

WHO WAS COUNTED LAST IN THE 1990 CENSUS?

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1. Background

In Census 2000 most households will receive a census questionnaire to complete and return by mail. One of the many changes proposed for Census 2000 involves the use of sampling to collect data for those households that do not respond by mail (i.e., nonresponse followup.) In the past several years, a series of research projects has been undertaken to determine how best to design this sample. One approach that was considered was to truncate nonresponse followup when 90 percent of the housing units in each tract had been enumerated. A sample of the last 10 percent would be selected. Critics of this approach were concerned that such a plan might imply that only minority households would end up being sampled. This research project was designed to address those concerns.

In addition, it is of value to understand if certain types of housing units or persons with certain characteristics are especially likely to be enumerated in the later stages of the census. Data have been analyzed to profile the characteristics of the households who respond to the mailout of census forms as opposed to those households who require nonresponse followup (Word 1997). This research project supplements that knowledge and allows us to assess if differences exist within the nonresponse followup universe.

2. Introduction

In the 1990 census most households received a form to be completed and returned in the mail. About 74 percent of occupied housing units, or households, returned a completed form by mail. A census form was completed for the remaining 26 percent during a personal visit by a census enumerator. Vacant housing units were also enumerated at this time. This operation was called nonresponse followup. Nonresponse followup employed about 300 thousand enumerators over a period of about three months. Work was continuously assigned until an office had completed about 95 percent of their nonresponse followup work. At this time, enumerators were instructed to make one final visit to all outstanding cases to complete the enumeration.

The primary objective of this study was to compare the demographic profiles of the group of final enumerations to the total set of census enumerations. When we study the characteristics of the people who were counted last, we usually think of these people as the "hardest to enumerate." In many cases this is likely to be

true. However, in some instances, the final enumerations may simply reflect the sequence of when certain cases were assigned. When interpreting these results, both possibilities should be considered.

This report includes an overview of the basic methodology that was used to obtain all tabulations. Two sets of analyses are provided. The first relies on a series of tables to profile and contrast the demographic characteristics of all enumerations to the final enumerations. The second employs logistic regression to measure the magnitude of the effects on households being in the last set of enumerations.

3. Methodology

3.1 Definition of Tabulation Files

Three sets of data from the 1990 Decennial Census were tabulated. One set includes all occupied housing units in the nation who either completed and returned their census form through the mail (i.e., were self-enumerated) or were enumerated during nonresponse followup. The universe includes about 91.9 million housing units. The other two sets were formed by defining the last of these enumerations in two different ways. All census enumerations were sorted by the date that they were "checked in" as either a mail return or an enumerator completed form. These check-in dates were referenced to simulate national and tract level truncations.

To simulate national level truncation, we identified the date corresponding to when 90 percent or more of the forms for occupied housing units in the nation had been checked-in. This date was June 3, 1990. All households enumerated on forms that were checked-in after this date were considered part of the last 10 percent under national level truncation. Mail returns that were received after this date were dropped. This resulted in a total of 8.5 million occupied housing units (9.2 percent of all occupied housing units).

To simulate tract level truncation, we identified, for each tract, the date corresponding to when 90 percent or more of the occupied housing units in the tract had been checked-in. The truncation date for this simulation varied across tracts. The households enumerated on these forms were considered part of the last 10 percent under tract level truncation. Mail returns that fell in this universe were dropped. This resulted in a total of 7.4 million occupied housing units (8.1 percent of all occupied housing units).

3.2 Summary of Data

Once the households were defined for each

simulation, the person and housing unit characteristics were obtained. For this study, all person characteristics were associated with the householder (i.e., Person 1). The tables in Section 4 contrast specific characteristics across three domains - (1) all occupied households in the nation, (2) approximately the last 10 percent of occupied households in the nation and (3) a national summary of approximately the last 10 percent of occupied households within each tract in the nation. Relative percentages were calculated based on denominators of 91.9 million (for the nation), 8.5 million (for the last 10 percent under national level truncation) and 7.4 million (for the last 10 percent under tract level truncation.) For example, Table 1 gives the percentages of single units and multi units in the entire nation and in the last 10 percent under tract level and national level truncation simulations. To arrive at the percentage of single units in the last 10 percent under tract truncation, we divided the number of single units in the last 10 percent under tract level truncation (4,730,623) by the total number of occupied housing units in the last 10 percent under tract level truncation (7.4 million) then multiplied by 100 to get 63.8 percent.

