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American Housing Survey

Weighting Strategy for 2007 Metropolitan CINCH Analysis

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American Housing Survey

Weighting Strategy for 2007 Metropolitan CINCH Analysis

Prepared for:
U.S. Department of Housing and Urban Development
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Weighting Strategy for 2007 Metropolitan CINCH Analysis

This paper adapts the weighting strategy used by Econometrica, Inc., in its components of inventory change (CINCH) analysis of changes in the national housing stock between 1998 and 2007.¹ The algorithm used for the 2007 metropolitan analysis differs from the one used for the 1998-2007 national analysis in several ways; the most important difference is the inability to adjust for mobile homes separately in five of the metropolitan areas because of an insufficient number of mobile home cases in those areas. This difference and other differences are explained in the sections that describe the steps in the weighting algorithms.

The seven metropolitan areas examined are: Baltimore, Boston, Houston, Miami-Ft. Lauderdale, Minneapolis-St. Paul, Tampa-St. Petersburg-Clearwater, and Washington. All of these areas, except Miami-Ft. Lauderdale, were last surveyed by the American Housing Survey (AHS) in 1998. The AHS surveyed Miami-Ft. Lauderdale in 2002.

The CINCH Objective

Figure 1 on the next page illustrates the question that CINCH analysis seeks to answer.

CINCH tries to explain how the housing stock evolves from one period to the next. Figure 1 contains four ovals and two rectangles. The Census Bureau provides estimates for both rectangles and one oval (units added through new construction between 1998 and 2007). No one estimates the other three ovals: the number of units that belong to both the 1998 and 2007 housing stock, units lost to the housing stock between 1998 and 2007, and other additions to the housing stock between 1998 and 2007.

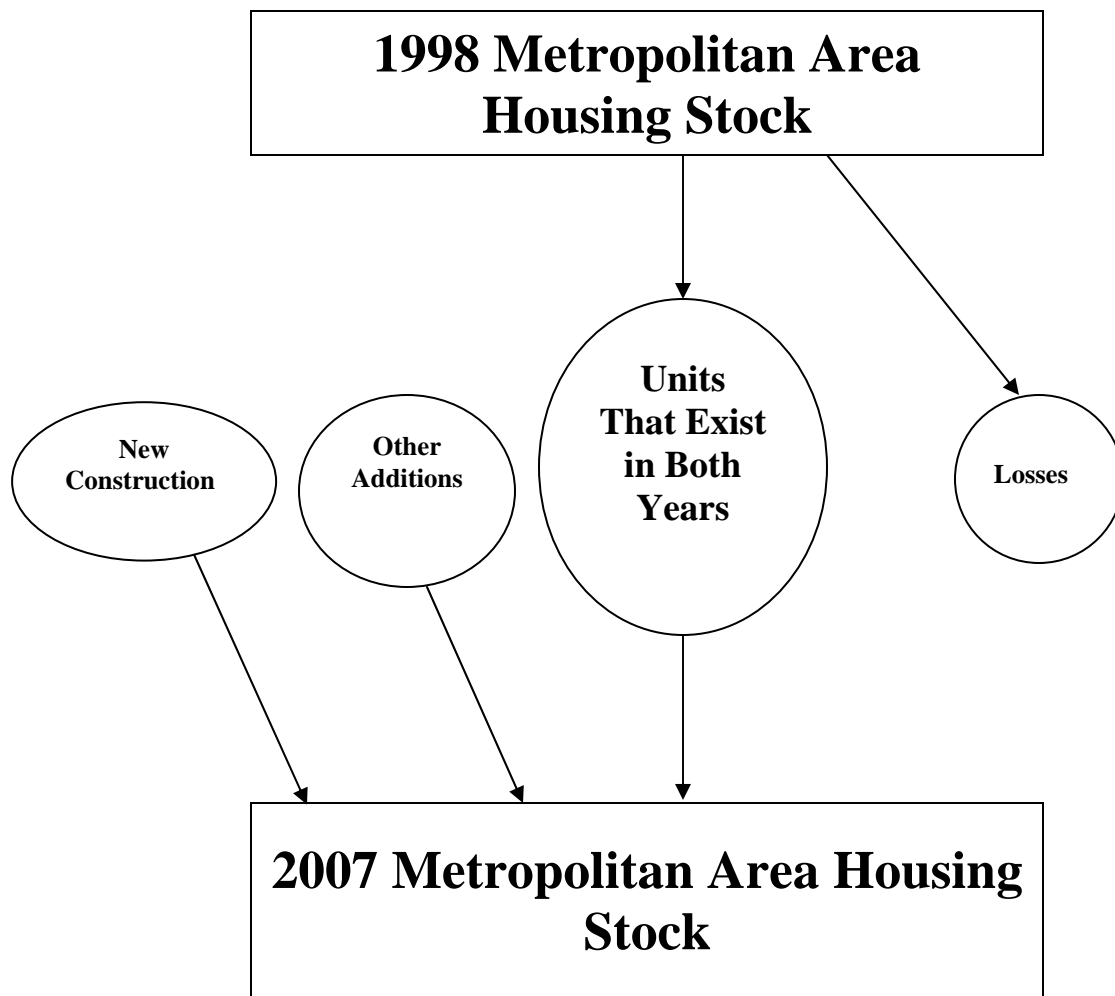
Losses can be either permanent or temporary. Units destroyed by natural disasters or intentionally demolished are permanent losses. Temporary losses include units that are merged into other units or units that are used for nonresidential purposes.² Besides new construction, additions can include units resulting from splitting up larger units, mobile home move-ins, and units that had been used formerly for nonresidential purposes.

In addition to determining the size of each oval, housing analysts find information about the characteristics of the units in the different ovals useful. Interesting characteristics include: structure type, age of the unit, size of the unit, location by region, location by metropolitan status, tenure, household size and composition, resident income, and resident race and ethnicity.

¹ See <http://www.huduser.org/datasets/cinch.html>.

² “Potentially reversible” might be a better term than “temporary” for these types of losses.

Figure 1: The CINCH Objective



CINCH analysis has three goals:

- To provide estimates for all six components of Figure 1.
- To disaggregate losses and other additions into relevant component parts.
- To characterize the units that survive from one period to the next and the units that are added or lost between periods.

The AHS has four features that make CINCH analysis possible:

- Each unit has weights that can be used to estimate its share of the overall stock.
- The AHS tracks new construction and the various types of losses and other additions.
- The AHS has detailed information about the characteristics of each unit and its occupants.
- The AHS tracks the same unit from one period to the next so that changes in status and characteristics can be observed directly.

Weighting

Ideally, analysts would like to solve two simultaneous equations using CINCH analysis:³

- (1) 1998 housing stock = units that exist in both years + losses.
- (2) New construction + other additions + units that exist in both years = 2007 housing stock.

Unfortunately, previous experience with CINCH analysis has shown it is difficult to find satisfactory simultaneous solutions to the equations. For this reason, Econometrica, Inc. chose to solve the two equations separately in previous CINCH studies.

Solving equation (1) is termed forward-looking analysis because it tracks what happens to the units in the 1998 housing stock. In terms of Figure 1, forward-looking analysis deals with the top rectangle and the two ovals on the right. Solving equation (2) is termed backward-looking analysis because it tracks where units in the 2007 housing stock came from. In terms of Figure 1, backward-looking analysis deals with the bottom rectangle and the three ovals on the left. In analytical terms, backward-looking analysis reverses the arrows at the bottom of Figure 1 by taking the 2007 housing stock as its starting point.

Separating the analysis into forward-looking and backward-looking components results in each observation having two weights: a weight for the forward-looking analysis (FLCINCHWT) and a weight for the backward-looking analysis (BLCINCHWT).

Issues Affecting Rental Dynamics Analyses Involving Metropolitan Areas Surveyed in 2007

Several issues affect the quality of rental dynamics analyses involving metropolitan areas surveyed in the 2007 AHS. Reconstitution of the manufactured housing sample in 2005 and a reduction in overall sample sizes in 2007 make the estimates less precise than those in previous rental dynamics analyses. For five metropolitan areas, these two factors make it infeasible to apply the same weighting algorithms used in the national level rental dynamics work because there are no sampled mobile homes in key cells. Changes in geographic boundaries affect the comparability of the housing stock between 1998 and 2002 for four metropolitan areas. Finally, an error in the 1998 Baltimore survey makes it difficult to compare the 1998 and 2007 rental stocks for that metropolitan area.

