Census 2000 Topic Report No. 10

Census 2000 Testing, Experimentation, and Evaluation Program

Issued March 2004

TR-10

Coverage Improvement in Census 2000 Enumeration

U S C E N S U S B U R E A U

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United States Census 2000

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Foreword

The Census 2000 Testing, Experimentation, and Evaluation Program provides measures of effectiveness for the Census 2000 design, operations, systems, and processes and provides information on the value of new or different methodologies. By providing measures of how well Census 2000 was conducted, this program fully supports the Census Bureau's strategy to integrate the 2010 planning process with ongoing Master Address File/TIGER enhancements and the American Community Survey. The purpose of the report that follows is to integrate findings and provide context and background for interpretation of related Census 2000 evaluations, experiments, and other assessments to make recommendations for planning the 2010 Census. Census 2000 Testing, Experimentation, and Evaluation reports are available on the Census Bureau's Internet site at: *www.census.gov/pred/www/*.

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1. Background

1.1 Introduction

This Coverage Improvement topic report identifies and describes the decennial operations and programs from Census 2000 that substantially influenced census coverage, i.e., they contributed to adding or subtracting persons or housing units to the census count. This report will cover these operations which began about a month before Census Day (April 1, 2000) with the delivery of questionnaires in the Update/Leave (U/L) operation, and continued with subsequent operations such as the Be Counted Campaign and the later followup operations of Nonresponse Followup (NRFU) and Coverage Improvement Followup (CIFU). Drawing from the results of some thirty Census 2000 evaluations, we will summarize the relative contribution of more than fourteen carefully orchestrated operations to decennial census coverage. However, we will not treat the various address listing or address building operations that took place before the actual decennial enumeration; these are discussed in the Address List Development Topic Report.

1.2 Historical perspective of census undercount and coverage improvement

To add depth to the evaluation of decennial coverage improvement, we have included a general background discussion of census undercount. It is only through some basic notion of overall coverage that the reader can assess not only where we are in terms of coverage improvement, but more importantly, where we might want to go in the future.

Censuses before 2000 have all been plagued by chronic undercount, and particularly by differential undercount of specific minority populations and other subgroups such as renters, males, and children. The need to improve census coverage to correct, or at least to reduce the undercount, was first identified by George Washington after the first census in 1790. While he complained that the 1790 census count of 3.9 million was too low, it was considered credible enough for apportionment. From the very first decennial census, local officials complained about undercounting their populations, particularly in the South during the Reconstruction period of the1870s. Under a new census superintendent, former Civil War General Francis Amasa Walker, an era of census innovation and census coverage improvement began. Walker was successful in removing U.S. Marshals, who had many competing interests, from supervising the census field activity. He prompted administrative reform in census procedures to minimize the problems of undercounts, overcounts, and curbstoning[1], and dramatically improved census efficiency and timing (Anderson and Fienberg, 1999, p. 21).

Even though a census undercount was widely believed to exist, it was not until the 1940s that demographers began to gain a much clearer understanding of the scope and nature of the ubiquitous census undercount. When they compared the 1940 census counts of draft age men to the selective service registration of October 1940, two interesting facts surfaced. First, the draft registration revealed some 425,000 more men than the census which yielded an undercount of 2.8 percent for this cohort. In particular, the draft registration of Black men recorded some 229,000 more than the census which yielded an undercount of 13.0 percent for this cohort. Demographers also demonstrated that Black men from urban states registered for the draft in dramatically higher levels than expected (Anderson and Fienberg, 1999, p. 29). Later demographic analysis using more modern methodology confirmed and further defined these findings.

The pervasive nature of decennial undercount has strongly influenced census design, including adding operations or programs specifically designed to improve coverage. Many of these coverage improvement operations/programs have generally been characterized by a strategy of inclusion that tended to "widen the net" to capture more and more of the undercounted populations. As a result, the total undercount over the past several censuses has continued to decline, except for 1990, which was somewhat higher than the 1980 Census. The undercount differential between the total and Black population, however, has not notably changed during this same time period. Table 1 shows

[1] Curbstoning is a census euphemism for fabrication. Enumerators could conceivably sit at the curb and fabricate data instead of properly conducting a personal household interview.

the overall undercount and the Black undercount from 1940 to 2000 as measured by demographic analysis.

In response to the presence of continued undercount, each successive census employed this strategy of inclusion, although each decennial census used a different mix of coverage improvement operations/programs (see Table 3). Since differential undercount has been even more constant than overall undercount, each census included coverage improvement operations specifically targeting undercounted populations. For example, in the 1990 Census, the Census Bureau implemented an operation to target a hard-to-enumerate population in the Parolee/Probationer Coverage Improvement operation. In Census 2000, the Census Bureau targeted another hard-to-enumerate population in the Service-Based Enumeration.

1.3 Census 2000 undercount

In order to minimize the undercount to the extent practicable, many of the operations in Census 2000 were designed to count the American population with some redundancy and overlap built into the enumeration process, including the construction of the address frame. Procedures to unduplicate were also built in where needed. Many respondents had an opportunity to answer the census in several different ways. In addition to the basic mailback response option, many respondents could also respond through other modes including: the Internet, telephone, enumerators, or by completing Be Counted questionnaires which were located at sites such as private businesses, churches, community organizations, Departments of Motor Vehicles, libraries, Post Offices, Questionnaire Assistance Centers, and others (schools or municipal buildings). Even though these operations were designed to reduce overall undercount and improve overall accuracy, the resulting redundancy contributed to counting some respondents more than once. The enumeration process, including these coverage improvement operations along with duplication in the housing unit frame, produced an overall net overcount in Census 2000 of 1.09 percent, or 0.48 percent with a correlation bias adjustment as measured by the Accuracy and Coverage Evaluation (A.C.E.) Revision II (Robinson and Adlakha, 2002). See Table 2. This is the first time we have measured an overall population overcount in the history of the United States Census.

Table 1.
Decennial Census Population Net Undercount Rates From Demographic Analysis: 1940 to 2000

	Year						
	1940	1950	1960	1970	1980	1990	2000
Total	5.4	4.1	3.1	2.7	1.2	1.8	0.1
Black	8.4	7.5	6.6	6.5	4.5	5.7	2.8
Difference: Black - Total	3.0	3.4	3.5	3.2	3.3	3.9	2.7

Table 2.
Percent of Net Undercount for Major Groups in Census 2000 Using A.C.E. Revision II and Demographic Analysis

	A.C.E. w/o correlation bias adjustment	A.C.E. with correlation bias adjustment	Demographic analysis
Total	–1.09	–0.48	0.12
Race: Hispanic Origin Domain			
Non Black	–1.18	–0.80	–0.29
Black	–0.49	1.72	2.78
Hispanic	-	0.71	-
Non Hispanic - Asian	-	–0.75	-
American Indians on Reservations	-	–0.88	-
Tenure Domain			
Owner	-	–1.25	-
Renter	-	1.14	-
Gender			
Male	-0.87	0.37	0.86
Female	-1.30	–1.30	–0.60

A negative net undercount denotes a net overcount.
A dash (-) indicates the data were not available.

2. Coverage Improvement Methods

2.1 Enumeration baseline

During the last four decennial censuses, the basic enumeration approach has been a mailout/mailback methodology with a personal visit to nonrespondents. A paper questionnaire was mailed to respondents who were instructed to complete the form and mail it back to the Census Bureau. In variants of this approach for Census 2000, some questionnaires were delivered to respondents by Census Bureau staff, some were left at post offices or other local sites, or some were sent to respondents by request; all of these were to be completed and mailed back. Nonresponding households were then visited by enumerators who completed the questionnaire for the household or housing unit. The mailback approach was also supplemented by complementary methods such as list/enumerate and update/enumerate, which closely resemble past conventional census methods, and the Internet and telephone response options. Coverage Improvement operations have been added to the basic enumeration approach to optimally improve overall census coverage.

2.2 Coverage improvement methods since 1970

The coverage improvement methods employed by the Census Bureau have changed, or in some cases, have been refined over the past several censuses. Table 3 lists these methods. The number and diversity of these methods indicate the scope and level of commitment to coverage improvement in the decennial censuses over the decades. Many of the methods employed in Census 2000 are modifications and improvements to methods of past censuses while others were new methods developed and tested during the decade after the 1990 Census. While many of the basic coverage improvement methods employed are similar from census to census,

Table 3.
Coverage Improvement Methods in the Decennial Census: 1970 to 2000

Method	Census			
Questionnaire delivery and enumeration	1970	1980	1990	2000
Rural Update/Leave	-	-	x	x
Urban Update/Leave	-	-	x	x
Urban Update/Enumerate	-	-	x	x
Postmaster Return Delivery (UAA* - 2000)	-	-	x	x
Casual Count/Shelter and Street Night (SBE - 2000)	-	x	x	x
Were You Counted? (Be Counted - 2000)	x	x	x	x
Overseas Enumeration (limited)	x	x	x	x
Nonhousehold Sources Program	-	x	-	-
Post Census Day Coverage Improvement				
Telephone Assistance Adds	-	-	x	x
Census Closeout Address Check	-	-	x	-
Vacant/Delete/Movers Check (CIFU - 2000)	x	x	x	x
Recanvass Operation	-	-	x	-
Post Census Local Review	-	x	x	-
Primary Selection Algorithm	-	-	x	x
Parolee/Probationer Program	-	-	x	-
Usual Home Elsewhere	-	x	x	x
Search/Match	-	-	x	-
Imputation	x	x	x	x
Housing Unit Unduplication Operation	-	-	-	x
Coverage Edit Followup	x	x	x	x
Coverage Questions	x	x	x	x
Transient Night (T-Night)	x	x	x	x
Paid Advertising Campaign	-	-	-	x
Promotion and Outreach	x	x	x	x

* UAA - Undeliverable as Addressed

the scope and operational implementation can vary greatly.

