

# An overview of Selected Components of the 1990 Census Research, Evaluation and Experimental Program Henry F. Woltman, Bureau of the Census

## I. INTRODUCTION

Since the 1940 Census, the Bureau of the Census has conducted special tests, research activities, and procedural evaluations in conjunction with each decennial census. Collectively, these comprise the Research, Evaluation, and Experimental (REX) Program. It has evolved into a comprehensive framework for improving the decennial census. These studies have yielded significant benefits and have become an integral part of the census process.

With a fledgling research program in 1940, we began to assess, through demographic estimates, the extent of underreporting in birth registration records. For the 1950 Decennial Census, we organized our research and experimental efforts into a more expansive program that focused on measuring errors in census coverage and content. This program evaluated the level of coverage error attributed to omissions and duplicate enumerations of persons and housing units. It also measured the level of error in questionnaire items resulting from response errors and processing errors. In addition, experimental programs tested alternative census-taking methods such as respondent self-enumeration.

The results of the 1950 REX Program were valuable to census planners and data users alike and substantially affected the 1960 Census planning operations. The 1960 Decennial Census was the last census that we conducted using primarily the traditional door-to-door method. Before and during the 1960 Census, we designed experiments that assessed, in part, the assistance of the Post Office Department to improve the coverage of the census -- the goal being to conduct a mail census. In the 1970 REX Program, we conducted tests that measured such items as the completeness of population and housing unit coverage, content error, content and coverage quality, interviewer error, and the effectiveness of alternative procedures that might improve future censuses.

The 1980 REX Program built on the results of prior tests and experiments. Conducting a census predominantly by mail placed significant emphasis on the evaluation of data collection methodologies. Evaluations and experiments focused on areas including coverage improvement and coverage measurement, alternative questionnaire designs, and techniques for recruiting, training, and motivating census interviewers. Data processing and quality control techniques also emerged as areas of primary importance for the 1980 REX Program; and a series of studies addressed respondent behavior, direct estimation of nonsampling error, and census promotion.

The formulation of the 1990 REX Program continued the tradition of improvement and innovation set by REX studies conducted in prior Censuses, starting in 1940. It established a comprehensive base from which we can proceed with the design of the Year 2000 Census.

## II. OBJECTIVES OF THE 1990 RESEARCH, EVALUATION AND EXPERIMENTAL PROGRAM

The primary objectives identified for the 1990 REX Program are:

1. to provide data for Census Bureau use in assessing and improving methods and operations for future censuses; and
2. to provide information to data users concerning the sources and effects of errors in census data.

The Bureau of the Census has grouped most of the component studies of the 1990 Research, Evaluation, and Experimental (REX) Program into three principal areas. These groupings are "Content", "Coverage", and "Procedures and Processing", respectively.

The **Content** grouping comprises those REX studies that will ensure that we obtain information on the quality of data from the 1990 Census in order that we might provide information about the sources and magnitude of nonsampling errors introduced during data collection and processing.

The **Coverage** studies for the 1990 Census will provide accurate and informative measures of population and housing coverage for different population groups, and will also provide information about selected correlates of undercoverage such as demographic and housing characteristics, type of enumeration, and geography. We will evaluate the success of coverage improvement programs and will also identify where coverage deficiencies remain.

Evaluation and research efforts in the area of census **Procedures and Processing** will emphasize new and expanded techniques for the 1990 Census. Since we have implemented major innovations in the areas of automated, decentralized data processing, we will concentrate on these areas in order to determine if the new techniques were cost effective and whether they produced the desired results. Properly designed, the content and coverage objectives described above will complement the procedural and processing studies by providing data on how methods and operations affect data quality.

The Bureau used the following specific criteria in selecting the components of the 1990 REX Program:

1. The proposal should be capable of integration within the staffing and fiscal resource limitations of the overall REX program;
2. The proposal should require an actual census environment for proper measurement. (Otherwise, it would be more appropriate to integrate the proposal into a test census or other special test.)
3. The proposal should not adversely affect the production and delivery of apportionment and redistricting counts by the legislated deadlines.
4. The proposal should not affect the quality of the census data in any way that would jeopardize their major uses.

