Appendix D. Errors

All numbers from the American Housing Survey national sample, except for sample size, are estimates. As in other surveys, errors come primarily from the following:

- Wrong answers (no adjustment is made for them and the size of the errors are not estimated)
- Incomplete data (adjustment is made by assuming the people answering are similar to those not answering, and the size of the errors is not estimated)
- Sampling (no adjustment for them was made and the size of the error is not estimated)

Incomplete data and wrong answers are usually the largest source of errors, larger than sampling errors. For example, the changes in weighting in 1981 and 1991 (see Appendix C) corrected some of the error due to incomplete data. Just that one correction averaged 2.5 percent in 1991. Worse errors from wrong answers and from incomplete data apply to some items, discussed in the next paragraphs.

Incomplete Data

Coverage errors. Because of deficiencies with the sampling lists, the homes in the survey do not represent all homes in the country. An attempt was made to adjust for the deficiencies by raising the raw numbers from the survey proportionally so that the numbers published here match independent estimates of the total number of homes. Housing unit undercoverage is about 1.7 percent.

The independent estimates changed around 2.5 percent in both 1981 and 1991 (after the 1980 and 1990 censuses, respectively) which implies that some error existed in the years just before the adjustment. The next correction will be after the 2000 census. Before adjustments, undercoverage varies from 2 and 20 percent for major categories of units (see Table 2 in Appendix D of *American Housing Survey for the United States in 1995)* but is usually less than 2 percent, on average. Table P lists units that have known coverage deficiencies.

It is not known how close the imputed values are to the actual values. For other items, "not reported" is shown as an answer category. The items with the most missing data are primarily those that people forget or consider personal: mortgages, other housing costs, and income.

Incompleteness can cause large errors since, when even 10 percent of homes are missed by a particular question, they represent about 10 million homes which have to be estimated on little or no basis (there are about 100 million homes in the United States). The survey estimates them by assuming that they are like some group of homes which did give data, an assumption which is never exactly true although it is usually better than ignoring the homes with the missing data. Thus, it is not surprising that large biases, as shown in Table Q, are possible when the survey has data for only 50 to 90 percent of homes for particular items. Again, readers should be wary of items with highly incomplete data.[2]

Missing data. Some people refuse the interview or some of the questions, or do not know answers. When the entire interview is missing, we let other similar interviewsrepresent the missing ones (See Appendix B). For most missing answers, we copy an answer from a similar household.[1]

Table P. **Poorly Covered Units**

Type of unit	Type of deficiency
Mobile homes, boats, and recreational vehicles (RVs)	No coverage of new mobile home parks, new marinas, and new RV parks since April 1980, in areas where addresses are complete and permits are required for new construction.
Conventional new construction	No coverage of permits issued fewer than 6 months before interviewing or homes built without permits wherepermits are required. In addition, eligible units could be missed and ineligible units included because of incorrect answers to questions used to screen out ineligible units.
New construction in special places (for example., college campuses, prisons, etc.)	Not covered.
Group quarters and houses moved in	Eligible units could be missed because of incorrect answers to questions used to screen out ineligible units.
Conversions from nonresidential units	Minimal coverage of nonresidential units in buildings with no living quarters at the time of the 1980 census which converted to housing units by 1991 (and no coverage since 1991) in areas where addresses are complete and permits are required for new construction.
Within-structure additions	Some extra apartments created illegally are probably missed because people don't report them for fear of penalties.

[1] Hot deck allocation is used: an answer is copied from the most recently processed similar household before the household with the missing item.

[2] Statistical note: The November 1990 paper, *How Response Error, Missing Data and Undercoverage Bias Survey Data,* estimates that 90 percent of errors from incomplete data are less than: 1.64 x

Table Q. **Errors for Incomplete Data Bias**

(Numbers in thousands)

When the AHS gives one of the following numbers—	The chances are 90 percent that the complete value[1] is inside the range of plus or minus
0	220
10	221
100	226
1,000	280
2,500	369
5,000	518
10,000	815
25,000	1,708
50,000	3,195
75,000	2,422
100,000	934
112,000	220

[1]"Complete value" means the value derived if there were no missing data.

Rates of completeness for 1997 were not computed. Table 2 in Appendix D of *American Housing Survey for the United States in 1995* gives the completeness rates for 1995. Because of the change in data collection methodology, the rates for 1997 may be higher or lower than in the past. However, the items that were most incomplete in 1995 are probably still the most incomplete for 1997.

