# A PRELIMINARY EVALUATION OF THE 1960 CENSUSES OF POPULATION AND HOUSING

By Conrad Taeuber and Morris H. Hansen Bureau of the Census

#### INTRODUCTION

The purpose of this paper is to summarize the findings to date of the work on the evaluation of the quality of the 1960 Censuses of Population and Housing. We are bringing together some of the material that has been presented by various staff members on other occasions and are adding some new material that has become available. A general familiarity with the traditional functions of the decennial census in the United States will be assumed. However, some notes about innovations in the 1960 Censuses are offered as background against which we may consider to what extent we achieved our goals.

On the whole, our intention was to collect much the same kind of population data in 1960 as in 1950. Although we planned essentially the same census as in 1950 with respect to content, we tried to achieve this goal with improved accuracy of data and with considerably earlier publication of results, at lower cost than would have been involved by using 1950 methods in 1960. The major changes were therefore procedural.

Among the principal changes in methods in 1960 were the following: (1) Extension of sampling, limiting the complete count to a few basic items, and collecting most of the information from a 25-percent sample of households; (2) extension in the use of <u>electronic equipment</u>, including an auxiliary device (FOSDIC), which eliminated manual card punching; (3) new enumeration methods including the taking of the census in two stages for most of the country, and making use of the Post Office for the distribution of the first-stage forms covering 100-percent data, to be completed and held for the enumerator on his regular door-to-door canvass when he also left the sample data forms at every fourth household for completion and mail-in; and (4) new and more widely applied methods of quality control in data collecting, editing, coding and all the steps in processing leading to the production of final results.

The evaluation work is only partially completed. We tentatively conclude, from the results now available, that in general, our 1960 methods have succeeded in producing a better census than the 1950 Census. More data on a small-area basis have become available (reference 1). We are presenting some evaluation information as a basis for discussion of the completeness of enumeration and accuracy of data on characteristics.

# RELATIVE COMPLETENESS OF COVERAGE OF 1960 AND 1950 CENSUSES

This analysis discusses the accuracy of the 1960 Census count of the total resident population of the United States relative to that of the 1950 Census. The discussion relates to the net change in the total resident population of the United States as indicated by the 1960 and 1950 Censuses and to the independent estimates of the components of change during the decade. The comparison of the independent estimates of change based on the components of change with the net change implied by the 1960 and 1950 Census counts provides some evidence as to whether the 1960 level of net undercount differs appreciably from the 1950 level and in which direction.

Estimates of population change and of the components are as follows:

## (In thousands)

Population April 1, 1960 Population April 1, 1950	.79 <b>,3</b> 23 .51 <b>,3</b> 26
Net increase	·27 <b>,</b> 997
Components of change: Births (corrected for under- registration) Deaths Net movement of aliens and citizens Net movement of Armed Forces abroad	40,963 15,608 +2,695 -330

Expected net increase.....+27,720

From the demographic components of population change indicated above, it appears that the absolute level of net undercount in 1960 was a little lower than in 1950; however, each of these components is subject to varying degrees of error, which have an important impact on the estimated net undercount. This estimate is subject to an error of 100 percent or more, and the impact of this and some alternative estimates will be indicated. Furthermore, 1960 computer processing may have introduced a new element in the intercensal balancing equation and its effect should be considered in any coverage evaluation. These topics are dealt with in more detail below.

First, however, we may speculate about the rate of net underenumeration in the two censuses on

the basis of this estimate. For 1950, we may take three rates for illustrative purposes from table B of The Post-Enumeration Survey: 1950 (Technical Paper No. 4):

	Estimated net undercount in 1950 Census			
Source	Amount (000's)	Percent of esti- mated totals		
PES estimate "Minimum reasonable" estimate Coale estimate	2,091 3,715 5,429	1.4 2.4 3.6		

If now, we subtract 277,000, the estimated increase in coverage, we obtain the following estimates for 1960:

	Estimated net undercount in 1960 Census			
1950 benchmark	Amount (000's)	Percent of esti- mated totals		
PES estimate "Minimum reasonable" estimates. Coale estimate	1,814 3,438 5,152	1.0 1.9 2.8		

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The estimate of births shown above was adjusted for incomplete registration on the basis of the results of the Birth Registration Test of 1950 and extension of these results to 1960. The 1950 Test indicated that 2.1 percent of the births occurring in the January-March 1950 period were not registered. The overall correction for the 1950-1960 decade is about 600,000, or 1.45 percent. If, for example, birth under-registration were 50 percent greater, the intercensal change would be about 300,000 greater and the estimated 1960 net undercount would be larger by that amount. If, on the other hand, birth under-registration were only half as great as estimated (as might be

the case if completeness improved within the stratum of births occurring out of hospitals), then the estimated net undercount in 1960 would be about 300,000 smaller.

#### Deaths

No evidence as to the extent of underregistration of deaths is available. In these computations, however, the data for infant deaths have been adjusted by the factor used for births; approximately 21,000 deaths were added for the entire decade. If, for example, we were to assume that all deaths were incompletely

registered to the same extent as births -- a very unlikely situation--the total adjustment would be 233,000, and the estimated undercount in 1960 would be that much less.

#### Net civilian immigration

Of the three demographic components of change, the estimate of net immigration to the United States is subject to the greatest margin of error. Although the size of the component (net) must be relatively small compared with that of the other components (about 3 million for the decade versus about 40 million births and 15 million deaths), the uncertainty involved in estimating the size of some of the elements that make up net immigration from abroad is very large.

The immigration statistics cover six principal classes of migrants, as defined by the Immigration and Naturalization Service (INS): Immigrant aliens, nonimmigrant aliens, and citizens arriving; emigrant aliens, nonemigrant aliens, and citizens departing. In addition, it is necessary to allow for movement between the United States and Puerto Rico and other outlying areas.

The estimates of the gross components that make up net immigration used in preparing the final intercensal population estimates are shown in table 1.

# Table 1.--MIGRATION: 1950 TO 1960

(In	thousands.	Figures	may	not	add	to	totals	because	of	rounding
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Class of migrant	Net	Total		
	movement	Arrivals	Departures	
Alien immigrants and emigrants Alien nonimmigrants and nonemigrants Citizen passengers arriving and departing Movement to and from Puerto Rico and other outlying areas Total	+2,249 -10 - +455 +2,695	<sup>1</sup> 2,500 <sup>3</sup> 3,459 NA 3,725 NA	<sup>2</sup> 251 <sup>3</sup> 3,469 NA 3,269 NA	

<sup>1</sup>Since July 1957, includes alien nonimmigrants whose status was later converted to immigrants. <sup>2</sup>Based on reported data to July 1957. The INS believes that the number of departures has been quite small in recent years. <sup>9</sup>Data to July 1956 only.

The net movement of U.S. citizens (exclusive of those moving between Puerto Rico and the mainland) was estimated from two different sets of data: (1) INS 'figures on sea and air travel; (2) the census counts of Americans abroad in 1950 and 1960. The first yielded estimates of arrivals and departures whereas the second gives an estimate of net movement only.

The first approach shows 12,264,000 arrivals and 11,984,000 departures, or a net in-movement of 280,000. In this approach, it is implicitly assumed that the large gross volume of movement over our land borders had a zero balance. Thus, the figure +280,000 is subject to a very large margin of error.

The second approach may be summarized as follows:

enumerated abroad, 1950-1960..... 10,000

There are several uncertainties in this estimate: (a) The 1950 Census did not count Americans abroad such as businessmen, students, retired persons, etc. It was assumed that this group, 188,000 in 1960, increased over the decade at the same rate as Federal employees and their dependents overseas; (b) the estimated number of alien dependents of Americans overseas had to be subtracted--41,000 in 1960 and 9,000 in 1950; and (c) births to U. S. citizens abroad are reported voluntarily to U. S. consuls, and the number is probably incomplete.

In view of the net in-movement shown by one estimate and the net out-movement by the other and of the uncertainties concerning both, it was simply assumed for purposes of this paper that there was no net movement of citizens in the 1950-1960 decade. Had the estimate of +280,000 been used, the estimated decrease in coverage would have been 3,000. On the other hand, had the -172,000 been used, the estimated increase in coverage would have been 449,000.

## Net movement of armed forces abroad

The estimate for this component is based on data from the Department of Defense and is believed to be subject to little error. The estimate includes allowance for deaths to Armed Forces overseas during the period and for overseas inductions. (With respect to the enumeration of military personnel overseas, there was about the same numerical difference in 1950 as in 1960 between the census data and data from the Department of Defense. In 1960 the census deficit in the overseas population was about 50,000 out of 700,000, compared with a 1950 deficit of 61,000 out of 400,000.)

#### Computer processing

As is mentioned in the United States summary of general population characteristics (reference 2), 776,655 persons were included in the 1960 count through computer imputation of population to housing units for which there was some evidence of occupancy. Part of this evidence came from an indication of an occupied unit on the housing schedule but with no corresponding FOSDIC-readable persons on the population schedule, and part from a reenumeration of a sample of field "close outs" that were so reported in which it was found that many such units were occupied. In any census there is always a marginal group from the standpoint of whether they were literally "counted." Granted that the 1960 procedure for computer imputation of population was a necessary final stage of the enumerative process, there is, nevertheless, some evidence that the computer may have "overimputed" persons. The amount of this overcount has not been closely determined, but its range could reasonably be from 100,000 to 400,000.

