Results of the Person Followup/Evaluation Followup Review for the Census 2000 Accuracy and Coverage Evaluation

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1. Introduction

As part of the Census 2000, the Census Bureau conducted the Accuracy and Coverage Evaluation (A.C.E.). The A.C.E. measures the net coverage of the census using an area sample of block clusters. The P-sample, or Population Sample, is an independently enumerated sample and is used to measure the census misses. The E-sample, or Enumeration Sample, consists of the census people enumerated in the A.C.E. sample areas. The E-sample is used to measure the census erroneous enumerations and duplicates. Following the A.C.E. production, the Census Bureau evaluates the quality of the A.C.E. operations using the Evaluation Followup (EFU).

After the A.C.E. housing unit and the person interviewing operations were completed, the person followup matching process was conducted. There were several major steps to the production person matching and followup process:

1. <u>Computer Match</u> - The P-sample and the E-sample people were matched by computer. The results were used during the before followup clerical matching.
2. <u>Before Followup Matching</u>–The clerical matchers reviewed the P-sample and E-sample persons who were not matched or were possibly matched by the computer, and census cases with insufficient information for matching. The matchers also attempted to identify and code duplicated persons within both the P-sample and the E-sample.
3. <u>Person Followup Interview (PFU)</u> - Unresolved and selected unmatched persons were sent to a field interview. During the interview additional information was obtained to help assign a final match and/or residence status to each person. For the E-sample, nonmatches were sent for a follow-up interview to determine if they were correctly or erroneously enumerated in the block cluster. Certain whole household nonmatches in the P-sample were not sent for a person followup interview (Childers 2001). Possible matches were also sent for an interview to resolve their match status.
4. <u>After Followup Coding</u> –The information obtained in the PFU interview was used to code the match and/or residence or enumeration status of the persons in question. These statuses were assigned based on the Residence Rules for Census 2000 (Childers 2001).
5. <u>Evaluation Followup</u> – Following the PFU, the Evaluation Followup interview (EFU) was conducted to assess the quality of the A.C.E. and, specifically, to review the assignment of residence status in the P-sample and enumeration status in the E-sample. The EFU interview was an expanded PFU interview. The same people followed up in the PFU were interviewed using the EFU form in addition to a sample of people (Krejsa 2000) not interviewed in the PFU. The EFU form was expanded to ask more detailed questions about other residences a person may have and about movers from a housing unit. Using this expanded information from the EFU, the Measurement Error Reinterview (MER) matching process (structured similarly to the after followup matching step) was conducted to determine residence and enumeration status of the persons in question.

In July, 2001, results from the MER matching operation using the EFU forms showed a net increase of approximately 1.9 million erroneous enumerations from the production estimate (Krejsa and Raglin, 2001, see Table 1). This increase seemed large, so additional review of the forms was deemed appropriate. A sample of the PFU and EFU forms for the E-sample were reviewed to determine the correct code based on each form, the best code (code that reflects the best data collection), and the reason for assigning the correct code. This evaluation process focused on the production interviewing and after followup matching steps in the person matching and followup process.

The sampling for the PFU/EFU Review was performed using the results of the MER. Our sample yielded 17,522 persons. We selected with certainty all cases where the enumeration status changed between production and MER. The remainder of the cases, where the enumeration status from production and MER were the same, were sampled at varying rates.

2. Methods

Unlike the production and evaluation coding operations, the Review was an analyst-only operation (that is, no technicians or clerks). Each analyst reviewed a workunit of sampled persons, coding the EFU form separately from the PFU form. Then, the analyst indicated which form contained the best code - both, EFU, PFU, or conflicting. We used the following rules to select the form with the best code:

- If either form was unresolved, we chose the other (resolved) form. An exception to this rule was when the unresolved form gave the analyst more information.

- If both forms were resolved and on one form the respondent was a proxy and on the other the respondent was a household member, we chose the form with a household member respondent.
- If both forms were resolved and the same type of respondent answered both, we picked the form that gave more information.

In some cases a clear determination of the best code could not be made; these cases were termed 'conflicting.' We coded a case conflicting in the following circumstances:

- Contradictory Information from the Same Respondent Type – A case was determined to be conflicting when both forms were completed by the same type of respondent - either both were household respondents or both were similar caliber proxies - who provided contradictory information that resulted in a different enumeration status for the followup person.

- Contradictory Geocoding Information – In addition, if one form indicated through geocoding information that the housing unit was in one place and the other form indicated it was elsewhere, the case was coded as conflicting.

