that were not mobile homes or trailers from the nonpermit-issuing universe.
5. Three noninterview cells for units from the coverage improvement universe.
6. One noninterview cell for units classified as vacants at the time of the 1970 census.
7. One noninterview cell for units classified as group quarters at the time of the 1970 census.

Within a given cell, the Type A noninterview adjustment factor was equal to the following ratio, using the basic weight times the Type M noninterview adjustment factor for the sample weight:

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

AHS-MS ratio estimation procedure for the 1970-based permit-issuing universe. The following ratio estimation procedure was employed for all sample housing units from the permit-issuing universe. This factor was computed separately for all sample housing units within each 1970-based permit-issuing universe noninterview cell mentioned previously. The ratio estimation factor for each cell was equal to the following:

$$\frac{\text{1970 census count of housing units from the 1970-based permit-issuing universe in the corresponding cell}}{\text{AHS-MS sample estimate of 1970-based housing units from the permit-issuing universe in the corresponding cell}}$$

For each metropolitan area, the numerators of the ratios were obtained from the 1970 Census of Population and Housing 20-percent file (long forms) of housing units enumerated in areas under the jurisdiction of permit-issuing offices.

The denominators of the ratio estimation factors were then obtained from weighted estimates of all the AHS-MS sample housing units from the 1970-based permit-issuing universe, using the existing weights (i.e., the basic weight times the Type A noninterview adjustment). The computed ratio estimation factor was then applied to the existing weight for each sample housing unit within the corresponding ratio estimation cells. This ratio estimation procedure was introduced to correct the probabilities of selection for samples in each of the strata used in the sample selection of the 1970-based permit-issuing universe. Prior to the AHS-MS sample selection within each metropolitan area, housing units already selected for other Census Bureau surveys were deleted from the permit-issuing universe. The same probability of selection was then applied to the remaining units to select the AHS-MS sample. Since the number of housing units deleted from the AHS-MS universe frame was not necessarily proportional among all strata, some variation in the actual probability of selection between strata was introduced during the sample selection process.

AHS-MS ratio estimation procedure for the 1980-based permit-issuing universe. The following ratio estimation procedure was employed for all sample units from the 1980-based permit-issuing universe. This factor was computed separately for all metropolitan areas within each 1980-based permit-issuing universe noninterview cell previously mentioned. The ratio estimation factor was equal to the following:

$$\frac{\text{1980 census count of housing units from the 1980-based permit-issuing universe in the corresponding cell}}{\text{AHS-MS sample estimate of 1980-based housing units from the permit-issuing universe in the corresponding cell}}$$

For each metropolitan area, the numerator of the ratio was obtained from the 1980 Census of Population and Housing 100-percent file of housing units enumerated in areas under the jurisdiction of permit-issuing offices. The denominator of the ratio was obtained from weighted estimates of all the AHS-MS sample housing units within the corresponding ratio estimation categories using the existing weight (i.e., the basic weight times the Type M noninterview adjustment factor times the Type A noninterview adjustment factor).

The computed ratio estimation factor was then applied to the existing weight for each sample housing unit within the corresponding ratio estimation categories.

This ratio estimation procedure was introduced to adjust the sample estimate in each of the strata used in the sample selection of the 1980-based permit-issuing universe to an independent estimate (1980 census count) for the strata. This adjustment was necessary since some sample units were dropped during processing.

AHS-National Weighting

Before implementing estimation procedures using the AHS-National units for the combined sample, the AHS-National sample units were assigned a weight that reflected the probability of selection for the unit. The AHS-National weighting procedure then made adjustments for units that could not be interviewed. For each of these adjustments, a factor was computed and applied to the appropriate units.

The first of these adjustments was done for permit segments only, to account for permits that could not be sampled and units that could not be located. These units were represented by all other units in permit segments including both interviews and noninterviews (excluding "unable to locate" noninterviews).

The second of the adjustments was done for units in structures built before April 1, 1980. It was done to account for units that could not be located. These units were represented by both interviews and noninterviews (excluding "unable to locate" noninterviews).

The last of these adjustments was done to account for units that could not be interviewed because either no one was home after repeated visits or the respondent refused to be interviewed. When prior-year AHS or 1980 census data were available, this information was used to determine the noninterview adjustment cell. The cells included characteristics such as tenure, geography, units in structure, and number of rooms. When these data were not available, adjustment factors were computed separately using more general characteristics such as type of area and type of housing unit (i.e., mobile home, nonmobile home). Additional information on the AHS-National weighting procedure can be found in the Current Housing Report H150/93.

