

CHAPTER III

METHODS OF ESTIMATING FUTURE SCHOOL ENROLMENT

1. PLAN OF THIS CHAPTER

In this chapter we shall first explain some of the terms commonly used in educational statistics which are relevant to estimating future school enrolment. The reader may find some of the terms used with different meanings in different countries or by different writers, since in the field of educational statistics very little has been done so far towards standardization of terms.¹ Nevertheless, for purposes of the present *Manual* we have adopted certain terms as explained below, and trust that the reader will keep these explanations in mind when he examines the case studies presented in the following chapters.

We shall avoid as far as possible the use of purely mathematical and statistical terms. Nor shall we attempt to define or explain those demographic terms relating to population projections which fall outside the scope of this *Manual*.² Again, those terms which are used in educational statistics in particular countries, but are not generally used elsewhere, have also been excluded from our list.³

After that we shall enumerate some of the basic data needed for estimating school enrolment, with special attention to problems of collecting and compiling such data in developing countries. This will not be an exhaustive list of all types of data useful to the educational administrator or even for the purposes of educational planning in general. The interested reader is referred to other works devoted more specifically to those needs.⁴

The chapter will conclude with a summary outline of methods appropriate for estimating future school enrolment in developing countries. This outline is not necessarily applicable to every kind of situation which may be found in developing countries; but, together with the case studies presented in Chapters IV to VI and examples from selected countries presented in Chapter VII, may be useful as a guide to the technician in a developing country who may be called upon, perhaps for the first time, to provide estimates of future school enrolment for purposes of educational administration and planning in his particular country.

For those who may be interested in methods of estimating population in general, and of population projections by sex and age in particular, we refer to a series of manuals published by the United Nations,

of which the following are of special relevance:

- Manual I: *Methods of estimating total population for current dates* (Population studies, No. 10);
Manual II: *Methods of appraisal of quality of basic data for population estimates* (Population studies, No. 23);
Manual III: *Methods for population projections by sex and age* (Population studies, No. 25).

2. EXPLANATION OF TERMS

The following terms which are relevant to estimating future school enrolment are explained as we understand them. These explanations are not intended as standard definitions, for in many cases such standardization does not yet exist and may not even be possible. The reader should be especially careful in adapting these and other terms when translating from one language to another, since the meaning of a term commonly accepted in one language may not be so clear or satisfactory when translated into another language.

When we speak of the *school-age population* we mean the total number of persons within certain age groups who are either required by law or are eligible to attend schools at a certain level. Thus we may distinguish a *compulsory school-age population* consisting of boys and girls in certain age groups who are required by law to be attending school, unless they are exempted for specific reasons. We may also speak of a *primary school-age population*, a *secondary school-age population*, or sometimes a *college-age*

1. See: Unesco. *Manual of educational statistics* (Paris, 1961); more particularly, "Recommendation concerning the international standardization of educational statistics," adopted by the General Conference of Unesco at its tenth session, December 1958.
2. For statistical terms, see: Kendall and Buckland, *Dictionary of statistical terms* (London, 1957); for demographic terms, see: United Nations, *Multilingual demographic dictionary* (English, French, Spanish, and Russian sections), in Population studies, No. 29 (New York, 1958).
3. See, however, Unesco, *Manual of educational statistics*; also glossaries under country chapters in Unesco, *World survey of education*, Vol. II or Vol. III (Paris, 1958, 1961).
4. See, for example: Unesco. "Statistics needed for educational planning", in *Economic and Social Aspects of Educational Planning*.

population when we can specify the respective age limits normally associated with school attendance at these levels.

By *school attendance* we mean the actual presence of a child at school during a specified period of time, which may be a school day, a school term, a school year, a calendar year, or any other specified period. A *school year* may sometimes correspond approximately to a calendar year, but very often includes several months of two successive calendar years, as for example from September of one year to June of the following year.

School enrolment refers to the fact that a child's name is entered or remains on the rolls or register of a school as a pupil. The term is also used to mean the total number of pupils on the school rolls at a given time, or sometimes the average number of pupils enrolled during a given period such as a school year.

The proportion of children in a given age group who are attending school at a given time is expressed by a *school attendance ratio*. The number of pupils enrolled in school, at a given level of education, related to a relevant school-age population, is called a *school enrolment ratio*. These ratios are generally stated as percentage ratios, as for example, the percentage of seven-year children attending school, or the number of pupils enrolled in primary schools per 100 children in the population 5 to 14 years of age.

