Module 2

Statistics for educational planning
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Welcome to Module 2 “Statistics for Educational Planning” of our distance education programme on Education Sector Planning.

In all countries, ministries of education invest important resources in order to know how their educational systems are functioning. The educational planning implies frequent assessment of past and current trends, and of strengths and weaknesses. Strong statistical tools and rigorous analyses are thus essential for an efficient educational planning. They allow us to create a review and monitor the progress achieved.

General objective:
This module will present you the basic indicators and quantitative techniques for analysing and describing the state of an educational system.

Course content:
- Definition of basic education indicators and their current use in educational planning and monitoring (EFA and other monitoring frameworks);
- Presentation of selected statistical measures and tools (including examples of tables, graphs, histograms and measures) used for assessing aspects of access, internal efficiency, quality, equity and expenditure;
- Overview and discussion of common problems of education data collection and its use;
- Presentation and calculation of selected basic indicators on the status of education in the participants’ country.

Expected learning outcomes:
Upon completion of Module 2 you should be able to:
- Define, calculate and explain the meaning of selected relevant basic indicators for educational planning and monitoring: access, internal efficiency/pupil progress, equity, and education expenditure indicators;
- Analyze different statistical measures for descriptive, evolution and disparity analyses;
- Select relevant tables and graphs to assess the status quo and trends in education;
Timeframe:

- This module will be held from 1 March to 23 April 2010.
- The formal study time required for this module is approximately 8 hours per week.

Need help?

The module instructor is Patricia Dias Da Graça. She will be in touch with you through the e-learning platform, providing you with information and guidance about the weekly activities you should prepare, and the deadlines for the submission of your group activities. She will also be in charge of evaluating your answers to your group activities as well as your individual examination.

In case you have any specific questions or certain difficulties in understanding the material or work instructions related to this module, you should first of all contact your country Group Coordinator who will assist you in addressing them. In case certain specific questions or difficulties remain open, the IIEP module instructor, Patricia Dias Da Graça, will be happy to address any further questions in a special session organized at the end of the module.

Activities:

- Throughout the module you will find a series of self-evaluation activities. Firstly, it is suggested that you start reading the material and answer each activity individually. Then, compare and discuss results and possible doubts with your colleagues during the weekly sessions organized by your Group Coordinator. Finally, your group will prepare a consolidated group response for each activity.
- You should submit the group response to the module instructor, Patricia Dias Da Graça.
- The group responses to the activities will be marked by the module instructor. The submission of the group response is compulsory and will be considered as a preparation for the group and individual examination.

Assessment:

- Assessment of group activities:
  
  At the end of module, your group will prepare a report that will be graded by the module instructor. You and your colleagues will have 1 week to prepare this report. You will find the group report on page 83.

- Assessment of individual achievements:
  
  At the end of June 2010, you will be invited to pass an individual exam during which you will be tested on the module’s content (as well as on Module 1 and 3). The examination of this module will mainly consist of practical exercises. Your individual attendance and participation in the module will be assessed by your Group Coordinator.
Reading:
For this module you are asked to read:

UNIT 1. INDICATORS AND THEIR CURRENT USE IN EDUCATIONAL PLANNING AND MONITORING

All countries seek, to varying degrees, to assess to what extent their education systems meet perceived needs. Such knowledge helps educational planners to measure progress towards specific objectives (such as providing basic education for all, improving internal efficiency), assessing disparities between different groups within a country (such as rural/urban, gender or ethnic differences), identifying to what degree the government devotes financial resources to the development of its education system, making cross-national comparisons or expressing goals in quantitative terms (such as the proportion of women graduating from universities), etc. To be able to do so in a consistent way, indices must be developed that capture different aspects and trends, as well as to what extent there are disparities in the achievement of the education system.

Unit Objective:
To introduce calculation and general concerns regarding the basic indicators needed to measure the participation and efficiency as well as quality and finance in an educational system.

Unit content:
- General introduction to indicators;
- Participation and efficiency indicators;
- Quality and finance indicators;
- Overview and discussion of common problems of education data collection and its use.

Expected learning outcomes:
Upon completion of Unit 1 you should be able to:
- define, calculate and explain the meaning of, selected relevant basic indicators for educational planning and monitoring: access, coverage, internal efficiency/pupil progress, quality, and education expenditure indicators.
Timeframe:

- The study time required for this unit is about 8 hours per week.

Activities:

- You will have to prepare self-evaluation activities through this Unit.
- Throughout the unit, you will collectively prepare and send the activities responses to the module instructor.
PART 1. GENERAL INTRODUCTION ON INDICATORS

It is important to keep in mind that the design, use and interpretation of indicators all occur within the confines of the information system. Indicators are an integral part of an Educational Management Information System (EMIS). International institutions are promoting the development of indicators, and their use as tools to monitor the functioning and progress of educational systems. The use of educational indicators in the information system is indeed a key input to planning, management, and to the improvement of decision making.

