

INTRODUCTION

The need for appraisal of demographic statistics

Population statistics, like all other statistics, whether they are obtained by enumeration, registration, or other means, are affected by errors. The errors may be large or small, depending on the obstacles to accurate recording which are present in the area concerned, the methods used in compiling the data, and the relative efficiency with which the methods are applied. The importance of the errors, given their magnitude, depends on the uses to which the data are put. Some applications are valid even if the statistics are subject to large errors; other uses require more accurate data. When dealing with any given problem, it is important to know whether the data are accurate enough to provide a significant answer.

Until quite recent times, Governments paid little attention to an appraisal of the accuracy of demographic statistics. It is now becoming widely recognized that an effective statistical programme in this as well as other fields involves not only the compilation of the needed statistics but also an adequate measurement of their reliability. Hence, efforts have been made recently in various countries to ascertain the probable extent of errors in the statistics being obtained. This practice, however, has so far been mainly confined to those countries where statistical activities have been most fully developed. The need for investigation of the quality of the data collected is at least as great in the countries where little work in this direction has so far been done.

In connexion with population estimates, the evaluation of the census or registration statistics on which the estimates are based has a double importance. In the first place, an investigation of the accuracy of the base data is a prerequisite to any attempt at determining the reliability of the estimates. Errors of estimation result both from inaccuracies in the basic population statistics and from errors in the assumptions involved in deriving the estimates (for example, in the assumed population changes between the date of the latest statistics and the date to which the estimate applies); and both sources of error must be taken into account if the degree of confidence that may be placed in the estimate is to be known. Second, where an investigation of reliability of the base data has revealed errors, the direction and magnitude of which can be estimated, it is possible to make compensating adjustments, as the estimates of population are prepared, and thus to avoid a compounding of errors. In some instances, where difficulties are involved in the publication of adjusted census or registration statistics, estimates of population may, nevertheless, be made which are more reliable than the published official base statistics themselves. An adequate programme of investigating the accuracy of basic population statistics is therefore indispensable for the work of making good population estimates.

Purpose of this manual

The purpose of this manual is to describe certain methods for appraising the accuracy of those types of statistics which are most commonly used as a basis for current population estimates and future population projections, namely, census figures on total population and on age groups, registration data on births and deaths, and statistics of migration. It is assumed that at least one census has been taken in the country concerned and that the results have been compiled. The statisticians of the country are faced with the problem of determining the accuracy of the census and other population data, but are not in a position to re-enumerate the whole population or repeat any major part of the census undertaking. With respect to the statistics of births, deaths and migration, the same assumption is made. The procedures used by the country for collecting these data are established, and the statisticians desire to appraise their accuracy in conjunction with the census results.¹

Procedures for appraising the accuracy of certain population data have been described in various United Nations publications. With reference to vital statistics, such procedures are discussed in the *Handbook of Vital Statistics*.² In *The Population of Tanganyika*³ there is an appendix on the problem of population statistics and in *Problems of Migration Statistics*,⁴ there is a "Note on the relationship between excess of arrivals over departures and net migration". A few publications have been concerned exclusively with appraisal procedures as, for example, "Accuracy Tests for Census Age Distributions Tabulated in Five-year and Ten-year Groups".⁵ Procedures that have been described in these other publications are referred to in this manual and only in rare instances are reproduced in summary form. In using this manual, therefore, it is desirable to have available for reference those publications mentioned above. As this manual is intended to supplement in certain respects the preceding manual on methods of estimating total popu-

¹ For information on the procedures of census enumeration and the collection of vital and migration statistics, see the following United Nations publications: *Population census methods*, document ST/SOA/Ser.A, Population Studies, No. 4, 1949; *Handbook of population census methods*, document ST/STAT/Ser.F, Studies and Methods, No. 5, 1954; *Handbook of vital statistics method*, document ST/STAT/Ser.F/7, in press, 1955; *Principles for a vital statistics system*, document ST/STAT/Ser.M, No. 19, 1953; *Informe final del primer Seminario Interamericano de Registro Civil, Santiago de Chile, 1954*, document ST/STAT/Ser.M/23, 1955; *Problems of migration statistics*, document ST/SOA/Ser.A, Population Studies, No. 5, 1949.