#### Summary

It is evident from the prior discussion that errors in the intercensal estimates of births, deaths, and of military movement are not likely to be of sufficient magnitude to affect the general picture regarding the relative accuracy of the 1960 and 1950 counts. Errors in the immigration data, on the other hand, may be fairly large; and, as stated earlier, it is not possible to determine the direction or approximate size of the net error. The nature of computer imputation for housing units with no occupants listed further clouds the picture.

In summary, if we make no allowance for any overimputation of persons in the special computer procedure, and if we assume no net immigration of citizens in the 1950-1960 decade, the estimated <u>amount</u> of net underenumeration is lower in 1960 than in 1950. If we allow 250,000 for computer overcount then the amount of net underenumeration would be about the same in 1960 as in 1950. Under either assumption the estimated <u>rate</u> of underenumeration would be lower in 1960, and sufficiently lower to indicate a gain of the order of 500,000 to 1,500,000 in the coverage in the 1960 census as compared with what it would have been if the 1950 rate of undercoverage had continued.

# ABSOLUTE ESTIMATES OF COVERAGE AND OF GROSS COVERAGE ERRORS

The previous discussion is concerned primarily with coverage of the 1960 Census as compared to the 1950 Census, and is based on 1950 evaluation study results, and on estimates of population changes between 1950 and 1960. Although the evaluative studies for the 1960 Census have not as yet been brought to final conclusion, many of the results are available, and preliminary findings can be given. Comparisons of independent estimates of coverage errors between censuses are difficult because the evaluation studies themselves differ in effectiveness.

One major method for studying coverage in both 1950 and 1960 was made through a <u>re-enumerative</u> procedure. Omissions and errors in the counting of occupied living quarters are analyzed, as a source of omission and duplicated enumeration of persons. Within properly enumerated living quarters, there can be omissions or erroneous inclusions of occupants. Table 2 shows estimates of coverage errors for 1960 and 1950, as estimated from re-enumerative surveys.

Table 2.--ESTIMATES OF POPULATION COVERAGE ERROR

(Percent of Census total)

Enumeration errors	1960	1950
Omissions of persons	3.0	2.3
In missed living quarters	1.6	1.6
In enumerated living quarters	1.4	0.6
Erroneous inclusions of persons	1.3	0.9
Net undercoverage of persons	1.7	1.4

The estimates in table 2 are not entirely comparable for 1960 and 1950. In 1960, the check for missed persons included "housing units" and all "group quarters." In 1950, the check included "dwelling units" (comparable to "housing units" in 1960) and "quasihouseholds" where less than 35 persons had been enumerated. In addition, there was a difference in the timing and effectiveness of the re-enumeration procedures.

On the basis of other studies and evidence, it was concluded that the net undercoverage in the 1950 Census was substantially underestimated by the 1950 Post-Enumeration Survey (PES) (reference 3), especially for persons not readily identified with a regular place of residence. As a consequence of weaknesses detected in 1950 re-enumerative procedures, steps were taken to strengthen corresponding procedures in 1960. Therefore, for 1960, there are higher, and perhaps more reasonable, estimates of net undercoverage than in 1950.

The results of analytical methods previously described may be combined with the evidence from the re-enumerative studies to give some overall estimates of net undercount. Through resurvey methods a net undercount of population of about 1.7 percent may be estimated, and through analytical methods between 1.0 and 2.9 percent. Considering the evidence now available, Steinberg (reference 4), et al have indicated that a reasonable estimate of the level of net undercount in 1960 seems to be in the range of 1.7 to 2.0 percent of the total as compared to the "minimum reasonable" estimate in the 1950 Census of 2.4 percent. In absolute terms, this amounts to a net undercount in 1960 of 3 million to 31 million people.

A composite of analytic methods, reported on by Akers (reference 5), gives us some estimates of net undercounts for 1960 by sex, age and color (see table 3). The estimates are fairly reliable for ages under 25 but are quite rough for the older ages. For ages under 25, the estimates are based on survivors of births. Coale's iterative method was used to estimate ages 25 to 64, as well as ages 65 to 74 for whites. Another iterative method using mortality data was used for the older ages and for nonwhites 65 to 74.

Table 3.--ESTIMATES OF NET CENSUS UNDERCOUNT BY BROAD AGE GROUPS, SEX, AND COLOR: 1960

(Composite of preferred methods. A plus sign indicates a net overcount.)

(Percent)

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Age	All classes	White male	White female	Non- white male	Non- white female
All ages	-2.3	-1.1	-1.7	-10.3	-7.1
Under 5 yrs. 5-14 yrs 15-24 yrs 25-44 yrs 45-64 yrs 65 yrs. and	-2.6 -2.1 -4.0 -2.6 -2.3	-2.1 -2.3 -3.3 -2.2 -0.2	-1.4 -1.3 -2.3 -0.7 -1.8	-7.9 -4.8 -13.9 -16.0 -13.0	-6.4 -3.8 -9.5 -6.2 -12.8
over	+0.9	+8.1	-4.5	+7.9	-2.6

Entirely different estimates of net census undercount of the population 65 and over are suggested by a comparison of estimates of the population 65 years and over in 1960. The 1960 estimate of this population based on survivors of the 1950 population and other factors fell short of the census count by about 900,000, or 5.5 percent. A similar discrepancy was also noted in 1950 and 1940. In the interpretation of this discrepancy for earlier censuses, greatest weight was given to erroneous reporting of age at the latest census. However, an examination of the population count for ages 55 to 64 in 1960 and of age misreporting as indicated in the reenumerative procedure tends to discount this factor as a major source of bias. Nor can a deficiency in the reporting of immigration contribute much to the explanation. In view of the lack of evidence regarding the relative weights of various factors, a fuller explanation of the discrepancy must await the results of the other studies in the evaluation program.

Table 4 shows a comparison of estimates for 1960 and 1950 for undercounts of children under one year of age and under five years for whites and nonwhites. These results reflect the accuracy of age reporting as well as completeness of coverage. The figures are based on estimates of survivors of births, using birth registration data and estimates of underregistration made by the National Vital Statistics Division. Each of the age and color groups shown, except 10 to 14, indicates considerable improvement in 1960.

Table 4.--ESTIMATED PERCENTAGE OF NET CENSUS UNDERCOUNT OF CHILDREN

Color and year	Under one year	Under five years old	5 to 9 years old	10 to 14 years old
TOTAL				
1960 1950	2.0 11.0	2.6 4.7	2.4 3.6	1.9 1.8
WHITE				
1960 1950	1.2 10.1	1.8 4.0	2.0 2.7	1.7 1.0
NONWHITE				
1960 1950	5.8 16.6	7.2 9.7	4.8 9.6	3.7 6.3

Further evaluation of the 1960 Census will be possible as final results of a series of studies become available. Of interest is a <u>de facto</u> enumeration of persons present in a sample of enumerated living quarters and a number of "reverse record checks" that are being carried through, involving samples from other sources being matched against the census.

#### NONRESPONSE RATES

Table 5 provides a comparison of nonresponse rates in the 1960 and 1950 Censuses for a few characteristics. Most of the nonresponse rates compared are higher in 1960 than in 1950.

In 1950, after an enumerator had made reasonable but unsuccessful efforts to obtain census information about persons from the usual acceptable respondents, he was instructed to make inquiries from neighbors. This procedure was followed in 1960 only for the 100-percent items for which neighbors might provide reasonably acceptable information.

In 1960, for the sample items, there was a close-out procedure instructing the enumerator to obtain information about persons from acceptable respondents only, and to terminate his efforts after three calls. This procedure was patterned after CPS policy which does not permit the enumerator to obtain information about a person from any source other than a responsible member of the household. In the 1960 Census, when a nonresponse rate in an enumerator's assignment was found to be unacceptable on review, further follow-up work was to be done by hourly rate enumerators.

The 1960 procedures were based on the assumption that allowing information to be obtained from neighbors and other unqualified respondents encouraged poor standards and loose work, and that with a reasonably low nonresponse rate, mechanical imputation yielded data that are more reliable than inquiry of neighbors or informal imputation by the enumerator. For some items (such as place of birth and mother tongue, occupation, place of work and means of transportation) nonresponses were not imputed in the computer, but were tabulated as NAs. The alternative methods for dealing with nonresponse still need to be evaluated. At present, it is difficult to appraise whether the higher nonresponse rates in 1960 (table 5) represented a deterioration or improvement in quality.

The increase in nonresponse for age, which is a 100-percent item, presumably results from the collection of information by date of birth, instead of age in years as of the last birthday.