3. Limits

Some data in this report were obtained from the EFU. The most significant limitation of the EFU is the nine to ten month time lag between Census Day, April 1, 2000, and when the EFU data were collected in January and February, 2001. Given the time lag, people could forget or inaccurately report information. In addition, people may have moved during that time period so more proxy data were collected. The EFU questionnaire was developed, though, to attempt to minimize such problems by asking questions of the respondent that aid them in recalling the correct information. Another limitation is that the EFU

did not have a full field quality assurance program as did the A.C.E. Person Interview and the PFU. For both the PFU and the EFU interviews, there is evidence that the questions were not always read as worded (Keeley 1999 and Krejsa 2001). This may have led to varying responses for questions. A third limitation is that standard errors presented in this report are simple jackknife estimates and do not fully capture all phases of the multiphase A.C.E. sampling.

4. Results

The focus of the results presented here are as follows:

- How do the results of the Review compare to the results of the MER and to the production results? Specifically, what is the net difference in erroneous enumerations according to the Review in comparison with those identified in MER and those identified in production?
- What is the source of the difference between the MER results and the Review?
- Why are cases coded as erroneous that were previously coded as correct enumerations?

This paper uses the following abbreviations:

PFU1 = Production Code, which included matches without followup and cases with followup
PFU2 = Code from the Review of the PFU form
EFU1 = Code from the MER study
EFU2 = Code from the Review of the EFU form
Best = Code of the chosen form in the Review

From the MER, we compared production (PFU1) codes to MER codes (EFU1) in Table 1.

We see the following results:

- Correct to Erroneous – There is an estimated 2,827,414 production correct enumerations that were coded erroneous enumerations in the MER. This includes 54.3 percent that were matched.
- Erroneous to Correct – There is an estimated 908,385 production erroneous enumerations that were coded correct enumerations in the MER.
- Net Difference in Erroneous Enumeration Coding – The net difference between the two cells described above is estimated to be 1,919,029. This number represents the additional erroneous enumerations found by the MER.
- Unresolved Rate – The unresolved rate following the MER coding was estimated to be 1.7 percent. The

unresolved rate for the production cases in the MER sample was estimated to be 2.6 percent.

Table 2 shows results comparing production versus best code from the PFU/EFU Review. Important Results from Table 2:

- Correct to Erroneous – The estimate of production correct enumerations coded as erroneous enumerations decreased from 2,827,414 during the Measurement Error Reinterview to 1,816,315 in the Review. Of these erroneous enumerations, an estimated 1,139,407 were from cases where the census and Accuracy and Coverage Evaluation matched during production, most of which were not followed up during production.

- Erroneous to Correct – The number of production erroneous enumerations coded as correct enumerations decreased from an estimated 908,385 in the Measurement Error Reinterview to an estimated 361,400 in the Review.

- Net Difference in Erroneous Enumeration Coding – The net difference in the Correct Enumeration to Erroneous Enumeration less the Erroneous Enumeration to Correct Enumeration cells decreased from an estimated 1,919,029 in the Measurement Error Reinterview to an estimated 1,454,915 in the Review. This number represents the additional erroneous enumerations found by the evaluation followup interview. The change was in part due to an assignment of some cases as conflicting, an increase in unresolved cases attributed to consistent application of matching rules with the census residence rules, and in part due to matching error.

- Unresolved Rate – The estimate of unresolved people in the Review is 12,640,503 (4.82 percent). The number of unresolved people in the MER was an estimated 4,559,691 (1.7 percent). This represents an increase in unresolved cases from the MER to the Review.

- Unresolved and Conflicting Cases – There were an estimated 15,235,142 persons that were coded as either unresolved or conflicting by the expert matchers. Some small but unknown portion of these cases would also be considered erroneous, thus increasing the 1,454,915 number.

The source of the changes from correct to erroneous include, but are not limited to:

- Coding Error – There is a small amount of coding error in production (measured between 0.60% and 0.70%, Bean 2001, and Adams and Krejsa, 2001).
- Conflicting – We allowed conflicting cases during the PFU/EFU Review. Some of these cases would have

been coded as erroneous enumerations during the MER.
- Increased Unresolved Rate – On the EFU form, Census Day addresses were not collected for certain types of cases leading to differences in match code results. Part of the increase in the unresolved rate is due to the fact that the MER used slightly different rules than production for certain other types of cases.[2]

Table 3 details the why codes for cases coded as a correct enumeration in production and as an erroneous enumeration in the PFU/EFU Review. It shows why the erroneous code was used for each person. These are the people in the correct to erroneous cell in Table 2 (n=1,816,315). Note that the conflicting cases are not included here.