COMBINED SAMPLE WEIGHTING

Introduction

The estimates for the combined sample were obtained by summing the sample weights of interviewed AHS-MS and AHS-National units. For AHS-MS sample units, the starting weight was obtained after the AHS-MS ratio estimation procedure. For AHS-National units, the starting weight was obtained after the Type A noninterview adjustment. To account for the use of two different samples representing one metropolitan area, weighting factors were assigned to each unit prior to the combined sample ratio estimation procedures.

Weighting Factor Adjustment

The weighting factor adjustment was computed separately for each metropolitan area by sample design (AHS-MS or AHS-National) according to "new construction" or "old

construction" classification. New construction was defined as units built in permit-issuing areas since the 1980 census; old construction units were then categorized by tenure classification (renter/owner).

For a given characteristic, the AHS-MS weighting factor adjustment was a function of the sample size in each survey and the variance associated with each survey's estimates.

The corresponding weighting factor was then applied to the existing weight of each AHS-MS and AHS-National sample unit and the weights were then combined according to characteristic (i.e., AHS-MS new construction + AHS-National new construction, etc).

Combined Sample Ratio Estimation Procedures

For the three ratio estimate procedures described below, each metropolitan area was subdivided into geographic areas consisting of a combination of counties.

Mobile home ratio estimation. The following ratio estimation procedure was applied in all areas:

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

Sample estimate of mobile homes
for the corresponding geographic subdivision
of the metropolitan area

The numerator of this ratio was determined using data from the 1990 census. The denominator was obtained using the existing weight of AHS sample mobile home units (i.e., the starting weight times the combined sample weighting factor).

Independent total housing unit ratio estimation. The following ratio estimation procedure was applied in all areas

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

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 from 1990 census data. The denominator was obtained using the existing weight of AHS 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 effect of these ratio estimation procedures was to reduce 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, it can be expected that the sample housing population, or different portions of it, is brought into agreement with known good estimates of the metropolitan area housing population.

Building Loss Estimates

Sample building loss units from the AHS-MS data were weighted using a three-stage ratio estimation procedure. Since National data was not used for loss estimates, the building loss sample units were not included in the combined weighting procedures. Before the implementation of the ratio estimation procedures, the 1993 basic weight was adjusted to account for panel drops and Type M and Type A noninterviews.

Building loss adjustment factor. Building loss estimates incorporate an adjustment unique to the building loss data. Panel 4 was dropped from the sample in 1988, panels 11 and 12 were dropped from sample in 1989 and all panels were reinstated in 1993. Since we did not collect data on dropped units in 1988 or 1989, we cannot use them to make estimates of housing characteristics of building losses. Thus, sample housing units, from dropped panels, that were losses to the housing inventory in 1993 were dropped from the building loss sample.

Since not all of the nine panels in sample for 1993 were used to make building loss estimates, the probability of selection was reduced. Consequently, the tables containing building loss data in these publications reflect this adjustment.

Type M noninterview adjustment. A description of this factor can be found in the previous section describing the AHS-MS weighting for the housing inventory. For building loss estimates, the Type M factor that was calculated the year the loss unit was interviewed (1988 or 1989) was used to compute the final weight.

Type A noninterview adjustment. A description of this factor can be found in the previous section describing AHS-MS weighting for the housing inventory. For building loss estimates, a separate Type A noninterview factor was computed using only loss units and data from the prior year enumeration.

AHS-MS ratio estimation procedure for the 1970-based permit-issuing universe. A description of this factor can be found in the previous section describing the AHS-MS weighting for the housing inventory. For building loss

estimates, the 1970-based permit-issuing factor that was calculated the year the loss unit was interviewed (1988 or 1989) was used to compute the final weight.

AHS-MS ratio estimation procedure for the 1980-based permit-issuing universe. A description of this factor can be found in the previous section describing the AHS-MS weighting for the housing inventory. For building loss estimates, the 1980-based permit-issuing factor that was calculated the year the loss unit was interviewed (1988 or 1989) was used to compute the final weight.

Mobile home ratio estimation. A description of this factor can be found in the previous section describing the AHS-MS weighting for the housing inventory. For building loss

estimates, the mobile home ratio estimation factor that was calculated the year the loss unit was interviewed (1988 or 1989) was used to compute the final weight.

Independent total housing unit ratio estimation. A description of this factor can be found in the previous section describing the AHS-MS weighting for the housing inventory. For the estimates of housing units removed from the inventory since the 1988 or 1989 survey, the new methodology was not used in the numerator. Since, for building loss estimates, the independent total housing unit ratio estimation factor that was calculated the year the loss unit was interviewed (1988 or 1989) was used to compute the final weight, the numerator for these loss estimates is based on the previous methodology described in the H170 series for 1988 and 1989.