**American Housing Survey**

**Weighting Strategy for**

**2011–2013 CINCH Analysis**

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WEIGHTING STRATEGY FOR 2011–2013 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 2007 and 2009.[[1]](#footnote-1)

## The CINCH Objective

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

**Figure 1: The CINCH Objective**

**2011 National Housing Stock**

**2013 National Housing Stock**

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 2011 and 2013). No one estimates the other three ovals: the number of units that belong to both the 2011 and 2013 housing stock, units lost to the housing stock between 2011 and 2013, and other additions to the housing stock between 2011 and 2013.

Losses can be either permanent or temporary. Units destroyed by natural disasters or intentionally demolished are permanent losses. Temporary losses include units that are condemned pending extensive repairs or units that are used for nonresidential purposes.[[2]](#footnote-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.

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 American Housing Survey (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]](#footnote-3)

1. 2011 housing stock = units that exist in both years + losses.
2. New construction + other additions + units that exist in both years = 2013 housing stock.

Unfortunately, previous experience with CINCH analysis has shown that it is difficult to find satisfactory simultaneous solutions to the equations. For this reason, Econometrica 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 2011 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 2013 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 2013 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).

Solving the equations separately also results in two independent estimates of “units that exist in both years,” one based on each set of weights. This paper develops algorithms to carry out the forward-looking and backward-looking analyses.

## New Issues With the 2011–2013 CINCH

### Oversample of HUD-assisted units

In 2011, HUD and the Census Bureau took two steps to make the AHS more useful for studying assisted rental housing. For the first time, the 2011 Public Use File (PUF) contains a variable, HUDADMIN, that identifies public housing units, units in HUD-assisted privately owned rental properties, and units whose households have HUD housing vouchers. In addition, the Census Bureau added a sample of public housing units and units in HUD-assisted privately owned rental properties to the regular AHS sample to facilitate analysis of this important subset of the housing stock by increasing the number of units available for study. The 2013 AHS included the oversample of HUD-assisted units.

The addition of the oversample complicated the construction of weights for the AHS, specifically WGT90GEO. We do not yet have reliable information on how the weights were adjusted in 2011 for the oversample, and it appears that different adjustments may have been made in the 2013 AHS. We do not know whether these adjustments create any concerns for the CINCH weighting strategy.[[4]](#footnote-4)

### Changes in how values for REUAD are assigned

One reason the AHS has been so valuable for CINCH analysis is that the Census Bureau tracks new construction and the various types of losses and other additions. The variable REUAD[[5]](#footnote-5) indicates how new units joined the sample.

For the 2013 PUF, the Census Bureau changed the coding of REUAD. In earlier years, REUAD was based on information from the field representatives for all cases new to the sample. In 2013, the following changes were made:

1. The value of 3 (new construction) was given for cases that were added as part of a permit sample or built since the last survey year in a non-permit-issuing area.
2. The value of 4 (mobile home moved in) was set for mobile homes that were found as additional or extra units in 2013. Mobile homes in new construction were also moved to this category. Prior to the 2009–2011 CINCH analysis, new mobile homes were not classified as new construction. In 2013, the coding was changed to include new mobile homes as new construction. In the 2011–2013 CINCH, they will once again be counted as other additions.
3. There is no longer a value of 5 (house moved in). This was never a large group.
4. A value of 6 (building relisted due to structural changes) was given to additional and extra units found during the interview process that the field representatives determined to be part of this category resulting from a follow-up questionnaire about additional and extra cases. This collapses the old categories 6 (buildings relisted due to structural changes), 7 (unit created when original living quarters split into more units), and 8 (unit created when original quarters merged to fewer units).
5. Values 9 (conversion of nonresidential unit) and 10 (other, specify) were dropped. Presumably these cases are now included under the value 6.
6. A value of 11 (sample adjustment) was set for all cases that were added to the sample due to some form of sample expansion or coverage improvement.

These changes require a change in the structure of the backward-looking CINCH tables.

## SAMEDU2

The AHS contains a variable to identify cases where the unit interviewed in one survey may not be the same unit that was interviewed in the previous survey. The variable (SAMEDU) takes only yes/no values. For the purpose of CINCH analysis, we created a modified version (SAMEDU2) that uses information from multiple AHS surveys to attempt to specify how the unit might differ from the unit in the previous survey. The construction of SAMEDU2 is explained in a companion paper.[[6]](#footnote-6) In creating weights, SAMEDU2 is used to eliminate cases that may not be valid for CINCH analysis and to distinguish types of losses and additions.

In the weighting discussion, interpret SAMEDU2 as follows:

IN13\_SAMEDU2 = B Not applicable.

IN13\_SAMEDU2 = 1 Not clear why SAMEDU = '2' (no).

IN13\_SAMEDU2 = 2 Possibly the wrong unit was interviewed in 2011.

IN13\_SAMEDU2 = 3 A new type C non-interview (a permanent loss).

IN13\_SAMEDU2 = 4 Vacant mobile home lot that was occupied in 2011.

IN13\_SAMEDU2 = 5 Mobile home move-in (to a vacant lot, replacing an old mobile home, or replacing a non-mobile-home structure)—note that this implies either a mobile home move-out or a demolition of another structure type.

IN13\_SAMEDU2 = 6 Possible merger.

IN13\_SAMEDU2 = 7 Possible split.

IN13\_SAMEDU2 = 8 Possible merger or split—we cannot tell because the work has not been completed or the unit was not interviewed.

## Changes to Weighting Algorithms

For the 2011–2013 CINCH, we adopted a more aggressive weighting strategy based on successful experimentation in developing weights for the backward-looking metropolitan 2009–2011 CINCH.[[7]](#footnote-7)

In previous CINCH analyses, we compared estimates of various subsets of the housing stock based on CINCH weights with published estimates using AHS weights. While the two sets of estimates were generally close, we reported some deviations in estimates of race of householder, Hispanic origin of householder, metropolitan–nonmetropolitan distribution of the housing stock, and regional distribution. For the 2011–2013 CINCH, we conducted four preliminary adjustments to the weights to match published totals in these areas in the hope that the preliminary adjustments would improve the final match between the published estimates and the CINCH estimates after the last adjustments to the weights.

Finally, we expanded a step suggested by a former statistician at the Census Bureau to improve estimates of mobile homes.[[8]](#footnote-8) For this CINCH analysis, we control the weights in the final adjustment to equal published totals by both occupancy status (owner-occupied, renter-occupied, or vacant) and seasonal use and by structure type (single-family detached, single-family attached, structures with 2–4 units, structures with 5–19 units, structures with 20–49 units, structures with 50 or more units, and mobile homes).

## Forward-Looking Weighting Algorithm: From 2011 to 2013

The following are the steps necessary to prepare the data to analyze what happened between 2011 and 2013 to units that existed in 2011. AHS variables are given their codebook names and presented in capital letters. We refer to 2011 variables by the prefix IN11\_; 2013 variables are labeled IN13\_.

1. Use the 2009, 2011, and 2013 PUFs to create SAMEDU2 for any units in the 2013 PUF that have SAMEDU = '2'—see *Listing of Programs and Variables Used in CINCH and Rental Dynamics Analysis for 2011 and 2013 American Housing Surveys* for the construction of SAMEDU2.

*{Dav, this draft includes the revised coding for SAMEDU2 because the referenced paper is still being written. – Fred}*

IN13\_SAMEDU2 = B

IF IN13\_SAMEDU = '2', IN13\_SAMEDU2 = 1

IF (IN13\_SAMEDU = '2' AND (((IN09\_NUNIT2 = IN13\_NUNIT2) AND (IN11\_NUNIT2 NE IN13\_NUNIT2)) OR ((IN09\_ROOMS = IN13\_ROOMS) AND (IN11\_ROOMS NE IN13\_ROOMS)))) THEN IN13\_SAMEDU2 = 2

IF (IN13\_SAMEDU = '2' AND ((IN11\_NOINT = 'B' OR IN11\_NOINT LT 30) AND IN13\_NOINT GE 30)) THEN IN13\_SAMEDU2 = 3

IF (IN13\_SAMEDU = '2' AND (IN11\_NUNIT2 = 4 AND IN13\_NOINT = 13)) THEN IN13\_SAMEDU2 = 4

IF (IN13\_SAMEDU = '2' AND IN13\_SAMEDU2 NE 2 AND (IN13\_NUNIT2 = 4 AND (IN11\_NUNIT2 = B OR (IN11\_NUNIT2 = 4 AND (IN11\_BUILT NE IN13\_BUILT)) OR IN11\_NUNIT2 LT 4))) THEN IN13\_SAMEDU = 5

