AN EVALUATION OF COVERAGE IN THE 1960 CENSUS OF POPULATION BY TECHNIQUES OF DEMOGRAPHIC ANALYSIS AND BY COMPOSITE METHODS

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Method of Demographic Analysis

Introduction.--This paper presents (1) the results of studies using methods of demographic analysis to evaluate the 1960 Census counts and (2) several sets of composite estimates which combine (a) the results derived by various analytic techniques or (b) the results derived by analytic techniques and the case-by-case checking techniques involving reinterviews and matching against independent lists discussed in the companion paper by Messrs. Marks and Waksberg. Because of the close relation between coverage of the total population and the accuracy of the data by age, sex, and color, we are concerned here both with overall underenumeration and with net undercounts (or overcounts) by age, sex, and color.

There are a variety of specific techniques of evaluation that may be classified as techniques of demographic analysis. These techniques make possible the comparison of census counts with some expected result or standard usually derived by the manipulation of such demographic data as census counts and birth, death, and immigration data. There are a number limitations to these techniques. First, the expected results or standards may be defective, either because of errors in the data underlying them or because of oversimplified assumptions in their construction. Second, these techniques serve best to provide estimates of census error which are relative to a previous census or to other categories in the same census, rather than absolute estimates of error. Third, these techniques provide measures of net census error only--i.e., they cannot distinguish between content and coverage error or between compensating overcoverage and undercoverage. Thus, for example, in dealing with the population of the United States classified by age, sex, and color, the method cannot distinguish between coverage error and errors in classifying persons by age, sex, and color.

The advantages of these techniques are, basically, that they deal with an entire universe or subuniverse and are, for the most part, not handicapped by sampling error or the problems of matching; they focus on levels of error which may be more effectively measured, e.g., net census error or deviations from expected ratios; and the defects of the standards or expected results may be small. In addition, the techniques of demographic analysis often provide a strong basis for judging the demographic reasonableness of census results and of other methods of evaluation.

Although the analytic techniques cannot identify the sources of error, it is still advisable to maintain a conceptual distinction vis-a-vis these sources. Thus, when the focus of our analysis is on the total population, the estimated net errors are estimates of coverage error only. In this context we shall use the term "net underenumeration." When the focus of the analysis is on some segment of the total population, e.g., a specific age-sex-color group, the net error actually refers to the joint effect of both errors of coverage and errors of classification. In this context, we shall use the term "net undercount (or overcount)."

Intercensal estimating equation.--An estimate of the accuracy of the 1960 Census count relative to the 1950 Census count can be arrived at by comparing the difference between the two census figures, on the one hand, and the algebraic sum of the estimates of the components of change during the decade, on the other. If the former figure is larger than the latter figure, then the absolute amount of net census underenumeration has decreased; if the latter is larger, then the absolute amount of net census underenumeration has increased. This assumes that the estimate of net change based on components is without error. Several reports and papers have presented the results of comparisons of this kind.1/ The latest Census Bureau's report giving intercensal population estimates for 1950 to 1960 implies that the amount of net underenumeration was almost exactly the same (difference of 3,000) in 1960 as in 1950. However, in their study published in Demography, Taeuber and Hansen gave an estimate of 277,000 increase in coverage between 1950 and 1960. The difference in these two estimates is a result of different assumptions concerning the amount of net migration of U.S. citizens (exclusive of those moving between Puerto Rico and the United States).2/

Taeuber and Hansen note another element of uncertainty in the determination of the relative levels of coverage in the two censuses, namely the possibility of overenumeration in the 1960 Census figures due to over-imputation of persons. The authors state that the range of this overenumeration could reasonably be from 100,000 to 400,000. However, they do not make an allowance for over-imputation in their estimates.

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If we make maximum and minimum allowances for over-imputation and net movement of U.S. citizens, we can generate a range of estimates for the change in coverage between 1950 and 1960. Thus, assuming 400,000 over-imputations and net in-migration of 280,000 U.S. citizens gives a reduced coverage of 403,000 in 1960. Alternatively, assuming no over-imputations and net out-migration of 172,000 U.S. citizens results in an increased coverage of 449,000 in 1960.

Table 1 shows, for various estimates of the percent net underenumeration in 1950, the percent of net underenumeration in 1960 assuming the following changes in absolute coverage between 1950 and 1960: a) no change; b) an increase of 277,000; c) a decrease of 403,000; and d) an increase of 449,000. If the net underenumeration in 1950 was 1.4 percent, as indicated by the 1950 Post-Enumeration Survey, and if the absolute decrease in coverage between 1950 and 1960 was 403,000, then the percent net underenumeration was the same in 1960 as in 1950. All other comparisons show a smaller percent underenumeration in 1960 than in 1950.

Estimates by age, sex, and color.--Estimates have also been obtained of the relative consistency of the 1950 and 1960 Census counts by age, sex, and color. The residuals derived by comparing the expected population is 1960, based on the 1950 Census counts and data on births, deaths, and net immigration, with the census counts in 1960 represent also the differences between the net undercounts in 1960 and 1950 for age cohorts, assuming that the estimates of intercensal change based on component data are without error. The estimates of intercensal change used to bring the 1950 Census figures forward are consistent with an overall estimate of no change (3,000) in absolute coverage between 1950 and 1960. The estimates of intercensal change and the resulting residual estimates have been set forth in Current Population Reports, Series P-25, No. 310.3/ Such estimates are of quite limited usefulness, however, in establishing the net undercounts in the later census since it is almost impossible to eliminate from the residuals the contribution of errors in the earlier census. They may, however, direct attention to possible anomalies in one or the other census, as for example, the apparent large net overcount of persons 65 and over in 1960, especially of nonwhites (13 percent for each sex), an anomaly which has now appeared in three successive censuses.

Some analytic studies carried out at the Census Bureau have yielded estimates of absolute coverage of population by age, sex, and color in 1960. In Current Population Reports, Series P-25, No. 310, adjusted census data for 1950 and 1960 were employed in the process of preparing intercensal estimates of the population from 1950 to 1960. The adjustments in 1960 were derived by carrying adjusted census figures for 1950 forward to 1960 by estimates of intercensal change and comparing the results with the 1960 Census counts. In the case of whites, the estimates of net census undercounts for ages 15 and over for 1950 were those developed by Coale and Zelnik for native whites.4/

The Coale-Zelnik estimates of net undercounts for native whites 15 and over are based on estimates of births for 1855-1934, which in turn result from the backward projection of females 15-29 in the eight censuses from 1880 to 1950 and the assumption of a uniform level of net undercount of these females amounting to 1.4 percent. Coale and Zelnik found that the figures for white female births obtained by "reviving" native white females enumerated in the age span 15-29 were consistently higher than comparable estimates of the same birth cohorts derived by "reviving" females enumerated for ages below 15 and above age 30; i.e., females 15-29 appeared to be the most fully enumerated group. The estimate of 1.4 percent is offered as the minimum net undercount implied by the available evidence and is associated in part with a net undercount of 1.0 percent for white women 15-54 years of age shown by the 1950 Post-Enumeration Survey. The assumption of a net undercount of females 15-29 in recent censuses, combined with the fact that births estimated from females 15-29 in one census are (approximately) equal to births estimated from females 15-29 in the preceding and following censuses, led to the assumption of uniform net undercounts over time. In order to derive estimates of male births, female births were inflated by a constant sex ratio at birth; this was equivalent to increasing births estimated from males by 3 percent, on the average.

