



Getting Started with the Public Use File: 2015 and Beyond

LAST UPDATED: SEPTEMBER 2022

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1. Overview

The purpose of this document is to introduce American Housing Survey (AHS) users to the 2015 and later AHS Public Use File (PUF) microdata. This guide is organized into sections, with each section addressing an important PUF topic. If applicable, comparisons will be made with prior year PUFs.

Using the PUF requires a statistical program such as SAS, STATA, or R. Although it is technically possible to use the PUF in Microsoft Excel or Access, users will find doing so difficult. PUF users who do not have the resources to purchase a statistical program such as SAS or STATA can obtain a free program such as R or Python Data Analysis Laboratory (Pandas).

2. 2015 Sample Design Review

For 2015, the U.S. Department of Housing and Urban Development (HUD) and the U.S. Census Bureau drew an entirely new sample for the AHS. The 2015 AHS longitudinal sample is composed of an integrated national longitudinal sample and 20 independent metropolitan area longitudinal oversamples. The national longitudinal sample is described as integrated because it incorporates a few different types of samples. The integrated national longitudinal sample includes:

- A representative sample of the nation.
- Representative oversamples of each of the top 15 most populated group of metropolitan areas¹.
- A representative oversample of HUD-assisted housing units.

The entire integrated national longitudinal sample will be surveyed every two years, meaning it is a two-year survey cycle.

In 2015, HUD and the Census Bureau identified a “Next 20” group of metropolitan areas to be surveyed in 2015 and later years. This Next 20 group is described as independent so as not to be confused with the Top 15 metropolitan areas that are part of the integrated national longitudinal sample. The Next 20 group is a set of metropolitan areas ranging from the 16th to 51st largest by population at the time the sample was drawn, and it includes: ²

- The first ten of the Next 20 group were surveyed in 2015 and 2019. They are scheduled to be surveyed every four years thereafter (2023, etc.).
- The second ten of the Next 20 group of metropolitan area longitudinal oversamples were surveyed in 2017 and are scheduled to be surveyed every four years thereafter (2021, 2025, etc.).

Throughout the rest of this document, the phrase “independent metropolitan area longitudinal samples” is shortened to “metropolitan area samples.”

¹ The Top 15 group of metropolitan area longitudinal oversamples use the 2013 Office of Management and Budget’s core based statistical area definitions as of February 2013

² For more information about how the Next 20 group of metropolitan areas was selected, see [Metropolitan Area Selection Strategy: 2015 and Beyond](#).



3. PUF Availability

Like prior year PUFs, separate PUFs will be published for the integrated national longitudinal sample and the metropolitan area samples. These PUFs are referred to as the national PUF and the metropolitan Area PUF.

As in recent years, HUD and the Census Bureau are providing the PUF in two structures—relational and flat. The structure of the PUFs is discussed in the next two sections.

All PUFs will be published in SAS and CSV formats. Besides the difference in file type, two other important differences exist between the SAS and CSV formats. First, the SAS files will include descriptive column labels. Second, the representation of “not applicable” and “missing/refused” is different.³

3. PUF File Structures

3.1. PUF Relational File Structure

The PUF relational structure is similar to prior years’ structure. The following chart describes each table within the relational structure.

Exhibit 3.1. PUF Relational File Structure Table Overview

2015 and Later Relational Table Name	Description
HOUSEHOLD	Includes one record for each housing unit. Also includes certain householder information, such as race and sex. The householder information is also present on the <i>PERSON</i> table but is duplicated in the <i>HOUSEHOLD</i> table for ease of use.
PERSON	Includes one record for each person in the household, up to 20 persons. For 2015 and forward, each person in the <i>PERSON</i> table receives a person number <i>PLINE</i> , which is unique within each household and will not change unless the entire household is replaced. In addition, each person will receive a <i>PERSONID</i> identifier, which is unique for the life of the longitudinal sample.
MORTGAGE	Includes one record for each mortgage or similar debt owned by the household. The PUF includes the first three mortgages (values 1–3); the IUF includes all mortgages reported by the respondent (up to five).
PROJECT	Includes one record for each home improvement project undertaken by the household within the past two years. At most, there are 26 records per household, reflecting up to 26 projects.

