

## 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, which apply to some items, are discussed in the next paragraphs.

**Wrong or inconsistent answers.** Wrong answers happen because people misunderstand questions, cannot recall the correct answer, or do not want to give the right answer. Table E 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 E 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. In this metropolitan area, housing unit undercoverage is less than 1 percent. The following table lists units that have known coverage deficiencies.

Table A. **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 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 B shows, for the 1993 AHS-National sample, some of the items that have the least complete data for all occupied units and for those below the poverty level. The rates in table B 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 particular items.<sup>1</sup> Again readers should be wary of items likely to have highly incomplete data.<sup>2</sup>

<sup>1</sup>For 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).

<sup>2</sup>Statistical 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 “Explanations and Cautions” at the front of this book.

**Table B. 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.

**Effect on income.** The nonsampling errors interact particularly badly for income. Income questions are inconsistently answered (table E), incompletely answered (table B), 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.)

**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 C 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 following this table. As with the other types of errors, readers should be wary of numbers with large errors from sampling.

**Table C. Errors From Sampling to Compute a 90-Percent Confidence Interval**

When this book lists one of the following numbers—	The chances are 90 percent that the actual value is inside the range of the listed number plus or minus—
0 . . . . .	0.3
1 . . . . .	0.9
5 . . . . .	2.1
10 . . . . .	2.9
25 . . . . .	4.6
50 . . . . .	6.4
75 . . . . .	7.7
100 . . . . .	8.7
300 . . . . .	13.1
500 . . . . .	13.9
900 . . . . .	3.8

Note: This table represents a conservative example. The numbers are in thousands.

To obtain 90-percent confidence intervals for other estimates in this publication, use the following formulas. To construct the range, add and subtract the error computed from the formulas to the publication estimate.

For owner housing units, use:

$$1.64 \times \sqrt{(.317388 \times A) - (.000346 \times A^2)} \quad (1a)$$

For renter housing units, use:

$$1.64 \times \sqrt{(.275851 \times A) - (.000301 \times A^2)} \quad (1b)$$

For combinations of housing units, including owners, renters, and vacant units, use:

$$1.64 \times \sqrt{(.291215 \times A) - (.000317 \times A^2)} \quad (1c)$$

For mobile homes, use:

$$1.64 \times \sqrt{(.309533 \times A) - (.009199 \times A^2)} \quad (1d)$$

For new construction, use:

$$1.64 \times \sqrt{(.271657 \times A) - (.000296 \times A^2)} \quad (1e)$$

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.<sup>3</sup>

*Example:* For example table 2-1 shows 513,700 owner-occupied housing units in this metropolitan area (i.e., A is 513.7).

Use formula 1a:

$$1.64 \times \sqrt{(.317388 \times 513.7) - (.000346 \times 513.7 \times 513.7)} = 13.9$$

<sup>3</sup>The 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.

The 90-percent confidence interval can then be formed by adding and subtracting this error to the survey estimate of 513.7 (i.e.,  $513.7 \pm 13.9$ ). Statements such as the actual value is in the range  $513.7 \pm 13.9$  (499.8 to 527.6) 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 associated with a percentage apply one of the following formulas:<sup>4</sup>

Owner housing units:

$$1.64 \times \sqrt{\frac{.317388 \times p \times (100-p)}{A}} \quad (2a)$$

Renter housing units:

$$1.64 \times \sqrt{\frac{.275851 \times p \times (100-p)}{A}} \quad (2b)$$

Combinations of housing units including owner, renter, and vacant units:

$$1.64 \times \sqrt{\frac{.291215 \times p \times (100-p)}{A}} \quad (2c)$$

Mobile homes:

$$1.64 \times \sqrt{\frac{.309533 \times p \times (100-p)}{A}} \quad (2d)$$

New Construction:

$$1.64 \times \sqrt{\frac{.271657 \times p \times (100-p)}{A}} \quad (2e)$$

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

*Example:* Table 2-3 shows that of 513,700 owner-occupied housing units, 114,000 or 22.2 percent had two bedrooms. Apply formula 2a to obtain a 90-percent confidence interval for the percentage:

$$1.7 = 1.64 \times \sqrt{\frac{.317388 \times 22.2 \times (100 - 22.2)}{(513.7)}}$$

<sup>4</sup>The formulas 2a through 2e are equivalent to  $1.64 \times \sqrt{p(100-p)/n}$ , since  $.317388/A, .275851/A, \dots .271657/A$  adjust the data to the effective sample size.