The estimates of net undercounts for nonwhites 15 years old and over in 1950 were derived by a variation of Coale's iterative technique using an assumption that the percent of net undercount in 1940 for each 5-year age group below age 35 and each 10-year age group 35 and over was the same as the average of the percents of net undercount for the same age groups in 1950 and 1960.5/ In the case of both whites and nonwhites, estimates of net undercounts under 15 years of age in 1950 were determined by use of birth statistics adjusted for underregistration, brought forward with allowance for changes due to death and migration. Tables 2 (col. 2) and 3 (col. 4) give the resulting percent net undercounts by age, sex, and color, for the resident population of the United States in 1960. 6/

Recent work suggests that the pattern of net undercounts by age in 1960 is markedly different from the patterns in 1950, 1940, and 1930, even though the age patterns in the three earlier censuses are not too dissimilar from one another.7/ As a result of this difference, the iterative technique linking 1950 and 1960 is probably not a suitable technique for estimating net undercounts in 1960, as was done for the

nonwhite estimates in Series P-25, No. 310. We have, therefore, prepared alternative estimates of net undercounts in 1960 for the nonwhite population carrying forward the original Coale estimates of adjusted nonwhite population in 1950 (i.e., those published in 1955) with our estimates of intercensal changes.8/ The Coale estimates of 1950 were derived by an iterative technique on the general hypothesis that the age-patterns of net undercounts were similar in the 1930, 1940, and 1950 Censuses, and on the specific conservative hypothesis that the percent errors in 1930 were equal to those of 1940 or 1950, whichever is less. The least reliable results of this method are at the older ages. Accordingly, the Post-Enumeration Survey results were substituted for persons 65 and over. The 1950 Coale estimates extended to 1960 are offered here as no less reasonable than, and possibly superior to, the other estimates available (see table 3, col. 5).

Estimates based on adjusted births.--In all of the estimates which have been presented up to this point, the expected populations under age 15 in 1950 and under age 25 in 1960 are based on registered births adjusted for underregistration, registered deaths, and estimates of net migration. Since the number of births in any period of time is considerably larger than the number of deaths and net migrants, errors in the completeness of birth registration are of greater consequence for estimates of net census underenumeration and net census undercounts than errors in the other components.

Two tests of the completeness of registration of births have been conducted--one in conjunction with the 1940 Census, the other in conjunction with the 1950 Census. The percent completeness by color and occurrence in hospitals, according to these tests, is as follows:

Year and color	Total	In hospital	Not in hospital
1940			
All classes....	92.5	98.5	86.1
White.....	94.0	98.6	88.2
Nonwhite.....	82.0	96.3	77.2
1950			
All classes....	97.9	99.4	88.2
White.....	98.6	99.5	88.2
Nonwhite.....	93.5	98.2	88.2

Estimates of the completeness of registration for the intercensal years 1940 to 1950 were derived by interpolating between the 1940 and 1950 test results. Specifically, it was assumed that the change in percent completeness followed a linear trend between the decennial years with respect to hospital and non-hospital births, for the white and nonwhite groups separately, for each State.

No test of birth registration completeness was carried out in 1960. As a result, estimates of the completeness of birth registration for years subsequent to 1950 were based on the results of the 1950 test, on the assumption that percent completeness by occurrence in- and not-in-hospital, by color and by State, was the same as in 1950. (In effect, an estimated change in registration for each color group comes about from changes in the proportion utilizing hospitals for childbirth.) Similarly, the results of the 1940 test were used to derive estimates of the completeness of birth registration for the years 1935-39.

Although there were some differences in the designs of the two Birth Registration Tests, they consisted, essentially, of matching birth records covering some specified period of time immediately preceding the census with cards prepared for infants born during that period and enumerated in the census. The major source of error in this procedure, ignoring problems of matching, involves infants who were not enumerated. If, among these persons, the proportion whose birth was not registered was the same as among those enumerated, then their omission from the census would not affect the estimate of completeness of birth registration. However, it is quite likely that among the not enumerated, the proportion whose birth was not registered was higher than among those enumerated. This would mean that estimates of the completeness of birth registration were too high, thereby introducing a downward bias in estimates of population based on adjusted births.

Chandra Sekar and Deming have examined the effect on the estimates of completeness of registration, of the omission of infants in the census 9/ and have suggested a method for estimating the bias. The basic objective of the method is to subdivide an area (either geographically or by a combination of characteristics) into sub-groups each of which is highly homogeneous with respect to enumeration completeness (a completely homogeneous population is defined as one in which each individual has an equal probability of being enumerated). Within such sub-groups, the correlation between unregistered and unenumerated events would be very low. An estimate of the total number of births (registered and unregistered) in the area could then be derived by cumulating the "total number of births" corrected for underregistration. Relating the figure for registered birth to this total would then give a figure approximating the unbiased estimate of completeness of registration. This method was applied by the National Office of Vital Statistics to the results of the 1940 and 1950 tests--in the former case to all States and in the latter to the State with the lowest registration completeness in 1950. The results indicated that underenumeration had little effect on estimates of registration completeness.

In a further attempt to explore this question, we have used the national results of the 1950 Birth Registration Test and the 1950

Infant Enumeration Study in conjunction with two assumptions of dependence between unregistered and unenumerated events to generate two alternative estimates of birth registration completeness in 1950 for total United States. The assumptions we employed were: a) the degree of "not registered" was zero for the "not enumerated" group, and b) the degree of "not registered" for the "not enumerated" was ten times as great as the degree of "not registered" for the "enumerated." These two assumptions led to estimates of completeness of registration of 98.0 percent and 96.9 percent, respectively, as contrasted to the actual estimate of 97.9 percent. Thus, rather extreme assumptions had only very slight effects on the level of the completeness of registration.