The *PERSON*, *MORTGAGE*, and *PROJECT* tables each have a many-to-one relationship with the *HOUSEHOLD* table. They can be linked to the *HOUSEHOLD* table using the variable *CONTROL*. *CONTROL* can also be used to link records from year to year.

3.2. PUF Flat File Structure

The flat file structure includes the *HOUSEHOLD* table combined with flattened versions of the *PERSON*, *MORTGAGE*, and *PROJECT* tables. For instance, suppose a household has three persons; the variable *RACE* from the *PERSON* table in the relational file structure will be flattened into *RACE1*, *RACE2*, and

³ See the subsequent section, “Not Applicable” and “Not Reported” Codes in the PUF.



RACE3 in the flat file structure. The number appended to *RACE* reflects the number of the person. The same convention is used for the *MORTGAGE* and *PROJECT* tables.

4. AHS Codebook

A codebook is a necessary tool for working with the PUF. The AHS Codebook is a web-based utility that includes metadata from surveys conducted for 1973 and later,⁴ including all variables that have appeared on any AHS PUF from 1973 through 2021. For 2015 and later, variables that appear only on the IUF are also included in the AHS Codebook.

Several features are built into the AHS Codebook to meet the needs of PUF users. Exhibit 4.1 describes these features.

Exhibit 4.1. PUF Features of the AHS Codebook

Feature	Description
Filter by survey year	This feature enables users to filter the AHS Codebook by survey year. Users wishing to download an entire codebook for a specific year should use this feature.
Filter by topic or subtopic	This feature enables users to filter the AHS Codebook by topic and, if desired, subtopic. This feature is helpful for viewing all the variables in a particular topic.
Download button	This feature enables users to download a selected portion of the AHS Codebook. Format options include PDF and CSV.
Mini-codebook download	This feature enables users to download a PDF of all the variables in the AHS for 1973 AHS or later. The file includes the following fields: topic, subtopic, variable name, and description. The purpose of the file is to enable users to quickly review all the variables in the selected PUF and IUF.

5. PUF and the Internal Use File

HUD and the Census Bureau make every attempt to include each possible AHS variable on the PUFs. However, our duty to protect respondents' confidentiality prevents public release of some variables. We maintain another file, the Internal Use File (IUF), that includes such variables. The AHS Codebook database contains an "Availability" section that has two possible values for 2015 and later—*PUF* or *IUF ONLY*. When a variable is listed as *IUF ONLY*, it means the variable exists on the IUF but, for various reasons, is not on the PUFs.

If an AHS PUF user cannot complete an analysis because one or more AHS variables is not available on the PUF, HUD and the Census Bureau may be able to help in two ways. First, HUD and Census Bureau staff can run special tabulations using *IUF ONLY* variables. Second, HUD and Census Bureau staff can assist AHS users with the process of obtaining access to the AHS IUF. However, AHS users should note this process requires:

- Submitting a detailed proposal.
- Submitting to a background check and obtaining a non-sensitive federal security clearance.
- Agreeing to become subject to legally binding disclosure restrictions.



- Willingness to travel to a Federal Statistical Research Data Center.⁵
- Willingness to pay a fee to access the Research Data Center.

6. PUF Respondent Types

The AHS PUF includes occupied interviews, usual residence elsewhere interviews, and vacant interviews. The variable *INTSTATUS* indicates which of these three types of interviews was conducted. The 2015 and later AHS PUF does not include noninterviews. HUD and the Census Bureau created the *Sample Case History File* to track all sampled housing units in the integrated national longitudinal sample and the Next 20 independent metropolitan area samples. **AHS users who want to know why various sample cases were not surveyed or were nonresponses for 2015 (or any future year) can review this file.**⁶

As in past years, noninterviews are classified as one of three types as indicated in Exhibit 6.1.