## III. OVERVIEW OF REX RESULTS

An attempt to provide an overview of the REX results is not an easy task given that the number of individual studies under the REX umbrella is sixty or more. Thus my goal is to weave together the results of various research, evaluation and experimental studies to provide a picture of the overall quality of the census data resulting from the processes and methods used to collect information in the 1990

Census. Results from the surveys designed to measure the coverage of the population (Post Enumeration Survey) and housing units (Housing Unit Coverage Check) enumerated in the Census are not within the scope of this paper. Other important research results related to coverage issues, such as results from the ethnographic research studies are not included. Selected results are presented for the major phases of the census taking process. The phases covered include:

1. Development of the address list,
2. Questionnaire Delivery,
3. Mail back of the questionnaires,
4. Editing of the mailback questionnaires, and
5. Field follow-up and other special coverage improvement procedures.

References citing internal Census Bureau evaluation and research memoranda are provided.

#### IV. DEVELOPMENT OF THE ADDRESS LIST

A key requirement for a successful mail Census is the development of a complete list of addresses. The Census Bureau invests considerable time and resources into developing an accurate address list. The address list is of little value until each address is assigned to Census geography ... down to the block level. The combination of compiling and geocoding addresses results in the basic address file used to control data collection.

The methods for census-taking by mail include three basic variations that are used in different types of areas across the country. These areas may be loosely labelled as urban, suburban and rural. Rural areas refer only to the most rural mail census areas. The address list development and delivery methods used in urban, suburban and rural areas are tailored to the population density and the addressing systems used by the United States Postal Service (USPS).

In each of these types of areas, the Census Bureau uses various methods to develop an initial address list followed by various sequential procedures designed to update and refine these initial lists.

The REX program includes detailed evaluations of the basic list development procedures and each of the updating operations. The evaluations of the updating operations include detailed data on various aspects of the operation relating to improved coverage, operational problems/recommendations as well as the overall and per "unit" costs of the operation. The details of these evaluations are beyond the scope of this paper but I will mention some general overall conclusions about the updating operations. First, let me briefly describe the basic address list development procedures for each area.

The global purposes of the address list updating operations are to add addresses not already on the basic source lists, delete nonexistent and nonresidential addresses, identify duplicate addresses, obtain correct geocodes, identify addresses that will not allow mail delivery (i.e. undeliverables) and finally to verify and correct (if necessary) mailing addresses.

The chart below shows the basic source of the address list and major updating operations for each area: urban, suburban and rural. Brief definitions of the updating procedures are also provided.

#### Address List Development Procedures - Mailback Areas

<u>Area</u>	<u>Basic Source</u>	<u>Questionnaire Delivery</u>	<u>Update USPS</u>	<u>Operations Census</u>
<u>Bureau</u> Urban	Commercial Vendor Address List	USPS	Advance Post Office Check (APOC)	Precanvass Casing Address Check Yellow Cards
Suburban	Prelist (1988)	USPS	Advance Post Office Check (APOC)	APOC Reconciliation Casing Address Check
Rural	Prelist (1989)	Census Bureau Enumerators	None	Update/Leave

#### Definitions:

**Advance Post Office Check (APOC):** Coverage improvement operation conducted by the USPS to verify the completeness and accuracy of the vendor and prelist address lists.

**Precanvass:** Canvassing operation by Census enumerators to verify completeness and accuracy of lists in urban areas; conducted after APOC.

**Casing Address Check:** Conducted by USPS prior to Census day to verify completeness and accuracy of list.

**Yellow Cards:** Conducted by Census Bureau staff for the purpose of assigning correct geocodes to addresses that remained ungeocoded after prior precensus activities or had conflicting geocodes.

**APOC Reconciliation:** Conducted by Census Bureau enumerators in suburban areas (1988 Prelist) after APOC for the purpose of field checking units indicated by the USPS in the APOC as adds, duplicates or undeliverables. Enumerators verified that added addresses were residential and not already included on the address list, and to assign geographic codes to valid adds.

**Update/Leave:** Conducted by Census Bureau enumerators in rural areas (1989 Prelist) to verify the completeness and accuracy of the lists while delivering Census questionnaires.