We shall have occasion to compute separate enrolment ratios for each segment of the school-age population, as for example, a *primary enrolment ratio* giving the number of primary school pupils per 100 children of primary school age; a *secondary enrolment ratio* relating pupils enrolled in secondary schools to the secondary school-age population, and so forth. For international comparisons Unesco has recommended that a primary enrolment ratio be related to the population aged 5 to 14 years inclusive; a secondary enrolment ratio be related to the population 15 to 19 years inclusive; and a *total enrolment ratio* be related to the population aged 5 to 19 years inclusive.

We speak of three *levels of education* - first, second and third - by which we classify different types of schools. Thus we designate as the *first level of education* that which is usually provided in primary or elementary schools, sometimes including kindergarten or infant classes. Secondary schools providing general, vocational or technical instruction or specialized training for teachers are classified as the *second level of education*. Intermediate schools are sometimes included with schools at the first level, but may also be classified as the lower stage of the second level. Teacher training schools above the second level, as well as general, technical and professional education, which require the

completion of a second-level education as a condition for admission, are considered to be at the *third level of education*.

Depending on the controlling authority we distinguish between *public schools*, which may also be called government schools, and *private schools*, sometimes called non-public or non-government schools. This distinction is not always easy to maintain because there are different degrees of control, both administrative and financial, exercised by public authorities of different countries over different types of schools at each level of education. In practice, some classification along these lines is usually possible for any individual country, though it may not agree with the classification in another country.

Returning to the school-age population, the *age* of a person may refer to age in completed years, sometimes called age at last birthday; or to age in rounded years, sometimes called age at nearest birthday. An *age group* may refer to all persons at the same single year of age, such as the seven-year-olds; or it may refer to all persons included within specified age limits, such as from ten years up to under fifteen. In the latter case we would designate the group as aged 10-14 years (inclusive). When we speak of the *median age* of a group of pupils we refer to that age which divides the group of pupils into two equal halves, one half of the group being above, and the other half being below the median age.

Pupils at the first and the second levels of education are generally classified by *grade* or *year of study*. (In some countries they are called classes or forms; they may be numbered from the lowest to the highest, or sometimes from the highest to the lowest). We shall generally number the grades from the lowest to the highest, within each level of school. The *median grade* of a group of pupils refers to that grade which divides the group into two equal halves, similar to the idea of the median age.

A *cohort* - a term most commonly used in demography - means group of persons experiencing a certain event in a specified period of time. Thus an *age-grade-cohort* refers to children of the same age entering the same grade during a given year. A *grade cohort* means a group of pupils, regardless of age, entering a certain grade at school during the same year. When we follow a given cohort of pupils through successive grades, to find out how many of them remain in school after so many years, this is called a *cohort-survival analysis*.

Grade progression refers to the course of pupils progressing from any grade to the next higher one. This is usually accomplished by means of *promotion* at the end of a school year. Pupils not promoted are expected to repeat the same grade the following years; they are called *repeaters*. Pupils who leave school before completing the full course of study at a specified level are counted as *drop-outs*; they

may have dropped out during a school year or between school years.

The proportion of pupils who progress regularly from one grade to the next, as related to the original grade cohort, is called the *grade progression ratio*. The proportion of pupils who fail to make regular progress from one grade to the next is sometimes called the *grade attrition ratio*. The proportion of pupils who repeat a specified grade is similarly called the *repeater ratio*. When the repeater ratio is added to the grade progression ratio, we have the *grade retention ratio* which is the number of pupils in a higher grade (including repeaters) compared to the number of pupils in the next lower grade of the previous school year. When all the repeaters in the different grades from an original cohort are added to the number of pupils who have progressed regularly through all the grades of a specified level of school, and the resulting number is related to the original grade cohort, we obtain the over-all *school retention ratio*, which measures the holding power of the school over a group of pupils starting out together in the lowest grade.

All these ratios concerning school progression and retention are computed as percentage ratios. When the experience of several grade cohorts is pooled by averaging their respective ratios, we obtain average grade retention or school retention ratios. These ratios may then be used as basis for estimating future school enrolment.

A cohort of new pupils in the beginning grade of a school level is called the *intake* of that school level. When the intake is compared to a group of persons eligible for entering that school level, we have an *intake ratio*. Similarly, the group of pupils who complete a given course at a specified time constitute the *output* of that school level; and an *output ratio* is obtained by relating it to the intake at the beginning of the same course. The intake and output ratios are also generally given as percentage ratios.

Another kind of ratio is computed when we divide the total pupil enrolment at a specified school level by the total number of teachers at that school level. Thus we obtain a *pupil-teacher ratio*, which is of course not a percentage ratio, but expresses the average number of pupils enrolled per *teacher in service*. This is not to be confused with the average size of a class taught by one teacher. The latter may be, and often is, higher than the pupil-teacher ratio, since part-time teachers and school principals who do not teach classes are usually included in the number of teachers in service. Administrative and supervisory staff, as well as various types of auxiliary personnel, should in principle be excluded from the number of teachers in service when computing pupil-teacher ratios. Similarly, *teachers in training* such as student teachers should also be excluded.