2.3 Coverage improvement development in Census 2000

The Coverage Improvement Program for Census 2000 was originally developed in an environment in which coverage measurement, including integrated adjustment, dominated the decennial landscape. The Census Bureau was dedicated to the objective of producing a "one number census," meaning there would be one final published census count which would be statistically adjusted for undercount using the results from the A.C.E. survey. There would not be, as in past censuses, an unadjusted count accompanied by one or more plans to potentially adjust that count. Rather than open the door to the wrangling that accompanied the results of the past two censuses, the Census Bureau had widely publicized the intent up front to statistically adjust the Census 2000 results.

The one number census concept had an influence on overall decennial planning, but particularly on coverage improvement planning since there was always a "safety net" behind the planning. If certain hard-to-enumerate populations were undercounted, the A.C.E. would adjust for such an imperfection. In this environment, the intent was to design a quality census but not emphasize the same level of coverage improvement as would be expected without the safety net. The statistical sampling components of the census design influenced the timing of all the census operations including coverage improvement operations. The coverage improvement operations that were integrated into the one number census design were selected based on their potential impact on coverage and how or whether they fit into the other decennial operations.

In January of 1999, just over a year from Census Day, the Supreme Court ruled that the Census Bureau could not use the A.C.E. to adjust the census count for the purpose of apportionment. The one number or sampling census was thus replaced by a more traditional census. This decision had a dramatic effect on planning for Census 2000. While waiting for the court's decision on adjustment, the Census Bureau had, for a time, been planning a census on a dual track - an adjusted census track and a traditional census track. But it did so without sufficient resources available to adequately plan both tracks simultaneously.

The result of the court's ruling was that late in the census cycle, the Census Bureau had to redesign a decennial census that was composed of an extremely complex array of programs, operations, systems and procedures without the opportunity to thoroughly test all of the ensuing interactions, redundancies, synergies or shortcomings. Coverage improvement programs were expanded. And all of the coverage improvement programs were implemented with the expectation that experience and sound judgement would overcome the fact that we did not have the opportunity to test them together in the dress rehearsal that occurred the year before the court ruling. Thus the 2000 Census was conducted in an environment of increased operational risk.

3. Coverage Improvement Effects

3.1 Adds (deletes) from Census 2000 coverage improvement operations

Table 4 contains a summary of the decennial operations that influenced coverage. The list is composed of the operations identified by an interdivisional team as having a measurable impact on decennial coverage for Census 2000. The reader should keep in mind that this list of operations is subjective and should be interpreted as operations that had an effect on overall census coverage even though they were not all planned as coverage improvement operations.

Most of the operations in Table 4 were directly assessed through a specific evaluation in the Census 2000 Evaluation Program; these studies are found in the reference section. For those not familiar with the myriad of Census 2000 operations, a brief description of these operations, along with additional summary statistics related to coverage, is contained in Section 4. Also included at the end of Section 4 are descriptions of other decennial operations not in Table 4 for which direct measurements of coverage improvement were not available or not known, such as the Partnership and Marketing Program. Common sense would suggest that this program, if only from its magnitude and focus, had an effect, perhaps even a profound effect, on census coverage but no direct measurable effects were available.

3.2 Limitations

3.2.1 An interdivisional team with representatives from the Decennial Statistical Studies Division, the Decennial Management Division, and the Planning, Research and Evaluation Division convened to determine which operations should/should not be included in the definition of "coverage improvement." While the group reached concensus on which operations to include in this report, the selection was difficult. Thus the list of operations in Table 4 is subjective and should be interpreted as operations that had an effect on overall census coverage, even though they were not all planned as coverage improvement operations.

3.2.2 The effect of an operation in terms of adds or deletes is somewhat dependent on the other operations and on its place in the overall sequence of operations, so a clean measure is difficult. In essence, the numbers in Table 4 are not mutually exclusive. Because of the overlapping nature of these operations, it is difficult to measure the total influence of any one operation.

3.2.3 Nonresponse Followup and Coverage Improvement Followup "deletes" are not included in Table 4 because these deletes were not necessarily the 'final' status. The census "two strike" delete rule employed in Census 2000, deleted an address from the census only if two different sources identified the address as a delete.

3.2.4 The Primary Selection Algorithm operation added at least 513,413 persons in two ways:

- When there were two or more forms for a given ID and one of those forms was a partial household Be Counted form or a Group Quarters - Usual Home Elsewhere form, and there were no persons in common between the Be Counted or GQ-UHE form and the other form(s), the persons from the Be Counted form or GQ-UHE form were included at that ID. Some 153,768 persons were added to the census from the Primary Selection Algorithm in this manner (Baumgardner, 2002).
- There were 359,645 cases where the Primary Selection Algorithm considered two forms for an ID where both forms had at least one person in common. The PSA designated one form as the "basic" return and persons from the other return that were not matched to a person on the "basic" return were added to the count for that ID. The exact number of added persons from this source is not available but it is at least 359,645 persons, which can be considered a lower bound of added persons from this source.

3.2.5 The availability of data from the various Census 2000 evaluations from which most of the data for this report were extracted was limited. In some cases, data that would be desirable were not available. While this did not appreciably limit the scope of this report, it did limit the amount of detail.

Table 4.
Adds (Deletes) From Census 2000 Attributed to Various Coverage Improvement Operations

Coverage improvement method	Persons Added (Deleted)	Housing Units Added (Deleted)
Questionnaire Delivery and Enumeration		
Update/Leave (U/L)[1]	NA	1,401,169
Urban Update/Leave (UU/L)[1]	NA	10,455
Update/Enumerate (U/E)[1]	NA	122,735
Service-Based Enumeration (SBE)	[2]283,898	-
Be Counted Campaign	560,880	[3]236,482
Telephone Questionnaire Assistance (TQA)	NA	209,861
Post Census Day Coverage Improvement		
Nonresponse Followup (NRFU) Adds	662,284	[4]348,584
NRFU - WHUHE Probe[5]	29,302	-
Coverage Edit Followup (CEFU)	[6](105,199)	NA
Coverage Improvement Followup (CIFU)[7]		
Vacants (converted to Occupied)	1,693,958	842,059
Deletes (converted to Occupied or Vacant)	1,375,116	1,091,694
New Construction Adds	244,759	175,009
Feb & Apr Delivery Sequence File Adds	398,673	227,028
CIFU Adds	191,478	[8]103,592
T-Night Enumeration	127,766	[9]87,338
Primary Selection Algorithm (PSA)	[10]513,413	-
Housing Unit Unduplication	(3,572,799)	(1,371,320)
Coverage Questions C1 and C2	[11](6,110)	NA

The number of housing units and persons in this table are not mutually exclusive.
The number of added/deleted persons and housing units in this table do not include Puerto Rico.
NA indicates the data were "not available" and a dash (-) indicates "does not apply."

[1] The housing unit adds for these operations represent the number of adds that were counted in the Census.

[2] This is a count of persons enumerated at shelters, soup kitchens, regularly scheduled mobile food vans and targeted non-sheltered outdoor locations. The SBE operation was not designed and was never intended to be a complete count of the homeless population nor those who used services in 2000. This number includes 35,121 persons with no usual residence who were enumerated on a Be Counted form.

[3] These households contained persons who were enumerated from the Be Counted form; 116,019 were enumerated by the Be Counted form only; the remaining 120,463 households were enumerated by a Be Counted form and other census forms.

[4] These housing units were added to the address list during the NRFU operation. These data were taken from the LCO Profile for Census 2000 (H.9) - Tables B, C and H; these NRFU adds were identified by the source of return variable (RSOURCE) on the DRF2.

[5] NRFU - WHUHE: Nonresponse Followup - Whole Household Usual Home Elsewhere

[6] The CEFU operation added 152,683 persons and deleted 257,882 for a net loss of 105,199 persons.

[7] The CIFU was a catch-all operation; in addition to verifying the NRFU vacants and deletes, it was used as a field verification for the New Construction adds and a final attempt to enumerate the nonresponding addresses from other operations not processed in time to be included in NRFU.