Table 5.--PERCENT OF NONRESPONSE FOR SELECTED CHARACTERISTICS: 1960 AND 1950

Selected characteristics	Percent nonresponse		
	1960	1950	
Age State of birth	<sup>1</sup> 1.7 2.7	0.2 1.0	
(persons 5-34 yrs. old) Highest grade completed	8.3	<sup>2</sup> 5.9	
(persons 25 and over)	4.9	4.6	
Employment status (persons 14 & over)	3.1	1.0	
Occupation (employed persons)	4.9	1.3	
Children ever born (to women ever married) Income (persons 14 & over)	6.0 6.2	9.0 6.7	

<sup>1</sup>Year or decade of age not reported. The 1.7 figure is obtained on the basis of Stage I or 100percent enumeration. In Stage II, the corresponding nonresponse figure was 1.0 percent. <sup>2</sup>Enrollment data available only for persons 5

"Enrollment data available only for persons 5 to 29 years old in 1950.

In considering the NA rates for occupation, it should be noted that employment status was computer-allocated in 1960, but not in 1950 when NA's for employment were placed in the category, "Not in the labor force." The NA rates with respect to "occupation" are taken relative to the number of employed persons. The 1960 allocation procedure for employment tends to increase the NA's for occupation. Hence, the difference in procedure probably accounts for a part of the higher NA rate for occupation in 1960 compared with 1950.

The income NA rates shown here for 1960 and 1950 are also not strictly comparable because the additional editing performed in 1960 and the revised questions tended to reduce the number of NA's that had to be imputed by the computer. For example, in 1950, all persons who failed to report on work experience and on earnings were counted as income nonrespondents; in 1960, persons who failed to report on work experience and on earnings, but were subsequently assigned by the computer to the category "Did not work in 1959" were assigned "None" codes in "Wage or salary" and in self-employment income and were not counted as NA's on earnings. Also, the modification in the 1960 questions eliminated from consideration those persons who did not have work experience during the preceding 10 years. In 1950, however, the income questions were to be asked of all persons 14 years of age and over. Both these changes tended to reduce the NA rates for 1960.

The Census in 1960 was taken by a two-stage procedure for about 82 percent of the population, and by the usual "one-stage" procedure elsewhere (reference 6), including, for the most part, the more sparsely settled areas. Some comparisons of nonresponse rates for occupation for 1960 and 1950 were made for single-stage and two-stage cities of similar size by Shryock and Greene (reference 7). Sixteen of the largest singlestage cities were selected and matched to cities of similar size enumerated by the two-stage procedure. The entire 1950 Census was taken in one stage. Comparisons were made with the 1950 nonresponse rates for the same 32 cities selected for 1960. The results are summarized in table 6.

Table 6.--EMPLOYED PERSONS NOT REPORTING OCCUPA-TION, PERCENTAGES FOR SELECTED CITIES ENUMERATED BY SINGLE-STAGE AND TWO-STAGE METHODS IN 1960 BY COLOR: 1960 AND 1950

	Percent of nonresponse for occupation				
(employed persons)	Single- stage cities	Two- stage cities			
All persons, 1960	4.0	6.5			
All persons, 1950	1.0	1.1			
White persons, 1960	3.9	5.8			
Nonwhite persons, 1960	4.4	10.1			

Thirteen of the two-stage cities had a nonresponse rate in excess of their "comparable" single-stage cities. For 1950, however, the nonresponse rates do not indicate any pattern of difference between the two groups of cities.

An inspection of nonresponse rates for 100percent items (see table 7) can be made for 1960 by size of place (reference 8). The central cities of urbanized areas, where there are special problems of enumeration, had a relatively large number of imputations compared with percentages for the United States as a whole. Corresponding figures for rural areas were relatively low, and those for urban areas outside central cities of urbanized areas were generally near those for rural areas.

Table 7.--ALLOCATION FOR NONRESPONSE FOR THE UNITED STATES BY SIZE OF PLACE: 1960

Size of place	Number of persons	Per- sons sub- sti- tuted (per- cent)	Per- sons with one or more allo- cations (per- cent)
United States Urban total Central cities Urban fringe Other urban:	179,323,175 125,268,750 57,975,132 37,873,355	0.4 0.5 0.6 0.3	3.0 3.2 3.9 2.6
or more Places of 2.500	16,172,839	0.3	2.7
to 10,000 Rural total: Places of 1,000	13,247,424	0.4	2.5
to 2,500 Other rural	6,496,788 47,557,637	0.3 0.4	2.4 2.4

This type of allocation shown in the column "Persons substituted," not included in the other percentages in this table, consists of cases where persons, and all their characteristics, were substituted for an estimated number of persons in households for which the enumerator obtained no population data.

As indicated earlier, moderate NA rates, of themselves, are not in general a satisfactory indicator of quality of the census measurements for characteristics. The NA rate for CPS, which we regard as of high quality relative to the census, is approximately four or five percent for most items, and considerably higher for some. In part, this NA rate results from the fact that interviewing must be completed within a very short time.

On the other hand, where NAs run to 25 or 50 percent or more for a particular area, it can only be interpreted as providing poor data for that area. This, for example, was the situation in the city of Chicago where among census tracts having 1,000 inhabitants or more, there were three tracts, each containing one or more EDs, in which allocation rates were 50 percent or more for a majority of the sample items.

# ERRORS IN PROGRAMMING AND TABULATING

It is not possible, of course, to give a meaningful quantitative summary of errors in programming and tabulating. Some errors are important; others are trivial. Minor differences between tables resulted from imperfections in the processing of the data, but these are much smaller in magnitude for the 1960 Census than for earlier censuses. There is at least one major tabulation error, however, which was not caught until after publication. The figure for Westchester County (N.Y.) residents born in the United Kingdom was shown as being larger than the county's total population.

Programming errors affected all publication areas, except that sometimes an error was found and corrected after several States had already been tabulated and retabulation of the first States was not deemed feasible. Sometimes corrected figures are obtained and shown separately with the errata. At other times, the reader is simply told the nature of the error (and usually the direction of the bias), but the corrected figures are not available.

# RESPONSE BIAS

# Introduction

Since NA rates, when they are relatively low, do not necessarily provide an adequate measure of quality, a more valid test of the results is made after imputation for the NAs. Such measures of quality are estimated by comparing census results with other data regarded for this purpose, as of better quality or as "preferred" for particular items of information. In this context, preferred data may be informa-tion independently obtained through record keeping or reporting systems, other independent surveys, or reinterview surveys. When the census and the "preferred" data collection method yield comparable summary measurements of the same characteristics, the differences between corresponding summary statistics, taking sampling error into account, can be considered as a measurement of <u>net response error</u>, or

response bias. Gross error, or response variance, will be discussed later.

For purposes of this discussion of response bias, census results will be compared with results from the Current Population Survey, with information independently obtained by other governmental agencies for education and income, and with results obtained through intensive reinterviews of a sample of 1960 Census respondents. We take the difference between a census result (C) and a comparable result from another source regarded for the present as a standard (S), and compute: (C-S)/S as a measure of relative response bias.

# Comparison of Census results with CPS results

Labor force data were not collected in the intensive reinterview study; the Current Population Survey is used as the standard against which census statistics of the employment status of the population are measured (see table 8 and reference 9). The April CPS data for 1950 and 1960 are used for comparison although there are differences in the time reference. The census enumeration was spread over time and the data do not relate to a single week, but they relate mostly to a week in April.

Without exception, for all population groups shown, there is evidence, according to CPS results, of census undercount of persons in the labor force. However, except for persons employed in agriculture, the differences relative to CPS results are smaller for 1960 than for 1950. Differences in employment in agriculture may be especially affected by the variations in time reference.

(It should be noted that the usual sampling error estimates apply to the CPS data, and also to the differences between Census and CPS data, regarding sampling error for the census results as trivial.)

The response biases, as previously defined, are indicated in columns 4 and 8 of table 8.

# Response bias in 1960 Census education statistics

Two basic items of information on education were collected in the census: school enrollment and educational attainment.

# Table 8. --- COMPARISON OF EMPLOYMENT STATUS, CENSUS AND CPS

(Percent)

