Demographic aspects of educational planning

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Fundamentals of educational planning

The booklets in this series are written primarily for two types of clientele: those engaged in educational planning and administration, in developing as well as developed countries; and others, less specialized, such as senior government officials and policy-makers who seek a more general understanding of educational planning and of how it is related to overall national development. They are intended to be of use either for private study or in formal training programmes.

Since this series was launched in 1967 practices and concepts of educational planning have undergone substantial change. Many of the assumptions which underlay earlier attempts to rationalize the process of educational development have been criticized or abandoned. Even if rigid mandatory centralized planning has now clearly proven to be inappropriate, this does not mean that all forms of planning have been dispensed with. On the contrary, the need for collecting data, evaluating the efficiency of existing programmes, undertaking a wide range of studies, exploring the future and fostering broad debate on these bases to guide educational policy and decision-making has become even more acute than before. One cannot make sensible policy choices without assessing the present situation, specifying the goals to be reached, marshalling the means to attain them and monitoring what has been accomplished. Hence planning is also a way to organize learning: by mapping, targeting, acting and correcting.

The scope of educational planning has been broadened. In addition to the formal system of education, it is now applied to all other important educational efforts in non-formal settings. Attention to the growth and expansion of education systems is being complemented and sometimes even replaced by a growing concern for the quality of the entire educational process and for the control of its results. Finally, planners and administrators have become more and more aware of the importance of implementation strategies and of the role of different regulatory mechanisms in this respect: the choice of financing methods,
the examination and certification procedures or various other regulation and incentive structures. The concern of planners is twofold: to reach a better understanding of the validity of education in its own empirically observed specific dimensions and to help in defining appropriate strategies for change.

The purpose of these booklets includes monitoring the evolution and change in educational policies and their effect upon educational planning requirements; highlighting current issues of educational planning and analyzing them in the context of their historical and societal setting; and disseminating methodologies of planning which can be applied in the context of both the developed and the developing countries.

For policy-making and planning, vicarious experience is a potent source of learning: the problems others face, the objectives they seek, the routes they try, the results they arrive at and the unintended results they produce are worth analysis.

In order to help the Institute identify the real up-to-date issues in educational planning and policy-making in different parts of the world, an Editorial Board has been appointed, composed of two general editors and associate editors from different regions, all professionals of high repute in their own field. At the first meeting of this new Editorial Board in January 1990, its members identified key topics to be covered in the coming issues under the following headings:

1. Education and development.
2. Equity considerations.
3. Quality of education.
4. Structure, administration and management of education.
5. Curriculum.
6. Cost and financing of education.
7. Planning techniques and approaches.
8. Information systems, monitoring and evaluation.

Each heading is covered by one or two associate editors.
The series has been carefully planned but no attempt has been made to avoid differences or even contradictions in the views expressed by the authors. The Institute itself does not wish to impose any official doctrine. Thus, while the views are the responsibility of the authors and may not always be shared by UNESCO or the IIIEP, they warrant attention in the international forum of ideas. Indeed, one of the purposes of this series is to reflect a diversity of experience and opinions by giving different authors from a wide range of backgrounds and disciplines the opportunity of expressing their views on changing theories and practices in educational planning.

What are the demographic challenges facing educational planning today? It is vital for planners and decision-makers to know the structure and distribution of the population at a given date, as well as how it has changed in recent years.

This booklet, which has been in great demand ever since the first edition appeared in 1969, has been entirely revised and rewritten by the author to incorporate the latest developments in the fields of demography and education. Among the new challenges facing planners today is the AIDS pandemic, whose devastating effects are being felt at many levels: radical changes in population structure, a drop in the number of births, and growing numbers of orphans.

The author provides the keys to understanding the various types of demographic data and the essential techniques needed by those who desire to apply such data to the management of education systems. The Institute wishes to thank him for this extremely clear and comprehensive volume.

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Preface

In the preface to the first edition of this volume in the Fundamentals of Educational Planning series, C.E. Beeby, then General Editor of the series, wrote:

“All of us who are engaged in educational planning, or in writing about it, face the same embarrassing problem; the field is so vast and varied that, in almost any corner of it, we find ourselves working alongside specialists who, in that particular area, know very much more than we do. This is a source of strength rather than weakness if each is willing to admit his ignorance, but the admitting of ignorance is not always simple, as anyone will testify who has greeted a forgotten acquaintance like a long-lost friend only to be driven a couple of hours later to the indignity of asking him his name. Many of us in planning are in much the same position with the technical terms and concepts of colleagues coming from other disciplines …

This is what makes Dr. Ta Ngoc Châu’s booklet so valuable and timely. The findings of the demographer are the foundation on which most educational plans are built, and those who are responsible for the superstructure cannot afford to be hazy on the meaning of the terms [they use]… The crudest error the unskilled planner can make is to ignore, in whole or part, the effects of demographic changes on plans for education, but it is almost as dangerous to take at their face value every set of demographic data that is published. Ta Ngoc Châu sets out to warn us against both extremes. His booklet makes no pretence of being a manual on demography (though a useful list of these will be found at the end of this study) and, in a publication of this length, certain topics, such as theories of population and demographic analysis properly so called, have had to be omitted entirely. But no intelligent layman could read this essay without becoming more acutely aware of the significance of the
Preface

demographer’s work for educational planning at all levels and of the traps into which the unwary can fall unless they know how the figures have been arrived at. With admirable professional restraint the author deals with demographic techniques only up to the point where they must be understood if one is to know the exact limits within which reliance can be placed on the final results.

For a booklet whose purpose is the clarification of concepts and the orderly presentation of technical processes to the layman, the Institute was fortunate in finding an author ... [like] Ta Ngoc Châu. ...

The author insists that he is not a professional demographer but an economist who has been led into demography by his interest in educational planning. It is this that gives the booklet its essentially practical character; it is written to be of immediate use to planners and administrators in the field and to those who are preparing themselves for these careers. It is in no way intended to make every planner his own demographer, but rather to help them use the findings – and particularly the projections – of the demographer with the proper blend of confidence and caution. The booklet should be of special value in developing countries, where reliable data are often hard to find and where the assumptions on which demographic projections are based are such as to demand skilled interpretation of the figures by practitioners who will build on them the educational plans for a whole country.”

Thirty years later, all of Mr. Beeby’s comments are still valid.

Although this booklet had been out of print for several years, it remains one of the most frequently requested titles in the ‘Fundamentals’ series. The Editorial Committee for the series therefore judged it advisable to ask Ta-Ngoc Châu to update his work, in order to make it as useful to the planners of the year 2000 as it was to those of the 1970s.

Demographic techniques have not greatly changed since 1969. The principal difference lies in the use of computers, which have
made it much easier to analyze censuses and population surveys and to generate projections.

Some new problems have arisen, however, that will affect the demographics of school systems. HIV/AIDS, for example, is threatening to undermine all the progress made towards education for all, particularly in Africa, but also in Asia and the Caribbean. Demographers have not yet taken the full measure of the impact of this pandemic on the adult population, teachers, the birth-rate, and the number of children in need of schooling. Research on this issue must continue, but in the meantime demographers and planners cannot afford to ignore it. Other challenges include the ageing of the developed countries’ populations and the world-wide upsurge in migratory flows, due in particular to the proliferation of conflicts and crises.

Demography remains one of the fundamental sciences underpinning the work of educational planners. The Editorial Committee extends its thanks to Ta-Ngoc Châu for agreeing to update a monograph that is of such value to all education specialists.

Françoise Caillods
Co-General Editor
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Introduction

Demographic analysis may be defined as the study of human groups. One way of approaching this subject is to try to explain demographic facts and to seek the causes behind them. This could be called theoretical demographic analysis. Another way is to limit oneself to a purely descriptive approach, leading in the end to a ‘statistical description of populations’. In reality, however, the distinction is not as clear as this; population forecasts, for instance, cannot be made without a minimum of demographic analysis.

Whichever approach is adopted, demographers have two possible fields of study distinct from each other, both in objectives and in method.

Interest may centre on the current situation of the population. This is commonly known as static demographic analysis, and what is studied in this case is the state of populations, in other words, their structure or composition.

On the other hand, interest may centre on the trend of the population, which is the dynamic aspect of population analysis. The population trend – also called movement of the population – will depend on a number of factors, particularly on such demographic events as births, marriages and deaths.

We shall respect this traditional distinction by examining in Part I the structure of a population and its effects on educational problems, and in Part II, population trends or movements and their impact on educational planning over the longer term.
I. Population structure and its effects on education

Studying the structure of a population means studying its composition, i.e., its distribution according to certain pre-defined criteria.

Educational planners may be concerned with the distribution of the population for various reasons. First, they may be interested in its distribution by age and sex. This enables them to measure the relative size of the school-age population, which is the foundation and the point of departure for any educational policy.

Second, they may be concerned with the distribution of the population by sector of economic activity and, within each of these sectors, by occupation. Without accurate knowledge of the distribution by sector and occupation, it is impossible to estimate manpower requirements\(^1\), and hence to determine targets for technical, vocational and higher education.

Third, planners may be concerned with the geographical distribution of the population, which affects both the cost of education and the choice of types, sizes and locations of schools.

Our examination of population structure will be confined to the three above-mentioned aspects. First, however, we should give a brief outline of the methods of analysing population structure, and in particular methods of census-taking.

*Censuses and the study of population structure*

Governments have always felt the need to know how many people they govern. It is necessary to know the size of a population in order to determine the volume of recruiting for the armed forces, to distribute the tax burden, to make an equitable distribution of land, etc.

\(^1\) It should be borne in mind that manpower requirements are influenced by a great many factors, and that forecasts of such requirements are therefore only approximate.
As the functions of government have increased and its fields of activity have widened, the need for census data has become even more compelling, and a constantly increasing amount of information needs to be collected.

Censuses no longer consist in merely counting the population; they now provide the opportunity to obtain a wide variety of information. They have thus become more and more complex operations, and an increasingly specialized and numerous staff is needed to carry them out. For this reason, the cost of census-taking has considerably escalated.

Moreover, owing to the size of the operation, which is supposed to cover the entire population, and owing to the number and variety of the statistics to be compiled, it takes some time to process census data. The problem is that in population analysis, as in other fields, statistical data lose some of their value if they are not made public quickly. These data are not intended merely to satisfy a purely scientific interest in the population; rather, their primary purpose is to help us in our planning. This means that we must have the data as promptly as possible. In fact, the number of questions asked is often restricted in order to speed up the processing stage.

There are various possible methods of taking a census, and the choice of method depends to a great extent on the facilities available and the number of personnel which can be used for the operation.

**Types of census**

The types of census can be classified according to the scope of the operations planned, either as a complete census of the population, or a survey by sampling.

A complete census of the population is the method which produces the most detailed and the most accurate results. It involves making contact with all the inhabitants of the territory and getting data *separately* for every one of them. But it is readily apparent that a total or exhaustive census of the population entails considerable expense and a sizeable staff. For this reason, in addition to the exhaustive
censuses, which are generally taken every 10 years, surveys of population samples are conducted during the periods in between full censuses.

Any census is subject to errors of observation, but random sampling introduces in addition a type of error peculiar to itself, stemming from the possibility that the sample may not be truly representative of the whole. The fact remains, however, that in census-taking by sampling, the job can be done by a smaller staff, which means that the latter can be better trained and better supervised. Errors of observation can thereby be substantially reduced. In fact, the results obtained in a well-conducted sample census may sometimes prove to be better than those obtained in an exhaustive census organized under inadequate conditions.

As stated above, complete censuses of the population are taken only at 10-year intervals. The problem, therefore, is to collect demographic data for the years between censuses. The surest method is to maintain a permanent, constantly-updated database on the population considered. This is done by preparing a record for each individual in the national territory at a given time, adding new records for all births and persons entering the territory, and removing records of all deaths or persons leaving. This kind of database makes it possible to determine the size and structure of the population at any given moment.

Where there is no such database, one can attempt to extrapolate the figures on the basis of the trends observed in the two preceding censuses. An extrapolation of this kind may produce inaccurate results, however, because there would be no assurance that the trends observed in the past would continue in the future.

It is also possible, to the extent that fertility and survival rates by age are known, to make projections based on the data of the last census. We shall have occasion to return to this problem in Part II.

This review of census-taking methods shows the complexity of the problem and the difficulties encountered in obtaining accurate
demographic statistics. The result is that demographic data are rarely free of errors, particularly in developing countries.

**Limitations on the value of demographic data**

Three types of errors may be distinguished:

1. Errors due to sampling
2. Errors due to the organization of the surveys
3. Errors of observation.

**Errors due to sampling**

As mentioned above, these errors arise when the sample selected is not fully representative of the overall population. They will therefore depend on the size of the sample and the quality of the sampling procedure, and hence on the skill and know-how of the staff in charge of the survey.

**Errors due to the organization of surveys**

Carrying out demographic surveys is a particularly difficult and sensitive task in developing countries. The inadequacy of infrastructure (the scanty development and often poor quality of road networks, coupled with the great distances to be travelled in order to make contact with sparse and sometimes mobile populations) and the harsh terrain and climate, all hamper the smooth operation and supervision of a census.

Moreover, it is not easy to recruit sufficient census-taking agents who are trained and able to carry out these difficult surveys and who are at the same time willing to work under such conditions. The quality of the data collected in the course of the survey depends, after all, on the competence and the conscientiousness of the census-takers.

**Errors of observation**

Errors of observation are also apt to be relatively large in developing countries. Most demographic data are obtained from
statements by individuals; thus, *when part of the population is illiterate*, and when people attach *little* importance to precise notions of time and date, the chances are that some statements will be inaccurate.

In addition, demographers must reckon with false statements – that is, *intentionally untrue* statements. These may occur where the people do not understand the exact meaning and purpose of the census questions and suspect that they represent some kind of a government investigation, which may have an adverse effect on them in the form of taxes, military service, or other such obligations. There are also cases where superstition or taboos forbid revealing certain facts of one’s life. It is easy to see, therefore, how important and sensitive the work of the census-takers is, for they must instil confidence in the people, explain to them why the information is being collected, and, to win their sincere co-operation. The quality of the information collected will depend on the tact and know-how of the census-takers.

The many errors which infiltrate into a census-taking operation because of the above-mentioned factors can be corrected to the extent that the direction of error – whether the errors bias the results upward or downward – and the relative size of the errors is known. For this reason, a *control* census is sometimes performed. Such a census covers a smaller number of groups or units, but it is conducted with better facilities and a more highly qualified staff. Comparison of the results obtained in the control census with those obtained in the initial census reveals the *types* of errors committed, their *direction*, and their relative *size*.

Although demographic data are often marred by errors, educational planners must nevertheless use them as the basis for taking certain decisions and for determining certain educational targets. They should therefore inform themselves on the methods by which the data were obtained, and especially on their degree of accuracy. Planners must always bear in mind the limitations on the value of such statistics in their work and should allow some room for adjustment in their plans so that they can, if necessary, compensate for the effects of errors in population estimates.
Structure of the population by age and sex

The simplest method of studying the population structure by age and by sex is to construct an ‘age pyramid’. As an example, Figure 1 shows an age pyramid for the population of France as of 1 January 2001.

The age structure of the population is very important in demographic analysis because it provides a sort of summary of the demographic history of the nation, and also because, as we shall see in Part II, it governs to some extent the future growth of the population.

The age structure summarizes the demographic history of the nation. The number of individuals at each age, or in each age group, depends on:

- the number of births in the generation, or generations, of which they were born;
- the effect of mortality on that generation or those generations;
- the size of migratory flows at various times, and the ages of the migrants.

Hence, to identify past events which may have affected the population of a country, one needs only to look closely at an age pyramid. In the age pyramid of the French population (Figure 1), the following main events can be observed:

1. the shortage of births resulting from the first world war (1914-1918);
2. the drop in the number of births as the depleted age groups born during the first world war reached child-bearing age;
3. the shortage of births during the second world war (1939-1945);
4. the post-war ‘baby boom’;
5. the end of the baby boom as from 1971, resulting in a situation where generations were no longer replacing the preceding generation.
In addition, a higher male mortality is observed among the older groups: the pyramid is asymmetrical for people born before 1914, with men in the minority.

**Figure 1. Age pyramid of the population of France as of 1 January 2001**

1) Deficit in natality following the 1914-1918 war  
2) Effect of fewer children born in 1914-1918 reaching child bearing-age  
3) Deficit in natality during the war from 1939-1945  
4) Baby boom  
5) End of the baby boom  

*Source: The Institut National d’Etudes Démographiques web site (www.ined.fr).*

This is the kind of information that can be obtained by interpreting the irregularities of an age pyramid. But in order for the conclusions to be true, the irregularities of the pyramid must be *real*; that is, based on actual facts and not on the inaccurate statements of individuals.
Inaccurate age data and methods of adjusting the age pyramid

The age structure of a population is determined on the occasion of a general census. It is therefore the task of the census-takers not only to count the population, but also to determine the ages on the basis of individual statements.

They may, however, receive inaccurate, or even false statements. Inaccurate statements come from those who do not know exactly how old they are and who therefore give an approximate age, while false statements come from those who know how old they are but for one reason or another state a different figure.