[8] These housing units were added to the address list during the CIFU operation. These data were taken from the LCO Profile for Census 2000 (H.9) - Tables B, C and H; these CIFU adds were identified by the source of return variable (RSOURCE) on the DRF2

[9] It was necessary to impute the housing unit status (occupied, vacant or delete) of approximately 63 percent of these T-Night units. Thus the population count for these units was also imputed.

[10] This number is a lower bound on the persons added through the PSA; it includes 153,768 persons from Be Counted partial households that are also included in the Be Counted Campaign persons added. See Section 4.13 for additional details.

[11] The coverage questions, C1and C2, added 77,050 persons and deleted 83,160 persons, respectively, for a net loss of 6,110

4. Coverage Improvement Operations

This section contains a brief description of the operations shown in Table 4 including some summary statistics related to coverage. Listed after these operations are several additional operations that are related to coverage improvement for which we have no direct measurement of added or deleted housing units or persons.

4.1 Update/Leave operation

For Census 2000 the country was divided into nine types of enumeration areas, determined by address types and special enumeration procedures. The primary enumeration methodology was Mailout/Mailback which was used in areas that have predominately city-style addresses such as 121 Main Street. The second largest enumeration methodology, in terms of number of housing units, was Update/Leave. Update/Leave was intended for use in areas where some addresses were not city-style. Non-city style addresses such as Rural Route and Box or Post Office Box are often not linked to the physical location of the housing unit. Where there is only a location description for a unit but no address, mail delivery of the questionnaire is not a possibility. In Puerto Rico, update/leave was the sole enumeration method used.

In the Census 2000 Update/Leave operation, questionnaires with preprinted address labels were hand-delivered to every housing unit on the address list. Existing housing units that were not listed on the address register were given a hand-addressed questionnaire. During this delivery, field staff would update (corrections, deletions, additions) the address register. Questionnaire delivery began on March 3, 2000 with the intent that all questionnaires would be delivered by Census Day, April 1, but the operation was not complete in some areas until April 6, 2000.

There was a total of 24,996,482 addresses in the Update/Leave workload, including Puerto Rico. Approximately 23.2 million addresses were on the listing pages for the operation and more than 1.7 million were added to the listing pages during the Update/Leave operation. Stateside, the Update/Leave operation added 1,644,174 addresses and 1,401,169 of these were in the Census; Puerto Rico added 111,787 addresses during Update/Leave and 93,607 were in the Census. Nonrespondents in added housing units were visited by enumerators in the Coverage Improvement Followup operation (Pennington, 2003).

4.2 Urban Update/Leave operation

Mailout/Mailback was the enumeration methodology for most areas that had mail delivery to city-style addresses (i.e., addresses with a house number and street name). The Urban Update/Leave operation in Census 2000 targeted areas deemed unsuitable for Mailout/Mailback. These unsuitable units were primarily in (1) multi-unit buildings where the United States Postal Service (USPS) delivers the mail to a drop point instead of individual unit designations and (2) urban communities that had city-style addresses but whose residents picked up their mail at a post office box. The Urban Update/Leave operation relied on the Census Bureau's Regional Census Centers to identify these areas based on their knowledge of whether the USPS could adequately deliver the census questionnaires. Individual regions had the choice of whether or not to participate; eight of the twelve Regional Census Centers participated in the Urban Update/Leave operation.

The objective of the Census 2000 Urban Update/Leave operation was to improve coverage in the following ways: improve the deliverability of the questionnaires and update address information and census maps. The Census Bureau conducted the Urban Update/Leave operation from March 3 to March 31, 2000. In Urban Update/Leave areas, enumerators delivered the census questionnaires and updated their address registers and census maps concurrently. Residents were asked to complete and mail their questionnaires. Housing units for which the Census Bureau did not receive a completed questionnaire on or before April 18, 2000 were visited and enumerated during Nonresponse Followup.

The Urban Update/Leave workload consisted of 280,136 housing units - 267,005 addresses were printed on the address registers and 13,131 addresses were added

to the registers during questionnaire delivery. Of these added addresses, 10,455 were in the census. Ultimately 238,216 Urban Update/Leave addresses were enumerated in the census as either occupied (85.1 percent) or vacant (14.9 percent) housing units; 511,195 persons were enumerated. The Urban Update/Leave operation enumerated a higher percentage than the overall self-enumerated of the following typically undercounted groups: renters, persons under 18 years old and African Americans (Rosenthal, 2002a).

4.3 Update/Enumerate operation

In Census 2000, the Update/Enumerate operation primarily targeted communities with special enumeration needs and areas where most housing units may not have had house number and street name mailing addresses. These areas included resort areas with high concentrations of seasonally vacant housing units, selected American Indian reservations and colonias. (Colonias are Hispanic-occupied unincorporated communities near the Mexican border.)

Update/Enumerate was similar to Update/Leave except the interviewers enumerated the housing unit (both occupied and vacant) at the time of their visit rather than leaving a questionnaire to be completed by a resident and mailed to a data capture center. In both operations, the enumerator updated the address registers and census maps. The operation was conducted from March 13 to June 5, 2000.

There were 1,056,553 housing units in the Update/Enumerate workload - 926,861 addresses were printed on the address registers and 129,692 addresses were added during field enumeration. Of these added addresses, 122,735 were in the Census. Ultimately 956,214 Update/Enumerate addresses were enumerated in the census as either occupied (61.3 percent) or vacant (38.7 percent) housing units; the majority of the vacants (more than 78 percent) were seasonal vacants. There were 1,727,361 persons enumerated during the Update/Enumerate operation. The average household size in Update/Enumerate was 2.9 persons compared to 2.6 persons nationally. The Update/Enumerate operation enumerated a greater percentage of persons under 18 years old, Hispanics and American Indian/Alaska Natives. The Hispanics and American Indian/Alaska Natives were traditionally undercounted groups that the Census Bureau enumerated by targeting colonias and selected American Indian reservations (Rosenthal, 2002b).

4.4 Service-Based Enumeration

The goal of Service-Based Enumeration was to provide people without conventional housing an opportunity to be included in the census. Census 2000 included the following Service-Based Enumeration sites: emergency and transitional shelters for people without conventional housing; shelters for abused women and their children; shelters for children who were runaways, neglected, or without conventional housing; hotels, motels or other facilities that provided shelter services to people without conventional housing; soup kitchens; regularly scheduled mobile food vans; and targeted non-sheltered outdoor locations. In Census 2000, we visited Service-Based Enumeration locations several weeks before the enumeration. During the advance visit, we collected information such as how many people were expected to be housed at each shelter, how many meals were served, which meal served the most people at each soup kitchen and how many people received services at each regularly scheduled mobile food van site.

The Census 2000 Service-Based Enumeration operation occurred March 27 - 29, 2000. An Individual Census Report or Individual Census Questionnaire was used to enumerate every person, including children. Every sixth person received a long form questionnaire at the shelters and the soup kitchens; long-form questionnaires were not completed at the regularly scheduled mobile food vans and the targeted non-sheltered outdoor locations.

- March 27 we enumerated people at shelters.
- March 28 we enumerated people at soup kitchens.
- The evening of March 28 we enumerated people at regularly scheduled mobile food vans.
- March 29 we enumerated people at targeted non-sheltered outdoor locations.

In addition, people on Be Counted forms who marked the box "No address on April 1, 2000" or indicated they were homeless in the address section of the form were also included in the Service-Based Enumeration universe. It is important to understand that the results from the Service-Based Enumeration operation do not provide a count of the population experiencing homelessness. Nor do these results provide a count of the population who used services in 2000.

There were 258,728 person records data captured from shelters, soup kitchens, regularly scheduled mobile food vans, and targeted non-sheltered outdoor locations. There were 35,121 people added to the SBE population as a result of the Be Counted Campaign. A total of 283,898 people were counted in the Census 2000 as a result of the Service-Based Enumeration operation (McNally, 2002).

Of the 170,706 people tabulated in emergency and transitional shelters in Census 2000 (see Smith and Smith, 2001), approximately 61.4 percent of this population were male, 74.3 percent were people 18 years and over, approximately 40.4 percent were Black or African American, and 19.9 percent were Hispanic or Latino (of any race). Demographics are not available for the persons in the remaining shelters, soup kitchens, mobile food vans, and non-sheltered outdoor locations enumerated by this operation.