Aside from the issue just discussed, it has been suggested that the results of the Birth Registration Tests are biased upward, especially in the case of nonwhites, because of the difficulties of establishing matches.10/ Since it is not possible at this date to examine the original documents, we have employed a fairly extreme assumption to measure the sensitivity of the estimates of net census undercount to an overestimate of the incompleteness of registration. We have assumed for illustrative purposes a reduction of one-third in the annual estimates of the incompleteness of registration of births, by color. Table 4 compares the estimates of net census undercount, for the population under 25 years of age, by age, sex, and color, based on the official estimates of the completeness of registration of births, with estimates employing the assumption stated. We want to emphasize that the results do not provide any information on the accuracy or inaccuracy of the official estimates of the completeness of birth registration. They merely indicate what the effect would be on estimates of net census undercount if the estimates of completeness of registration were in error by as large a margin as we have assumed. The effect is especially noticeable for nonwhites in the age groups 15-19 and 20-24. The estimate of net undercount of nonwhite males 20-24 is reduced from 21 to 11 percent; the corresponding figure for females is reduced from 11 percent to 2 percent.

We are inclined to accept the official estimates of completeness of birth registration, even though these estimates lead to large estimates of net census undercount for nonwhites, especially males. The estimates for nonwhite males aged 20-24 in 1960 arrived at through the use of the official birth registration figures are not very different from the undercounts estimated for nonwhite males aged 20-24 in 1950 by Coale, using an iterative technique,11/ and these estimates are, in turn, similar to the undercount estimated for nonwhite males in 1940 by Price,12/ using Selective Service data. While consistency in the level of net census undercount over three censuses is not proof of the accuracy or validity of any one or all three of the estimates, it does suggest the reasonableness of the estimates. Confidence in the estimates is increased by the fact that the undercounts for the 1940 and 1960 censuses are based on two quite different methods and bodies of data.13/ In our opinion the high undercounts for nonwhite males in 1960 and concern with the possibility of inadequate matching in the tests do not provide sufficient reason for rejecting the results.

Method of expected sex ratios.--We have also employed another analytic technique for estimating net undercounts by age, sex, and color--namely, the application of "expected sex ratios." There are two problems involved in the use of this technique if it is to provide absolute estimates of adjusted population for both sexes. First, it requires an acceptable, independently determined, set of estimates of net undercounts, by age, for one sex. Second, the estimation of expected sex ratios involves a number of approximations which may lead to varying degrees of error. Both of these problems are more difficult to resolve in the case of nonwhites and the older population. We have completed the preparation of a set of expected sex ratios for the resident population, by age and color, which take account of the observed or estimated "actual" sex ratios of births, changing mortality by sex (represented by sex ratios of survival rates from various official life tables combined as quasi-generation life tables), excess war deaths, and the cumulative effects to 1960 of net civilian and military movement to and from the United States by sex. These sex ratios are offered as more realistic than those serving the same purpose which are computed from a single sex ratio of births and a conventional life table for 1960.

The method assumes that the underregistration of births does not vary by sex and that the sex ratios of survival rates are not seriously affected by errors in the basic data used in constructing official life tables. In order to measure illustratively the effect of net census undercounts on the level of the sex ratios of survival rates, and hence on the level of expected sex ratios, the 1900 and 1960 life tables for Negroes or nonwhites were recalculated on the basis of the percent net undercounts for 1960 and the resulting sex ratios of survival rates were compared with similar ratios based on unadjusted life tables. These computations indicate that the expected sex ratios would tend to be higher at most ages if the life tables were adjusted and that they are particularly sensitive to the level of the net undercounts at the older ages, where mortality rates are high.

A comparison of the expected sex ratios and the "enumerated" ratios in 1960 indicates ratios lower than expected at all ages below 50, for whites and nonwhites separately,

especially at ages 20 to 49 for nonwhites (ee table 5 for summary results). At ages above 55 the "enumerated" ratios are usually higher than expected, especially for nonwhites. (Adjustment of the expected sex ratios at these ages for net census undercount does not bring them up to the level of the "enumerated" ratios, however.) The expected sex ratios agree quite closely with the sex ratios of the estimated population under 25 years of age, by age and color, based on births adjusted for underregistration, deaths, and net immigration. Estimates of adjusted male population 25 and over in 1960, employing the sets of expected sex ratios, were derived from the analytic estimates for females and are shown in table 2 (col. 3) and table 3 (col. 6).

Estimates of Negro population.--Another analytic set of estimates of net undercounts is that prepared by Bogue and his associates for the Negro population by age and sex (table 3, last col.).14/ We have given only limited attention to these estimates in our evaluation studies because, as the published critique by Zelnik indicates,15/ they suffer from a number of deficiencies. The methodology includes the use of an adjustment for age heaping to allow for net age-misreporting of grouped data (although the former type of adjustment is not particularly relevant to the latter problem), an (arbitrary) 2-percent estimate of net undercoverage by age, an additional (duplicate) allowance for net undercount of children under 10 based on births adjusted for underregistration, and use of a synthetic life table for 1960 to determine the sex ratios by age. The estimates of net undercounts arrived at by this procedure are generally lower than the other analytic estimates, with the outstanding exception at ages under 10. Coale has pointed out that the Bogue's study has the highly doubtful implication that birth registration has been deteriorating.

Preferred analytic composite.--Using the analytic techniques described so far, a set of estimates was defined representing a "preferred composite based on demographic analysis" (table 6, cols. 3 and 4). The percents of adjustment under age 25 by age and sex were derived from births adjusted for underregistration, carried forward with deaths and net immigration. The percents for the white population 25 and over by age and sex were based on extensions to 1960 of the Coale-Zelnik estimates for 1950. The estimates for nonwhite females 25 and over by age were based on extensions to 1960 of the Coale estimates for 1950. The figures for nonwhite males were obtained by applying expected sex ratios to the nonwhite female population.

Results by age, sex, and color.--The differences among the alternative sets of estimates of net undercounts derived by demographic analysis, excluding the Bogue-Misra-Dandekar estimates, are small. Thus, the estimated net underenumeration for the total population is 3.1 or 3.2 percent, depending on the specific combination made of estimated net undercounts for the sex-color groups. For males, the estimates range from 3.8 to 4.0 percent and for females from 2.3 to 2.4 percent. These alternative sets of estimates yield the same estimate of net undercount for whites, 2.2 percent. For nonwhites, the estimates vary from 10.2 to 10.6 percent. All of these undercounts assume no change in the overall coverage of the 1950 and 1960 Censuses (i.e., a net immigration of 280,000 civilian citizens between 1950 and 1960).

The estimated net undercount for white females is 1.6 percent and for white males 2.8 or 2.9 percent. The differences between the two sexes are most pronounced from ages 15 to 49. At ages beyond this, females appear to be no better enumerated than males. The estimated undercounts for nonwhite males vary from 12.2 to 12.7 percent and for nonwhite females from 7.8 to 8.8 percent. The nonwhites show approximately the same pattern as the whites--smaller undercounts for females through the young adult ages, with smaller undercounts for males at the older ages.

There is wide variation in the estimates of net undercount for persons 65 and over, particularly for white and nonwhite males.