The number of students completing their courses in teacher training schools in a given year constitute the *teacher output* for that year. The number of *new teachers* required for a school system in a given year should be enough to take care of increases in total pupil enrolment as well as needs for the replacement of teachers who are lost through death, retirement, resignation, change of occupation and other causes.

It may be useful at this point to explain a few other terms which we are going to use in the following chapters - terms which are somewhat technical in nature, applicable not only to school enrolment estimates but to statistical analysis and estimation in general.

When we say *observed data* we mean statistical data, such as number of children attending school, pupil enrolment, number of teachers in service, resulting from actual counts made by census enumerators or taken from school records. They are presumably complete and accurate, even though they may not be entirely up to date. For up-to-date figures we may have to resort to some estimation, in order to fill in the gaps where needed data are missing. Such *estimated data* are of course subject to error; hence they should be clearly marked as estimates. If we have sufficiently complete and reliable observed and estimated data for a number of years up to the present, we may try to discover any consistent and reasonable *trends*, as for example in the growth of pupil enrolment, at each level and for each type of school. Such *rates of growth* are usually expressed as annual rates, and may be averaged over a number of years.

Before we can estimate future school enrolment, we must make some *assumptions*, or guesses, concerning future trends. Will the growth of enrolment continue at the same rate as in the past? Is it more likely to grow at a faster rate? Or would it be more reasonable to assume a slowing down in the rate of growth? Similarly, for example, assumptions have to be made concerning future trends in grade progression ratios, repeater ratios, school retention ratios; distribution of pupil enrolment between public and private schools, between urban and rural schools; future trends in girls' enrolment as compared to boys', second-level as compared to first-level, vocational as compared to general enrolment; and the like.

When we can base our assumptions concerning future trends rather solidly upon observed trends in the past, with suitable modifications where necessary, we can speak of making *projections*. On the other hand, where we have not discerned clear trends from observed data, or where we are unable to make definite assumptions concerning the future, we shall nevertheless do our best to make some *estimations* based on such data as we have and such assumptions as we can justify.

This leads us to the question of *errors*. It is of course well known that all statistics, with the best of intentions, will always contain errors. Some errors, such as those due to *rounding*, are generally inconsequential. Other errors, such as those due to faulty observation, reporting or recording, can be serious and should certainly be avoided or corrected wherever possible. But the *errors of estimation* are inherent in the process, and therefore unavoidable. It is only necessary that every precaution be taken to minimize the errors of estimation, without being afraid to make any estimates for fear of errors.

With these words of explanation concerning our terminology and our general approach to the subject, we shall now proceed to specify the kinds of basic data which would enable us to make some meaningful and reasonable estimates of future school enrolment in developing countries.

3. BASIC INFORMATION REQUIRED

In order to estimate future school enrolment, we need at least four general types of basic information. The first relates to the population of school age, the second to pupil enrolment, the third to various rates and ratios derived from the first two types of data, and the fourth to questions of administrative policy affecting education in general and school enrolment in particular.

Before we can have any idea as to how many pupils will be enrolled in school at any given time in the future, we must first ask: How many children will there be who will be eligible to go to school? Where education is compulsory by law, the question becomes: How many places must be provided in the school system if all children required to attend school are to be accommodated? In addition, how many more children below or above the ages of compulsory schooling will have a right to ask for admission to the schools of the country? We therefore need to know the probable size of the total school-age population for such periods of time as we are required to estimate the future school enrolment.

Thus we must have future population estimates by age, covering not only the period of compulsory schooling but the whole span of years which a child may spend in schools at different levels of education. Let us say we are interested in all levels of education, from the pre-school to the university. The full span of years that may be spent by a person in acquiring a complete formal education could extend from the age of 2 or 3 years up to say 30 years and over. Within this span certain age groups may be associated with each level of education, as for example: pre-school, 2-5 years; first level, 6-13; second level, 14-17; third level, 18 and over, in accordance with the particular organization of the

school system. If our concern should be limited to the first and second levels of education, we may need estimates of population within a narrower range of ages, say from 5 or 6 up to 18 or 19 years. It would be useful, though not absolutely essential, that we have these population estimates by single years of age, and if possible, separately for each sex. For example, we could have population estimates for five-year age groups, as is commonly done in many countries: 0-4, 5-9, 10-14, 15-19, and so forth. Since these age groups rarely correspond to specific levels of education, a method will be introduced in this *Manual* for obtaining, by interpolation, population estimates for suitable age groups derived from the data given in the standard five-year age groups.