4.5 Be Counted campaign

During the 1970, 1980 and 1990 Censuses, the Census Bureau implemented a post-Nonresponse Followup (NRFU) campaign called "Were You Counted?" Anyone believing they were not counted could complete and return a "Were You Counted?" form. These forms were printed in local newspapers and other media. This campaign did not start until most census field enumeration activities were completed. The Be Counted Campaign for Census 2000 was similar to the "Were You Counted?" campaign but the start and finish dates coincided with Census Day (April 1) and the start of NRFU, respectively. The four goals for the Be Counted Campaign of Census 2000 were:

- to count persons who did not receive a census questionnaire
- to count persons who believed they were not included on any other census form
- to encourage participation of persons who are traditionally undercounted in the census
- to provide a means for persons with no usual residence to be counted

The Census 2000 Be Counted form contained census short form data questions. Since the Be Counted forms were not intended to replace the basic mailout/mailback census questionnaire, they were made available to the public in targeted locations in hard-to-enumerate areas only. The Be Counted forms were available in targeted locations on March 31, 2000 and were removed from the sites on April 17, 2000. There were 51,692 Be Counted distribution sites located throughout communities; these sites included private businesses, churches, community organizations, Departments of Motor Vehicles, libraries, Post Offices, Questionnaire Assistance Centers, and others (schools or municipal buildings). The Be Counted forms were available in English, Spanish, Chinese, Korean, Tagalog, and Vietnamese. Approximately 1.7 million forms were picked-up by respondents from the distribution sites.

Respondents returned 804,939 Be Counted forms to the Census Bureau; 239,128 Be Counted forms added persons to the census that were not included on other census forms. This number excludes the Be Counted forms sent to other operations such as the SBE and the Special Place/Group Quarters enumeration. There were 236,482 households that contained some persons who were enumerated from the Be Counted form. Of these households, 116,019 were enumerated *only* by the Be Counted form and the remaining 120,463 were enumerated by the Be Counted forms as well as other census forms. There were 560,880 persons enumerated on these Be Counted forms (Carter, 2002). The Be Counted campaign disproportionately increased coverage in groups that have been traditionally hard to count such as renters, children and minority groups. The Be Counted forms that were received for persons with no usual residence were counted in the Service-Based Enumeration population (see McNally, 2002). These Be Counted forms added 35,121 persons to the SBE population.

Partial household Be Counted forms along with GQ-UHE forms added 153,768 persons during the final step of the Primary Selection Algorithm. These forms were matched to other forms, such as mailback forms, for that ID (address) and the match showed there were no persons in common between the forms. Since the Be Counted forms were identified as partial household forms, the persons on them were added to the count for that ID. Likewise, persons on these GQ-UHE forms were also added to the count for the ID (Baumgardner, 2002).

4.6 Telephone Questionnaire Assistance

The Telephone Questionnaire Assistance (TQA) was a program implemented to assist the public in completing their census forms. The TQA provided the following services:

- Answered questions about the census and the census questionnaires

- Allowed respondents to request a census form or language guide by mail
- Allowed callers, who met certain criteria, to respond to the census through Telephone Questionnaire Assistance

The Telephone Questionnaire Assistance network was available to the public through language specific toll-free numbers from March 3 through June 30, 2000. The English and Spanish toll-free numbers connected to an Interactive Voice Response system that allowed callers to enter and obtain information through a series of menu options using either the telephone keypad (touch tone) or for English speaking callers, voice response. The objective of the system was to provide users with information without being transferred to an agent. A caller was transferred to an agent/operator if the caller gave two invalid responses to a menu option, selected a menu option that automatically transferred the caller, or chose to speak to an agent. Callers could access the Interactive Voice Response portion of the network 24 hours a day, 7 days a week. Telephone Questionnaire Assistance agents were available 7 days a week from 8:00 a.m. to 9:00 p.m. for each of the nation's nine time zones. The Asian language toll-free numbers connected directly to bi-lingual agents; the Asian languages supported were Chinese, Korean, Vietnamese and Tagalog.

Based on the 1990 Census call volume and allowing for growth, the Census 2000 Telephone Questionnaire Assistance program built a system to accommodate a call volume of eleven million calls. The Census Bureau received approximately six million calls and approximately 51 percent of these were serviced by an agent. There were 209,861 short form interview calls that were included in the Census enumeration (Chesnut, 2003).

4.7 Nonresponse Followup

The objective of Nonresponse Followup for Census 2000 was to obtain completed questionnaires from households in the mailback areas that did not respond by mail, through the Internet, or a Telephone Questionnaire Assistance operator. If a questionnaire was not checked-in before the universe selection process began, the housing unit was targeted for Nonresponse Followup. There were 119,090,016 housing units (including Puerto Rico) potentially eligible for followup. The initial Nonresponse workload of 44,928,883 housing units was identified on a flow basis and distributed to the local census offices. A Late Mail Return operation subsequently identified 2,555,918 housing units that were checked in after the initial universe was identified. A list of these IDs was sent to the local offices where clerks manually removed them from the address registers. The resulting workload, including Puerto Rico, was 42,372,965 or 35.6 percent of the eligible universe. The Nonresponse Followup operation was scheduled to occur from April 27 through July 7, 2000. The actual start and finish dates were April 27 and June 26, 2000, respectively; the operation finished 10 days ahead of schedule.

During NRFU, enumerators visited each non-responding unit to determine its occupancy status as of Census Day. The Census Day status was one of three possible conditions: occupied, vacant or nonexistent (delete). Based on status, enumerators completed the applicable items on the appropriate (short or long form) questionnaire. After the required number of six attempts, if an enumerator could not contact a household member at the followup address by either personal visit or phone, the enumerator attempted to obtain Census Day status of the address from a knowledgeable non-household (proxy) respondent. There were 42.4 million housing units and 80.7 million people enumerated in Nonresponse Followup. Nonresponse Followup enumerated a higher percentage than were self-enumerated of males, young people (34 years old or younger), Hispanics, and people of all races except Whites (Moul, 2002).

During the enumeration phase, if enumerators came across any units that were not on their address listing, they had the ability to add the housing units. There were 348,584 housing units added by the NRFU operation stateside; 276,485 had a final status of occupied and 72,099 had a final status of vacant. The associated population count was 662,284 persons. These "NRFU Adds" were obtained from the Local Census Office Profile for Census 2000 (H.9) - Tables B, C and H (Imel, 2003) - and are consistent with data in the topic report Response Rates and Behavior Analysis (Treat, 2003). These adds were identified by the source of return variable (RSOURCE) on the Decennial Response File - Stage 2.

4.8 Nonresponse Followup - Whole Household Usual Home Elsewhere probe

The Whole Household Usual Home Elsewhere (WHUHE) probe is a questionnaire coverage improvement operation used to determine if all members of a household had

Table 5.
Coverage Edit Workload of Eligible Cases by Edit Failure Type

Type of edit failure	Number	Percent
Total	2,544,072	100.0
Large household	1,395,623	54.9
Count discrepancy	1,148,449	45.1

another residence (on Census Day) where they lived most of the time. The WHUHE probe was added to the Census 2000 design as a possible way to improve the coverage of persons with multiple addresses. This probe was accomplished by asking a set of screening questions from the enumerator questionnaire. During Nonresponse Followup and Coverage Improvement Followup, and as part of the List/Enumerate and Update/Enumerate operations, respondents were asked whether or not the address was a seasonal or vacation home. If it was a seasonal or vacation home, the enumerator reported the unit as "vacant-usual home elsewhere" on the back of the labeled enumerator questionnaire and completed a blank unlabeled questionnaire for the "usual residence" or Census Day address. If all household members had another residence where they lived most of the time, the enumerators collected census data for all household members for their "usual residence" or Census Day address.

There were 113,807 questionnaires completed by census enumerators for the point-of-contact address that should have generated a WHUHE return; approximately 80.0 percent of these were from Nonresponse Followup. There were 110,902 WHUHE addresses enumerated and 113,991 data defined persons on the occupied WHUHE returns. Approximately 66.0 percent of these data defined persons were found on other forms. A total of 29,302 persons enumerated on WHUHE returns were counted in the Census and would not have been counted otherwise (Viator and Alberti, 2003).

4.9 Coverage Edit Followup

The Coverage Edit Followup for Census 2000 was a telephone operation used to improve within household coverage and improve data quality in two ways. First, it was used to collect person data for all persons beyond the first six in large households. (There was space to enumerate only six people on the mailback Census form.) Second, it resolved count discrepancies between the reported household population count and the actual number of data defined persons recorded on the census form.

Calls were made 7 days a week from 8 a.m. to 10 p.m. local time. A maximum number of twelve calls, made at different times and on different days of the week, were made to each case. Six of the twelve calls had to be made on the weekend. Nine coverage probe questions were asked of each respondent. The main reason for cases not being completed was the Census Bureau's inability to get valid telephone numbers. There was no field visit or enumerator followup for the approximately 885,000 Coverage Edit cases that were not resolved over the telephone. The actual start and finish dates for the operation were May 8 and August 13, 2000, respectively.

There were 2,599,484 total cases selected for CEFU from the Census 2000 mailback and Internet forms. Enumerator forms (used for NRFU, CIFU, and U/E) were not eligible for CEFU since these questionnaires contained coverage questions designed to ensure the household roster was correct, allowed enumerators to collect data for large households on continuation forms, and count discrepancies were resolved by field staff before the forms were checked-in.

Of the cases selected for CEFU, 2,544,072 eligible cases and almost 97 percent of these were distributed to the thirteen call centers for interviewing. We see in Table 5 that large household cases accounted for approximately 55 percent of the CEFU cases and count discrepancy cases made up the remaining 45 percent.