Some overall conclusions are:

#### Urban Areas

- The vendor lists were the major source of addresses on the final precensus list; but the APOC and precanvass operations also made significant contributions. The distribution is as follows.

<u>Source</u>	<u>Percent of Total Precensus Addresses</u>
Vendor	87.2%
APOC	2.7%
Precanvass	10.1%

- The relative contribution of the update operations varied considerably by district office. In nine percent of the DO's, the updates combined to increase the number of addresses by more than 25 percent. This suggests these update operations are critical to list development in some areas.
- During APOC the USPS provided the Census Bureau with valuable information on missing, as well as undeliverable, addresses. All of this information was not used in updating the address list. If we could take better advantage of all information provided by the USPS we could undoubtedly improve the quality and deliverability of addresses.
- The prec canvass operation resulted in higher than expected add rates (about 11 percent). It is believed that this was due in part to a high level of geocoding corrections.
- Results from the quality assurance procedures for the updating operations indicate the need for improvements. In APOC, the QA results indicate that the USPS may fail to add one-third of the addresses not on the vendor list; similarly, QA results for the prec canvass operation suggest enumerators fail to add a similar proportion.

Suburban Areas

- Overall, the APOC and APOC reconciliation operations added about 1.2 million addresses (4.2 percent increase) to the initial 1988 prelist address list.
- Only 21 percent of 2.9 million addresses indicated by the USPS during the APOC as "missed" were verified as "true adds" during the reconciliation. The remainder were matched to addresses the USPS identified as undeliverable (35%), were matched to addresses the USPS identified as deliverable (16%), or were never located by APOC reconciliation enumerators (28%).
- The approximately one million APOC adds which APOC reconciliation enumerators matched to APOC undeliverables (35% of 2.9 million) confirms the difficulty the USPS has in recognizing addresses listed by Census Bureau field staff.

Rural Areas

- While delivering questionnaires, enumerators added about 400,000 addresses (4.0% increase) to the initial 1989 prelist address list.
- Approximately 69 percent of addresses in rural areas had non-city style addresses (i.e., were not house number/street name type address). This fact, combined with the higher vacancy rate (13.5% compared to 9.4% in urban and suburban areas) and higher rate of incomplete addresses (21% compared to 3%) suggests that the areas designated for update/leave enumeration were areas where the USPS might have had problems delivering Census questionnaires.

**V. QUESTIONNAIRE DELIVERY**

Having prepared the final address lists, the next step was delivery of the questionnaires ... both by the USPS in primarily urban and suburban areas and by Census Bureau staff in more rural areas for which most mailing addresses were of the type that cannot be located on the ground without further information. Of critical concern is the extent to which each such

address actually received a Census questionnaire. From the results of various studies we can put together a picture of the success of the questionnaire delivery operation. About 100 million questionnaires were delivered by the USPS and Census Bureau enumerators. One of the first indicators of delivery problems came from an operation in the Census itself ... the telephone questionnaire assistance (TQA) operation. Soon after delivery of the Census questionnaires, the telephone questionnaire assistance units started receiving a large volume of telephone calls. While most calls were for specific assistance with filling out the questionnaires, it became apparent that a larger than expected number of calls were from persons reporting they had not received a questionnaire. About 992,000 such calls were received .. about two-thirds occurring prior to April 12, 1990.

Table 1. below provides data from a sample of the forms filled out for persons reporting non receipt of a questionnaire.

**Table 1. TQA EVALUATION RESULTS**

Total Calls	992,000
On address list at time of delivery	59.9%
Time of delivery adds	17.7%
<hr/>	
Total	77.6%

Thus, slightly less than 80 percent of the callers should have eventually received a questionnaire. The remaining addresses were not on our original list but were added. It is estimated that there was 158,000 such addresses. The majority (84%) of the added addresses already on our list had a house number/street name address. Two-thirds of the added addresses were for single unit structures.

More substantive evidence of delivery problems is based on an evaluation of an operation designed to have each District Office (DO) try to redeliver Census questionnaires returned by the USPS as undeliverable (denoted as post master returns or PMR's). The following data are based on the results of a survey of DO's that attempted to gather information about the number of PMR questionnaires received, and delivered.