IF (IN13\_SAMEDU = '2' AND IN13\_NUNIT2 NE 4 AND (IN13\_BUILT LT 2011 AND ((IN09\_ROOMS = IN11\_ROOMS) AND (IN11\_ROOMS LT IN13\_ROOMS))) AND IN13\_NOINT = B) THEN IN13\_SAMEDU2 = 6

IF (IN13\_SAMEDU = '2' AND IN13\_NUNIT2 NE 4 AND (IN13\_BUILT LT 2011 AND ((IN09\_ROOMS = IN11\_ROOMS) AND (IN11\_ROOMS GT IN13\_ROOMS))) AND IN13\_NOINT = B) THEN IN13\_SAMEDU2 = 7

IF (IN13\_SAMEDU = '2' AND IN13\_NUNIT2 NE 4 AND (IN13\_BUILT LT 2011 AND ((IN09\_ROOMS = IN11\_ROOMS) AND (IN11\_ROOMS NE IN13\_ROOMS))) AND 1 LE IN13\_NOINT LE 12) THEN IN13\_SAMEDU2 = 8

|  |  |
| --- | --- |
| **IN13\_SAMEDU** | **IN13\_SAMEDU2** |
| **1** | **2** | **3** | **4** | **5** | **7** | **8** | **B** | **Total** |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 67,659 | 67,659 |
| 2 | 31 | 7 | 280 | 32 | 10 | 1 | 2 | 0 | 363 |
| Total | 31 | 7 | 280 | 32 | 10 | 1 | 2 | 67,659 | 68,022 |

1. Merge the 2011 and 2013 files, using the flat files.
	1. Eliminate non-matches.

|  |  |
| --- | --- |
| A: IN BOTH 11 & 13 | 68,022 |
| B: IN 11 ONLY | 118,426 |
| C: IN 13 ONLY | 16,333 |

* 1. Test to see if there are any cases in the matched sample where IN11\_NATLFLAG = '2' (part of the metropolitan sample in 2011). If there are such units, we may have to adjust the pure weight (PWT) for these units. No cases with IN1\_NATLFLAG = '2' were found.
	2. Test to see if there are any cases in the matched sample that are part of the special oversample of HUD-assisted units (IN11\_HUDSAMP = '1'), which began in 2011. If there are such units, we may have to adjust PWT for these units. Count the number of these cases. There are 4,208 cases with IN11\_HUDSAMP = '1'
	3. Do an unweighted frequency distribution of IN13\_NOINT.

| **IN13\_NOINT** | **Frequency** | **Percent** | **Cumulative****frequency** | **Cumulative****percent** |
| --- | --- | --- | --- | --- |
| B | 56,780 | 83.47 | 56,780 | 83.47 |
| 1 | 952 | 1.40 | 57,732 | 84.87 |
| 2 | 89 | 0.13 | 57,821 | 85.00 |
| 3 | 6,977 | 10.26 | 64,798 | 95.26 |
| 4 | 41 | 0.06 | 64,839 | 95.32 |
| 5 | 68 | 0.10 | 64,907 | 95.42 |
| 6 | 1,399 | 2.06 | 66,306 | 97.48 |
| 10 | 10 | 0.01 | 66,316 | 97.49 |
| 11 | 26 | 0.04 | 66,342 | 97.53 |
| 12 | 219 | 0.32 | 66,561 | 97.85 |
| 13 | 165 | 0.24 | 66,726 | 98.09 |
| 14 | 275 | 0.40 | 67,001 | 98.50 |
| 15 | 64 | 0.09 | 67,065 | 98.59 |
| 16 | 166 | 0.24 | 67,231 | 98.84 |
| 17 | 87 | 0.13 | 67,318 | 98.97 |
| 30 | 272 | 0.40 | 67,590 | 99.36 |
| 31 | 88 | 0.13 | 67,678 | 99.49 |
| 32 | 39 | 0.06 | 67,717 | 99.55 |
| 33 | 35 | 0.05 | 67,752 | 99.60 |
| 36 | 5 | 0.01 | 67,757 | 99.61 |
| 37 | 250 | 0.37 | 68,007 | 99.98 |
| 40 | 15 | 0.02 | 68,022 | 100.00 |

* 1. Eliminate cases where IN13\_NOINT GE 38. This eliminates losses due to 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. (15 cases)
	2. Eliminate cases where 1 LE IN13\_SAMEDU2 LE 2. This eliminates cases where it is possible that the Census Bureau went to the wrong unit in 2011. (38 cases)
1. Do an unweighted frequency distribution of IN11\_NOINT.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IN11\_NOINT** | **Frequency** | **Percent** | **Cumulative****frequency** | **Cumulative****percent** |
| B | 58,367 | 85.87 | 58,367 | 85.87 |
| 1 | 705 | 1.04 | 59,072 | 86.91 |
| 2 | 43 | 0.06 | 59,115 | 86.97 |
| 3 | 6,549 | 9.64 | 65,664 | 96.61 |
| 4 | 68 | 0.10 | 65,732 | 96.71 |
| 5 | 34 | 0.05 | 65,766 | 96.76 |
| 6 | 1,006 | 1.48 | 66,772 | 98.24 |
| 10 | 23 | 0.03 | 66,795 | 98.27 |
| 11 | 64 | 0.09 | 66,859 | 98.37 |
| 12 | 287 | 0.42 | 67,146 | 98.79 |
| 13 | 181 | 0.27 | 67,327 | 99.06 |
| 14 | 290 | 0.43 | 67,617 | 99.48 |
| 15 | 62 | 0.09 | 67,679 | 99.57 |
| 16 | 196 | 0.29 | 67,875 | 99.86 |
| 17 | 94 | 0.14 | 67,969 | 100.00 |

Eliminate all observations that were 2011 type B or type C losses (10 LE IN11\_NOINT). These units were not part of the 2011 stock and therefore are not tracked in the forward-looking analysis. Note that because of the changed treatment of type C losses in PUFs beginning with the 2011 survey, merging and keeping only matches eliminates any type C units from 2011. (1,197 cases)

1. Adjust PWTs for 2011 in 28 metropolitan areas surveyed as part of the metropolitan AHS.

In 2011, the AHS combined the national and metropolitan surveys. Twenty-eight metropolitan areas have sample cases from the national sample and the metropolitan sample. The cases from the metropolitan sample cannot be used in the national CINCH as they have no 2013 matches. For the 28 areas, each case has 4 weights in 2011: PWT, an adjusted weight to be used in the national analysis (WGT90GEO), an adjusted weight to be used for the metropolitan analysis (WGTMETRO), and an adjusted weight to be used for national analysis *if* only national cases are used (PUFWGT). CINCH weights are based on PWTs. For these areas, PWT takes into account both samples in 2011 and therefore is smaller than what we would desire it to be.

The following table uses only cases from the national sample. It reports the average ratio of (PWT in 2009)/(PWT in 2011). The table demonstrates that the PWTs for 2011 for cases in the 28 metropolitan areas are lower than the typical national case, and the ratio is very consistent for each area.

| **Area** | **Sample size** | **Ratio of (PWT in 2009)/(PWT in 2011)** |
| --- | --- | --- |
| **Mean** | **90th per** | **75th per** | **Median** |
| Anaheim | 378 | 2.242302 | 2.15324 | 2.15324 | 2.15324 |
| Atlanta | 359 | 2.262804 | 2.16734 | 2.16734 | 2.16734 |
| Birmingham | 98 | 2.645409 | 2.27609 | 2.27609 | 2.27609 |
| Buffalo | 161 | 2.197836 | 2.19905 | 2.19905 | 2.19905 |
| Cincinnati | 195 | 2.986955 | 2.39809 | 2.39809 | 2.39809 |
| Cleveland | 282 | 2.441410 | 2.20399 | 2.20399 | 2.20399 |
| Columbus | 218 | 2.171913 | 2.17280 | 2.17280 | 2.17280 |
| Dallas | 445 | 2.195513 | 2.12841 | 2.12841 | 2.12841 |
| Denver | 124 | 2.457298 | 1.97604 | 1.97604 | 1.97604 |
| Fort Worth | 234 | 2.154470 | 2.15694 | 2.15694 | 2.15694 |
| Indianapolis | 180 | 3.188909 | 2.20961 | 2.20961 | 2.20961 |
| Kansas City | 244 | 2.346076 | 1.98021 | 1.98021 | 1.98021 |
| Los Angeles | 1,335 | 3.376580 | 3.04836 | 3.04836 | 3.04836 |
| Memphis | 144 | 2.616419 | 2.38010 | 2.38010 | 2.38010 |
| Milwaukee | 211 | 2.376914 | 2.20947 | 2.20947 | 2.20947 |
| New Orleans | 173 | 2.344619 | 2.34825 | 2.34825 | 2.34825 |
| Oakland | 356 | 2.601272 | 2.05593 | 2.05593 | 2.05593 |
| Phoenix | 506 | 2.196403 | 2.13824 | 2.13824 | 2.13824 |
| Pittsburgh | 302 | 2.498695 | 2.15729 | 2.15729 | 2.15729 |
| Portland | 262 | 2.148079 | 1.91498 | 1.91498 | 1.91498 |
| Providence | 196 | 2.885895 | 2.05373 | 2.05373 | 2.05373 |
| Riverside | 266 | 2.272109 | 2.05198 | 2.05198 | 2.05198 |
| Sacramento | 222 | 2.647437 | 2.17844 | 2.17844 | 2.17844 |
| San Diego | 417 | 2.361211 | 2.19389 | 2.19389 | 2.19389 |
| San Francisco | 297 | 2.332360 | 2.10562 | 2.10562 | 2.10562 |
| San Jose | 248 | 2.285886 | 2.14742 | 2.14742 | 2.14742 |
| St. Louis | 323 | 3.025786 | 2.17598 | 2.17598 | 2.17598 |
| Virginia Beach | 250 | 2.879743 | 2.19378 | 2.19378 | 2.19378 |
| Rest of sample  | 46,639 | 1.258179 | 1.15233 | 1.15233 | 1.15233 |