There were 152,683 persons added to household rosters and 257,882 persons removed (deleted or removed as duplicates) through CEFU Thus, there was a net coverage loss of 105,199 people. The approximately 153 thousand persons added were disproportionately children and minorities; the almost 258 thousand deleted persons were primarily college students and persons at second/vacation homes (Sheppard, 2003).

4.10 Coverage Improvement Followup

Coverage Improvement Followup was an operation developed for Census 2000 that followed Nonresponse Followup; it was designed to improve coverage of housing units in the mailback areas. The majority of the workload consisted of units classified as vacant or delete in Nonresponse Followup, excluding units that were identified as vacant or delete by two census operations, NRFU

vacant units identified as seasonal vacants, and NRFU vacant/delete units also identified as "undeliverable as addressed." Additional components of the Coverage Improvement Followup workload included:

- Adds from the New Construction Program[2]
- Nonrespondents from the Update/Leave and Urban Update/Leave Adds
- Blank Mail Returns not identified during NRFU
- Lost Mail Returns[3]
- Nonrespondents from the Response Mode and Incentive Experiment (RMIE)
- February and April 2000 Delivery Sequence File (DSF) Adds
- Local Update of Census Addresses (LUCA) 1998 and 1999 Appeals
- Hialeah, Florida Nonresponse Followup units
- Miscellaneous units such as POP99s (units identified as occupied during Nonresponse Followup that had no population count) and Residual Nonresponse Followup units

The Coverage Improvement Followup operation was conducted in three waves as groups of local census offices completed Nonresponse Followup. The operation officially began on June 26, 2000 and ended on August 23, 2000. The CIFU operation contacted 8.9 million housing units and enumerated 5.3 million people.

Table 6, which includes Puerto Rico, shows that Coverage Improvement followed-up 3.9 million vacant units and 2.6 million units targeted for deletion. Approximately 21.9 percent of the vacants were converted to occupied and 24.6 percent of the deletes were converted to occupied. These converted units resulted in a gain of 3.1 million people. Approximately 18.1 percent of the deletes were converted to vacant; the followup of deleted units resulted in the addition of 1.1 million housing units to Census 2000. Also, in Table 6, we see that more than 88 percent of the lost mail returns and approximately 81.2 percent of the blank mail returns yielded valid (occupied or vacant) housing units. The housing unit/person adds for vacant, deleted, new construction, DSF and 'other components' shown in Table 4 do not include Puerto Rico.

Like Nonresponse Followup, Coverage Improvement Followup enumerated a higher percentage than the self-enumerated of the groups that are typically undercounted, such as males, young people (34 years old and younger), Hispanics, and Blacks and Some Other Race. Table 7 shows the distribution of Hispanic origin and

[2] The Census Bureau offered local officials in the mailout/mailback areas only the opportunity to provide residential addresses for new construction. These updates represented new construction adds between the completion of LUCA review and April 1, 2000. They were added to the DMAF with a provisional add status and CIFU acted as the field verification for these units.

[3] When mail return questionnaires were returned to the data capture center, a check-in file was created. As forms successfully passed through the data capture system, data capture files were created. The check-in and data capture files were compared at the end of mail return data capture, and any questionnaires corresponding to housing units that were on the check-in file without a data capture record were considered lost. The housing units associated with the lost forms became part of the CIFU universe.

Table 6.
Coverage Improvement Followup Housing Unit Status by Source

Source	Total		CIFU final housing unit status					
			Occupied		Vacant		Delete	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	8,854,304	100.0	2,375,668	26.8	3,846,067	43.4	2,632,027	29.7
Vacant	3,927,175	100.0	859,953	21.9	2,687,466	68.4	379,471	9.7
Delete	2,606,520	100.0	642,480	24.6	471,785	18.1	1,492,054	57.2
New Construction	371,812	100.0	100,668	27.1	74,341	20.0	196,792	52.9
U/L & UU/L Adds	775,055	100.0	350,137	45.2	295,924	38.2	128,982	16.6
Lost Mail Returns	65,281	100.0	50,555	77.4	7,187	11.0	7,535	11.5
Blank Mail Returns	475,194	100.0	140,597	29.6	245,079	51.6	89,500	18.8
RMIE Nonrespondents	5,285	100.0	2,985	56.5	1,418	26.8	880	16.7
Feb & Apr DSF Adds	547,383	100.0	174,589	31.9	52,439	9.6	320,347	58.5
LUCA 98 & 99 Appeals	17,178	100.0	5,292	30.8	962	5.6	10,924	63.6
Hialeah	61,547	100.0	47,335	76.9	8,947	14.5	5,264	8.6
Miscellaneous	1,874	100.0	1,077	57.5	519	27.7	278	14.8

Note: The columns do not sum to the total column because the table does not include the 542 housing units that had a final status of undetermined at the end of the CIFU operation.
* The numbers in this table include Puerto Rico.

Table 7.
Hispanic Origin and Race Characteristics of the CIFU, NRFU, and Self-Enumerated Households

	CIFU-enumerated		NRFU-enumerated		Self-enumerated	
	Number	Percent	Number	Percent	Number	Percent
Hispanic Origin						
Not Hispanic	4,349,153	82.5	66,187,643	82.0	166,950,304	88.3
Hispanic	921,454	17.5	14,547,485	18.0	22,172,351	11.7
Race Characteristics						
White	3,744,171	71.0	54,248,751	67.2	151,560,251	80.1
Black	895,754	17.0	14,573,315	18.1	18,828,965	10.0
American Indian / Alaskan Native	50,123	1.0	970,025	1.2	2,017,678	1.1
Asian	175,744	3.3	3,515,009	4.4	7,129,558	3.8
Native Hawaiian / Other Pacific Islander	12,645	0.2	267,640	0.3	311,233	0.2
Some Other Race	392,170	7.4	7,160,388	8.9	9,274,970	4.9
Total People Enumerated	5,270,607	100.0	80,735,128	100.0	189,122,655	100.0

Race for the self-enumerated persons and those enumerated in CIFU and NRFU. For more information on the Coverage Improvement Followup demographics, see Moul 2003.

During the enumeration phase, if enumerators came across any units that were not on their address listing, they had the ability to add the housing units. There were 103,592 housing units added by the CIFU operation stateside; 75,965 had a final status of occupied and 27,627 had a final status of vacant. The associated population count was 191,478 persons. These "CIFU Adds" were obtained from the Local Census Office Profile for Census 2000 (H.9) - Tables B, C and H (Imel, 2003) - and are consistent with the data shown in the topic report Response Rates and Behavior Analysis (Treat, 2003). These adds were identified by the source of return variable (RSOURCE) on the Decennial Response File - Stage 2.

4.11 Transient Night (T-Night) enumeration

Locations such as recreational vehicle (RV) parks, campgrounds, marinas, racetracks, fairs and carnivals were known as transient locations since persons living or staying there on Census Day were not likely to be at that location year-round. Persons at these locations were enumerated during the T-Night operation if they indicated they had no other usual home. At RV parks, marinas and campgrounds the object was to enumerate persons who primarily lived in RVs and houseboats or other mobile or temporary housing. At racetracks, fairs and carnivals the population being enumerated was the resident workforce.

Housing unit questionnaires were used to enumerate these people. Enumerators were instructed to write a two-digit code in a box on the housing unit questionnaire to identify it as a questionnaire from a T-Night location. A total of 87,338 housing unit records were identified as T-Night records. It was necessary to impute the housing unit status (occupied, vacant, or delete) of more than half of the T-Night housing units the Census Bureau was able to identify. The timing of the Decennial Master Address File update prevented the data captured records for 54,992 T-night housing units from being included in the Decennial Response File (DRF). Because these housing units were not on the DRF, census data were imputed for these records.

The T-Night population was 127,766 persons. Approximately 63 percent of these persons were enumerated in five Sun Belt states: California, Nevada, Arizona, Texas, and Florida; approximately 15 percent were counted in the Northwest - both Pacific and Rocky Mountain Northwest, including Alaska (Jonas, 2002).

4.12 Primary Selection Algorithm

There were several ways in which to respond to Census 2000, including mailing back a questionnaire, completing the form on the Internet, using a Be Counted form, and being enumerated by field operations such as Nonresponse Followup and Coverage Improvement Followup. While these methods, and others, of collecting population data were implemented with the desire of obtaining a more accurate census count, the various methods also presented the possibility of receiving multiple responses for a single census ID (address). The Primary Selection Algorithm (PSA) was the computer program designed to resolve the

receipt of multiple responses from housing units. Major features of the Census 2000 PSA design included performing person matching between returns, constructing PSA households, selecting the primary PSA household and selecting additional persons for the census household that were not in the primary PSA household.

All PSA households had a return that was designated as the basic return. The basic return was selected by sequentially applying a set of criteria to all the returns that make up the PSA household until one return was selected. The criteria were different depending on whether the PSA household was occupied or vacant.