3.3 Logistic Regression Analysis

The data for each simulation were analyzed using logistic regression for a two-level response - being in the last 10 percent or being in the first 90 percent of census enumerations. The analysis measures the magnitude of the effects on households being in the last 10 percent of returns, and identifies associations between variables. The objective was to find the major factors/terms and interpret the results more so than to build a model for prediction. The models show which variables explain the variability in the response after adjusting for other variables in the model. The factors involved in this analysis are race (White/ NonWhite), ethnicity (Hispanic/NonHispanic), number of persons in the household (single person/multi-person), tenure (owner/renter), and locality (urban/rural). Type of structure was left out of the study due to limitations in available cross tabulations.

4. Summary of Tables

In general, the demographic profile of the last 10 percent under tract level truncation tends to look more like the nation than the last 10 percent under national level truncation. Since approximately 10 percent of each tract is represented under tract level truncation and the tracts are relatively homogeneous, one might have expected this result. Under national level truncation some tracts are not represented but more important, certain tracts have a large portion of their tract represented.

Sections 4.1 through 4.9 briefly summarize nine national-level tables. In addition to the relative proportions, the tables document the percent differences of the last 10 percent relative to the entire nation. The

column, "Percent Difference," refers to the difference between percentages in the last 10 percent relative to the entire nation. For example, in Table 7, the last 10 percent under tract level truncation included 7.3 percent Hispanic householders, while 6.5 percent of the occupied units in the nation were classified as having Hispanic householders. The percent difference between these two rates is $(7.3 - 6.5) / 6.5$ or 12.3 percent. This indicates that the last 10 percent under tract level truncation included about 12.3 percent more Hispanic householders than expected if using the entire nation's distribution of Hispanic householders as a predictor. The relative difference for the last 10 percent under national level truncation is much greater (60.0 percent).

4.1 Type of Structure

There are a greater percentage of multiunit structures in the last 10 percent under both tract level and national level truncation than there are in the nation. About 27 percent of all occupied housing units in 1990 were in multi unit structures. That rate rose to about 36 percent and 44 percent, respectively, for the last 10 percent under tract level and national level truncation. The percentage of multi unit structures in the last 10 percent under national level truncation is about 65 percent greater relative to that of the nation

Type of Structure	In Nation	Last 10% - Tract Level Truncation		Last 10% - National Level Truncation	
	Percent	Percent	Percent Difference	Percent	Percent Difference
Single Unit	73.2	63.8	- 12.8	55.7	- 23.9
Multi Unit	26.8	36.2	+ 35.1	44.3	+ 65.3

4.2 Tenure (Owner/Renter)

There are a larger percentage of renters in the last 10 percent (tracts and nation) than there are in the nation. Approximately 36 percent of occupied housing units in 1990 were occupied by renters. More than 50 percent of the occupied households in the last 10 percent (tracts and nation) were occupied by renters. The percentage of renters in the last 10 percent in the nation is about 57 percent, which is almost 59 percent greater relative to that of the entire nation.

Tenure	In Nation	Last 10% - Tract Level Truncation		Last 10% - National Level Truncation	
	Percent	Percent	Percent Difference	Percent	Percent Difference
Owner	64.2	49.2	-23.4	43.2	-32.7
Renter	35.8	50.7	+41.6	56.8	+58.7

4.3 Number of Persons in Household

There are a larger percentage of single person households in the last 10 percent (tracts and nation) than there are in the nation. For instance, the percentage of single person households in the last 10 percent under national level truncation is about 31, which is almost 25 percent greater relative to that of the entire nation (25 percent). About the same result was found under tract level truncation.

Number of Persons	In Nation	Last 10% - Tract Level Truncation		Last 10% - National Level Truncation	
	Percent	Percent	Percent Difference	Percent	Percent Difference
Single Person	24.6	30.6	+24.4	30.7	+24.8
Multiple Persons	75.4	69.4	-8.0	69.3	-8.1

4.4 Locality (Urban/Rural)

For this one-way table, the locality of a housing unit does not seem to be related to timing of enumeration. Urban areas are defined as urbanized areas and places of 2500 or more people outside of urbanized areas. In 1990, about 76 percent of occupied units were considered urban. The percentage of rural housing units in the last 10 percent under national level truncation is almost 21, which is only about 13 percent lower relative to that of the nation. The percent in the last 10 percent under tract level truncation is essentially the same as found in the nation.