Effect on income. The nonsampling errors interact particularly badly for income. Income questions are inconsistently answered (Table T), incompletely answered, and the totals fall short of totals known from the National Income Accounts, especially for the elderly.[3]

Change over time. Several aspects of the 1997 AHS make estimates of change from previous data unreliable. These changes may elicit different answers from the past, even if nothing changed in the housing unit. Wording and question order for most questions changed. Also, the questionnaire now runs on interviewers' portable computers (as described in Appendix C), resulting in the following possible changes:

- The correct questions should be asked. Skip patterns will be followed more accurately.
- Inconsistent answers (such as reporting a move-in date before the date built) are probed during the interview, rather than just being changed in later computer processing, so these problems should be resolved more accurately.
- Large changes from prior year data are probed during the interview, for some questions, to reduce mistaken measurements of large change.
- Some respondents may dislike the presence of the computer, though interviewers do not report many problems.
- It is now a little harder for interviewers to go back to a question much earlier in the questionnaire, if a respondent suddenly remembers something.

In the future, efforts may be made to estimate the net effects of these differences.

Wrong Answers

Wrong answers happen because people misunderstand questions, cannot recall the correct answer, or do not want to give the right answer. Table T shows which items have been measured for inconsistency when people are reinterviewed after a few weeks. The actual survey did not catch and reconcile these inconsistencies and continuously occurring errors are not measured at all. Thus, a high rate of wrong answers remains for some items. The U.S. Census Bureau categorizes these levels of inconsistency into three ranges:

1. Less than 20 is considered a low level of inconsistency and answers are considered reliable.
2. Between 20 and 50 is considered a moderate level of inconsistency and the answers are considered moderately reliable.
3. Greater than 50 is considered a high level of inconsistency indicating that responses are not reliable.

Not all questions have been checked for inconsistencies. The ones checked were the questions where inconsistencies seemed likely. Questions measuring opinions were likely to have high inconsistencies. For 1997, we changed the wording for some questions. We expect this change to lower the level of inconsistency for the changed items.

The numbers in Table T are percents. They are nearly the same as: 100 minus the correlation between answers in the original interview and the reinterview. For example, an inconsistency of 20 means a correlation of 80 percent, which is good. This is the correlation between answers to the same question, usually from the same respondents, a month apart. Wrong answers make results wrong and mean that data on groups (for example, income groups) are infected with data from people who really are not like the group at all. Errors are especially troublesome for rare

(.0012 x U + .0363 x (lesser of A or U–A)) where A is any count from the AHS and U is the total number of housing units in the United States (both in thousands, result also in thousands). Weights are adjusted to reduce these errors, but it is not known how much error remains. *How Response Error, Missing Data and Undercoverage Bias Survey Data,* order number HUD-6458, is available from HUD User (see "Sources for American Housing Survey Data" in the section Explanations and Cautions).

[3]Data are the in the *Codebook for the American Housing Survey Volume 1,* available from HUD User. Newer comparisons, through for a different survey, are in *Money Income of Households Families, and Persons in the United States: 1992,* Series P60-184, pages C12-C14, available from the Superintendent of Documents (see "Sources for American Housing Survey Data" in the section Explanations and Cautions).

items where even small errors overwhelm the true data. Readers should be wary of drawing firm conclusions from items with high inconsistency or from categories smaller than a few million homes.

SAMPLING ERRORS

Sampling errors definition. Error from sampling reflects how estimates from a sample vary from the actual value. (Note: "actual value" means the value derived if all housing units had been interviewed, under the same conditions, rather than only a sample). A confidence interval is a range which contains the actual value with a specified probability. The range of nonsampling error is usually larger than this confidence interval.

Counts. Most numbers from the AHS are counts of housing units (for example, units with basements or units with an elderly person). These counts have error from sampling. Table R gives a convenient list of errors for a range of numbers. As with the other types of errors, readers should be wary of numbers with large errors from sampling.

The error from sampling cannot be known exactly. We approximate it using the following formula for constructing a 90-percent confidence interval:

$$1.64 \times \sqrt{3.85 \times A - .000034 \times A^2}$$

where A is a number (a count of units in thousands) from the AHS. This formula is an overestimate for most items. To get a more accurate estimate, use the appropriate formula in Table U. Remember in any case that the total error is larger than sampling error.