$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		1960				1950			
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Employment status	Census	April CPS	Difference	Difference rel. to CPS	Census	April CPS	Difference	Difference rel. to CPS
All persons, 14 years old and over       55.5       57.0       -1.5       -2.7       53.7       56.9       -3.2       -5.6         Employed		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	All persons, 14 years old and over								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	In labor force	55.5	57.0	-1.5	-2.7	53.7	56.9	-3.2	-5.6
In agriculture	Employed	52.6	54.0	-1.4	-2.6	51.2	53.7	-2.6	-4.8
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	In agriculture	3.5	4.4	9	-21.3	6.3	6.6	3	-5.0
Unemployed.2.93.01-4.72.63.26-19.9Not in labor force.44.543.01.53.646.343.13.27.4White11.3-2.353.456.5-3.0-5.4Buployed.52.754.0-1.3-2.451.153.5-2.44.6Unemployed.2.62.62.6-0.0282.43.0-6-19.9Not in labor force.44.743.41.33.046.643.53.07.0Nomhite52.154.6-2.5-4.552.155.6-3.5-6.3In memployed.50.06.1-1.2-19.44.45.6-1.1-20.3Not in labor force.43.039.33.79.343.438.84.611.9Male111.67.5-2.075.878.3-2.6-3.3In agriculture.6.67.8-1.3-1.611.811.811.8-6In agriculture.3.94.2-2.2-3.644.066.5-2.5-3.8Unemployed.3.94.2-2.2-6.03.95.0-1.1-20.3In labor force.21.920.11.88.720.316.73.621.7Female11.811.811.811.8-6-3.8-3.6-4.4In nan-agricultural industries32.3	In non-agricultural industries	49.2	49.6	5	9	44.9	47.1	-2.2	-4.8
Not in labor force.44.543.01.53.646.343.13.27.4WhiteIn labor force.55.356.6 $-1.3$ $-2.3$ 53.456.5 $-3.0$ $-5.4$ In labor force.52.754.0 $-1.3$ $-2.4$ 51.153.5 $-2.4$ $-4.6$ Unemployed.2.62.6 $02$ $8$ $2.4$ 3.0 $6$ $-19.9$ Not in labor force.44.743.41.33.046.643.53.07.0Nomwhite57.060.7 $-3.7$ $-6.0$ 56.6 $61.2$ $-4.6$ $-7.5$ Imployed.52.154.6 $-2.5$ $-4.5$ 52.155.6 $-3.5$ $-6.3$ Unemployed.50.06.1 $-1.2$ $-19.4$ 4.45.6 $-1.1$ $-20.3$ Not in labor force.78.180.0 $-1.8$ $-2.2$ 79.783.3 $-3.6$ $-4.4$ Imployed.75.7 $-1.5$ $-2.00$ 75.878.3 $-2.6$ $-3.3$ In agriculture.6.667.9 $2$ $3$ 64.066.5 $-2.5$ $-3.8$ In non-agricultural industries67.667.9 $2$ $3$ 64.066.5 $-2.5$ $-3.8$ In labor force.21.920.11.88.720.316.73.621.7FemaleIn labor force.34.936.3 $-1.4$ $-3.9$ 29.232.1 $-2.9$ $-9.2$ In non-agriculturel indu	Unemployed	2.9	3.0	1	-4.7	2.6	3.2	6	-19.9
White55.356.6-1.3-2.353.456.5-3.0-5.4Employed	Not in labor force	44.5	43.0	1.5	3.6	46.3	43.1	3.2	7.4
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	White				I				
Employed52.754.0 $-1.3$ $-2.4$ 51.153.5 $-2.4$ $-4.6$ Unemployed2.62.6 $02$ $8$ 2.43.0 $6$ $-19.9$ Not in labor force44.743.41.33.046.643.53.07.0NomwhiteIn labor force	In labor force	55.3	56.6	-1.3	-2.3	53.4	56.5	-3.0	-5.4
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Employed	52.7	54.0	-1.3	-2.4	51.1	53.5	-2.4	-4.6
Not in labor force. $44.7$ $43.4$ $1.3$ $3.0$ $46.6$ $43.5$ $3.0$ $7.0$ Nomwhite $57.0$ $60.7$ $-3.7$ $-6.0$ $56.6$ $61.2$ $-4.6$ $-7.5$ Employed. $52.1$ $54.6$ $-2.5$ $-4.5$ $52.1$ $55.6$ $-3.5$ $-6.3$ Unemployed. $50$ $6.1$ $-1.2$ $-19.4$ $4.4$ $5.6$ $-1.1$ $-20.3$ Not in labor force. $43.0$ $39.3$ $3.7$ $9.3$ $43.4$ $38.8$ $4.6$ $11.9$ Male $78.1$ $80.0$ $-1.8$ $-2.2$ $79.7$ $83.3$ $-3.6$ $-4.4$ Employed. $78.1$ $80.0$ $-1.8$ $-2.2$ $79.7$ $83.3$ $-3.6$ $-4.4$ Male $74.2$ $77.7$ $-1.5$ $-20.0$ $75.8$ $78.3$ $-2.6$ $-3.3$ In agriculture. $6.6$ $7.8$ $-1.3$ $-16.3$ $11.8$ $11.8$ $1$ $-56$ In non-agricultural industries $67.6$ $67.9$ $2$ $3$ $64.0$ $66.5$ $-2.5$ $-3.8$ Unemployed. $3.9$ $4.2$ $2$ $-6.0$ $3.9$ $5.0$ $-1.1$ $-21.6$ Not in labor force. $34.9$ $36.3$ $-1.4$ $-3.9$ $29.2$ $32.1$ $-2.9$ $-9.2$ Employed. $33.0$ $34.3$ $-1.4$ $-4.0$ $27.8$ $30.5$ $-2.7$ $-8.8$ In agriculture. $6$ $1.3$ $6$ $-50.0$ $1.0$ <	Unemployed	2.6	2.6	02	8	2.4	3.0	6	-19.9
Nomwhite57.060.7 $-3.7$ $-6.0$ 56.661.2 $-4.6$ $-7.5$ Employed52.154.6 $-2.5$ $-4.5$ 52.155.6 $-3.5$ $-6.3$ Unemployed506.1 $-1.2$ $-19.4$ $4.4$ 5.6 $-1.1$ $-20.3$ Not in labor force43.039.33.79.343.438.84.611.9Male $-74.2$ 75.7 $-1.5$ $-2.2$ 79.783.3 $-3.6$ $-4.4$ Employed6.67.8 $-1.3$ $-16.3$ 11.811.8 $-1.6$ $-3.7$ In agriculture6.67.8 $-1.3$ $-16.3$ 11.811.8 $-1.6$ $-6$ In non-agriculturel industries67.667.9 $2$ $3$ 64.066.5 $-2.5$ $-3.8$ Unemployed21.920.11.88.720.316.73.621.7Female $-1.4$ $-3.9$ 29.232.1 $-2.9$ $-9.2$ $-9.2$ In labor force34.936.3 $-1.4$ $-3.9$ 29.232.1 $-2.9$ $-9.2$ Employed33.034.3 $-1.4$ $-3.9$ 29.232.1 $-2.9$ $-9.2$ In nagriculture61.3 $6$ $-50.0$ 1.01.6 $6$ $-37.2$ In non-agricultural industries32.3 $33.1$ $7$ $-2.2$ $26.8$ $28.9$ $-2.1$ $-7.3$ In non-agricul	Not in labor force	44.7	43.4	1.3	3.0	46.6	43.5	3.0	7.0
In labor force.57.060.7 $-3.7$ $-6.0$ 56.661.2 $-4.6$ $-7.5$ Employed.52.154.6 $-2.5$ $-4.5$ 52.155.6 $-3.5$ $-6.3$ Unemployed.5.06.1 $-1.2$ $-19.4$ 4.45.6 $-1.1$ $-20.3$ Not in labor force.43.039.33.79.343.438.84.611.9Male </td <td>Nonwhite</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	Nonwhite								
Employed52.154.6 $-2.5$ $-4.5$ 52.155.6 $-3.5$ $-6.3$ Unemployed5.06.1 $-1.2$ $-19.4$ 4.45.6 $-1.1$ $-20.3$ Not in labor force43.039.33.79.343.438.84.611.9MaleIn labor force78.180.0 $-1.8$ $-2.2$ 79.783.3 $-3.6$ $-4.4$ Employed6.67.8 $-1.3$ $-16.3$ 11.811.8 $-1.6$ $-3.3$ In agriculture6.67.8 $-1.3$ $-16.3$ 11.811.8 $-1.6$ $-3.6$ Unemployed3.9 $4.2$ $2$ $-6.0$ $3.9$ $5.0$ $-1.1$ $-21.6$ Not in labor force21.920.11.88.720.316.7 $3.6$ 21.7Female $-6$ $-50.0$ 1.01.6 $6$ $6$ In agriculture $-6$ $-7$ $-2.2$ $26.8$ $28.9$ $-2.1$ $-2.7$ $-8.8$ In agriculture $-6$ $-7$ $-2.2$ $26.8$ $28.9$ $-2.1$ $-7.3$ In non-agricultural industries $32.3$ $33.1$ $7$ $-2.2$ $26.8$ $28.9$ $-2.1$ $-7.3$ In	In labor force	57.0	60.7	-3.7	-6.0	56.6	61.2	-4.6	-7.5
Unemployed5.0 $6.1$ $-1.2$ $-19.4$ $4.4$ $5.6$ $-1.1$ $-20.3$ Not in labor force43.0 $39.3$ $3.7$ $9.3$ $43.4$ $38.8$ $4.6$ $11.9$ Male $78.1$ $80.0$ $-1.8$ $-2.2$ $79.7$ $83.3$ $-3.6$ $-4.4$ Employed $74.2$ $75.7$ $-1.5$ $-2.0$ $75.8$ $78.3$ $-2.6$ $-3.3$ In agriculture $6.6$ $7.8$ $-1.3$ $-16.3$ $11.8$ $11.8$ $11.8$ $-1.6$ In non-agricultural industries $67.6$ $67.9$ $2$ $3$ $64.0$ $66.5$ $-2.5$ $-3.8$ Unemployed $3.9$ $4.2$ $2$ $-6.0$ $3.9$ $5.0$ $-1.1$ $-21.6$ Not in labor force $21.9$ $20.1$ $1.8$ $8.7$ $20.3$ $16.7$ $3.6$ $21.7$ Female $-1.4$ $-3.9$ $29.2$ $32.1$ $-2.9$ $-9.2$ In agriculture $.6$ $1.3$ $6$ $-50.0$ $1.0$ $1.6$ $6$ In agriculture $.6$ $1.3$ $6$ $-50.0$ $1.0$ $1.6$ $6$ $-37.2$ In non-agricultural industries $32.3$ $33.1$ $7$ $-2.2$ $26.8$ $28.9$ $-2.1$ $-7.3$ In babor force $1.9$ $1.9$ $04$ $-2.1$ $1.3$ $1.6$ $2$ $-15.8$ Not in labor force $65.1$ $63.7$ $1.4$ $2.2$ $70.8$ $67.9$ $2.9$	Employed	52.1	54.6	-2.5	-4.5	52.1	55.6	-3.5	-6.3
Not in labor force	Unemployed	5.0	6.1	-1.2	-19.4	4.4	5.6	-1.1	-20.3
Male78.180.0 $-1.8$ $-2.2$ 79.783.3 $-3.6$ $-4.4$ Employed74.275.7 $-1.5$ $-2.0$ 75.878.3 $-2.6$ $-3.3$ In agriculture6.67.8 $-1.3$ $-16.3$ 11.811.8 $-1.1$ $6$ In non-agricultural industries67.667.9 $2$ $3$ 64.066.5 $-2.5$ $-3.8$ Unemployed3.94.2 $2$ $3$ 64.066.5 $-2.5$ $-3.8$ Unemployed21.920.11.88.720.316.73.621.7Female33.034.3 $-1.4$ $-3.9$ 29.232.1 $-2.9$ $-9.2$ Employed33.034.3 $-1.4$ $-4.0$ 27.830.5 $-2.7$ $-8.8$ In agriculture61.3 $-6$ $-50.0$ 1.01.6 $6$ $-37.2$ In non-agricultural industries32.3 $33.1$ $7$ $-2.2$ $26.8$ 28.9 $-2.1$ $-7.3$ Unemployed1.91.9 $04$ $-2.1$ $1.3$ $1.6$ $2$ $-15.8$ Not in labor force $65.1$ $63.7$ $1.4$ $2.2$ $70.8$ $67.9$ $2.9$ $4.3$	Not in labor force	43.0	39.3	3.7	9.3	43.4	38.8	4.6	11.9
In labor force.       78.1       80.0       -1.8       -2.2       79.7       83.3       -3.6       -4.4         Employed.       74.2       75.7       -1.5       -2.0       75.8       78.3       -2.6       -3.3         In agriculture.       6.6       7.8       -1.3       -16.3       11.8       11.8       -1.1      6         In non-agricultural industries       67.6       67.9      2      3       64.0       66.5       -2.5       -3.8         Unemployed.       3.9       4.2      2       -6.0       3.9       5.0       -1.1       -21.6         Not in labor force.       21.9       20.1       1.8       8.7       20.3       16.7       3.6       21.7         Female	Male								
Employed74.275.7-1.5-2.075.878.3-2.6-3.3In agriculture6.67.8-1.3-16.311.811.8-1.16In non-agricultural industries67.667.92364.066.5-2.5-3.8Unemployed3.94.22-6.03.95.0-1.1-21.6Not in labor force21.920.11.88.720.316.73.621.7FemaleIn labor force34.936.3-1.4-3.929.232.1-2.9-9.2In agriculture61.36-50.01.01.66-37.2In non-agricultural industries32.333.17-2.226.828.9-2.1-7.3Unemployed1.91.904-2.11.31.62-15.8Not in labor force65.163.71.42.270.867.92.94.3	In labor force	78.1	80.0	-1.8	-2.2	79.7	83.3	-3.6	-4.4
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Employed	74.2	75.7	-1.5	-2.0	75.8	78.3	-2.6	-3.3
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	In agriculture	6.6	7.8	-1.3	-16.3	11.8	11.8	1	6
Unemployed	In non-agricultural industries	67.6	67.9	2	3	64.0	66.5	-2.5	-3.8
Not in labor force       21.9       20.1       1.8       8.7       20.3       16.7       3.6       21.7         Female       34.9       36.3       -1.4       -3.9       29.2       32.1       -2.9       -9.2         Im labor force       34.9       36.3       -1.4       -3.9       29.2       32.1       -2.9       -9.2         Imployed       6       1.3      6       -50.0       1.0       1.6      6       -37.2         In non-agricultural industries       32.3       33.1      7       -2.2       26.8       28.9       -2.1       -7.3         Unemployed       1.9       1.9      04       -2.1       1.3       1.6      2       -15.8         Not in labor force	Unemployed	3.9	4.2	2	-6.0	3.9	5.0	-1.1	-21.6
Female       34.9       36.3       -1.4       -3.9       29.2       32.1       -2.9       -9.2         Im labor force	Not in labor force	21.9	20.1	1.8	8.7	20.3	16.7	3.6	21.7
In labor force.       34.9       36.3       -1.4       -3.9       29.2       32.1       -2.9       -9.2         Employed.       33.0       34.3       -1.4       -4.0       27.8       30.5       -2.7       -8.8         In agriculture.       .6       1.3      6       -50.0       1.0       1.6      6       -37.2         In non-agricultural industries       32.3       33.1      7       -2.2       26.8       28.9       -2.1       -7.3         Unemployed.       1.9       1.9      04       -2.1       1.3       1.6      2       -15.8         Not in labor force.       65.1       63.7       1.4       2.2       70.8       67.9       2.9       4.3	Female								
Employed	In labor force	34.9	36.3	-1.4	-3.9	29.2	32.1	-2.9	-9.2
In agriculture	Employed	33.0	34.3	-1.4	4.0	27.8	30.5	-2.7	-8.8
In non-agricultural industries       32.3       33.1      7       -2.2       26.8       28.9       -2.1       -7.3         Unemployed       1.9       1.9      04       -2.1       1.3       1.6      2       -15.8         Not in labor force       65.1       63.7       1.4       2.2       70.8       67.9       2.9       4.3	In agriculture	.6	1.3	6	-50.0	1.0	1.6	6	-37.2
Unemployed         1.9         1.9        04         -2.1         1.3         1.6        2         -15.8           Not in labor force         65.1         63.7         1.4         2.2         70.8         67.9         2.9         4.3	In non-agricultural industries	32.3	33.1	7	-2.2	26.8	28.9	-2.1	-7.3
Not in labor force 65.1 63.7 1.4 2.2 70.8 67.9 2.9 4.3	Unemployed	1.9	1.9	04	-2.1	1.3	1.6	2	-15.8
	Not in labor force	65.1	63.7	1.4	2.2	70.8	67.9	2.9	4.3