Most Census IDs (90.5 percent) had one return. Less than 10 percent of all Census IDs were enumerated by more than one return; most of these were enumerated by only two returns (see Table 8). Two-return Census IDs were most often formed by two enumerator returns (such as Nonresponse Followup and Coverage Improvement Followup) or one mail return combined with one enumerator return (Baumgardner, 2002).

The Primary Selection Algorithm was originally created to select one return - from multiple returns - to represent an ID/address in the census. In Census 2000, however, the Primary Selection Algorithm was designed to consider all returns and, among other things, to perform person matching between multiple returns and select additional persons for a census household that were not already in the primary PSA household. As a result, the PSA added at least 513,413 persons and it did so in two situations.

Table 8.
Number of Returns Per Census ID

Number of returns	Total	
	Number	Percent
One return	107,305,027	90.54
Two returns	10,740,311	9.06
Three or more returns	473,635	0.4
Total	118,518,973	100.0

First, when there were two or more forms for an ID and one of those forms was a partial household Be Counted Form (meaning the respondent indicated that the form was not intended to included everyone at that address) or a GQ-UHE form, and there were no persons in common among the forms, all persons on the Be Counted form or GQ-UHE form were included at that ID. There were 153,768 persons added to the census at 104,346 IDs.

Second, there were 359,645 cases where the Primary Selection Algorithm considered two forms for an ID where one form was the "basic" form and the second form had persons in common with the "basic" form (but was not completely redundant). Thus the second form added at least one additional person to the count for that ID. The exact number of added persons from this source is not available but is at least 359,645 persons; this can be considered a lower bound of added persons for this situation.

Although the PSA added approximately 350,400 persons in 1990 and 513,413 persons in 2000, it has the potential to add many more in the future. In 1990 when we received multiple forms for a given ID, we selected one of the forms to represent that ID in the census. We did not conduct matching across forms to construct a household as the PSA did in 2000. The 1990 PSA, however, conducted a search related to the non-selected forms to determine whether the non-selected persons were counted in the census. They were added to the census if they were not already counted. In the analogous situation in 2000, when two forms for a given ID did not have anyone in common, we discarded one of the forms without additional searching outside of the ID. This is probably because we had already conducted person matching and felt the non-selected form resulted from a postal delivery error and the persons on the non-selected form were either already counted in the census or else another household was counted as a surrogate. There were approximately 1.1 million of these cases in Census 2000. Recommendation Section 6.6 discusses this issue further as it relates to future censuses.

4.13 Housing Unit Unduplication operation

The Census Bureau's ability to match names in Census 2000 had a dramatic effect in identifying and eliminating duplicate housing units and duplicate persons. Advances in data capture technology allowed the capture of respondents' names and the subsequent matching of these names to assist in identifying duplicate housing units. More importantly, the capability to improve on this ability to unduplicate creates the potential to make

substantial reductions in erroneous enumerations in future censuses.

Census 2000 contained some duplication of housing units because of the address building process. The Master Address File (MAF) development process for Census 2000 was considerably different from the process used in the 1990 Census. A major impetus for this change was the undercounts experienced in the 1990 and earlier decennial censuses, nearly a third of which was attributed to entirely missed housing units. Among the responses to this persistent pattern of decennial census undercounts was a Congressionally-sponsored initiative called the Census Address List Development Act of 1994, Public Law 103-430. This act required the U.S. Postal Service to provide, and the Census Bureau to use, the U.S. Postal Service's Delivery Sequence File along with address information from local and tribal governments to build the Census 2000 address list. The Census Bureau also implemented several field operations that canvassed the ground for the purpose of creating an address list (in list/enumerate and update/leave areas) and updating the address list (in mailout/ mailback areas). Other field operations were designed to verify the existence of specific housing units. Thus, the Census Bureau devised a strategy of redundancy using a variety of sources for addresses to overcome the historic undercoverage in the address list for its decennial censuses. Their redundant address list building efforts are believed to have resulted in very complete coverage of the housing unit inventory of the nation. Using multiple sources of addresses is important because prior census experience showed that each contributes unique information to the process. Given that the Census 2000 address list development process was susceptible to including duplicate housing units, it was decided that a process needed to be implemented to identify and remove duplicate housing units that still remained on the decennial file after all data collection activities had been completed. Hence, the Housing Unit Unduplication Operation was developed as an ad hoc interdivisional effort.

Phase 1 of the program consisted of identifying potential duplicates by performing both address-level and person-level matching. A small number of duplicates was also identified during the misallocation/block split operations. Phase 1 activities yielded 2,645,387 matched pairs of potential address duplicates. For each cluster of matched MAF IDs, one MAF ID was retained in the Census, while the remaining MAF IDs (2,411,743 of them) were flagged for potential deletion. These flagged cases were temporarily disregarded from further census processing until their final housing unit status was determined.

Phase 2 of the program identified which of the 2.4 million MAF IDs flagged for potential deletion would be reinstated and thus included in the final census counts. The MAF IDs were reinstated if they were not likely to represent duplicate housing units but reflected other situations such as mover households or instances of questionnaire misdelivery. After substantial research, rules were developed to classify MAF IDs or housing units as either reinstated or deleted (and removed from the final census counts). Because of the need for complete coverage, the determination to delete an address was based on conservative rules. That is, it favored retaining units unless there was a high probability of matching (Nash, 2000a and 2000b).

The results from applying the rules was to reinstate 1,019,057 (42.0 percent) MAF IDs/housing units and to delete 1,392,686 (58.0 percent) housing units or 3,643,970 duplicate person records. Stateside the Census Bureau reinstated 1,002,951 MAF IDs/housing units and deleted 1,371,320 housing units or 3,572,799 duplicate person records (Treat, 2002). Although there was room for error in the final determination to reinstate or delete a potential duplicate, overall the Unduplication Operation vastly improved enumeration accuracy.

4.14 Coverage gains from coverage questions C1 and C2 on enumerator-completed questionnaires for Census 2000

Census 2000 coverage improvement operations were intended to improve the coverage of groups usually under-represented in the Census. In the 1990 Census, enumerators began their interview with an explanation of who should be included as residents of the household. This procedure was changed for Census 2000 to facilitate an easier interview. Enumerators now began by asking how many people were living or staying in the housing unit on Census Day. After collecting the appropriate person and housing unit information, the enumerator asked two coverage questions which were designed to get an accurate enumeration of all housing units. The first question (C1) asked if the enumerator missed anyone who should have been counted at the respondent's housing unit. The second question (C2)

asked if anyone listed on the form should have been counted elsewhere.

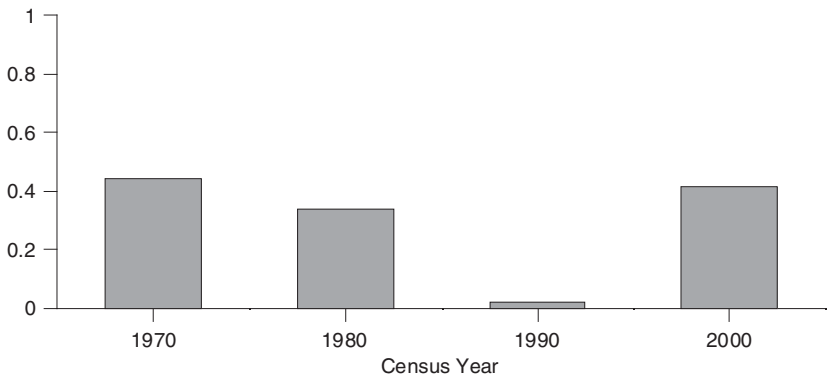
There was a total of 46.9 million enumerator returns and 311,286 of these returns had question C1 marked "yes" and 204,688 had question C2 marked "yes." Only 21.8 percent of the returns that had "yes" marked for C1 also had the "add" box marked; approximately 43.4 percent of the returns that had "yes" marked for C2 also had the "cancel" box marked. Without the "add" or "cancel" boxes marked, we could not tell which people to add or delete. This lack of information makes it difficult to get an accurate account of the people who were missed or included in error. Therefore, the following numbers should be considered lower bounds of people added or deleted as a result of these coverage questions.

Based on the returns with the coverage question (C1 or C2) marked "yes" and the corresponding "add" or "cancel" box marked, we added 77,050 people and deleted 83,160; the net result for these cases was the deletion of 6,110 people. Among the people recorded as adds, we showed higher percentages than the self-enumerated in the traditionally undercounted groups such as non-Whites, young people (24 years old or younger), males and renters (Zelenak and Nguyen, 2003).