For example if A is 200:

$$1.64 \times \sqrt{3.85 \times 200 - .000034 \times 200 \times 200} = 45$$

The 90-percent confidence interval can then be formed by adding and subtracting this error to the survey estimate of 200 (that is, 200 plus or minus 45). Statements such as "the actual value is in the range 200 plus or minus 45 (155 to 245)," are right 90 percent of the time and wrong 10 percent of the time.[4]

Numbers in the book are printed in thousands, so 200 means 200,000. The formulas are designed to use numbers directly from the book; do not add zeros. The result is also in thousands, so 45 means 45,000.

[4]The formula in the text is based on 1.64 times the standard error from sampling. This formula give "90-percent confidence interval errors." For 95-percent confidence interval errors, multiply by 1.96 instead of 1.64; for 99-percent confidence, multiply by 2.58 instead of 1.64.

Table R. **Errors From Sampling**

(Numbers in thousands)

When the AHS gives one of the following numbers—	The chances are 90 percent that the actual value is inside the range of plus or minus
0	9
10	10
100	32
1,000	101
2,500	159
5,000	222
10,000	307
25,000	449
50,000	538
75,000	512
100,000	348
112,000	112

Source: These errors were computed based on a formula in Table U with high error. This table represents a conservative example. The numbers are in thousands.

Percents. Any subgroup can be shown as a percent of a larger group. The error from sampling for a 90-percent confidence interval for this percent is:

$$1.64 \times \sqrt{3.85\ P\ (100 - P)\ /A}$$

where P is the percent; A is the denominator, or base of the percent in thousands. This formula is an overestimate for most items. To get a more accurate estimate, replace the first number under the square root sign with the first number under the square root sign of the appropriate formula in Table U.[5]

For example, the error from sampling for a 90-percent confidence interval for 40 percent of 200 (meaning 200,000) is:

$$1.64 \times \sqrt{3.85 \times 40 \times 60/200} = 11.1$$

Statements such as "the actual percent is in the range 28.9 percent to 51.1 percent" are right 90 percent of the time.

Note that when a ratio C/D is computed where C is not a subgroup of D (for example, the number of Hispanics as a ratio of the number of Blacks) the error from sampling is different.[6]

[5]This formula is actually $1.64 \times \sqrt{(p(100-p)/n)}$, since 3.85/A adjusts the data to the effective sample size.

[6]The error from sampling for a 90-percent confidence interval for a ratio C/D is $C/D\sqrt{(\text{error for C/C})^2 + (\text{error for D/D})^2}$ where the error for C should be interpreted as the error for a 90-percent confidence interval for C. Likewise, the error for D should be interpreted as the error for a 90-percent confidence interval for D.

Table S. **Medians.** The following steps calculate the error from sampling for a 90-percent confidence interval for medians. This is an approximation to the error.[7]

Steps for calculations	The formula	An example	Your data
How many total units is the median based on (in thousands, exclude "not reported" and "don't know")?	A	200	
What are the end-points of the category the median is in?	X-Y	$50-74	
What is the width of this category (in dollars, rooms, or whatever the item measures?	W	$25	
How many housing units are in this median category (in thousands)?	B	30	
Then the error from sampling for the median is approximately:	$\frac{1.8 \times W \times \sqrt{A}}{B}$	$\frac{1.8 \times 25 \times \sqrt{200}}{30}$	
The 90-percent confidence interval for the median is:	median $\pm \frac{1.8 \times W \times \sqrt{A}}{B}$	median ± $21	

Differences. Two numbers from the AHS, like 34 and 40 or 40 percent and 45 percent have a "statistically significant difference" if their ranges of error from sampling for a 90-percent confidence interval do not overlap.[8]

[7]For small bases, the confidence interval on medians cannot be estimated reliably. To estimate a median's sampling error more accurately, find the sampling error on 50 percent as described under Percents and compute the 90-percent confidence interval. For example, if the error is ± 4 percentage points, the confidence interval is from 46 to 54 percent. Find the points in the distribution (that is, the 46th to 54th percentile). This is the confidence interval of the median.

