

QUALITY ASSURANCE IN CENSUS 2000 ENUMERATION OPERATIONS¹

Jennifer W. Reichert, Rebecca I. Piegari, U.S. Census Bureau
U.S. Census Bureau, SFC #2 Room 2500, Washington, DC 20233

Key Words: enumerate, quality assurance, reinterview

1.0 Background

Every ten years, the U.S. Census Bureau is mandated to conduct a census of all United States households to obtain a complete count of the population. The results of the decennial censuses are mainly used for apportionment of federal funding and re-districting for political purposes. However, the data from the decennial censuses also provide the most comprehensive snapshot of the total U.S. population at a particular point in time. The data collected in decennial censuses include not only counts of the number of persons, but also information on various demographic and household characteristics.

The decennial censuses involve many individual operations that combine to contact and count as much of the U.S. population as possible. The operations involve collecting information to update and improve the address lists for the census as well as collecting information on U.S. households and residents. The operations consist of:

- mailing out questionnaires to U.S. households,
- visiting households to update addresses and maps,
- visiting households to drop off questionnaires,
- visiting households to collect information on the household and household members, and
- visiting households in remote U.S. locations.

Most of the data we collect in the censuses are gathered during the mailout/mailback (MO/MB) phase of the census. The next largest operation is the nonresponse followup (NRFU) operation where enumerators visit households who did not return their questionnaires in the mail and attempt to complete questionnaires for the households. There are various smaller operations that complete the coverage of the entire U.S. For example, enumeration operations to cover Remote Alaska and the Island Areas.

Given the size and complexity of the operations, workforce, and workload, the task of providing quality assurance (QA) plans that ensure the quality of all aspects of census data collection is a challenge. The objectives of the census QA program are to maintain the quality of the data collected and to ensure high-quality performance by all personnel working on census activities. Both of those objectives apply to the work performed in census enumeration operations. The enumeration operations are those operations where enumerators visit households to collect information and complete census questionnaires.

This paper will present an overview of the Census 2000 enumeration operations, the QA activities associated with those operations, and some preliminary results from the QA operations. All data presented in this paper are preliminary and subject to revision.

2.0 Census 2000 Enumeration Operations

In Census 2000, the enumeration operations were designed to collect information from U.S. households that we could not mail to or that we mailed to, but for which we did not receive a completed questionnaire by the designated deadline. For each of these households, a census enumerator visited the household and either left a questionnaire for the household to complete and return, or the enumerator collected the necessary information and completed a census questionnaire. There were seven such operations in Census 2000:

- Update / Leave
- List / Enumerate
- Remote Alaska
- Island Areas
- Update / Enumerate
- Nonresponse Followup
- Coverage Improvement Followup

We will briefly discuss each of these operations in turn.

2.1 Update / Leave (U/L)

The Census Bureau conducted an U/L operation in areas of the United States and Puerto Rico for which the Census Bureau believed the address information on file was insufficient to mail a form. Enumerators visited each household to deliver a census questionnaire and update the address for the housing unit as necessary. Respondents completed the questionnaires and returned them by mail. Enumerators visited approximately 22,590,000 housing units during U/L.

The QA program for U/L focused on observing enumerators as they began working to identify and correct any errors, and reviewing an enumerator's assignment upon completion to ensure the work met or exceeded the established quality level. The QA program resulted in approximately 75,000 enumerators and 114,000 assignments being reviewed.

2.2 List / Enumerate (L/E)

In sparsely populated areas of the country, the Census Bureau implemented the L/E methodology. In these areas, the Census Bureau did not have an address list, so enumerators canvassed every road in their assignment looking for housing units. At

¹ This paper reports the results of research and analysis undertaken by Census Bureau Staff. It has undergone a Census Bureau review more limited in scope than that given to official Census Bureau publications. This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress.

each housing unit, the enumerator identified the unit on the census map and conducted an interview with a household respondent to collect the census data. Enumerators visited approximately 375,000 housing units during L/E.

The QA program for L/E required reviews of each completed assignment and questionnaire to ensure compliance with procedures and to ensure that the assignment was completed accurately. Additionally, an independent staff revisited some households to ensure the original enumerators were accurately collecting and recording data. Reviews in the QA program covered approximately 1,400 enumerators and 10,000 assignments.