Manufactured (Mobile) Homes

One concern in preparing new algorithms based on the old algorithms is the reconstitution of the manufactured (mobile) home sample in 2005. The Census Bureau added new mobile home units in metropolitan surveys after 2005 and dropped some mobile home units that had been in previous AHS samples. Approximately half the mobile homes in the pre-2005 samples were dropped in the 2007 sample and replaced by different mobile homes.

³ The equations are “simultaneous” because the term “units that exist in both years” appears in each equation.

Step 4 in the forward-looking algorithm and step 5 in the backward-looking algorithm were added to correct this problem. The logic of the mobile-home adjustment is as follows. The general algorithms attempt to adjust the pure weight of each sample unit sequentially for (1) deviations between the aggregate of the pure weights and the published total stock, (2) the loss of sample due to type A non-interviews, and (3) deviations between the sum of the adjusted pure weights and key published subtotals. The step 4 adjustment in the forward-looking algorithm and the step 5 adjustment in the backward-looking algorithm occur as part of stage (1) and change the pure weights of the mobile home units from previous samples that were retained in the 2007 sample so that they sum to the pure weights of all the mobile home units (except newly manufactured mobile homes). This means that mobile home units enter stages (2) and (3) with the correct aggregate count.

We adjusted the weights only for mobile homes built prior to 2000 because the Census Bureau did not drop any units built in 2000 or later. The Census Bureau used the address list for the 2000 census to update the mobile home sample and therefore could not replace units built in 2000 or later with other units built in 2000 or later. The new steps are written to take this fact into account, but this distinction applies only to Miami-Ft. Lauderdale, the only site in which the previous sample was drawn post-2000.

Step 4 in the forward-looking and step 5 in the backward-looking algorithm should allow us to obtain reasonable counts of mobile homes in both years. Using the mobile homes available in both the previous surveys and the 2007 survey and sampled mobile homes manufactured after 2000, we will provide estimates of losses and additions to the stock by type of loss and type of addition. The estimates of losses and additions and the estimates of type of loss and type of addition depend upon the extent to which the retained mobile homes are a representative sample of all mobile homes in both previous survey years and 2007. We can correct for the decline in the sample, but not for any biases introduced by dropping and adding mobile homes.

Sample Sizes

HUD reduced the size of both the national AHS sample and the metropolitan AHS samples in 2007. The 2007 metropolitan public use file (PUF) contains data on seven metropolitan areas, one surveyed previously in 2002 and six surveyed previously in 1998. The table at the top of the next page compares the 2007 sample sizes to the sample sizes in the previous surveys.

The smaller sample sizes in 2007 and the reconstitution of the mobile home sample in metropolitan AHS samples after 2002 combine to create problems when applying the weighting algorithms developed for the national sample to the metropolitan samples.

Metropolitan Area	SMSA	Last AHS Survey Year	Sample Size in Last Survey	2007 Sample Size
Baltimore	0720	1998	4,741	2,733
Boston	1120	1998	4,528	2,771
Houston	3360	1998	4,819	2,868
Miami-Ft. Lauderdale	5000	2002	4,770	2,647
Minneapolis-St. Paul	5120	1998	4,796	2,847
Tampa-St. Petersburg	8280	1998	4,825	3,064
Washington	8840	1998	4,816	2,781

Problems in the Forward-Looking Algorithm: Step 4 in the forward-looking algorithm adjusts the pure weights of mobile homes that were built before 2000 and that appear in both the 1998 and 2007 samples. The adjustment is large in some metropolitan areas, ranging from 1.4 in Miami-Ft. Lauderdale to 9.5 in Boston, where the 3 mobile homes retained in the 2007 sample are forced to carry the weight of 42 mobile homes in the 1998 sample.

Problems in the Backward-Looking Algorithm: Steps 12 and 13 in the backward-looking algorithm adjust the weights to account for the loss of sample due to type A non-interviews. These steps separately adjust SAMEs (units appearing in both surveys), new construction, and other additions to the stock. In the national algorithm, the adjustment for newly constructed units is made separately for mobile homes and other units. By step 12, however, there are no newly manufactured (constructed) mobile homes in the Boston, Baltimore, Miami-Ft. Lauderdale, Minneapolis-St. Paul, and Washington samples. Step 12 and 13 are applied differently to these five metropolitan areas.

Problems for Both Algorithms: The national algorithms force the weights counts to equal eight published totals: owner-occupied units, renter-occupied units, vacant units, and seasonal units distinguished by manufactured housing (mobile homes) and all other structure types. As the tables on the next page show, there are empty cells when the samples are divided in this way.

For steps 11 and 12 in the forward-looking algorithm, separate adjustments for mobile homes and other structure types can be done only for Miami-Ft. Lauderdale and Tampa-St. Petersburg. These steps must be revised for the other five sites because the empty cells in the distribution of sample units would lead to division by zero.⁴

⁴ The published reports for Baltimore and Minneapolis-St. Paul indicate that there are no seasonal mobile homes in either metropolitan area. (This means that the full sample contains no seasonal mobile homes.) We could apply the full breakout in steps 11 and 12 to these places and not compute ratio 10 in step 11 because it is irrelevant. However, the numbers of renter-occupied and vacant mobile home sample units are so few in Baltimore and Minneapolis-St. Paul that we decided to use the simpler form of steps 11 and 12 in these sites.

Sample Sizes after Step 10 in the Forward-Looking Algorithm

	Baltimore	Boston	Houston	Miami-Ft. Lauderdale	Minneapolis -St. Paul	Tampa-St. Petersburg	Washington
owner-occupied mobile homes	7	3	9	14	12	54	5
owner-occupied other homes	1030	545	683	776	1332	968	1045
renter-occupied mobile homes	2	0	6	3	1	7	1
renter-occupied other homes	424	397	464	444	433	407	540
vacant mobile homes	1	0	1	4	1	40	0
vacant other homes	161	69	121	150	63	194	140
seasonal mobile homes	0	0	0	4	0	22	0
seasonal other homes	2	8	7	29	4	27	3
Total	1627	1022	1291	1424	1846	1719	1734

For steps 14 and 15 in the backward-looking algorithm, separate adjustments for mobile homes and other structure types can be done only for Miami-Ft. Lauderdale and Tampa-St. Petersburg. Empty cells in the distribution of sample units would lead to division by zero for Boston, Baltimore, Houston, Minneapolis-St. Paul, and Washington.

Sample Sizes after Step 13 in the Backward-Looking Algorithm

	Baltimore	Boston	Houston	Miami-Ft. Lauderdale	Minneapolis -St. Paul	Tampa-St. Petersburg	Washington
owner-occupied mobile homes	12	3	17	17	12	80	5
owner-occupied other homes	1188	877	1057	1027	1526	1127	1309
renter-occupied mobile homes	1	1	7	5	3	17	3
renter-occupied other homes	476	499	576	478	485	448	570
vacant mobile homes	0	0	1	2	2	21	0
vacant other homes	184	145	287	349	175	313	196
seasonal mobile homes	1	0	0	5	0	27	0
seasonal other homes	8	13	24	93	8	52	13
Total	1870	1538	1969	1976	2211	2085	2096

Changes in Geographical Boundaries

The published reports for the 2007 metropolitan surveys contain the following caution:

Additional counties were added to the Miami, Houston, and Washington, DC MSAs since the last enumeration of these areas. Caution is recommended when comparing prior years' data with the 2007 data for these areas.

The Boston estimates are no longer based on the MSA that contains the city of Boston; they are now based on the NECTAD of Boston. Again, caution is recommended when making comparisons to prior years' data.

No boundary changes have occurred in the Baltimore, Minneapolis, and Tampa MSAs.

In the algorithms, boundary changes have the following effects. Analysis of units that are present in both the 1998 (2002 for Miami) and 2007 surveys cases applies to the geography common to both the old and new definitions.⁵ Analysis of losses to the stock applies to the geography common to both the old and new definitions.⁶ Analysis of additions to the stock applies to the geography of the 2007 survey.⁷

Data Recordation Problems in Baltimore in 1998

Units that should have been classified as “renter occupied” were coded as either “vacant for rent” or “other vacant,” with most probably being classified as “vacant for rent.” Because the problem occurred during data collection, the Census Bureau could not correct the error, as would be possible if this had been a processing error. The Census Bureau believes that the extent of the misclassification is large because the 1998 AHS rental vacancy rate for the Baltimore Central City was 29.3 percent compared with a 1998 Housing Vacancy Survey (HVS) rate of 3.8 percent and a Census 2000 rate of 7.6 percent.