Locality	In Nation	Last 10% - Tract Level Truncation		Last 10% - National Level Truncation	
	Percent	Percent	Percent Difference	Percent	Percent Difference
Urban	76.2	76.3	+0.1	79.2	+3.9
Rural	23.8	23.7	-0.4	20.8	-12.6

4.5 Locality and Tenure

Urban renters make up the majority of the last 10 percent (tracts and nation). Urban owners comprise the

majority of the nation. The largest relative difference in the percentages exists between urban renters in the last 10 percent under national level truncation and the nation (almost a 63 percent increase). The second largest relative difference comes between rural renters in the last 10 percent under tract level truncation and the entire nation (52 percent).

Locality X Tenure	In Nation	Last 10% - Tract Level Truncation		Last 10% - National Level Truncation	
	Percent	Percent	Percent Difference	Percent	Percent Difference
Urban-Owner	45.0	32.5	-27.8	28.3	-37.1
Urban-Renter	31.2	43.8	+40.4	50.8	+62.8
Rural-Owner	19.2	16.7	-13.0	14.9	-22.4
Rural-Renter	4.6	7.0	+52.2	6.0	-30.4

4.6 Race

Race distributions are based on the race of Person 1 and were found to be close to the same for the last 10 percent under tract level truncation when compared to the nation. However, significant percent differences were found when making these comparisons. The largest difference between the last 10 percent under tract level truncation and the entire nation is for black householders where there is almost a 24 percent difference. The differences are much greater when comparing the last 10 percent under national level truncation to the nation. For instance, the percentage of black householders in the last 10 percent under national level truncation is almost twice that of the nation (a 95 percent increase).

Race of Person 1	In Nation	Last 10% - Tract Level Truncation		Last 10% - National Level Truncation	
	Percent	Percent	Percent Difference	Percent	Percent Difference
White	83.6	80.0	-4.3	69.8	-16.5
Black	10.9	13.5	+23.9	21.2	+94.5
American Indian, Eskimo, Aleut	0.6	0.7	+16.7	0.9	+50.0
Asian and Pacific Islander	2.2	2.7	+22.7	3.3	+50.0
Other Race	2.7	3.1	+14.8	4.7	+74.1

4.7 Ethnicity

Ethnicity distributions are also based on the ethnicity of Person 1 and were found to be close to the same for the last 10 under tract level truncation when compared to the nation. However, in the last 10 percent under national level truncation, the percentage of Hispanic householders is 60 percent higher relative to the entire nation.

Ethnicity Person 1	In Nation	Last 10% - Tract Level Truncation		Last 10% - National Level Truncation	
	Percent	Percent	Percent Difference	Percent	Percent Difference
Hispanic	6.5	7.3	+12.3	10.4	+60.0
Not Hispanic	93.5	92.7	-0.9	89.6	-4.2

4.8 Race and Tenure

Under tract level truncation for the last 10 percent, all race categories associated with renters have a higher percentage than the corresponding percentage for the nation, which suggests that renters tend to respond slowly to the census or be enumerated in the later stages, as measured by the last 10 percent criteria. Under national level truncation for the last 10 percent, white owners are the only group with a percentage less than its corresponding percentage in the nation, which says this group responds quickly to the census or is enumerated in the earlier stages, as measured by the last 10 percent criteria. The largest relative differences between the percentages in the last 10 percent under national level truncation and that of the nation are for Black renters, Asian, Pacific Islander renters, and renters in the 'other race' category. In all of these instances the rates more than doubled.