2.3 Remote Alaska (RA)

For the remote settlements in Alaska, the Census Bureau used a modified form of the L/E methodology to enumerate households. Enumeration needed to be conducted during the winter in Alaska so that respondents would be at home and travel could be accommodated via small airplanes landing on the ice, dog sleds, etc. Enumerators went from house to house within the village to list each unit and collect information on the household and household members. Enumerators also visited and enumerated any known campsites outside of the villages. Enumerators visited approximately 26,500 housing units during RA.

The QA program for RA focused on observing enumerators as they began working to identify and correct any errors, and revisiting all housing units identified by enumerators as vacant. All questionnaires completed by the enumerators were also reviewed to ensure compliance with completeness rules. Reviews in the QA program covered approximately 100 enumerators.

2.4 Island Areas (IA)

The Island Areas are made up of American Samoa, Guam, the U.S. Virgin Islands, and the Commonwealth of the Northern Mariana Islands. Addresses in the Island Areas do not always consist of a house number and street name, nor is mail delivered to each housing unit. Rather, mailboxes are grouped together usually at the end of a main street. Enumerators canvassed their assignment areas and listed all housing units. At each housing unit, the enumerator identified the unit on the census map, picked up and reviewed completed Advance Census Reports (ACRs), or conducted an interview for households where an ACR was not completed. Enumerators visited approximately 60,000 housing units during the IA enumeration operation.

For the Island Areas QA program, supervisors reviewed the enumerators' completed assignments to ensure accuracy of the data collection process, and they monitored the enumerators' performance to ensure the enumerators were following all prescribed procedures. In addition to the supervisory reviews, an independent staff reviewed a sample of each enumerator's work to minimize the occurrence of falsified data. The completed assignment reviews looked for housing units that might have been missed. Reviews in the QA program covered approximately 800 enumerators and 1,300 assignments.

2.5 Update / Enumerate (U/E)

The Census Bureau applied the U/E methodology in areas of the country expected to contain a high number of seasonal vacants, such as campgrounds or coastal resorts. Many areas occupied by Native Americans also implemented U/E. In these areas, the Census Bureau had an address list, but the high number of expected vacancies would make it difficult to implement a successful mailout/mailback operation. So, to increase the probability of making contact with these households, enumerators visited each household to complete a census questionnaire and update the address for the housing unit as necessary. Enumerators visited approximately 1,040,000 housing units during U/E.

Similar to the L/E operation, the QA program for U/E involved reviewing each completed address-listing assignment and census questionnaire. It was important to make sure the enumerators were following appropriate procedures and collecting the data accurately. Additionally, an independent staff revisited some households to make certain the original enumerators were accurately collecting and recording data. Reviews in the QA program covered approximately 3,000 enumerators and 18,000 assignments.

2.6 Nonresponse Followup (NRFU)

The largest enumeration operation conducted during Census 2000 was the NRFU operation where enumerators visited households for which the Census Bureau did not receive a questionnaire. Only the MO/MB areas of the country were eligible for this operation. During NRFU, enumerators visited each unit designated for followup and determined the occupancy status of the unit on Census Day to complete the questionnaire accordingly. Enumerators visited approximately 41,500,000 housing units during NRFU.

The QA program for NRFU required a review of each completed questionnaire to ensure compliance with procedures. Additionally, an independent staff revisited some households to ensure the original enumerators were accurately collecting and recording data. The independent staff reviewed some work completed by all enumerators. Reviews in the QA program covered approximately 450,000 enumerators.

2.7 Coverage Improvement Followup (CIFU)

After the completion of the NRFU operation, the CIFU operation visited designated households one final time for Census 2000. The universe for CIFU contained questionnaires for addresses identified as vacant or delete during NRFU, residual NRFU cases (such as mail return forms that have been checked in but lost or are blank), addresses discovered during the new construction update by local governments, and late adds from U/L. CIFU enumerators visited each unit designated for followup and completed the questionnaire according to the occupancy status of the unit on Census Day. Enumerators visited approximately 8,850,000 housing units during CIFU.

The QA program for CIFU required a review of each completed questionnaire to ensure compliance with

procedures. Households that received a vacant or delete status in CIFU, but were not vacant or delete in NRFU, were re-visited to ensure the accuracy of the unit status. Reviews in the QA program covered approximately 638,000 housing units.

