

Appendix D. Errors

All numbers in this book are estimates. As in other surveys, errors come primarily from wrong answers, incomplete data, and sampling.

NONSAMPLING ERRORS

Nonsampling errors are usually the largest source of errors, larger than sampling errors. Worse errors, from wrong answers and from incomplete data, apply to some items, are discussed in the next paragraphs.

Wrong answers. Wrong answers happen because people misunderstand questions, cannot recall the correct answer, or do not want to give the right answer. Table H shows which items have high inconsistency when people are reinterviewed after a few weeks. The actual survey cannot catch and reconcile these inconsistencies, so a high rate of wrong answers remains. 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.

The numbers in table H 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, (e.g., income groups), are infected with data from people who really are not like the group at all. Readers should be wary of drawing firm conclusions from items with high inconsistency.

Coverage errors. Each home in the AHS-MS sample represents a large number of other homes. However, because of incomplete sampling lists (i.e., undercoverage) the homes in the survey do not represent all homes in this metropolitan area. Therefore, the raw numbers from the survey are raised proportionally so that the numbers published here match independent estimates of the total number of homes. These independent estimates are based on the 1990 Census of Housing, plus changes since then. The approximate housing unit undercoverage rates for the metropolitan areas in 1993 AHS-MS are given in table A. Table B lists units that have known coverage deficiencies.

Table A. Approximate Undercoverage Rates

MSA	Undercoverage rate (percent)
Boston, MA-NH	Less than 1
Detroit, MI	6
Minneapolis-St. Paul, MN-WI	4
San Francisco-Oakland, CA	4
San Jose, CA	3
Tampa-St. Petersburg, FL	9
Washington, DC-MD-VA	5

Table B. Undercoverage Units

Type of unit	Reason for undercoverage
Mobile homes	Poor coverage of new mobile home parks in permit-issuing areas
Conventional new construction	Permits issued less than 8 months before interviewing are not considered
New construction in special places	Not covered in either permit-issuing or nonpermit-issuing areas
Conversions from nonresidential units	Nonresidential units at the time of the 1970 or 1980 census which converted to residential units were missed

Incomplete data. Incomplete data happen because sampling lists are incomplete; and because people refuse the interview or some of the questions, or do not know answers. Table C shows, for the 1993 AHS-National sample, some of the items that have the least complete data for all units and for those below the poverty level. The rates in table C indicate what percent of the publication estimates are based on actual responses. These are primarily items that people forget or consider personal: mortgages, other housing costs, and income. The computer may assign, or "impute" values for these items. We do not know how close the imputed values are to the actual values. 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 U.S.). 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. Thus it is not surprising that large nonsampling errors are possible when the survey has data for only 50-90 percent of homes for

Table C. Selected Completeness Rates for the American Housing Survey—1993 National Sample

Characteristics	Total occupied units	Units below poverty level
Current loan as percent of value	39	26
Total outstanding principal amount	41	29
Income sources of families and primary individuals	52	59
Land rent fee	59	-
Mobile home park fee	66	-
Lot size	68	54
Ratio of value to current income	68	47
Annual taxes paid per \$5,000 value	69	51
Mobile home site placement	70	65
Monthly housing costs as percent of income	72	64
Light fixtures in public halls	73	73
Previous occupancy	75	67
Household income	76	70
Income of families and primary individuals	76	69
Square feet per person	76	69
Household income as percent of poverty level	76	70
Square footage of unit	76	69
Units using each fuel	77	70
Average monthly cost for real estate taxes	77	67
Value	79	65
Property insurance paid	79	80
Monthly payment for principal and interest	79	67

- means not applicable or sample too small.

particular items.¹ Again readers should be wary of items likely to have highly incomplete data.²

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

SAMPLING ERRORS

Definition. Error from sampling reflects how estimates from a sample vary from the actual value. (Note: "actual value" means the value that would appear 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 estimate with a specified probability.)

¹For a table of completeness rates for all items in the 1993 AHS-National sample, see appendix D, table 2, in *American Housing Survey for the United States in 1993* (H150/93).