The age pyramid constructed from the population census of Turkey in 1945 is mainly of historical interest, but it offers a good illustration of the consequences of inaccurate statements (Figure 2). A glance at the Turkish age pyramid, based on the statements taken during the census, is sufficient to show the very high proportion of figures ending in 0 or 5. Owing to this trend, a shortfall is observed in the number of persons who declared their ages as one year before or one year after those preferred figures (ages ending in 9 or 1 and in 4 or 6). Setting aside figures ending in 0 or 5, even numbers were preferred to odd numbers.

This preference for ages ending in 0 or 5, and the slightly less popular choice of even numbers over odd numbers, is of course not confined to Turkey in 1945. They are found in all countries where the majority of the people do not know their exact age.

An age pyramid of the type shown in Figure 2 is, of course, too inexact to be utilized directly. Adjustments must therefore be made. There is a tendency to lose sight of the fact that the main purpose of an adjustment is to obtain an estimation as close as possible to the real situation. The purpose is not to produce a more regular pyramid, or one more in conformity with some ‘model’ age pyramid. Irregularities resulting from the demographic history of a nation must on no account be erased under the pretext of making an adjustment. For example,
the irregularities to be observed in the age pyramid of France are clearly due to the events of the past.

**Figure 2.** Population of Turkey, by sex, age and 5-year age groups, according to the 1945 census


Since the inaccuracy of declarations of age is due to a preference for figures ending in 0 or 5, combining single-year age groups into groups covering five consecutive years reduces the inaccuracies, because in each five-year group there is an age ending either in 5 or in 0. This was done in the age pyramid for Turkey (parts shown in outline without shading).

It may also be the case that only the data for five-year age groups are available, but it is data concerning single-year age groups that are
needed. For example, to measure enrolment rates in primary education, it is necessary to know not only the numbers of children in the 5-9 and 10-14 age groups, but also the actual numbers of children aged 6, 7, 8, 9, etc.

In such a case, an interpolation can be performed using Sprague multipliers. Details concerning this method are given in the appendix. Sprague multipliers are simple to use and constitute a convenient tool for the educational planner. It should be borne in mind, however, that this method is nothing but an interpolation, and hence that the results obtained are merely approximations.

This method should therefore be used only when no data are available other than the figures for the five-year age groups, and when there is reason to believe that there has been no great variation in the birth rate or infant mortality rate in the preceding years. Examples of such variation would be a shortage of births due to hostilities or the French baby boom of the post-war years. Such declines and increases in the birth rate can have a decisive effect on the numbers of individuals in the corresponding age groups.

If relatively accurate birth statistics are available, and if survival rates are known for different ages, it may be preferable to estimate the numbers of individuals at different ages on the basis of the number of births and the survival rates. The procedure for making such estimates will be explained in Part II.

This warning about the inaccuracies of population statistics must not, however, lead educational planners to disregard demographic issues. Demographic data are the foundation on which all educational planning is built, and they play a part whenever options are formulated or decisions taken. But at the same time, planners must not lose sight of the limits to their accuracy.

**Age structure of the population and educational development**

We saw above how a population pyramid can be interpreted. But a close study of such a pyramid reveals other characteristics which may be very important for the development of education systems.
Age structure and teacher requirements

Returning to the age pyramid for France (Figure 1), a decided rise in the birth rate is observed from 1945, corresponding to the ‘baby boom’ in the immediate post-war years and the continuation of this trend through 1970.

The last three decades have seen a major reversal of this trend, however, with a substantial drop in the birth rate leading to insufficient renewal of generations, as we will see below when the net reproduction rate is discussed.

The persistence of a high birth rate from 1945 to 1970, followed by a drop as from 1970, has had a considerable impact on education. In 2000, for example, pupils and university students belonged to the generations born from 1975 to 1994 (the 6-25 year age group), which were relatively small generations owing to the downward trend in the birth rate. The majority of teachers, however, belonged to the generations born from 1945 to 1975, i.e., the large generations resulting from the baby boom. This unusual demographic situation is currently making it easier to hire teachers in France, despite the fact that, for other reasons, teaching careers are considered somewhat less desirable than they were previously.

More generally, whenever the birth rate falls for one reason or another, this decrease will affect the number of children in primary education six years later, the number in secondary school 12 years later and the number in higher education 18 years later. This has occurred in some Asian countries, such as the Republic of Korea, China and Thailand, and such Latin American countries as Chile and Costa Rica. Such a trend makes it easier to absorb the increased social demand for secondary and higher education.

The structure of the population by age can yield much other useful information for educational planning. It can be used, in particular, to measure the relative burden of expenditures on education.

2. Assuming that, as is often the case, the official age for admittance to primary school is six years and that primary schooling and secondary schooling each last six years.
Age structure and relative burden of educational expenditures

Expenditures on education are proportionate to enrolment and consequently depend indirectly on the school-age population, but the financing of education can be considered as a levy on the output of the economically active part of the population.

If the school-age population is made up of children from 5 to 14 years of age inclusive, and the active population is recruited from persons aged 15 to 64, an estimate of the relative burden of educational expenditures on the active population is obtained by calculating the ratio of the 5 to 14-year-old population to the 15 to 64-year-old population.

This proportion varies widely from one country or region of the world to the next, as shown in Table 1. In Africa – with the exception of Mauritius, whose situation is somewhat exceptional, and South Africa – the ratio of children aged 5 to 14 to the active population exceeds 50 per cent. This means that, for purely demographic reasons, the goal of ‘education for all’ is much harder to achieve in Africa than elsewhere.

The proportion is also very high in the Arab states, whereas in Asia the situation is more diversified: In the Republic of Korea it is only 22.3 per cent, whereas in the Philippines it amounts to 42.5 per cent, a level comparable to that of the African and Arab countries.

In Latin America, where the influence of the Catholic Church is still predominant, the situation lies between these two extremes, but with significant differences from one country to another, ranging from 29.8 per cent in Chile to 39.3 per cent in Venezuela.
### Table 1. School-age population and working-age population (in thousands), 1995

<table>
<thead>
<tr>
<th>Country</th>
<th>Age group</th>
<th>(1)</th>
<th>(2)</th>
<th>(1)/(2) %</th>
<th>Country</th>
<th>Age group</th>
<th>(1)</th>
<th>(2)</th>
<th>(1)/(2) %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-Saharan Africa</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Latin America</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mauritius</td>
<td>198</td>
<td>742</td>
<td>26.7%</td>
<td></td>
<td>Chile</td>
<td>2,714</td>
<td>9,094</td>
<td>29.8%</td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>8,693</td>
<td>22,669</td>
<td>38.3%</td>
<td></td>
<td>Argentina</td>
<td>6,641</td>
<td>21,452</td>
<td>31.0%</td>
<td></td>
</tr>
<tr>
<td>Senegal</td>
<td>2,282</td>
<td>4,548</td>
<td>50.2%</td>
<td></td>
<td>Brazil</td>
<td>34,419</td>
<td>101,185</td>
<td>34.0%</td>
<td></td>
</tr>
<tr>
<td>Cameroon</td>
<td>3,572</td>
<td>6,881</td>
<td>51.9%</td>
<td></td>
<td>Colombia</td>
<td>8,518</td>
<td>23,549</td>
<td>36.2%</td>
<td></td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>3,044</td>
<td>5,849</td>
<td>52.0%</td>
<td></td>
<td>Jamaica</td>
<td>539</td>
<td>1,471</td>
<td>36.6%</td>
<td></td>
</tr>
<tr>
<td>Nigeria</td>
<td>27,311</td>
<td>51,950</td>
<td>52.6%</td>
<td></td>
<td>Mexico</td>
<td>21,146</td>
<td>54,869</td>
<td>38.5%</td>
<td></td>
</tr>
<tr>
<td>Congo</td>
<td>702</td>
<td>1,301</td>
<td>53.9%</td>
<td></td>
<td>Costa Rica</td>
<td>810</td>
<td>2,079</td>
<td>39.0%</td>
<td></td>
</tr>
<tr>
<td>Kenya</td>
<td>8,138</td>
<td>13,853</td>
<td>58.7%</td>
<td></td>
<td>Venezuela</td>
<td>5,155</td>
<td>13,106</td>
<td>39.3%</td>
<td></td>
</tr>
<tr>
<td><strong>Arab countries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Industrialized countries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syria</td>
<td>2,084</td>
<td>5,411</td>
<td>38.5%</td>
<td></td>
<td>Japan</td>
<td>14,053</td>
<td>87,078</td>
<td>16.1%</td>
<td></td>
</tr>
<tr>
<td>Iraq</td>
<td>6,154</td>
<td>15,787</td>
<td>39.0%</td>
<td></td>
<td>Germany</td>
<td>9,146</td>
<td>55,774</td>
<td>16.4%</td>
<td></td>
</tr>
<tr>
<td>Tunisia</td>
<td>15,882</td>
<td>35,999</td>
<td>44.1%</td>
<td></td>
<td>Sweden</td>
<td>1,056</td>
<td>5,606</td>
<td>18.8%</td>
<td></td>
</tr>
<tr>
<td>Algeria</td>
<td>7,155</td>
<td>16,049</td>
<td>44.6%</td>
<td></td>
<td>United Kingdom</td>
<td>7,522</td>
<td>37,784</td>
<td>19.9%</td>
<td></td>
</tr>
<tr>
<td>Morocco</td>
<td>4,691</td>
<td>10,185</td>
<td>46.1%</td>
<td></td>
<td>Canada</td>
<td>4,000</td>
<td>20,087</td>
<td>19.9%</td>
<td></td>
</tr>
<tr>
<td>Egypt</td>
<td>5,486</td>
<td>10,891</td>
<td>50.4%</td>
<td></td>
<td>France</td>
<td>7,659</td>
<td>38,003</td>
<td>20.2%</td>
<td></td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>4,260</td>
<td>7,427</td>
<td>57.4%</td>
<td></td>
<td>Australia</td>
<td>2,584</td>
<td>11,934</td>
<td>21.7%</td>
<td></td>
</tr>
<tr>
<td><strong>Asia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>United States</td>
<td>38,985</td>
<td>174,364</td>
<td>22.4%</td>
<td></td>
</tr>
<tr>
<td>Rep. of Korea</td>
<td>7,102</td>
<td>31,869</td>
<td>22.3%</td>
<td></td>
<td>New Zealand</td>
<td>562</td>
<td>2,401</td>
<td>23.4%</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>219,693</td>
<td>822,628</td>
<td>26.7%</td>
<td></td>
<td>Pakistan</td>
<td>213,809</td>
<td>597,546</td>
<td>35.8%</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>11,429</td>
<td>39,269</td>
<td>29.1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lastly, this percentage is lowest in the countries that have long been industrialized. In Japan and Germany, it is only about 16 per cent. Educational development thus has two factors working in its favour in the wealthy countries: abundant resources, and a proportionally smaller school-age population.

The school-age population as a percentage of the working population indicates the youthfulness or the agedness of a population. To measure this, we have another indicator that is particularly convenient: the median age of the population, which may be defined as the age that divides the population into two equal parts.

This indicator is provided for various countries in Table 2 below and confirms what we have just seen. Whereas in Kenya and the Congo half of the population is aged 17 and under, in Japan the median age is close to 40. In other words, half of the Japanese population is at least 40 years old. More generally, the African and Arab countries have the lowest median ages (of around 20 years, often less), while those of the industrialized countries are substantially higher.

Age structure and school enrolment rates

As we have seen, the age structure enables us to estimate the relative size of the school-age population. It also enables us to calculate school enrolment rates in order to try to answer the following question: ‘What proportion of children receive an education?’.

Although the answer to this question seems very clear, we cannot give an entirely satisfactory answer because two different indicators are recommended: the gross enrolment rate, and the net enrolment rate.
### Table 2. Median age of the population of selected countries, 1995

<table>
<thead>
<tr>
<th>Country</th>
<th>Median age</th>
<th>Country</th>
<th>Median age</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-Saharan Africa</strong></td>
<td></td>
<td><strong>Latin America</strong></td>
<td></td>
</tr>
<tr>
<td>Mauritius</td>
<td>27.2</td>
<td>Chile</td>
<td>27.0</td>
</tr>
<tr>
<td>South Africa</td>
<td>21.9</td>
<td>Argentina</td>
<td>27.4</td>
</tr>
<tr>
<td>Senegal</td>
<td>17.2</td>
<td>Brazil</td>
<td>24.2</td>
</tr>
<tr>
<td>Cameroon</td>
<td>17.7</td>
<td>Colombia</td>
<td>22.9</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>18.0</td>
<td>Jamaica</td>
<td>23.4</td>
</tr>
<tr>
<td>Nigeria</td>
<td>17.6</td>
<td>Mexico</td>
<td>21.5</td>
</tr>
<tr>
<td>Congo</td>
<td>16.9</td>
<td>Costa Rica</td>
<td>23.1</td>
</tr>
<tr>
<td>Kenya</td>
<td>16.6</td>
<td>Venezuela</td>
<td>21.9</td>
</tr>
<tr>
<td><strong>Arab countries</strong></td>
<td></td>
<td><strong>Industrialized countries</strong></td>
<td></td>
</tr>
<tr>
<td>Syria</td>
<td>17.3</td>
<td>Japan</td>
<td>39.7</td>
</tr>
<tr>
<td>Iraq</td>
<td>18.4</td>
<td>Germany</td>
<td>38.4</td>
</tr>
<tr>
<td>Tunisia</td>
<td>22.8</td>
<td>Sweden</td>
<td>38.9</td>
</tr>
<tr>
<td>Algeria</td>
<td>19.7</td>
<td>United Kingdom</td>
<td>36.9</td>
</tr>
<tr>
<td>Morocco</td>
<td>21.6</td>
<td>Canada</td>
<td>34.8</td>
</tr>
<tr>
<td>Egypt</td>
<td>20.9</td>
<td>France</td>
<td>36.1</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>19.1</td>
<td>Australia</td>
<td>33.9</td>
</tr>
<tr>
<td><strong>Asia</strong></td>
<td></td>
<td>United States</td>
<td>34.2</td>
</tr>
<tr>
<td>Rep. of Korea</td>
<td>29.2</td>
<td>New Zealand</td>
<td>32.7</td>
</tr>
<tr>
<td>China</td>
<td>27.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>25.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>18.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>20.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The gross enrolment rate is calculated as the ratio of the total number enrolled at a given educational level to the age group corresponding to the official age at that level. If, for example, primary education comprises five years of schooling and the official age of admission is six years, the gross enrolment rate in primary education is equal to:

$$ ER_{Gross} = \frac{\text{Total number of pupils in primary education}}{\text{Total 6 to 10-year-old population}} $$

This method of calculation leads to overestimation of school enrolment: Some children may be admitted early, before the official age; while others are over the official age, owing to either late admission or repetition of grades.

To illustrate this discrepancy between pupils’ real age and the official age, Figure 3 shows the age distribution of pupils in the various grades of primary education in Tunisia. Although primary education comprises only six years of study and, officially, is attended by children from 6 to 11 years of age, in reality both 5-year-olds and children of 12, 13 and even 14 years attend primary school.
Figure 3. Pyramid showing age distribution in primary education in Tunisia (1997-1998)

For this reason, a net enrolment rate is also calculated:

\[
ER_{\text{Net}} = \frac{\text{No. of pupils 6 to 10 years of age in primary education}}{\text{Total 6 to 10-year-old population}}
\]

Unfortunately, the net enrolment rate has the opposite disadvantage as the gross rate: it underestimates enrolment rates, since all pupils above and below the official age range are excluded.

The enrolment rate for an entire educational level, whether gross or net, is thus not an entirely satisfactory indicator. For this reason, enrolment rates are also calculated for each year of age. The enrolment rate for 6-year-olds, for example, is equal to:

\[
ER_{6 \text{ years}} = \frac{\text{No. of 6-year-old pupils in primary education}}{\text{Total 6-year-old population}}
\]

Enrolment rates by specific age are more precise than those by age group, but they do not fully dispel the ambiguity. A 6-year-old enrolment rate of less than 100 per cent does not mean that not all children are admitted to school. Some may enter school at 7 years of age, at 8, or even later still.

In addition, at 12 years some children are still in primary education, while others have entered secondary school. How, then, should the enrolment rate for 12-year-olds be calculated, and most importantly, how should this indicator be interpreted?

It is possible that the question ‘What proportion of children receive an education?’ is not entirely appropriate, and that it would be better to split it into two questions:

- What proportion of children are admitted to school?
- What level do they reach?

The first question has to do with access to education, while the second relates to the efficiency of the education system (from an...
Demographic aspects of educational planning

We shall have occasion to return to this question. See ‘Planning the location of schools’ at the end of Part I.

(a) Measuring access to education

Access to education is first and foremost a question of school location. How is provision of schooling organized? What is its geographical distribution? How far must children travel to attend school?

This question of the physical accessibility of schooling is the principal issue, but it is not the only issue: There is also ‘economic’ accessibility (the costs to parents of sending their children to school) and ‘socio-cultural’ accessibility (parents’ attitudes regarding the need to send children to school) (Carron and Châu, 1981).

Access to education can be measured by the gross admission rate, or apparent admission rate, which is obtained as follows:

\[
AR_{\text{Gross}} = \frac{\text{New admissions to primary education}}{\text{Total 6-year-old population}}
\]

The gross or apparent rate of admission has disadvantages similar to those of the gross enrolment rate. As a result of early or late admissions, it may exceed 100 per cent, with no assurance that all children have really been admitted to school.