Synthesis of Methods of Evaluation

Comparison of results.--We have described several sets of purely analytic estimates of net undercounts in the 1960 Census and the Marks-Waksberg paper has described the estimates of coverage error derived from the record-matching studies and the reinterview studies. We should now like to consider these in relation to one another.

The results of the various methods for females, and particularly white females, are close, but the results for the other sex-color groups are quite different. (For this discussion, the analytic series principally referred to is the series identified as "preferred composite based on demographic analysis.") The comparative estimates of missed females are 1.8 percent for the reinterview method and 2.4 percent for the analytic method, and of missed males are 1.8 percent for the reinterview procedure and 3.9 percent for the analytic method. Both for males and females the discrepancy is much greater for nonwhites than for whites, although the figures for white males differ significantly too. For nonwhites as a whole, the respective figures are 3.8 percent and 10.5 percent. The estimate of net underenumeration of white females from the reinterview studies and the demographic analysis is virtually identical, 1.7 and 1.6 percent.

The relationships are much more erratic for individual age groups. Figures from the reinterview studies are affected not only by coverage errors but also by age-reporting errors and

other problems of estimation, including sampling errors. Although differences between the analytic estimates and the reinterview estimates (whether total net census error or net coverage error), considered in terms of broad age groups, are relatively small for white female, they are particularly great for white males in the age groups 15-29, 30-44, and 65 and over, for nonwhite males in all age groups except 5 to 14, and for nonwhite females under 5, 15-29, 45 to 64, and 65 and over. In these cases, with the exception of the age group 65 and over, the analytic method shows the larger net undercounts.

Relative limitations of methods.--Each of the three methods of evaluation is subject to various limitations and varying degrees of error. Reference was made to the limitations of the reinterview and record check studies in the paper by Marks and Waksberg. In brief, the record check studies provide an impracticably wide range of estimates of the extent of gross underenumeration. Allowing for gross overenumeration of 1.3 percent, the figures on net undercoverage range from 1.3 percent to 3.4 percent, depending on the assumptions made with regard to the coverage of persons for whom a definite determination about inclusion in the 1960 Census could not be made (16.5 percent of the sample). The figures encompass the available estimates, although some narrowing of the range may be possible.

The analytic studies strongly suggest that the reinterview studies understate the overall coverage error for males and nonwhites. This deficiency applies in the case of all sex-color groups except white females. The understatement of the error for nonwhite males by the reinterview studies is especially apparent in comparison with the "preferred analytic" estimates, but it remains evident even when the "analytic" estimates for males are derived by applying expected sex ratios to female population adjusted by the net coverage error from the reinterview studies. The 4 percent net underenumeration of nonwhite males from the reinterview studies compares with 12 percent and 7 percent from the analytic estimates referred to (table 6, cols. 1, 3, and 5). Some of the estimates of net coverage error by age are unreasonably low, as for example, 0.1 percent for nonwhite males aged 15-29 and 1.2 percent for white males aged 15-29, or unreasonably high, as for example, 6.7 percent for nonwhite males 65 and over. Furthermore, the population sex ratios by age implied by the net coverage errors from the reinterview studies tend to be too low, particularly for nonwhites, although there are some striking "errors" in the opposite direction (table 5, col. 5).

Marks and Waksberg caution against the use of the theoretically more appropriate estimates of net census errors (net coverage error combined with net age-misreporting error) from the reinterview studies on the ground that the age-misreporting-error component is subject to very large sampling errors and response biases, too large to add any information to that afforded by the net coverage error. This component is also affected by the assumptions of the estimating method. Accordingly, we must generally rely on the net coverage error from the reinterview studies to represent the net census error; yet the net coverage error may substantially understate or overstate the net census error if there is a pronounced bias in age reporting. The reliability of the net census errors should be greater for whites and broader age groups.

The analytical approach also has its limitations. There is considerable dependence of the estimates of net undercounts for persons under 25 on the results of the Birth Registration Tests in 1940 and 1950 and yet there is some uncertainty as to the accuracy of these tests. Difficulties in matching of the census records with birth certificates would tend to cause an overstatement of the underregistration of births; and, as indicated earlier, the estimates of net undercounts are quite sensitive to any errors in the correction for underregistration. On the basis of the 1940 test results indicating that 18 percent of nonwhite births were not registered, there is no doubt that there was substantial underregistration of nonwhite births in 1940, but there is a real question about the precise extent of underregistration.

Next, the estimates of net undercounts for nonwhites above age 25 (i.e., 1950 Coale estimates extended to 1960) depend heavily on the assumption of similarity of the pattern of net undercounts at successive recent censuses (1930, 1940, and 1950 in the Coale estimates) and on the estimates of net undercounts for children in these censuses based on births adjusted for underregistration (under 15 in the 1950 Coale estimates). The iterative technique has a tendency to accumulate errors as one goes up the age scale, so that the estimates for the older ages, particularly 65 and over, may be defective. Coale himself rejected his original estimates for 65 and over.

Furthermore, the Census Bureau extension of the 1950 Coale-Zelnik estimates of net undercounts for whites above age 25 in 1960 may be questioned on a number of grounds. There is, first, the acceptability of the fundamental assumptions by which the basic estimates were derived in 1950, particularly the assumption of a common level of net undercount for females 15-29 in each prior census. Further questions relate to the procedure of estimating population by age in 1950 after the historical series of birth estimates was determined, the procedure of extending the estimates for native whites in 1950 to include the foreign-born, and, as in

general, the adequacy of the estimates of intercensal change by which the adjusted population in 1950 was carried to 1960.

Composite estimates based on reinterview studies and demographic analysis.--Despite these limitations, we want to take advantage of these various estimates to develop a set or sets of estimates of population for April 1, 1960, by age, sex, and color, that would be significantly more accurate than the 1960 Census statistics and which could be recommended for general use.

A number of possible criteria for such estimates may be identified. A single set of "best" estimates of net undercounts may be sought. On the other hand, it may be preferable to try to establish a range, giving high and low estimates, or minimum and maximum estimates, of net undercounts. These could be developed in combination with, or independent of, a set of "best" estimates. The range would suggest the degree of uncertainty associated with the estimates of net undercount, although no specific mathematical probabilities could be assigned to the high and low figures. The calculation of alternative estimates has certain limitations and certain advantages. Offering alternative estimates presents certain practical difficulties to many users, who prefer a single set of figures; on the other hand, the availability of a set of high and low figures makes possible choice by the user in conformity with a cost analysis of his problem, which may call for a high or a low figure. He will often prefer the high series, particularly if this is consistent with maximum costs. On the other hand, the high estimates involve the risk of deviating from the true figure more than the census counts do, i.e., they involve the risk of serious overstatement. In fact, it may be considered desirable to avoid overstatement altogether and to develop a set of adjustments which may be regarded with a high degree of certainty as being understatements of the errors in the census counts and yet the largest acceptable estimates of error. As lower bounds of the true figures or "minimum reasonable" estimates, such figures may be described as representing a highly conservative choice of a single set of best estimates.