3.0 Census 2000 Quality Assurance

Designing and implementing a QA program for the Census 2000 enumeration operations described above represented an immense challenge. There were many factors that we had to account for to ensure we had adequate QA coverage for all census activities, but primarily the challenges we faced were due simply to our census environment. Our QA program had to ensure that all enumerators had their work checked in a timely fashion to ensure the quality of the data they were collecting. Conducting the QA program in a timely fashion was a challenge because the U.S. census must, by law, be produced under a very tight schedule. The use of technology to speed up the transfer of information between the production side of the operations and the QA side helped us to facilitate the implementation of the QA operations.

The goal of any QA program is to promote continuous improvement of the processes. In the census environment, this was difficult due to the lack of real-time information to analyze. The timing constraints mentioned above contributed to this significantly. Throughout Census 2000, we faced the persistent challenge of obtaining data from the QA programs in time to affect change in the operations to improve the process and results. What we could do, however, is use results from the QA operations to make “on-the-fly” improvements to the operation whenever possible. In addition, we are in the process of documenting findings and lessons learned from Census 2000 that we can use to make improvements to future censuses.

3.1 QA for Data Quality

One of the objectives of the Census 2000 QA program was to ensure the quality of the data collected. To achieve this objective, we implemented two main QA operations:

- Questionnaire Review
- Data Entry QA

3.1.1 Questionnaire Review

When enumerators completed their assigned cases, they met regularly with their Crew Leader, who reviewed all questionnaires completed by the enumerators. The Crew Leaders would ensure that the questionnaires were completed correctly, according to the skip pattern on the questionnaire and the rules for interview completeness. This QA check prevented questionnaires that were completed incorrectly from being submitted, which would cause data inconsistencies and could also lead to additional followup with the households and additional burden on our respondents.

Our findings from this QA program indicate that this was a successful endeavor. Table 1 shows the percent of total enumerator questionnaires reviewed and the percent of total questionnaires that required corrections prior to being accepted.

Table 1. Results from the Questionnaire Review Program

Operation	Percent of Total Questionnaires Reviewed	Percent of Total Questionnaires Corrected
RA	46.9	24.6
L/E	72.6	14.6
IA	90.0	80.0
U/E	64.0	12.4
NRFU	74.0	19.4
CIFU	10.0	43.0

These data were taken from the Address Registers and Binders filled out while the enumerators completed their assignments. We believe that more questionnaires were reviewed than documented in the registers and binders. The data for the CIFU operation in Table 1 illustrate this clearly (i.e., only 10 percent reviewed, but 43 percent corrected). So, although the data suggest that we did not achieve our goal of reviewing 100 percent of the questionnaires submitted, we suspect incomplete documentation would account for most of the shortfall.

Based on the results in Table 1, there is clear evidence that the questionnaire review successfully identified and repaired errors on the questionnaires prior to being sent to the office. This early identification and rectification of errors provided feedback to the enumerators regarding errors made and also minimized the time required to correct errors since the errors were identified in the field instead of the office.

3.1.2 Data Entry QA

After enumerators completed questionnaires in the enumeration operations, those questionnaires would be submitted to the Local Census Offices (LCOs) for shipment to the data capture centers. Before the LCOs packaged and shipped the completed questionnaires, clerks within the LCOs would enter key data items from the questionnaires into the automated control system. This control system was designed to allow staff to monitor the progress and results of the enumeration operations in real time. The data items that the clerks keyed were housing unit status (e.g., occupied, vacant, etc.), population count for the household, and vacancy type for vacant households (e.g., seasonal vacant, condemned, etc.).

The data entry system that the LCOs used for this activity contained a QA check that was designed to prevent keying errors. The clerks were required to enter each item twice and if there was a discrepancy between the two values keyed, the system would notify the clerk so they could verify the information they were keying.

Table 2 provides data on the number of times re-keying was required during data entry. These data are broken down by operation (the LCOs did not key data into the control system for the IA and RA operations):

Table 2. Results of the Data Entry QA Program

Operation	Percent of Questionnaires Re-Keyed
L/E	1.3
U/E	1.6
NRFU	1.9
CIFU	1.4

Table 2 illustrates that the clerks in the LCOs were very successful in the consistency of their keying efforts. For all operations, they had to re-key their entries for less than 2 percent of the questionnaires. The data show that keying errors were minimized through the re-keying process. Data are not available regarding which types of keying errors occurred most often.