The error affects only units that were rental in 1998. The effect on the CINCH estimates will be overestimates of the movement of vacant units into the stock between 1998 and 2007 in both the forward-looking and backward-looking CINCH estimates.

Use of SAMEDU

In developing new weighting algorithms for the national 2007 PUF, we incorporated a number of changes that sought to make better use of the information in SAMEDU and that revised the treatment of cases added as sample adjustments (IN07_REUAD = 11).

The national weighting algorithms incorporated SAMEDU in two steps: (1) efforts were made to categorize the reasons why units in 2007 were different than units in the previous survey (SAMEDU = 2), and (2) once classified, units were incorporated into the analysis in accordance with the classification. Units that were permanent losses in 2007 were dropped; units that differed in 2007 because of probable structural changes were treated both as losses in 2005 and additions in 2007; and units classified as probable interviews of wrong units in 2005 or unclassified were dropped as potentially being interviews of the wrong unit.

⁵ In the algorithms, these are cases where SAME = 1.

⁶ In the algorithms, these are cases where INTLOSS = 1.

⁷ In the algorithms, these are cases where INTNC = 1 or INTADD = 1.

The classification system used in the national algorithms involved incorporating data from the 2003 PUF as well as the 2005 and 2007 PUFs. This approach is not practicable for CINCH analysis involving the metropolitan 2007 PUF. For example, the survey prior to the 1998 survey of Baltimore was conducted in 1991 using a different sample. Therefore, the only use of SAMEDU in the metropolitan CINCH analysis is to eliminate all cases where SAMEDU =2 because, for these units, we cannot distinguish (a) major structural changes between the previous survey and the 2007 survey from (b) situations where the Census Bureau interviewed the wrong unit in the previous survey.

Forward Looking: From Previous Survey to 2007

The following are the steps necessary to prepare the data to analyze what happened between the previous survey and 2007 to units that existed in the previous survey. AHS variables are given their codebook names and presented in capital letters. We refer to the previous survey variables by the prefix IN98_; 2007 variables are labeled IN07_. In the algorithm, IN98_ stands for IN02_ in the case of Miami. The algorithm should be applied to each metropolitan area separately.

1. Merge the previous survey file and 2007 files, using the flat files, and keep cases in both files. The 2007 file is smaller than the previous survey file because HUD dropped cases from the sample in 2007 for budgetary reasons. The Census Bureau did not include records for these cases in the 2007 PUF.
 - a. Eliminate non-matches.

Metropolitan Area	SMSA	Last AHS Survey Year	Sample Size in Our Data Sets (LAST SURVEY)	2007 Sample Size	Matched Records (Forward)
Baltimore	0720	1998	4,741	2,733	2,254
Boston	1120	1998	4,528	2,771	1,599
Houston	3360	1998	4,819	2,861	1,811
Miami-Ft. Lauderdale	5000	2002	4,770	2,647	1,778
Minneapolis-St. Paul	5120	1998	4,796	2,847	2,367
Tampa-St. Petersburg	8280	1998	4,825	3,053	2,455
Washington	8840	1998	4,816	2,781	2,226

The difference between the number of matched cases and the number of 2007 cases is somewhat surprising. New construction and other additions were important contributors to the 2007 housing stock between 1998 and 2007. Also, boundary adjustments caused some mismatches in four of the metropolitan areas.

- b. Eliminate cases where IN07_NOINT GE 38. This eliminates losses from sample changes. CINCH should ignore these losses because they are not physical losses and because we cannot say anything useful about what happens to them.

Metropolitan Area	SMSA	Last AHS Survey Year	Matched Records (Forward) After STEP 1.b
Baltimore	0720	1998	2,227
Boston	1120	1998	1,566
Houston	3360	1998	1,772
Miami-Ft. Lauderdale	5000	2002	1,754
Minneapolis-St. Paul	5120	1998	2,332
Tampa-St. Petersburg	8280	1998	2,246
Washington	8840	1998	2,213

- c. Eliminate cases where IN07_SAMEDU = 2. This eliminates cases where it is possible that the Census Bureau went to the wrong unit in the previous survey.

Metropolitan Area	SMSA	Last AHS Survey Year	Matched Records (Forward) After STEP 1.c
Baltimore	0720	1998	2,175
Boston	1120	1998	1,526
Houston	3360	1998	1,697
Miami-Ft. Lauderdale	5000	2002	1,734
Minneapolis-St. Paul	5120	1998	2,290
Tampa-St. Petersburg	8280	1998	2,194
Washington	8840	1998	2,164

2. Eliminate all observations that were type B or type C losses (10 LE IN98_NOINT Lt 38) in the previous survey. These units were not part of the housing stock in the previous survey year and therefore are not tracked in the forward-looking analysis.

Metropolitan Area	SMSA	Last AHS Survey Year	Matched Records (Forward) After STEP 2
Baltimore	0720	1998	2,081
Boston	1120	1998	1,470
Houston	3360	1998	1,593
Miami-Ft. Lauderdale	5000	2002	1,655
Minneapolis-St. Paul	5120	1998	2,208
Tampa-St. Petersburg	8280	1998	2,094
Washington	8840	1998	2,116

3. For all units let $MPWT = \max(IN07_PWT, IN98_PWT)$. (PWT is the pure weight.) In general, IN07_PWT should be greater than IN98_PWT because of the elimination of 5,000 units to save costs.

a. As a check, define:

$$\begin{aligned}
 CHPWT &= 1 \text{ if } IN07_PWT > IN98_PWT \\
 &= 0 \text{ if } IN07_PWT = IN98_PWT \\
 &= -1 \text{ otherwise}
 \end{aligned}$$

Table of CHPWT by Metropolitan Area								
CHPWT	Metropolitan Area							Total
Frequency	Baltimore	Boston	Houston	Miami-Ft. Lauderdale	Minneapolis-St. Paul	Tampa-St. Petersburg	Washington	
1	2,081	1,470	1,593	1,655	2,208	2,094	2,116	13,217
Total	2,081	1,470	1,593	1,655	2,208	2,094	2,116	13,217

4. Adjust the pure weights of manufactured (mobile) homes.

- a. From the previous file before merger, compute a pure weight count of mobile homes built before 2000 (IN98_OLDMHPWT) by summing PWT for cases where $IN98_NUNIT2 = 4$ AND $IN98_BUILT \leq 1999$.
- b. From merged file, compute a pure weight count of mobile homes built before 2000 that are in both years (IN98_OLDMHKEPT) by summing MPWT for cases where $IN98_NUNIT2 = 4$ AND $IN98_BUILT \leq 1999$.
- c. Adjust the pure weights of all manufactured (mobile) homes.
IF $IN98_NUNIT2 = 4$ AND $IN98_BUILT \geq 2000$
 $MPWT = MPWT$

IF IN98_NUNIT2 = 4 AND IN98_BUILT LE 1999
 MXPWT = MXPWT*(IN98_OLDMHPWT/IN98_OLDMHKEPT)

Metropolitan Area	N	IN98_OLDMHPWT	N	IN98_OLDMHKEPT	IN98_OLDMHPWT/ IN98_OLDMHKEPT
Baltimore	47	10,506	11	5,295	1.98
Boston	42	12,689	3	1,337	9.49
Houston	118	38,028	16	9,540	3.99
Miami-Ft. Lauderdale	109	38,636	25	27,288	1.42
Minneapolis-St. Paul	78	19,191	16	8,065	2.38
Tampa-St. Petersburg	524	134,260	129	71,067	1.89
Washington	31	11,937	6	4,457	2.68

5. Obtain from the published report an estimate of the housing stock (BASECOUNT) in the previous survey.
 - a. Compute $SMXPWT = \text{sum of MXPWT after step 4}$; this sum is a first estimate of the size of the housing stock based on the units retained for analysis.
 - b. Compute a $FLCINCHWT = MXPWT * (\text{BASECOUNT} / SMXPWT)$. This computation ratios the weights up so that they sum to the housing stock in the previous survey.