- Between 5.4 to 7.6 million PMR's were returned to the DO's for redelivery.
- Between 3.1 to 4.3 million PMR's were assigned for redelivery by DO staff.
- Over 50% of the questionnaires assigned for redelivery were actually delivered.
- A major reason for undeliverability indicated by the USPS was that the unit was vacant.

These data suggest that for some reason USPS had problems delivering a substantial number of Census questionnaires, and that a major reason was that the housing unit was apparently vacant. Our procedures do not specifically tell the USPS to deliver a questionnaire to vacant units. Subsequent analysis was undertaken to analyze PMR's that both the USPS and DO staffs could not deliver. About 5.3 million questionnaires could not be delivered by USPS or the DO staff.

Table 2. shows a distribution of the undeliverability reason.

**Table 2. USPS UNDELIVERABILITY REASON**

USPS Undeliverability Reason	(Standard Error)		
	Number	Percent	Error
Vacant	1,771,379	33.6	(2.5)
Duplicate	478,481	9.1	(1.1)
Demolished/ New Construction	168,260	3.2	(0.4)
Nonresidential	99,233	1.9	(0.3)
No Such Address	1,281,319	24.3	(1.7)
No Such Apartment	447,602	8.5	(0.8)
Post Office Box	21,229	0.4	(0.1)
No Mail Receptacle	259,370	4.9	(0.8)
Other	272,789	5.2	(0.5)
No Reason Written	472,736	9.0	(1.9)
<b>Total</b>	<b>5,272,398</b>		
	(SE = 460,000)		

Given that "Vacant" connotes a deliverable address, an estimated 3.5 million addresses were undeliverable or about 4% of the mailout/mailback universe.

Table 3. shows the USPS undeliverability reason crossed by the final status of unit in the census ... occupied, vacant or delete. These data suggest that a classification of undeliverable by USPS does not automatically mean we should delete the unit from our address list. On the other hand, some of the undeliverable reasons ... vacant, demolished, new construction, nonresidential and no such address or apartment are correlated with the final census status. The Census Bureau should investigate methods of incorporating the USPS information with census data before sending these types of addresses to non response followup as this could result in savings of time and money.

**Table 3. USPS Undeliverability Reason by Final Census Status**

USPS Undeliverability Reason	Percent (Standard Error)			
	Occupied	Vacant	Delete/ Kill	Number
Vacant	19.8 (0.9)	60.6 (1.6)	19.5 (1.2)	1,771,000
Duplicate	39.6 (2.2)	11.3 (2.1)	49.1 (2.6)	478,000
Demolished, New Construction or Nonresidential	6.2 (0.6)	12.8 (1.4)	81.0 (1.8)	267,000
No Such Address or No Such Apartment	23.3 (1.6)	12.6 (1.2)	64.1 (2.3)	1,729,000
Post Office Box or No Mail Receptacle	29.2 (3.3)	45.6 (4.4)	25.2 (3.0)	281,000
Other or No Reason Written	28.0 (3.2)	29.2 (2.9)	42.8 (3.0)	746,000
<b>Number</b>	<b>1,250,000</b>	<b>1,726,000</b>	<b>2,296,000</b>	<b>5,272,000</b>

**VI. RETURNING THE QUESTIONNAIRES**

The lower than expected response to the Census in the mail back areas increased the cost of the 1900 Census and has been cited by some observers as cause to rethink the whole Census design. Within a month

following delivery, approximately 65% of the questionnaires had been returned by mail.

Subsequent analysis is now available to look at the 1990 Census mail return rates ... rates that are calculated with only occupied units as the base. These provide a more meaningful measure of respondent cooperation. Table 4. below provides 1990 Census mail returns rates by form type - short vs. long and type of enumeration area. Overall, the mail return rate was about 74%. Comparisons of 1990 mail return rates to those for 1980 are shown in Table 5.