²Statistical note: The paper, "How Response Error, Missing Data and Undercoverage Bias Survey Data," estimates that 90 percent of errors from incomplete data are less than: $200 + .058 \times (\text{lesser of } A \text{ or } 100,000 - A)$, where A is any count published in this book (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" is available from HUD User at the address in "Explanation and Cautions" at the front of this book.

Counts. Most numbers in this book are counts of housing units (e.g., units with basements or units with an elderly person). These counts have error from sampling. Table D gives a convenient list of errors for a range of numbers. These errors are an overestimate for most items. To get a more accurate answer, use the appropriate formula shown in table E. As with the other types of errors, readers should be wary of numbers with large errors from sampling.

Table D presents conservative examples of sampling errors to compute 90-percent confidence intervals. To obtain errors for estimates not included in table D, refer to table E. To construct the range, add and subtract the error computed from the formulas to the publication estimate. For estimates involving building loss housing units, multiply the error by the factors given in the footnote of the appropriate table (table D or E).

The letter "A" in the formulas represents the publication estimate. These estimates are given in thousands and should be used in the formulas as given; do not add zeros.

Ranges of 90 and 95 percent are commonly used. The range of error is also referred to as the confidence interval since there is a certain level of confidence the actual value is within the interval.

Example: For example, table 1-1 shows 928,800 owner-occupied housing units in the Boston, MA-NH CMSA (i.e., A is 928.8).

Apply the appropriate formula from table E to obtain a 90-percent confidence interval:

$$1.64 \times \sqrt{(.361833 \times 928.8) - (.000215 \times 928.8 \times 928.8)} = 20.1$$

The 90-percent confidence interval can then be formed by adding and subtracting this error to the survey estimate of 928.8 (i.e., 928.8 ± 20.1). Statements such as the actual value is in the range 928.8 ± 20.1 (908.7 to 948.9) are right 90 percent of the time and wrong 10 percent of the time.

Percents. The reliability of an estimated percentage, computed by using the sample data for both numerator and denominator, depends upon both the size of the percentage and the size of the total upon which the percentage is based. Estimated percentages are relatively more reliable than the corresponding estimates of the numerators of the percentages, particularly if the percentages are 50 percent or more.

To obtain a 90-percent confidence interval error associated with a percentage use the appropriate formula in table F. For estimates involving building loss housing units, multiply the error by the factors given in the footnote of table F.

The "p" is the estimated percentage, and the "A" is the base (denominator) of the percentage.

Example: Table 1-1 shows that of 1,535,500 occupied housing units in Boston, 248,000 or 16.2 percent had four

rooms. Apply the appropriate formula from table F to obtain a 90-percent confidence interval error for the percentage:

$$0.9 = 1.64 \times \sqrt{\frac{.370536 \times 16.2 (100 - 16.2)}{(1,535.5)}}$$

Consequently, there is a 90-percent chance we'd be correct if we concluded that the actual proportion is within the range 16.2 ± 0.9 , or 15.3 to 17.1 percent.

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. The error from sampling for a 90-percent confidence interval for a ratio C/D is:

$$C/D \times \sqrt{((\text{error for C})/C)^2 + ((\text{error for D})/D)^2}$$

Medians. The following steps in table G calculate the error from sampling for a 90-percent confidence interval for medians. For medians with small bases, use the more accurate approach in table I.

Differences. Two numbers from this book, 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. When ranges of error 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:

$$\sqrt{(\text{error for first number})^2 + (\text{error for second number})^2}$$

Table 1-1 shows that 280,100 occupied housing units in the Boston area have 5 rooms. The difference between occupied units with 4 rooms and occupied units with 5 rooms is 32,100 (32.1). The error for 248.0 is 14.5, and the error for 280.1 is 15.3. The 90-percent confidence interval for the difference is:

$$32.1 \pm \sqrt{14.5^2 + 15.3^2} \\ = 32.1 \pm 21.1$$

Since the interval does not include zero, we can conclude that these two estimates are statistically different.