63

In a paper by Nam (reference 10) for overall figures on enrollment in the public schools, two comparisons were made from information now available (see table 9). First, in accordance with its annual practice, the U. S. Office of Education issued an estimate of total enrollment, from kindergarten through the twelfth grade, based on a brief mail questionnaire sent to all offices of State school systems in the fall of 1959 requesting enrollment figures as of October 1, 1959, or as close to that date as enrollment stabilization was believed to have occurred. The census information referred to school enrollment between February 1, 1960 and the census date. Secondly, the CPS had a school enrollment question in October 1959. This information was gathered in the usual CPS way, and is subject to CPS sampling error.

Table 9

Source	Enrollment (millions)
1960 Census	35.3
1959 Office of Education Survey	35.2
1959 CPS (October)	34.9

The census figure might be expected to be slightly lower than the 1959 OE fall figure because the Census data refer to the spring semester and some slight attrition at these grades takes place between the fall and spring terms. However, some shifting from parochial or other private schools to public schools probably also takes place during that time, and this shifting would tend to compensate for the attrition effect. At any rate, the figures are quite close. Also, when considering comparable figures on a State basis (reference 10), in only 13 States is the difference between Census and the OE figures as great as 3 percent and in only one State (Alaska) is the deviation extreme. Most of these differences by States, moreover, can probably be attributed, in great part, to varying definitions of residence or to transfers or residential mobility between States in the interval from fall to spring.

College enrollment data from the 1960 Census can also be compared with the October 1959 CPS and with the 1959-60 biennial Office of Education Survey (see table 10). The OE information is obtained from college and university officials. Although the CPS and OE figures are in close agreement, the Census differs from both to a marked degree.

Table 10

Source	Enrollment (millions)
1960 Census	2.9
1959 CPS (Oct.)	3.3
1959-1960 OE Survey	3.4

A special inquiry concerning fall and spring enrollment, sent to the largest universities in six States where the Census figure fell appreciably below the OE figure, showed that the attrition rate was very close to the difference between the two sets of figures.

# Response bias in 1960 Census income data

For evaluation of census income data with respect to response bias, two sources of information are now available: CPS data and estimates of the Office of Business Economics (OBE). In the present section, some findings reported by Miller (reference 11), about CPS and OBE estimates compared with Census data (see table 11) are made. All relate to aggregate income for the year 1959 for 1960 comparisons and the year 1949 for 1950 comparisons.