Metropolitan Area	BASECOUNT	SMXPWT	RATIO	SUM_FLCINCHWT
Baltimore	1,028,200	890470.20	1.15467	1,028,200
Boston	1,345,900	653356.30	2.05998	1,345,900
Houston	1,547,300	1302791.54	1.18768	1,547,300
Miami-Ft. Lauderdale	1,638,800	1552874.93	1.05533	1,638,800
Minneapolis-St. Paul	1,150,400	1112018.33	1.03452	1,150,400
Tampa-St. Petersburg	1,138,300	1098395.60	1.03633	1,138,300
Washington	1,817,300	1710044.12	1.06272	1,817,300

6. Identify *sames*, *losses*, and *interviewed losses*:
 - a. $SAME = 1$ if $IN98_ISTATUS = 1, 2, \text{ or } 3$ AND $IN07_ISTATUS = 1, 2, \text{ or } 3$.
 - b. $LOSS = 1$ if $IN98_ISTATUS = 1, 2, 3, \text{ or } 4$ AND (10 LE $IN07_NOINT$ LT 38)
 Note that the previous metropolitan CINCH analysis used LE rather than LT; this change results from the new step 1b.

- c. $INTLOSS = 1$ if $IN98_ISTATUS = 1, 2, \text{ or } 3$ AND $LOSS = 1$

Metropolitan Area	SAME	LOSS	INTLOSS
Baltimore	1,570	60	57
Boston	1,006	20	16
Houston	1,244	52	47
Miami-Ft. Lauderdale	1,405	19	19
Minneapolis-St. Paul	1,822	29	24
Tampa-St. Petersburg	1,683	53	36
Washington	1,709	28	25
Total	10,439	261	224

7. Calculate:

- $SSAME = \text{sum of FLCINCHWT for all SAME} = 1$
- $SLOSS = \text{sum of FLCINCHWT for all LOSS} = 1$
- $SINTLOSS = \text{sum of FLCINCHWT for INTLOSS} = 1$

Metropolitan Area	SSAME	SLOSS	SINTLOSS
Baltimore	776,407	29,515	28,039
Boston	925,822	18,242	14,570
Houston	1,197,527	51,228	46,592
Miami-Ft. Lauderdale	1,394,376	18,691	18,691
Minneapolis-St. Paul	949,108	14,992	12,385
Tampa-St. Petersburg	925,289	26,952	18,307
Washington	1,468,700	24,047	21,471

8. For CINCH analysis, we need information on the characteristics of units and their occupants in both the previous survey and 2007 for all units that were part of the stock in both the previous survey and 2007. For units that are part of the stock in only the previous survey, we need information on the characteristics of the units and their occupants in the previous survey but only in the previous survey. Up to this point, we retained units that failed to meet these conditions so that we can get good estimates of the number of losses (SLOSS).

Keep for future analysis only those units where $SAME = 1$ OR $INTLOSS = 1$.

9. Calculate:

- $Ratio1 = (BASECOUNT - SLOSS)/SSAME$
- $Ratio2 = SLOSS/SINTLOSS$

Metropolitan Area	RATIO_1	RATIO_2
Baltimore	1.28629	1.05263
Boston	1.43403	1.25207
Houston	1.2493	1.0995
Miami-Ft. Lauderdale	1.16189	1.0
Minneapolis-St. Paul	1.19629	1.21053
Tampa-St. Petersburg	1.20108	1.47222
Washington	1.22098	1.12

10. Recalculate FLCINCHWT as follows:

- a. For SAME = 1, $FLCINCHWT = Ratio1 * FLCINCHWT$
- b. For INTLOSS = 1, $FLCINCHWT = Ratio2 * FLCINCHWT$

Metropolitan Area	SUM_FLCINCHWT
Baltimore	1,028,200
Boston	1,345,900
Houston	1,547,300
Miami-Ft. Lauderdale	1,638,800
Minneapolis-St. Paul	1,150,400
Tampa-St. Petersburg	1,138,300
Washington	1,817,300

At this point, the algorithm differs by metropolitan area because of the small number of mobile homes in the samples for Baltimore, Boston, Houston, Minneapolis-St. Paul, and Washington.

The following steps 11 and 12 are for Miami-Ft. Lauderdale and Tampa-St. Petersburg only:

11. From published reports, obtain estimates from the previous survey counts for all owner-occupied units, all renter-occupied units, all vacant, and all seasonal units, distinguishing between mobile homes and all other structure types (non-mobile homes). Calculate new adjustment ratios using the formulas in columns C & D of the table:

Table for Forward-Looking Step 11

	A	B	C	D
		The Previous Survey	Sum of FLCINCHWT	Ratio Adjustment
1	Housing Stock			
2	Occupied			
3	Owner-Occupied (mobile homes)		IN98_ISTATUS = "1" AND IN98_TENURE = 1 AND IN98_NUNIT2 = 4 $\Sigma =$	D3 = B3/C3 =
4	Owner-Occupied (other)		IN98_ISTATUS = "1" AND IN98_TENURE = 1 AND IN98_NUNIT2 NE 4 $\Sigma =$	D4 = B4/C4 =
5	Renter (mobile homes)		IN98_ISTATUS = "1" AND (2 LE IN98_TENURE LE 3) AND IN98_NUNIT2 = 4 $\Sigma =$	D5 = B5/C5 =
6	Renter (other)		IN98_ISTATUS = "1" AND (2 LE IN98_TENURE LE 3) AND IN98_NUNIT2 NE 4 $\Sigma =$	D6 = B6/C6 =
7	Vacant (mobile homes)		(IN98_ISTATUS='2' OR IN98_ISTATUS='3') AND NOT(8 LE IN98_VACANCY LE 11) AND IN98_NUNIT2 = 4 $\Sigma =$	D7 = B7/C7 =
8	Vacant (other)		(IN98_ISTATUS='2' OR IN98_ISTATUS='3') AND NOT(8 LE IN98_VACANCY LE 11) AND IN98_NUNIT2 NE 4 $\Sigma =$	D8 = B8/C8 =
9	Seasonal (mobile homes)		(IN98_ISTATUS='2' OR IN98_ISTATUS='3') AND (8 LE IN98_VACANCY LE 11) AND IN98_NUNIT2 = 4 $\Sigma =$	D9 = B9/C9 =
10	Seasonal (other)		(IN98_ISTATUS='2' OR IN98_ISTATUS='3') AND (8 LE IN98_VACANCY LE 11) AND IN98_NUNIT2 NE 4 $\Sigma =$	D10 = B10/C10 =

Metropolitan Area	GROUP	PUBLISHED	SUM_FLCINCHWT	RATIO
Miami-Ft. Lauderdale	3	34,300	25,846	1.32707
Miami-Ft. Lauderdale	4	892,900	881,236	1.01324
Miami-Ft. Lauderdale	5	7,600	5,871	1.29446
Miami-Ft. Lauderdale	6	499,500	508,199	0.98288
Miami-Ft. Lauderdale	7	7,800	7,828	0.99639
Miami-Ft. Lauderdale	8	160,800	168,844	0.95236
Miami-Ft. Lauderdale	9	3,400	7,828	0.43432
Miami-Ft. Lauderdale	10	32,500	33,148	0.98046
Tampa-St. Petersburg	3	94,800	63,028	1.50409
Tampa-St. Petersburg	4	572,200	590,445	0.9691
Tampa-St. Petersburg	5	23,100	7,624	3.02978
Tampa-St. Petersburg	6	245,600	251,527	0.97644
Tampa-St. Petersburg	7	53,100	64,683	0.82093
Tampa-St. Petersburg	8	104,600	120,402	0.86876
Tampa-St. Petersburg	9	29,500	23,962	1.23111
Tampa-St. Petersburg	10	15,400	16,629	0.9261

12. Use the new adjustment ratios to make final adjustment in the FLCINCHWT.
- If $IN98_ISTATUS = "1"$ (occupied units) AND $IN98_TENURE = 1$ (owner-occupied units) AND $IN98_NUNIT2 = 4$ (mobile homes), $FLCINCHWT = D3 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for owner-occupied mobile homes.
 - If $IN98_ISTATUS = "1"$ (occupied units) AND $IN98_TENURE = 1$ (owner-occupied units) AND $IN98_NUNIT2 \neq 4$ (non-mobile home), $FLCINCHWT = D4 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for owner-occupied non-mobile homes.
 - If $IN98_ISTATUS = "1"$ (occupied units) AND $(2 \leq IN98_TENURE \leq 3)$ (renter-occupied units) AND $IN98_NUNIT2 = 4$ (mobile homes), $FLCINCHWT = D5 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for renter-occupied mobile homes.
 - If FLCINCHWT in which $IN98_ISTATUS = "1"$ (occupied units) AND $(2 \leq IN98_TENURE \leq 3)$ (renter-occupied units) AND $IN98_NUNIT2 \neq 4$ (non-mobile homes), $FLCINCHWT = D6 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for renter-occupied non-mobile homes.