A few experimental sets of estimates of this kind have been prepared. The starting point for the first set is the estimate of net coverage error for white females obtained from the reinterview studies and the demographic analyses. As noted, the estimate is virtually identical in both sources, 1.7 or 1.6 percent of the census count. The estimated errors for white females differ somewhat by age group in the two series, however. The estimates of net coverage error from the reinterview studies, which are remarkably constant up to age 45 and approximately so throughout the age distribution, were adopted. Thus, estimates of the total number of white females in the United States by age were obtained from the reinterview studies. Since we are attempting to understate the net error, the estimates of nonwhite females derived from the reinterview studies were used in the same way (3.4 percent at all ages as compared with 8.8 percent from the demographic analyses). To derive estimates of the adjusted male population, expected sex ratios were applied to the estimates of adjusted female population. The results are shown in broad age groups in table 6 (set 1). The resulting net errors are: for whites males 3.0 percent, for nonwhite males 6.7 percent, and for the total population 2.6 percent. The use of expected sex ratios gives a net undercount for white males 1.3 percentage points greater than for white females and 3.3 percentage points greater for nonwhite males than for nonwhite females. The resulting figures for males exceed the net coverage errors of the reinterview studies in most age groups and hence are not minimal in relation to the available estimates. However, the net coverage errors for males from the reinterview studies are, for the most part, untenably low now only in relation to the figures for males obtained from the adjusted figures for females and expected sex ratios but also in relation to the net coverage errors for females.

The second set of composite estimates of net undercounts (whites only) also makes use of the fact that the overall net coverage error for white females obtained in the reinterview studies is about the same as the figure shown by the analytic studies. In these calculations, estimates of the population under 25 years of age based on adjusted births, deaths, and net immigration were combined with estimates for females 25 and over consistent with an all-ages coverage error of 1.6 percent for females, and estimates for males 25 and over were then derived from the estimates for females by use of expected sex ratios. These calculations happen to imply a net coverage error of 1.6 percent for the white female population 25 and over also. Females were assigned the net census errors (net coverage error plus net age-reporting error) from the reinterview studies for very broad age groups (Series A, ages 25-44, 45-64, and 65 and over; Series B, ages 25-34, 35-44, 45-54, and 55 and over), and the figures so adjusted were distributed into smaller age groups on the basis of the "demographic" estimates. The resulting estimates of error are shown in table 6 (set 2). The net error for white males is 2.9 percent.

Still another approximation to "conservative best" estimates or "minimum reasonable" estimates are given as set 3 in table 6. In this set the demographic estimates of net undercounts based on adjusted births, deaths, and net immigration were accepted only for ages under 15 (under 5 and 5 to 14).16/ This choice implies sufficient confidence in the results of the 1950 Birth Registration Test to accept the estimates based on births since 1945, but not in the results of the 1940 Test to accept the estimates based on earlier births.17/ For the next three

older groups of females, 15-29, 30-44, and 45-64, we selected the smaller figure as between the estimates of net undercount from the demographic analyses and the net coverage error from the reinterview studies. Accordingly, all figures came from the reinterview studies except that for white females 30-44 years of age. For this group, the figure selected was quite small, 0.1 percent, but it agrees with the net census error from the reinterview studies. Estimates of net undercounts for males were derived by applying expected sex ratios to the adjusted figures for females. To complete this set of estimates, the population 65 and over, for whites and nonwhites, was assumed to have no net error since we have been unable to establish whether the census counts overstated or understated the population. The census counts were then divided by sex on the basis of expected sex ratios.

Estimates for males so calculated are often well above the coverage errors for males from the reinterview studies. This set of figures shows net errors of 2.4 percent for white males, 1.1 percent for white females, 8.0 percent for nonwhite males, and 4.7 percent for nonwhite females (table 6, set 3). These levels of net error are somewhat lower for white males and females, and somewhat higher for nonwhite males and females, than the levels indicated by the composite estimates based on both demographic analysis and reinterview studies, previously computed (i.e., sets 1 and 2 of table 6). The overall level of net underenumeration in 1960, 2.2 percent, is roughly the same as the figure expected on the basis of the Census Bureau's "minimum reasonable" estimate of 2.5 percent for 1950.

A logical weakness of this procedure is that it is unlikely that the net error for all nonwhites 65 and over is zero while nonwhite males are substantially overstated (6 percent) and nonwhite females are substantially understated (5 percent). If, on the other hand, the census counts for both sex groups are taken without adjustment, the implied sex ratio for nonwhites is quite unreasonable (90 as compared with an expected value of 80).

Of course, many other sets of composite estimates of net undercounts, designed to represent conservative estimates, are possible. One could accept the "preferred composite based on demographic analysis" as the best estimates, and reduce these by a fixed proportion, say one third or one-quarter, to derive a set of conservative best estimates. However, this procedure would give estimates for white females below those from the reinterview studies and estimates for ages under 25 below those based on adjusted births.

The various composite series described here would not necessarily increase the accuracy of the relative distribution by age, for the census date. Furthermore, the changes by age since the census date, implied by current estimates of population adjusted on the basis of the composite estimates of net census undercounts, would not necessarily be more realistic than if the data had not been adjusted. These limitations result from the fact that the proportion of the actual net undercounts allowed for in these composite estimates varies from age to age. On the other hand, the absolute level of the adjusted census counts or current estimates at each age (except possibly 65 and over) would be closer to the theoretical truth.

Differential coverage.--One of the main reasons for the concern about the extent of coverage error in censuses stems from the fact that it varies widely among groups of the population (age, sex, color, socioeconomic status, etc.) and geographic areas in the country (States, cities, counties, urban-rural, etc.). If the level of coverage error were the same among all population groups and geographic areas, there would be less need for and concern about the availability of estimates of coverage error.

In general, we believe that coverage error contributes more heavily to the anomalies of the census counts by age, sex, and color than errors of age reporting. Therefore, we are less concerned about age-reporting errors than undercoverage for most of the age distribution; possibly at ages over 50, age-reporting errors become relatively important and may dominate.

Our studies of the quality of the 1960 Census data have indicated the following differences in coverage:

1. The enumeration of males is less complete than that of females, at least up until 45 or 50.

2. The enumeration of nonwhites is substantially less complete than that of whites, probably at all ages but certainly up until about age 60 or 65.

3. The enumeration of males at ages 15 through 44, especially for nonwhites, is less complete than at other ages or the average level over all ages. The population under 5 is no longer to be singled out as a group with especially bad coverage.

In addition, by inference from the 1960 reinterview studies and from the results of the 1950 Post-Enumeration Survey, we may conclude that:

1. There are important geographic variations in the completeness of enumeration. Coverage is probably poorer in the central cities of our metropolitan areas than in the suburban counties and probably poorer in the South than in the rest of the United States. Coverage is probably poorest in the slum areas of our big cities, but we do not have evidence from interview or other studies to support this conclusion.