Table D. Errors From Sampling to Compute a 90-Percent Confidence Interval¹

Size of estimate	Boston, MA-NH CMSA	Detroit, MI PMSA	Minneapolis- St. Paul, MN-WI MSA	San Francisco- Oakland, CA PMSA's	San Jose, CA PMSA	Tampa- St. Petersburg, FL MSA	Washington, DC-MD-VA MSA
0	0.4	0.5	0.3	0.3	0.1	0.3	0.4
1	1.0	1.1	0.9	1.0	0.6	0.9	1.0
5	2.2	2.5	2.0	2.1	1.4	1.9	2.2
10	3.1	3.6	2.8	3.0	1.9	2.7	3.1
25	5.0	5.6	4.3	4.7	3.0	4.3	4.9
50	7.0	7.9	6.0	6.6	4.1	6.0	6.8
75	8.5	9.6	7.3	8.0	4.9	7.3	8.3
100	9.7	11.0	8.3	9.2	5.5	8.3	9.5
300	15.7	17.8	12.8	14.8	7.2	12.8	15.4
500	18.7	21.4	14.2	17.5	4.4	14.2	18.3
700	20.2	23.2	13.3	18.6	NA	13.6	19.7
900	20.4	23.7	9.8	18.4	NA	10.6	19.8
1,110	19.5	23.0	NA	16.9	NA	NA	18.7
1,300	17.2	21.0	NA	13.6	NA	NA	16.2
1,500	12.8	17.1	NA	6.2	NA	NA	11.2

NA means not applicable.

¹For estimates of building losses in San Jose, apply a factor of 1.1 to the formula to obtain an error of the estimate. For estimates of building losses in all other MSA's, apply a factor of 1.2.

Table E. Formulas for 90-Percent Confidence Intervals¹

MSA and estimate type	The formula is— ²
Boston, MA-NH CMSA:	
Owner	$1.64 \times \sqrt{(.361833 \times A) - (.000215 \times A^2)}$
Renter	$1.64 \times \sqrt{(.357349 \times A) - (.000212 \times A^2)}$
Combined owner and renter	$1.64 \times \sqrt{(.370536 \times A) - (.000220 \times A^2)}$
Mobile homes	$1.64 \times \sqrt{(.759643 \times A) - (.045000 \times A^2)}$
New construction	$1.64 \times \sqrt{(.421516 \times A) - (.000250 \times A^2)}$
Detroit, MI PMSA:	
Owner	$1.64 \times \sqrt{(.473252 \times A) - (.000267 \times A^2)}$
Renter	$1.64 \times \sqrt{(.363751 \times A) - (.000206 \times A^2)}$
Combined owner and renter	$1.64 \times \sqrt{(.438371 \times A) - (.000248 \times A^2)}$
Mobile homes	$1.64 \times \sqrt{(.838555 \times A) - (.014003 \times A^2)}$
New construction	$1.64 \times \sqrt{(.279980 \times A) - (.000158 \times A^2)}$
Minneapolis-St. Paul, MN-WI MSA:	
Owner	$1.64 \times \sqrt{(.285549 \times A) - (.000273 \times A^2)}$
Renter	$1.64 \times \sqrt{(.217346 \times A) - (.000208 \times A^2)}$
Combined owner and renter	$1.64 \times \sqrt{(.243971 \times A) - (.000234 \times A^2)}$
Mobile homes	$1.64 \times \sqrt{(.301688 \times A) - (.012815 \times A^2)}$
New construction	$1.64 \times \sqrt{(.271868 \times A) - (.000260 \times A^2)}$
San Francisco-Oakland, CA PMSA's:	
Owner	$1.64 \times \sqrt{(.333877 \times A) - (.000216 \times A^2)}$
Renter	$1.64 \times \sqrt{(.326409 \times A) - (.000211 \times A^2)}$
Combined owner and renter	$1.64 \times \sqrt{(.336382 \times A) - (.000218 \times A^2)}$
Mobile homes	$1.64 \times \sqrt{(.425270 \times A) - (.020401 \times A^2)}$
New construction	$1.64 \times \sqrt{(.308025 \times A) - (.000199 \times A^2)}$
San Jose, CA PMSA:	
Owner	$1.64 \times \sqrt{(.138179 \times A) - (.000248 \times A^2)}$
Renter	$1.64 \times \sqrt{(.114978 \times A) - (.000210 \times A^2)}$
Combined owner and renter	$1.64 \times \sqrt{(.122250 \times A) - (.000220 \times A^2)}$
Mobile homes	$1.64 \times \sqrt{(.155216 \times A) - (.006593 \times A^2)}$
New construction	$1.64 \times \sqrt{(.147572 \times A) - (.000265 \times A^2)}$

Table E. Formulas for 90-Percent Confidence Intervals¹—Con.