**Table 4. Mail Return Rates by Type of Form, and Type of Enumeration Area**

Description	Mail Return Rate
National	74.1
Type of Form	
Short Form	74.9
Long Form	70.4
Type of Enumeration Area	
Urban	72.8
Suburban	76.1
Rural	76.8

**Table 5. 1990 Mail Return Rates vs. 1980 Mail Return Rates**

Description	Mail Return Rates		Percentage Point Difference
	1990	1980	
Overall	74.1	83.3	9.2
Short Form	74.9	83.6	8.7
Long Form	70.4	82.0	11.6
SF/LF Percentage Point Difference	4.5	1.6	

As shown, the 1990 mail return rate was about 9 percentage points lower than the official 1980 census mail return rate ... certainly suggesting deterioration in respondent cooperation and a cause for concern. Also note, the differential SF vs. LF rates were higher in 1990 than in 1980.

In an effort to explore hypothesis about the lower response/return rates, a number of research efforts were initiated. One, the Outreach Evaluation Survey, was conducted to evaluate the effects of programs designed to heighten awareness of the Census and to explain its uses and purposes. The survey comprised two waves of interviewing; one in the winter of 1990 prior to the start of outreach activities and the other in late April and early May.

The other survey, the Survey of 1990 Census Participation emerged from a joint statistical agreement between National Opinion Research Corporation and the Census Bureau. It's purpose was to measure a variety of characteristics that might be related to Census response. The results are given in Fay et al and Kulka et al. Their major results were summarized by Dillman in his discussion of these papers. A synopsis of his discussion follows.

The hypotheses that the 1990 media campaign did not reach people as well as in 1980 to inform them about the census and that general public attitudes towards the census have become more negative and therefore contributed to lower response, receive virtually no support from the data. Knowledge of the census was as great or greater among respondents in

1990 and attitudes were at least as positive. Further, the response rates of groups having correct knowledge of the census or holding positive attitudes were clearly lower in 1990. These data clearly suggest that focusing mostly on the media campaign and negative attitudes as reasons for lower response is not warranted.

At the same time, people with less knowledge and less positive attitudes were clearly less likely to respond by mail to the census. This finding might lead people to conclude simply that an even better media campaign is needed in 2000 to reach more people. We should resist drawing such a conclusion. Neither knowledge nor attitudes changed much between waves of the studies, and simply doing more to change them seems to be ineffective or, at best, an inefficient expenditure of resources.

The most provocative finding reported by Fay et al. is one of nonrespondents not being well integrated into the social

structure of U.S. society. One of the largest mail back response differences reported in this paper is that between people in households where all members are related and those where some occupants are unrelated. A detailed study of the characteristics of responding/nonresponding households is planned.

The Kulka et al. paper analyzes the 1990 survey of census participation. By breaking the act of responding into separate steps--1) did not receive (or remember receiving) the questionnaire, 2) received but did not open, 3) opened but did not start, 4) started, but did not finish, and 5) finished but did not mail, they carry out an especially useful and provocative analysis. They persuasively demonstrate that responding to the census questionnaire is not an all or nothing action. A significant number of individuals stop at each stage. It is not surprising that the proportion of individuals who discontinue responding at each stage is higher in households where all household residents are not related by blood/marriage, in households where the respondent was 29 years of age or less, and other households exhibiting the qualities of a lack of societal integration. Dillman goes on to suggest various methods that could be the focus of research on how to improve response rates.

In this connection, a study was conducted as part of the REX program to test alternative census questionnaires. The Alternative Questionnaire Experiment (AQE) tested five different census long form questionnaires during the census. Each form was designed to explore a unique set of hypotheses aimed at increasing the mail response/return rate. The paper by Bates and De Maio provides the major results relative to response rates. These results suggest the possibility of increasing response rates by improving the "physical" appearance structure and the user friendliness of the form.

#### VII. EDITING OF MAIL RETURN QUESTIONNAIRES

In order to provide the highest possible levels of coverage and data quality, the 1990 Census developed and implemented an elaborate procedure for editing questionnaires returned by mail, both short and long forms. The edit and repair system was extremely complex, and costly. The potentially high costs from the originally outlined procedures prompted the Census Bureau to revise the established edit and follow-up procedures in the Fall of 1989, some five months before Census day.

In general, the original processing plan required that all questionnaires that failed edit for reasons of coverage or content be sent to a followup operation conducted primarily by telephone but with personal visit in some cases.