* 1. Adjust PWT in each of the 28 metropolitan areas as follows:

If case is not in one of 28 areas: IN11\_ADJPWT = IN11\_PWT

If case is in one of 28 areas: IN11\_ADJPWT = (median from above table)\*IN11\_PWT.

* 1. MXPWT = IN11\_ADJPWT (Note: We dropped the old step 5 where MXPWT = max (IN13\_PWT, IN11\_ADJPWT) because of the change in PWT between surveys for HUD-assisted units.)
1. Obtain from the Census Bureau tables an estimate of the 2011 stock (BASECOUNT = 132,419,000).
2. Compute SMXPWT = sum of MXPWT after step 5; this sum is a first estimate of the size of the housing stock based on the units retained for analysis. SMXPWT = 125,303,787, based on 66,772 cases.
3. Compute FLCINCHWT = MXPWT\*(BASECOUNT/SMXPWT). This computation ratios the weights up so that they sum to the 2011 stock. BASECOUNT/SMXPWT = 1.0567837
4. Identify *sames, losses,* and *interviewed losses:*
5. SAME = 1 if IN11\_ISTATUS = 1, 2, or 3 AND IN13\_ISTATUS = 1, 2, or 3 AND NOT(IN13\_SAMEDU2 GE 4) (57,277 cases)
6. LOSS = 1 if IN11\_ISTATUS = 1, 2, 3, or 4 AND (10 LE IN13\_NOINT LT 38 OR IN13\_SAMEDU2 GE 4). IN13\_SAMEDU2 GE 4 means that the Census Bureau considers this a different unit than the unit in the 2011 sample and, therefore, we will treat the 2011 unit as a loss. (845 cases)
7. INTLOSS = 1 if IN11\_ISTATUS = 1, 2, or 3 AND LOSS = 1 (749 cases)
8. Calculate:

a. SSAME = sum of FLCINCHWT for all SAME = 1 SSAME = 103,066,125

b. SLOSS = sum of FLCINCHWT for all LOSS = 1 SLOSS = 1,710,733

c. SINTLOSS = sum of FLCINCHWT for INTLOSS = 1 SINTLOSS = 1,593,445

1. For CINCH analysis, we need information on the characteristics of units and their occupants in both 2011 and 2013 for all units that were part of the stock in both 2011 and 2013. For units that are part of the stock in only 2011, we need information on the characteristics of the units and their occupants only in 2011. 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.

Note that this formulation keeps a few 2013 type A non-interviews if the unit is interviewed in 2011 *and* is also an eligible SAMEDU = '2' case. Since we treat the 2013 version of the unit as a different unit, we do not need to know the characteristics of the unit or its occupants in 2013 for the forward-looking analysis.

1. Calculate:
2. Ratio1 = (BASECOUNT – SLOSS)/SSAME = 1.2681981
3. Ratio2 = SLOSS/SINTLOSS = 1.0736066
4. Recalculate FLCINCHWT as follows:
	1. For SAME = 1, FLCINCHWT = Ratio1\*FLCINCHWT
	2. For INTLOSS = 1, FLCINCHWT = Ratio2\*FLCINCHWT
5. Do a preliminary adjustment to FLCINCHWT to improve counts of householders by race.
	1. From published reports, obtain estimated 2011 counts for units by race.

|  |  |
| --- | --- |
| White alone | 92,820,000 |
| Black alone | 14,694,000 |

* 1. Develop estimates for these same categories using FLCINCHWT with these formulas:

|  |  |  |
| --- | --- | --- |
| White alone | IN11\_ISTATUS = '1' AND IN11\_RACE1 = '01' |  90,018,331  |
| Black alone | IN11\_ISTATUS = '1' AND IN11\_RACE1 = '02' |  13,823,846  |

* 1. Create new adjustment ratios by taking the ratio of the published numbers in step a to the estimates in step b.

For example, if the estimate in step b for units with “White only” householders is 90,018,331 units, then the ratio for the top cell in step c is 1.03112.

|  |  |
| --- | --- |
| White alone | 1.03112 |
| Black alone | 1.06295 |

* 1. Adjust FLCINCHWT by applying the new adjustment ratios to existing FLCINCHWT using the formulas in step b to determine which FLCINCHWT to adjust by which ratio. Calculate the sum of FLCINCHWT by category.

|  |  |
| --- | --- |
| White alone |  92,820,000  |
| Black alone |  14,694,000  |

1. Do a second adjustment to FLCINCHWT to improve count of householders by ethnicity.
2. From published reports, obtain estimated 2011 count for units by ethnicity.

|  |  |
| --- | --- |
| Hispanic | 13,841,000 |

1. Develop estimate for this category using FLCINCHWT with this formula:

|  |  |  |
| --- | --- | --- |
| Hispanic | IN11\_ISTATUS = '1' AND IN11\_SPAN1 = '01' |  14,983,978  |

1. Create new adjustment ratio by taking the ratio of the published number in step a to the estimate in step b. Ratio = 0.92372
2. Adjust FLCINCHWT by applying the new adjustment ratio to existing FLCINCHWT using the formula in step b to determine which FLCINCHWT to adjust. Calculate the sum of FLCINCHWT by category = 13,841,000.
3. Do a third adjustment to FLCINCHWT to improve regional counts.
	1. From published reports, obtain estimated 2011 counts for units by region.

|  |  |
| --- | --- |
| Northeast | 23,717,000 |
| Midwest | 29,545,000 |
| South | 50,381,000 |
| West | 28,776,000 |

* 1. Develop estimates for these same categories using FLCINCHWT with these formulas:

|  |  |  |
| --- | --- | --- |
| Northeast | REGION = '1' | 23,321,666 |
| Midwest | REGION = '2' | 31,253,062 |
| South | REGION = '3' | 51,294,317 |
| West | REGION = '4' | 29,078,800 |

* 1. Create new adjustment ratios by taking the ratio of the published numbers in step a to the estimates in step b.

For example, if the estimate in step b for Northeast units is 23,321,666, then the ratio for the top cell in step c is 1.01695.

|  |  |
| --- | --- |
| Northeast | 1.01695 |
| Midwest | 0.94535 |
| South | 0.98219 |
| West | 0.98959 |

* 1. Adjust FLCINCHWT by applying the new adjustment ratios to existing FLCINCHWT using the formulas in step b to determine which FLCINCHWT to adjust by which ratio.

For example, for units in the Northeast, create a revised FLCINCHWT by applying the formula:

FLCINCHWT = 1.01695\*FLCINCHWT

to all FLCINCHWT values of units where REGION = '1'

Enter the sum of FLCINCHWT into the following matrix:

|  |  |
| --- | --- |
| Northeast | 23,717,000 |
| Midwest | 29,545,000 |
| South | 50,381,000 |
| West | 28,776,000 |

1. Do a fourth adjustment to FLCINCHWT to improve metropolitan status counts.
2. From published reports, obtain estimated 2011 counts for units by metropolitan status.

|  |  |
| --- | --- |
| Central city | 38,599,000 |
| Suburb | 65,418,000 |
| Nonmetro | 28,402,000 |

1. Develop estimates for these same categories using FLCINCHWT with these formulas:

|  |  |  |
| --- | --- | --- |
| Central city | METRO3 = '1' | 40,519,628 |
| Suburb | METRO3 = {'2','3'} | 33,283,138 |
| Nonmetro | METRO3 = {'4','5'} | 58,616,234 |

1. Create new adjustment ratios by taking the ratio of the published numbers in step a to the estimates in step b.

For example, if the estimate in step b for units in central cities is 40,519,628 units, then the ratio for the top cell in step c is 0.95260.

|  |  |
| --- | --- |
| Central city | 0.95260 |
| Suburb | 1.11604 |
| Nonmetro | 0.85335 |

1. Adjust FLCINCHWT by applying the new adjustment ratios to existing FLCINCHWT using the formulas in step b to determine which FLCINCHWT to adjust by which ratio.