Exhibit 6.1. Noninterview Classifications

Noninterview Type	Reason for Noninterview	Eligibility for Future Surveys
Type A	Sample unit meets the definition of a housing unit, but the respondent refused the interview or could not be contacted.	Sample unit remains in the sample for future surveys.
Type B	Sample unit does not meet the definition of a housing unit but could become eligible in the future.	Sample unit remains in the sample for future surveys.
Type C	Sample unit does not exist or will not exist in the future.	Sample unit is permanently removed from the sample.

7. Variable Types and Names in the PUF

The PUF includes more than 420 variables across the four relational tables, plus edit flags and replicate weights. The PUF variables come in two types: numeric and categorical. Numeric variables are those that have a natural representation as a number. Examples include counts, dollars, and percent values. All other variables that do not meet the test of having a natural representation as a number are classified as categorical variables.

Many of the PUF variables represent the same or similar concepts as in past years. However, most variable names have changed since 2013. Because the 2015 AHS includes an entirely new sample, HUD and the Census Bureau changed variable names to make them more user friendly and to bring them in line with other surveys, most notably the American Community Survey (ACS). For example, several prior year AHS variables relating to the type and size of the housing unit have been replaced with a new variable, *BLD*, which corresponds to the ACS variable *BLD*.

Beginning with 2015 in several instances, multiple variables were collapsed into one variable. The 2015 PUF variable *FINROOMS* represents a combination of five variables found in the 2013 PUF and prior year PUFs. A similar strategy was used for heating and cooling and other variables.

⁵ For more information, see <https://www.census.gov/fsrdc>.

⁶ For more information, see <https://www.census.gov/programs-surveys/ahs/tech-documentation/help-guides/national-sample-case-history.html>.



A few variables, such as *REL*, have the same name but use different codes.

Due to the numerous changes in variable names, HUD and the Census Bureau have produced a crosswalk file comparing 2015 PUF variable names with PUF variable names from the 2011 AHS and 2013 AHS. The crosswalk helps users map new variable names to old variable names. This variable name crosswalk is available on the AHS website⁷.

AHS PUF users are strongly encouraged to carefully review the variables in their analysis, especially categorical variables, to ensure proper understanding of what the values of the variables represent.

8. Replicating PUF Estimates in the AHS Summary Tables

A frequent question of AHS PUF users is, “How can I replicate the results in the AHS summary tables?” In past years, HUD and the Census Bureau have published SAS formatted code that provides instructions on how to replicate most summary table estimates. This code was referred to as “Table Specifications.”

Starting with the 2011 PUF, HUD and the Census Bureau created a new product called “AHS summary table specifications.” This product represents a substantial improvement from the table specification published prior to 2013. It is organized to correspond exactly to each AHS summary table that is currently available in the AHS Table Creator. Each row provides the SAS code logic needed to replicate most summary table estimates. Table specification files are available from the Data section of the Census AHS website (<https://www.census.gov/programs-surveys/ahs/data.html>). To locate the table specifications, choose the year of survey you want, click on the link to the PUF, and then choose the National PUF or the Metropolitan PUF.

For 2015 and subsequent years, HUD and the Census Bureau will continue to produce AHS summary table specifications. Estimates calculated using the PUF might not be exactly the same as those published in the AHS summary tables due to disclosure avoidance techniques applied to the PUF.

9. “Not Applicable” and “Not Reported” Codes in the PUF

The “not reported” category means that the respondent did not provide an answer to the question, either because they refused to answer or because they did not know the answer. The “not reported” category is coded .M in the SAS format files and -9 in the CSV format files.

The “not applicable” category means the question was not asked of the respondent, because the question was not in scope for the respondent. For instance, if a respondent reported living in a single-family detached home, they would not receive questions related to mobile home features. The “not applicable” category is coded “.N” in the SAS format files and -6 in the CSV format files.

If PUF users want to better understand why a response is recorded as “not applicable,” they should consult the *Conditions in Universe* section of the AHS Codebook. AHS PUF users should also note that

⁷ <https://www.census.gov/programs-surveys/ahs/data/2015/ahs-2015-public-use-file--puf-/ahs-2015-national-public-use-file--puf-.html>



the codebook now lists conditions *in* universe, a change from the previous codebook's conditions *not in* universe.