A more appropriate means of measuring admissions is the cohort admission rate. This is obtained by monitoring a cohort of children born in the same year and counting how many are admitted to school successively at 5 years of age, then 6 years, then 7 years, etc. By following such a cohort, we obtain a more accurate view of real admissions and can ensure that we have arrived at a figure for total admissions.

3. We shall have occasion to return to this question. See ‘Planning the location of schools’ at the end of Part I.
Population structure and its effects on education

To calculate the cohort admission rate, one must first calculate the admission rates by age. For example, the admission rate at 6 years of age is equal to:

\[
AR_{6\,\text{years}} = \frac{\text{New admissions at 6 years of age}}{\text{Total 6-year-old population}}
\]

The table below shows admission rates by age for the period 1995 to 2000.

**Table 3. Admission rates by age**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5 years</td>
<td>5.2%</td>
<td>4.8%</td>
<td>4.4%</td>
<td>3.8%</td>
<td>3.7%</td>
<td>3.6%</td>
</tr>
<tr>
<td>6 years</td>
<td>60.4%</td>
<td>61.3%</td>
<td>63.2%</td>
<td>64.3%</td>
<td>65.7%</td>
<td>66.2%</td>
</tr>
<tr>
<td>7 years</td>
<td>16.2%</td>
<td>15.7%</td>
<td>15.3%</td>
<td>14.8%</td>
<td>14.3%</td>
<td>13.1%</td>
</tr>
<tr>
<td>8 years</td>
<td>10.1%</td>
<td>9.7%</td>
<td>9.4%</td>
<td>9.2%</td>
<td>8.7%</td>
<td>7.0%</td>
</tr>
<tr>
<td>9 years</td>
<td>6.0%</td>
<td>5.7%</td>
<td>5.3%</td>
<td>4.8%</td>
<td>4.1%</td>
<td>3.8%</td>
</tr>
<tr>
<td>10 years</td>
<td>2.5%</td>
<td>2.1%</td>
<td>1.8%</td>
<td>1.6%</td>
<td>1.4%</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

Examining the admission rates along the diagonal (the rates underlined and in bold type in Table 3), it is easily observed that these rates all relate to the same cohort, namely the cohort born in 1990.

Of the members of this cohort, 5.2 per cent were admitted at 5 years of age in 1995, 61.3 per cent at 6 years in 1996, 15.3 per cent at 7 years in 1997 and so on. By adding together these rates, once again diagonally, we obtain the cohort admission rate:

\[
AR_{cohort} = 5.2\% + 61.3\% + 15.3\% + 9.2\% + 4.1\% + 1.0\%
\]  
\[
= 95.1\%
\]
Demographic aspects of educational planning

The admission rate for the cohort can never exceed 100 per cent\(^4\), since the number of children in a cohort who have been admitted to school cannot be greater than the total number of children in the same cohort.

Obviously, no matter how great an effort is made to construct relevant and valid indicators (i.e. indicators corresponding to what one really wants to measure), the reliability of the indicator is still wholly dependent on that of the data used to calculate it.

(b) Measuring the efficiency of the education system

Having answered the question ‘What proportion of children are admitted to school?’, we now turn to the second question: ‘What level do they reach?’

To obtain a more precise answer, Johnstone (1982) suggests that this question be divided into three questions. He recommends three indicators that are intended to answer the following three questions:

(i) How many years on average does a child spend in primary education?
(ii) What is the average grade he or she reaches within this educational level?
(iii) What proportion of the pupils admitted to this educational level completes primary education?

The first indicator may be different from the second, since the average time spent in primary education may be greater than the grade reached, owing to repetitions.

The third indicator is perhaps the most meaningful for measuring the efficiency of the education system, as it indicates the proportion of children who have successfully completed primary education.

The following formulae are used to calculate these indicators:

4. If the data used to calculate it are accurate.
Population structure and its effects on education

Average number of years spent in education:

\[
T = \frac{1}{1-r_1} + \frac{p_1}{(1-r_1)(1-r_2)} + \ldots + \frac{p_1p_2p_3p_4}{(1-r_1)(1-r_2)(1-r_3)(1-r_4)(1-r_5)}
\]

Average grade reached:

\[
C = \frac{p_1}{1-r_1} + \frac{p_1p_2}{(1-r_1)(1-r_2)} + \ldots + \frac{p_1p_2p_3p_4p_5}{(1-r_1)(1-r_2)(1-r_3)(1-r_4)(1-r_5)}
\]

Proportion of admitted children who complete their schooling:

\[
D = \frac{p_1}{1-r_1} \times \frac{p_2}{(1-r_2)} \times \ldots \times \frac{p_5}{(1-r_5)}
\]

In these formulae, where it is assumed that the educational level in question comprises five grades,

\(p_1, p_2, p_3, p_4, \) and \(p_5\) are the promotion rates for Grades I, II, III, IV and V,

\(r_1, r_2, r_3, r_4, \) and \(r_5\) are the repetition rates for the same grades.

A fourth indicator may be added to the three mentioned above: the number of pupil-years of schooling that must be provided for one pupil to complete primary education. This indicator, which we shall call ‘A’, can be calculated from the preceding indicators, as follows:

\[
A = \frac{T}{D}
\]

The table below presents these four indicators for primary education in the various regions of Viet Nam in 1995/96.
Primary education in Viet Nam covers five years of schooling, but children spend more than five years in school on average in all regions except the Central High Plateaux and the Mekong Delta.

It is precisely in these two regions, moreover, that the average level reached is below fourth grade. There is also a contrast between the two southern regions: the South-East, where Saigon is located and where 80 per cent of pupils graduate from primary education, and the Mekong Delta, where only half of the pupils complete their primary schooling.

Table 4. Indicators of the efficiency of primary education in the various regions of Viet Nam, 1995/1996

<table>
<thead>
<tr>
<th>Region</th>
<th>Indicators of efficiency</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average number of years</td>
<td>Average grade reached</td>
<td>Proportion completing primary school</td>
<td>Pupil-years per completer</td>
</tr>
<tr>
<td>Northern High Plateaux</td>
<td>5.56</td>
<td>4.45</td>
<td>77.5%</td>
<td>7.2</td>
</tr>
<tr>
<td>Red River Delta</td>
<td>5.23</td>
<td>3.98</td>
<td>70.4%</td>
<td>7.4</td>
</tr>
<tr>
<td>Centre-North</td>
<td>5.37</td>
<td>4.11</td>
<td>68.0%</td>
<td>7.9</td>
</tr>
<tr>
<td>Central Coastal Region</td>
<td>5.35</td>
<td>4.19</td>
<td>71.7%</td>
<td>7.5</td>
</tr>
<tr>
<td>Central High Plateaux</td>
<td>4.92</td>
<td>3.59</td>
<td>56.5%</td>
<td>8.7</td>
</tr>
<tr>
<td>South-East Region</td>
<td>5.60</td>
<td>4.46</td>
<td>80.0%</td>
<td>7.0</td>
</tr>
<tr>
<td>Mekong Delta</td>
<td>4.81</td>
<td>3.44</td>
<td>51.6%</td>
<td>9.3</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>5.24</td>
<td>4.02</td>
<td>68.1%</td>
<td>7.7</td>
</tr>
</tbody>
</table>

*Source: Châu, 1996.*

Age structure of teachers and cost of teaching staff

Age distribution analysis may of course be used in areas other than that of the school-age population. For example, it may be applied to the teaching force.
As retirement is the major cause of the loss of teaching staff, accurate information on the age structure of the teaching force allows us to prepare for these losses\(^5\).

*Figure 4* presents the age pyramid for French secondary school teachers in 1998. There are slightly more women than men (225,611 against 170,938), and the women are slightly younger (their average age is 42.5 years, against 43.3 for men). Although the pyramid is irregular, it does display a degree of symmetry. In other words, the number of new teachers hired varies from year to year, but this variation is nearly the same for men as for women. In France, secondary school teachers generally retire at 60, but they may request to continue working until the age of 65. Since the age distribution is irregular, the number of retiring teachers will also vary over the next 15 years. Careful analysis of this pyramid will thus make it possible to forecast the number of new teachers that will need to be hired to replace those who retire, as well as to cope with increased enrolments.

*Figure 4. Age pyramid of French secondary school teachers, 1998*


5. The situation may be different, of course, in countries affected by the HIV/AIDS pandemic.
Another possible application of the age pyramid to the teaching force is concerned with salaries. Since teachers’ salaries are geared to levels of seniority, the structure of the teaching force by *year of seniority* enables us to forecast the financial effects of the shifts in pay grade that come with increasing seniority. It is obvious that the average salary, and consequently the unit costs, are higher when the bulk of the teaching force is made up of comparatively old persons than when the majority of teachers are relatively young.

*Population structure by economic activity and problems in forecasting manpower requirements*

The first question that arises under this heading is what proportion of the total population is economically active, or in other words, the distinction between the active population and the inactive population.

*Active and inactive population*

This apparently simple distinction actually presents a number of difficulties. First, it is necessary to give an exact and unambiguous definition – far from easy if we wish to take into account all the complexities of real situations. By way of illustration, here are some typical difficulties which may be encountered.

It is quite evident that household servants and family helpers should be considered as economically active persons. But what about homemakers or other female members of a family who do exactly the same work?

Difficulties of a similar nature may arise in connection with agriculture. Activity in this sector is essentially seasonal and the work differs in nature and intensity according to the periods of the year. At peak times (harvesting, for example) many persons are hired, but they are engaged only for periods of intense activity. Should they nevertheless be regarded as economically active? Similar questions arise concerning part-time workers, young men doing their military service, etc.
Definition of the active population

To show the complexity involved in arriving at a figure for the active population, let us consider the definition proposed by the United Nations. The active population designates ‘all persons of either sex who provide the labour available for the production of goods and services’ (United Nations, 1990b). In theory, it comprises the following groups (ILO, 1993):

1. Employees;
2. Employers;
3. Self-employed workers;
4. Members of producer co-operatives;
5. Unpaid family members working in the family business;
6. Workers who cannot be classified by occupation.

This very broad definition used by the United Nations is not universally accepted, however, and hence great care is needed when making comparisons between countries. In some countries, for example, people seeking employment for the first time are not included in the economically active population, nor are unpaid family workers, members of the armed forces and part-time workers.

Activity rates by age and sex

The proportion of economically active persons varies according to age and sex. For this reason, it is useful to calculate by sex the percentage of the population counted as being economically active in each age group. By way of illustration, the activity rates by sex and age in four countries are presented in Table 5.

In all four countries, the activity rates for men aged 25 to 59 years are very high: close to or above 90 per cent. For the 20-24 age group, these rates vary with the degree of development of higher education in the country. This explains why in Sweden the activity rate for men in this age group is only 67.9 per cent, whereas it is 92.3 per cent in Ethiopia, 83.8 per cent in Mexico and 73.7 per cent in Iran.
Where the data for women are concerned, in contrast, substantial differences can be observed between countries. The rate of economic activity for women is particularly low in Iran, but very high in Sweden. These differences are mainly due to the cultural characteristics of the countries. In this respect, note the striking contrast between Iran and Sweden from the standpoint of female participation in the labour force.

Table 5. **Active population: activity rates by age and sex in four countries (%)**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10-14</td>
<td>61.7</td>
<td>15.1</td>
<td>51.0</td>
<td>2.9</td>
<td>15.5</td>
<td>6.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-19(1)</td>
<td>77.0</td>
<td>70.0</td>
<td>34.7</td>
<td>8.6</td>
<td>54.8</td>
<td>29.2</td>
<td>26.6</td>
<td>31.3</td>
</tr>
<tr>
<td>20-24</td>
<td>92.3</td>
<td>78.3</td>
<td>73.7</td>
<td>13.2</td>
<td>83.8</td>
<td>43.9</td>
<td>67.9</td>
<td>59.4</td>
</tr>
<tr>
<td>25-29</td>
<td>97.7</td>
<td>80.0</td>
<td>90.3</td>
<td>14.1</td>
<td>95.4</td>
<td>45.0</td>
<td>84.8</td>
<td>77.0</td>
</tr>
<tr>
<td>30-34</td>
<td>98.1</td>
<td>80.6</td>
<td>95.0</td>
<td>12.9</td>
<td>97.9</td>
<td>45.1</td>
<td>89.8</td>
<td>83.0</td>
</tr>
<tr>
<td>35-39</td>
<td>98.4</td>
<td>80.2</td>
<td>95.8</td>
<td>12.1</td>
<td>98.1</td>
<td>47.3</td>
<td>90.3</td>
<td>86.1</td>
</tr>
<tr>
<td>40-44</td>
<td>97.6</td>
<td>76.4</td>
<td>95.0</td>
<td>12.9</td>
<td>97.4</td>
<td>47.3</td>
<td>89.9</td>
<td>87.5</td>
</tr>
<tr>
<td>45-49</td>
<td>97.3</td>
<td>73.0</td>
<td>92.7</td>
<td>10.0</td>
<td>95.7</td>
<td>43.0</td>
<td>90.7</td>
<td>88.1</td>
</tr>
<tr>
<td>50-54</td>
<td>95.7</td>
<td>65.9</td>
<td>85.9</td>
<td>7.2</td>
<td>91.9</td>
<td>37.6</td>
<td>89.2</td>
<td>85.6</td>
</tr>
<tr>
<td>55-59</td>
<td>93.3</td>
<td>58.6</td>
<td>81.1</td>
<td>5.5</td>
<td>86.8</td>
<td>32.4</td>
<td>84.4</td>
<td>78.9</td>
</tr>
<tr>
<td>60-64</td>
<td>89.4</td>
<td>50.0</td>
<td>73.3</td>
<td>4.5</td>
<td>77.3</td>
<td>25.9</td>
<td>55.5</td>
<td>46.5</td>
</tr>
<tr>
<td>65-69</td>
<td>65.7</td>
<td>27.5</td>
<td>54.0</td>
<td>2.7</td>
<td>67.1</td>
<td>19.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) 16-19 in Sweden, since the law prohibits children from working before the age of 16 years.

Population structure and its effects on education

Distribution of the population by sector of economic activity

Economic activity is traditionally divided into three sectors: the primary sector, covering activities in which production is based on natural resources (agriculture, mining, etc.); the secondary sector, which consists of the manufacturing and processing industries; and the tertiary sector, made up of the service industries.

The tertiary sector is the most heterogeneous. It includes all kinds of activities, but two of its sub-sectors merit special mention: the sub-sector of commerce in its broad sense (banking, insurance, transport and retailing), and the sub-sector of culture and recreation (education, radio, television, publishing, entertainment, etc.).

The relative sizes of these three sectors have varied considerably over time. In the wealthy countries, it is currently the tertiary sector that predominates, although in Germany and Japan, the secondary sector has retained its importance as it employs over one-third of the active population.

Table 6. Distribution of the active population by sector of activity in wealthy countries, 1990

<table>
<thead>
<tr>
<th>Sector of activity</th>
<th>United States</th>
<th>United Kingdom</th>
<th>Germany</th>
<th>France</th>
<th>Australia</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Secondary</td>
<td>26</td>
<td>29</td>
<td>38</td>
<td>29</td>
<td>26</td>
<td>34</td>
</tr>
<tr>
<td>Tertiary</td>
<td>71</td>
<td>69</td>
<td>58</td>
<td>66</td>
<td>68</td>
<td>59</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>


In the developing countries, substantial changes have occurred in sectoral structure since 1960. The share of the primary sector has diminished in all countries, but it remains the dominant sector in some
Demographic aspects of educational planning

African countries, such as Kenya and Zimbabwe, and in such Asian countries as India, China and Thailand.

The secondary sector has grown remarkably in the ‘newly industrialized’ countries such as Mauritius, Tunisia, the Republic of Korea and Argentina. The share of the tertiary sector has increased significantly in all countries.

Table 7. Change in the distribution of the active population by sector of activity in developing countries, 1960-1990

<table>
<thead>
<tr>
<th>Country</th>
<th>1960</th>
<th>1990</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Primary</td>
<td>Secondary</td>
<td>Tertiary</td>
<td>Primary</td>
<td>Secondary</td>
<td>Tertiary</td>
<td></td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congo</td>
<td>66</td>
<td>11</td>
<td>23</td>
<td>49</td>
<td>15</td>
<td>36</td>
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<tr>
<td>Kenya</td>
<td>86</td>
<td>5</td>
<td>9</td>
<td>80</td>
<td>7</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>77</td>
<td>11</td>
<td>12</td>
<td>68</td>
<td>8</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>31</td>
<td>30</td>
<td>39</td>
<td>14</td>
<td>32</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>Mauritius</td>
<td>34</td>
<td>25</td>
<td>41</td>
<td>17</td>
<td>43</td>
<td>54</td>
<td></td>
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<tr>
<td>Arab countries</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Algeria</td>
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<td>18</td>
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<td>66</td>
<td></td>
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<td>24</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Iran</td>
<td>48</td>
<td>27</td>
<td>25</td>
<td>32</td>
<td>25</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>72</td>
<td>12</td>
<td>16</td>
<td>64</td>
<td>16</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>58</td>
<td>15</td>
<td>27</td>
<td>46</td>
<td>15</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>78</td>
<td>10</td>
<td>12</td>
<td>72</td>
<td>15</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>80</td>
<td>6</td>
<td>14</td>
<td>64</td>
<td>14</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Rep. of Korea</td>
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<td>20</td>
<td>31</td>
<td>18</td>
<td>35</td>
<td>47</td>
<td></td>
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<tr>
<td>Latin America</td>
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<tr>
<td>Colombia</td>
<td>45</td>
<td>19</td>
<td>36</td>
<td>27</td>
<td>23</td>
<td>50</td>
<td></td>
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<tr>
<td>Costa Rica</td>
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<td>37</td>
<td>26</td>
<td>27</td>
<td>47</td>
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<td>Brazil</td>
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<td>20</td>
<td>33</td>
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<td>54</td>
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<tr>
<td>Mexico</td>
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<td>24</td>
<td>32</td>
<td>28</td>
<td>24</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Argentina</td>
<td>16</td>
<td>34</td>
<td>50</td>
<td>12</td>
<td>32</td>
<td>55</td>
<td></td>
</tr>
</tbody>
</table>

This classification by broad sectors of economic activity is too general to be used for any detailed calculations. In order to make comparisons between countries, the United Nations prepared an International Standard Industrial Classification of All Economic Activities, or ISIC (United Nations, 1990a), which comprises 18 categories of economic activity:

1. Agriculture, hunting and forestry
2. Fishing
3. Mining and quarrying
4. Manufacturing
5. Electricity, gas and water supply
6. Construction
7. Wholesale and retail trade
8. Hotels and restaurants
9. Transport, storage and communications
10. Financial intermediation
11. Real estate, renting and business activities
12. Public administration and defence
13. Education
14. Health and social work
15. Other community, social and personal service activities
16. Activities of private households as employers
17. Extraterritorial organizations and bodies
18. Miscellaneous activities

In addition to the distribution of the population by sector of activity, educational planners need to know the distribution by occupation in order to forecast manpower requirements.