For example, for units in the central cities, create a revised FLCINCHWT by applying the formula:

FLCINCHWT = 0.95260\*FLCINCHWT

to all FLCINCHWT values of units where METRO3 = '1'

Enter the sum of FLCINCHWT into the following matrix:

|  |  |
| --- | --- |
| Central city | 38,599,000 |
| Suburb | 65,418,000 |
| Nonmetro | 28,402,000 |

1. Adjust the FLCINCHWT to sum to the published totals for 2011 for units by unit type and occupancy status.
2. From published reports, obtain estimated 2011 counts for units by unit type and occupancy status.

The published numbers are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Owner-occupied** | **Renter-occupied** | **Vacant** | **Seasonal** |
| Single-family detached | 62,662,000 | 11,099,000 | 6,664,000 | 2,549,000 |
| Single-family attached | 4,090,000 | 2,654,000 | 798,000 | 226,000 |
| 2–4 unit structures | 1,419,000 | 7,537,000 | 1,535,000 | 187,000 |
| 5–19 unit structures | 1,101,000 | 9,341,000 | 1,712,000 | 228,000 |
| 20+ unit structures | 1,142,000 | 6,672,000 | 1,439,000 | 316,000 |
| Mobile homes | 5,678,000 | 1,512,000 | 1,233,000 | 626,000 |

1. Develop estimates for these same categories using FLCINCHWT with these formulas:

|  | **Owner-occupied** | **Renter-occupied** | **Vacant** | **Seasonal** |
| --- | --- | --- | --- | --- |
| Single-family detached | IN11\_ISTATUS = “1” AND IN11\_TENURE = 1 AND IN11\_NUNIT2 = '1' | IN11\_ISTATUS = “1” AND (2 LE IN11\_TENURE LE 3) AND IN11\_NUNIT2 = '1' | IN11\_ISTATUS = {'2','3'} AND NOT(8 LE IN11\_VACANCY LE 11) AND IN11\_NUNIT2 = '1' | IN11\_ISTATUS = {'2','3'} AND (8 LE IN11\_VACANCY LE 11) AND IN11\_NUNIT2 = '1' |
| Single-family attached | IN11\_ISTATUS = “1” AND IN11\_TENURE = 1 AND IN11\_NUNIT2 = '2' | IN11\_ISTATUS = “1” AND (2 LE IN11\_TENURE LE 3) AND IN11\_NUNIT2 = '2' | IN11\_ISTATUS = {'2','3'} AND NOT(8 LE IN11\_VACANCY LE 11) AND IN11\_NUNIT2 = '2' | IN11\_ISTATUS = {'2','3'} AND (8 LE IN11\_VACANCY LE 11) AND IN11\_NUNIT2 = '2' |
| 2–4 unit structures | IN11\_ISTATUS = “1” AND IN11\_TENURE = 1 AND IN11\_NUNIT2 = '3' AND IN11\_NUNITS = {2,3,4} | IN11\_ISTATUS = “1” AND (2 LE IN11\_TENURE LE 3) IN11\_NUNIT2 = '3' AND IN11\_NUNITS = {2,3,4} | IN11\_ISTATUS = {'2','3'} AND NOT(8 LE IN11\_VACANCY LE 11) IN11\_NUNIT2 = '3' AND IN11\_NUNITS = {2,3,4} | IN11\_ISTATUS = {'2','3'} AND (8 LE IN11\_VACANCY LE 11) IN11\_NUNIT2 = '3' AND IN11\_NUNITS = {2,3,4} |
| 5–19 unit structures | IN11\_ISTATUS = “1” AND IN11\_TENURE = 1 AND IN11\_NUNIT2 = '3' AND 5 LE IN11\_NUNITS LE 19  | IN11\_ISTATUS = “1” AND (2 LE IN11\_TENURE LE 3) AND IN11\_NUNIT2 = '3' AND 5 LE IN11\_NUNITS LE 19  | IN11\_ISTATUS = {'2','3'} AND NOT(8 LE IN11\_VACANCY LE 11) AND IN11\_NUNIT2 = '3' AND 5 LE IN11\_NUNITS LE 19 | IN11\_ISTATUS = {'2','3'} AND (8 LE IN11\_VACANCY LE 11) AND IN11\_NUNIT2 = '3' AND 5 LE IN11\_NUNITS LE 19  |
| 20+ unit structures | IN11\_ISTATUS = “1” AND IN11\_TENURE = 1 AND IN11\_NUNIT2 = '3' AND 20 LE IN11\_NUNITS  | IN11\_ISTATUS = “1” AND (2 LE IN11\_TENURE LE 3) AND IN11\_NUNIT2 = '3' AND 20 LE IN11\_NUNITS | IN11\_ISTATUS = {'2','3'} AND NOT(8 LE IN11\_VACANCY LE 11) AND IN11\_NUNIT2 = '3' AND 20 LE IN11\_NUNITS | IN11\_ISTATUS = {'2','3'} AND (8 LE IN11\_VACANCY LE 11) AND IN11\_NUNIT2 = '3' AND 20 LE IN11\_NUNITS |
| Mobile homes | IN11\_ISTATUS = “1” AND IN11\_TENURE = 1 AND IN11\_NUNIT2 = '4' | IN11\_ISTATUS = “1” AND (2 LE IN11\_TENURE LE 3) AND IN11\_NUNIT2 = '4' | IN11\_ISTATUS = {'2','3'} AND NOT(8 LE IN11\_VACANCY LE 11) AND IN11\_NUNIT2 = '4' | IN11\_ISTATUS = {'2','3'} AND (8 LE IN11\_VACANCY LE 11) AND IN11\_NUNIT2 = '4' |

The estimates are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Owner-occupied** | **Renter-occupied** | **Vacant** | **Seasonal** |
| Single-family detached | 60,104,119 | 11,143,050 | 7,946,013 | 2,158,779 |
| Single-family attached | 3,980,315 | 2,644,268 | 1,009,682 | 246,029 |
| 2–4 unit structures | 1,378,737 | 7,705,253 | 1,994,606 | 177,471 |
| 5–19 unit structures | 1,119,958 | 9,727,534 | 2,425,585 | 270,822 |
| 20+ unit structures | 1,213,177 | 7,312,820 | 2,007,250 | 390,423 |
| Mobile homes | 4,577,721 | 1,231,509 | 1,199,181 | 454,697 |

1. Create new adjustment ratios by taking the ratio of the published numbers in step a to the estimates in step b.

For example, if the estimate in step b for owner-occupied single-family detached units is 60,104,119, then the ratio for the upper left cell in step c is 1.04256.

The ratios are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Owner-occupied** | **Renter-occupied** | **Vacant** | **Seasonal** |
| Single-family detached | 1.04256 | 0.99605 | 0.83866 | 1.18076 |
| Single-family attached | 1.02756 | 1.00368 | 0.79035 | 0.91859 |
| 2–4 unit structures | 1.02920 | 0.97816 | 0.76958 | 1.05369 |
| 5–19 unit structures | 0.98307 | 0.96026 | 0.70581 | 0.84188 |
| 20+ unit structures | 0.94133 | 0.91237 | 0.71690 | 0.80938 |
| Mobile homes | 1.24036 | 1.22776 | 1.02820 | 1.37674 |

1. Adjust FLCINCHWT by applying the new adjustment ratios to existing FLCINCHWT using the formulas in step b to determine which FLCINCHWT to adjust by which ratio.

For example, for owner-occupied single-family detached units, create a final FLCINCHWT by applying the formula:

FLCINCHWT = 1.04256\*FLCINCHWT

to all FLCINCHWT values of units where IN11\_ISTATUS = “1” AND IN11\_TENURE = 1 AND IN11\_NUNIT2 = '1'

Enter the sum of FLCINCHWT into the following matrix:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Owner-occupied** | **Renter-occupied** | **Vacant** | **Seasonal** |
| Single-family detached |  62,662,000  |  11,099,000  |  6,664,000  |  2,549,000  |
| Single-family attached |  4,090,000  |  2,654,000  |  798,000 |  226,000  |
| 2–4 unit structures |  1,419,000  |  7,537,000  |  1,535,000  |  187,000  |
| 5–19 unit structures |  1,101,000  |  9,341,000  |  1,712,000  |  228,000  |
| 20+ unit structures |  1,142,000  |  6,672,000  |  1,439,000  |  316,000  |
| Mobile homes |  5,678,000  |  1,512,000  |  1,233,000  |  626,000  |

At the end of the weighting process, we have created weights (FLCINCHWT) that reproduce exactly the published counts for occupancy status by structure type.