Table 11.--CENSUS, CPS AND OBE ESTIMATES OF AGGREGATE INCOME, BY TYPE OF INCOME, FOR THE UNITED STATES: 1959 AND 1949

<u> </u>	Cen	sus <sup>1</sup>	CPS <sup>2</sup>			
Year and type of income	Dollar amount	Per- cent dif- fer- ence from OBE	Dollar amount	Per- cent dif- fer- ence from OBE	OBE 3	
1959						
Total income Wages & salaries Self-employment.	331.7 246.5 47.9	-5.6 -1.0 13.5	306.7 233.5 38.3	-12.7 -6.3 -9.2	351.4 249.1 42.2	
than earnings	37.3	-37.9	32.7	-45.6	60.1	
1949						
Total income Wages & salaries Self-employment. Income other	173.2 124.3 431.1	-9.3 -3.5 -0.6	159.8 120.0 26.5	-16.3 -6.8 -15.3	191.0 128.8 31.3	
than earnings	416.6	-46.3	13.3	-57.0	30.9	

<sup>1</sup>Total population 14 years old and over. <sup>2</sup>Persons 14 years old and over, excluding inmates and members of Armed Forces living on base. <sup>3</sup>Total population, all ages.

<sup>4</sup>Estimates on preliminary sample tabulations because final data do not contain distribution of income by type.

A comparison of the Census and OBE estimates by type of income shows that in 1949 and 1959 there was very close agreement for wages and salaries but evidence of substantial underreporting of income other than earnings in the Census. In each case the Census estimate was in closer agreement with OBE than were the CPS figures and there was also substantial reduction in underreporting in 1960 compared to 1950. Census and OBE estimates for regions and States were in close agreement for 1959. Census estimates were less than 90 percent of OBE estimates for only four States.

# Age heaping

An additional point of some interest in relation to response bias, approached analytically, is a decline in "age heaping", as shown in a recent study (reference 12).

In each census in which data on single years of age have been collected, there have been overstatements of ages ending in certain digits and understatements for other digits. In 1960, further reduction in the overall age heaping has occurred, according to an index used by Myers (reference 13) based on a percentage distribution of ages by final digit for the population aged 23 to 99 years (see table 12 for 1960).

Table 12

Ending digit of age	Percent in digit group in 1960
All digits	100.0
0 1 2 3 4 5 6 7 8 9	9.9 9.9 9.8 10.1 10.3 9.9 10.1 9.8 10.3

The index is one-half the sum of the deviations from 10.0 percent, each taken without regard to sign. For 1960, this index is 0.8. Comparisons are made with other census years back to 1880 in table 13.

Table 13

Census years	Index of age-heaping
1880.         1890.         1900.         1910.         1920.         1930.         1940.         1950.         1960.	10.4 7.8 4.7 5.6 4.5 4.3 3.0 2.2 0.8

In 1960 and in 1900, "date of birth" rather than "age as of last birthday" was the inquiry, and the improved question together with the extension of the trend, and opportunity for selfenumeration in 1960 may be largely responsible for less age heaping. The reduction in 1960 compared with 1950 occurred for both males and females in the white and nonwhite classifications (see table 14).

Table 14 .-- SUMMARY INDEX OF AGE HEAPING

(Population 23 to 82 years)

	Wh	ite	Nonwhite		
Total	1960	1950	1960	1950	
Male Female	0.5 0.6	1.6 2.2	2.6 2.2	5.6 6.4	

However, when the age heaping indexes are combined for ages ending in 0-4 and 5-9, to measure the effect of heaping on age statistics tabulated in the conventional 5-year groups (table 14a), no improvement is noted between the 1950 and 1960 censuses and no particular trend appears over the years.

Table 14a .-- INDEX OF AGE HEAPING

(Combining 5-year age groups)

Census year	Index
1880.	0.3
1890.	0.3
1900.	0.1
1910.	0.3
1920.	0.6
1930.	0.4
1940.	0.2
1950.	0.3
1960.	0.4

Response bias for various characteristics as measured by the intensive reinterview survey

Following the 1960 Census as in 1950, a "population content evaluation study" was conducted to obtain measures of response error with respect to selected items of information. In 1960, an intensive reinterview approach was used (Study EP-10) comparable in some ways with the Post Enumeration Study (PES) (reference 3) of 1950. In both cases, the interviewer was to obtain responses before consulting previously obtained census responses. Following the reinterview procedure for the samples reported on here, the interviewer was to compare the new response with the corresponding census entries, and where there were differences, an effort was made to determine the more accurate response or an improved response ("reconciliation").

As reported by Pritzker and Hanson (reference 14) study EP-10 used a more intensive interview procedure than the PES, interviewer training was more thorough, and the study was conducted after a shorter time following the census. For these and other reasons, EP-10 results (1960 are believed to be more accurate than PES results (1950). Thus the net differences observed in tables 19 through 23 at the end of this paper must be interpreted in the light of procedural differences in the two studies.

In considering the results shown in this series of tables, note that a larger bias for 1960 than 1950 could result from an improved reinterview study in 1960, a reduced accuracy in the census in 1960, or both. The data in tables 19-23 are consistent with the view that, on the whole, both census and reinterview procedures produced more accurate results in 1960 than in 1950. However, the findings of Study EP-10 are difficult to interpret, and the tables are offered for consideration and discussion. The results are based on person-to-person comparisons of responses and for any item include only cases for which responses were obtained in both the census and in the evaluation program.

In 1960, EP-10 is regarded as giving "preferred" results; in 1950, the PES gives the "preferred" results. For each classification of persons, the percentage in the classification according to the reinterview study is subtracted from the corresponding census result. A negative sign for "bias" indicates a lower census value. Where both 1950 and 1960 results are available, the differences in the absolute values of the relative biases are given, where a plus sign indicates a higher level of error in 1950 than in 1960.

The population characteristics for which bias measures are shown in some detail are in the following tables at the end of this paper:

> Table 19.--Sex and color Table 20.--Age by five-year classes Table 21.--Mobility status Table 22.--Educational attainment Table 23.--School enrollment

#### EVIDENCE ON RESPONSE VARIANCE

Because of time and space limitations, this presentation does not discuss the technical development of measurement devices. Persons who are especially interested in theoretical considerations may consult references 14, 15, and 17 listed at the end of this paper.

We approach the estimation of response variance in two ways, the first of which is associated with repetitions of some defined phase of data collection or processing. This condition is approximated by the familiar concept of reinterview, or by "matching" information from two or more sources for identical individuals, or by the repetition of a processing operation such as the coding of the same interview data by different persons. This basic trialto-trial average variability results in gross differences. The intensive reinterview survey (EP-10) gave us two measurements for each person reinterviewed, for selected items of information. The diagram below illustrates the approach.

<u> </u>	Census							
Reinterview survey	In age class 40-44 years	Not in age class 40-44 years	Total					
In age class 40-44 years Not in age	8.	Ъ	a + b					
years	с	đ	c + d					
Total	a + c	b + d	n = a + b + c + d					

Where paired responses were identical, the "zero difference" made no contribution to the response variance (cells a and d). When the responses were different, the effect was to remove a person from one classification, and place him in another (cells b and c). For example, a person whose age in the census was reported as 43 years and as 45 years in the reinterview survey would be classified in the first case in the "age class 40-44 years," and in the second case "not in age class 40-44 years." This difference in response would result in an entry in cell c. Note that a minor change in response not resulting in a change in classification (or cell) would have, for present purposes, no statistical effect.

The sum (b + c) relative to the number of persons n, in both the original and the reinterview survey, (b + c)/n, is called the "gross difference rate," identified as "g."

The estimated "index of inconsistency," shown in the last columns of tables 19-23, and represented by I, makes use of the measure of "gross difference rate" in such a way as to make these estimates of inconsistency or response more comparable from one item to another. This is accomplished by dividing the gross difference rate by 2pq, where p is the proportion of the specified population that has the characteristic under consideration, and q = 1 - p.

That is  $I = \frac{g}{2pq}$ 

The denominator 2pq approximates the maximum value that the gross difference rate g can have under independent repetitions of a survey.

Some average values of I for sex, race, fiveyear age classes, mobility-status and educational attainment classes are shown in table 15. As for tables 19-23, table 15 makes use of parallel information from the PES of 1950 and Study EP-10 for 1960.

Table	15	. —— Pri	CLIMINA.	RY E	STI	MATE	cs of	THE	A VERAG	Е
INDEX	OF	INCOL	ISISTEN	CY (	I)	FOR	SELE(	TED	POPULA	-
		TION	STATIS	TICS	:	1960	) AND	1950	0	
		(	ENSUSE	s of	PO	PULA	TION			

	Estimated unweighted average index per class				
Characteristic	1960 Census	1950 Census	Dif- fer- ence		
	(1)	(2)	(3)		
Sex Race Five-year age classes Mobility-status classes <sup>1</sup>	.018 .045 .054 .120	n.a. n.a. .070 .335	n.a. n.a. .016 .215		
classes (population 25 years old and over only)	.256	.394	.138		

<sup>1</sup>Mobility during a one-year period in 1950 and during a five-year period in 1960.