2. The underenumeration of young children (children under 5 years of age) is very probably closely related to the underenumeration of their parents. According to the Infant Enumeration Study of 1950, in 80 percent of the cases where infants were missed their parents were also missed.18/

Age-reporting errors.--Because of the limitations of the record-matching studies and the reinterview studies, we have little basis for describing the pattern of age-reporting errors in the 1960 Census. Two estimates are available: (1) estimates based directly on the reinterview studies and (2) estimates derived by taking the difference between the net undercounts based on demographic analysis and the net coverage errors from the reinterview studies. Reference has already been made to the inadequacies of the former estimates arising from sampling error, response biases, and the assumptions in the estimating method. The lack of comparability of the components of the second estimate and the limitations of each component have also been noted. The estimates for white females alone may be informative. In short, we do not have any solid facts about the age-reporting errors in the 1960 Census.

There is some evidence, although far from conclusive (for example, the residual estimates for the population 65 and over for the 1950-60 decade), to suggest that the 1960 Census may contain a net overstatement of persons 65 years old and over. This overstatement is accompanied by an understatement, arising from age-reporting errors, in the age groups that immediately precede the 65-and-over group. However, as of now, we do not know the extent, or even the direction, of error in the census count 65 and over. Further research may contribute to a clarification of this question.

Conclusion.--In conclusion, we know little in a formal manner regarding the reasons for underenumeration or the geographic variations in coverage error, and have only rough or approximate measures of net census errors by age, sex, and color. We continue to have considerable concern about the validity of the differences by color and by age shown by the available estimates of net coverage error or net census error. We have greater confidence in the validity of our estimates of the differences by sex.

We have developed a number of sets of estimates of net undercounts by age, sex, and color, some involving a synthesis of methods and techniques, but we have so far been unable to arrive at a single set of figures which we feel we can recommend for general use. Efforts along these lines will continue with the hope of achieving this goal.

Footnotes

1. See U.S. Bureau of the Census, Current Population Reports, Series P-25, Nos. 331 and 310; Donald S. Akers, "Estimating Net Census Undercount in 1960 Using Analytical Techniques," paper presented at the annual meeting of the Population Association of America, Madison, Wisconsin, May 1962; and Conrad Taeuber and Morris H. Hansen, "A Preliminary Evaluation of the 1960 Censuses of Population and Housing," Demography, Vol. I, No. 1, 1964.

2. On the basis of the two available estimates of net movement of this group (-172,000 and +280,000), Taeuber and Hansen assumed zero net movement while the other studies had adopted the figure of +280,000.

3. U.S. Bureau of the Census, "Estimates of the Population of the United States and Components of Change, by Age, Color, and Sex, 1950 to 1960," Current Population Reports, Series P-25, No. 310, by J. S. Siegel, D. S. Akers, and W. D. Jones, June 30, 1965.

4. Ansley J. Coale and Melvin Zelnik, New Estimates of Fertility and Population in the United States, Princeton University Press, Princeton, N. J., 1963.

Other estimates of net undercounts for (native) whites in 1960 than those described in the text are shown in: M. Zelnik, "Errors in the 1960 Census Enumeration of Native Whites," Journal of the American Statistical Association, Vol. 59, June 1964, pp. 437-459.

5. The results were adjusted by the application of sex ratios based on quasi-generation life tables. The estimates for 10-year groups in 1950 were then distributed into 5-year groups by a graduation method. See, also, Akers, op cit.

6. The estimates of intercensal change used to bring the 1950 adjusted census figures forward are consistent with an estimate of no change (3,000) in overall coverage between 1950 and 1960; the figures are those shown in table 12 of Current Population Reports, Series P-25, No. 310. The estimates of net undercounts in 1960, shown in tables C-2 of that report, refer to the total population of conterminous United States (excluding Alaska and Hawaii), including members of the Armed Forces overseas, and are based on the population adjusted for net undercounts.

7. Melvin Zelnik, "An Examination of Alternative Estimates of Net Census Undercount, by Age, Sex, and Color: 1950 and 1960," paper contributed to the annual meeting of the Population Association of America, New York, N.Y., April 1966.

8. A. J. Coale, "The Population of the United States...A Revision of Census Figures," op. cit; M. Zelnik, "An Examination of Alternative Estimates...," op. cit.

9. C. Chandra Sekar and W. E. Deming, "On a Method of Estimating Birth and Death Rates and the Extent of Registration," Journal of the American Statistical Association, Vol. 44, No. 245, March 1949.

10. D. J. Bogue, B. D. Misra, and D. P. Dandekar, "A New Estimate of the Negro Population and Negro Vital Rates in the United States, 1930-1960," Demography, Vol. I, 1964.

11. A. J. Coale, op. cit.

12. Daniel O. Price, "A Check on Underenumeration in the 1940 Census," American Sociological Review, Vol. XII, Feb. 1947, pp. 44-49.

13. Other grounds for accepting the official registration figures have been offered by A. J. Coale. He points out that, if failure to match had represented a considerable part of what was considered underregistration, some of this would have occurred in hospital births, which were in fact nearly completely registered. He has also indicated that a study by J. T. Yamaguchi of the Princeton Office of Population Research, comparing the population as enumerated in 1960 by age, by geographic division of birth, with corresponding estimates for the census date based on births in each geographic division adjusted for underregistration, tends to confirm the high level of underregistration of births in 1940.

14. Bogue, Misra, and Dandekar, op. cit.

15. Melvin Zelnik, "An Evaluation of New Estimates of the Negro Population," Demography, Volume 2, 1965, pp. 630-639.

16. For whites these were generally lower than the estimates of net coverage error; for nonwhites they were higher.

17. This is an arbitrary choice since 1945 does not represent a turning point in the improvement of birth registration; rather, improvement was gradual during the forties.

18. U.S. Bureau of the Census, Infant Enumeration Study: 1950, Procedural Studies of the 1950 Censuses, No. 1, 1953.

Table 1. Estimated Percent of Net Underenumeration in 1960, for Various Percents of Net Underenumeration in 1950 and Various Absolute Amounts of Change in Coverage Between 1950 and 1960

(Base of percent is census count of resident population)

1950		1960 percent net underenumeration according to 1950-60 change in coverage			
Source	Percent net underenumeration	No change in coverage	Coverage increase of 277,000	Coverage decrease of 403,000	Coverage increase of 449,000
PES estimate 1/.....	1.4	1.2	1.0	1.4	0.9
Minimum reasonable estimate 1/.....	2.5	2.1	1.9	2.3	1.8
Arbitrary 3 percent.....	3.0	2.5	2.4	2.8	2.3
Coale estimate 2/.....	3.6	3.0	2.9	3.3	2.8

1/ U.S. Bureau of the Census, The Post-Enumeration Survey: 1950, Technical Paper No. 4, 1960.