The revised plan called for short-form questionnaires failing edit for reasons of content only to be sampled at a 10% rate and only those in sample would be included in followup. Long-form questionnaires as well as questionnaires that failed edit for coverage reasons were not affected by this change. Almost 9 million mail return short form questionnaires were identified as content only edit failures (CEF's).

The results of an evaluation of this decision on the item nonresponse rates for 100% data items follows. Data in Table 6. below compare, for the universe of short form questionnaires returned by mail, item nonresponse rates based on the revised followup procedures versus the rates that would have occurred if all CEF's had been included in the followup operation (i.e., the original procedure).

Table 6. ITEM NON RESPONSE RATES - 100% ITEMS

ITEM DESCRIPTION	ITEM NONRESPONSE (%)			
	TYPE 1 DATA		TYPE 2 AND 3 DATA	
	ORIGINAL(1)	REVISED	ORIGINAL(1)	REVISED
Relationship	0.6	2.4	1.1	1.4
Sex	0.8	2.2	0.8	0.8
Race	5.0	7.7	2.0	2.8
Spanish Origin	4.4	15.8	5.4	13.7
Units in				
Structure	0.5	2.9	0.7	2.3
No. of Rooms	0.3	2.1	0.4	1.6
Tenure	1.0	3.5	0.8	2.1
Value of				
Property	1.7	2.1	2.3	2.7

(1) Estimates of the item nonresponse rates if all CEF's had been included in the followup operation.

Universe: Short-form occupied mail return questionnaires.

Here Type 1 Data is for the district offices in the major metropolitan areas and Type 2 and 3 Data are for all other district offices. As is evident, the item nonresponse rates were increased for all items shown. In particular, the increase in the item nonresponse rate for the Spanish origin question was quite substantial.

The overall impact of the change to the content edit and followup procedures for the Spanish origin question is shown in Table 7. This table shows the final allocation and substitution rates (see Table 7. for definitions) for this question in the 1990 Census. The 1980 Census rates are shown as well. The origin question was the most unanswered 100 percent population item. Respondents often assumed that the question applied only to persons of Spanish origin and was not to be answered by everyone. As a result, this question was the most adversely affected by the change in the content edit and followup procedure.

Table 7. Final Allocation and Substitution Rates - Spanish Origin Question

1990 Census	TOTAL	NOT ALLOC	ALLOC	SUBS	TOTAL	NOT ALLOC	ALLOC	SUBS
Spanish origin	22,354,059	20,555,476	1,612,621	185,962	100.0%	92.0%	7.2%	0.8%
Mexican	13,495,938	12,821,095	574,694	100,149	100.0%	95.0%	4.3%	0.7%
Puerto Rican	2,727,754	2,478,695	215,499	33,560	100.0%	90.9%	7.9%	1.2%
Cuban	1,043,932	944,160	92,213	7,559	100.0%	90.4%	8.8%	0.7%
Other Spanish	5,086,435	4,311,526	730,215	44,694	100.0%	84.8%	14.4%	0.9%
Not Spanish origin	226,355,814	201,789,860	23,151,160	1,414,794	100.0%	89.1%	10.2%	0.6%
<b>PERSONS IN HUS/GQS</b>	<b>248,709,873</b>	<b>222,345,336</b>	<b>24,763,781</b>	<b>1,600,756</b>	<b>100.0%</b>	<b>89.4%</b>	<b>10.0%</b>	<b>0.6%</b>
<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>
1980 Census	TOTAL	NOT ALLOC	ALLOC	SUBS	TOTAL	NOT ALLOC	ALLOC	SUBS
Spanish origin	14,608,673	13,900,918	378,813	328,942	100.0%	95.2%	2.6%	2.3%
Mexican	8,740,439	8,346,155	198,548	195,736	100.0%	95.5%	2.3%	2.2%
Puerto Rican	2,013,945	1,909,848	56,681	47,416	100.0%	94.8%	2.8%	2.4%
Cuban	803,226	757,672	24,244	21,310	100.0%	94.3%	3.0%	2.7%
Other Spanish	3,051,063	2,687,243	99,340	64,480	100.0%	94.6%	3.3%	2.1%
Not Spanish origin	211,937,132	199,764,325	9,233,335	2,939,472	100.0%	94.3%	4.4%	1.4%
<b>PERSONS IN HUS/GQS</b>	<b>226,545,805</b>	<b>213,665,243</b>	<b>9,612,148</b>	<b>3,268,414</b>	<b>100.0%</b>	<b>94.3%</b>	<b>4.2%</b>	<b>1.4%</b>
<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>	<b>-----</b>