MSA and estimate type	The formula is— ²
Tampa-St. Petersburg, FL MSA:	
Owner	$1.64 \times \sqrt{(.280116 \times A) - (.000260 \times A^2)}$
Renter	$1.64 \times \sqrt{(.203222 \times A) - (.000189 \times A^2)}$
Combined owner and renter	$1.64 \times \sqrt{(.245353 \times A) - (.000228 \times A^2)}$
Mobile homes.....	$1.64 \times \sqrt{(.4308722 \times A) - (.002554 \times A^2)}$
New construction.....	$1.64 \times \sqrt{(.234788 \times A) - (.000218 \times A^2)}$
Washington, DC-MD-VA MSA:	
Owner	$1.64 \times \sqrt{(.359432 \times A) - (.000219 \times A^2)}$
Renter	$1.64 \times \sqrt{(.350801 \times A) - (.000214 \times A^2)}$
Combined owner and renter	$1.64 \times \sqrt{(.355741 \times A) - (.000217 \times A^2)}$
Mobile homes.....	$1.64 \times \sqrt{(.576793 \times A) - (.050239 \times A^2)}$
New construction.....	$1.64 \times \sqrt{(.302465 \times A) - (.000184 \times A^2)}$

¹The formulas in the text are based on 1.64 times the error from sampling. This formula gives 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.

²For estimates of building losses in San Jose, apply a factor of 1.1 to the results of these formulas to obtain an error of the estimate. For estimates of building losses in all other MSA's, apply a factor of 1.2.

Table F. Formulas for 90-Percent Confidence Intervals Associated With a Percentages

MSA and estimate type	The formula is— ^{1 2}
Boston, MA-NH CMSA:	
Owner	$1.64 \times \sqrt{(.361833 \times p \times (100-p))/A}$
Renter	$1.64 \times \sqrt{(.357349 \times p \times (100-p))/A}$
Combined owner and renter	$1.64 \times \sqrt{(.370536 \times p \times (100-p))/A}$
Mobile homes	$1.64 \times \sqrt{(.759643 \times p \times (100-p))/A}$
New construction	$1.64 \times \sqrt{(.421516 \times p \times (100-p))/A}$
Detroit, MI PMSA:	
Owner	$1.64 \times \sqrt{(.473252 \times p \times (100-p))/A}$
Renter	$1.64 \times \sqrt{(.363751 \times p \times (100-p))/A}$
Combined owner and renter	$1.64 \times \sqrt{(.438371 \times p \times (100-p))/A}$
Mobile homes	$1.64 \times \sqrt{(.838555 \times p \times (100-p))/A}$
New construction	$1.64 \times \sqrt{(.279980 \times p \times (100-p))/A}$
Minneapolis-St. Paul, MN-WI MSA:	
Owner	$1.64 \times \sqrt{(.285549 \times p \times (100-p))/A}$
Renter	$1.64 \times \sqrt{(.217346 \times p \times (100-p))/A}$
Combined owner and renter	$1.64 \times \sqrt{(.243971 \times p \times (100-p))/A}$
Mobile homes	$1.64 \times \sqrt{(.301688 \times p \times (100-p))/A}$
New construction	$1.64 \times \sqrt{(.271868 \times p \times (100-p))/A}$
San Francisco-Oakland, CA PMSA's:	
Owner	$1.64 \times \sqrt{(.333877 \times p \times (100-p))/A}$
Renter	$1.64 \times \sqrt{(.326409 \times p \times (100-p))/A}$
Combined owner and renter	$1.64 \times \sqrt{(.336382 \times p \times (100-p))/A}$
Mobile homes	$1.64 \times \sqrt{(.425270 \times p \times (100-p))/A}$
New construction	$1.64 \times \sqrt{(.308025 \times p \times (100-p))/A}$
San Jose, CA PMSA:	
Owner	$1.64 \times \sqrt{(.138179 \times p \times (100-p))/A}$
Renter	$1.64 \times \sqrt{(.114978 \times p \times (100-p))/A}$
Combined owner and renter	$1.64 \times \sqrt{(.122250 \times p \times (100-p))/A}$
Mobile homes	$1.64 \times \sqrt{(.155216 \times p \times (100-p))/A}$
New construction	$1.64 \times \sqrt{(.147572 \times p \times (100-p))/A}$