Tenure X Race of Person 1	In Nation	Last 10% - Tract Level Truncation		Last 10% - National Level Truncation	
	Percent	Percent	Percent Difference	Percent	Percent Difference
White-Owner	57.1	42.4	-25.7	33.9	-40.6
White-Renter	26.6	37.7	+41.7	35.9	+35.0
Black-Owner	4.7	4.5	-4.3	6.5	+38.3
Black-Renter	6.1	8.9	+45.9	14.7	+141.0
AI-Owner	0.4	0.3	-25.0	0.5	+25.0
AI-Renter	0.3	0.4	+33.3	0.4	+33.3

API-Owner	1.1	1.1	0.0	1.2	+9.1
API-Renter	1.0	1.6	+60.0	2.2	+120.0
Other-Owner	1.0	0.9	-10.0	1.1	+10.0
Other-Renter	1.7	2.2	+29.4	3.6	+111.8

4.9 Ethnicity and Tenure

Regardless of the ethnicity of the householder, all percentages in the last 10 percent (tracts and nation) pertaining to renters are larger when compared to the nation. The largest relative difference is in the last 10 percent under national level truncation compared to the entire nation for Hispanic renters (105 percent).

Tenure X Ethnicity of Person 1	In Nation	Last 10% - Tract Level Truncation		Last 10% - National Level Truncation	
	Percent	Percent	Percent Difference	Percent	Percent Difference
Hispanic - Owner	2.7	2.3	- 14.8	2.8	+ 3.7
Hispanic - Renter	3.7	5.0	+ 35.1	7.6	+ 105.4
Not Hispanic - Owner	61.5	46.9	- 23.7	40.4	- 34.3
Not Hispanic - Renter	32.1	45.8	+42.7	49.2	+ 53.3

5. Logistic Regression Results

These nine national-level tables give a profile of the last enumerations for one or two variables at a time. However, the effect of one variable may depend on a different variable. For instance, the race effect on being in the last 10 percent is stronger for owners than for renters. Furthermore, seemingly unimportant effects shown in one-way tables, like locality, may have an effect due to adjusting for other variables. To further investigate the table summaries in Section 4, logistic regression was used to measure the effects and associations between five variables.

Although logistic regression did not use the variable of type of structure, it seems from table 1 in section 4.1, that the percentages are different for the last 10 percent groups as compared to that of the nation. Multi unit structures are more likely than single unit structures to be in the last 10 percent.

5.1 Tract Level Truncation

First, logistic regression results are discussed for the

group 'last 10 percent in tracts'. Table 10 gives the analysis of maximum likelihood estimates for the final model. This model shows an interaction between race and tenure (parameter estimate = 0.0642). That is, the race effect depends on whether the housing unit is rented or owned. Odds ratios were calculated from the coefficients to help summarize this dependency. Among owned units, NonWhite householders are 1.35 more likely than White householders to be in the last 10 percent of returns. Among rented units, NonWhite householders are 1.05 more likely than White householders to be in the last 10 percent of returns. Therefore, the race effect is stronger among owned units than among rented units.

Effect	Estimate	Standard Error
Intercept	-2.2225	0.000613
Tenure	-0.2834	0.000511
Race	0.0885	0.000507
Number of Persons	-0.1064	0.00043
Locality	0.0923	0.000468
Tenure * Race	0.0642	0.000503

All model chi-squares are significant at $p < .0001$

A strong tenure effect is exemplified by the parameter estimate of 0.2834 shown in table 10. As measured by tract-level truncation, in general, white owners tend to be enumerated first in the census, while Nonwhite renters and white renters seem to be enumerated last.

For the number of persons in the household, the parameter estimate is 0.1064, which says that single person housing units are 1.24 more likely than multiple person housing units to be enumerated in the last 10 percent. The parameter estimate for locality is 0.0923 which says that rural units are 1.21 more likely than urban units to be enumerated last. This is different from the summary for the locality table in Section 4.4, so this is a case where adjusting for other variables in the model brings out a different and more general conclusion than in a one-variable analysis for locality. Interactions relating to ethnicity and the main effect for ethnicity had small chi-square values, therefore the terms relating to ethnicity were dropped.

5.1 National Level Truncation

The logistic regression for national truncation provided maximum likelihood estimates as shown in Table 11. The final model shows strong interactions between race and ethnicity and between tenure and locality. There is also a notable association between race and tenure.