1. In steps 13, 14, 15, and 16, we successively adjusted the weights to reproduce exactly the count of householders by race, the count of householders by ethnicity, the count of units by region, and the count of units by metropolitan/nonmetropolitan status. The final adjustment reproduces exactly the published counts for occupancy status by structure type. However, each step has disturbed the match achieved by the previous steps so that by the end the only exact match is occupancy status by structure type.

Now we compare estimates to published counts to see how closely the final weights estimate counts by race, ethnicity, region, and metropolitan/nonmetropolitan status.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Category** | **Formula** | **Estimate** | **Published** | **Percent error** |
| ***Region*** |  |  |  |  |
| Northeast | REGION = '1' | 23,977,582 | 23,717,000 | 1.1 |
| Midwest | REGION = '2' | 29,209,333 | 29,545,000 | -1.1 |
| South | REGION = '3' | 50,236,671 | 50,381,000 | -0.3 |
| West | REGION = '4' | 28,996,413 | 28,776,000 | 0.8 |
| ***Metropolitan*** |  |  |  |  |
| Central city | METRO3 = '1' | 37,400,153 | 38,599,000 | -3.1 |
| Suburb | METRO3 = {'2','3'} | 65,872,038 | 65,418,000 | 0.7 |
| Nonmetro | METRO3 = {'4','5'} | 29,147,809 | 28,402,000 | 2.6 |
| ***Race/ethnicity*** |  |  |  |  |
| White only | RACE1 = '01' | 93,136,989 | 92,820,000 | 0.3 |
| Black only | RACE1 = '02' | 14,415,727 | 14,694,000 | -1.9 |
| Hispanic | SPAN1 = '01' | 13,973,879 | 13,841,000 | 1.0 |

The stepwise adjustment process has achieved close fits for these key categories.

1. Next we derive estimates of units in public housing and units in HUD-assisted, privately owned properties to see if there are any major discrepancies in this important area. We compare these estimates first to estimates based on AHS weights and then to numbers from the HUD budget.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **CINCH estimates** | **AHS estimates** | **Percent error** | **HUD budget** | **Percent error** |
| Public housing | 1,053,471 | 886,616 | 18.8 | 1,033,000 | 2.00 |
| Vouchers | 2,111,468 | 1,817,042 | 16.2 | 2,086,000 | 1.20 |
| Privately owned | 1,334,731 | 1,113,262 | 19.9 | 1,419,000 | -5.90 |

The comparison between estimates based on CINCH weights and AHS weights is the legitimate test. Our weights appear to inflate the count of HUD-assisted units as reported by the AHS. Interestingly the forward-looking CINCH estimates are much closer to the HUD budget estimates.

1. As a final check, compare FLCINCHWT to IN11\_PWT and IN11\_PUFWGT to see if there are any obvious problems in the structure of the weights.
2. Create two new variables, FLRATPWT and FLRATWGT, as follows:

IF MXPWT = 0 THEN FLRATPWT = "."

IF MXPWT GT 0 THEN FLRATPWT = FLCINCHWT/MXPWT

IF IN11\_PUFWGT = 0 THEN FLRATWGT = "."

IF IN11\_PUFWGT GT 0 THEN FLRATWGT = FLCINCHWT/ IN11\_PUFWGT

1. Determine means, mode, medians, and key percentiles for the distribution of MXPWT, IN11\_WGT90GEO, FLCINCHWT, FLRATPWT, and FLRATWGT.

|  | **MXPWT** | **IN11\_PUFWGT** | **FLCINCHWT** | **Ratio FLCINCHWT/MXPWT** | **Ratio FLCINCHWT/PUFWGT** |
| --- | --- | --- | --- | --- | --- |
| Mean | 1,866.63 | 2,217.12 | 2,495.85 | 1.33268 | 1.26892 |
| Mode | 2,046.60 | 1,652.62 | 3,232.17 | 1.57929 | 1.12288 |
| Minimum | 12.05 | 0.00 | 13.59 | 0.65616 | 1.02557 |
| 1 percentile | 126.43 | 113.07 | 135.90 | 0.85185 | 0.42258 |
| 5 percentile | 126.43 | 166.45 | 167.55 | 0.94207 | 0.63036 |
| 10 percentile | 773.65 | 618.77 | 919.91 | 1.06112 | 0.73029 |
| 25 percentile | 2,046.60 | 2,732.93 | 2,136.03 | 1.18856 | 0.92480 |
| 50 percentile | 2,046.60 | 2,338.71 | 2,604.77 | 1.32217 | 1.13311 |
| 75 percentile | 2,046.60 | 2,732.93 | 3,110.91 | 1.52004 | 1.38253 |
| 90 percentile | 2,358.36 | 3,149.44 | 3,346.54 | 1.59117 | 1.79849 |
| 95 percentile | 2,358.36 | 3,628.11 | 3,612.62 | 1.63517 | 2.29845 |
| 99 percentile | 3,369.09 | 5,096.69 | 4,540.47 | 1.87891 | 3.73057 |
| Maximum | 26,264.64 | 23,253.44 | 40,778.00 | 2.03779 | 19.02400 |

We would expect FLCINCHWT to be larger than either MXPWT or PUFWGT because we eliminated a large number of cases from the 2011 PUF at step 10. Nothing alarming stands out from this overview of FLCINCHWT. We suspect the high maximum and 90–99 percentiles for the ratio of FLCINCHWT to PUFWGT result from the low final weights assigned to some units in the HUD oversample. We are satisfied with the ratio of FLCINCHWT to PUFWGT; its interquartile range is 0.92480 to 1.38253.

## Backward-Looking Weighting Algorithm: From 2013 to 2011

The following are the steps necessary to prepare the data to analyze what happened between 2011 and 2013 to units that existed in 2013. AHS variables are given their codebook names and presented in capital letters. We refer to 2013 variables by the prefix IN13\_; 2011 variables are labeled IN11\_.

1. Merge the 2013 and 2011 files, using the flat files.
2. Eliminate cases not in the 2013 PUF—that is, the merged file should consist of units found in 2013, whether or not they are in 2011.

|  |  |
| --- | --- |
| A: IN BOTH 11 & 13 |  68,022  |
| B: IN 11 ONLY | 118,426  |
| C: IN 13 ONLY |  16,333  |
| A + C |  84,355  |

1. Test to see if there are any cases in the matched sample where IN11\_NATLFLAG = '2' (part of the metropolitan sample in 2011). If there are such units, we may have to adjust PWT for these units. No cases in A have IN11\_NATLFLAG = '2'
2. Test to see if there are any cases in the matched sample that are part of the special oversample of HUD-assisted units (IN11\_HUDSAMP = '1'), which began in 2011. If there are such units, we may have to adjust PWT for these units. (4,208 cases with IN11\_HUDSAMP = '1')
3. Do unweighted frequency distributions of IN13\_REUAD and IN13\_NOINT.

|  |  |  |
| --- | --- | --- |
| **IN13\_REUAD** | **Frequency** | **Percent** |
| B | 74,100 | 87.84 |
| D | 2 | 0.00 |
| 3 | 738 | 0.87 |
| 4 | 10 | 0.01 |
| 6 | 1 | 0.00 |
| 7 | 37 | 0.04 |
| 8 | 4 | 0.00 |
| 9 | 13 | 0.02 |
| 10 | 37 | 0.04 |
| 11 | 9,413 | 11.16 |

|  |  |  |
| --- | --- | --- |
| **IN13\_NOINT** | **Frequency** | **Percent** |
| B | 70,044 | 83.0 |
| 1 | 1,227 | 1.5 |
| 2 | 101 | 0.1 |
| 3 | 8,576 | 10.2 |
| 4 | 71 | 0.1 |
| 5 | 87 | 0.1 |
| 6 | 1,753 | 2.1 |
| 10 | 20 | 0.0 |
| 11 | 105 | 0.1 |
| 12 | 284 | 0.3 |
| 13 | 197 | 0.2 |
| 14 | 308 | 0.4 |
| 15 | 84 | 0.1 |
| 16 | 204 | 0.2 |
| 17 | 106 | 0.1 |
| 30 | 442 | 0.5 |
| 31 | 100 | 0.1 |
| 32 | 69 | 0.1 |
| 33 | 59 | 0.1 |
| 36 | 9 | 0.0 |
| 37 | 478 | 0.6 |
| 38 | 5 | 0.0 |
| 40 | 26 | 0.0 |
| Total | 84,355 | 100.0 |