Again, it would be useful, but not essential, to have future population estimates for each year for which we are to estimate the future school enrolment. More commonly we would find future population estimates given at five-year or ten-year intervals, as for example, for 1965, 1970, 1975, 1980, and so forth; or simply for 1960, 1970, 1980, and so forth. In such cases, we could also derive by interpolation approximate estimates for the years in between, such as 1966, 1967, 1968, 1969, and so forth.

If estimates of future population are not available, we may have to construct those before we can begin or complete our estimates of school enrolment. Methods of estimating future population, based on assumed rates of birth, death and migration, are explained in other works, to which the interested reader is referred.¹ In the present *Manual* we shall assume that estimates of future population, at least in five-year age groups, say from 0 to 29 years, are either available or may be constructed for the purpose.

The second type of information necessary for estimating future school enrolment relates to past and present figures on the number of pupils enrolled in schools at each level and for each kind of institution. In an ideal situation, we should have pupil enrolment data by sex, age and grade (year of study) for as many years as possible up to the current school year. These data should cover both public (government) schools and private (non-government) schools. They should also distinguish between enrolment in different kinds of schools at each level, especially at all levels above the first (primary or elementary) level. Where it is important, separate enrolment figures should be available for schools in urban and in rural areas. Enrolment figures for each province or district would also be useful; they are of course essential if estimates of future enrolment are to be made separately for each of these areas.

1. See United Nations manuals on population estimates, more particularly, Manual III: *Methods for population projections by sex and age* (Population studies, No. 25)

In addition, we should have the number of pupils who drop out of school each year and of those who have to repeat their grades due to non-promotion. At the end of each level of school (first and second) or of each stage of instruction (elementary, intermediate, junior secondary, senior secondary) account should be taken of the number of pupils who complete successfully that level or stage, by examination or otherwise. At the beginning of each level or stage, a count should be made of all new admissions each year - that is, of all pupils who had not previously been admitted to any school at that level or stage.

All such detailed information concerning pupil enrolment, from their first admission to a school until the completion of their course, is important for many administrative purposes; it is quite essential for the purpose of providing a sound basis for estimating future school enrolment. This will become clear when we proceed with our explanation of the methods for obtaining such estimates. These methods, in one way or another, will involve the computation of various rates and ratios, to which we shall now give our attention. They are the third type of basic information needed for our purpose.

If the question of school attendance is included in a census of population, as is the practice in many countries, we obtain the number of persons at each age who claim to have attended school during a certain period of time up to the date of the census. If we divide the number of persons thus reported to have attended school by the total number of persons at that age, we obtain a school attendance ratio specific for age, or specific for sex and age.

A variation of this measure, which we shall call the school enrolment ratio, is obtained by taking the number of pupils of a specified age enrolled in school (as reported in current school statistics) and dividing it by the estimated number of persons at that age. Due to the difference in time reference and in the source of information, the resulting ratios do not have the same meaning. The major advantage of the school enrolment ratio, however, is that it can be easily obtained from regular school enrolment reports, without the necessity of a census enumeration or a household survey.

Where school enrolment is not reported by age, a useful ratio can be computed by relating the total enrolment of a school level, such as primary schools, to the estimated population of an appropriate age group, such as 6 - 12 or 7 - 13 years. The resulting ratio in this case may be called a primary school enrolment ratio, but it will not be an age-specific ratio, because the ages of the children enrolled in school do not necessarily correspond to those included in the population group.

When we have comparable school attendance or school enrolment ratios for two or more years, we can compute annual rates of change (increase or

decrease) of the ratio. If the data are separated by several years, an average annual rate of change may be computed.¹ Such a rate, if based on original data of good quality, has the advantage of taking into consideration at the same time the rate of population change as well as the rate of growth in school enrolment.

One of the useful measures which may be derived from enrolment data by sex, age and grade is the median age of pupils by grade. When compared to the normal age of pupils for each grade, this gives an indication of the average amount of school retardation in terms of the chronological age of pupils. Another approach to this measure is by computing the percentage of pupils above normal age for each grade.

Where enrolment data are distributed by age and by grade, for a given level or type of school, but are not cross-tabulated in a two-way distribution, it could still be useful to compute the median age and the median grade of pupils in order to get an over-all view of the distribution of pupils within the same level or type of school. An uneven distribution in one or both respects may be the result of either a rapid increase in the number of new admissions or a substantial amount of retardation, or both. Further analysis with additional data would be necessary to isolate the influence of these two factors.