Table F. Formulas for 90-Percent Confidence Intervals Associated With a Percentages—Con.

MSA and estimate type	The formula is— ^{1 2}
Tampa-St. Petersburg, FL MSA:	
Owner	$1.64 \times \sqrt{(.280116 \times p \times (100-p))/A}$
Renter	$1.64 \times \sqrt{(.203222 \times p \times (100-p))/A}$
Combined owner and renter	$1.64 \times \sqrt{(.245353 \times p \times (100-p))/A}$
Mobile homes.....	$1.64 \times \sqrt{(.430872 \times p \times (100-p))/A}$
New construction.....	$1.64 \times \sqrt{(.234788 \times p \times (100-p))/A}$
Washington, DC-MD-VA MSA:	
Owner	$1.64 \times \sqrt{(.359432 \times p \times (100-p))/A}$
Renter	$1.64 \times \sqrt{(.350801 \times p \times (100-p))/A}$
Combined owner and renter	$1.64 \times \sqrt{(.355741 \times p \times (100-p))/A}$
Mobile homes.....	$1.64 \times \sqrt{(.576793 \times p \times (100-p))/A}$
New construction.....	$1.64 \times \sqrt{(.302465 \times p \times (100-p))/A}$

¹For estimates of building losses in San Jose, apply a factor of 1.1 to the results of these formulas to obtain an error of the estimate. For estimates of building losses in all other MSA's, apply a factor of 1.2.

²These formulas are equivalent to $1.64 \times 9100-p/n$. Since for owners in Boston, for example, .361833/A adjusts the data to the effective sample size.

Table G. How to Compute a 90-Percent Confidence Interval for a Median

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	1410.7	_____
What are the end-points of the category the median is in?	X - Y	\$700-7,99	_____
What is the width of this category (in dollars, rooms, or whatever the item measures)?	W	\$100	_____
How many housing units are in this median category (in thousands)?	B	117.8	_____
Then the error from sampling for the median is approximately: ¹	$\frac{K \times W \times \sqrt{A}}{B}$	$\frac{.499 \times 100 \times \sqrt{1410.7}}{117.8}$	_____
The 90-percent confidence interval for the median is:	median $\pm \frac{.499 \times W \times \sqrt{A}}{B}$	median \pm \$15.9	_____

¹The appropriate value for K is obtained by multiplying the numerator of the formula for computing the error from sampling for 50 percent by a factor of .01. Refer to table F for the appropriate formula. For example, for combined owner and renter occupied units in Boston, MA-NH CMSA, $K = .01 \times (1.64 \times \sqrt{.370536 \times 50 \times 50}) = .499$; for owner occupied units in Boston, $K = .493$; for renter occupied units in Boston, $K = .490$; for mobile homes in Boston, $K = .715$; and for new construction units in Boston, $K = .532$.