10. Geographic Indicators in the PUF

The 2015 and later PUFs will not include many of the geographic indicators included in prior year PUFs due to disclosure avoidance procedures required by the Census Bureau.

The 2015 and later national PUF will include two geographic variables: *Census Division* and *OMB13CBSA*. The variable *OMB13CBSA* is the 2013 Office of Management and Budget Core Based Statistical Area (CBSA) code. However, this variable is populated with values for only the 15 largest metropolitan areas. The metropolitan area PUF will include *OMB13CBSA* but not *Census Division*.

HUD and the Census Bureau may add additional geographic variables at a later date, including adding additional CBSA codes to the variable *OMB13CBSA*.

As a final note, PUF users may notice that a handful of variables in the subtopic "Nearby Features" are not included in the PUF, although they are present in the IUF. Because these variables are inherently geographic, they pose a disclosure risk. Census Bureau disclosure avoidance procedures require they not be included in the PUF.

11. Core and Rotating Topical Modules

The 2015 and later AHS questionnaires are organized into question modules, where a module is a set of related questions about a topic. HUD and the Census Bureau group all the modules into two types—core and rotating topical. Core modules are administered in every survey. In some cases, questions in the core modules may be edited or deleted, or HUD and the Census Bureau may add a question to a core module. When a question is edited, removed, or added to a core module, the change is intended to be permanent.

Rotating topical modules⁸ may appear in one survey, not appear in the next survey, but reappear in a future survey. AHS users interested in reviewing the specific questions in the topical modules can review the AHS questionnaire.

To maximize the number of rotating topical modules that can be included in a survey year, beginning with the 2013 AHS, HUD and the Census Bureau adopted a strategy of splitting the AHS sample into two groups, then administering some topical modules to Group 1 and some modules to Group 2.

When producing estimates with variables derived from rotating topical module questions, PUF users must use a special split sample weight pertaining to the topical module group. These weights are discussed in the section on Weights in the PUF.

Exhibit 11.1 lists the rotating topical modules, their topical module groups, and where the variables are located in the AHS Codebook.

⁸ See the [Topical Module History Report](#) for a full list and description of all rotating topical modules used in the AHS since 2009.



Exhibit 11.1. Topical Module Information in the AHS Codebook

Survey Year	Topical Module	Topical Module Group	Topic in the Codebook Database
2015	Arts and Culture	Group 1	Art
2015	Food Security	Group 1	Food Security
2015	Housing Counseling	Group 1	Housing Counseling
2015	Healthy Homes	Group 2	Healthy Homes
2017	Commuting	Group 1	Commuting
2017	Disaster Planning	Group 2	Disaster Planning
2017	Delinquent Payments and Notices	Full sample	Delinquency
2019	Post-Secondary Education	Group 1	Demographics
2019	Food Security	Group 1	Food Security
2019	Home Accessibility	Group 2	Accessibility
2021	Delinquent Payments and Notices	Full sample	Delinquency
2021	Housing Search	Group 1	Recent Movers
2021	Intent to Move	Group 1	Recent Movers
2021	Smoking	Group 2	Healthy Homes
2021	Household Pets	Group 2	Pets
2021	Wildfire Risk	Group 2	Disaster Planning

12. Weights in the PUF

The 2015 and later PUF has three weighting variables and corresponding replicate weights. Exhibit 12.1 describes each weight and its corresponding replicate weights.

Exhibit 12.1. PUF Weights and Replicate Weights

Weighting Variable Name	Description	Replicate Weights
WEIGHT	Use <i>WEIGHT</i> to produce national and metropolitan area estimates for all variables other than those found in topical modules.	REPWEIGHT1– REPWEIGHT160
SP1WEIGHT	Use <i>SP1WEIGHT</i> to produce national and metropolitan area estimates for variables in the topical module Group 1.	SP1REPWGT1–SP1REPWGT160
SP2WEIGHT	Use <i>SP2WEIGHT</i> to produce national and metropolitan area estimates for variables in the topical module Group 2.	SP2REPWGT1–SP2REPWGT160

Regarding weights, AHS PUF users should note three other pieces of information:

- For some AHS respondents in topical module Group 1 (Group 2), the value of *SP1WEIGHT* (*SP2WEIGHT*) will be 0, but the value of *WEIGHT* will be positive. This happens when the respondent answers enough survey questions to be considered a completed interview but does not fully respond to enough questions in the Group 1 or Group 2 topical modules to be considered sufficient for publication purposes.