² *Op. cit.*, especially chapter XIV.

³ United Nations, Population Studies, No. 2, 1949.

⁴ United Nations, Population Studies, No. 5, 1949.

⁵ *Population Bulletin of the United Nations*, No. 2, October 1952.

lation,⁶ study of the latter will in some instances make clearer the meaning or purpose of some of the procedures described here.

The nature and quality of the demographic data existing in different countries vary greatly. Population censuses have been taken with varying frequency and available series of birth and death statistics contain different kinds of detail. Migration across national boundaries may be relatively important or not. Consequently, different methods have to be employed in different situations for the appraisal of the accuracy of statistics. It has not been possible in the present manual to consider all the possible situations in which it may be desired to test the existing statistics. Nor has it been possible to consider all the detailed tests to which every conceivable kind of data on the subjects covered here can be submitted. The methods presented here may, therefore, not always be directly applicable to a specific problem; modifications must be worked out by the statisticians in the country to suit their particular requirements.

The best appraisal of a country's statistics can be made only if all available statistics, published or unpublished, are at hand and if various other information concerning a country's economic and social conditions is also utilized. It has not been possible in the preparation of this manual to consider in every detail all the possible information which, in a given country, can be utilized for an appraisal of its demographic data.

The results of the tests described in this manual are of various kinds. Sometimes, a test will reveal only that statistics are either "probably reasonably accurate" or "suspect"; if they are "suspect", further intensive investigation is required before a definite judgement can be made. Other tests will not only indicate that errors are present, but also lead to an estimate of the direction and probable extent of the error. In the latter case, it is desirable to adjust or correct the faulty statistics and to revise the estimates based on them. The description of procedures to be used in the revision of estimates, however, is outside the scope of this manual.

Types of testing procedures

Whether one is dealing with census data, vital statistics, or records of migration, the same basic types of testing procedures are applicable. This similarity results from the fact that demographic phenomena are interrelated both among themselves and with other social and economic phenomena. Some of these relationships are direct and necessary. For example, the increase in population during a given interval is precisely determined by the numbers of births and deaths, and the migratory movements, occurring in that interval. Other relationships are less precise and less definite. For example, in some countries, an economic depression is likely to result in a declining, and prosperity in a rising, birth rate, but the exact amount by which the birth rate will change cannot be inferred even from detailed knowledge of the economic situation.

The basic types of possible testing procedures can be summarized as follows:

- (a) Comparison of observed data with a theoretically expected configuration;
- (b) Comparison of data observed in one country with those observed elsewhere;
- (c) Comparison with similar data obtained for non-demographic purposes;
- (d) Balancing equation of directly interrelated data; and
- (e) Direct checks (re-enumeration of samples of the population et cetera).

The first two types of tests are similar. The demographic changes observed in some other country where conditions are presumably similar can sometimes be substituted for a theoretically expected configuration. When the observed data are compared with those which are theoretically expected, the two sets of figures will always be found to differ, whether by a large or a small amount. The essence of the test then rests on the answer to the question: Can the difference between the observed and expected values readily be explained by historical events or current conditions in the country, the data of which are being tested? If not, then it must be concluded that the observed data are "suspect" and may be in error. Further investigation may yield an explanation of the difference, or it may furnish clear indications that the "suspect" data are indeed in error. Very often this kind of method is to be applied merely as a preliminary step, to suggest along what lines further testing should be undertaken.

In many countries, other data are available which can be compared with the demographic statistics. For example, young men may be registered for the purposes of military recruitment. Estimates of the whole or parts of the population are often obtained from tax lists, voters' registers, school statistics, housing censuses et cetera. If such estimates differ from the population census data, the question arises whether there is a satisfactory explanation for the difference. This is the essence of the third type of tests.