- e. If FLCINCHWT in which (IN98_ISTATUS='2' OR IN98_ISTATUS='3') AND NOT(8 LE IN98_VACANCY LE 11) (URE and vacant units) AND IN98_NUNIT2 = 4 (mobile homes), $FLCINCHWT = D7 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for vacant mobile homes.
- f. If FLCINCHWT in which (IN98_ISTATUS='2' OR IN98_ISTATUS='3') AND NOT(8 LE IN98_VACANCY LE 11) (URE and vacant units) AND IN98_NUNIT2 NE 4 (non-mobile homes), $FLCINCHWT = D8 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for vacant non-mobile homes.
- g. If FLCINCHWT in which (IN98_ISTATUS='2' OR IN98_ISTATUS='3') AND (8 LE IN98_VACANCY LE 11) (Seasonal units) AND IN98_NUNIT2 = 4 (mobile homes), $FLCINCHWT = D9 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for seasonal mobile homes.
- h. If FLCINCHWT in which (IN98_ISTATUS='2' OR IN98_ISTATUS='3') AND (8 LE IN98_VACANCY LE 11) (Seasonal units) AND IN98_NUNIT2 NE 4 (non-mobile homes), $FLCINCHWT = D10 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for seasonal non-mobile homes.

The following steps 11 and 12 are for Baltimore, Boston, Houston, Minneapolis-St. Paul, and Washington only:

- 11. From published reports obtain estimated 2007 counts for all owner-occupied units, all renter-occupied units, all vacant units, and all seasonal units, distinguishing between mobile homes and all other units.

Table for Forward-Looking Step 11

	A	B	C	D
		2007	Sum of FLCINCHWT	Ratio Adjustment
1	Housing Stock			
2	Occupied			
3	Owner-Occupied		IN98_ISTATUS = "1" AND IN98_TENURE = 1 Σ=	D3 = B3/C3 =
5	Renter		IN98_ISTATUS = "1" AND (2 LE IN98_TENURE LE 3) Σ=	D5 = B5/C5 =
7	Vacant		(IN98_ISTATUS='2' OR IN98_ISTATUS='3') AND NOT(8 LE IN98_VACANCY LE 11) Σ=	D7 = B7/C7 =
9	Seasonal		(IN98_ISTATUS='2' OR IN98_ISTATUS='3') AND (8 LE IN98_VACANCY LE 11) Σ=	D9 = B9/C9 =

Metropolitan Area	NEW_GROUP	PUBLISHED	SUM_FLCINCHWT	RATIO
Baltimore	3	634,500	657,944	0.96437
Baltimore	5	285,600	268,443	1.06391
Baltimore	7	105,500	100,547	1.04926
Baltimore	9	2,500	1,265	1.97554
Boston	3	760,800	728,582	1.04422
Boston	5	503,400	516,987	0.97372
Boston	7	72,700	89,798	0.80959
Boston	9	9,000	10,533	0.85446
Houston	3	819,500	838,588	0.97724
Houston	5	567,000	557,460	1.01711
Houston	7	155,300	143,410	1.08291
Houston	9	5,500	7,843	0.70129
Minneapolis-St. Paul	3	812,400	836,311	0.97141
Minneapolis-St. Paul	5	299,500	271,431	1.10341
Minneapolis-St. Paul	7	35,600	40,162	0.88641
Minneapolis-St. Paul	9	2,900	2,495	1.16218
Washington	3	1,078,200	1,101,472	0.97887

Metropolitan Area	NEW_GROUP	PUBLISHED	SUM_FLCINCHWT	RATIO
Washington	5	594,400	567,338	1.0477
Washington	7	141,800	145,607	0.97386
Washington	9	2,900	2,884	1.00565

12. Use the new adjustment ratios to make final adjustment in the FLCINCHWT.

- a. If $IN98_ISTATUS = "1"$ (occupied units) AND $IN98_TENURE = 1$ (owner-occupied units), $FLCINCHWT = D3 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for owner-occupied homes.
- b. If $IN98_ISTATUS = "1"$ (occupied units) AND $(2 \leq IN98_TENURE \leq 3)$ (renter-occupied units), $FLCINCHWT = D5 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for renter-occupied homes.
- c. If FLCINCHWT in which $(IN98_ISTATUS='2' \text{ OR } IN98_ISTATUS='3')$ AND $NOT(8 \leq IN98_VACANCY \leq 11)$ (URE and vacant units), $FLCINCHWT = D7 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for vacant units.
- d. If FLCINCHWT in which $(IN98_ISTATUS='2' \text{ OR } IN98_ISTATUS='3')$ AND $(8 \leq IN98_VACANCY \leq 11)$ (Seasonal units), $FLCINCHWT = D9 * FLCINCHWT$.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for seasonal homes.

The remaining steps apply to all areas:

13. Calculate the sum of FLCINCHWT after final weighting for cases with $SAME=1$, cases with $LOSS=1$, cases with $INTLOSS = 1$, and for all cases:

Table for Forward-Looking Step 13

Metropolitan Area	SAME=1 SUM	INTLOSS=1 SUM	Total	Basecount
Baltimore	997,448	30,652	1,028,100	1,028,200
Boston	1,328,085	17,815	1,345,900	1,345,900
Houston	1,495,609	51,691	1,547,300	1,547,300
Miami-Ft. Lauderdale	1,620,699	18,101	1,638,800	1,638,800
Minneapolis-St. Paul	1,134,253	16,147	1,150,400	1,150,400
Tampa-St. Petersburg	1,112,490	25,810	1,138,300	1,138,300
Washington	1,792,943	24,357	1,817,300	1,817,300
ALL	9,481,528	184,572	9,666,100	9,666,200

14. Check on the estimate of mobile homes (IN98_NUNIT2 = 4) and single-unit, detached (IN98_NUNIT2 = 1):

Table for Forward-Looking Step 14

Metropolitan Area	Manufacture Housing			Single-Unit Detached		
	Published	Estimated	Percent different	Published	Estimated	Percent different
Baltimore	16,200	14,054	-13.2%	520,000	529,364	1.8%
Boston	13,700	39,142	185.7%	738,400	704,300	-4.6%
Houston	67,800	55,823	-17.7%	951,400	964,763	1.4%
Miami-Ft. Lauderdale	53,000	53,100	0.2%	712,700	717,577	0.7%
Minneapolis-St. Paul	28,100	20,257	-27.9%	748,200	761,238	1.7%
Tampa-St. Petersburg	200,600	200,500	0.0%	641,300	641,762	0.1%
Washington	16,000	15,337	-4.1%	917,000	927,290	1.1%
Total	395,400	398,213	0.7%	5,229,000	5,246,294	0.3%

The estimates of mobile homes for Miami and Tampa are controlled to equal the published totals. As noted above, the algorithms were not able to control the mobile home totals in the remaining places because of small sample sizes. The estimation error is very large in Boston, where the reconstitution of the mobile home sample, the smaller sample sizes in 2007, and the change in geography between 2005 and 2007 resulted in a reduction in the number of mobile homes in the sample useable for the CINCH analysis from 42 to 3.

Backward Looking: From 2007 to the Previous Survey

The following are the steps necessary to prepare the data to analyze where 2007 units came from. AHS variables are given their codebook names and presented in capital letters. 2007 variables are labeled IN07_; we refer to variables in the previous survey by the prefix IN98_. In the algorithm, IN98_ stands for IN02_ in the case of Miami. The algorithm should be applied to each metropolitan area separately.

1. Merge files from the previous surveys and 2007 files, using the flat files. Keep units that appear in both years and in the 2007 file only.

Metropolitan Area	Frequency	Percent	Cumulative	Cumulative
			Frequency	Percent
Baltimore	2733	13.88	2733	13.88
Boston	2771	14.07	5504	27.95
Houston	2861	14.53	8365	42.48
Miami-Ft. Lauderdale	2647	13.44	11012	55.92
Minneapolis-St. Paul	2847	14.46	13859	70.38
Tampa-St. Petersburg	3053	15.5	16912	85.88
Washington	2781	14.12	19693	100

2. Create a new variable, REVREUAD as follows:

```
IN07_REVREUAD = IN07_REUAD
IF (1 LE IN98_ISTATUS LE 4 AND 3 LE IN07_REUAD LE 11 ), REVREUAD = 2
```

IN07_REUAD identifies units added to the sample in 2007. Discussion with staff at the Census Bureau indicates that the REUAD values for some cases are erroneous. Specifically, there are cases with IN07_REUAD values that were part of the previous survey. Normally REUAD would be used in step 9 to identify additions to the stock, but these erroneous values would lead to double counting, that is, there would be cases identified both as SAME and as additions. Therefore, a revised version of REUAD is needed.