**Distribution of the active population by occupation**

The distribution of the active population by occupation does not necessarily correspond to the distribution by sector of activity. While all farmers will, of course, be listed in the broad category ‘agriculture, hunting and forestry’, a mechanic may work in any of a wide variety of branches, such as agriculture, mining, manufacturing industry, electricity supply or transport.
To make international comparisons easier, the International Labour Office prepared an International Standard Classification of Occupations, or ISCO (see ILO, 1991), based upon nine types of occupations and employment:

1. Professionals in scientific, technical, health, legal, and related fields
2. Senior officials and managers
3. Clerks and related workers
4. Sales representatives and shop and market salespersons
5. Service workers
6. Farmers, animal producers, forestry workers, fishery workers and hunters
7. Skilled and unskilled non-agricultural workers and motor vehicle drivers
8. Workers who cannot be classified by occupation
9. Members of the armed forces.

In order to prepare forecasts of manpower requirements, it is often necessary – since all sectors of economic activity do not develop at the same pace – to make cross-classifications, giving, for example, the classification by occupation within each sector of economic activity.

If the expected increase in production in each sector of activity is known, the manpower requirements for the various occupations or types of employment can be estimated on the basis of this cross-classification.

A difficult problem remains, however, in linking jobs to qualifications; that is, matching the occupation to the type of training received.

In any event, no matter how many precautions are taken, any forecast of manpower requirements will only be an approximation (Harbison, 1967; Youdi and Hinchliffe, 1985; Bertrand, 1992).
Geographical distribution of the population and the problem of location of educational institutions

The distribution of the population over a country’s territory is far from uniform; some areas are densely populated, others much less so.

Moreover, when there is no policy for balanced growth (such as a regional development plan), this difference may even increase: The population of already densely inhabited areas may continue to grow, while that of scarcely populated areas may diminish.

Measuring the geographical distribution of a population

A first method of assessing the geographical distribution of a population is to conduct a study of the population density of different areas. In order for a survey of this kind to be meaningful and useful, it must be conducted at the level of the smallest geographical or administrative units, as an average density figure is of less significance.

In addition, the presence of a large town or city in a certain area automatically raises the population density of the administrative unit to which it belongs, and thereby distorts the data for the surrounding rural areas contained within that unit. For this reason, the population of urban centres is sometimes excluded from density calculations.

Another way of estimating the geographical distribution of the population is to classify administrative units by number of inhabitants. But here again there is a sizeable drawback, because the overall size of the population of such a unit provides no indication as to the local characteristics of human settlements within that unit (whether they be concentrated or dispersed). This is a problem because such data are the most important factor in planning the location of schools.

Planning the location of schools

Two considerations, which may sometimes be contradictory, must be taken into account when locating schools: the size of the local
Demographic aspects of educational planning

population, and the catchment areas of the school. Where population size is concerned, the issue is obvious: There must be a minimum number of pupils living in an area in order to justify the building or installation of a school. This is particularly true for secondary schools, with their greater number of both compulsory and optional subjects.

It is also important, however, that the area served should not be too large, so that the pupils can easily reach the school from their homes. The acceptable limits of that area depend on the ages of the children, the facilities provided (e.g. the existence of a school lunch room), the means of transport available (e.g. whether a school bus service is provided), the nature of the terrain (plains or mountainous areas) and the severity of the climate.

Of course, in densely populated areas, the size of the area served is no longer problematic; there is always a sufficient population so the area served by the school does not need to be very large. But the situation is different in more thinly populated areas, and especially in rural areas.

At the secondary level, because of the optional courses offered and the number of subjects to be taught, a greater number of students is needed to justify the creation of a school. Depending on the age distribution of the local population and the proportion of children attending school, the overall population size will vary considerably, and the catchment area for the secondary school may be very large. Of course, the provision of a school bus system or accommodation for boarding students could allow the catchment area to be extended, but such measures increase the cost.

In any event, it should be noted that the location of schools is not and cannot be based on purely theoretical considerations. Many factors have to be taken into account, and all these factors may vary from one area to another. It is the people at the local level who are more familiar with these factors, and that is why the local authorities should be as involved as possible in the school mapping process.

Another problem that may arise relates to differences in enrolment rates from one area to another. In such cases, it is up to the government
to decide whether existing differences should be reduced, or whether – on the contrary – educational development should focus first on the areas where demand is strongest. The problem of reducing regional disparities in access to education is highly complex, requiring not only a deliberate policy choice, but also additional resources:

“The school system tends to develop more quickly in areas where it is already well established, rather than in disadvantaged areas … Moreover, the way in which demand is expressed and the strength it acquires also vary according to the economic, political and cultural situation of groups and according to the resources at their disposal for organizing themselves. For this reason, an education policy that consists in satisfying demand on a first-come first-served basis as it is expressed by different groups tends to sharpen disparities rather than reduce them. To the contrary, reduction of disparities – which presupposes a rebalancing of educational development from area to area and a special effort in favour of disadvantaged areas – requires working against the spontaneous development of the system. It can therefore only be deliberate, and at the same time difficult to implement.” (Carron and Châu, 1981)

A further complication arises when different areas have different unit costs (due to lower pupil/teacher ratios and the necessity of paying salary bonuses to encourage teachers to take less desirable posts). Following the same line of thought, it must be noted that as the school enrolment rate increases, so does the number of problems regarding choosing school locations. The objective of compulsory schooling implies the creation of schools in increasingly out-of-the-way places, with all the consequences this can have on costs. Planning the location of schools is still more complicated in multi-ethnic and multi-lingual countries, since it is necessary to take these special local characteristics into account (Hallak, 1977; Caillods, 1983).

To this point, we have discussed the various aspects of population structure and tried to show the effects which that structure may have on education-related problems. But educational planners cannot be content with knowing the current situation; they must also have an
accurate picture of the problems to be encountered in the future. In particular, they must know how the population will change in future years. This is the subject we shall address in Part II as we study population changes and their impact on educational planning.
II. Population changes and their impact on educational planning

The study of population changes must take into account the trend of any increase (or, in some cases, decrease) in the population over time. The two main factors which affect this trend are natality and mortality. The combination of these two factors, plus migration, determines the changes in the size of a population.

Natality

In this section, we shall first discuss methods of measuring natality before looking at some of the trends in natality in selected countries.

Methods of measuring natality

Two types of rates are used to assess natality: the crude birth rate, and fertility rates.

The crude birth rate

This, the simplest rate, is calculated as the ratio of the number of live births during a year to the average population for that year. The average population for a year can be considered either as the population figure for 1 July of that year, or as the average of the population figures for the beginning and the end of the year.

As an example, we shall calculate the crude birth rate of the United States in 1998. The total number of births in that year was 3,944,046, and the average population (population at mid-year) was 270,561,000 (Demographic Yearbook 1999, 2001: 291, 295).

Thus the birth rate was:

\[
\frac{3,944,046 \times 1,000}{270,561,000} = 14.58\%\text{.}
\]
Note that the birth rate is given per thousand, as is often the case for demographic rates.

Although the crude birth rate has the advantage of being a simple rate, easily obtained from general data, it nevertheless has certain disadvantages. One of these disadvantages is that it gives the ratio of live births to the total population, whereas, in fact, only a part of the female population is capable of bearing children.

Consequently, the crude birth rate will vary with the structure of the population by age and sex, or more precisely the percentage of women of child-bearing age in relation to the total population. This rate, therefore, cannot be used to make comparisons between countries, because age structures may be very different in one country than in another. This is why demographers prefer to use fertility rates rather than the crude birth rate.

**Fertility rates**

The term ‘fertility’ is used to indicate the proportion between the number of births and the number of women of child-bearing age. A distinction can be made, however, between the general fertility rate and age-specific fertility rates.

- **The general fertility rate**

  This rate is the ratio of live births to the number of women of child-bearing age (considered by convention to be women of 15 to 49 years). As in the case of the crude birth rate, this rate is expressed per thousand.

---

6. A distinction is often made in demographic analysis between ‘fertility’ and ‘fecundity’; fecundity referring to the biological capacity for having children (potential fertility) and fertility referring to actual births (actual fertility). When there is no deliberate limitation of births or birth control, the two terms mean the same thing, but otherwise they are different in meaning, as a ‘fecund’ woman may in fact remain voluntarily ‘infertile’ (i.e. childless).
One of the drawbacks of the general fertility rate is that it does not give a detailed picture of natality. It is known that fertility varies with age and is particularly high in women between 20 and 30. The general fertility rate of the population may therefore be higher or lower depending on the proportion of women aged 20 to 30. For this reason planners prefer to calculate age-specific fertility rates.

- Age-specific fertility rates

Fertility rates can of course be calculated for each year of age, but in general they are given by age groups (ages 15-19, 20-24, 25-29, etc.).

Where there is no deliberate birth control, fertility rates by age indicate the biological capability of women to bear children: the fertility rate is higher among young women and tends to fall as their age rises. In this case, it is possible to forecast the number of future births with some degree of accuracy on the basis of the age distribution of women and the fertility rate by age.

Where birth control is practised, however, this rate becomes difficult to interpret. When the size of the family is intentionally restricted and when the births are deliberately spaced, the age of women is no longer the only factor affecting fertility. Other factors come into play, such as age at marriage, length of time married, and the number of children preceding a given birth.

Natality trends in selected countries

Figure 5 shows the trend in the number of births in France from 1961 to 1998. After a period of comparative stability from 1961 to 1971, the number of births dropped sharply from 1971 to 1976, then rose from 1976 to 1981, and subsequently dropped again. In view of these variations, serious errors can be made when trying to extrapolate the number of births from past trends. The projection used in 1997, for example, was immediately changed in 1998.
The number of births has great significance for educational planners, as this number will determine the future number of pupils and students in the various levels of the education system. In most countries, educational planning is concerned with increases in the number of pupils and students, but in others – after a period of declining natality – it may involve planning for a drop in this number, a task that raises problems of similar complexity.

A decrease in the birth rate is not the only cause of a declining number of school pupils. As will be seen below, internal migration may cause a substantial drop in the rural population. In such cases, the number of pupils in rural schools will decline, resulting in under-utilization of such schools, while at the same time, new schools must be built in urban areas to accommodate the children of those who have migrated to the cities. Thus, planning for an increased number of pupils in some areas may take place simultaneously with planning for decreased numbers in other areas within the same country.

Declining natality is a general phenomenon observed in all countries of western Europe. As early as the beginning of the 1950s, the general fertility rate in Germany, the United Kingdom and Sweden had fallen...
to about 2, meaning that the following generation would be barely large enough to replace the current generation.

**Table 8. Trends in the general fertility rate in developed countries**

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
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<td>2.30</td>
<td>2.49</td>
<td>2.32</td>
<td>1.64</td>
<td>1.52</td>
<td>1.46</td>
<td>1.43</td>
<td>1.30</td>
</tr>
<tr>
<td>Germany</td>
<td>2.16</td>
<td>2.30</td>
<td>2.49</td>
<td>2.32</td>
<td>1.64</td>
<td>1.52</td>
<td>1.46</td>
<td>1.43</td>
<td>1.30</td>
</tr>
<tr>
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<td>2.08</td>
<td>2.02</td>
<td>2.00</td>
<td>2.07</td>
<td>1.81</td>
<td>1.76</td>
<td>1.66</td>
<td>1.49</td>
</tr>
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<td>2.85</td>
<td>2.61</td>
<td>2.31</td>
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<td>1.72</td>
</tr>
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<td>3.73</td>
<td>3.90</td>
<td>3.61</td>
<td>2.51</td>
<td>1.98</td>
<td>1.75</td>
<td>1.66</td>
<td>1.75</td>
<td>1.73</td>
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<tr>
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<td>2.18</td>
<td>2.49</td>
<td>2.81</td>
<td>2.52</td>
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<td>1.72</td>
<td>1.80</td>
<td>1.81</td>
<td>1.78</td>
</tr>
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<td>3.41</td>
<td>3.27</td>
<td>2.87</td>
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<td>2.09</td>
<td>1.93</td>
<td>1.87</td>
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<tr>
<td>Sweden</td>
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<td>2.23</td>
<td>2.34</td>
<td>2.12</td>
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<td>1.65</td>
<td>1.64</td>
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<td>2.55</td>
<td>2.02</td>
<td>1.79</td>
<td>1.82</td>
<td>1.92</td>
<td>2.05</td>
</tr>
</tbody>
</table>


Since 1950, natality has dropped further still in the rich countries owing to advances in methods of contraception and the increasing influence of women in family matters, such as size and number of children. The decline has been particularly marked in countries such as Germany, where the general fertility rate has fallen to 1.30.

This decline in natality, combined with a remarkable increase in human life spans, has led to a number of imbalances, and in particular to a high proportion of retired people with respect to the active population.

Some developing countries, considering that their populations were growing too quickly, have applied a policy of birth control. In others, increased education of girls, urbanization, and the gradual liberation
of women have brought about a sharp drop in natality without the need for a restrictive policy; all that was needed was adequate information and easy access to methods of contraception. This was the case in such Asian countries as Taiwan, Singapore, the Republic of Korea and Thailand.

In India, the Philippines and Iran, the fertility rate has fallen gradually but remains high. In Pakistan, where Islam is the dominant influence, the fertility rate remained stable at a high level (6.5-7 children per woman on average) until 1985.

Table 9. Trends in the general fertility rate in Asia

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
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<td>2.92</td>
<td>2.50</td>
<td>1.80</td>
<td>1.70</td>
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<td>5.59</td>
<td>5.72</td>
<td>6.06</td>
<td>4.86</td>
<td>3.32</td>
<td>2.55</td>
<td>2.46</td>
<td>1.92</td>
</tr>
<tr>
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<td>5.97</td>
<td>5.92</td>
<td>5.81</td>
<td>5.69</td>
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<td>4.83</td>
<td>4.47</td>
<td>4.07</td>
<td>3.56</td>
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<td>7.09</td>
<td>6.61</td>
<td>6.04</td>
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<td>4.96</td>
<td>4.74</td>
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<td>6.50</td>
<td>6.80</td>
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<td>6.50</td>
<td>6.00</td>
<td>5.51</td>
<td></td>
</tr>
</tbody>
</table>


Latin America presents a rather diversified picture. In Argentina and Chile, the fertility rate has been rather low throughout the period, at a level comparable to that of the European countries. In the other Latin American countries, natality has fallen steadily since the 1950s. The average number of children per woman, which stood at 7 at the end of the second world war, has fallen to 3, or even fewer, today.
Population changes and their impact on educational planning

Table 10.  Trends in the general fertility rate in Latin America

<table>
<thead>
<tr>
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<td>3.44</td>
<td>3.15</td>
<td>3.00</td>
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<td>2.54</td>
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<td>4.31</td>
<td>3.63</td>
<td>2.96</td>
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<td>3.89</td>
<td>3.50</td>
<td>3.36</td>
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<td>5.90</td>
<td>4.94</td>
<td>4.47</td>
<td>3.96</td>
<td>3.65</td>
<td>3.30</td>
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</tbody>
</table>


Lastly, the highest natality rates in the world today are found in the Arab and African countries.