An essential step in the analysis of basic data on school enrolment is to discover how a cohort of pupils progress through a school system in the course of a given number of years, under prevailing conditions of admission, promotion, dropping out, repetition, and graduation. Thus we need to compute such measures as the intake ratio, grade progression ratio, grade attrition ratio, repeater ratio, grade and school retention ratios, culminating in the output ratio. These various ratios should be computed for a number of years, in order to identify any trends which may be taken into consideration in estimating future enrolment.

Although we are not directly concerned here with the whole problem of estimating teacher supply and demand, it would still be useful and sometimes necessary to enter into this area in order to estimate future enrolment in teacher training schools. For this purpose, we should have past and current data on the number of teachers in service, average pupil-teacher ratios, and the annual number of teachers leaving the service (through death, retirement, resignation, change of occupation and other causes), as well as the number of teachers in training and the annual output of the teacher training institutions.

We have spoken of the various types of data which should be available under ideal conditions.

1. For a discussion of this topic, see: Unesco, *World survey of education*, Vol. II, Chapter III (Paris 1958).

Unfortunately, conditions are not always ideal, in any school situation, especially in a developing country. What if we do not have the desired kinds of information, adequate in amount, detail, completeness, recency and comparability?

Obviously we have to come to terms with the realities of the situation, and be ready to settle for less than the ideal. Where certain kinds of data are just not available, we could to some extent compromise by substitution or adaptation, with full realization that the quality of our results might not be up to our expectations. For instance, if our basic data on school-age population are available without distribution by sex, and we need to estimate future enrolment separately for each sex, perhaps we could find an approximate sex distribution of the school-age population from another country fairly similar otherwise in demographic characteristics.

Again, if we should have enrolment data concerning all public schools but only incomplete information relating to private schools, we would not give up our job until we have at least tried to estimate the missing data on private schools with the help of any clues which we may find from other sources. Or, if enrolment data by age are not obtainable, but we do have figures on enrolment by grade (which is very often the case in developing countries), let us proceed with our analysis and our estimation in terms of broad age groups, or simply by school levels, and wait for the time when our school authorities will realize the importance of collecting enrolment figures by age of pupils.

The reader will find many instances of assumptions made necessary due to missing data, in the three case studies presented for illustrative purposes in the following chapters, as well as in the additional examples from more developed countries given in Chapter VII of this *Manual*. What we wish to emphasize is that the need for estimating future school enrolment, with or without all the necessary basic data, is often more urgent precisely in those situations where we cannot expect to have all the desired figures at our disposal. Hence we can hardly do less than make the best attempt possible to meet the need.

We now come to the last category of basic information required for estimating future school enrolment. We refer here to questions of policy objectives rather than facts and figures. These are questions on whose answers will depend the validity and efficiency of the estimates, since they can affect fundamentally the extent, direction, and speed of the development of education, of which future school enrolment is only one of the quantitative manifestations.

For example, we need to know if there is to be any change in law or in public policy regarding such matters as the following:

- (a) Introduction or enforcement of compulsory education;

- (b) Prolongation, if any, of the length of compulsory schooling;
- (c) Equality, or otherwise, of educational opportunities for boys and girls;
- (d) Respective roles of government, religious organizations and other non-governmental bodies in the future development of school education;
- (e) Future emphases on the relative development of schools in urban and rural areas;
- (f) Future emphases on the relative development of education at the different levels: primary, secondary, and higher;
- (g) Future emphases on the relative development of different types of formal education: general, vocational, technical, professional;
- (h) Increase or decrease in the average class size or pupil-teacher ratio;
- (i) How to deal with the problems of drop-outs or premature school-leaving;
- (j) How to deal with the problems of repeaters due to non-promotion of pupils;
- (k) How to increase the intake and output of schools at each level, in accordance with the needs for educated manpower;
- (l) Provisions for the preparation of qualified teachers to meet the needs of a development school system;
- (m) Provisions for the building of additional schools, classrooms, and other facilities;
- (n) Possibilities of financing a developing school system - and especially limitations thereof.

In short, if estimates of future school enrolment are to be valid and efficient for purposes of educational planning, they must be realistically based on the most probable course of the future development of the school system for which the plans are being laid. In other words, the statistician who is to provide the enrolment estimates can function most effectively when he is a member of the team responsible for the process of development planning.

4. OUTLINE OF METHODS

Assuming that the statistician has the mandate to prepare some estimates of future school enrolment, say for a period of ten, fifteen or twenty years; and assuming that he has as far as possible the types of basic data and other information necessary to guide him in making such estimates, we shall now set down briefly an outline of methods which he could follow in carrying out his task.

First we shall distinguish between two principal approaches to the problem - one of which is based primarily on the level of current school enrolment and estimated ratios of intake, retention, and output

of the school system; the other depends more directly on estimates of future school-age population and future school attendance or enrolment ratios. For convenience we shall call the first approach the "grade-cohort method" and the second approach the "enrolment-ratio method". We shall see that the two approaches are not mutually independent of each other.