2/ Ansley J. Coale, "The Population of the United States in 1950 Classified by Age, Sex, and Color--A Revision of Census Figures," Journal of the American Statistical Association, Vol. 50, March 1955, pp. 16-54.

Table 2.--ESTIMATES OF PERCENT NET CENSUS UNDERCOUNT OF THE WHITE POPULATION, BASED ON ANALYTIC AND COMPOSITE METHODS, BY AGE AND SEX: 1950 AND 1960

(Base of percent is census count of resident population; minus sign denotes net census overcount)

Sex and age	1950	1960			
	Series P-25, No. 310[1]	Series P-25, No. 310[2]		Composite estimate[5]	
		A[3]	B[4]	A	B
Male, all ages	3.2	2.8	2.9	2.9	2.9
Under 5	4.5	2.0	2.0	2.0	2.0
5-9	3.1	2.5	2.5	2.5	2.5
10-14	1.0	2.6	2.6	2.6	2.6
15-19	4.2	4.0	4.0	4.0	4.0
20-24	5.9	4.5	4.5	4.5	4.5
25-29	5.2	4.9	4.4	4.9	4.7
30-34	4.5	5.1	3.2	3.7	3.5
35-39	2.1	4.8	2.6	3.1	3.3
40-44	3.4	3.5	1.9	2.4	2.6
45-49	2.2	2.5	1.6	0.7	-0.1
50-54	2.2	4.4	3.7	2.7	2.0
55-59	5.3	0.7	0.4	-0.6	0.7
60-64	3.6	3.6	3.1	2.1	3.4
65 and over	-2.0	-3.4	4.0	4.7	4.4
Female, all ages	2.1	1.6		1.6	1.6
Under 5	3.8	1.2		1.2	1.2
5-9	2.5	1.6		1.6	1.6
10-14	1.1	1.5		1.5	1.5
15-19	1.8	2.5		2.5	2.5
20-24	1.6	2.5		2.5	2.5
25-29	0.3	1.4		1.9	1.7
30-34	0.1	0.6		1.1	0.9
35-39	-1.4	-0.2		0.2	0.4
40-44	2.0	-0.2		0.3	0.4
45-49	1.5	0.7		-0.3	-1.0
50-54	2.7	4.4		3.4	2.7
55-59	7.6	1.6		0.7	2.0
60-64	7.3	4.4		3.4	4.7
65 and over	2.3	2.1		2.8	2.5

[1] U.S. Bureau of the Census, Current Population Reports, Series P-25, No. 310, 1965. Figures relate to resident population of the United States. Estimates under 15: Based on adjusted births, deaths, and net immigration data. Estimates 15 and over: Based on Coale-Zelnik estimates for native whites.

[2] Estimates under 25: Based on adjusted births, deaths, and net immigration data.

[3] Estimates 25 and over for males and females are extensions to 1960 of Coale-Zelnik estimates for 1950.

[4] Males 25 and over: Expected sex ratios applied to adjusted female population.

[5] Males and females under 25: Based on adjusted births, deaths, and net immigration data. Males 25 and over: Expected sex ratios applied to adjusted female population. Females 25 and over: Adjusted for net census error in broad age groups, as indicated by reinterview studies, consistent with an all-ages net coverage error of 1.6 percent and a uniform net coverage error of 1.6 percent for ages 25 and over by age. Percent redistribution of females into 5-year age groups in alternative series based on:

A. Distribution within age groups 25-44 and 45-64 from P-25, No. 310.

B. Distribution within age groups 25-34, 35-44, 45-54, and 55 and over from P-25, No. 310.

Table 3.--ESTIMATES OF PERCENT NET CENSUS UNDERCOUNT OF THE NONWHITE POPULATION, BASED ON ANALYTIC AND COMPOSITE METHODS, BY AGE AND SEX: 1950 AND 1960

(Base of percent is census count of resident population; minus sign denotes net census overcount)

Sex and age	1950			1960			
	P-25, No. 310[1]	Coale[2]	Bogue et al.[3]	P-25, No. 310[1]	1950 Coale estimates extended to 1960[4]		Bogue et al.[3]
					A[5]	B[6]	
Male, all ages	14.8	15.0	8.8	12.7	12.6	12.2	8.9
Under 5	11.1	11.0	8.9	8.4	8.4	8.4	11.0
5-9	11.9	12.0	2.8	6.0	6.0	6.0	8.9
10-14	6.6	7.0	-	5.5	5.5	5.5	3.0
15-19	15.3	18.0	11.7	14.3	14.3	14.3	4.7
20-24	19.0	19.0	22.6	21.2	21.2	21.2	16.8
25-29	24.9	20.0	19.5	18.9	21.7	24.5	17.7
30-34	34.4	20.0	19.2	16.0	16.0	22.0	18.7
35-39	19.6	12.0	6.3	22.7	17.8	16.9	16.9
40-44	13.6	20.0	5.3	28.8	14.4	14.6	12.8
45-49	16.4	13.0	4.8	21.8	13.5	13.1	7.4
50-54	14.8	11.0	8.3	15.5	22.8	21.7	6.2
55-59	18.0	17.0	17.3	13.3	9.3	6.3	-2.0
60-64	17.1	24.0	20.2	18.5	13.5	10.6	10.6
65 and over	-13.7	12.0	-15.7	-9.2	12.2	1.9	-10.1
Female, all ages	9.5	11.0	3.5	7.8	8.8		3.8
Under 5	10.3	10.0	7.6	6.8	6.8		9.8
5-9	9.7	10.0	0.3	5.1	5.1		8.1
10-14	7.0	7.0	-1.7	4.4	4.4		2.1
15-19	8.7	12.0	3.4	11.2	11.2		1.3
20-24	2.6	8.0	3.3	10.7	10.7		2.7
25-29	6.7	8.0	4.3	6.4	9.6		2.2
30-34	8.6	9.0	4.3	1.0	6.3		1.5
35-39	2.2	3.0	-5.2	5.4	6.7		3.3
40-44	5.6	18.0	1.1	6.4	6.8		1.3
45-49	12.3	12.0	2.8	8.3	9.2		-
50-54	19.6	16.0	12.4	8.3	22.3		2.7
55-59	35.0	30.0	30.9	11.5	11.1		-1.3
60-64	36.4	36.0	36.4	20.9	16.5		10.8
65 and over	6.5	5.0	-14.4	17.2	14.0		0.8

- Represents zero or rounds to zero.

[1] U.S. Bureau of the Census, Current Population Reports, Series P-25, No. 310, 1965. Figures relate to resident population of the United States.

[2] A. J. Coale, Journal of the American Statistical Association, 1955. Figures relate to resident population of conterminous United States.