Table 11.  General fertility rates of Arab and African countries

<table>
<thead>
<tr>
<th></th>
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</tr>
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<td>6.89</td>
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<td>5.69</td>
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<td>5.90</td>
<td>5.10</td>
<td>4.25</td>
<td>3.33</td>
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<td>6.56</td>
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<td>5.27</td>
<td>5.06</td>
<td>4.58</td>
<td>3.80</td>
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<td>7.09</td>
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<td>7.44</td>
<td>7.38</td>
<td>6.60</td>
<td>4.70</td>
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<td>7.18</td>
<td>7.18</td>
<td>7.11</td>
<td>6.56</td>
<td>6.35</td>
<td>6.15</td>
<td>5.70</td>
</tr>
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<td>7.26</td>
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<td>7.28</td>
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<td>6.37</td>
</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>5.72</td>
<td>4.24</td>
<td>3.25</td>
<td>3.06</td>
<td>2.45</td>
<td>2.17</td>
<td>2.30</td>
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<td>6.50</td>
<td>5.68</td>
<td>4.80</td>
<td>4.45</td>
<td>4.15</td>
<td>3.85</td>
<td>3.55</td>
</tr>
<tr>
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<td>7.50</td>
<td>7.50</td>
<td>7.50</td>
<td>7.20</td>
<td>6.60</td>
<td>6.19</td>
<td>5.50</td>
<td>4.50</td>
</tr>
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<td>7.82</td>
<td>8.12</td>
<td>8.12</td>
<td>8.12</td>
<td>7.50</td>
<td>6.80</td>
<td>5.40</td>
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<td>5.99</td>
<td>6.19</td>
<td>6.29</td>
<td>6.29</td>
<td>6.29</td>
<td>6.29</td>
<td>6.20</td>
</tr>
</tbody>
</table>

Of course, there are some exceptions: Tunisia, Morocco and Egypt among the Arab countries; South Africa and Mauritius in sub-Saharan Africa. In all the other countries, however, the general fertility rate is around 6 children per woman, or higher. Zimbabwe is a special case: the recent decline in natality is due to the spread of HIV/AIDS, as we shall see below.

**Mortality**

A distinction can usually be made between two types of mortality, depending on the cause of death: endogenous mortality and exogenous mortality.

*Endogenous* mortality means death occurring from a cause which is to some extent inherent in the individual. Thus, when a child is born with deformities and dies because of these deformities, the death of that child can be declared endogenous. Deaths due to old age, or the diseases which accompany old age, can also be classified under this category.

*Exogenous* mortality, in contrast, refers to deaths from other causes, such as accidents, contagious diseases, and dietary deficiencies. Although this may appear to be a very clear-cut distinction, it is much less clear in practice, either because the causes of death may be unknown or not declared, or because there may be multiple causes of death. The distinction can nonetheless prove very useful.

Although the progress of hygiene and medical care on the one hand, and the rise in living standards on the other, are capable of reducing exogenous mortality to a marked extent, they have very little effect on endogenous mortality. The fact is that although medical progress can prevent certain premature deaths, it cannot prolong life beyond a certain limit.

As in the case of natality, we shall first examine methods of measuring mortality, and then the mortality trend in selected countries.
Methods of measuring mortality

The simplest way of measuring mortality is the crude death rate. This rate is obtained by dividing the total number of deaths in a specific year by the average population figure for that year. It thus resembles the crude birth rate discussed above.

This rate is quite straightforward to calculate and does not require detailed mortality statistics. However, it has the same drawbacks as the crude birth rate where international comparisons are concerned. As an example, over the 1990-1995 period the crude death rate in Syria was 5.6 per thousand, while that of the United Kingdom was 9.4 per thousand. These figures give the misleading impression that the mortality level was higher in the United Kingdom than in Syria.

This apparent paradox is easily explained by the fact that mortality varies greatly with age: it is low among younger people and, of course, higher for more advanced ages. The proportion of deaths in relation to the total population will therefore depend on the age structure of that population. A youthful population such as that of Syria (i.e. a population in which the proportion of younger people is larger than that of older people) will have fewer deaths and hence a lower crude death rate than an older population.

The general nature of the crude death rate thus diminishes its significance to demographers, who – faced with the fact that the level of mortality varies substantially according to age – are inclined to calculate age-specific mortality rates. These rates obviously provide much more accurate indications of the level of mortality in a given population.

Mortality rates are of course calculated separately for men and for women, for they also differ between the sexes. Most countries display excess male mortality, i.e. the mortality rate is higher for men than for women at advanced ages.
Age-specific mortality rates

To calculate mortality rates by age, demographers generally use the concept of the ‘cohort’, which refers to all the people born during the same calendar year. We have already mentioned this concept in discussing the cohort admission rate.

The number of individuals in a cohort decreases over time, owing to deaths. Thus, we can study the effects of mortality by following the change in the size of a cohort over time. Figure 6 below presents this trend for a cohort of 420,000 children born in 1998 (i.e. from 1 January to 31 December 1998).

**Figure 6. Mortality trend in a cohort born in 1998**

<table>
<thead>
<tr>
<th>2 years</th>
<th>J 394,210</th>
<th>K 400,939</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,567</td>
<td>1,589</td>
</tr>
<tr>
<td>1 year</td>
<td>F 396,859</td>
<td>G 402,528</td>
</tr>
<tr>
<td></td>
<td>6,561</td>
<td>6,655</td>
</tr>
<tr>
<td>Birth</td>
<td>A 420,000</td>
<td>B 426,000</td>
</tr>
<tr>
<td></td>
<td>16,580</td>
<td>16,817</td>
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<tr>
<td></td>
<td>1,082</td>
<td>1,589</td>
</tr>
</tbody>
</table>

To follow the cohort, one must read the figure diagonally. Of the 420,000 children born in 1998 (segment AB), only 403,420 remain on 1 January 1999 (segment BF) and only 396,859 when the cohort
Population changes and their impact on educational planning

reaches 1 year of age (segment FG). When the same cohort reaches the age of 2, the number of children has fallen to 394,210 (segment JK), and so on.

Figure 6 also shows that 16,580 members of this cohort die between 1 January 1998 and 1 January 1999, and 6,561 others die between 1 January 1999 and 1 January 2000 before reaching their first birthday, making a total of 23,141\(^7\). The probability that the members of the cohort will die at 0 years of age\(^8\) is therefore as follows:

\[
Q_0 = \frac{16,580 + 6,561}{420,000} = 55.1 \text{‰}
\]

This probability of dying at age 0 is called the mortality rate at 0 years.

The mortality rate at 1 year may be calculated from Figure 6 in the same way:

\[
Q_1 = \frac{1,567 + 1,082}{396,859} = 6.7 \text{‰}
\]

The calculation of mortality rates requires detailed statistical data, notably including statistics for the number of survivors in a cohort at a given age and the number of deaths at the same age for the same cohort.

In many cases, however, such detailed statistics are not available, so instead of calculating mortality rates at different ages, demographers settle for calculating death rates, which give the number of deaths at a given age during a calendar year as a ratio of the total population of that age during the same year.

---

7. These deaths are spread over two consecutive years, making it more complicated to calculate mortality rates.
8. In demographic analysis, age is always given as the number of full years lived. Children of 0 years old are children from 1 to 365 days old.
Returning to Figure 6, we shall now calculate the death rate at 0 years of age. The number of deaths at 0 years during the year 1999 is equal to:

\[ 6,561 + 16,817 = 23,378 \]

The total 0-year-old population in 1999 is assumed to be the population of 0-year-olds as of 1 July 1999. Figure 6 shows that the 0-year-old population is 403,420 as of 1 January 1999 (segment BF) and 409,183 as of 1 January 2000 (segment CG). The 0-year-old population as of 1 July 1999 is considered to be the average of these two figures, i.e.:

\[ (403,420 + 409,183) / 2 = 406,301.5 \]

Hence the death rate at 0 years of age is equal to:

\[ \frac{23,378}{406,301.5} = 57.5 \, \text{‰} \]

It is readily apparent that the death rate at 0 years of age differs from the mortality rate. This distinction between mortality rate and death rate may seem needlessly complicated, but it is essential to distinguish these two concepts:

- the death rate is convenient to calculate. Using civil registration data, it is easy to count deaths at a given age and express them as a ratio of the population of that age;
- calculating the mortality rate requires more detailed data, but this rate expresses a probability and hence is easier to interpret.

In our example, the mortality rate at 0 years is 55.1 per thousand. This means that for children 0 years of age, the chance – or rather the risk – of dying before their first birthday is 55 in 1,000.

Ultimately, although death rates are easy to calculate and certainly give valuable information concerning the mortality characteristics of a population, they do not enable us to make more detailed calculations,
and in particular to draw up life tables, which will be discussed below. For this reason, efforts have been made to find a method of converting from death rates to mortality rates.

Conversion from death rates to mortality rates: the Reed-Merell method

Reed and Merell (1939) examined the populations of the individual states of the United States in 1910, 1920 and 1930, for which both the death rates and the mortality rates were available, in an attempt to find connecting links between these values.

It is impossible here to go into all the details of their methods of adjustment and calculation. We shall simply note that the results of Reed and Merell’s work were published in the form of tables giving the equivalent mortality rate for all likely values of death rates for 4-year, 5-year and 10-year-old age groups.

The fact that Reed and Merell used statistics for the United States to establish their relationships between death rates and mortality rates somewhat limits the significance of their work, as the age structure of the population and death rates by age in the developing countries do not necessarily correspond to those observed in the United States some 80 years ago.

Despite this reservation, the Reed-Merell tables are a very convenient tool and make it possible to convert rapidly from death rates (which are more easily obtained) to mortality rates when there are no other available means of doing so.

Comparison of mortality levels between countries

We showed above that the crude death rate is a very imperfect way of comparing mortality levels between one country and another. For example, simply comparing the crude death rate of the United Kingdom to that of Syria can lead to the erroneous conclusion that mortality is higher in the former country. Mortality rates by age are

much more accurate for this purpose, but they have the disadvantage of being too detailed and analytical, making them inconvenient for the comparison of overall mortality levels.

To make such a comparison, one of two methods may be used: the direct standardization method or the indirect standardization method. Consider once again the example of the mortality rate of Syria compared to that of the United Kingdom. The direct standardization method consists of asking what the crude death rate of the United Kingdom would be if it had the same age structure as Syria. This hypothetical death rate may be calculated as follows:

**Table 12. Calculating the hypothetical death rate**

<table>
<thead>
<tr>
<th>Age group</th>
<th>Population of Syria</th>
<th>Death rate of the United Kingdom</th>
<th>Hypothetical number of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>( P_{0-4} )</td>
<td>( t_{0-4} )</td>
<td>( P_{0-4} \times t_{0-4} )</td>
</tr>
<tr>
<td>5-9</td>
<td>( P_{5-9} )</td>
<td>( t_{5-9} )</td>
<td>( P_{10-19} \times t_{10-19} )</td>
</tr>
<tr>
<td>10-14</td>
<td>( P_{10-14} )</td>
<td>( t_{10-14} )</td>
<td>( P_{20-29} \times t_{20-29} )</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>70-74</td>
<td>( P_{70-74} )</td>
<td>( t_{70-74} )</td>
<td>( P_{30-39} \times t_{30-39} )</td>
</tr>
<tr>
<td>75-79</td>
<td>( P_{75-79} )</td>
<td>( t_{70-79} )</td>
<td>( P_{40-49} \times t_{40-49} )</td>
</tr>
<tr>
<td>80+</td>
<td>( P_{80+} )</td>
<td>( t_{80+} )</td>
<td>( P_{50-59} \times t_{50-59} )</td>
</tr>
</tbody>
</table>

The hypothetical rate thus obtained: \( \Sigma P_i \times t_i / \Sigma P_i \) can then be compared to the real death rate in Syria. It will then be observed that this hypothetical rate is less than the real rate of Syria, and that the United Kingdom in fact has a lower mortality level than Syria.

In the indirect standardization method, the death rates for Syria are applied to the age structure of the population of the United Kingdom.
Here again, it will be observed that the theoretical rate obtained is greater than that of the United Kingdom and that Syria indeed has a higher level of mortality than the United Kingdom.

**Infant mortality**

In mortality studies, special attention should be given to infant mortality, because the mortality level of very young children is relatively high. The infant mortality level is of particular interest to educational planners because this level determines the number of children for whom schooling must be provided in the future.

Infant mortality is measured by the *mortality rate at age 0*, that is, the ratio of deaths from birth to 1 year of age to the total number of live births in the generation.

Still-births are not included in infant mortality, and this distinction can be carried even further, bringing us to the concept of *perinatal mortality*.

We have already discussed the differences between endogenous and exogenous mortality, pointing out that endogenous mortality in the case of infants relates to those who are born alive but considered as being doomed to a very short existence in the present state of medical knowledge. Perinatal mortality is therefore obtained by adding endogenous mortality to still-births.

Finally, we have two overlapping concepts:

Perinatal mortality = still-births + *endogenous* mortality  
Infant mortality = *endogenous* mortality + exogenous mortality

While the concepts of perinatal mortality and infant mortality are theoretically very accurate, it is often difficult to measure them accurately, and the distinctions made above remain theoretical rather than practical, even in countries where civil registration procedures are well organized.
Life tables

Life tables show the number of survivors at different ages of a group of individuals belonging to the same generation. Let us assume, for example, that it has been possible to follow a group of 100,000 persons since their birth 100 years ago to the present day. Of this group, 4,600 died before reaching the age of 1 year, 690 others before reaching the age of 2 years, 420 others before reaching the age of 3, and so forth. From these figures the number of survivors at different ages can be derived:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100,000</td>
<td>Births</td>
</tr>
<tr>
<td>96,400</td>
<td>Survivors at 1 year</td>
</tr>
<tr>
<td>95,710</td>
<td>Survivors at 2 years</td>
</tr>
<tr>
<td>95,290</td>
<td>Survivors at 3 years, etc.</td>
</tr>
</tbody>
</table>

A table of this kind is undoubtedly of historical value because it traces what happens to an actual cohort over a period of time. It has no current practical utility, however, because it relates to the mortality trends of the past. For example, the number of survivors at age 1 indicated in the above table is linked to the infant mortality of nearly a century ago.

For this reason, instead of constructing generation life tables based on a real cohort, demographers use current tables based on a theoretical cohort. These tables are constructed according to the same principle, in that they still start with a cohort of 100,000 individuals, but current mortality conditions are applied to this theoretical cohort.

Figure 7 retraces the mortality trend of a cohort of 100,000 individuals on the basis of mortality rates by age in five countries: the United Kingdom, China, Brazil, Zimbabwe and India.
The curve has more or less the same general shape for all five countries, with that of the United Kingdom being the highest. Up to the age of 40, the cohort of 100,000 individuals remains much the same size; in fact, the first substantial drop in the curve does not occur until age 60. The lowest curve among the five countries represented is that of India, which falls clearly below the others in the early years owing to infant mortality, but rejoins the curve for Zimbabwe after 40 years of age.

In many developing countries, however, mortality statistics are fragmentary and of doubtful accuracy, making the construction of life tables very difficult. Yet, we shall see that such tables are indispensable in establishing population projections. In the absence of a life table, provided that at least fragmentary data concerning mortality are available, it is possible to use the model life tables prepared by the demographic staff of the United Nations.

*Model life tables*

For a given population, the mortality level at different ages provides an abridged history of the impact of disease and death over...
the previous three or four generations. When societies live in similar
environments, have similar genetic structures and undergo comparable
cultural changes, it may be assumed that their experiences of morbidity
and mortality display analogies that are reflected in the similarity of
their mortality levels by age.

Through an analysis of life tables calculated from nineteenth-
and twentieth-century data for the developed societies, Coale and
Demeny (1966) identified four different patterns of mortality levels
by age, corresponding to four European geographical groups: one for
northern Europe, a second for southern Europe, a third for eastern
Europe, and a fourth, more diverse group including overseas
populations of western European descent.

Preston (1976) identified a fifth, ‘non-western’ pattern that is
closer to mortality in the Latin American countries; it differs from the
other four in the structure of causes of death, and hence in the structure
of mortality by age.

More recent data suggest, moreover, that the structure of mortality
by age may differ substantially from that of Coale and Demeny’s four
patterns. For this reason, the United Nations’ demographic staff
produced five series of model life tables that are better suited to the
characteristics of developing countries (United Nations, 1982).

These five series relate to:

1. Latin America;
2. the special case of Chile;
3. south Asia;
4. the Far East;
5. other developing countries.

For each of these mortality levels, the tables provide the following
variables:

\[ m_x \] average death rate at age \( x \);

\[ nq_x \] the mortality rate, i.e., the probability that an individual of age \( x \)
will die before reaching the age of \( x + n \);
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\[ l_x \] the number of survivors at age \( x \) in the life table, assuming an initial population of 100,000;

\[ d_x \] the number of deaths in the age interval \((x, x + n)\);

\[ L_x \] the number of person-years lived in the age interval \((x, x + n)\);

\[ T_x \] the number of person-years lived at ages \( x \) and over;

\[ e_x \] life expectancy at age \( x \); and

\[ a_x \] the average number of years lived in the age interval \((x, x+n)\) by those who die during this interval.

These tables, of course, give only average indications obtained from data relating to human groups at different periods of time and subject to a variety of economic and social conditions. Therefore, the application of one of these tables to a particular population involves a certain risk of error or inaccuracy.

It is nevertheless convenient to refer to these model tables when only fragmentary mortality data are available and when there is no other way of constructing a life table. By choosing the model table that best fits the fragmentary mortality statistics which are actually available, we obtain a complete set of data that can be used to make population projections.

In recent years, significant progress has been made in keeping birth and death records and compiling demographic databases. An increasing number of developing countries now have the data needed to construct their own cohorts instead of using model life tables. The United Nations’ *Demographic Yearbook* for 1996, which gives special emphasis to mortality statistics, contains cohorts reconstructed from national data for many countries.