"Balancing equations" can be applied to test the consistency of the increase in population shown by two enumerations at different dates, with the increase shown by statistics of the various elements of population change—births, deaths, and migration—during the interval. If all the data were accurate, the two measures of increase (or decrease) should evidently be balanced. Aside from population totals, the test can also be applied to sex and age groups and other categories of population that are identifiable in the statistics. Furthermore, by rearranging and re-defining the components of this equation, separate appraisals can be made regarding the accuracy of birth, death and migration statistics.

Direct checks involve a field investigation, such as a re-enumeration of a population sample, or a recount of births. The advantage of a direct check consists in the fact that the individual persons enumerated, or the individual events registered, can be identified, so that not only the consistency of totals, but the specific errors of omission or double-counting come to light.

It will be noted that the first four types of testing procedures only give an indication of *relative accuracy*, as it appears from the comparison of two sets of data both of which are subject to error. If several testing procedures are applied, or if there is a strong presumption that one set of data used in the comparison is highly

⁶ United Nations, *Manuals on methods of estimating population. Manual I: Methods of Estimating Total Population for Current Dates*, document ST/SOA/Ser.A, Population Studies, No. 10, 1952.

accurate, the evidence so secured can have considerable weight, amounting to a practical certainty. In other instances, the comparison may reveal little more than that at least one, if not both, sets of data are in error.

Nature of illustrative examples

Wherever possible, specific examples are included showing how various tests can be applied to the statistical data of certain countries. For the most part, the data for these examples have been drawn from the United Nations *Demographic Yearbook*. It is important to note that only a fraction of the data and knowledge which must be available in each country was actually used in working out these examples. Many more data, some of them not published anywhere, exist in these countries. In addition, the statistician's knowledge of the country, its people and their economic and social condition, and of the operations of the census and vital statistics system, is relevant to an appraisal of the demographic statistics. Hence, the examples presented here should be regarded merely as illustrations of methods and the results should not be taken as definitive evaluations of the quality of the particular data employed.

Organization of this manual

The procedures are presented in four chapters with supplementary illustrations in three appendices. Each of the four chapters is concerned with methods of testing as applied to a particular kind of statistics, namely census totals, statistics of births and deaths, statistics of population by age and sex, and statistics of migration. The five basic types of tests are presented, in so far as applicable, in each of these chapters. In each case, the problem of testing is considered both on the assumption that there has been only one census and that there have been two or more censuses in the past. The application of testing methods to statistics of a country's political subdivisions, such as provinces, departments, counties,

municipalities, cities et cetera, as well as to statistics for the entire country, is considered wherever possible.

The first chapter, on the accuracy of census totals, is concerned with testing only the accuracy of the "head count", that is to say the total number of persons enumerated, without reference to the characteristics of the population. In the second chapter, emphasis is placed on methods for evaluating the completeness of the registration of births and deaths. The procedures described in those two chapters are carried into further detail in the third chapter, which deals with the accuracy of age and sex reporting, a subject of considerable importance in making population estimates and in analysing mortality, fertility, economic activities of the people et cetera. The last chapter, on the adequacy of migration statistics, is mainly concerned with statistics of international migration, but some attention is also given to internal population movements.

Three appendices are included to show how various tests, described separately in the several chapters, can be combined and brought to bear on a particular problem of appraisal. Appendix A and appendix C deal with census statistics of Haiti and Honduras, respectively. It is emphasized that the calculations presented there have been made without detailed study of the sources of information or the conditions existing in these two countries; the results are therefore only illustrative and far from a definitive appraisal. The purpose is only to show how several methods can be combined in an attempt at appraising a particular set of data. Appendix B reproduces some tests which were applied by C. L. Pan⁷ to the Libyan censuses of 1931 and 1936, in an effort to appraise their accuracy. It is not expected that any other country will have exactly the same problems as these three, nor is it expected that the tests can be applied in other countries in exactly the same manner. The adaptation of these tests to meet the unique conditions of any specific country must be worked out by the statisticians of the country concerned.

⁷ Reproduced from Chia-lin Pan, "The Population of Libya", *Population Studies*, Vol. III, No. 1, June 1949.