4.15 Count imputation

The Census Bureau used count imputation in Census 2000 as it has in several prior censuses to address the problem of missing, incomplete, and contradictory data. The Census Bureau used count imputation for three categories of cases in Census 2000: household size imputation, occupancy imputation and status imputation. Household Size Imputation occurred when the Census Bureau records indicated that the housing unit was occupied but had insufficient information as to the number of individuals residing in the unit. Occupancy imputation occurred when Census Bureau records indicated that a housing unit existed but did not provide sufficient information to definitely classify it as either occupied or vacant; thus the Bureau imputed status of occupied or vacant. Status imputation occurred when the Census Bureau's records had insufficient information about whether an address represented a valid, non-duplicated housing unit. For these case, the Bureau imputed the status of the unit as either occupied, vacant, or delete. For all units imputed as occupied, the household size was also imputed.

Figure 1:
Count Imputation Rates in the Decennial Census (in percent)



A total of 620,650 housing units were imputed in the Count Imputation Process and 1,172,144 persons, or 0.42 percent of the total population, were added to the apportionment count in Census 2000 through count imputation. While this rate was in line with earlier censuses (see Figure 1), it was higher than the rate of count imputation in the 1990 Census. Accordingly, an interdivisional team was established to investigate and document the reasons for this occurrence. The explanations as to why more housing units were handled by the imputation process in Census 2000 than in 1990 vary by category of count imputation. For more information on this subject, see Nash, 2001.

4.16 Partnership and Marketing Program

The Census Bureau implemented a five-pronged, integrated marketing strategy to promote Census 2000. Two components of the strategy - the paid advertising campaign and the Partnership Program - were collectively known as the Partnership and Marketing Program. The paid advertising campaign generated awareness, educated people about Census 2000 and encouraged individuals to return their Census 2000 forms. The Partnership Program encouraged mail response by people who were not persuaded by direct mail, advertising, or other promotion methods.

The Census Bureau contracted with the National Opinion Research Center (NORC) to evaluate whether or not the Census 2000 Partnership and Marketing Program increased the public's awareness of the census and increased mailback response rates, especially among historically undercounted popula-

tions. To perform this task, the NORC implemented a *before* (Fall 1999), *during* (Winter 2000) and *after* (Spring 2000) research design with three waves of interviewing. Across the three waves, just under 10,000 interviews of American households were completed. The study examined the public's recall of eighteen sources of census communications. These eighteen sources were combined into two composite measures: mass-media and community-based communications. Since the effects of census marketing and partnership activities are confounded with one another, it was impossible for the Census 2000 Partnership and Marketing Program evaluation to measure their effects separately.

The study found that overall awareness of communications about Census 2000 increased significantly over time. There was significant evidence that awareness of both types of communications was greater after the Census 2000 Partnership and Marketing Program than before the onset of the program. It appears the program was effective for all six targeted populations in stimulating awareness.

Higher awareness of communications about Census 2000 correlates with a greater likelihood or intention of returning the census form for five of the targeted populations including Hispanics, non-Hispanic Blacks, non-Hispanic Whites, Asians, and Native Hawaiians; we were not able to demonstrate these effects for the American Indian population.

However, the Census 2000 Partnership and Marketing Program achieved mixed success in favorably impacting actual participation in the census. The data support a conclusion that census communications were less effective for the other-languages population than for the English population and less effective for younger adults than for older adults. Community-based communications were more effective in reaching non-Hispanic Blacks than non-Hispanic Whites (Wolter et al, 2002).

An important limitation in developing an in-depth understanding of the Census 2000 Partnership and Marketing Program is in its inherent inability to be accurately assessed. Research to measure the influence of advertising and partnership in the years leading up to the decennial census cannot take into effect the most important relevant element: census environment. Any improvement in census coverage that might be attributed to marketing and advertising is confounded with many other factors such as changes in all of the decennial operations and procedures, questionnaire changes, differences in questionnaire contact and implementation strategy, the unique implementation of coverage improvement operations, et cetera. We can measure awareness but not its separate effect - decennial response - which is correlated to coverage.

The fact that the mail return rate after the cut for Nonresponse Followup increased in Census 2000 over the 1990 Census is an indication that marketing and advertising may have had an influence on mailback response. In the 1990 Census, the amount of mailback response we measured after April 19 was about 1 percentage point. The analogous amount of mailback response we measured in Census 2000 after April 18 was 4.3 percentage points. Unlike the advertising campaign of 1990, the paid advertising of 2000 continued well into the summer. While this is not presented as proof of influence on the Census 2000 response, it is an indicator of such.

4.17 Local census office delivery operation of questionnaires determined undeliverable as addressed by the U. S. Postal Service

The Undeliverable As Addressed /Local Census Office (UAA/LCO) Delivery operation was a Census Bureau initiative to attempt to redistribute census questionnaires that the USPS did not deliver. These questionnaires were not delivered because of restrictions the USPS has on leaving mail under certain circumstances. For example, the Census Bureau may have had city style addresses for a town but the town received its mail through post office boxes only. Thus the USPS could not use our address information to deliver these questionnaires and therefore sent these questionnaires back to the Census Bureau. Since the Census Bureau had addresses for the town, they successfully delivered the questionnaires. The questionnaires the USPS could not deliver were designated as undeliverable as addressed (UAA). From previous census experience, we know there were a substantial number of these UAAs and that a high percentage of these were occupied. Thus the Census Bureau wished to provide questionnaires to as many households as possible for potential mail return and avoid costly enumerator visits to the household to obtain an interview.

Between March 13 and March 15, 2000, the USPS delivered Census questionnaires to housing units in the mailout/mailback areas. There were 10,478,481 questionnaires identified as UAA by the Postal Service and 4,183,783 sent to the UAA/LCO Delivery operation. Approximately 35.4 percent of the

4.2 million UAAs were delivered, which is significantly lower than the Census Bureau's goal of 66.0 percent. Of the 1,480,212 redelivered UAAs, 96.1 percent (1,422,170) were sent to the Nonresponse Followup operation because the redistributed UAA questionnaires were not mailed back before the deadline for creating enumerator assignments for the Nonresponse Followup operation. Approximately 78.5 percent of those sent to Nonresponse Followup required contact. Only 17.6 percent required no contact in Nonresponse Followup because the mailback form was received (Letourneau, 2003).

The UAA redistribution operation, as originally conceived, seemed like a worthwhile method of 1) significantly reducing the Nonresponse Followup workload and 2) creating goodwill with local communities where large pockets of population were missed in the original mailout. The UAA redistribution appeared to be a successful tool in dealing with local communities in accomplishing the latter objective. However, as it was actually implemented with other census operations, the UAA redistribution was not successful in the former goal for two reasons:

1. We redelivered 1,480,212 questionnaires at some nontrivial effort and expense and only reduced the Nonresponse Followup workload by 260,920 cases.
2. There was a "two strike" rule for deleting addresses in the census. One strike was a UAA and participation in the UAA redistribution operation took away that strike. As a result, the workload of the Coverage Improvement Followup operation, which came after Nonresponse Followup, was increased by 573,112 addresses. Clearly the UAA redistribution, as implemented, was not one of the Census Bureau's most efficient operations in Census 2000. (See Recommendation 6.4.)

5. Conclusions

5.1 Census 2000 operations influencing coverage

Which Census 2000 operation had the greatest influence on coverage? Although it is difficult to measure the direct influence of any one operation, the following discussion includes several operations from Census 2000 based on the adds and deletes from Table 4.

5.1.1 The Coverage Improvement Followup operation had the largest effect. Overall, 5.3 million persons and 6.2 million housing units were enumerated as a result of this operation. The vacant/delete check added the most persons and housing units while other components also added significant numbers. In the future, this may not be the case if the Nonresponse Followup operation is expanded to include the Coverage Improvement Followup workload. Mobile Computing Devices (MCD) may allow much more flexibility in modifying enumerator assignments and in applying real time edits during Nonresponse Followup; this might make Coverage Improvement Followup less desirable as a separate operation. The functions of Coverage Improvement Followup, however, will continue to be important. Following up vacant or deleted units will continue to be an important aspect of a decennial census.

5.1.2 The Housing Unit Unduplication Operation had the next largest impact on coverage improvement. More than 3.6 million persons and 1.4 million housing units were identified and removed during this operation. While this ad hoc operation may not exist in future censuses in its 2000 form, we will need a comprehensive unduplication program for the 2010 Census. Research and planning will dictate how and when unduplication will be done. It could be done in the creation of the address frame before the census, integrated into the decennial enumeration operations, after the enumeration during census processing, or it could take place during all three of these activities.

5.1.3 The Primary Selection Algorithm added at least 513,413 persons to Census 2000 but holds the potential to add more persons. There were 1.1 million times in Census 2000 when the Primary Selection Algorithm identified two separate occupied forms for a given ID (address). Matching across the forms showed no persons in common and neither of the forms was a partial household Be Counted form or a GQ-UHE form. Thus one of the two forms was selected in its entirety to be included in the census and the other form was discarded in its entirety. The 1990 PSA added a substantial number of persons to the 1990 Census by adding persons from the discarded forms not found during the Search/Match operation. There could be a similar payoff in the future through an analogous automated operation.