Table H. Different Answers a Month Apart

Item	When measured ¹	Level of inconsistency	Confidence interval ²
Other kinds of heating equipment (central warm-air)	89-MS	91	[73-100]
Mortgage payment include anything else (first mortgage)	90-MS	90	[72-111]
Water came in from other places	89-MS	81	[64-100]
Moved for other, financial/employment	85-MS	80	[62-104]
Moved for other, housing related	85-MS	79	[65-97]
Police protection problem in neighborhood	89-MS	78	[63-95]
Poor city/county service in neighborhood	89-MS	78	[63-95]
Moved for other reason	85-MS	73	[64-85]
Moved for better quality house	85-MS	69	[58-82]
Moved because other family/personal related	85-MS	68	[54-86]
Cost for water supply and sewage disposal	81-N	68	[61-76]
Other problem in neighborhood	89-MS	67	[61-74]
Undesirable industries/businesses in neighborhood	89-MS	66	[54-82]
Rats	89-MS	65	[54-69]
Noise in neighborhood	89-MS	64	[57-72]
Other kinds of heating equipment (none)	89-MS	63	[60-67]
Peeling paint on the ceiling	81-N	63	[49-80]
Other kinds of heating equipment (unvented room)	89-MS	62	[45-86]
How LIKELY to move to place prefer to live in 5 years	85-MS	62	[54-71]
How LIKELY to still be living in this unit in 5 years	85-MS	60	[49-74]
Gross income	82-MS	59	not available
Open cracks or holes in building	81-N	58	[47-72]
Electric fuses or breaker switches blown	81-N	58	[50-68]
Other major repairs over \$500 each—repair done	85-MS	57	[50-64]
People in neighborhood	89-MS	57	[52-62]
Central air conditioning/dehumidifier	80-N	56	not available
Satisfactory police protection	77-N	55	[49-62]
Moved for lower rent or less expensive house to maintain	85-MS	55	[43-70]
Broken plaster or peeling paint	89-MS	55	[46-65]
Water came in from walls, doors, windows	89-MS	55	[45-67]
A working electric wall outlet	77-N	55	[42-71]
Other kinds of heating equipment (fireplace with no insert)	89-MS	54	[49-59]
Shopping	77-N	54	[47-61]
Broken plaster on the ceiling	81-N	53	[40-70]
Water came in from roof	89-MS	53	[46-60]
Payments the same during whole length of the mortgage	85-MS	52	[46-59]
Litter in neighborhood	89-MS	51	[44-60]
Main reason moved	85-MS	51	[47-55]
Which best describes place at that time	85-MS	51	[46-55]
Yearly cost for garbage	81-N	51	[43-62]
Rate the place (10 categories)	89-MS	51	[49-53]
Other major repairs over \$500 each—someone in household do work	85-MS	51	[36-72]
Other kinds of heating equipment (other built-in electric)	89-MS	50	[38-66]
Holes in the floors	81-N	50	[33-74]
Oil, coal, kerosene, wood and any other fuel cost	81-N	50	[40-64]
Type of vacant	81-N	50	[38-65]
Central air fuel	85-N	50	[40-63]
At age 16, live in this area/different place	85-MS	50	[44-57]
Public transportation	77-N	50	[44-56]
Cookstove or range with oven	85-N	50	[39-64]
Traffic in neighborhood	89-MS	49	[43-54]
Moved to establish own household	85-MS	48	[38-59]
Rate the place (categories 1-6 combined)	89-MS	48	[46-51]
Other kinds of heating equipment (portable electric)	89-MS	47	[41-54]
Real estate taxes	81-N	47	[33-67]
Central air conditioning/none	80-N	47	not available
Crime in neighborhood	89-MS	47	[41-53]
Any additions built—repair done	85-MS	46	[35-61]
Water came in from basement	89-MS	45	[38-55]
Moved to change from owner to renter/renter to owner	85-MS	44	[36-55]

Table H. Different Answers a Month Apart—Con.