[8]When ranges or error from sampling for a 90-percent confidence interval do overlap, numbers are still statistically different if the result of subtracting one from the other is more than $\sqrt{(\text{error for 1st number})^2 + (\text{error for 2nd number})^2}$. The error for first and second numbers should be interpreted as the error for a 90-percent confidence interval for the first and second numbers, respectively.

Table T. **Different Answers a Month Apart**

Item	Level of inconsistency[1]	Confidence interval [2]	When measured [3]
ITEMS WITH HIGHLY UNRELIABLE ANSWERS			
Kinds of heating equipment (central warm-air)	91	(73 - 100)	89-MS
Mortgage payment include anything else (first mortgage)	90	(72 - 111)	90-MS
Water came in from other places	81	(64 - 100)	89-MS
Other, financial/employment	80	(62 - 104)	85-MS
Other, housing related	79	(65 - 97)	85-MS
Poor city/county service	78	(63 - 95)	89-MS
Police protection	78	(63 - 95)	89-MS
Number of business rooms with direct access to outside	76	(63 - 91)	95-N
Moved for other reasons	73	(64 - 85)	85-MS
Number of other rooms	73	(64 - 83)	95-N
Difficulty hearing with or without a hearing aid	72	(59 - 88)	95-N
Rooms used both as business space and for something else	70	(62 - 80)	95-N
Cost for routine repairs and maintenance	70	(65 - 75)	95-N
Wanted better quality house	69	(58 - 82)	85-MS
Other family/personal related	68	(54 - 86)	85-MS
Cost for water supply and sewage disposal	68	(61 - 76)	81-N
Lower cost State or local mortgage	67	(54 - 83)	95-N
Other	67	(61 - 74)	89-MS
Number of living rooms	66	(53 - 82)	95-N
Shed, detached garage, or other building added or replaced in last 2 years	66	(49 - 88)	95-N
Water safe for drinking	66	(56 - 77)	95-N
Undesirable industries/businesses	66	(54 - 82)	89-MS
Difficulty reaching kitchen facilities	65	(49 - 87)	95-N
Number of family rooms, dens, recreation rooms and/or libraries	65	(57 - 75)	95-N
Rats	65	(54 - 69)	89-MS
Difficulty opening, closing, or going through any doors of home	64	(46 - 87)	95-N
Noise	64	(57 - 72)	89-MS
Difficulty moving between rooms	64	(49 - 84)	95-N
Number of business rooms without direct access to outside	64	(54 - 76)	95-N
Peeling paint on the ceiling	63	(49 - 80)	81-N
Kinds of heating equipment (none)	63	60 - 67	89-MS
How LIKELY to move to place prefer to live in 5 years	62	(54 - 71)	85-MS
Difficulty reaching bathroom facilities	62	(47 - 82)	95-N
Kinds of heating equipment (unvented room)	62	(45 - 86)	89-MS
Difficulty seeing with or without glasses or contact lenses	60	(49 - 72)	95-N
How LIKELY to still be living in this unit in 5 years	60	(49 - 74)	85-MS
Gross income	59	Not available	82-MS
Number of days worked at home	59	(49 - 72)	95-N
Patio, terrace, or detached deck added or replaced in last 2 years	58	(42 - 81)	95-N
Electric fuses or breaker switches blown	58	(50 - 68)	81-N
Open cracks or holes in building	58	(47 - 72)	81-N
People	57	(52 - 62)	89-MS
Other major repairs over $500 each—repair done	57	(50 - 64)	85-MS
Work done in last 2 years to attic, basement, garage, or unfinished area of home	56	(44 - 71)	95-N
Difficulty going up and down steps	56	(46 - 69)	95-N
Central air conditioning/dehumidifier	56	Not available	80-N
Satisfactory police protection	55	(49 - 62)	77-N
Wanted lower rent or less expensive house to maintain	55	(43 - 70)	85-MS
Broken plaster or peeling paint	55	(46 - 65)	89-MS
Water came in from walls, doors, windows	55	(45 - 67)	89-MS A
Working electric wall outlet	55	(42 - 71)	77-N
Home equity loans	55	(48 - 64)	95-N
Kinds of heating equipment (fireplace with no insert)	54	(49 - 59)	89-MS
Shopping	54	(47 - 61)	77-N
Special modifications, equipment, or assistance needed because of physical limitation	54	(44 - 66)	95-N

Table T. **Different Answers a Month Apart**—Con.