1. Eliminate:
	1. IN13\_NOINT GE 10. These are type B or type C losses in 2013. These units are not part of the 2013 stock, and therefore we do not track them backwards. (2,496 cases)
	2. 1 LE IN13\_SAMEDU2 LE 2. These are cases where it is possible that the Census Bureau interviewed a different unit in 2013. (16 cases)
	3. IN13\_REUAD = 11. These are cases added as sample adjustments. They are part of the 2013 housing stock, but we cannot tell whether they were in the 2011 stock or added by new construction or other means between 2011 and 2013. (8,921 cases after previous deletions—these cases were part of the metropolitan oversample for the 5 large metropolitan areas. Total cases after step 2: 72,922)
2. MXPWT = IN13\_PWT (Note: We dropped the old step 3 where MXPWT = max (IN11\_PWT, IN13\_PWT) because of the widespread change in PWT between surveys for HUD-assisted units. This step was used in the past to adjust for a few idiosyncratic changes in PWT between surveys.)
3. Obtain from the Census Bureau tables an estimate of the 2013 stock (CURRENTCOUNT = 132,832,000).
4. Compute SMXPWT = sum of MXPWT after step 3; this sum (120,668,913) is a first estimate of the size of the 2013 housing stock based on units retained for analysis.
5. Compute BLCINCHWT = MXPWT\*(CURRENTCOUNT/SMXPWT) = MXPWT \* 1.1007972. This computation ratios the weights up so that they sum to the 2013 stock.
6. Identify *sames, new construction, interviewed new construction, other adds,* and *interviewed other adds.*[[9]](#footnote-9)
	1. SAME = 1 if IN11\_ISTATUS = 1, 2, or 3 AND IN13\_ISTATUS = 1, 2, OR 3 AND NOT(IN13\_SAMEDU2 GE 4) AND NOT(IN13\_NUNIT2 = '4' AND IN13\_BUILT GE 2011 AND IN11\_BUILT NE 2011) (52,276)
	2. NC = 1 if IN13\_ISTATUS = 1, 2, 3, or 4 AND ((IN13\_REUAD = 3) OR (10 LE IN11\_NOINT LE 11) OR (IN13\_NUNIT2 = '4' AND IN13\_BUILT GE 2011 AND IN11\_BUILT NE 2011)) AND NOT(IN13\_SAMEDU2 GE 4) (687)
	3. INTNC = 1 IF NC = 1 AND IN13\_ISTATUS = 1, 2, or 3 (561)
	4. ADD = 1 if IN13\_ISTATUS = 1, 2, 3, or 4 AND ((4 LE IN13\_REUAD LE 10) OR (12 LE IN11\_NOINT LE 17) OR (IN13\_SAMEDU2 GE 4)) AND NOT NC = 1 (398)
	5. INTADD = 1 if ADD = 1 AND IN13\_ISTATUS = 1, 2, OR 3 (368)

(19,561 cases were not SAME = 1 because they were in the stock in both years but were not interviewed in both years.)

1. Calculate:
	1. SSAME = sum of BLCINCHWT for all SAME = 1 (100,834,548)
	2. SNC = sum of BLCINCHWT for NC = 1 (1,175,352)
		1. SNCMH = sum of BLCINCHWT for NC = 1 AND IN13\_NUNIT2 = 4 (16,227)
		2. SNCOTH = sum of BLCINCHWT for NC = 1 AND IN13\_NUNIT2 NE 4 (1,159,125)
	3. SINTNC = sum of BLCINCHWT for INTNC = 1 (966,586)
		1. SINTNCMH = sum of BLCINCHWT for INTNC = 1 AND IN13\_NUNIT2 = 4 (16,227)
		2. SINTNCOTH = sum of BLCINCHWT for INTNC = 1 AND IN13\_NUNIT2 NE 4 (950,359)
	4. SADD = sum of BLCINCHWT for ADD = 1 (766,953)
	5. SINTADD = sum of BLCINCHWT for INTADD = 1 (717,891)
2. Calculate:
	1. Ratio1 = (CURRENTCOUNT – (SADD + SNC))/SSAME = 1.2980640
	2. Ratio2 = SNCMH/SINTNCMH = 1
	3. Ratio3 = SNCOTH/SINTNCOTH = 1.2196709
	4. Ratio4 = SADD/SINTADD = 1.0683428
3. Keep units that are SAME = 1 OR INTNC = 1 OR INTADD = 1 (53,205 cases)

For CINCH analysis, we need information on the characteristics of units and their occupants in both 2011 and 2013 for all units that were part of the stock in both 2011 and 2013. For units that are part of the stock in only 2013, we need information on the characteristics of the units and their occupants only in 2013. Up to this point, we retained units that failed to meet these conditions so that we can get good estimates of the number of newly constructed units (SNC) and other additions (SADD). This step eliminated units (units that were in both the 2011 and 2013 stock and new units), leaving a sample of 53,205 units.

1. Recalculate BLCINCHWT as follows:
	1. For SAME = 1, BLCINCHWT = Ratio1\*BLCINCHWT
	2. For INTNC = 1 AND IN13\_NUNIT2 = 4, BLCINCHWT = Ratio2\*BLCINCHWT
	3. For INTNC = 1 AND IN13\_NUNIT2 NE 4, BLCINCHWT = Ratio3\*BLCINCHWT
	4. For INTADD = 1, BLCINCHWT = Ratio4\*BLCINCHWT
2. Do a preliminary adjustment to BLCINCHWT to improve counts of householders by race.
3. From published reports, obtain estimated 2013 counts for units by race and ethnicity of the householder.

|  |  |
| --- | --- |
| White alone | 93,298,000 |
| Black alone | 15,023,000 |

1. Develop estimates for these same categories using BLCINCHWT with these formulas:

|  |  |  |
| --- | --- | --- |
| White alone | IN13\_ISTATUS = '1' AND IN13\_RACE1 = '01' |  91,343,530  |
| Black alone | IN13\_ISTATUS = '1' AND IN13\_RACE1 = '02' |  13,081,274  |

1. Create new adjustment ratios by taking the ratio of the published numbers in step a to the estimates in step b.

For example, if the estimate in step b for units with “White only” householders is 91,343,530 units, then the ratio for the top cell in step c is 1.02140.

|  |  |
| --- | --- |
| White alone | 1.02140 |
| Black alone | 1.14844 |

1. Adjust BLCINCHWT by applying the new adjustment ratios to existing BLCINCHWT using the formulas in step b to determine which BLCINCHWT to adjust by which ratio.

For example, for units with “White only” householders, create a revised BLCINCHWT by applying the formula:

BLCINCHWT = 1.02140\*BLCINCHWT

to all BLCINCHWT values of units where IN13\_ISTATUS = '1' AND IN13\_RACE1 = '01'

Enter the sum of BLCINCHWT into the following matrix:

|  |  |
| --- | --- |
| White alone |  93,298,000  |
| Black alone |  15,023,000  |

1. Do a second adjustment to BLCINCHWT to improve count of householders by ethnicity.
2. From published reports, obtain estimated 2013 count for units by ethnicity.

|  |  |
| --- | --- |
| Hispanic | 14,681,000 |

1. Develop estimate for this category using BLCINCHWT with this formula:

|  |  |  |
| --- | --- | --- |
| Hispanic | IN13\_ISTATUS = '1' AND IN13\_SPAN1 = '1' | 14,993,557  |

1. Create new adjustment ratio by taking the ratio of the published number in step a to the estimate in step b.

14,681,000/14,993,557 = 0.97915

1. Adjust BLCINCHWT by applying the new adjustment ratio to existing BLCINCHWT using the formula in step b to determine which BLCINCHWT to adjust.

BLCINCHWT = 0.97915\*BLCINCHWT

for all BLCINCHWT values of units where IN13\_ISTATUS = '1' AND IN13\_SPAN1 = '1'

|  |  |
| --- | --- |
| Hispanic | 14,681,000 |

1. Do a third adjustment to BLCINCHWT to improve regional counts.
	1. From published reports, obtain estimated 2013 counts for units by region.

|  |  |
| --- | --- |
| Northeast | 23,719,000 |
| Midwest | 29,606,000 |
| South | 50,679,000 |
| West | 28,828,000 |

* 1. Develop estimates for these same categories using BLCINCHWT with these formulas:

|  |  |  |
| --- | --- | --- |
| Northeast | REGION = '1' | 19,065,453  |
| Midwest | REGION = '2' | 29,586,254  |
| South | REGION = '3' | 56,563,725  |
| West | REGION = '4' | 31,200,208  |

* 1. Create new adjustment ratios by taking the ratio of the published numbers in step a to the estimates in step b.