As seen in Table 3, over half of the erroneous enumerations missed by the production were either at a group quarters (33.83 percent) or at a second home (23.29 percent). Of the people who should have been counted in group quarters missed by production, about half (51.33 percent) of the erroneously enumerated people lived in dormitories on Census Day. Of the total missed erroneous enumerations, 17.37 percent were from dormitories.

Since we do not have a probability of correct enumeration for either conflicting cases or new unresolved cases, we consider the effects on the correct enumeration rate when we vary the correct enumeration probability for both. The resulting correct enumeration rates are in Table 4. Standard errors are in parentheses. The production correct enumeration rate for the PFU/EFU Review Sample was estimated to be 97.77 (se=0.10). This rate included the imputation for the production unresolved cases; therefore, it cannot be directly derived from Table 2.

If we vary the correct enumeration probability between 0.5 and 1 for the new unresolved cases and for the conflicting cases, we see that the correct enumeration rate varies between 95.50 (se=0.19) percent and 97.63 (se=0.12) percent. The production corrrect enumeration rate for this sample is 97.77 (se=0.10) percent. This difference equated to an estimated 5.9 million (se=0.4 million) net missed erroneous enumerations if we assumed 0.5 correct

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[2]There is some evidence that the unresolved rate is too high. This is due to an overacceptance of the EFU form when it was a noninterview due to unclear coding instructions. Approximately 6,000,000 of the 12,000,000 estimated unresolved cases should be correct enumerations in both production and the Review.

enumeration probabilities for both the conflicting and unresolved cases. However, the estimated number of missed erroneous enumerations is sensitive to the assumptions that we make about the conflicting and unresolved cases.

5. Conclusions

Results from the PFU/EFU Review indicate that the net number of erroneous enumerations not found by the production operations is estimated to be 1,454,915. Of these, 62.7 percent were matches, most of which did not go to followup. In addition, there were an estimated 15,235,142 persons that were coded as either unresolved or conflicting by the expert matchers. Some small but unknown portion of these cases would also be considered erroneous, thus increasing the 1,454,915 number. This error resulted in a bias in the dual system estimate that caused an overestimate of the net census undercount. In addition, the unresolved rate has increased from 1.7 percent reported by the MER to 4.8 percent.

The failure of A.C.E. production to find these erroneous enumerations is probably due to differences between the forms. The evaluation followup form incorporated an extensive battery of questions regarding residences other than the sample address. The production A.C.E. person interview and person followup interview were less extensive. They asked only basic questions about residences other than the sample address. Production most often missed erroneous enumerations in group quarters or other residence situations. Future coverage measurement studies will face the problem of how to ask sufficient questions about such other residences without significantly increasing respondent burden.

6. References

Adams, T. and Krejsa, E. (August 2001), "Independent Review of a Sample of the Person Followup and Evaluation Followup Forms", DSSD Census 2000 Procedures and Operations Memorandum Series, Chapter S-PT-24 and Planning, Research and Evaluation Division TXE/2010 Memorandum Series:CM-MER-S-4

Bean, S. (October 2001), "Matching Error in the Census 2000 Accuracy and Coverage Evaluation", ESCAP II, #7.

Childers, D. (January 2001), "Accuracy and Coverage Evaluation: The Design Document", DSSD Census 2000 Procedures and Operations Memorandum Series, Chapter S-DT-1.

Keeley, C. (1999), "Evaluation of the Integrated Coverage Measurement/Post Enumeration Survey Person Followup Questionnaire", Census 2000 Dress Rehearsal Evaluation Results Memorandum Series, Chapter C6.

Krejsa, E. (2000), "Measurement Error Reinterview Sample Selection", Planning, Research, and Evaluation Division TXE/2010 Memorandum Series: CM-MER-S-01.

Krejsa, E. (May 2001), "Observation of Accuracy and Coverage Evaluation - Evaluation Followup Interview and Office Edit January 22-24, 2001", Planning, Research, and Evaluation Division TXE/2010 Memorandum Series: CM-GEN-T-12.

Krejsa, E. and Raglin, D. (October 2001), "Evaluation Results for Changes in A.C.E. Enumeration Status", ESCAP II, #3.