- Weights are assigned only at the household level; there are no person-level weights present in the AHS. For additional information about how the weights were constructed, users should consult the integrated national and independent metropolitan area *Sample Design, Weighting, and Error Estimation* documents.
- For additional information about how replicate weights were constructed, users should consult *Guide to Estimating Variances for the American Housing Survey*."

13. Edits and Imputations

In some instances, AHS respondents provide answers that HUD and the Census Bureau deem likely to be incorrect. When this happens, the AHS variable containing the responses is edited.

In other instances, AHS respondents do not always provide answers to certain questions. In such cases, the value for the AHS variable may be imputed, but imputations are not made for every variable with a missing value.

There are two resources AHS PUF users can use to further investigate edits and imputations. First, nearly every variable in the 2015 AHS PUF and beyond includes a corresponding variable representing an edit or imputation flag. In keeping with the convention used in prior AHS PUFs, the edit-imputation variable will be named the same as the variable to which it refers but will begin with the letter J. For instance, the edit-imputation variable for the PUF variable *TOTROOMS* is *JTOTROOMS*. The name of the corresponding J variable can be found in the AHS Codebook in the Edit Flag Variable field. The Codebook also includes an Imputation Strategy field (to be populated at a later time).

The second resource AHS PUF users can use to further investigate edits and imputations is the document [*Item Nonresponse and Imputation: 2015 and Beyond*](#). This document provides the details concerning the procedures used to impute missing values.

14. Topcoding and Other Disclosure Avoidance Techniques

To ensure respondent confidentiality, the Census Bureau requires that disclosure avoidance techniques be applied to certain PUF variables. Some variables are not included in the PUF because of disclosure avoidance. The section on Geographic Indicators mentions that geographic indicators in the PUF are limited due to disclosure avoidance.

A handful of other disclosure avoidance techniques are applied to 2015 and later PUF variables. These procedures include topcoding, bottomcoding, noise, perturbation, rounding, recoding, and collapsing. For instance, the PUF variable *LOTSIZE* represents collapsing the answers to the lot size questions into various lot size groups.

Initially, all mortgage and financial characteristics in the 2015 and 2017 PUF were withheld due to the potential risk of disclosure. In April 2019, a subset of these withheld variables was released after further analysis, and in some instances, noise was added to them.

Users should note a few pieces of information regarding topcoding, noise, collapsing, and other disclosure avoidance techniques in PUF:

- If disclosure avoidance techniques have been applied to a variable, it will be denoted in the AHS Codebook in the Disclosure field.



- For some variables in the PUF, the original variable is retained in the IUF. For instance, the PUFs include a variable called *LOTSIZE* that presents lot size in categories. The IUF includes *LOTSIZE_IUF*, which is the raw lot size value, as reported by the respondent.

More information about disclosure methodology for all AHS variables, including the impact of noise injection, can be found at [Disclosure Avoidance Techniques: 2015 and Beyond](#).

15. Noise Injection Process and Impact

Noise factors were created using random, independent pulls from a Laplace distribution with a mean of 1 and a beta value of $k*(1/\sqrt{N})$, with N being the number of responses in geographic area and k being a proportional multiplicative factor determined in conjunction with the DRB. Original values are then multiplied by the noise factors following data edits.

Noise factors are independent across variables and years. Noise is applied at the variable level in a single year for all observations. Thus, the mean noise factor for a variable in any given year is 1. This limits the impact of noise injection at the aggregate level and allows means and correlations to be maintained. However, the more a variable is sliced, the higher the risk that the mean noise factor will deviate from 1. See the impact of this below.