*Life expectancy*

We have already referred to the concept of life expectancy, and it is now appropriate to define this concept. The calculation of life expectancy...
Demographic aspects of educational planning

expectancy presupposes the availability of a life table. Life expectancy at birth is equal to the *average number of years lived by a member of a cohort*. To calculate this, it is necessary first to compute the total number of years lived by all the members of that cohort and then divide it by the number of members of that cohort.

To obtain life expectancy at a given age – at age 1, for example – it is necessary to calculate the total number of years that will be lived by the survivors at 1 year of age and to divide this total by the number of such survivors. Life expectancy is of course greater at 1 year of age than at birth, as the death rate is particularly high from birth to age 1 (infant mortality).

*Mortality trends in selected countries*

In the countries of western Europe, mortality has gradually declined since the beginning of the nineteenth century. The crude death rate, which was about 30 per thousand in 1800, is now about 10 per thousand. This gradual decline is due to scientific progress and the improvement of medical and social facilities, as well as to the rise in the standard of living and cultural level of the population.

In the developing countries, the death rate has declined much more rapidly. Whereas as late as the early 1950s the crude death rate was 25 per thousand in almost all the developing countries, it stands today at a level similar to that of the developed countries, and in some cases it is even lower. As we have seen, however, this rate is a highly imperfect way of comparing mortality levels between countries. In fact, the very low death rates observed in developing countries are due both to the recent drop in mortality levels and to the youthfulness of their populations.

What should be compared, are mortality rates by age. Let us begin with infant mortality. Although the infant mortality rate has dropped substantially in most countries, it is still high in the developing

11. The proportion of deaths from birth to 1 year of age with respect to the total number of children born in the generation considered (see above, the section on ‘Infant mortality’).
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countries. Currently, this rate is approximately 5 per thousand in the
industrialized countries, whereas it can be as high as 100 per thousand
in some developing countries. In fact, the developing world presents a
rather diversified picture in this respect: Costa Rica, Mauritius, Saudi
Arabia and the Republic of Korea have relatively low rates, whereas
infant mortality is high in countries such as Congo, Zimbabwe, Egypt
and India. Iraq is an unusual case, as it is the only country where
infant mortality has increased since 1990, but this rise is due to the
exceptional circumstances of the Gulf War and its aftermath.

Table 13. Trends in infant mortality in selected countries
(‰)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>Mauritius</td>
<td>99</td>
<td>61</td>
<td>55</td>
<td>28</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Zimbabwe</td>
<td>120</td>
<td>106</td>
<td>93</td>
<td>76</td>
<td>69</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>Congo</td>
<td>169</td>
<td>130</td>
<td>95</td>
<td>88</td>
<td>87</td>
<td>89</td>
</tr>
<tr>
<td>Arab countries</td>
<td>Saudi Arabia</td>
<td>200</td>
<td>160</td>
<td>105</td>
<td>58</td>
<td>37</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Syria</td>
<td>160</td>
<td>125</td>
<td>88</td>
<td>59</td>
<td>49</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Egypt</td>
<td>200</td>
<td>175</td>
<td>150</td>
<td>115</td>
<td>75</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Iraq</td>
<td>165</td>
<td>130</td>
<td>96</td>
<td>78</td>
<td>64</td>
<td>127</td>
</tr>
<tr>
<td>Asia</td>
<td>Rep. of Korea</td>
<td>115</td>
<td>70</td>
<td>38</td>
<td>23</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Philippines</td>
<td>100</td>
<td>76</td>
<td>71</td>
<td>60</td>
<td>53</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>190</td>
<td>157</td>
<td>132</td>
<td>106</td>
<td>93</td>
<td>78</td>
</tr>
<tr>
<td>Latin America</td>
<td>Costa Rica</td>
<td>94</td>
<td>81</td>
<td>53</td>
<td>19</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Mexico</td>
<td>121</td>
<td>88</td>
<td>69</td>
<td>47</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Brazil</td>
<td>135</td>
<td>109</td>
<td>91</td>
<td>64</td>
<td>55</td>
<td>47</td>
</tr>
<tr>
<td>Developed</td>
<td>Japan</td>
<td>51</td>
<td>25</td>
<td>12</td>
<td>7</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>countries</td>
<td>France</td>
<td>45</td>
<td>25</td>
<td>16</td>
<td>9</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>United States</td>
<td>28</td>
<td>25</td>
<td>18</td>
<td>13</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>


Lastly, mortality levels may also be compared by considering life
expectancy at birth, as shown in Figure 8.
Figure 8. Life expectancy at birth

![Life expectancy at birth chart]


Life expectancy has increased rapidly in all of the countries represented in the figure, except for Iraq and Zimbabwe in recent years. We have already indicated that Iraq is a special case. As for Zimbabwe, the drop in life expectancy is due to the spread of HIV infection and the increased number of cases of AIDS.

The appearance of AIDS and its impact on demography and educational development

The year 1981 saw the appearance of a disease with dire consequences. The first diagnosed cases were related to various severe illnesses that could develop only within an organism with a seriously compromised immune system. The population groups in which these diseases first appeared – recipients of blood transfusions, drug addicts sharing syringes and needles, individuals having many sexual partners (homosexual men in particular) – allowed researchers to identify the two principal means of transmission of this disease: sexual contact and contact with infected blood.
**Nature of the disease**

HIV destroys certain white blood cells (T4 lymphocytes, or CD4+ T cells) that orchestrate the body’s anti-bacterial immune response. Once HIV enters these lymphocytes, it spreads very rapidly through the organism, which responds by producing HIV-specific antibodies. The presence of these antibodies in the serum can be detected by testing, but not until the end of the sero-conversion period, three months after infection.

HIV infection progresses in three distinct stages: the acute primary infection stage; the chronic asymptomatic infection stage, or latency period; and the end-stage disease, AIDS.

(a) **The acute primary infection stage**

This occurs in only one infected person out of five, two weeks to three months after the primary infection.

(b) **The chronic asymptomatic infection stage**

This stage, which may last up to seven years (and occasionally even longer), is a period of rapid viral replication. In most cases, the infected person shows no symptoms during this period, and many do not even realize that they are ill, even though they may infect other people.

(c) **AIDS**

The mature form of the infection, known as AIDS (acquired immunodeficiency syndrome), is the severe end-stage disease resulting from immune deficiency.

**The current prevalence of the disease**

Precise information on the number of HIV-infected people is very difficult to obtain. One reason for this is the elusive nature of the disease and its typically long latency period. As mentioned above, during the asymptomatic infection stage, infected persons are often unaware that they are ill.
A second reason is that the disease was long associated with either drug addiction or disapproved sexual behaviour, and it is still strongly stigmatized by society today, and so victims tend to conceal the fact that they are infected for as long as possible. The only recourse, therefore, is to estimate the number of infected people by indirect methods.

Although the resulting figures are only approximations, they do indicate an order of magnitude. As Figure 9 shows, the prevalence of the disease varies greatly from country to country.

The highest percentages of infected people are found in the poorest countries, particularly in Africa and the Caribbean, and in countries where sexual tourism is tolerated, notably a few south-east Asian countries.

**Figure 9. Countries having a rate of HIV-prevalence in the adult population greater than 4% (2001)**

Owing to the lack of adequate information and of prevention through systematic use of the condom, the virus is spreading very rapidly in some countries, notably in Africa. Another factor fuelling the rate of infection is the subordinate situation of women, who in many cases are not able to refuse unprotected sex.

**Treatment**

At the time of writing, there is still no prospect of a vaccine. Furthermore, there is no treatment that really cures this disease. Some existing therapies – such as Zidovudine (AZT) and Didanosine (DDI) – do no more than inhibit the replication of the virus. Others are protease inhibitors, which destroy the enzymes required by the virus to produce the proteins it needs to survive.

These three drugs are generally combined (tritherapy) for greater overall effectiveness. This treatment does bring about a temporary improvement in the patient’s condition, but there is currently no therapy that offers a hope of eradicating the virus from the organism, as it forms part of the genome of the infected lymphocytes.

Preventive and curative therapies are also used to treat the consequences of immunodeficiency: mainly antibiotics, antifungal agents, antimitotics, radiation therapy, and surgery.

It is improbable that an effective vaccine against HIV will be developed in the near future. As for drug therapies, we have noted that their effectiveness is quite limited. Although they do slow the progression of the disease, these drugs are very expensive and must be administered continuously; as a result, they are unaffordable for many developing countries. Some encouraging progress has been made in this respect: some of the countries most affected by AIDS have decided to manufacture generic drugs themselves, and some pharmaceutical companies have agreed, under the pressure of public opinion, to offer preferential prices for the poorest countries. Nevertheless, prevention is still the most effective means of controlling the disease.
**Preventing HIV infection**

The first form of prevention – the form that is in keeping with traditional moral systems and recommended by religious authorities – is a change of sexual behaviour, and more specifically abstinence from extramarital sex. Owing to improved information, particularly about the deadliness of AIDS, this shift towards more prudent behaviour can already be observed in many countries.

Preventive education programmes can be delivered in schools, in non-formal education programmes, and by the media (UNESCO, 2001). The aim of such programmes is to inform young people and adults of various ways of protecting themselves against infection.

In addition to changes in behaviour, there are three other forms of prevention more directly related to the specific characteristics of HIV and AIDS: prevention of transmission by contact with infected blood, prevention of sexual transmission, and prevention of transmission through the placenta. In all of these cases, education has a leading role to play (UNESCO, 2001).

(a) **Prevention of transmission by contact with infected blood**

This form of prevention is based on systematic analysis of blood products before they are used. There remains, nevertheless, a risk – estimated at 1 in 300,000 – due to the three-month latency period; it is therefore recommended that blood transfusions be limited and that, whenever possible (i.e. for all surgery except in emergency cases), the practice of self-transfusion (transfusion of the patient’s own blood, collected before the operation) be preferable.

As the percentage of new infections is steadily rising among injecting drug addicts who share needles and syringes, preventive measures must address drug addiction itself.
Population changes and their impact on educational planning

(b) Prevention of sexual transmission

Transmission through sexual intercourse is prevented primarily by the use of the condom, which to date is the only effective protection against AIDS and which, moreover, offers protection against other sexually transmitted diseases.

(c) Prevention of transmission through the placenta

In this case, prevention consists of informing the women concerned: infected women are recommended not to conceive, as they may transmit the virus to the child; the same recommendation applies to infected men, who may infect the mother and hence the child as well.

(d) Preventive education

Recent experience shows that preventive education campaigns concerning HIV infection can yield good results if they are conducted rigorously. In France, for example, the number of new cases of AIDS dropped very sharply within three years, from 1995 to 1998, as can be seen in Figure 10 (extracted from Nizard. 2000: 503-564).
Figure 10. New AIDS cases in France (including French overseas départements), by year diagnosed and by transmission group

Sources: French National Public Health Network (Réseau national de santé publique), French National Institute for Health Surveillance (Institut national de veille sanitaire), European Centre for the Epidemiological Monitoring of AIDS and the UNAIDS website.
This decline is observed both among men – regardless of whether the mode of transmission is homosexual, heterosexual or between injecting drug users – and among women.

One must be careful to avoid arriving at premature conclusions, however. The decline in new AIDS cases may be due to the increasing use of tritherapy, which can delay the appearance of end-stage AIDS. In other words, a decline in the number of new end-stage cases does not necessarily signify a drop in the number of newly infected people.

Moreover, although the number of new AIDS cases is falling, the total number of cases is still rising, and there is still no cure for the disease. In any event, this decline in the number of cases is not yet a firm result, which implies that strict preventive measures must be continued.

Nevertheless, the results obtained in the more advanced countries are encouraging. Since prevention is currently the only means of combating AIDS, the facts we have just discussed should motivate the countries most affected by this calamity to enforce preventive measures as strictly as possible.

In these countries, the principal means of infection is heterosexual transmission, and use of condoms is the only effective means of protection. If prevention is to be successful, however, three conditions must be met. First, men must agree to use this sole effective means of prevention. Successful prevention thus requires a decrease in the ‘machismo’ that persists in some cultures. Second, the success of prevention campaigns depends on a clear commitment on the part of a country’s highest political authorities and on a change of stance on the part of the leaders of certain religions. Lastly, preventive methods must be available to all. Although the price of a condom may seem negligible, it constitutes a significant expense for the poor and disadvantaged. This matter should therefore be a leading priority of international development co-operation.
The demographic impact of HIV infection and the spread of AIDS

To illustrate the demographic impact of HIV infection and the spread of AIDS, we shall use a population projection for Botswana produced by the International Programs Center of the US Census Bureau. It is a 30-year projection – the baseline year is 1990, and the time horizon selected is 2020 – and its value lies in the fact that it was carried out using two different scenarios: with AIDS and without AIDS.

The essence of this projection is captured in the dramatic figures below:

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population in 1990</td>
<td>627</td>
<td>677</td>
<td>1,304</td>
</tr>
<tr>
<td>Population in 2020</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without impact of AIDS</td>
<td>1,244</td>
<td>1,323</td>
<td>2,567</td>
</tr>
<tr>
<td>with impact of AIDS</td>
<td>663</td>
<td>655</td>
<td>1,318</td>
</tr>
</tbody>
</table>

Without AIDS, the population would nearly have doubled in size from 1990 to 2020; with AIDS, it is projected to remain almost stable. The various age groups are of course affected very differently, as shown in Figure 11, in which the white pyramid represents the population of Botswana in 2020 had AIDS not been present, and the black pyramid represents the population if HIV infection were to continue at the current rate.
Population changes and their impact on educational planning

Figure 11. Projection of Botswana’s population in 2020, with and without impact of AIDS

The shape of the white pyramid is familiar: it corresponds to a fairly young population in which the birth rate has stabilized. The pyramid is relatively wide from its base to the 20-24 year age group, at which point it gradually narrows, reflecting the decreasing size of the older age groups.

The shape of the black pyramid is much more surprising. As we have stated, 1990 was used as the baseline year. In the projection for 2020, therefore, it is necessary to distinguish people under 30 years of age, who were born after 1990 and are affected by the natality trend that results from AIDS, from people over 30, who are the survivors of the 1990 population and who are affected only by the mortality trend due to AIDS.

Demographic aspects of educational planning

(a) The impact of AIDS on natality

Examination of the black pyramid reveals that, for both men and women, the 20-24 year age group (born from 1995 to 1999) is larger than the 25-29 year group (born from 1990 to 1994). Thus, it may be said that from 1990 to 1999, AIDS has had little impact on natality, as the number of births continued to grow.

Beginning with the 15-19 year age group, however, the numbers in each age group fall lower and lower. This decline in natality is primarily the result of the premature deaths of HIV-infected women who die before the age of 49, i.e. before the end of their child-bearing years.

(b) The impact of AIDS on mortality

The steady decrease in size of the under-25 age groups results not only from the decline in natality, but also from the increase in infant mortality due to the transmission of the virus from infected mothers to their children, either through the placenta or through breast-feeding.

For the over-30 age groups, the difference between the white and black pyramids stems exclusively from the increase in mortality due to the spread of AIDS.

The impact of AIDS on educational development

In countries where the level of HIV infection is already high, AIDS has, of course, a considerable impact on educational development and quality.

In analyzing this problem, it is appropriate to start by examining the impact of AIDS on the work and performance of teachers and its effect on student learning.
(a) The impact of AIDS on the work, performance and number of teachers

As shown above, AIDS strikes young adults first, primarily the 30-40 year age group, which is the group containing the bulk of the teaching force (both men and women). Moreover, it appears that teachers are especially at risk:

“Although the data on the rates of infection and mortality among teachers are limited, both in quantity and in quality, they indicate that, in a number of countries, the current teaching force is a group at risk … Screening tests performed on Zambian teachers and office works in the early 1990s revealed that rates of infection were considerably higher in this population group than in other groups …” (Kelly, 2000)

In its early stages – i.e. during the primary infection stage and the asymptomatic infection stage, or latency period – HIV infection has little impact on the work performed by teachers, especially if, as is often the case, the infected person does not know that he or she is HIV-positive.

The impact on teachers’ performance begins to be felt in the end stage of the infection, i.e. AIDS, when there is a considerable risk of opportunistic infection\(^\text{12}\). At this stage, there is a dramatic increase in the amount of sick leave taken for periods of varying length.

Even worse, AIDS leads inevitably to death, and the resulting decimation of the teaching force, trained with difficulty and at considerable expense, forms an additional barrier to the development and qualitative improvement of basic education, particularly for the poorest countries.

“According to the initial projections of the World Bank, 14,460 teachers will die of AIDS in Tanzania by the year 2010,

12. For example, when the patient is infected by Koch’s bacillus (which causes tuberculosis) and this bacillus ‘takes advantage’ of the breakdown of the patient’s immune system to proliferate.
Demographic aspects of educational planning

and this figure will rise to 27,000 by 2020. Screening tests performed on Zambian teachers and office workers in the early 1990s revealed that rates of infection were considerably higher in this population group than in other groups. Seven years later, the hard figures confirmed this grim conclusion: the death rate of Zambian teachers stood at 39 per thousand, a rate 70 per cent higher than that of the overall population of this country. In Kenya, the number of deaths among teachers rose from 450 in 1995 to 1,400 in 1999, primarily owing to HIV/AIDS. ... in Botswana, the death rate among teachers was between 2 and 5 per cent each year. As for South Africa, where 20 to 30 per cent of teachers are infected, it is estimated that 88,000 to 133,000 teachers will die between now and 2010.” (Kelly, 2000: 70)

(b) The impact of AIDS on student learning

The frequent absence of teachers, and the lack of substitute teachers, definitely has an impact on children’s learning and achievement. Children’s learning process may also be perturbed when a family member or friend is infected by HIV, particularly when the infected person is one of their parents.