Item	When measured ¹	Level of inconsistency	Confidence interval ²
Number of living rooms	85-N	44	(33-57)
Major equipment, such as furnace or central air replace /added—repair done	85-MS	44	(35-55)
Five years from now, would you prefer living in this area or someplace else	80-N	44	(32-60)
Water leaked into home from outdoors	89-MS	43	[39-47]
Rate the place (4 combined categories)	89-MS	43	[41-46]
Other kinds of heating equipment (fireplace with insert)	89-MS	43	[35-52]
Concealed wiring	89-MS	43	[33-57]
Siding replaced or added in last 2 years—repair done	85-MS	42	(32-56)
Heat breakdown	89-MS	41	[30-56]
Yearly cost of insurance (reported in \$100 increments to \$1,000)	89-MS	41	[38-44]
Moved to be closer to school/work	85-MS	41	(32-53)
Heating equipment broke down for 6 hours or more	89-MS	41	[30-56]
Cost for real estate taxes	81-N	40	(35-46)
Central air conditioning/portable fan	80-N	40	not available
Public elementary school satisfactory	89-MS	40	[34-47]
Mice or rats or signs of	76-N	40	not available
House/apartment cold for 24 hours	89-MS	40	[36-45]
Current mortgage same year as bought home	85-MS	39	(27-56)
Prefer to be living in another home in this area in 5 years	85-MS	38	(31-48)
Anything about the neighborhood that bothers you	89-MS	38	[35-41]
Change in taxes/insurance/principal balance	85-MS	37	(28-51)
Other kinds of heating equipment (stove)	89-MS	36	[28-47]
Bathrooms remodeled or added—repair done	85-MS	35	(28-45)
Married, widowed, divorced, or separated	85-MS	35	not available
Costs for gas for the month of August	89-N	35	[24-54]
All or part of roof replaced in last 2 years—repair done	85-MS	35	(29-42)
New storm doors or storm windows bought, installed—repair done	85-MS	33	(27-41)
Moved because needed larger house or apartment	85-MS	33	(26-41)
Number of other rooms	85-N	32	(28-38)
Kitchen remodeled or added—repair done	85-MS	32	(25-41)
Insulation added—repair done	85-MS	32	(25-44)
House and lot sell on today's market	90-MS	31	29-34]
Moved for new job or job transfer	85-MS	30	(22-39)
Average monthly cost for gas	89-N	29	[23-37]
Average monthly cost for electricity	89-N	28	[24-34]
Number of dining rooms	85-N	27	(24-29)
Type of mortgage (for the first mortgage/loan) (non-CATI)	89-N	27	[21-36]
Change based on interest rates	85-MS	26	(18-38)
Year the building was built	85-MS	25	not available
All or part of roof replaced in last 2 years—someone in household do work	85-MS	25	(15-44)
Number of family rooms	85-N	25	(21-30)
Mortgage payment include homeowner's insurance (first mortgage)	90-MS	24	[21-27]
Prefer to be living in this house/apartment/someplace else	85-MS	24	(20-29)
Clothes washer age	85-N	22	(19-25)
Any other rooms	85-N	22	(20-25)
How many years for mortgage	85-MS	22	(17-29)
New storm doors/windows bought/installed—someone in household do work	85-MS	19	(11- 35)
Attend a public school or a private school	89-MS	19	[15-25]
Oven/cooking burner age	85-N	18	(16- 21)
Heating equipment broke	89-MS	18	[9-34]
Clothes dryer age	85-N	18	(15-21)
Refrigerator age	85-N	18	(16-20)
Garbage disposal age	85-N	18	(15-22)
Insulation added—someone in household do work	85-MS	16	(8-33)
Monthly payment (first mortgage)	90-MS	16	[14-18]

Table H. Different Answers a Month Apart—Con.

Item	When measured ¹	Level of inconsistency	Confidence interval ²
Number of half bathrooms	85-N	16	(14-18)
New storm doors or storm windows bought and installed—job cost	85-MS	15	(8-32)
New assumed mortgage	85-MS	15	(11-22)
Mortgage payment include property tax (first mortgage)	90-MS	15	(12-18)
How much was borrowed	85-MS	14	(11-18)
Monthly payment (for first mortgage/loan) (non-CATI)	89-N	14	[11-19]
Dishwasher age	85-N	14	(11-17)
Where was mortgage borrowed (non-CATI)	89-N	13	[7-28]
Mortgage on this house/apartment	90-MS	13	[11-15]
How much was borrowed (for the first mortgage/loan)? (non-CATI)	89-N	13	[10-17]
Have property insurance	89-MS	12	[10-14]
Clothes dryer fuel	85-N	12	(9-14)
Number of room air conditioners	85-N	11	(9-15)
Interest rate on the mortgage (for the first mortgage/loan) (non-CATI)	89-N	10	[7-15]
Room air conditioners	85-N	10	(8-12)
Kitchen remodeled or added—someone in household do work	85-MS	9	(3-26)
Living quarters	85-N	8	(6-9)
Clothes washer	85-N	8	(6-9)
Number of units in building	85-N	8	(6-9)
Number of bedrooms	85-N	7	(6-8)
Number of full bathrooms	85-N	6	(5-8)
Dishwasher	85-N	6	(5-7)
Cooking fuel	85-N	5	(4-6)
Clothes dryer	85-N	5	(4-7)
Number of apartments	85-N	5	(4-8)
Garbage disposal	85-N	5	(4-7)
Central air conditioning	85-N	5	(4-6)