“2” is not a value for REUAD, so the 31 cases with values of “2” in the following table are cases that need to be treated as “sames” rather than additions.

The Census Bureau also informed us that the coding of REUAD in 2007 for the metropolitan areas contains an error. All cases of REUAD = 5 should be treated as REUAD = 11.

IN07_REVREUAD	Frequency	Percent	Cumulative Frequency	Cumulative Percent
B	15470	78.56	15470	78.56
D	118	0.6	15588	79.16
R	1	0.01	15589	79.16
2	31	0.16	15620	79.32
3	2536	12.88	18156	92.2
4	163	0.83	18319	93.02
5	661	3.36	18980	96.38
6	43	0.22	19023	96.6
7	105	0.53	19128	97.13
8	15	0.08	19143	97.21
9	14	0.07	19157	97.28
10	532	2.7	19689	99.98
11	4	0.02	19693	100

3. Delete cases where:

- a. (IN07_NOINT GE 38) There are 396 observations that were deleted in prelist subsampling or were inappropriate for the sample. The units may still be part of the housing stock but the AHS provides no information on them. They are not part of the sample that is traced backwards. In the past, the algorithm combined steps 1a and 1b. The result is the same, but treating them as separate steps emphasizes the difference in rationales for deleting the cases.
- b. (10 LE IN07_NOINT LT 38) There are 1,264 type B or type C losses in 2007. These units are not part of the 2007 stock, and therefore we do not track them backwards.
- c. (IN07_SAMEDU = 2) There are 170 cases where it is possible that the Census Bureau interviewed the wrong unit in 2005.
- d. IN07_REVREUAD = 11 There are 4 cases added as sample adjustments. They are part of the 2007 housing stock, but we cannot tell whether they were in the 1998 stock or added by new construction or other means between 1998 and 2007. This is the third place where the backward-looking algorithm differs from past procedures.
- e. IN07_REUAD = 5 Delete all cases where IN07_REUAD = 5. These 661 cases are mostly likely cases added as a sample adjustment.
- f. (IN07_NUNIT2 = '4' AND IN07_BUILT LE 1999 AND NOT(IN98_ISTATUS = '1' OR IN98_ISTATUS = '2' OR IN98_ISTATUS = '3' OR IN98_ISTATUS =

'4')) These 207 cases are the mobile homes added to the sample in 2005. We cannot use them for CINCH analysis because we have no information on their status in 1998 or 2002. (In the national 2003-2005 CINCH analysis, dropping cases where REVREUAD = 11 eliminated the mobile homes added in 2005. This approach does not work for the metropolitan PUFs, as seen from step 3d where there were only 4 cases in which REVREUAD = 11.) Note that this approach may eliminate some cases that should be included in other additions, namely, mobile home move-ins, but REVREUAD = 4 may not be a reliable way to distinguish legitimate move-ins from sample replacements.

Metropolitan Area	After merge	After step 3a	After step 3b	After step 3c	After step 3d	After step 3e	After step 3f
Baltimore	2,733	2,706	2,503	2,484	2,484	2,430	2,423
Boston	2,771	2,722	2,557	2,538	2,534	2,225	2,221
Houston	2,861	2,822	2,597	2,543	2,543	2,487	2,443
Miami-Ft. Lauderdale	2,647	2,623	2,458	2,452	2,452	2,270	2,243
Minneapolis-St. Paul	2,847	2,812	2,659	2,642	2,642	2,641	2,620
Tampa-St. Petersburg	3,053	2,844	2,626	2,603	2,603	2,594	2,498
Washington	2,781	2,768	2,633	2,601	2,601	2,551	2,543
Total	19,693	19,297	18,033	17,863	17,859	17,198	16,991

After steps 3a-d, there were 2,702 fewer cases in the file.

4. For all units let $MXPWT = \max(IN07_PWT, IN98_PWT)$. (PWT is the pure weight.) In general, IN07_PWT should be greater than IN98_PWT because of the elimination of sample cases to save costs.
 - g. As a check, define:

$$\begin{aligned}
 CHPWT &= 1 \text{ if } IN07_PWT \text{ GT } IN98_PWT \\
 &= 0 \text{ if } IN07_PWT = IN98_PWT \\
 &= -1 \text{ otherwise}
 \end{aligned}$$

Frequency	Baltimore	Boston	Houston	Miami-Ft. Lauderdale	Minneapolis-St. Paul	Tampa-St. Petersburg	Washington	Total
0	0	1	0	0	0	0	0	1
1	2,423	2,220	2,443	2,243	2,620	2,498	2,543	16,990
Total	2,423	2,221	2,443	2,243	2,620	2,498	2,543	16,991

5. Adjust the pure weights of manufactured (mobile) homes.
 - a. From the previous file before merger, compute a pure weight count of mobile homes built before 2000 (IN07_OLDMHPWT) by summing PWT for cases where IN07_NUNIT2 = 4 AND IN07_BUILT LE 1999.
 - b. From merged file after step 3, compute a pure weight count of mobile homes built before 2000 that are in both years (IN07_OLDMHKEPT) by summing MXPWT for cases where IN07_NUNIT2 = 4 AND IN07_BUILT LE 1999.

Metropolitan Area	N	IN98_OLDMHPWT	N	IN98_OLDMHKEPT	IN98_OLDMHPWT/ IN98_OLDMHKEPT
Baltimore	22	9,555	15	6,999	1.365
Boston	9	4,011	4	1,783	2.250
Houston	68	55,656	16	9,540	5.834
Miami-Ft. Lauderdale	61	58,115	31	33,076	1.757
Minneapolis-St. Paul	42	21,171	19	9,577	2.211
Tampa-St. Petersburg	259	137,312	153	81,889	1.677
Washington	15	11,960	6	4,457	2.683

- c. Adjust the pure weights of all manufactured (mobile) homes.
 IF IN07_NUNIT2 = 4 AND IN07_BUILT GE 2000
 MXPWT = MXPWT
 IF IN07_NUNIT2 = 4 AND IN07_BUILT LE 1999
 MXPWT = MXPWT*(IN07_OLDMHPWT/IN07_OLDMHKEPT)
6. Obtain an estimate of the 2007 stock (CURRENTCOUNT) from the AHS publication for 2007.
7. Compute SMXPWT = sum of MXPWT after step 5; this sum is a first estimate of the size of the 2007 housing stock based on units retained for analysis.

Metropolitan Area	CURRENTCOUNT	SMXPWT	RATIO_0
Baltimore	1,109,600	1,027,332	1.08008
Boston	1,151,000	960,939	1.19779
Houston	2,160,100	1,980,306	1.09079
Miami-Ft. Lauderdale	2,419,700	2,097,817	1.15344
Minneapolis-St. Paul	1,329,700	1,297,354	1.02493
Tampa-St. Petersburg	1,324,000	1,279,192	1.03503
Washington	2,133,500	2,043,847	1.04387

8. Compute a $BLCINCHWT = MXPWT * (CURRENTCOUNT / SMXPWT)$. This computation ratios the weights up so that they sum to the 2007 stock.

Metropolitan Area	SUM_BLCINCHWT	CURRENTCOUNT
Baltimore	1,109,600	1,109,600
Boston	1,151,000	1,151,000
Houston	2,160,100	2,160,100
Miami-Ft. Lauderdale	2,419,700	2,419,700
Minneapolis-St. Paul	1,329,700	1,329,700
Tampa-St. Petersburg	1,324,000	1,324,000
Washington	2,133,500	2,133,500

9. Identify *sames*, *new construction*, *interviewed new construction*, *other adds*, and *interviewed other adds*:⁸
- SAME = 1 if IN98_ISTATUS = 1, 2, or 3 AND IN07_ISTATUS = 1, 2, OR 3
 - NC = 1 if IN07_ISTATUS=1, 2, 3, or 4 AND ((IN07_REVREUAD = 3) OR (10 LE IN98_NOINT LE 11))
 - INTNC = 1 IF NC=1 AND IN07_ISTATUS=1, 2, or 3
 - ADD = 1 if IN07_ISTATUS=1, 2, 3, or 4 AND ((4 LE IN07_REVREUAD LT 11) OR (12 LE IN98_NOINT LE 17))
 - INTADD = 1 if ADD =1 AND IN07_ISTATUS=1, 2, OR 3

Metropolitan Area	SAME	NC	INTNC	ADD	INTADD
Baltimore	1,570	213	211	89	89
Boston	1,006	304	304	229	228
Houston	1,244	583	578	148	147
Miami-Ft. Lauderdale	1,405	426	424	147	147
Minneapolis-St. Paul	1,822	348	348	43	41
Tampa-St. Petersburg	1,683	360	360	42	42
Washington	1,709	341	340	49	47
Total	10,439	2,575	2,565	747	741

10. Calculate:

- SSAME = sum of BLCINCHWT for all SAME = 1

⁸ Other adds are units that were type B losses in the previous survey but are in the 2007 housing stock, plus new housing units that are not new construction, such as the conversion to residential use of a warehouse or mobile home move-ins.