5.1.4 The Coverage Edit Followup operation had an influence on coverage beyond its net total of 105 thousand deletes; it added 153 thousand persons and deleted 258 thousand persons or influenced 411 thousand total adds and deletes. It was limited to only those cases where we could contact the household on the telephone which was just more than 50 percent of the time. Thus there were about 1.1 million households that were not contacted because the Census Bureau could not reach them by telephone. If they conducted a personal visit followup of these cases, the Coverage Edit Followup may not only collect better demographic data for these households but may also appreciably affect the total census count for these households.

5.2 Census 2000 operations influencing differential coverage

Several operations from Census 2000 contributed a disproportionate number of adds from traditionally undercounted populations such as minorities, males, renters and children. The census operations that contributed most to reducing the differential undercount were:

- Coverage Improvement Followup
- Be Counted Campaign
- Service-Based Enumeration
- Coverage Edit Followup
- Update/Enumerate Operation
- Urban Update/Leave Operation

5.3 Future coverage improvement development

To assess the overall level of coverage improvement and to make recommendations for future coverage improvement development, the Census Bureau traditionally provides two measures: one from the Demographic Analysis, and one from a post-enumeration survey employing dual system estimation methodology, which was the A.C.E. in Census 2000. Until Census 2000, the two estimates have been relatively close. For example, in 1990 the undercount estimate from Demographic Analysis was 1.8 percent and the Dual System Estimation undercount was 1.6 percent. For Census 2000 the two methods produced estimates that did not share the consistency of the past. Therefore, the Census Bureau subsequently made several revisions to each method based on varying assumptions. The final estimates announced in March 2003 were a net undercount of 0.1 percent from Demographic Analysis and a net overcount of 0.5 percent from the A.C.E.

There has consistently been substantial undercounts in past censuses. In Census 2000, however, we measured a slight undercount or a modest overcount, depending on which estimate is used to assess the overall effectiveness of the 2000 coverage improvement program. If our ultimate goal is a "zero" undercount, then the balance between coverage improvement programs and other decennial operations in Census 2000 was closer to optimal than in past censuses.

Because of a technological development that surfaced late in the census processing, it probably does not matter which estimate is used to assess coverage or make recommendations for the future. That development is our new ability to identify and remove duplicates from the census. Early versions of this were applied to the census to identify and remove 3.6 million duplicate persons from the 2000 Census (Unduplication Operation). This ability was further developed during the A.C.E. Revision II work. Thus it appears that unduplication has the potential to produce a dramatic impact on both decennial coverage improvement and decennial coverage measurement in the future.

So what might this mean for the next census? Our new and improved ability to identify and remove duplicates during the census will more than compensate for a continued aggressive program of coverage improvement. Ever widening of the net will capture many duplicates but it will also capture many potential omissions. If our research during the mid-decade enables us to correctly identify and remove these duplicates, the 2010 Census will have substantially fewer erroneous enumerations. But unless we can identify and add omissions commensurately, we will likely be moving back into an era of census undercount. With this in mind, we propose the following recommendations to improve coverage in the 2010 Census.

6. Recommendations

6.1 Improve the unduplication process

Continue the research (which began in preparation for the 2004 Census Test) to improve the unduplication process that was employed late in the Census 2000 production. This research should be focused on several areas:

- **Improve the process of identifying and removing duplicates.** The ad hoc unduplication operation conducted in Census 2000 was characterized by high error rates which may be dramatically reduced by applying improved decision methodology and more refined matching techniques. If we made a concerted effort to develop and thoroughly test improved unduplication methods, we could eliminate a large portion of decennial duplicates before or during census processing.
- **Learn more about the causes of the duplication.** Although we know that some nontrivial component of the duplication comes from such sources as college students or joint custody children, more research is needed to reveal the cause and nature of much of the other duplication. (Other duplication might come from sources such as multiple responses, multiple sources in constructing address lists, redundancy in enumeration or processing procedures, postal misdelivery, geocoding errors, et cetera.) While we do not necessarily need to know the causes of duplication to be able to identify and remove duplicates, we do need to learn the causes of duplication in order to develop a strategy to effectively reduce the duplication for the next census.
- **Consider developing techniques to estimate gross erroneous enumerations.** Develop methodology to more accurately estimate Dual System Estimation components of gross error, especially gross erroneous enumerations, of which duplication is the principal part. This would give decennial planners a better estimate of duplicates. If the measure of these components of gross error was available in "real time," this could also be a valuable monitoring and management tool for census managers.

6.2 Continue a strategy of inclusion

Continue to employ a strategy of inclusion for coverage improvement. Past censuses contained many programs to "widen the net" to capture hard-to-enumerate populations. Although that strategy contributed to an over-enumeration in Census 2000, the same strategy of inclusion may not lead to a census overcount in the next census. New and improved methods to identify and remove duplicates during the census may more than compensate for a 2000-like coverage improvement program. Ever widening of the net will capture many duplicates (most of which can be identified and removed) but it will also capture many potential omissions. This combination will not only lead to fewer gross errors in the census (a more accurate census) but is also likely to lead us back into an era of census undercount. This is because of our dramatically improved ability to reduce erroneous enumerations (duplicates) but only modest success in reducing omissions. In spite of overcounts in Census 2000, if future undercounts appear likely, the Census Bureau should be more aggressive, not less, in implementing coverage improvement programs in the next census. This strategy suggests that most of the coverage improvement programs they employed in Census 2000 should be considered for an encore in 2010. However, some programs that had little effect, such as the Whole Household Usual Home Elsewhere Probe, should be considered for elimination.

6.3 Reduce the differential undercount

Keep all of the coverage improvement programs that reduced differential undercount. Regardless of how successfully we are able to reduce undercounts in the next census, differential undercount is still a near certainty for the future. Among the programs that had a positive influence on reducing the differential undercount are Coverage Improvement Followup, the Be Counted Campaign, Service-Based Enumeration, Coverage Edit

Followup, Urban Update/Leave, and Update/Enumerate. The Census Bureau should also strongly consider additional operations that specifically target hard-to-enumerate populations such as the 1990 Parolee and Probationer Coverage Improvement program. Except for the Vacant/Delete/Movers Check, that operation added more persons than any other single coverage improvement program in the 1990 Census. The high level of errors associated with the Parolee and Probationer program (which may have eliminated it from serious consideration for Census 2000) was due largely to the fact that it was hastily implemented late into the 1990 Census cycle, not necessarily that the overall concept lacked merit. If the methodology for that program were thoughtfully developed and appropriately tested during this decade, the Parolee and Probationer program could possibly identify and enumerate large numbers of hard-to-enumerate persons who would otherwise not be included in the 2010 Census counts.

Another possibility for targeting would be the use of administrative records and matching them back to the Census, which is similar to the Nonhousehold Sources Program employed in 1980. Our matching capability has improved enough where this approach could be much more efficient than the 1980 operation.

6.4 Integrate the undeliverable as addressed redistribution operation

Retain the UAA Redistribution Operation if it can effectively be redesigned or at least integrated into the other census operations. This program was well intended and provided beneficial public relations but in concert with other decennial procedures, did not efficiently contribute to coverage improvement. Of the 10.5 million UAAs, 4.2 million were sent to Local Census Offices for redelivery. Census staff redelivered 1.5 million UAAs but only 260,920 were mailed back in time to make the cutoff date for Nonresponse Followup and thus reduce the NRFU workload. Because of the "two strike rule" for census deletes, it unnecessarily added 573,112 cases to the Coverage Improvement Followup workload. If new technology allows more flexibility in making enumerator assignments during Nonresponse Followup (Mobile Computing Devices are currently being tested that we hope will mitigate this issue) and the Census Bureau successfully modifies the census delete rules, the UAA Redistribution can successfully meet the purpose in 2010 for which it was intended.

6.5 Expand the Primary Selection Algorithm

Conduct a search of discarded Primary Selection Algorithm forms. Although we added at least 513,413 persons from the Primary Selection Algorithm in Census 2000, we may be able to add more. There were more than 1.1 million cases in Census 2000 where the Primary Selection Algorithm identified two separate occupied forms for an ID (address) that did not have anyone in common between the two forms. These were cases where neither of the forms was a partial household Be Counted form or a GQ-UHE form. One of the two forms was selected in its entirety to be included in the census and the other was discarded. We recommend that we take another look at these discarded forms and research ways to identify and correctly add persons from these forms that are not already counted. This would require a thorough understanding of the unduplication process applied in the census to allow correct enumeration of these cases.

6.6 Conduct a complete Coverage Edit Followup

Contact all households in Coverage Edit Followup. There were 2.5 million households selected for Coverage Edit Followup but only 54 percent could be contacted during the telephone followup interview. The missing data associated with the non-contacted households were imputed because we had not planned a personal visit followup. These missing data, as they relate to Coverage Edit Followup, deal with large households and count discrepancies. Since Coverage Edit Followup dealt with the missing data quite differently than the imputation (count imputation), we recommend that we conduct personal visits to all of the households not contacted by telephone and, to the extent practicable, ensure the imputation and the interviews reflect the same basic philosophy in adding (deleting) persons.

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