Item	Level of inconsistency[1]	Confidence interval [2]	When measured [3]
ITEMS WITH HIGHLY UNRELIABLE ANSWERS—Con.			
Difficulty entering and exiting home	54	(43 - 67)	95-N
Broken plaster on the ceiling	53	(40 - 70)	81-N
Water came in from roof	53	(46 - 60)	89-MS
Driveways or walkways added or replaced in last 2 years	53	(42 - 67)	95-N
Difficulty with personal activities—bathing/showering	53	(42 - 66)	95-N
Payments the same during whole length of the mortgage	52	(46 - 59)	85-MS
Difficulty with personal activities—cooking and preparing food	52	(41 - 66)	95-N
Other major repairs over $500 each—someone in household do work	51	(36 - 72)	85-MS
Number of hours worked at home as self-employed, contract worker, or business owner	51	(43 - 61)	95-N
Litter	51	(44 - 60)	89-MS
Which best describes place at that time	51	(46 - 55)	85-MS
Rate the place (10 categories)	51	(49 - 53)	89-MS
Main reason moved	51	(47 - 55)	85-MS
Yearly cost for garbage	51	(43 - 62)	81-N
ITEMS WITH MODERATELY RELIABLE ANSWERS			
Holes in the floors	50	(33 - 74)	81-N
Type of vacant	50	(38 - 65)	81-N
Cookstove or range with oven	50	(39 - 64)	85-N
Public transportation	50	(44 - 56)	77-N
Oil, coal, kerosene, wood and any other fuel cost	50	(40 - 64)	81-N
Kinds of heating equipment (other built-in electric)	50	(38 - 66)	89-MS
Central air fuel	50	(40 - 63)	85-N
At age 16, live in this area/different place	50	(44 - 57)	85-MS
Difficulty with personal activities—housework/laundry	50	(41 - 61)	95-N
Do work at home	50	(43 - 58)	95-N
Traffic	49	(43 - 54)	89-MS
To establish own household	48	(38 - 59)	85-MS
Rate the place (categories 1-6 combined)	48	(46 - 51)	89-MS
Fencing or walls added or replaced in last 2 years	48	(37 - 61)	95-N
Drive to work alone or with others	48	(38 - 59)	95-N
Real estate taxes	47	(33 - 67)	81-N
Kinds of heating equipment (portable electric)	47	(41 - 54)	89-MS
Central air conditioning/none	47	Not available	80-N
Crime	47	(41 - 53)	89-MS
Bathroom or kitchen remodeled in last 2 years	46	(39 - 54)	95-N
Fixed place of work	46	(37 - 57)	95-N
Any additions built—repair done	46	(35 - 61)	85-MS
Water came in from basement	45	(38 - 55)	89-MS
Any other rooms	45	(42 - 49)	95-N
Change from owner to renter/renter to owner	44	(36 - 55)	85-MS
Five years from now, would you prefer living in this area or someplace else	44	(32 - 60)	80-N
Major equipment, such as furnace or central air replaced or added—repair done	44	(35 - 55)	85-MS
Major disaster in last 2 years required repairs	44	(31 - 60)	95-N
Water leaked into home from outdoors	43	(39 - 47)	89-MS
Concealed wiring	43	(33 - 57)	89-MS
Kinds of heating equipment (fireplace with insert)	43	(35 - 52)	89-MS
Rate the place (4 combined categories)	43	(41 - 46)	89-MS
Difficulty with personal activities - grooming/dressing	43	(30 - 60)	95-N
Siding replaced or added in last 2 years - repair done	42	(32 - 56)	85-MS
Be closer to school/work	41	(32 - 53)	85-MS
Yearly cost of insurance (reported in $100 increments to $1,000)	41	(38 - 44)	89-MS
Heat breakdown	41	(30 - 56)	89-MS
Heating equipment broke down for 6 hours or more	41	(30 - 56)	89-MS
Public elementary school satisfactory	40	(34 - 47)	89-MS
Cost for real estate taxes	40	(35 - 46)	81-N

Table T. **Different Answers a Month Apart**—Con.