In general, the grade-cohort method may be used to advantage when we have fairly complete and detailed school enrolment data by sex, age and grade, or at least by sex and grade, for a sufficient number of years. The number of years covered by these data should be at least equal to the number of grades at each level of education, preferably several years more. If, in addition, we have data on promotions, drop-outs and repeaters for each grade, also for a sufficient number of years, it would greatly facilitate our work by the use of this method. Finally, some current and future estimates of school-age population by sex and age would be needed to complete our estimates of future school enrolment.

Where current school enrolment data are not available in such detail, but school-age population by sex and age may be obtained from recent censuses and current estimates, we could use the enrolment-ratio method for some approximate estimates of future school enrolment. Especially if a question on school attendance has been included in two or more census enumerations or household surveys, such data could serve as the starting point for future enrolment estimates. They could then be completed with the help of available data on school enrolment from current reports.

Thus we find that either approach requires the use of both population and enrolment data. In fact, if we had adequate data on population and enrolment, and tried both approaches, we should in principle arrive at fairly comparable results.

Regardless of which approach we use, there are three logical stages which it would be advisable to follow in our work:

(1) We analyse our available data to bring out basic characteristics and trends, which must be taken into consideration when we proceed to make our estimates of future school enrolment. It is at this stage that we find out, for instance, if our total school enrolment has been growing, and at what rate; how it is distributed by level of education and by type of school; what is the proportion of boys and girls in the total enrolment and at each level of education; what part of the enrolment is attributed to public and to private schools; how does the extent and rate of growth of rural school enrolment compare with that of urban schools; and so forth. We also compute the various appropriate ratios based on the existing data: ratios of grade progression, drop-outs, grade retention; intake and output ratios at the different

levels; pupil-teacher ratios; and the like. We would also make use of population estimates by age groups and compute enrolment ratios and their rate of change. Some of this analysis may of course be carried out as we proceed with our next stage, which is the estimation of future enrolment, but it would seem preferable that we anticipate our needs for the various measures and have them prepared before we start on our estimation.

(2) Our second stage will be to make our estimates of future school enrolment based on available data, more or less digested in the course of our preliminary analysis. The steps to be followed in this stage will depend on our choice of method and also to some extent on the results of our preliminary analysis. In other words, we shall carry our analysis further, in order to move forward from our base year to our target years. Sometimes it may be advisable first to make some provisional estimates, in order to have an idea of the general order of magnitude. If we are satisfied with the look of things at this point we may go on to make more refined or more precise calculations. Otherwise this pause would give us an opportunity to re-examine our data and our assumptions and see where we may have to introduce some necessary modifications. As we proceed with our estimation, we shall be watching for any inconsistency in our results - inconsistency within the same set of figures or between one set of figures and another. Finally we assemble our figures, draw up our tables, and perhaps embody our results in one or more graphic charts.

(3) Our third and final stage will consist of the checking of our estimates by bringing together observed data for past years and estimated data for future years; enrolment figures for different levels of education and types of schools; population figures by sex and age; in short all the related elements which have gone into the making of our estimates. In this way we can satisfy ourselves as to the consistency of our data, the reasonableness of our assumptions, and possibly the accuracy of our computations.

Perhaps we should mention here that there are two more stages to our work after our estimates are completed and accepted, or even after they are published in official documents. When sufficient time has elapsed after our estimates are made and more up-to-date figures on population and on school enrolment become available, we should take up our estimates and re-examine them in the light of the additional data and of our further understanding of the problems. Revisions may then be introduced, so that any major errors would not be perpetuated.

Finally, after the passing of the first or some of our target years, we should compare our estimates with the actual school enrolment of that year or of those years and see how closely we have been able to approach the reality with our estimates. This may

be a source of satisfaction (if we have come reasonably close) or cause for embarrassment (if, as is likely to happen, we shall have missed the mark by a more or less wide margin). In either case, we shall be wiser by that time, and better prepared to embark on our next project of this nature.

We shall conclude the present chapter by summarising the various steps in the procedure for estimating future school enrolment, in a hypothetical situation, by the use of: (A) the grade-cohort method; and (B) the enrolment-ratio method. Where appropriate, reference will be made to the illustrative case studies presented in the next three chapters or to the examples given in Chapter VII.

(A) *The grade-cohort method*

Sometimes known as the "cohort survival" method, this requires data on pupil enrolment by grade for at least as many years as the number of grades at the given school level; if possible also the number of new pupils and repeaters by grade. Separate figures by sex are usually desirable; by public and private schools, and by urban and rural areas as far as possible. The following steps are suggested:

(1) Assemble all available data and analyse them for any characteristic trends.