Moreover, one of the most tragic social consequences of the rapid spread of AIDS is the huge increase in the number of orphans, who cannot always be placed in a foster home owing to the loosening of family ties, the decline in traditional mechanisms of solidarity (particularly in urban areas), the fear of incurring further expenses, and the sometimes irrational fear of contagion.
Table 14. Estimate of the number of orphans resulting from the spread of HIV infection in selected African countries

<table>
<thead>
<tr>
<th>Country</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethiopia</td>
<td>1,040,000</td>
<td>2,540,000</td>
</tr>
<tr>
<td>Kenya</td>
<td>380,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Mozambique</td>
<td>290,000</td>
<td>880,000</td>
</tr>
<tr>
<td>Tanzania</td>
<td>480,000</td>
<td>920,000</td>
</tr>
<tr>
<td>Uganda</td>
<td>590,000</td>
<td>680,000</td>
</tr>
<tr>
<td>South Africa</td>
<td>360,000</td>
<td>1,820,000</td>
</tr>
<tr>
<td>Zambia</td>
<td>430,000</td>
<td>530,000</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>420,000</td>
<td>660,000</td>
</tr>
</tbody>
</table>

*Source: Hunter and Williamson, 2000.*

The last section of *Part II* deals with the forecasting of school enrolments. Such forecasting requires population projections, and since AIDS, as we have seen, affects both natality and mortality trends, it will have an impact on these projections. This impact is considerable in some countries and less significant in others.

**Forecasting school enrolment figures**

The future trend in population size and its impact on the school-age population are of special interest to educational planners. Our examination of population growth will therefore give special emphasis to methods of making population projections and forecasting future school enrolments.

**Population growth**

The growth of a population is determined by the combined action of natality and mortality. International migration also plays a part, but since the characteristics of such migration are peculiar to each country and to each specific situation, migrational movements are usually studied separately. For this reason, a distinction is made between the *natural* growth of a population, which takes into consideration only natality and mortality, and its *total* growth.
(a) The crude rate of natural population growth

Since natural growth is equivalent to the difference between births and deaths, the crude rate of natural population growth is simply the difference between the crude birth rate and the crude death rate.

Table 15 shows the trend in these three rates since the 1950s in selected countries. In Africa, the rate of population growth is still high. In Cameroon, for example, the crude birth rate changed very little over the period, while the crude death rate fell substantially, resulting in a very high natural rate of population growth (27.8 per thousand).

Zimbabwe is an unusual case. The crude death rate fell steadily until the late 1980s, but since then it has begun to rise again. This trend is due to the spreading of HIV infection, as mentioned above.

In Asia, the situation of China may be contrasted with that of Pakistan. China has implemented a strict birth control policy, particularly since the late 1970s, and the crude birth rate has fallen sharply, by much more than the crude death rate. As a result, population growth has been fairly modest (11.1 per thousand).

Table 15. Crude birth rates, death rates and natural growth rates for selected countries, 1950-1995 (% e)

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<tr>
<td>Cameroon</td>
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<td>43.4</td>
<td>45.4</td>
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Population changes and their impact on educational planning

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</tbody>
</table>


In Pakistan, however, the birth rate has remained very high, although it began to decline very slightly in the early 1980s. When combined with a falling crude death rate, this results in a very high rate of population growth (30.3 per thousand). If this rate of growth continues, the population will double in size over a period of 23 years.

In Latin America, the situation of Argentina may be contrasted with that of Colombia. In Argentina, the crude birth rate, which was already fairly low in the early 1950s, has continued to fall since then. The crude death rate has hardly changed at all, and the crude rate of natural population growth (12.6 per thousand) is only slightly above that of the industrialized countries.

In Colombia, the crude birth rate was particularly high in the early 1950s. Although it has dropped since then, the crude death rate has fallen at the same time, and hence population growth is still rather high (21.8 per thousand).

In the industrialized countries, as expected, the natural growth rate is very low. In the United Kingdom, the birth rate has fallen since the 1950s, while the crude death rate has remained practically
unchanged\textsuperscript{13}. As a result, the rate of population growth is very low (1.9 per thousand). A similar situation is found in Japan.

The rate of natural population growth is easily calculated and convenient to use, but it is derived from the crude birth rate and crude death rate, and thus has the same drawbacks as these rates: it does not take account of the age structure, and thus does not allow meaningful comparisons between countries.

For this reason, the concept of ‘reproduction’ may be substituted for the concept of population growth. The idea here is to find out \textit{whether the current generation is capable of quantitatively replacing the preceding generation} which gave birth to it.

\textbf{(b) Reproduction rate}

If we follow a generation from birth to the point where it has completed the procreation of all its descendants, and if we then compare the number of these descendants with the number of persons in the original generation, we obtain a measurement of the ‘replacement’ of one generation by another. This forms the basis for calculating the reproduction rate.

In general, however, instead of comparing the total number of descendants with the total number in the generation to which they were born, demographers compare the number of female births with the number of women in the generation\textsuperscript{14}.

The \textit{crude} reproduction rate is therefore equal to the average number of female babies born to each woman of the generation considered.

\textsuperscript{13} As discussed above, the crude death rate is not easily interpreted. The fact that this rate is stable does not mean that mortality has diminished. In reality, the decline in mortality observed through a comparison of death rates by age is offset by the ageing of the population.

\textsuperscript{14} It should be noted that, in general, more boys are born than girls, and that the relative male birth rate is about 1.05. In other words, out of every 1,000 births, there are approximately 512 boys and 488 girls ($512/488 = 1.05$).
To obtain a more complete and accurate view of reproduction, however, we must take into account not only the fertility, but also the mortality of women. Some women die before reaching child-bearing age (15 years) or during the child-bearing period (15-49). For this reason, a net reproduction rate is calculated, which takes into consideration both the fertility and the mortality of women.

In principle, the reproduction rate is a generation rate. In order to calculate this, it would be necessary to follow a cohort of women born 50 years ago, and count the total number of female babies to whom they gave birth.

What interests us here, however, is not the past trend in fertility, but its current characteristics. For this reason, instead of computing actual generation rates, current rates are used. The differences between these two methods have already been mentioned in connection with life tables.

By way of illustration, we shall calculate the net reproduction rate of a population whose mortality and fertility characteristics are given in Calculation Table A.

We start with a theoretical cohort of 10,000 women. Since we want a current rate, we must use current mortality rates to calculate the number of survivors at different ages. Next, we apply the current fertility rates by age group to these survivors to obtain the annual number of births. As each woman spends five years in each age group, however, this number of births must be multiplied by five to obtain the total number of births for the group.
Demographic aspects of educational planning

Table 16. Calculation Table A

<table>
<thead>
<tr>
<th>Age group</th>
<th>Survivors of a cohort of 10,000</th>
<th>Fertility rate (‰)</th>
<th>Annual number of births</th>
<th>Number of births for the age group</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>9,487</td>
<td>22</td>
<td>209</td>
<td>1,045</td>
</tr>
<tr>
<td>20-24</td>
<td>9,445</td>
<td>126</td>
<td>1,190</td>
<td>5,950</td>
</tr>
<tr>
<td>25-29</td>
<td>9,391</td>
<td>169</td>
<td>1,587</td>
<td>7,935</td>
</tr>
<tr>
<td>30-34</td>
<td>9,333</td>
<td>116</td>
<td>1,083</td>
<td>5,415</td>
</tr>
<tr>
<td>35-39</td>
<td>9,268</td>
<td>70</td>
<td>649</td>
<td>3,245</td>
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<tr>
<td>40-44</td>
<td>9,188</td>
<td>31</td>
<td>285</td>
<td>1,425</td>
</tr>
<tr>
<td>45-49</td>
<td>9,076</td>
<td>5</td>
<td>45</td>
<td>225</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>25,240</td>
</tr>
</tbody>
</table>

The total number of births amounts to 25,240. As we have seen\textsuperscript{15}, an average of 488 girls are born in every 1,000 births. The number of female births is thus:

\[
25,240 \times 0.488 = 12,317
\]

Dividing this number by the total number of women in the cohort, which initially was 10,000, yields the net reproduction rate: 1.2317.

The net reproduction rate is greater than 1, which means that the following generation is larger than the current generation, and that the population will increase.

Table 16 shows the net reproduction rates of selected countries. Examination of these rates leads us to roughly the same conclusions as our analysis of natural population growth rates.

\textsuperscript{15} See note 14.
In Africa and the Arab countries, the net reproduction rate is close to 2, and in some cases even higher. At this rate, the following generation will be approximately twice as large as the current generation, and the population will therefore grow at a rather fast pace in the future.

In Latin America, the net reproduction rate has gradually decreased, but is still greater than 1. The population will therefore continue to grow, but at a slower rate.

In some Asian countries, such as the Republic of Korea, China and Thailand, the net reproduction rate fell very rapidly in past years and is now less than 1. Although the populations of these three countries are still growing slightly today – as we saw above – the fact that the net reproduction rate is less than 1 indicates that the populations will diminish in the long term.

In studying the future trend of a population, the net reproduction rate is undoubtedly more useful than the crude rate of natural growth, which merely expresses the current balance between births and deaths. A decline in the birth rate may well be masked by a declining death rate, with results in the births-to-deaths balance remaining positive. But natality may decline to such a level that the generations no longer replace themselves. The population becomes older (increase in the proportion of old people), and after a certain lapse of time it declines (decrease in total number of people).

The net reproduction rate owes its popularity precisely to the fact that it was the means of showing the danger of depopulation of western Europe in spite of a positive births-to-deaths balance. In almost all the European countries, as well as the United States and Australia, the net reproduction rate is well below 1. The lowest such rate is found in Germany, standing at only 0.62.
Table 17. Trends in the net reproduction rate in selected countries

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
<th>50-55</th>
<th>60-65</th>
<th>70-75</th>
<th>80-85</th>
<th>85-90</th>
<th>90-95</th>
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<td>Mauritius</td>
<td>2.32</td>
<td>2.41</td>
<td>1.42</td>
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<td>Kenya</td>
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<td>2.67</td>
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<td>2.21</td>
<td>2.21</td>
<td>2.28</td>
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<tr>
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<td>1.72</td>
<td>1.96</td>
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<td>1.79</td>
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<td>2.65</td>
<td>2.67</td>
<td>2.26</td>
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<tr>
<td></td>
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<td>2.02</td>
<td>2.31</td>
<td>2.57</td>
<td>3.10</td>
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<td>2.94</td>
</tr>
<tr>
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<td>1.15</td>
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<td>1.60</td>
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</tr>
<tr>
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<tr>
<td>Asia</td>
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</tr>
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<td>1.12</td>
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<td>1.29</td>
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<tr>
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<td>1.67</td>
<td>1.59</td>
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</tr>
<tr>
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<td>2.49</td>
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<td>2.28</td>
</tr>
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<td>0.77</td>
<td>0.70</td>
<td>0.69</td>
<td>0.62</td>
</tr>
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<td>0.85</td>
<td>0.80</td>
<td>0.72</td>
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<tr>
<td></td>
<td>France</td>
<td>1.26</td>
<td>1.34</td>
<td>1.10</td>
<td>0.90</td>
<td>0.87</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>United Kingdom</td>
<td>1.02</td>
<td>1.34</td>
<td>0.97</td>
<td>0.87</td>
<td>0.87</td>
<td>0.86</td>
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<tr>
<td></td>
<td>Australia</td>
<td>1.48</td>
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<td>1.20</td>
<td>0.93</td>
<td>0.90</td>
<td>0.90</td>
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<tr>
<td></td>
<td>United States</td>
<td>1.60</td>
<td>1.56</td>
<td>0.96</td>
<td>0.87</td>
<td>0.92</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>Sweden</td>
<td>1.04</td>
<td>1.11</td>
<td>0.90</td>
<td>0.79</td>
<td>0.92</td>
<td>0.96</td>
</tr>
</tbody>
</table>


Preparing population projections

There are two main reasons for making population projections. The first is scientific curiosity, which can lead one to investigate, for example, what would be the trend and structure of a population if certain demographic parameters were to change.
An attempt can be made, for instance, to discover the consequences for a given population of a gradual decline in infant mortality over the next 20 years. Projections of this kind are sometimes called *conditional projections*, because they show what would occur if such and such a condition were fulfilled, without attempting to determine the most probable future situation. In this sense, such forecasts can never be mistaken! Nevertheless, they can be very useful and instructive, as they provide a means of detecting the indirect consequences of certain possible population changes.

The second concern is of much greater *practical usefulness*. In this case, an attempt is made to forecast future population growth. Starting with the current situation, particularly the *current structure* of the population by sex and age and the *current* level of mortality and fertility, the basic aim is to forecast what this level will be in the near future. This leads to the estimation of *projective rates*. Using these projective rates, it is possible to calculate the number of survivors and then to complete the picture by making a forecast or projection of births.

*(a) Calculation of survivors*

The calculation of survivors is one of the most reliable aspects of population projection, since this calculation deals with cohorts which are already *born*; the only assumptions which have to be made concern mortality. If the death rate at the earliest ages (0-4 years) is excluded, the death rate among young people (5-20 years) is low and the risk of error is not very high. For that reason, short-term school enrolment forecasts and projections for the active population are relatively accurate.

In discussing mortality, we spoke of the mortality rate and the death rate. But it is evident that instead of considering the number of deaths, one can take the number of survivors: for example, one can calculate the proportion of individuals of the same cohort, at a given age, who are still living one year later. This gives us what is known as a *survival rate*. 
If out of the 420,000 children 1 year old in a given cohort, 2,100 die before reaching the age of 2, the survival rate at 1 year is:

\[
\frac{420,000 - 2,100}{420,000} = 0.995
\]

Instead of calculating the survival rate at a given age, we can compute the survival rate for a whole age group. We can determine, for example, the proportion of children in the 0-4 year group who, five years later, will constitute the 5-9 year group.

On the basis of current survival rates and the probable mortality trend in the near future, we can estimate projective survival rates. As the mortality level is not the same for men and women, we must compute these rates separately for each sex.

In this connection, the model life tables compiled by the demographic staff of the United Nations can again be of some use. These tables offer the advantage of describing the various levels of mortality (corresponding to increasingly higher life expectancy at birth). The corresponding survival rates are annexed to these tables. Hence, if no other means are available for estimating projective survival rates and if a certain decline in mortality is nevertheless expected, the survival rates corresponding to a slightly lower mortality level can be used as projective rates. Such an approximation cannot be used, however, for countries ravaged by HIV/AIDS.

When the projective rates have been determined, one need only apply them to the current population figures by age or by age group in order to arrive at an estimation of the age structure in future years.

Let us assume, for example, that the age structure of the male population as of 1 January 1995 and the projective survival rates are those given in Calculation Table B. On the basis of these data, we can easily estimate the age structure of the male population in 2000.
Table 18. Calculation Table B

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>42,970</td>
<td>0.9563</td>
<td>42,903</td>
</tr>
<tr>
<td>5-9</td>
<td>41,091</td>
<td>0.9984</td>
<td>40,809</td>
</tr>
<tr>
<td>10-14</td>
<td>41,027</td>
<td>0.9931</td>
<td>40,822</td>
</tr>
<tr>
<td>15-19</td>
<td>40,745</td>
<td>0.9950</td>
<td>40,472</td>
</tr>
<tr>
<td>20-24</td>
<td>40,541</td>
<td>0.9933</td>
<td>40,231</td>
</tr>
<tr>
<td>25-29</td>
<td>40,270</td>
<td>0.9923</td>
<td>39,908</td>
</tr>
<tr>
<td>30-34</td>
<td>39,961</td>
<td>0.9910</td>
<td>39,488</td>
</tr>
<tr>
<td>35-39</td>
<td>39,602</td>
<td>0.9882</td>
<td>38,911</td>
</tr>
<tr>
<td>40-44</td>
<td>39,133</td>
<td>0.9826</td>
<td>38,061</td>
</tr>
<tr>
<td>45-49</td>
<td>38,450</td>
<td>0.9726</td>
<td>36,755</td>
</tr>
<tr>
<td>50-54</td>
<td>37,397</td>
<td>0.9559</td>
<td>34,727</td>
</tr>
<tr>
<td>55-59</td>
<td>35,748</td>
<td>0.9286</td>
<td>31,644</td>
</tr>
<tr>
<td>60-64</td>
<td>33,196</td>
<td>0.8852</td>
<td>27,164</td>
</tr>
<tr>
<td>65-69</td>
<td>29,385</td>
<td>0.8183</td>
<td>21,161</td>
</tr>
<tr>
<td>70-74</td>
<td>24,046</td>
<td>0.7201</td>
<td>14,105</td>
</tr>
<tr>
<td>75-79</td>
<td>17,316</td>
<td>0.5866</td>
<td>7,357</td>
</tr>
<tr>
<td>80+</td>
<td>10,158</td>
<td>0.4248</td>
<td></td>
</tr>
</tbody>
</table>

This table gives data for a five-year projection, but of course projections can be made for more distant dates, provided that the required projective rates are available.