Item	Level of inconsistency[1]	Confidence interval [2]	When measured [3]
ITEMS WITH MODERATELY RELIABLE ANSWERS—Con.			
Mice or rats or signs of	40	Not available	76-N
House/apartment cold for 24 hours	40	(36 - 45)	89-MS
Central air conditioning/portable fan	40	Not available	80-N
Current mortgage same year as bought home	39	(27 - 56)	85-MS
Mode of transportation to work last week	38	(31 - 46)	95-N
Anything about the neighborhood that bothers you	38	(35 - 41)	89-MS
Prefer to be living in another home in this area in 5 years	38	(31 - 48)	85-MS
Change in taxes/insurance/principal balance	37	(28 - 51)	85-MS
Number of mortgages on home/property	36	(28 - 47)	95-N
Kinds of heating equipment (stove)	36	(28 - 47)	89-MS
Costs for gas for the month of August	35	(24 - 54)	89-N
Bathrooms remodeled or added—repair done	35	(28 - 45)	85-MS
All or part of roof replaced in last 2 years—repair done	35	(29 - 42)	85-MS
Married, widowed, divorced, or separated	35	Not available	85-MS
Number of dining rooms	35	(32 - 38)	95-N
Highest level of school/degree	34	(32 - 35)	95-N
New storm doors or storm windows bought and installed—repair done	33	(27 - 41)	85-MS
Needed larger house or apartment	33	(26 - 41)	85-MS
Number of homes source of water serving	33	(22 - 49)	95-N
Number of other rooms	32	(28 - 38)	85-N
Insulation added—repair done	32	(25 - 44)	85-MS
Kitchen remodeled or added - repair done	32	(25 - 41)	85-MS
House and lot sell on today's market	31	[29-34]	90-MS
New job or job transfer	30	(22 - 39)	85-MS
Average monthly cost for gas	29	(23 - 37)	89-N
Average monthly cost for electricity	28	(24 - 34)	89-N
Type of mortgage (for the first mortgage/loan) (nonCATI)[4]	27	(21 - 36)	89-N
Change based on interest rates	26	(18 - 38)	85-MS
Year the building was built	25	Not available	85-MS
All or part of roof replaced in last 2 years—someone in household do work	25	(15 - 44)	85-MS
Number of family rooms	25	(21 - 30)	85-N
Mortgage payment include homeowner's insurance (first mortgage)	24	(21 - 27)	90-MS
Prefer to be living in this house/apartment/someplace else	24	(20 - 29)	85-MS
Number of half bathrooms	24	(20 - 27)	95-N
Clothes washer age	22	(19 - 25)	85-N
How many years for mortgage	22	(17 - 29)	85-MS
ITEMS WITH HIGHLY RELIABLE ANSWERS			
Attend a public school or a private school	19	(15 - 25)	89-MS
New storm doors or storm windows bought and installed—someone in household do work	19	(11 - 35)	85-MS
Garbage disposal age	18	(15 - 22)	85-N
Refrigerator age	18	(16 - 20)	85-N
Heating equipment broke	18	(9 - 34)	89-MS
Clothes dryer age	18	(15 - 21)	85-N
Oven/cooking burner age	18	(16 - 21)	85-N
Monthly payment (first mortgage)	16	(14 - 18)	90-MS
Insulation added—someone in household do work	16	(8 - 33)	85-MS
New storm doors or storm windows bought and installed—job cost	15	(8 - 32)	85-MS
Mortgage payment include property tax (first mortgage)	15	(12 - 18)	90-MS
New/assume	15	(11 - 22)	85-MS
How much was borrowed	14	(11 - 18)	85-MS
Monthly payment (for first mortgage/loan) (non-CATI)	14	(11 - 19)	89-N
Mortgage, home equity loan or other loan on this house/ apartment	14	(11 - 17)	95-N
Dishwasher age	14	(11 - 17)	85-N
Number of full bathrooms	13	(11 - 15)	95-N
Where was mortgage borrowed (non-CATI)	13	(7 - 28)	89-N
How much was borrowed (for the first mortgage/loan)? (non-CATI)	13	(10 - 17)	89-N
Number of bedrooms	12	(11 - 14)	95-N

Table T. **Different Answers a Month Apart**—Con.