Original values of 0 were not impacted by the multiplicative noise injection. Thus, the more 0 values a noise-injected variable has, the more the mean noise will deviate from 1. We recommend calculating means using non-0 values; for example, determining the mean of *INSURAMT* for those that paid at least \$1 in insurance.

15.1. How will noise impact my cross-sectional analysis?

For the integrated national longitudinal sample, excluding the Top 15 metropolitan areas, the impact of noise injection in cross-sectional analysis is minimal. For the independent metropolitan area longitudinal oversamples and Top 15 metropolitan areas within the integrated national longitudinal sample, the impact of noise is greater. For estimates at the metro area level, Census does not recommend using noise-injected data for analysis that cross-tabulates more than three variables because the error rates will be high. If your analysis requires this level of granularity, use of the Internal Use File (IUF) will be required.

15.2. Are certain variables impacted more by noise injection?

LOTAMT and *MORTPURCH* are impacted by noise injection more than other noise-injected variables. *MORTPURCH* was removed from the 2021 AHS PUF, however, so its noise injection only applies to 2015 to 2019. Beginning in 2021, *HELOCLIM*, *MORTADDTN*, and *REFICSHAMT* were also added to the PUF with noise and are similarly impacted.

LOTAMT, *HELOCLIM*, *MORTADDTN*, and *REFICSHAMT* data are uncommon and are more at-risk for disclosure; thus, more noise had to be injected. When producing estimates for independent metropolitan area samples and the Top 15 group of metropolitan area longitudinal oversamples, we do not recommend using these variables in an analysis that requires cross-tabulating them by more than one variable. For other uses, we recommend binning them into large bins to absorb the impact of noise injection.

MORTPURCH is impacted by editing. There are many cases of *MORTPURCH* grouped around (and at) 100, and noise injection would often increase these values to above 100. Noise-injected values above 100 were then edited and rounded down to 100. Thus, mean noise is no longer 1 for *MORTPURCH*.



When producing estimates for independent metropolitan area samples and the Top 15 group of metropolitan area longitudinal oversamples, we recommend binning noise-injected *MORTPURCH* data or truncating/binning the upper end of the data to absorb the impact of post-noise editing. Beginning in 2021 *MORTADDTN* has a similar structure to *MORTPURCH*. However, the distribution of *MORTADDTN* includes a smaller percentage of records in this top category, so the impact is less severe.

15.3. How will noise impact my longitudinal analysis?

For cases that are in the integrated national longitudinal sample but are not part of the Top 15 metropolitan areas, the impact of noise injection for longitudinal analysis will be minimal. For the Top 15 metropolitan areas, which are interviewed every survey cycle, noise injection will have a greater impact. Ultimately, noise injection will hide true changes in means of non-0 values across years when the noise injected is, on average, larger than the fluctuation across time.

For the Top 15 metropolitan areas, longitudinal analysis should not be used for analysis cross-tabulating more than two variables (e.g., change in the mean of *MARKETVAL* in Memphis by *BEDROOMS* and *FIRSTHOME* from 2015 to 2017). If your analysis requires this level of granularity, use of the IUF will be required.

Longitudinal analysis using numeric noise-injected versions of *LOTAMT*, *HELOCLIM*, *MORTADDTN*, *REFICSHAMT* and *MORTPURCH* should be avoided. We recommend binning these variables into broad categories for longitudinal analysis.

16. Value Labels Package

The PUF includes a significant number of categorical variables. For AHS users of numerous PUF categorical variables, altering a categorical variable's values (for example, 1, 2, 3) such that they reflect descriptive names (for example, mobile homes, single-family detached, single-family attached) can be a labor-intensive task.

In keeping with prior year practice, HUD and the Census Bureau created an AHS Value Labels Package. The package is a zip file that includes instructions for applying value labels to categorical variables and a spreadsheet that maps categorical variable values to descriptive names. Although the instructions are generally for SAS users, non-SAS users should be able to use the contents of the Value Labels Package.

U.S. Department of Housing and Urban Development
Office of Policy Development and Research
Washington, DC 20410-6000



September 2022