¹This notation consists of the year followed by the survey from which the item was measured. For example, 89-MS means that the item was measured during the 1989 AHS-Metropolitan (MS) Survey and 81-N means that the item was measured during the 1981 AHS-National (N) Survey.

²Confidence intervals enclosed by square brackets are at the 90-percent confidence level, all others are at the 95-percent confidence level. The confidence intervals for the years prior to 1989 have a confidence level of 95 percent. Since that time it has been the policy of the U.S. Bureau of the Census to publish a 90-percent confidence level for all testing.

Table I. Calculation of the 90-Percent Confidence Interval for Medians

The following steps calculate the 90-percent confidence interval for medians. First we give some cost data to work with (all numbers are in thousands):

		Cumulative number of housing units
Total housing units	1,535.5	
Less than \$600	599.0	599.0
\$600 to \$699	146.1	705.1
\$700 to \$799	117.8	822.9
\$800 to \$999	181.9	1,004.8
\$1,000 or more	405.9	1,410.7
Not reported	124.9	
Median	\$700	

Item	Formula	Bottom limit		Top limit	
		Example	Your data	Example	Your data
How many total units is the median based on (in thousands, exclude "not reported" and "don't know")?	A	1,410.7	_____		
Half the total, for the median (in thousands)	A/2	705.35	_____		
Error from sampling for 50 percent of the base of this median (1st line) ¹	$49.9/\sqrt{A}$	1.33	_____		
Multiply this percentage error by .01 to turn it into a fraction and by total units to give the error in housing units	$.499\sqrt{A}$	18.74	_____		
Bottom of error range (2nd line minus 4th line, in thousands)	B _{bottom}	*686.61	_____		
Top of error range (2nd line plus 4th line, in thousands)	B _{top}			*724.09	_____
* Start adding up the housing units in the table, category by category, cumulatively from the beginning of the table, until you exceed the starred number above. What interval does the starred number fall in?		\$600-699	_____	\$700-799	_____
How many housing units are in all the categories before this one (in thousands)?	C	559.0	_____	705.1	_____
How many housing units are in this category (in thousands)	D	146.1	_____	117.8	_____
What is the bottom limit of this category (in dollars, rooms, or whatever the item measures)?	E	\$600	_____	\$700	_____
What is the bottom limit of the next category (in dollars, rooms, etc)?	F	\$700	_____	\$800	_____
Formula to calculate limits of confidence interval	$\frac{(B-C)}{D}(F-E)+E$	$\frac{(686.61 - 559.0)}{146.1}(100)+600$		$\frac{(724.09 - 705.1)}{117.8}(100)+700$	
Limits of confidence interval (in dollars, rooms, etc.)		\$687		\$716	

* Starting with the starred step, this worksheet is equivalent to interpolation, for those who are familiar with this term.

¹Statistical note: This formula is based on the error from sampling for 50 percent (using the appropriate formula, $164 \times \sqrt{.370536 \times 50 \times (100 - 50)/A} = 49.9/\sqrt{A}$) for medians involving combined owner- and renter-occupied units in the Boston CMSA. Refer to table F for the appropriate formula. As an example, for medians involving only owner-occupied units in Boston, use $49.3/\sqrt{A}$; for medians involving renter-occupied units in Boston, use $49.0/\sqrt{A}$; for medians involving Boston mobile homes, use $71.5/\sqrt{A}$; and for medians involving new construction units in Boston, use $53.2/\sqrt{A}$.