3.2 QA for Field Work

The second main objective for the Census 2000 QA program was to ensure high-quality performance by the employees conducting the census activities. Our approach to achieve this objective involved performing various checks on the employees' work to make sure they were following prescribed procedures. Primarily, there were three such QA checks -- the Initial Observation, the Dependent QA Check, and the Reinterview program.

3.2.1 Initial Observations

Because all enumerators who worked on Census 2000 enumeration operations were newly-hired, temporary employees, in a couple of enumeration operations, we implemented a QA program that required all enumerators go through an initial observation period. During the enumerators' first assignments, they were "shadowed" by a supervisor. The supervisor would observe the enumerators' work to ensure that they were following proper procedures. During this observation, the supervisor would provide feedback and on-the-job training to the enumerators. Poorly performing enumerators can not only have a negative effect on the quality of the data they are collecting, but also can cause additional burden on our respondents. It is a high priority for the Census Bureau to see to it that our employees conduct themselves in a professional and competent manner.

The initial observation program helped to identify employees who needed additional training or, in some cases, should not be given any further assignments. This provided assurances that the enumerators who were conducting the interviews to collect the census data were abiding by the Census Bureau's high standards for data collection and interviewing.

The goal for the initial observation program was to have all enumerators observed during their initial assignments. We fell short of this goal for both RA and U/L. In the RA operation, approximately 60 percent of the enumerators were observed, and in the U/L operation, approximately 87 percent of the enumerators were observed. However, supervisors were instructed to concentrate their observation efforts on those enumerators who appeared, in the training sessions, to have a weaker grasp on the

concepts and procedures. So, those enumerators who were observed were likely the most in need of immediate feedback on their performance. For all enumerators who were observed, the initial observation program provided important feedback regarding errors made, and it also reinforced high-quality performance.

3.2.2 Dependent QA Check

The Dependent QA program was used for those enumeration operations where the enumerators were responsible for updating the Census Bureau's address lists and maps. In these operations, the enumerators would visit households or geographic regions to verify housing units and map spots on existing lists and maps to ensure accuracy. If enumerators found a household not on the list or map, they would add that household. Similarly, if they found that a household was listed or mapped in error, they would delete that address or map spot, or correct the address or map spot as necessary. Our goal in the QA program for these enumeration operations was to make sure the enumerators were making the correct changes to the address lists and/or maps and thereby minimizing undercoverage or overcoverage.

The Dependent QA check involved a different enumerator re-visiting households and geographic areas that were previously canvassed to verify that the changes made were accurate. The QA enumerator would make note of any errors made by the original enumerator and then make a pass/fail decision based on the number of errors found. If the original enumerator's assignment failed the QA check, that assignment would be re-canvassed by a different enumerator. This program prevented faulty addresses from being added to the Census Bureau's address lists and maps and minimized the occurrence of missed housing units. It also prevented "good" households from being deleted from the lists and maps. The Census Bureau depends heavily on its address lists and maps not only for the decennial censuses, but also the many other surveys it conducts for various internal and external customers. The quality of the address lists and maps is critical to the Census Bureau's mission.

The results from the Dependent QA program (see Table 3 below) show that, for most operations, we were able to check a substantial percent of cases and the vast majority of those cases passed the dependent QA check. For those assignments that did not pass the dependent QA check, the field staff performed 100 percent rectification to ensure the quality of the data.

Table 3. Results from the Dependent QA Operations

Operation	Sampling Rate	Percent of Assignments Passing Dependent QA Check
U/L	6%	96.0
L/E	20%	90.0
IA	13%	98.0
U/E	16%	98.0
CIFU	7%	80.0

3.2.3 Reinterview

The Reinterview program was implemented for most of the enumeration operations (L/E, IA, U/E, and NRFU) and consisted of two components – random and administrative. This program involved a different enumerator re-visiting a sample of households to verify that the original enumerator visited the correct household and collected the necessary information. The additional interview was designed to be a very short so as to minimize the additional respondent burden. The goal of the reinterview program was to detect and deter poor performance in the form of falsification (intentional fabrication of data on the original questionnaire) and unintentional errors. The results of the reinterview program could be used to identify enumerators who needed additional training or who had to be terminated from the operations.