- b. $SNC = \text{sum of BLCINCHWT for } NC = 1$
 $SNCMH = \text{sum of BLCINCHWT for } NC=1 \text{ AND } IN07_NUNIT2 = 4$

There were no SNCMH in Baltimore, Boston, Miami-Ft. Lauderdale, Minneapolis-St. Paul, or Washington.

$$SNCOTH = \text{sum of BLCINCHWT for } NC=1 \text{ AND } IN07_NUNIT2 \text{ NE } 4$$

- c. $SINTNC = \text{sum of BLCINCHWT for } INTNC=1$

$$SINTNCMH = \text{sum of BLCINCHWT for } INTNC=1 \text{ AND } IN07_NUNIT2 = 4$$

$$SINTNCOTH = \text{sum of BLCINCHWT for } INTNC=1 \text{ AND } IN07_NUNIT2 \text{ NE } 4$$

- d. $SADD = \text{sum of BLCINCHWT for } ADD = 1$

- e. $SINTADD = \text{sum of BLCINCHWT for } INTADD = 1$

Metropolitan Area	SSAME	SINTNC	SINTNCMH	SINTNCOTH	SINTADD
Baltimore	723,541	93,406		93,406	38,666
Boston	527,397	149,246		149,246	118,365
Houston	1,121,628	489,409	3,399	486,010	124,011
Miami-Ft. Lauderdale	1,534,735	440,807		440,807	157,631
Minneapolis-St. Paul	940,344	165,913		165,913	15,909
Tampa-St. Petersburg	913,702	177,055	1,073	175,982	19,015
Washington	1,442,665	280,469		280,469	36,921

11. For CINCH analysis, we need information on the characteristics of units and their occupants in both the previous survey and 2007 for all units that were part of the stock in both the previous survey and 2007. For units that are part of the stock in only 2007, we need information on the characteristics of the units and their occupants in 2007 but only in 2007. Up to this point, we retained units that failed to meet these conditions so that we can get good estimates of the number of other additions (SADD).

Keep for future analysis only those units where: $SAME = 1 \text{ OR } INTNC = 1 \text{ OR } INTADD = 1$.

12. Calculate:

For Baltimore, Boston, Miami-Ft. Lauderdale, Minneapolis-St. Paul, and Washington:

- a. $\text{Ratio1} = (\text{CURRENTCOUNT} - (\text{SADD} + \text{SNC})) / \text{SSAME}$
b. $\text{Ratio2} = \text{SNC} / \text{SINTNC}$

c. Ratio4 = SADD/SINTADD

Metropolitan Area	RATIO_1	RATIO_2	RATIO_4
Baltimore	1.34976	1.00985	1
Boston	1.67399	1	1.00451
Miami-Ft. Lauderdale	1.18529	1.00488	1
Minneapolis-St. Paul	1.2196	1	1.06495
Washington	1.2571	1.00301	1.0457

For Houston and Tampa-St. Petersburg:

- Ratio1 = (CURRENTCOUNT – (SADD + SNC))/SSAME
- Ratio2 = SNCMH/SINTNCMH
- Ratio3 = SNCOTH/SINTNCOH
- Ratio4 = SADD/SINTADD

Metropolitan Area	RATIO_1	RATIO_2	RATIO_3	RATIO_4
Houston	1.37436	1	1.00884	1.00693
Tampa-St. Petersburg	1.23446	1	1	1

13. Recalculate BLCINCHWT as follows:

For Baltimore, Boston, Miami-Ft. Lauderdale, Minneapolis-St. Paul, and Washington:

- For SAME = 1, BLCINCHWT = Ratio1*BLCINCHWT
- For INTNC= 1, BLCINCHWT = Ratio2*BLCINCHWT
- For INTADD = 1, BLCINCHWT = Ratio4*BLCINCHWT

For Houston and Tampa-St. Petersburg:

- For SAME = 1, BLCINCHWT = Ratio1*BLCINCHWT
- For INTNC= 1 AND IN07_NUNIT2 = 4, BLCINCHWT = Ratio2*BLCINCHWT
- For INTNC= 1 AND IN07_NUNIT2 NE 4, BLCINCHWT = Ratio3*BLCINCHWT

d. For $INTADD = 1$, $BLCINCHWT = Ratio4 * BLCINCHWT$

The following table gives the sum of BLCINCHWT after step 13. For each metropolitan area the sum equals the CURRENTCOUNT.

Metropolitan Area	SUM_BLCINCHWT	CURRENTCOUNT
Baltimore	1,109,600	1,109,600
Boston	1,151,000	1,151,000
Houston	2,160,100	2,160,100
Miami-Ft. Lauderdale	2,419,700	2,419,700
Minneapolis-St. Paul	1,329,700	1,329,700
Tampa-St. Petersburg	1,324,000	1,324,000
Washington	2,133,500	2,133,500

At this point, the algorithm differs by metropolitan area because of the small number of mobile homes in the samples for Baltimore, Boston, Houston, Minneapolis-St. Paul, and Washington.

The following steps 14 and 15 are for Miami-Ft. Lauderdale and Tampa-St. Petersburg only:

14. From published reports obtain estimated 2007 counts for all owner-occupied units, all renter-occupied units, all vacant units, and all seasonal units, distinguishing between mobile homes and all other units.

Table for Backward-Looking Step 14

	A	B	C	D
		2007	Sum of BLCINCHWT	Ratio Adjustment
1	Housing Stock			
2	Occupied			
3	Owner-Occupied (mobile homes)		IN07_ISTATUS = "1" AND IN07_TENURE = 1 AND IN07_NUNIT2 = 4 $\Sigma =$	D3 = B3/C3 =
4	Owner-Occupied (other)		IN07_ISTATUS = "1" AND IN07_TENURE = 1 AND IN07_NUNIT2 NE 4 $\Sigma =$	D4 = B4/C4 =
5	Renter (mobile homes)		IN07_ISTATUS = "1" AND (2 LE IN07_TENURE LE 3) AND IN07_NUNIT2 = 4 $\Sigma =$	D5 = B5/C5 =
6	Renter (other)		IN07_ISTATUS = "1" AND (2 LE IN07_TENURE LE 3) AND IN07_NUNIT2 NE4 $\Sigma =$	D6 = B6/C6 =
7	Vacant (mobile homes)		(IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND NOT(8 LE IN07_VACANCY LE 11) AND IN07_NUNIT2 = 4 $\Sigma =$	D7 = B7/C7 =
8	Vacant (other)		(IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND NOT(8 LE IN07_VACANCY LE 11) AND IN07_NUNIT2 NE 4 $\Sigma =$	D8 = B8/C8 =
9	Seasonal (mobile homes)		(IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND (8 LE IN07_VACANCY LE 11) AND IN07_NUNIT2 = 4 $\Sigma =$	D9 = B9/C9 =
10	Seasonal (other)		(IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND (8 LE IN07_VACANCY LE 11) AND IN07_NUNIT2 NE 4 $\Sigma =$	D10 = B10/C10 =

Metropolitan Area	GROUP	PUBLISHED	SUM_BLCINCHWT	RATIO
Miami-Ft. Lauderdale	3	56,600	40,616	1.39355
Miami-Ft. Lauderdale	4	1,263,000	1,242,295	1.01667
Miami-Ft. Lauderdale	5	15,500	13,539	1.14481
Miami-Ft. Lauderdale	6	576,500	585,825	0.98408
Miami-Ft. Lauderdale	7	9,400	4,597	2.0448
Miami-Ft. Lauderdale	8	371,400	410,987	0.90368

Miami-Ft. Lauderdale	9	8,900	13,539	0.65734
Miami-Ft. Lauderdale	10	118,400	108,302	1.09324
Tampa-St. Petersburg	3	116,400	87,229	1.33442
Tampa-St. Petersburg	4	666,800	676,839	0.98517
Tampa-St. Petersburg	5	24,600	17,106	1.43812
Tampa-St. Petersburg	6	267,100	266,039	1.00399
Tampa-St. Petersburg	7	28,700	22,874	1.25467
Tampa-St. Petersburg	8	160,900	184,567	0.87177
Tampa-St. Petersburg	9	33,500	37,458	0.89433
Tampa-St. Petersburg	10	26,100	31,888	0.8185

The algorithm uses the ratios reported above to adjust the weights to match the bottom eight rows in the Table for Backward-Looking Step 14 for each metropolitan area.