(2) If enrolment data include number of new pupils and repeaters by grade, compute grade progression ratio, repeater ratio and grade retention ratio between grades 1 and 2, between grades 2 and 3, and so on. (See Chapter IV, tables IV-11, IV-12, and IV-13.)

(a) If enrolment is reported without separate numbers of new pupils and repeaters, approximate grade retention ratios may be computed. (See Chapter IV, table IV-20; Chapter VI, table VI-14.)

(b) If there are no repeaters, or if the number of repeaters is known to be negligible, the grade progression ratio may be considered as equivalent to the grade retention ratio. (See Chapter VII, table VII-13.)

(3) When grade retention ratios have been computed for a number of years, they should be examined for trend. If no clear trend is discernible, the ratios may be averaged over a number of years. (See bottom lines of table IV-13.)

(a) If a clear trend is shown, as for example, where the grade retention ratio between two successive grades is consistently rising, due to the reduction in the number of drop-outs, then the yearly ratios should not be averaged. In such case, the observed trend should be taken into consideration when projecting this ratio into the future.

(b) Where grade retention ratios for male and female pupils are found to be quite different, separate computations and estimates should be carried out for each sex. Where there is no significant

difference between the sexes, much work can be saved by using combined ratios for the two sexes together.

(4) When the grade retention ratios from the first to the last grade of the given school level are compounded, that is, multiplied together one after the other, approximate school retention ratios may be obtained. Such ratios can refer to the retention in school of a beginning cohort of pupils after one year, after two years, and so on, until they have all left the school by dropping out or by completing the final grade.

(a) A more refined method of computing school retention ratios, by following a first-grade cohort through all the grades, with the help of appropriate grade progression and repeater ratios, is explained and illustrated in Chapter IV.

(b) Where information on drop-outs and repeaters is lacking, only approximate ratios can be computed with the help of various assumptions, as illustrated in Chapter VI.

(5) After the yearly and average grade retention ratios have been computed, we must make some assumptions as to the ratios which will probably be obtained for future years. In a developing school system, we would expect - at least hope - that the grade retention ratios would continually improve till they come as closely as possible to 100 per cent. (See Chapter IV, tables IV-23 and IV-28.)

(6) From these assumed grade retention ratios, hypothetical school retention ratios may be computed, to give the percentage of pupils from each grade 1 cohort who may be expected to remain in school after one year, two years, and so on. (See Chapter IV, tables IV-24 and IV-29.)

(7) Now it will be necessary to estimate the size of future cohorts in the beginning grade. This may be done by observing the rate of growth of past cohorts, and estimating future cohorts by assuming a hypothetical rate or annual amount of increase. (See Chapter IV, tables IV-22, IV-25, IV-27 and IV-30.)

(a) Where estimates of population in appropriate age-groups are available, the beginning cohorts may be estimated by means of an intake ratio based on past observations, assumed either to increase or to remain unchanged. (See Chapter VI, table VI-15.)

(b) Beginning cohorts for higher levels of schools may be estimated from observed intake ratios based on the relationship between the last grade of the lower school and the first grade of the higher school. (See Chapter VI, tables VI-17 and VI-19, Chapter VII, table VII-15.)

(8) By applying assumed school retention ratios to the estimated beginning cohorts for the future years, estimates of total enrolment are obtained. (See Chapter IV, tables IV-22, IV-25, IV-27, IV-30;

Chapter VI, tables VI-15, VI-17 and VI-19.)

(a) Sometimes it may be convenient to depart from the grade-cohort method and to estimate total enrolment at one level (for example, second level - teacher training) from the estimated enrolment at another level (for example, first level - primary schools). (See Chapter IV, pages IV-56 to IV-63.)

(b) A short-cut method may also be used to estimate enrolment in one type of school from estimates already made for another type of school. (See Chapter IV, table IV-31, where vocational school enrolment is derived from estimates of enrolment in general secondary schools and teacher training schools.)

(9) Separate estimates for urban and rural schools may be obtained from estimates of total enrolment by assuming certain proportions between urban and rural schools, based on past observations. (See Chapter IV, table on page 49; also Chapter V, table V-19.)

(a) Similarly, if desired, separate estimates for public schools and private schools may be derived from estimates of total enrolment by assuming certain proportions in the future distribution of total enrolment between public and private schools. (See Chapter V, table V-20.)

(10) As a last step, it is suggested that all estimates of future school enrolment should be tested for their consistency and reasonableness, by examining them together with observed enrolment data for past years, and with population estimates for appropriate age groups. (See the last sections of Chapters IV, V, and VI.)