In general, comparisons of the indexes of inconsistency show lower indexes for 1960 than for 1950. At first glance, this might seem to be a clear indication of a reduction in response variance in the 1960 Census. Actually the situation is not so simple; an improved evaluation program in 1960 would reduce the indexes of inconsistency, even with no changes in the quality of the census. It follows that reductions in the indexes of inconsistency might have occurred as a result of improvement of the intensive reinterview survey in 1960 as compared with 1950, or as a result of improvement in the 1960 Census as compared with 1950, or both. Efforts were made to achieve improvements in both the census and the evaluation program, and on the basis of this fact and other evidence there are reasons to believe that both of these factors influenced the reduction in the indexes of incosistency.

Another study common to 1960 and 1950, offering comparable estimates of indexes of inconsistency, is the Current Population Survey results matched in the census results (CPS- Census Match) (reference 14). As noted earlier, the CPS is regarded as the "preferred" method, compared to the census, for the collection of labor force information. In the CPS-Census Match, Stanley Greene brought together the data for a sample of about 8,000 households enumerated in both the April 1960 CPS and in the 1960 Census. Estimates of indexes of inconsistency for 1960, and the comparable CPS-Census match data for 1950, are shown in table 16.

Again it should be noted that often the census data have a different time reference from the CPS data. However, there is some reason to believe that the CPS was of about equivalent quality in 1950 and 1960. Column 3 of table 16 shows differences in the respective indexes of inconsistency, most of which are slightly favorable to the 1960 Census.

Although CPS reinterview in relation to original CPS results are somewhat irrelevant in a discussion of census results, it may be of interest to have a measure of the reliability of CPS data since they are used to evaluate census data (see table 17). Columns 7 and 8 show indexes of inconsistency for both reconciled and unreconciled results (reference 15). Indexes for the unreconciled results, which are more directly comparable to the CPS-Census match in which there was no reconciliation, are roughly half the values for I for 1960 shown in table 17.

The coding variance study (reference 16) was largely a by-product of the quality control scheme used in the 1950 census, using a sample of 1 in 40 households from the 25 percent sample for whom occupation and industry data were collected. Three different coding clerks with approximately the same training and coding experience all coded independently from the census schedule, but only one person, the "Census Coder," entered his code on the census schedule. The coded results were then matched. An index of inconsistency, analagous to the one previously described, made use of all three codes.

	Index of inco	Difference <sup>1</sup>	
Sex and labor-force status	1960 Census	1950 Census	(2) - (1)
	(1)	(2)	(3)
Males			
In the civilian labor force	.177	.205	+.028
Employed	.170	.196	+.026
<ol> <li>In agriculture</li></ol>	.224 .132	.144 .140	080 +.008
Unemployed	.500	.513	+.013
Not in the civilian labor force	.177	.205	+.028
Females			
In the civilian labor force	.192	.195	+.003
Employed	.175	.180	+.005
<ol> <li>In agriculture</li></ol>	.593 .156	.957 .145	+.364 011
Unemployed	.720	.751	+.031
Not in the civilian labor force	.192	.195	+.003

Table 16.--ESTIMATES OF THE "INDEX OF INCONSISTENCY" FOR LABOR-FORCE CLASSIFICATIONS IN THE 1960 AND 1950 CENSUSES OF POPULATION, FOR THE "IDENTICAL POPULATION" FOURTEEN YEARS OLD AND OVER, BY SEX

 $^1\rm Minus$  sign indicates greater unreliability in 1960 Census than in 1950 Census; plus sign indicates greater unreliability in 1950 Census.

Table 17.—PROPORTIONS OF PERSONS IN INDICATED CLASSIFICATIONS IN ORIGINAL AND REINTERVIEW SURVEYS (FOR IDENTI-CAL PERSONS) AND GROSS DIFFERENCE RATES RELATIVE TO 2 pq FOR RECONCILED AND UNRECONCILED RESULTS AS SPECIFIED

Survey and item classification	<pre>p1: proportion in class in original survey (percent)</pre>		<pre>p2: proportion in class in reinterview survey (percent)</pre>		g (percent)		g relative to 2pq <sup>1</sup> (I)	
	Unrec- onciled	Recon- ciled	Unrec- onciled	Recon- ciled	Unrec- onciled	Recon- ciled	Unrec- onciled	Recon- ciled
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CPS, 1958-1961, status in labor force-								
In labor force	55.8	56.2	56.0	56.9	4.1	1.6	.08	.03
Employed	52.3	52.8	52.5	53.2	3.9	1.4	.08	.03
Agriculture	4.8	4.6	4.8	4.7	1.2	.4	.13	.05
Nonagriculture	47.6	48.1	47.7	48.5	3.5	1.4	.07	.03
Full time	36.1	36.7	36.4	36.5	4.4	1.5	.09	.03
Part time	9.1	9.0	9.2	9.6	4.6	1.7	.28	.10
With a job, not at work	2.4	2.4	2.2	2.4	1.4	.5	.32	.11
Not employed	3.4	3.5	3.5	3.6	1.9	.8	.29	.11
Not in labor force	44.2	43.8	44.0	43.2	4.1	1.6	.08	.03

<sup>1</sup>Here, p is defined as  $(p_1 + p_2)/2$ , and q is 1-p.

	Ind	lustry code	28	Occupation codes					
Index of inconsistency	Number of codes	Percent of codes	Estimated percent of labor force <sup>1</sup>	Number of codes	Percent of codes	Estimated percent of labor force			
.001100 .101200 .201300 .301400 .401500 More than .500 Total codes <sup>*</sup>	59 56 23 6 2 4 150	39.3 37.3 15.3 4.1 1.3 2.7 100.0	73.6 18.8 6.6 0.8 0.1 0.1 100.0	142 93 41 11 4 5 29 <b>6</b>	48.0 31.4 13.9 3.7 1.3 1.7 100.0	74.4 22.4 2.6 0.2 0.3 (2) 100.0			

Table 18. ---NUMBER OF INDUSTRY AND OCCUPATION CODES BY INDEX OF INCONSISTENCY

<sup>1</sup>Estimates based on a sample of 420,000.

<sup>2</sup>Less than .05 percent.

<sup>3</sup>Includes the codes for "not report."

<sup>4</sup>Excludes Code 000 "Accountants and auditors" because of programming error.

Table 18 gives the distributions of the 149 industry codes and 296 occupation codes by size of the inconsistency index. A substantially larger proportion of occupation codes have low indexes of inconsistency than do industry codes. Forty-eight percent of the occupation codes as compared with 39 percent of the industry codes had indexes between .001 and .100. For both types of coding, the .001 to .100 class accounted for about 74 percent of the experienced civilian labor force.

A further study, made of the 20 percent or so codes having the highest indexes indicated that industry codes for <u>wholesale trades</u> were particularly troublesome.

For all classifications of the data discussed, it should be noted that gross differences which may be compensating in substantiating degree for simple means may have more significant effect when measuring relationships between classes of the population. The effect of gross differences on relationships should be a subject for further study.

## Enumerator variance study

The special concern of this evaluation study was to develop estimates of the variance in census results attributable to enumerators and their immediate supervisors. It was anticipated that the heavy use of self-enumeration on sample items, and the consequent use of enumerators only in the follow-up program in 1960 would reduce the effect of the variability attributable to enumerators well below that of 1950. The preliminary results available from 24 out of 50 studies designed to measure enumerator variance support this conclusion. More definitive answers will be available on the completion of the 50 studies.

# SUMMARY REMARKS AND CONCLUSIONS

Evaluation of the completeness of coverage and quality of measurement of a census is difficult. Attempts have been made to compare the relative quality of the 1960 and the 1950 Censuses. In addition, an effort has been made to compare each of these censuses with other sources of data, but at best such comparisons can provide only limited evidence. There is reason to believe that for some elements in the population it is becoming increasingly difficult to conduct a satisfactory enumeration. Substantial efforts to develop improved procedures are needed to keep up with changing conditions and to avoid deterioration from one census to the next.

On the whole, we conclude that there were improvements in the quality of the 1960 Census as compared with 1950. Some of the indicated improvements have been substantial and some have been minor. Publication of results has been much earlier than in the comparable period following 1950; costs were less than would have been indicated by the changes in price levels and the growth of the population, and there was an increase in the amount of information that was made available.

Users generally have been given more information concerning the quality of the published data than ever before. Not all of the gains that were hoped for were achieved and hindsight reveals a number of errors that one wishes had been avoided. For some areas and for some topics the rates of non-response are troublesome to the users of the data.

We are by no means complacent that we have achieved the quality of results that are needed or can be achieved. It is obvious that much remains to be desired in improved quality of censuses in both coverage and content. In the discussion with this and other groups, a great deal of attention should be concentrated on the effect of errors on the various uses to which census results are put, and on methods and studies that may result in increased accuracy of census results. We welcome the discussion and consideration that is offered by this meeting.