Consequently, there is a 90-percent chance we'd be correct if we concluded that the actual proportion is within the range  $22.7 \pm 1.7$ , or 20.5 to 23.9 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:

*Formula<sup>5</sup>*

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

**Medians.** The following steps 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 F.

**Table D. 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	455.8	_____
What are the end-points of the category the median is in?	X - Y	\$1,000-1,249	_____
What is the width of this category (in dollars, rooms, or whatever the item measures)?	W	\$250	_____
How many housing units are in this median category (in thousands)?	B	51.9	_____
Then the error from sampling for the median is approximately: <sup>1</sup>	$\frac{K \times W \times \sqrt{A}}{B}$	$\frac{.462 \times 250 \times \sqrt{455.8}}{51.9}$	_____
		= \$47.5	
The 90-percent confidence interval for the median is:	median $\pm \frac{K \times W \times \sqrt{A}}{B}$	median $\pm$ \$47.5	_____

<sup>1</sup>Substitute one of the following for K as appropriate: use .443 for medians involving combined owners and renters, use .462 for medians involving owners only, use .431 for medians involving renters only, use .456 for medians involving mobile homes, and use .427 for medians involving new construction.

<sup>5</sup>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.

**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:

*Formula<sup>6</sup>*

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

<sup>6</sup>Error for first number should be interpreted as the error for a 90-percent confidence interval for the first number. Likewise, error for the second number should be interpreted as the error for a 90-percent confidence interval for the second number.

Table 2-3 shows that 114,000 owner-occupied housing units have 2 bedrooms and 214,500 have 3 bedrooms. The difference between the number of 2 bedroom owner and 3 bedroom owner units is 100,500 (100.5). The error for 114.0 is 9.2, and the error for 214.5 is 11.8. The 90-percent confidence interval for the difference is:

$$100.5 \pm \sqrt{9.2^2 + 11.8^2}$$

$$= 100.5 \pm 15.0$$

Since the interval does not include zero, the number of owner 2 bedroom and owner 3 bedroom homes is statistically different.

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

Item	When measured <sup>1</sup>	Level of inconsistency	Confidence interval <sup>2</sup>
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)

Table E. Different Answers a Month Apart—Con.

Item	When measured <sup>1</sup>	Level of inconsistency	Confidence interval <sup>2</sup>
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)
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]

Table E. Different Answers a Month Apart—Con.

Item	When measured <sup>1</sup>	Level of inconsistency	Confidence interval <sup>2</sup>
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]
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)

<sup>1</sup>This 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.

<sup>2</sup>Confidence 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 F. 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	513.7	
Less than \$800	163.9	163.9
\$800 to \$999	37.5	201.4
\$1,000 to \$1,249	51.9	253.3
\$1,250 to \$1,499	60.0	313.3
\$1,500 or more	142.5	455.8
Not reported	57.7	
Median	\$1,127	

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	455.8	_____		
Half the total, for the median (in thousands) .....	A/2	227.9	_____		
Error from sampling for 50 percent of the base of this median (1st line) <sup>1</sup> .....	$46.2/\sqrt{A}$	2.16	_____		
Multiply this percentage error by .01 to turn it into a fraction and by total units to give the error in housing units .....	$.462\sqrt{A}$	9.86	_____		
Bottom of error range (2nd line minus 4th line, in thousands) .....	B <sub>bottom</sub>	*218.04	_____		
Top of error range (2nd line plus 4th line, in thousands) .....	B <sub>top</sub>			*237.76	_____
* 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? .....		\$1,000-1,249	_____	\$1,000-1,249	_____
How many housing units are in all the categories before this one (in thousands)? .....	C	201.4	_____	201.4	_____
How many housing units are in this category (in thousands) .....	D	51.9	_____	51.9	_____
What is the bottom limit of this category (in dollars, rooms, or whatever the item measures)? .....	E	\$1,000	_____	\$1,000	_____
What is the bottom limit of the next category (in dollars, rooms, etc)? .....	F	\$1,250	_____	\$1,250	_____
Formula to calculate limits of confidence interval .....	$\frac{(B-C)}{D}(F-E)+E$	$\frac{(218.04 - 201.4)}{51.9}(250)+1,000$		$\frac{(237.76 - 201.4)}{51.9}(250)+1,000$	
Limits of confidence interval (in dollars, rooms, etc.) .....		\$1,080		\$1,175	

<sup>1</sup>Statistical note: This formula is based on the error from sampling for 50 percent. From the percent formula above use,  $1.64 \times .317388 \times 50 \times (100-50)/A = 46.2/\sqrt{A}$  for medians involving owner-occupied units. For medians involving combined owner and renter occupied units use  $44.3/\sqrt{A}$ , for medians involving renter-occupied units only use  $43.1/\sqrt{A}$ , for medians involving mobile homes use  $45.6/\sqrt{A}$ , and for medians involving new construction units use  $42.7/\sqrt{A}$ .

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