(B) *The enrolment-ratio method*

This method, based essentially on the projection into the future of past and current ratios of school enrolment or of school attendance, requires estimates of population by age and sex, and either school attendance data (from census and surveys) or school enrolment data (from current school statistics), also by age and sex. Enrolment data by level of school are always necessary; additional information on distribution by grade is desirable, as well as distribution by urban and rural schools, by public and private schools, and by different types of schools at each level. The following steps are suggested:

(1) Assemble all available data and analyse them for any characteristic trends.

(2) Determine appropriate age-groups for each level of education, and make first approximate estimates of school-age population according to these age-groups. (See Chapter V, table V-10.)

(a) Where population estimates are given in two or more series, such as "high", "low" and "medium" estimates, it may be decided at this point whether school enrolment estimates should

also be made in alternative series correspondingly.

(b) In view of the uncertainties involved both in the estimation of population and of school enrolment, especially in a developing country, it would seem advisable to save time and effort by choosing only one series of population estimates, and to prepare only one set of estimates for school enrolment.

(3) Since population estimates are usually prepared for five-year age-groups, rather than for single years of age, it would be necessary to derive estimates of school-age population, in appropriate age-groups, by means of interpolation.

(a) A method of interpolation used by some demographers, based on an arbitrary set of weights, known as "Sprague's multipliers", may be applied to split up estimates in five-year age-groups into single-year-of-age estimates and then recombine them into the desired age-groups. (This is illustrated in Chapter V, tables V-12, V-13 and V-14.)

(b) The "Sprague's multipliers" may be adapted to obtain estimates of the population in the desired age-groups without first splitting up into single-year-of-age estimates. (This is illustrated in Chapter V, table V-15.)

(4) Where future population estimates are given only at intervals of several years (say at five-year intervals), and if estimates of school-age population are required for intervening years, further interpolation is necessary. This operation may be performed on estimates of the school-age population at five-year intervals, resulting from the previous step.

(5) Assume school attendance or enrolment ratios for each sex and age-group, based on past observations, to be applied to estimated population for future years.

(a) In a developing country, the goal will be to increase the ratios as rapidly as possible, so that nearly 100 per cent of the primary-school-age population will eventually be enrolled in school; the practical goal of maximum enrolment may be 98 or 99 per cent instead of 100 per cent. (See, for example, projected enrolment ratios for the United States, in Chapter VII, table VII-5.)

(b) The projection of school enrolment ratios for specified age groups may be done graphically, according to certain assumptions. (See, for example, projections of school enrolment ratios for France, in Chapter VII, charts VII-4 and VII-5.)

(6) Multiplication of estimated future population by age-groups by the assumed enrolment ratios for the corresponding age-groups will produce the number of children expected to be in school at given dates in the future. (See Chapter V, table V-17.)

(a) Where possible, the estimated enrolment for each age group should be distributed by school level, allotting appropriate percentages, for

example, to kindergarten, primary and secondary grades. (See Chapter VII, table VII-6.)

(b) Where it is not possible to make such distribution by detailed age-groups, an overall distribution of estimated total school enrolment may be made between the first (primary) and second (secondary) levels. (See Chapter V, table V-18.)

(7) If required, the estimated total enrolment in primary schools may be further distributed between urban and rural areas, in accordance with observed trends and desired goals. (See Chapter V, table V-19.)

(8) Similarly the estimated total enrolment at the second level may be distributed between general and vocational schools (and teacher training schools, if they exist at that level). (See Chapter V, table V-21.)

(9) Where appropriate, the estimated enrolment at each level may be distributed between public and private schools. (See, for example, Chapter VII, table VII-7.)

(a) If no clear trends are shown by past data, and the direction of future development is uncertain, alternative estimates may be made by using different assumptions. This applies also to the other types of distribution, such as urban-rural, or general-vocational. (See Chapter V, table V-20.)

(10) Finally, all estimates of future school enrolment, by sex, age, level and type of school, should be tested for consistency and reasonableness. (See the last sections of Chapters IV, V, and VI).

It should be emphasized that the outline of methods given above, and especially the suggested step-by-step procedure, must be adapted to the actual situation as to the availability of data, the amount of detail required, and the degree of approximation that would be considered satisfactory. They are illustrated in the three case studies presented in Chapters IV, V, and VI, to which reference has been made in this Chapter.

Further suggestions concerning methods and procedures may be found in Chapter VII, which gives some examples of actual work in several of the more developed countries. Special attention of the reader is called to the outlines of procedure given in connexion with the work of the United States Office of Education (See Chapter VII, page 120) the Southern Regional Education Board (See Chapter VII, page 129) and the New Zealand Department of Education (See Chapter VII, pages 141 and 142).