## ACKNOWLEDGMENTS

Most of the evaluation program of the 1960 Censuses has been carried out under the direction of Joseph Steinberg, Chief, Statistical Methods Division. The planning has been the joint responsibility of Leon Pritzker, Chief, Response Research Branch, Statistical Research Division, Joseph Steinberg, and numerous other staff members, under the general direction of William N. Hurwitz, Chief, Statistical Research Division. Many persons in the Bureau played important parts in collecting the data and reducing it to manageable form. Their contributions are too many and varied to acknowledge here. The principal work of drafting this paper was done by Marie D. Wann, Mathematical Statistician. Henry S. Shryock, Jr., Assistant Chief (Program Development), Population Division, drafted the section on comparative coverage of the 1960 and 1950 Censuses, and has provided helpful comments and advice, as have many others who have participated in the various aspects of the evaluation program.

Characteristic and category	1960 Census (percent)	Bias <sup>1</sup> x 100	Relative bias x 100	I	
	(1)	(2)	(3)	(4)	
Sex					
Male	49.3	+0.2	+0.4	.018	
Female	50.7	-0.2	-0.4	.018	
Color					
White	88.6	+0.2	+0.2	.045	
Nonwhite	11.4	-0.2	-1.7	.045	

Table 19.--ESTIMATES OF BIAS IN THE STATISTICS AND OF THE "INDEX OF INCON-SISTENCY" FOR SEX AND COLOR IN THE 1960 CENSUS OF POPULATION, FOR THE "IDENTICAL POPULATION"

NOTE: See section VII A of text for explanation of "Index of Inconsistency". <sup>1</sup>Minus sign indicates understatement in Census; plus sign indicates over-

Table	20ESTIMATES C	F BIA	5 IN	THE	STATI	ISTICS	AND (	OF THE	"INDEX	OF	INCONS	SIST	ENCY "	FOR	FIVE-YE	AR AGE
	CLASS	ES IN	THE	1960	AND	1950	CENSUS	SES OF	POPULA	TION	, FOR	THE	"IDE	NTICA	L POPUL	ATION"

	Perce distri	Percentage distribution Bias x 100 <sup>1</sup> Rela			Relative x 10	bias O	Index	Index of inconsistency, I			
Age class	1960 Census	1950 Census	1960 Census	1950 Census	1960 Census	1950 Census	Difference <sup>2</sup> (6)-(5)	1960 Census	1950 Census	Difference <sup>2</sup> (9) - (8)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
0-4. 5-9. 10-14. 15-19. 20-24. 25-29. 30-34. 35-39. 40-44. 45-49.	11.3 10.4 9.4 7.4 6.0 6.1 6.7 7.0 6.5 6.1	10.7 8.8 7.4 7.1 7.6 8.1 7.6 7.5 6.8 6.0	+.01 +.02 +.05 07 04 +.08 03 +.12 +.03 12	18 +.08 +.01 +.11 +.02  +.04 +.06 +.09	+.06 +.16 +.47 -1.00 79 +1.53 49 +1.85 +.44 -1.85	-1.63 +.92 +.11 +1.64 +.26 03 +.48 +.78 +1.38 07	+1.57 +.76 36 +.64 53 -1.50 01 -1.07 +.94 -1.78	.020 .029 .024 .029 .037 .036 .043 .058 .078 .071	.025 .028 .034 .040 .051 .062 .076 .075 .088 .101	+.005 001 +.010 +.011 +.014 +.026 +.033 +.017 +.010 +.030	
50-54	5.4 4.7 4.0 3.5 2.6 3.1	5.5 4.8 4.0 3.3 2.3 2.6	+.03 +.10 10 +.09 11 05	+.02 16 04 02 03	+.59 +2.11 -2.77 +2.63 40 -1.80	+.30 -3.11 -1.04 52 +.12 -1.07	29 +1.00 -1.73 -2.11 28 73	.078 .063 .098 .078 .095 .032	.112 .103 .084 .090 .095 .051	+.034 +.040 014 +.012 +.019	

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NOTE: See section VII A of text for explanation of "Index of Inconsistency". <sup>1</sup>Minus sign indicates understatement in Census; plus sign indicates overstatement. <sup>2</sup>Minus sign indicates higher level of error in 1960 Census than in 1950 Census; plus sign indicates higher level of error in 1950 Census.

	Percent	in class	Bias x 100 <sup>2</sup>		R	elative	bias <sup>3</sup> x 100	Index of inconsistency, I			
Mobility-status classes <sup>1</sup>	1960 Census	1950 Census	1960 Census	1950 Census	1960 Census	1950 Census	Difference <sup>3</sup> (6)-(5)	1960 Census	1950 Census	Difference <sup>3</sup> . (9) - (8)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Same house	50.7	82.6	+1.4	+0.3	+2.6	+0.3	-2,3	.072	.223	+,151	
Different house, same county	30.3	11.4	+0.3	-0.7	+1.2	-5.8	+4.6	.125	.260	+.135	
Different county, same State	8.7	3.0	-0.7	+0.1	-7.6	+2.3	-5.3	.108	.274	+.166	
Different State	9.0	2.7	-0.9	+0.2	-11.2	+8.3	-2.9	.107	.336	+.229	
Abroad	1.3	0.4	-0.2	+0.2	-13.3	+278.3	+265.0	.187	.584	+,397	

Table 21 .-- ESTIMATES OF THE BIAS IN THE STATISTICS AND OF THE "INDEX OF INCONSISTENCY" FOR MOBILITY-STATUS CLASSES IN THE 1960 AND 1950 CENSUSES OF POPULATION, FOR THE "IDENTICAL POPULATION" FIVE YEARS OLD AND OVER IN 1960 AND ONE YEAR OLD AND OVER IN 1950

NOTE: See section VII A of text for explanation of "Index of Inconsistency."

Residence five years prior to the Census data for the 1960 Census; residence one year prior to the Census data for the 1950 Census. <sup>2</sup>Minus sign indicates understatement in Census; plus sign indicates overstatement. <sup>3</sup>Minus sign indicates higher level of error in 1960 Census than in 1950 Census; plus sign indicates higher level of error in 1950 Census.

Table 22.--ESTIMATES OF BIAS IN THE STATISTICS AND OF THE "INDEX OF INCONSISTENCY" FOR EDUCATIONAL ATTAINMENT CLASSES IN THE 1960 AND 1950 CENSUSES OF POPULATION, FOR THE "IDENTICAL POPULATION" TWENTY-FIVE YEARS OLD AND OVER

Andrew States of the Antonia Contractory	Percentage distribution		<b>Bias x</b> 100 <sup>1</sup>			Relative x 10	bi <b>as</b> O	Index of inconsistency, I			
Educational attainment class	1960	1950	1960	1950	1960	1950	Difference <sup>2</sup>	1960	1950	Difference <sup>2</sup>	
	Census	Census	Census	Census	Census	Census	(6)+(5)	Census	Census	(9) - (8)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
None	2.3	2.6	-0.01	-1.0	-0.7	-29.0	+28.3	.238	.554	+.316	
Elementary, 1-4 years	6.1	8.5	-0.5	+0.3	+8.5	+3.6	-4.9	. 309	.360	+.051	
Elementary, 5-6 years	7.5	9.4	-0.8	-0.6	-11.0	-5.7	-5.3	. 333	.479	+.146	
Elementary, 7 years	6.4	7.0	-0.8	-1.2	-11.1	-14.3	+3.2	. 399	.604	+.205	
Elementary, 8 years	17.5	20.8	+0.7	+1.4	+4.6	+7.3	+2.7	. 300	.400	+.100	
High school, 1-3 years	19.2	17.4	+0.7	-0.7	+3.6	-4.0	+0.4	.240	. 375	+.135	
High school, 4 years	24.6	20.7	-0.5	+0.3	-1.9	+1.3	_0.7	.186	. 263	+.077	
College, 1-3 years	8.8	7.3	+1.0	+1.0	+11.4	+15.0	+3.6	.224	.339	+.115	
College, 4 or more years.	7.7	6.2	+0.2	+0.5	+3.1		+5.6	.074	.170	+.096	

NOTE: See section VII A of text for explanation of "Index of Inconsistency".

<sup>1</sup>Minus sign indicates understatement in Census; plus sign indicates overstatement. <sup>2</sup>Minus sign indicates higher level of error in 1960 Census than in 1950 Census; plus sign indicates higher level of error in 1950 Census.

Table 23.--ESTIMATES OF BIAS IN THE STATISTICS AND OF THE "INDEX OF INCONSISTENCY" FOR SCHOOL ENROLLMENT CLASS IN THE 1960 CENSUS OF POPULATION, FOR THE "IDENTICAL POPULATION" 5 TO 34 YEARS OLD

School enrollment class	Percent of total population in class	Bias x 100 <sup>1</sup>	Relative bias x 100	Index of inconsistency, I
Kindergarten and elementary	37.8	-1.0	-2.2	.038
High school	11.8	-0.1	-1.1	.096
College	3.6	+0.4	+14.9	.158
Not enrolled	46.9	+0.7	+1.9	.041

NOTE: See section VII A of text for explanation of "Index of Inconsistency". <sup>1</sup>Minus sign indicates understatement in Census; plus sign indicates overstatement.

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