Notes: Substitution occurs when an entire household of people, along with all their characteristics, is imputed. This is done by replicating another household in the nearby area from a substitution matrix. Allocation occurs when one or more person characteristic are imputed into a household where there are data defined persons on the questionnaire for that household. Persons imputed into household where there is sufficient data for others in the household are said to be "totally allocated." This is done from an allocation matrix.

The tabulation of substitutions and allocations shown in these tables differ between 1980 and 1990. In 1980, if allocation bits had been set for persons duplicated in the substitution process, the characteristic was considered "allocated" instead of "substituted." Therefore, the total number of substitutions is not constant from one item to the next in the 1980 counts as it is in the 1990 counts.

**VIII. FIELD FOLLOW-UP AND OTHER COVERAGE IMPROVEMENT PROCEDURES**

After the nonresponse followup was completed, the next major operation (Field Followup) was conducted. A major purpose of this operation was to check verify the status of units classified as vacant or delete during nonresponse followup.

For each unit which had been classified as vacant or delete by a nonresponse followup enumerator, an enumerator was sent to verify this status. Enumerators could not conduct field followup in the same areas in which they conducted nonresponse followup.

The major results of this operation are as follows.

- Of the 10.2 million vacant/delete units in the followup, about 634,000 vacant units were converted to occupied and 189,000 deleted units were converted to occupied.
- About 1.5 million persons were added to the census population count. About one-third of these persons were minority persons (Black and/or Hispanic)
- Conversion of deleted units to either vacant or occupied resulted in the addition of almost 600,000 housing units.

In addition to the vacant/delete check, a number of other special coverage improvement efforts took place after the conclusion of the nonresponse and field followup operations. For example,

- The "Were You Counted?" campaign provided an opportunity for persons who believed they had been missed to report data for their household on a form printed in newspapers, distributed through other mechanisms, or by calling one of the toll-free telephone numbers.
- The Parolee/Probationer check was conducted because research had shown this group may have been disproportionately undercounted in previous censuses. Each state and the District of Columbia was asked to participate by distributing questionnaires through parole and probation officers to those under their jurisdiction. The parolees and probationers were asked to provide their Census Day address.

During the Search/Match (S/M) operation, forms received from the above two and several other special coverage improvement procedures were checked against completed questionnaires to see if the persons on the forms needed to be added to the census questionnaire for the reported census day address. This had to be done because these types of cases might otherwise result in duplication. For example, a "Were You Counted?" questionnaire might be sent in by someone who did not know that another household member had mailed back the original questionnaire for the address. Similarly, parolees or probationers may have been reported as a household member by someone on a regular census questionnaire. This approach also was needed to process individual forms filled out by persons temporarily away from home in hotels; military personnel at U.S. bases or on shipboard; and whole households who were at a second home or temporary address, but reported their usual home was elsewhere.

An evaluation of the S/M operation is given by Beverage and Moriarity. Table 8. below provides their estimates of the number of persons added to the

census for the "Were You Counted" and Parole/Probationer coverage improvement operations.

**Table 8. Search/Match Coverage Improvement**

<u>Operation</u>	<u>No. of Persons Added</u>
WYC	260,000
PP	445,000
All S/M Forms	1,084,000

As evident from these data, fairly substantial numbers of persons were added to the census from these procedures. The extent of erroneous enumerations resulting from these procedures is under investigation. Future use of these special coverage improvement procedures along with the S/M methodology to be used warrants much additional research.

Two additional coverage improvement operations were conducted involving field operations.