[3] D. J. Bogue et al., Demography, 1964. Figures relate to resident Negro population of conterminous United States.

[4] Estimates under 25: Based on adjusted births, deaths, and net immigration data.

[5] Males and females 25 and over: 1950 Coale estimates carried forward to 1960 by estimates of intercensal change given in Series P-25, No. 310.

[6] Males 25 and over: Expected sex ratios applied to adjusted female population for 1960.

Table 4.--ESTIMATED PERCENTS OF NET CENSUS UNDERCOUNT FOR THE POPULATION UNDER 25 YEARS OF AGE, BY AGE, COLOR, AND SEX, BASED ON ADJUSTED BIRTHS: 1960

(Base of percent is census count of resident population)

Color and age	Official factors for underregistration of births		Assuming one-third reduction in underregistration of births	
	Male	Female	Male	Female
WHITE				
Under 5	2.0	1.2	1.7	0.9
5-9	2.5	1.6	2.1	1.3
10-14	2.6	1.5	1.9	0.9
15-19	4.0	2.5	2.0	0.6
20-24	4.5	2.5	1.5	0.1
NONWHITE				
Under 5	8.4	6.8	6.9	5.2
5-9	6.0	5.1	3.9	3.1
10-14	5.5	4.4	1.7	0.8
15-19	14.3	11.2	6.3	3.8
20-24	21.2	10.7	10.6	1.8

Table 5.--COMPARISON OF "ENUMERATED" AND EXPECTED SEX RATIOS WITH SEX RATIOS OF ADJUSTED POPULATIONS, BY BROAD AGE GROUPS AND COLOR: 1960

(Males per 100 females in resident population)

Age and color	"Enumerated" sex ratios	Expected sex ratios	Sex ratios based on populations adjusted by--[1]				
			Net coverage error from reinterview studies	Preferred composite based on demographic analysis	Composite based on reinterview studies and demographic analysis		
					Set 1	Set 2	Set 3
WHITE							
All ages	97.4	98.6	97.3	98.5	98.6	98.6	98.7
Under 5	104.0	104.8	103.6	104.8	104.8	104.8	104.8
5-14	103.9	104.9	102.9	104.9	104.9	104.9	104.9
15-29	98.5	100.8	98.2	100.7	100.8	100.6	100.8
30-44	96.4	98.8	96.1	100.6	98.8	98.8	98.8
45-64	95.6	95.2	96.5	95.8	95.2	95.2	95.2
65 and over	82.3	83.8	83.1	77.8	83.8	83.8	83.8
NONWHITE							
All ages	94.7	97.6	95.4	97.6	97.6	(X)	97.7
Under 5	99.9	101.4	100.7	101.5	101.4	(X)	101.5
5-14	100.0	100.9	101.3	101.0	100.9	(X)	101.0
15-29	91.6	98.7	89.6	99.1	98.7	(X)	98.7
30-44	88.4	97.9	89.7	97.8	97.9	(X)	97.9
45-64	95.8	95.0	97.1	94.9	95.0	(X)	95.0
65 and over	90.1	80.5	94.4	80.5	80.5	(X)	80.5

X Not applicable.
[1] See footnotes of tables 2, 3, and 6 for an explanation of the basis of the adjusted figures.

Table 6.--ESTIMATED PERCENTS OF NET COVERAGE ERROR AND OF NET CENSUS UNDERCOUNTS BASED ON ANALYTIC AND COMPOSITE METHODS, BY SEX, COLOR, AND BROAD AGE GROUPS: 1960

(Base of percent is census count of resident population; minus sign denotes net census overcount)

Age and color	Net coverage error from reinterview studies[1]		Preferred composite based on demographic analysis[2]		Composite based on reinterview studies and demographic analysis[3]					
					Set 1[4]		Set 2[5]		Set 3[6]	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
WHITE										
All ages	1.6	1.7	2.8	1.6	3.0	1.7	2.9	1.6	2.4	1.1
Under 5	1.3	1.7	2.0	1.2	2.5	1.7	2.0	1.2	2.0	1.2
5-14	0.6	1.6	2.5	1.6	2.5	1.6	2.5	1.6	2.5	1.6
15-29	1.2	1.6	4.5	2.2	3.9	1.6	4.4	2.3	3.9	1.6
30-44	1.3	1.6	4.5	0.1	4.2	1.6	3.1	0.6	2.6	0.1
45-64	2.8	1.9	2.8	2.6	1.4	1.9	1.4	1.8	1.4	1.9
65 and over	2.3	1.3	-3.4	2.1	3.1	1.3	4.4	2.5	1.0	-0.8
NONWHITE										
All ages	4.2	3.4	12.2	8.8	6.7	3.4	(X)	(X)	8.0	4.7
Under 5	2.6	1.8	8.4	6.8	3.3	1.8	(X)	(X)	8.4	6.8
5-14	4.6	3.3	5.8	4.8	4.1	3.3	(X)	(X)	5.8	4.8
15-29	0.1	2.5	19.5	10.6	10.3	2.5	(X)	(X)	10.4	2.5
30-44	5.8	4.2	18.0	6.6	15.3	4.2	(X)	(X)	15.4	4.2
45-64	7.3	5.9	13.4	14.4	5.0	5.9	(X)	(X)	5.0	5.9
65 and over	6.7	1.8	1.9	14.0	-8.9	1.8	(X)	(X)	-5.9	5.3

X Not applicable.

[1] Based on reinterview studies EP-8 and EP-9.

[2] Whites and nonwhites under 25: Consistent with percents of net undercount in Series P-25, No. 310 (based on adjusted births, deaths, and net immigration data). Whites 25 and over: Consistent with percents of net undercount in Current Population Reports, Series P-25, No. 310 (Coale-Zelnik estimates for 1950 extended to 1960). Nonwhite females 25 and over: Coale estimates for 1950 extended to 1960. Nonwhite males 25 and over: Expected sex ratios applied to the adjusted female population.

[3] Lower bounds of true errors or "minimum reasonable" estimates.

[4] Females: Net coverage error from the reinterview studies. Males: Expected sex ratios applied to the adjusted female population.

[5] Males and females under 25: Based on adjusted births, deaths, and net immigration data. Females 25 and over: Adjusted for net census error in broad age groups as indicated by reinterview studies, consistent with an all-ages net coverage error of 1.6 percent and a uniform net coverage error of 1.6 percent for ages 25 and over by age. Males 25 and over: Expected sex ratios applied to adjusted female population. Estimates correspond to detailed estimates labeled "Composite estimates B," table 2.

[6] Males and females under 15: Based on adjusted births, deaths, and net immigration data. Females 15-64: Net coverage error from reinterview studies or preferred composite based on demographic analysis, whichever is lower. Males 15-64: Expected sex ratios applied to adjusted female population. Population 65 and over: Census counts by color, distributed by sex on the basis of expected sex ratios.