All Standard Errors in Parentheses

Table 1. Production vs. Measurement Error Reinterview (Evaluation)

Production (PFU1)	Evaluation (EFU1)				Percent of Total
	Correct	Erroneous	Unresolved	Total	
Total Correct Enumerations	247,114,898 (6,503,469)	2,827,414 (223,232)	1,424,770 (254,610)	**251,367,081 (6,566,293)**	**95.8**
Matched	218,343,361 (6,768,798)	1,534,800 (182,422)	1,086,812 (224,742)	**220,964,973 (6,217,824)**	**84.2**
Nonmatched Correct Enumerations	28,771,537 (1,160,932)	1,292,613 (116,974)	337,957 (56,248)	**30,402,108 (1,183,903)**	**11.5**
Erroneous Enumerations	908,385 (99,213)	3,118,191 (202,208)	124,641 (23,343)	**4,151,217 (238,893)**	**1.6**
Unresolved	2,873,110 (399,655)	928,719 (117,386)	3,010,280 (203,994)	**6,812,110 (489,361)**	**2.6**
Total	**250,896,393 (6,581,557)**	**6,874,324 (363,830)**	**4,559,691 (353,112)**	**262,330,408 (6,729,865)**	

Source: E-Sample Evaluation Report on Erroneous Enumerations in the Measurement Error Reinterview," (Krejsa and Raglin, 2001)

Table 2. Production vs. Best Code from the PFU/EFU Review

Production (PFU1)	Best Code from Second Review				
	Correct	Erroneous	Unresolved	Conflicting	Total
Total Correct Enumerations	238,786,314 (6,297,622)	1,816,315 (189,188)	9,151,011 (770,433)	1,613,442(2 31,082)	**251,367,081 (6,452,556)**
Matched	210,222,189 (5,995,657)	1,139,407 (160,901)	8,763,973 (758,243)	563,514 (184,718)	**220,689,083 (6,144,855)**
Nonmatched Correct Enumerations	28,564,125 (1,240,041)	676,908 (96,217)	387,038 (105,973)	1,049,928 (136,905)	**30,677,998 (1,271,329)**
Erroneous	361,400 (46,064)	2,936,887 (199,370)	186,418 (30,064)	666,512 (87,071)	**4,151,217 (237,530)**
Unresolved	2,529,422 (393,331)	664,929 (67,479)	3,303,074 (226,500)	314,685 (45,382)	**6,812,110 (488,029)**
Total	**241,677,134 (6,358,186)**	**5,418,131 (299,065)**	**12,640,503(84 3,845)**	**2,594,639(2 58,383)**	**262,330,408 (6,603,343)**
Percent	92.13	2.07	4.82	0.99	100.00

Table 3. Why Codes for Production Correct Enumerations to Best Erroneous Enumerations

Reason for Erroneous	Number of People	Percent of Reason Total	Overall Percent
Movers	292,950		16.13
Never Lived Here/Address Mixup	112,929		6.22
Other Residence–Interview at First Home	4,711		0.26
Other Residence–Interview at Second Home	*423,066*	*100.00*	*23.29*
Other Home	123,555	29.20	6.80
Joint Custody	73,940	17.48	4.07
Visiting	84,985	20.09	4.68
Other Home for Work	62,352	14.74	3.43
Other Types of Second Residences	78,233	18.49	4.31
Other Residence–Unspecified	103,292		5.69
Group Quarters	*614,451*	*100.00*	*33.83*
Dorm	315,406	51.33	17.37
Nursing Home	152,101	24.75	8.38
Other GQ's	146,945	23.91	8.09
Geocoding	120,530		6.64
Other	144,386		7.95
Total	**1,816,315**		**100.00**

Table 4 – Correct Enumeration Rate for the PFU/EFU Review

	Unresolved Cases Possible Correct Enumeration Probability				
Conflicting Cases Possible Correct Enumeration Probability	**0**	**0.25**	**0.5**	**0.75**	**1**
0	93.37 (0.32)	94.19 (0.26)	95.01 (0.21)	95.83 (0.17)	96.64 (0.16)
0.25	93.62 (0.31)	94.44 (0.25)	95.25 (0.2)	96.07 (0.16)	96.89 (0.14)
0.5	93.86 (0.3)	94.68 (0.24)	95.5 (0.19)	96.32 (0.15)	97.14 (0.13)
0.75	94.11 (0.3)	94.93 (0.24)	95.75 (0.18)	96.57 (0.14)	97.39 (0.12)
1	94.36 (0.3)	95.18 (0.24)	96.0 (0.18)	96.81 (0.14)	97.63 (0.12)