Between late July and early October, the Census Bureau recanvassed over 500,000 blocks containing about 15 million housing units, or about 15 percent of all housing units. This operation, called the Housing Coverage Check, was done for these blocks based on a variety of data sources, most of them internal to the Census Bureau.

These blocks were systematically canvassed to identify and list missing addresses. The recanvass identified 300,000 housing units as potential adds. Enumerators visited each of these and obtained an interview if the housing unit was in existence April 1, 1990. About 139,000 units were added to the census.

In late August of 1990, the Census Bureau sent to 39,189 local governments preliminary housing unit and group quarters counts, by block, for the Postcensus Local Review. The local governments were asked to report discrepancies between these counts and their local data. The Census Bureau then recanvassed all blocks with significant differences to make sure units had not been missed or geocoded to the wrong block. After unduplicating the list of blocks with the Housing Coverage Check (see above) about 168,000 blocks were recanvassed during this operation yielding 81,000 added units.

**IX. OTHER REX PROJECTS**

The previous sections of this paper covered selected REX results for several phases of the Census taking process. Several other REX projects that do not fit neatly into any particular phase are worth noting. Primary among these are the projects related to the evaluation of the content, and those related to understanding more about how coverage errors occur ... both missed persons/housing units and erroneous enumerations.

With respect to content, the Content Reinterview Survey (CRS) is the major content evaluation vehicle, as it has been for the last few censuses. The CRS is a nationwide sample using reinterviews to measure response variance and response bias for selected data items. Of primary concern is evaluation new data items and those that have been revised since the 1980 Census based on content tests conducted prior to the 1990 Census. The full results of this evaluation will be available shortly, but preliminary results are given by Thomas and Dingbaum.

Concerning the causes of coverage errors, the paper by Griffin and Moriarity presents preliminary results of an evaluation to determine if coverage errors, both missed and erroneously enumerated persons, vary by, for example,

- how the data were collected ... mail return vs. enumerator return
- who provided the data ... household member vs. non-household member
- when the data were collected ... date of enumeration
- size of household and type of address (single vs. multi-unit)

Finally, another research project called Coverage Sampling Research was designed to test alternative data collection techniques in urban areas. The Census Bureau conducted a reinterview of a sample of mail return and non mail return households to explore within household coverage issues. Also in 10 district offices alternative nonresponse followup procedures were tested. Changes to nonresponse followup procedures included increased supervision, shorter enumeration period, reducing the time from 6 to 3 weeks, expanded quality assurance procedures and additional enumerator callbacks. Results will be available by the end of 1992.

#### X. CONCLUSION

The 1990 Census REX program achieved the major objectives set forth in Section II. The REX program results provide a wealth of information about the quality of all aspects of the methods, procedures and operations used to take the 1990 Census.

These data also provide information necessary to design the research and development agenda for the year 2000 Census.

#### REFERENCES

1. Fay, Robert E., Bates, Nancy and Moore, Jeffrey, "Lower Mail Response in the 1990 Census: A Preliminary Interpretation", Bureau of the Census, 1991 Annual Research Conference Proceedings, pp 3-32.
2. Kulka, Richard A., Holt, Nicholas A., and Carter, Woody, " Self-Reports of Time Pressures, Concerns for Privacy, and Participation in the 1990 Mail Census", Bureau of the Census, 1991 Annual Research Conference Proceedings, pp 33-54.
3. Bates, Nancy, and De Maio, Theresa, "The 1990 CensusQuestionnaire Experiment", 1992 meeting of the American Association of Public Opinion Research.
4. Beverage, Susan and Moriarity, Christopher, "Preliminary Results from the 1990 Search Match Operation", Internal Census Bureau Memorandum.
5. Cecco, Kevin and Abramson, Florence, "Evaluating the Local Review Operation from the 1990 Decennial Census", paper presented at the 1992 meetings of the American Statistical Association, Boston, Massachusetts.
6. Thomas, Kathryn and Dingbaum, Tamara, "How Good Are These Data Anyway", paper presented at the 1992 meeting of the American Statistical Association, Boston, Massachusetts.
7. Griffin, Deborah and Moriarity, Christopher, "Causes of Census Error", paper presented at the 1992 meeting of the American Statistical Association, Boston, Massachusetts.