Effect	Estimate	Standard Error
Intercept	-1.8623	0.000787
Tenure	-0.3133	0.000551
Race	0.2526	0.000643
Ethnicity	0.1053	0.00063
Number of Persons	-0.1097	0.000411
Locality	0.0541	0.000496
Race * Ethnicity	-0.1581	0.000626
Tenure * Race	0.0571	0.000432
Tenure * Locality	0.1077	0.000494

All model chi-squares are significant at $p < .0001$

The parameter estimate for the number of persons in the household is -0.1097 which says single person households are 1.25 more likely than multiple person households to be enumerated in the last 10 percent. The race and ethnicity interaction says that NonWhite Hispanic householders are 1.21 more likely than White Hispanic householders to have been enumerated last in 1990 (as measured by the last 10 percent in the nation). Among NonHispanic householders, NonWhites are 2.27 more likely than Whites to have been enumerated last. Therefore, the race effect is stronger for NonHispanic householders than for Hispanic householders.

Whites are less likely than NonWhites to be in the last 10 percent. This race effect is supported by the large parameter estimate for race (0.2526). As measured by national-level truncation at 90 percent of enumerations, in general, White NonHispanic households have the lowest conditional probabilities of being enumerated last.

The tenure and locality interaction says that urban renters are 2.32 more likely than urban owners to be enumerated in the last 10 percent, while rural renters are 1.51 more likely than rural owners to be enumerated in the last 10 percent. Therefore, the tenure effect is stronger among urban housing units than among rural housing units. Between the tenure and locality groups, urban owners tend to be enumerated first in the Census, while urban and rural renters tend to be enumerated last, as measured by the last 10 percent in the nation criteria. The tenure effect, like race, is strong as shown by the parameter estimate of 0.3133.

The tenure and race interaction says that among renters, NonWhites are 1.34 more likely than Whites to be enumerated in the last 10 percent, while among owners, NonWhites are 1.86 more likely than Whites to be enumerated last. Therefore, the race effect is stronger

among owners than among renters. As measured by national-level truncation at 90 percent of enumerations, in general, White owners tend to be enumerated first in the Census.

6. Conclusions

Truncating enumeration at 90 percent in every tract causes the race and ethnicity distributions among the last 10 percent in tracts to be more similar to that of the entire nation. However, truncation at 90 percent in the nation causes race and ethnicity distributions among the last 10 percent in the nation to be different from that of the entire nation. The reason is that tracts are relatively homogeneous and under tract level truncation, each tract will be represented in the last 10 percent universe.

This study reveals the following similarities between national level and tract level truncation:

1. There is a strong tenure effect on late enumeration.
2. There is an association between race and tenure where the race effect is stronger among owners than among renters.
3. The effect of household size is about the same.

The study also reveals the following differences between national and tract level truncation:

1. Under national level truncation, the race and ethnicity effects are much stronger.
2. There is an important race and ethnicity association and locality and tenure association under national level truncation that is not important under tract level truncation.

Under tract truncation, NonWhite owners are much more likely than White owners to be enumerated last, while NonWhite renters are slightly more likely than White renters to be enumerated last. Single person households are more likely than multiple person households to be enumerated last. And when adjusting for other variables, rural households are more likely than urban households to be enumerated in the last 10 percent. The ethnicity effect was unimportant.

Under national level truncation, among Hispanic householders, NonWhites are slightly more likely than Whites to be enumerated last; while among NonHispanic householders, NonWhites are much more likely than Whites to be enumerated last. Among urban households, renters are much more likely than owners to be enumerated last, while among rural households, renters are more likely than owners to be enumerated last, but not as strongly as among urban households. Among renters, NonWhites are more likely than Whites to be enumerated in the last 10 percent, but not as strongly as among owners, where NonWhites are much more likely than Whites to be enumerated in the last 10 percent. Single person households are more likely than multiple person households to be enumerated last. This indicates that the last enumerations in the 1990 census, those conducted in the late summer, were especially likely to represent NonWhites among NonHispanics, renters as opposed to owners in urban households, NonWhites among owners and single as opposed to multi person households.

These data support a tract level truncation as the preferred approach, given truncation. Based on other related research, the Bureau has proposed the use of direct sampling as opposed to truncation. In addition to providing valuable insights in truncation, these data help us to better understand the characteristics of the persons who were enumerated late in the enumeration process in 1990. This information should be used in planning for nonresponse followup.

7. Acknowledgments

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8. References

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