For example, if the estimate in step b for Northeast units is 19,065,453, then the ratio for the top cell in step c is 1.24408.

|  |  |
| --- | --- |
| Northeast | 1.24408 |
| Midwest | 1.00067 |
| South | 0.89596 |
| West | 0.92397 |

* 1. Adjust BLCINCHWT by applying the new adjustment ratios to existing BLCINCHWT using the formulas in step b to determine which BLCINCHWT to adjust by which ratio.

For example, for units in the Northeast, create a revised BLCINCHWT by applying the formula:

BLCINCHWT = 1.24408\*BLCINCHWT

to all BLCINCHWT values of units where REGION = '1'

Enter the sum of BLCINCHWT into the following matrix:

|  |  |
| --- | --- |
| Northeast |  23,719,000  |
| Midwest |  29,606,000  |
| South |  50,679,000  |
| West |  28,828,000  |

1. Do a fourth preliminary adjustment to BLCINCHWT to improve metropolitan status counts.
2. From published reports, obtain estimated 2013 counts for units by metropolitan status.

|  |  |
| --- | --- |
| Central city | 39,980,000 |
| Suburb | 64,968,000 |
| Nonmetro | 27,884,000 |

1. Develop estimates for these same categories using BLCINCHWT with these formulas:

|  |  |  |
| --- | --- | --- |
| Central city | METRO3 = '1' |  37,594,696  |
| Suburb | METRO3 = {'2','3'} | 35,667,202  |
| Nonmetro | METRO3 = {'4','5'} |  59,570,102  |

1. Create new adjustment ratios by taking the ratio of the published numbers in step a to the estimates in step b.

For example, if the estimate in step b for units in central cities is 37,594,696 units, then the ratio for the top cell in step c is 1.06345.

|  |  |
| --- | --- |
| Central city | 1.06345 |
| Suburb | 0.78178 |
| Nonmetro | 1.09061 |

1. Adjust BLCINCHWT by applying the new adjustment ratios to existing BLCINCHWT using the formulas in step b to determine which BLCINCHWT to adjust by which ratio.

For example, for units in the central cities, create a revised BLCINCHWT by applying the formula:

BLCINCHWT = 1.06345\*BLCINCHWT

to all BLCINCHWT values of units where METRO3 = '1'

Enter the sum of BLCINCHWT into the following matrix:

|  |  |
| --- | --- |
| Central city |  39,980,000  |
| Suburb |  27,884,000  |
| Nonmetro |  64,968,000  |

1. Final adjustment: Adjust the BLCINCHWT to sum to the published totals for 2013 for units by unit type and occupancy status.
2. From published reports, obtain estimated 2013 counts for units by unit type and occupancy status.

The published numbers are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Owner-occupied** | **Renter-occupied** | **Vacant** | **Seasonal** |
| Single-family detached | 63,414,000 | 11,714,000 | 6,771,000 | 2,425,000 |
| Single-family attached | 4,057,000 | 2,593,000 | 737,000 | 228,000 |
| 2–4 unit structures | 1,390,000 | 7,760,000 | 1,414,000 | 241,000 |
| 5–19 unit structures | 1,065,000 | 9,884,000 | 1,642,000 | 259,000 |
| 20+ unit structures | 1,173,000 | 6,928,000 | 1,401,000 | 360,000 |
| Mobile homes | 4,577,000 | 1,340,000 | 917,000 | 544,000 |

1. Develop estimates for these same categories using BLCINCHWT with these formulas:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Owner-occupied** | **Renter-occupied** | **Vacant** | **Seasonal** |
| Single-family detached | IN13\_ISTATUS = “1” AND IN13\_TENURE = 1 AND IN13\_NUNIT2 = '1' | IN13\_ISTATUS = “1” AND (2 LE IN13\_TENURE LE 3) AND IN13\_NUNIT2 = '1' | IN13\_ISTATUS = {'2','3'} AND NOT(8 LE IN13\_VACANCY LE 11) AND IN13\_NUNIT2 = '1' | IN13\_ISTATUS = {2','3'} AND (8 LE IN13\_VACANCY LE 11) AND IN13\_NUNIT2 = '1' |
| Single-family attached | IN13\_ISTATUS = “1” AND IN13\_TENURE = 1 AND IN13\_NUNIT2 = '2' | IN13\_ISTATUS = “1” AND (2 LE IN13\_TENURE LE 3) AND IN13\_NUNIT2 = '2' | IN13\_ISTATUS = {'2','3'} AND NOT(8 LE IN13\_VACANCY LE 11) AND IN13\_NUNIT2 = '2' | IN13\_ISTATUS = {'2','3'} AND (8 LE IN13\_VACANCY LE 11) AND IN13\_NUNIT2 = '2' |
| 2–4 unit structures | IN13\_ISTATUS = “1” AND IN13\_TENURE = 1 AND IN13\_NUNIT2 = '3' AND IN13\_NUNITS = {2,3,4} | IN13\_ISTATUS = “1” AND (2 LE IN13\_TENURE LE 3) IN13\_NUNIT2 = '3' AND IN13\_NUNITS = {2,3,4} | IN13\_ISTATUS = {'2','3'} AND NOT(8 LE IN13\_VACANCY LE 11) IN13\_NUNIT2 = '3' AND IN13\_NUNITS = {2,3,4} | IN13\_ISTATUS = {'2','3'} AND (8 LE IN13\_VACANCY LE 11) IN13\_NUNIT2 = '3' AND IN13\_NUNITS = {2,3,4} |
| 5–19 unit structures | IN13\_ISTATUS = “1” AND IN13\_TENURE = 1 AND IN13\_NUNIT2 = '3' AND 5 LE IN13\_NUNITS LE 19  | IN13\_ISTATUS = “1” AND (2 LE IN13\_TENURE LE 3) AND IN13\_NUNIT2 = '3' AND 5 LE IN13\_NUNITS LE 19  | IN13\_ISTATUS = {'2','3'} AND NOT(8 LE IN13\_VACANCY LE 11) AND IN13\_NUNIT2 = '3' AND 5 LE IN13\_NUNITS LE 19  | IN13\_ISTATUS = {'2','3'} AND (8 LE IN13\_VACANCY LE 11) AND IN13\_NUNIT2 = '3' AND 5 LE IN13\_NUNITS LE 19  |
| 20+ unit structures | IN13\_ISTATUS = “1” AND IN13\_TENURE = 1 AND IN13\_NUNIT2 = '3' AND 20 LE IN13\_NUNITS  | IN13\_ISTATUS = “1” AND (2 LE IN13\_TENURE LE 3) AND IN13\_NUNIT2 = '3' AND 20 LE IN13\_NUNITS | IN13\_ISTATUS = {'2','3'} AND NOT(8 LE IN13\_VACANCY LE 11) AND IN13\_NUNIT2 = '3' AND 20 LE IN13\_NUNITS | IN13\_ISTATUS = {'2','3'} AND (8 LE IN13\_VACANCY LE 11) AND IN13\_NUNIT2 = '3' AND 20 LE IN13\_NUNITS |
| Mobile homes | IN13\_ISTATUS = “1” AND IN13\_TENURE = 1 AND IN13\_NUNIT2 = '4' | IN13\_ISTATUS = “1” AND (2 LE IN13\_TENURE LE 3) AND IN13\_NUNIT2 = '4' | IN13\_ISTATUS = {'2','3'} AND NOT(8 LE IN13\_VACANCY LE 11) AND IN13\_NUNIT2 = '4' | IN13\_ISTATUS = {'2','3'} AND (8 LE IN13\_VACANCY LE 11) AND IN13\_NUNIT2 = '4' |

The estimates are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Owner-occupied** | **Renter-occupied** | **Vacant** | **Seasonal** |
| Single-family detached |  60,979,926  |  11,641,697  |  7,764,528  |  2,423,985  |
| Single-family attached |  3,595,217  |  2,323,111  |  808,273  |  231,728  |
| 2–4 unit structures |  1,354,591  |  7,838,418  |  1,804,014  |  263,839  |
| 5–19 unit structures |  1,032,997  |  10,306,271  |  2,267,012  |  267,528  |
| 20+ unit structures |  1,061,355  |  7,349,091  |  1,921,146  |  352,712  |
| Mobile homes |  4,407,031  |  1,265,412  |  1,048,579  |  523,541  |

1. Create new adjustment ratios by taking the ratio of the published numbers in step a to the estimates in step b.

For example, if the estimate in step b for owner-occupied single-family detached units is 60,979,926, then the ratio for the upper left cell in step c is 1.03992.