The two reinterview programs complimented each other to provide comprehensive QA coverage of interviewing activities. The random reinterview provided for broad protection, and thus an effective deterrent, across all enumerators; while the administrative reinterview was a targeted approach that identified suspect work quickly and provided a higher probability of detection.

3.2.3.1 Random Reinterview

The random reinterview was implemented by a computer system that selected a random sample of cases from the initial cases that every enumerator completed to be placed into reinterview. This type of reinterview program provided a good deterrent to poor performance because the enumerators were aware their work was eligible for reinterview at any time. The random reinterview was implemented for the IA and NRFU operations. The goal for the random reinterview was to reinterview approximately four percent of the total interviewing workload.

Table 4. Results from the Random Reinterview Operations

	IA	NRFU
Sample Workload	5.6%	4.8%
Number of Enumerators Reinterviewed	713	450,000
Number of Enumerators Committing Errors	32	17,024

Table 4 shows that we exceeded our workload goals for the random reinterview operation in both IA and NRFU. This means that the random reinterview component actually provided greater protection against faulty data than we expected. The random reinterview operations successfully identified enumerators committing errors. The percent of enumerators committing errors was about 0.04 percent for both IA and NRFU. This consistency is important because it shows that the size of the operation was not a factor in the performance of the enumerators. The errors documented in Table 4 contain both intentional and unintentional errors.

3.2.3.2 Administrative Reinterview

The administrative reinterview system was designed as a selective mechanism to identify and flag “suspect” enumerators for further review. The automated program identified enumerators for reinterview by collecting data from enumerators' completed work, producing statistics from those data, and producing a report for supervisors that contained comparisons of characteristics of the enumerators' work to that of the other enumerators in their enumeration area. Any enumerators whose work was significantly different was flagged on the reports and more of their cases possibly placed into reinterview by their supervisor. The reports made supervisors aware of enumerators who were “out of control” for one or more of five variables:

- vacant household rate
- one-person household rate
- household delete rate
- partial interview rate
- average population per household

After reviewing the reports, the supervisors would immediately make the initial determination as to whether or not there was a reasonable explanation for the outlier nature of the enumerator's work. If there was not a reasonable explanation, that enumerator was placed into reinterview so their future work could be checked for continued discrepancies.

The benefit of the administrative reinterview was that it focused on enumerators whose work showed signs of poor performance. Hopefully, the administrative reinterviews resulted in a higher success rate for detecting errors than a straight random check of enumerators. However, to perform the administrative test to identify the suspect enumerators, it was necessary to have sufficient data to make meaningful comparisons. Early in the interviewing activities, there were not enough data, so the random reinterview was necessary to provide adequate early protection against poor performance.

Table 5. Results from the Administrative Reinterview Operations

	L/E	U/E	NRFU
Sample Workload	1.6%	0.8%	0.3%
Number of Enumerators Flagged	2,298	2,931	190,422
Number of Enumerators Reinterviewed	1,342	2,145	34,401
Number of Enumerators Committing Errors	121	297	9,993

The administrative reinterview was expected to have a workload of approximately one percent of the total interviewing workload in each operation. This was based on the parameters in the administrative selection model. From Table 5, it is clear that the L/E operation exceeded our expectation, but the U/E and NRFU did not. One lesson we learned from Census 2000 was that we need to better communicate the goals and objectives of the administrative reinterview so we can ensure that the LCOs understand the importance of using the results of the administrative selection model to guide their reinterview efforts.

Table 5 also illustrates that the administrative model successfully targeted enumerators committing errors. By comparing the data in Tables 4 and 5, it is clear that the administrative reinterview identified a higher percentage of enumerators committing errors than the random reinterview (0.04 percent in the random reinterview versus 29 percent in the administrative reinterview). This is evidence that some or all of the variables we used to identify possible errors did accurately identify enumerators committing errors. We are conducting further research to identify additional variables that will further improve the administrative model's ability to detect poor enumerator performance.

4.0 Conclusion

It is widely believed that Census 2000 was the best census ever conducted by the U.S. Census Bureau. It is clear that the QA program for Census 2000 was the most comprehensive and successful ever conducted. Because the QA program provided coverage of all key enumeration activities, we can feel confident that the quality of the data collected by enumerators in Census 2000 met the high standards set by the U.S. Census Bureau and its customers. We faced many challenges in developing the QA program and we met those challenges with innovation and tenacity – two elements that quality products depend upon.