Item	Level of inconsistency[1]	Confidence interval [2]	When measured [3]
ITEMS WITH HIGHLY RELIABLE ANSWERS—Con.			
Clothes dryer fuel	12	(9 - 14)	85-N
Insurance	12	(10 - 14)	89-MS
Number of room air conditioners	11	(9 - 15)	85-N
Room air conditioners	10	(8 - 12)	85-N
Interest rate on the mortgage (for the first mortgage/loan) (non-CATI)	10	(7 - 15)	89-N
Source of water serving 15 or more homes	10	(8 - 13)	95-N
Kitchen remodeled or added—someone in household do work	9	(3 - 26)	85-MS
Number of units in building	8	(6 - 9)	85-N
Clothes washer	8	(6 - 9)	85-N
Living quarters	8	(6 - 9)	85-N
Source of water	8	(6 -11)	95-N
Dishwasher	6	(5 - 7)	85-N
Garbage disposal	5	(4 - 7)	85-N
Number of apartments	5	(4 - 8)	85-N
Central air conditioning	5	(4 - 6)	85-N
Clothes dryer	5	(4 - 7)	85-N
Cooking fuel	5	(4 - 6)	85-N

[1]Levels are in percents. They are nearly the same as: 100 minus the correlation between answers in the original interview and the reinterview a month later. For example, an inconsistency of 80 means a correlation of 20 percent, which is not good.
[2]Square brackets show 90-percent confidence intervals. Parentheses show 95-percent confidence intervals (used in 1988 and before).
[3]Measured in National Surveys (N) or metropolitan surveys (MS).
[4]CATI is computer-assisted telephone interviewing; where shown, inconsistency was measured separately for CATI and non-CATI interviews.

Table U. **Formulas for Error From Sampling**

The letter "A" in the formulas represents a number (a count of units in thousands) from AHS (see Sampling Errors text for an example a of how "A" is used). The minimum error from sampling is ±9 (meaning ±9 thousand).[1] If a formula gives an error smaller than 9, use 9.

The formulas give the errors for a 90-percent confidence interval. For 95-percent confidence interval, multiply by 1.96 instead of 1.64; for a 99-percent confidence interval, multiply by 2.58 instead of 1.64.

If an item falls into two different categories in Table U, use the formula that gives the largest error. For example, for Hispanics' income in the South, use the formulas for the South. (Since there is no specific formula for income, errors for the South will be bigger than those for Hispanics).

Characteristics	General formulas—All items except those listed under other formulas	Other formulas	
		Fuels, heating/cooling equipment and neighborhood items	Special items (defined below)
Total units, Midwest, West, elderly, Black, new construction, mobile homes, vacants	$1.64 \times \sqrt{3.16 \times A - 0.000028 \times A^2}$	$1.64 \times \sqrt{3.16 \times A - 0.000028 \times A^2}$	$1.64 \times \sqrt{3.85 \times A + 0.000255 \times A^2}$
Northeast, central city, Hispanic, urban, suburbs	$1.64 \times \sqrt{2.51 \times A - .000022 \times A^2}$	$1.64 \times \sqrt{2.51 \times A - .000022 \times A^2}$	$1.64 \times \sqrt{3.85 \times A + 0.000255 \times A^2}$
Rural, South, outside (P)MSAs	$1.64 \times \sqrt{3.02 \times A - 0.000027 \times A^2}$	$1.64 \times \sqrt{3.85 \times A - 0.000034 \times A^2}$	$1.64 \times \sqrt{3.85 \times A + 0.000255 \times A^2}$

Neighborhood items include all characteristics in Table 2-8 "Neighborhood" tables except those listed as a special item.

We define the following items as special items:

1. Cooperatives or condominiums
2. No complete bathroom
3. Less than 1,500 square feet of detached one-family or mobile homes
4. Well serving 1 to 5 units
5. Mobile homes in a group
6. Area within 300 feet includes open space, park, farm, or ranch
7. Septic tank, cesspool, chemical toilet
8. Five or more acres in lot size
9. No bedroom
10. No complete bathroom
11. Lacking complete kitchen facilities
12. Lacking some plumbing facilities
13. No flush toilet
14. Major street repairs needed

[1]This minimum formula is based on the binomial 90-percent confidence interval on zero, $U \times (1-.1^{3.85/U}) = 9$ (where U is the total number of homes from the AHS). For a 95-percent confidence interval, substitute .05 for .1 in the above formula. For a 99-percent confidence interval, substitute .01 for .1. More discussion and other approximations are in the paper "Sampling Errors for Small Groups" available from HUD User (see "Sources for American Housing Survey Data" in the section Explanations and Cautions).