The ratios are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Owner-occupied** | **Renter-occupied** | **Vacant** | **Seasonal** |
| Single-family detached | 1.03992 | 1.00621 | 0.87204 | 1.00042 |
| Single-family attached | 1.12844 | 1.11618 | 0.91182 | 0.98391 |
| 2–4 unit structures | 1.02614 | 0.99000 | 0.78381 | 0.91344 |
| 5–19 unit structures | 1.03098 | 0.95903 | 0.72430 | 0.96812 |
| 20+ unit structures | 1.10519 | 0.94270 | 0.72925 | 1.02066 |
| Mobile homes | 1.03857 | 1.05894 | 0.87452 | 1.03908 |

1. Adjust BLCINCHWT by applying the new adjustment ratios to existing BLCINCHWT using the formulas in step b to determine which BLCINCHWT to adjust by which ratio.

For example, for owner-occupied single-family detached units, create a final BLCINCHWT by applying the formula:

BLCINCHWT = 1.03992\*BLCINCHWT

to all BLCINCHWT values of units where IN13\_ISTATUS = '1' AND IN13\_TENURE = 1 AND IN13\_NUNIT2 = '1'

Enter the sum of BLCINCHWT into the following matrix:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Owner-occupied** | **Renter-occupied** | **Vacant** | **Seasonal** |
| Single-family detached | 63,414,000 | 11,714,000 | 6,771,000 | 2,425,000 |
| Single-family attached | 4,057,000 | 2,593,000 | 737,000 | 228,000 |
| 2–4 unit structures | 1,390,000 | 7,760,000 | 1,414,000 | 241,000 |
| 5–19 unit structures | 1,065,000 | 9,884,000 | 1,642,000 | 259,000 |
| 20+ unit structures | 1,173,000 | 6,928,000 | 1,401,000 | 360,000 |
| Mobile homes | 4,577,000 | 1,340,000 | 917,000 | 544,000 |

1. In steps 12, 13, 14, and 15, we successively adjusted the weights to reproduce exactly the count of householders by race, the count of householders by ethnicity, the count of units by region, and the count of units by metropolitan/nonmetropolitan status. The final adjustment reproduces exactly the published counts for occupancy status by structure type. However, each step has disturbed the match achieved by the previous steps so that by the end the only exact match is occupancy status by structure type.

Now we compare estimates to published counts to see how closely the final weights estimate counts by race, ethnicity, region, and metropolitan/nonmetropolitan status.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Category** | **Formula** | **Estimate** | **Published** | **Percent error** |
| ***Region*** |  |  |  |  |
| Northeast | REGION = '1' | 24,076,279 | 23,719,000 | 1.5 |
| Midwest | REGION = '2' | 28,936,849 | 29,606,000 | -2.3 |
| South | REGION = '3' | 50,203,871 | 50,679,000 | -0.9 |
| West | REGION = '4' | 29,617,001 | 28,828,000 | 2.7 |
| ***Metropolitan*** |  |  |  |  |
| Central city | METRO3 = '1' | 39,436,398 | 39,980,000 | -1.4 |
| Suburb | METRO3 = {'2','3'} | 65,504,986 | 64,968,000 | 0.8 |
| Nonmetro | METRO3 = {'4','5'} | 27,892,616 | 27,884,000 | 0.0 |
| ***Race/ethnicity*** |  |  |  |  |
| White only | RACE1 = '01' | 93,590,782 | 93,298,000 | 0.3 |
| Black only | RACE1 = '02' | 14,877,350 | 15,023,000 | -1.0 |
| Hispanic | SPAN1 = '01' | 14,741,346 | 14,681,000 | 0.4 |

1. Next we derive estimates of units in public housing and units in HUD-assisted, privately owned properties to see if there are any major discrepancies in this important area. We compare these estimates first to estimates based on AHS weights and then to numbers from the HUD budget.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **CINCH estimates** | **AHS estimates** | **Percent error** | **HUD budget** | **Percent error** |
| Public housing | 994,110  | 848,769  | 17.1 | 1,033,000 | -3.8 |
| Vouchers | 2,608,772  | 2,143,564  | 21.7 | 2,086,000 | 25.1 |
| Privately owned | 1,413,756  | 1,170,009  | 20.8 | 1,419,000 | -0.4 |

The comparison between estimates based on CINCH weights and AHS weights is the legitimate test. Our weights appear to inflate the count of HUD-assisted units as reported by the AHS. Interestingly the backward-looking CINCH 2013 estimates are much closer to the HUD budget estimates for 2011 for public housing and privately owned assisted housing.

1. As a final check, compare BLCINCHWT to IN13\_PWT and IN13\_WGT90GEO.
2. Create two new variables, BLRATPWT and BLRATWGT, as follows:

IF MXPWT = 0 THEN BLRATPWT = "."

IF MXPWT GT 0 THEN BLRATPWT = BLCINCHWT/MXPWT

IF IN13\_WGT90GEO = 0 THEN BLRATWGT = "."

IF IN13\_WGT90GEO GT 0 THEN BLRATWGT = BLCINCHWT/ IN13\_WGT90GEO

1. Determine means, mode, medians, and key percentiles for the distribution of MXPWT, IN13\_WGT90GEO, BLCINCHWT, BLRATPWT, and BLRATWGT.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **MXPWT** | **IN13\_WGT90GEO** | **BLCINCHWT** | **Ratio BLCINCHWT/MXPWT** | **Ratio BLCINCHWT/WGT90GEO** |
| Mean | 1,750.43 | 2,152.39 | 2,496.65 | 1.46559 | 1.24927 |
| Mode | 2,049.63 | 2,346.38 | 3,039.71 | 1.48306 | 1.12524 |
| Minimum | 8.24 | 0.00 | 12.37 | 0.59664 | 0.09018 |
| 1 percentile | 121.18 | 110.06 | 171.20 | 0.87281 | 0.53811 |
| 5 percentile | 136.83 | 174.30 | 217.21 | 1.00129 | 0.71813 |
| 10 percentile | 446.22 | 466.37 | 637.63 | 1.06310 | 0.81726 |
| 25 percentile | 1,537.22 | 1,519.73 | 2,069.10 | 1.21759 | 1.00228 |
| 50 percentile | 2,049.63 | 2,293.70 | 2,733.44 | 1.47984 | 1.22079 |
| 75 percentile | 2,049.63 | 2,716.56 | 3,130.87 | 1.62598 | 1.44321 |
| 90 percentile | 2,148.12 | 3,250.73 | 3,417.78 | 1.93492 | 1.70999 |
| 95 percentile | 2,148.12 | 3,738.79 | 4,083.96 | 2.05929 | 1.88776 |
| 99 percentile | 3,866.61 | 5,456.01 | 4,745.73 | 2.22783 | 2.36315 |
| Maximum | 26,303.46 | 29,501.26 | 51,566.12 | 2.51252 | 5.89489 |

We would expect BLCINCHWT to be larger than either MXPWT or WGT90GEO because we eliminated a large number of cases from the 2013 PUF at step 10. Nothing alarming stands out from this overview of BLCINCHWT. We are satisfied with the ratio of BLCINCHWT to WGT980GEO; its interquartile range is 1.00228 to 1.44321.

1. *Weighting Strategy for 2007–2009 CINCH Analysis* at: <http://www.huduser.org/portal/datasets/cinch/cinch09/Strategy_07-09_CINCH.pdf>. [↑](#footnote-ref-1)
2. “Potentially reversible” might be a better term than “temporary” for these types of losses. [↑](#footnote-ref-2)
3. The equations are “simultaneous” because the term “units that exist in both years” appears in each equation. [↑](#footnote-ref-3)
4. Aware that the AHS weighting process for HUD-assisted units might be different in 2011 and 2013, we eliminated a step in both the forward-looking and backward-looking algorithms. [↑](#footnote-ref-4)
5. REUAD is the “reason unit added” variable used since 1997 to track other additions to the housing stock. [↑](#footnote-ref-5)
6. *Listing of Programs and Variables Used in CINCH and Rental Dynamics Analysis for 2011 and 2013 American Housing Surveys.*  [↑](#footnote-ref-6)
7. See *Weighting Strategy for 2011 Metropolitan CINCH Analysis* by Frederick J. Eggers and Fouad Moumen at <http://www.huduser.gov/portal/datasets/cinch/cinch11/Metro_Weighting_Strategy_revised.pdf>. [↑](#footnote-ref-7)
8. See page 6 of *Weighting Strategy for 2003–2005 CINCH Analysis* by Frederick J. Eggers at <http://www.huduser.gov/portal/datasets/cinch/cinch05/CINCHWeightingStrategy2007.pdf>. [↑](#footnote-ref-8)
9. *Other adds* are units that were type B losses in 2011 but are in the 2013 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-in. [↑](#footnote-ref-9)