15. Use the new adjustment ratios to make final adjustment in the BLCINCHWT.

- a. If $IN07_ISTATUS = "1"$ (occupied units) AND $IN07_TENURE = 1$ (owner-occupied units) AND $IN07_NUNIT2 = 4$ (mobile homes), $BLCINCHWT = D3 * BLCINCHWT$.
This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for owner-occupied mobile homes.
- b. If $IN07_ISTATUS = "1"$ (occupied units) AND $IN07_TENURE = 1$ (owner-occupied units) AND $IN07_NUNIT2 \neq 4$ (non-mobile home), $BLCINCHWT = D4 * BLCINCHWT$.
This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for owner-occupied non-mobile homes.
- c. If $IN07_ISTATUS = "1"$ (occupied units) AND $(2 \leq IN07_TENURE \leq 3)$ (renter-occupied units) AND $IN07_NUNIT2 = 4$ (mobile homes), $BLCINCHWT = D5 * BLCINCHWT$.
This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for renter-occupied mobile homes.
- d. If BLCINCHWT in which $IN07_ISTATUS = "1"$ (occupied units) AND $(2 \leq IN07_TENURE \leq 3)$ (renter-occupied units) AND $IN07_NUNIT2 \neq 4$ (non-mobile homes), $BLCINCHWT = D6 * BLCINCHWT$.
This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for renter-occupied non-mobile homes.
- e. If BLCINCHWT in which $(IN07_ISTATUS = "2" \text{ OR } IN07_ISTATUS = "3")$ AND $NOT(8 \leq IN07_VACANCY \leq 11)$ (URE and vacant units) AND $IN07_NUNIT2 = 4$ (mobile homes), $BLCINCHWT = D7 * BLCINCHWT$.
This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for vacant mobile homes.

- f. If BLCINCHWT in which (IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND NOT(8 LE IN07_VACANCY LE 11) (URE and vacant units) AND IN07_NUNIT2 NE 4 (non-mobile homes), $BLCINCHWT = D8 * BLCINCHWT$. This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for vacant non-mobile homes.
- g. If BLCINCHWT in which (IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND (8 LE IN07_VACANCY LE 11) (Seasonal units) AND IN07_NUNIT2 = 4 (mobile homes), $BLCINCHWT = D9 * BLCINCHWT$. This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for seasonal mobile homes.
- h. If BLCINCHWT in which (IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND (8 LE IN07_VACANCY LE 11) (Seasonal units) AND IN07_NUNIT2 NE 4 (non-mobile homes), $BLCINCHWT = D10 * BLCINCHWT$. This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for seasonal non-mobile homes.

The following steps 14 and 15 are for Baltimore, Boston, Houston, Minneapolis-St. Paul, and Washington only:

- 14. From published reports obtain estimated 2007 counts for all owner-occupied units, all renter-occupied units, all vacant units, and all seasonal units, distinguishing between mobile homes and all other units.

Table for Backward-Looking Step 14

	A	B	C	D
		2007	Sum of BLCINCHWT	Ratio Adjustment
1	Housing Stock			
2	Occupied			
3	Owner-Occupied		IN07_ISTATUS = "1" AND IN07_TENURE = 1 Σ=	D3 = B3/C3 =
5	Renter		IN07_ISTATUS = "1" AND (2 LE IN07_TENURE LE 3) Σ=	D5 = B5/C5 =
7	Vacant		(IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND NOT(8 LE IN07_VACANCY LE 11) Σ=	D7 = B7/C7 =
9	Seasonal		(IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND (8 LE IN07_VACANCY LE 11) Σ=	D9 = B9/C9 =

Metropolitan Area	NEW_GROUP	PUBLISHED	SUM_BLCINCHWT	RATIO
Baltimore	3	721,600	714,355	1.01014
Baltimore	5	290,700	281,217	1.03372
Baltimore	7	93,000	108,372	0.85816
Baltimore	9	4,300	5,656	0.76032
Boston	3	656,700	644,825	1.01842
Boston	5	400,500	390,159	1.02651
Boston	7	85,200	105,609	0.80675
Boston	9	8,700	10,407	0.83597
Houston	3	1,242,100	1,194,517	1.03983
Houston	5	629,900	635,940	0.9905
Houston	7	265,400	306,728	0.86526
Houston	9	22,600	22,915	0.98625
Minneapolis-St. Paul	3	908,500	923,915	0.98332
Minneapolis-St. Paul	5	321,400	294,229	1.09235
Minneapolis-St. Paul	7	95,200	106,708	0.89215
Minneapolis-St. Paul	9	4,600	4,847	0.94896
Washington	3	1,329,600	1,336,878	0.99456
Washington	5	619,600	589,112	1.05175
Washington	7	175,500	196,190	0.89454
Washington	9	8,800	11,320	0.77737

15. Use the new adjustment ratios to make final adjustment in the BLCINCHWT.

- a. If $IN07_ISTATUS = "1"$ (occupied units) AND $IN07_TENURE = 1$ (owner-occupied units), $BLCINCHWT = D3 * BLCINCHWT$.
This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for owner-occupied homes.
- b. If $IN07_ISTATUS = "1"$ (occupied units) AND (2 LE $IN07_TENURE$ LE 3) (renter-occupied units), $BLCINCHWT = D5 * BLCINCHWT$.
This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for renter-occupied homes.
- c. If BLCINCHWT in which ($IN07_ISTATUS='2'$ OR $IN07_ISTATUS='3'$) AND NOT(8 LE $IN07_VACANCY$ LE 11) (URE and vacant units), $BLCINCHWT = D7 * BLCINCHWT$.
This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for vacant units.
- d. If BLCINCHWT in which ($IN07_ISTATUS='2'$ OR $IN07_ISTATUS='3'$) AND (8 LE $IN07_VACANCY$ LE 11) (Seasonal units), $BLCINCHWT = D9 * BLCINCHWT$.
This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for seasonal homes.

16. Sum of weights after final adjustment:

Table for Backward-Looking Step 16

Metropolitan Area	Baltimore	Boston	Houston	Miami-Ft. Lauderdale	Minneapolis-St. Paul	Tampa-St. Petersburg	Washington
SAME=1	976,853	884,561	1,542,013	1,820,226	1,147,200	1,133,032	1,816,307
INTADD=1	38,177	116,611	123,397	160,522	17,930	19,468	37,432
INTNC=1	94,570	149,929	494,591	438,952	164,570	171,600	279,762
ALL	1,109,600	1,151,100	2,160,000	2,419,700	1,329,700	1,324,100	2,133,500
CURRENT COUNT	1,109,600	1,151,000	2,160,100	2,419,700	1,329,700	1,324,000	2,133,500

17. Check on the estimate of mobile homes:

Table for Backward-Looking Step 17

Metropolitan Area	Manufactured housing			Single-unit detached		
	Estimated	Published	Percent different	Estimated	Published	Percent different
Baltimore	12,678	19,400	-34.6%	573,644	545,800	5.1%
Boston	8,207	5,500	49.2%	550,979	550,700	0.1%
Houston	93,218	138,700	-32.8%	1,375,410	1,343,800	2.4%
Miami-Ft. Lauderdale	90,400	90,400	0.0%	1,041,639	1,051,700	-1.0%
Minneapolis-St. Paul	23,292	33,300	-30.1%	849,845	828,000	2.6%
Tampa-St. Petersburg	203,200	203,200	0.0%	716,092	710,100	0.8%
Washington	17,857	22,800	-21.7%	1,066,172	1,043,900	2.1%
Total	448,853	513300	-12.6%	6,173,780	6074000	1.6%

In Miami-Ft. Lauderdale and Tampa-St. Petersburg, the full algorithm ensured a perfect match to the count of mobile homes. In those two metropolitan areas, the estimated counts of single-unit detached structures were within 1 percent of the published counts. In the other five metropolitan areas, the estimated counts of mobile homes are substantially different than the published counts. In these five places, the counts of single-unit detached structures are within 5 percent or less of the published counts.