It should be noted, however, that in a five-year projection based only on a survivor calculation, there is no figure for the 0-4 year age group (as these children are not yet born). By the same token, in a ten-year projection both the 0-4 and the 5-9 age groups will be missing, and so on. For this reason, it is necessary to make birth projections in order to have a complete picture of the future age structure.

(b) Birth projections

Whereas the calculation of survivors is made on the basis of the current population structure by sex and the mortality level, birth projections are based on the age structure of the female population (in particular women of child-bearing age) and the fertility level.
It should be noted that while the mortality rates at the younger ages are low (which reduces the possibility of numerical errors in estimating survivors), fertility rates at these ages are not low, and hence the results of birth projections are not as accurate as those of survivor calculations. This is especially true when there is a sudden and unexpected variation in fertility.

The first step in making birth projections is to calculate projective fertility rates. This can be done by taking current fertility data and making various assumptions as to the future trend.

The next step is to estimate the number of women in the various cohorts. Let us assume, for example, that the projective fertility rates by age and the numbers of women in the cohorts are as shown in Calculation Table C.

**Table 19. Calculation Table C**

<table>
<thead>
<tr>
<th>Year of birth of the female cohort</th>
<th>Number as of 1 January 1995</th>
<th>Number as of 1 January 2000</th>
<th>Projective fertility rate (%‰)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975-1979</td>
<td>39,397</td>
<td>37,427</td>
<td>104</td>
</tr>
<tr>
<td>1965-1969</td>
<td>39,002</td>
<td>32,335</td>
<td>794</td>
</tr>
<tr>
<td>1960-1964</td>
<td>38,760</td>
<td>29,831</td>
<td>541</td>
</tr>
<tr>
<td>1955-1959</td>
<td>38,491</td>
<td>27,240</td>
<td>324</td>
</tr>
<tr>
<td>1950-1954</td>
<td>38,159</td>
<td>24,422</td>
<td>142</td>
</tr>
<tr>
<td>1945-1949</td>
<td>37,693</td>
<td>21,391</td>
<td>23</td>
</tr>
</tbody>
</table>

Let us first consider the cohort of women born from 1975 to 1979, i.e. those who are 15 to 19 years old as of 1 January 1995. The number of women at that date is 39,397. Owing to deaths, however, this figure falls to 37,427 as of 1 January 2000.

The average number of women in this cohort over the period is thus:
The table also shows a projective fertility rate of 104 per thousand. The expected number of births for this cohort is therefore:

\[
\frac{38,412 \times 104}{1,000} = 3,995
\]

The same procedure is used for the other cohorts, yielding the results shown in Calculation Table D:

**Table 20. Calculation Table D**

<table>
<thead>
<tr>
<th>Year of birth of the female cohort</th>
<th>Number as of 1 January 1995</th>
<th>Number as of 1 January 2000</th>
<th>Average number over the period</th>
<th>Projective fertility rate (‰)</th>
<th>Number of births forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975-1979</td>
<td>39,397</td>
<td>37,427</td>
<td>38,412</td>
<td>104</td>
<td>3,995</td>
</tr>
<tr>
<td>1965-1969</td>
<td>35,147</td>
<td>32,335</td>
<td>33,741</td>
<td>794</td>
<td>26,790</td>
</tr>
<tr>
<td>1960-1964</td>
<td>33,518</td>
<td>29,835</td>
<td>31,675</td>
<td>541</td>
<td>17,136</td>
</tr>
<tr>
<td>1955-1959</td>
<td>32,047</td>
<td>27,240</td>
<td>29,644</td>
<td>324</td>
<td>9,604</td>
</tr>
<tr>
<td>1950-1954</td>
<td>30,151</td>
<td>24,422</td>
<td>27,287</td>
<td>142</td>
<td>3,875</td>
</tr>
<tr>
<td>1945-1949</td>
<td>28,146</td>
<td>21,391</td>
<td>24,769</td>
<td>23</td>
<td>570</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>83,472</td>
</tr>
</tbody>
</table>

Now that the total birth figures have been projected, we need to determine the respective numbers of boys and girls. Assuming that the male/female ratio is 105:100, there will be 42,754 boys and 40,718 girls.
Some of these children will die before 1 January 1995, however, so in order to obtain the number in the 0-4 age group as of 1 January 1995, the preceding figures should be multiplied by the corresponding survival rates.

**Forecasting school enrolments**

Forecasting future school enrolments involves two distinct stages. The purpose of such a forecast may be to estimate total educational costs, and hence the funding required. In this case, the enrolment figures with which one is concerned are the overall figures for the country.

When it concerns implementing an educational plan, however, it is necessary to know also how these school enrolments are distributed over the country’s territory. This involves forecasting on the local scale.

(a) **On the national scale**

Firstly, one needs to estimate the school-age population. This can be done on the basis of the number of births. As an example, we shall consider the data for China. *Figure 12* shows the birth trend in China from 1980 to 1998. With the notable exception of the 1983-1985 period, the number of births increased at a moderate pace from 1980 to 1990. It fell fairly rapidly from 1990 to 1992, then more slowly from 1992 onwards.

These variations are in part the result of the difficulties encountered by the Chinese government in enforcing its one-child policy.\(^{16}\)

\(^{16}\) In a country where Confucian ethics has been an important influence in the past (and in fact still is), there is a very strong preference for male progeny, not only to carry on the family name, but because the oldest son (not the oldest daughter) has a special role to play – in fact, a duty – in ancestor worship. This preference for male descendants is a considerable barrier to enforcement of the single-child policy, leading to undesired consequences and sometimes regrettable practices such as failure to register girls at birth and abortion when the sex of the child can be determined before birth.
On the basis of the number of births observed, it is possible to estimate the numbers of children of primary school age (6-11) and lower secondary school age (12-14), as shown in Figure 13. The decline in the number of births as from 1990 will not be reflected in a drop in the school-age population corresponding to primary education until 1997, nor in that corresponding to lower secondary education until 2003.

Figure 13. Projection of the school-age population in primary and lower secondary education in China, 1994-2009

Up to the end of compulsory schooling, the forecasting of school enrolment figures presents no particular difficulties, as the number of children enrolled in school is approximately equal to the school-age population. But at the other educational levels, only a part of the school-age population will have access to education.

In theory, this proportion depends on both social demand (i.e. the desire for education expressed by pupils and parents) and the policy established by the government. In practice, however, things are not quite so simple. Even the most authoritarian governments are obliged to take social demand into account when setting policy. By the same token, all governments, no matter how liberal, seek to influence that social demand. In the end, therefore, it is the combined action of these two factors that determines the level of educational enrolment rates.

Where the sole aim is to satisfy social demand, it is necessary to estimate how this demand will change in the future. In this case, the
study of past trends may be instructive: on the basis of the observed levels of the enrolment rate in the past, extrapolation gives us the probable level of this rate in the future.

If, however, educational development is regarded as a priority – in other words, if an effort is to be made to facilitate such development to the greatest possible extent (anticipating, and to some extent encouraging, social demand) – then school enrolment rates become targets to be met. For example, it might be decided to raise the enrolment rate gradually in order to achieve universal compulsory education within a given number of years.

As stated above, however, the implementation of an educational plan requires more than forecasting the overall numbers for a country; it is also necessary to try to see how these numbers will be distributed throughout the country. Thus, after forecasting the number of enrolments on a national scale, it is necessary to make similar forecasts on the local scale.

(b) On the local scale

In forecasting at the local level, it is of course necessary to take into account migration. In general, international migration has little effect on the school-age population, except in cases of civil war, such as in Liberia, Sierra Leone and Afghanistan.

Internal migration, however, may have a strong impact on the school-age population. These migratory movements are sometimes very large. Increases in the populations of towns and cities are due as much to internal population movements as to the natural growth of the population, if not more so. Unfortunately, very little is known about such internal migration. In most cases, no accurate data are available as to the origin or the age of migrants, and even the size of these migratory movements is measured only from time to time when population censuses are taken. It is thus understandable that any forecasts concerning internal migration will be very approximate.

In any event, there are three kinds of internal migration:
Demographic aspects of educational planning

1. movements from one part of the country to another;
2. movements from rural areas towards urban areas close by;
3. movements away from the centres of urban areas towards the surrounding areas.

Movements from the centre of large towns or cities towards the surrounding areas are observed mostly in the developed countries, but movements from rural areas towards towns and cities (urbanization) are now a feature of all countries, developed and developing, and it is these movements that have the greatest effect on educational development.

Since the factors which may affect such internal population movements are mostly to be found at the local level (the extent to which towns and cities attract inflows from the surrounding areas, the flow of people towards areas where development is most rapid, etc.), it is the local authorities who are most familiar with them. Local authorities are also the best informed of the specific educational problems of the region or area, past educational enrolment levels, etc. For all these reasons, they are in the best position to forecast future numbers of students on the local scale. Many errors could be avoided by involving local authorities as closely as possible in the formulation of educational plans.
Conclusion

Throughout this booklet, we have tried to show the effects that demographic factors may have on educational development. We have also indicated how population data may be used in the preparation of an educational plan.

Owing to the limited scope of this work, a number of topics could not be addressed in detail. For example, demographic techniques have been mentioned in a very cursory fashion. But it is not the purpose of this booklet to analyse demographic techniques in detail; they have been discussed only to the extent to which they help show how population data are collected, the assumptions which must sometimes be made for lack of sufficiently detailed data, the adjustments which must be made in order to correct any discernible errors, and so on.

In countries where statistics are reliable, where censuses are taken regularly and carefully, and vital statistics units operate efficiently, population data are presented with all the necessary accuracy and precision, and the demographic projections based on such data have every chance of being accurate as well – although there is always the possibility of error in the event of abrupt changes in population behaviour.

In other countries, however, and especially the developing countries, planners do not have such accurate data and must take precautions in using whatever statistics are available.

Population data are nevertheless crucial to educational planning. No meaningful planning is possible without reference to the current and future demographic profile of the country. If that profile is known with only some degree of accuracy, it is essential to be sufficiently flexible in the determination of educational targets to allow adjustments to be made should more accurate data later become available.
Appendix

Disaggregating five-year age groups into single-year groups: Sprague multipliers

Sprague interpolation is based not only on the number of people in the age group being considered, but also on the numbers in the two preceding and the two following age groups.

Since this method requires that the numbers in the two preceding and the two following age groups be known, it cannot be strictly applied to very young age groups (0-4 and 5-9) or to very old age groups (75-79 and over 80). For this reason, the interpolation of the 0-4 age group is carried out on the basis of the numbers in the three following age groups, while that of the 5-9 age group is based on the one preceding group and the two following groups. The same procedure is adopted for very old age groups: the interpolation of the 75-79 age group is based on the numbers in the two preceding groups and the one following group, while that of the over-80 age group is based on the numbers in the three preceding groups.

Tables of coefficients have been compiled in order to facilitate the computations. As indicated by the remarks above, several tables are needed: a first table for the 0-4 age group, enabling the interpolation to be based on the numbers in the three following age groups; a second table for the 5-9 age group, for performing the interpolation on the basis of the numbers in the preceding age group and the two following age groups; and an intermediate table which can be used for all other age groups, since in each case the numbers in the two preceding and the two following age groups are known. Two more tables of coefficients are of course necessary for the two oldest age groups.

As educational planners will primarily need the first two tables and the intermediate table, these are provided below.

If $F_0$ is the number of people in the age group under consideration, $F_{+1}, F_{+2},$ and $F_{+3}$ the numbers in the three following age groups, and $F_{-1}$ and $F_{-2}$ the numbers in the two preceding age groups, and if,
Furthermore, $F_a$, $F_b$, $F_c$, $F_d$, and $F_e$ represent respectively the first, second, third, fourth and fifth age years of the group, the table of Sprague multipliers can be presented in the following form:

<table>
<thead>
<tr>
<th></th>
<th>$F_{-2}$</th>
<th>$F_{-1}$</th>
<th>$F_0$</th>
<th>$F_{+1}$</th>
<th>$F_{+2}$</th>
<th>$F_{+3}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>First table</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F_a$</td>
<td>$+0.3616$</td>
<td>$-0.2768$</td>
<td>$+0.1488$</td>
<td>$-0.0336$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F_b$</td>
<td>$+0.2640$</td>
<td>$-0.0960$</td>
<td>$+0.0400$</td>
<td>$-0.0080$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F_c$</td>
<td>$+0.1840$</td>
<td>$+0.0400$</td>
<td>$-0.0320$</td>
<td>$+0.0080$</td>
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<tr>
<td>$F_d$</td>
<td>$+0.1200$</td>
<td>$+0.1360$</td>
<td>$-0.0720$</td>
<td>$+0.0160$</td>
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<tr>
<td>$F_e$</td>
<td>$+0.0704$</td>
<td>$+0.1968$</td>
<td>$-0.0848$</td>
<td>$+0.0176$</td>
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</tr>
<tr>
<td>Second table</td>
<td></td>
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<tr>
<td>$F_a$</td>
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<td>$+0.2272$</td>
<td>$-0.0752$</td>
<td>$+0.0144$</td>
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<tr>
<td>$F_b$</td>
<td>$+0.0080$</td>
<td>$+0.2320$</td>
<td>$-0.0480$</td>
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<td>$F_c$</td>
<td>$-0.0080$</td>
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<td>$-0.0080$</td>
<td>$+0.0000$</td>
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<tr>
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<td>$-0.0160$</td>
<td>$+0.1840$</td>
<td>$+0.0400$</td>
<td>$-0.0080$</td>
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<td></td>
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<tr>
<td>$F_e$</td>
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<td>$+0.1408$</td>
<td>$+0.0912$</td>
<td>$-0.0144$</td>
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<td></td>
</tr>
<tr>
<td>Intermediate table</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>$F_a$</td>
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<td>$+0.1504$</td>
<td>$-0.0240$</td>
<td>$+0.0016$</td>
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<tr>
<td>$F_b$</td>
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<td>$-0.0416$</td>
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<td>$+0.2544$</td>
<td>$-0.0336$</td>
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<td>$+0.0144$</td>
<td>$-0.0016$</td>
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<tr>
<td>$F_e$</td>
<td>$+0.0016$</td>
<td>$-0.0240$</td>
<td>$+0.1504$</td>
<td>$+0.0848$</td>
<td>$-0.0128$</td>
<td></td>
</tr>
</tbody>
</table>

By way of illustration, the following is the procedure for estimating the numbers of children of 6, 7, 8, 9, 10 and 11 years when the numbers of individuals in the 0-4, 5-9, 10-14, 15-19 and 20-24 year age groups are known.

The figures given are as follows:

- **0-4 age group**: 111,792
- **5-9 age group**: 108,718
- **10-14 age group**: 101,256
- **15-19 age group**: 96,390
- **20-24 age group**: 81,506
The number of 6-year-old children corresponds to line $F_b$ in the second table, since this table is concerned with children from 5 to 9 years of age. Thus:

Number of 6-year-olds

$$\begin{align*}
= & \ 0.0080 \ F_{-1} + 0.2320 \ F_0 - 0.0480 \ F_1 + 0.0080 \ F_2 \\
= & \ (0.0080 \times 111,792) + (0.2320 \times 108,718) \\
& - (0.0480 \times 101,256) + (0.0080 \times 96,390) \\
= & \ 894 + 25,223 - 4,860 + 771 \\
= & \ 22,028
\end{align*}$$

The same procedure is used for the number of children of other ages, as shown in the tables below. Note that in order to obtain the number of 10- and 11-year-olds, it is necessary to use the intermediate table.

### Estimate of numbers of children 6, 7, 8 and 9 years of age

<table>
<thead>
<tr>
<th>Age group</th>
<th>Multiplied by the corresponding coefficient</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>111,792</td>
<td></td>
</tr>
<tr>
<td>5-9</td>
<td>108,718</td>
<td></td>
</tr>
<tr>
<td>10-14</td>
<td>101,256</td>
<td></td>
</tr>
<tr>
<td>15-19</td>
<td>96,390</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>6 years</th>
<th>7 years</th>
<th>8 years</th>
<th>9 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 years</td>
<td>894</td>
<td>-894</td>
<td>-1,788</td>
<td>-1,968</td>
</tr>
<tr>
<td>7 years</td>
<td>25,222</td>
<td>23,483</td>
<td>20,004</td>
<td>15,307</td>
</tr>
<tr>
<td>8 years</td>
<td>-4,860</td>
<td>-810</td>
<td>4,050</td>
<td>9,235</td>
</tr>
<tr>
<td>9 years</td>
<td>771</td>
<td>0</td>
<td>-771</td>
<td>-1,388</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 years</td>
<td>22,028</td>
</tr>
<tr>
<td>7 years</td>
<td>21,779</td>
</tr>
<tr>
<td>8 years</td>
<td>21,495</td>
</tr>
<tr>
<td>9 years</td>
<td>21,186</td>
</tr>
</tbody>
</table>
### Estimate of numbers of children 10 and 11 years of age

<table>
<thead>
<tr>
<th>Age Group</th>
<th>0-4</th>
<th>5-9</th>
<th>10-14</th>
<th>15-19</th>
<th>20-24</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>111,792</td>
<td>108,718</td>
<td>101,256</td>
<td>96,390</td>
<td>81,506</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multiplied by the corresponding coefficient</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 years -1,431</td>
<td>9,220</td>
</tr>
<tr>
<td>11 years -179</td>
<td>1,566</td>
</tr>
</tbody>
</table>
References


References


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