In addition to providing a clear, relevant and simple description, indicators should measure events or changes of interest to the various agents of the educational system. However it is necessary that clear and measurable objectives for the educational system should be defined. These can be presented in different ways: through a plan, a policy framework, informal measures in the educational policy or in certain decrees, etc. The work then consists in designing the most appropriate indicators to the selected policy orientation.

Setting up an indicator system is particularly relevant in the framework of the World Forum of Dakar on Education For All, where countries have officially defined ambitious objectives, such as reduction of disparities, universalization of basic education and improvement of quality.

The goals of the Millennium Declaration, drawn from the Millennium Summit, also state two preoccupations common to EFA: ensuring primary education for all (Giving all children, boys and girls alike, the means to achieve a full course of primary schooling by 2015); and, promoting gender equality and women’s empowerment (Eliminating gender disparities in primary and secondary education by 2005 and if possible, ensuring gender equality in education by 2015 at the latest). A set of indicators needs to be developed in order to monitor these objectives efficiently.

The technical dimension

Indicators are intended to serve as an instrument for providing information on the functioning of the educational system within the framework of the objectives laid down in the educational policy. They highlight the major aspects and elements of this functioning. However, they cannot identify the causes of problems nor can they provide solutions. You could compare them to the dashboard of a car: a red warning light tells the driver if the engine overheats, but it does not tell him why it is overheating, nor does it tell him what to do about the problem.

In conclusion, indicators reveal the system’s ‘state of health’ but diagnosis and identification of suitable strategies require more searching questions and analyses. Different indicators might show an officer that some schools are performing better than others or that the results of some schools are far more disparate than those of others. However, while certain other indicators might suggest a ‘clue’, it can only be explored by more thorough analysis, both quantitative and qualitative.

---

1 For further reading on EMIS, see appendix 1 at the end of the module
Limitations

Although indicator systems are now strongly recommended and valued in most countries, they also have some disadvantages. In fact, they are limited to the quantitative description of the educational system and hence they are insufficient in the analysis of its operation.

Some experts are concerned by the fact that quantitative indicators reduce the rich diversity and quality of the information on the education process. They consider that indicators should not make the functioning of the system appear too simple but, as far as possible, should address more qualitative objectives.

PART 2. PARTICIPATION AND EFFICIENCY INDICATORS

2.1 Measuring access to education

Access to the first level of education is measured in terms of the proportion of children admitted relative to the total child population eligible for enrolment at that level, and this measure is described as the in-take rate. Access to subsequent levels of education is measured in terms of the proportion of children admitted, relative to the number of those who were, the year before, in the final school-year of the preceding level. This measure is described as the transition rate. In making such measurements the educational planner is particularly concerned with estimating the number of places that will need to be provided for pupils at various levels in the education system.

2.1.1 In-take rates

Here, two rates that are commonly used for measuring admission: the gross in-take rate and the age-specific in-take rate will be explored. Both rates provide useful insights into admission processes, but, as will be illustrated, the age specific in-take rate is capable of providing a deeper insight.

a) Gross in-take rate. This rate identifies the number of children newly admitted to the first year of school, regardless of age as a percentage of children who are entitled to admission.

Activity 1 will help you to learn how to calculate the gross in-take rate.

---

3 In-take rate: In some countries, the term “admission rate” is used.
Activity 1

In NOVANIA there are 1,215,001 pupils in Grade 1 of primary school, in 2003. Of these 124,736 are known to be repeating the grade. The number of children legally entitled to gain admission to Grade 1 (6 years) is 872,217; calculate the gross in-take rate for the country using the following definition:

Gross in-take rate (%)

\[
\frac{\text{No. of new pupils in Grade 1 regardless of age}}{\text{Population of legal admission age}} \times 100
\]

One of the problems with the gross in-take rate is that it often produces an illusion of a high rate of admission when this is not really the case. In fact, educational planners and administrators know from experience that gross in-take rates for primary education can be in excess of 100 per cent. This can happen when new Grade 1 pupils consist not only of children of the legal age of admission, but also of children of different ages. Some may be younger than the legal admission age, but the gross in-take rate is more likely to be affected by those that are older.

Late entrants to Grade 1 are typically found in systems where education has expanded rapidly in recent years. In such situations one can find a significant accumulation of older children, unable to find a place in school when their legal turn came round, who gained admission later when the system expanded. Sooner or later, this accumulation will be absorbed and the annual number of new pupils will be brought into line with the number of children of legal school admission age, and this will gradually dispel the statistical illusion of a high rate of admission. The point remains that gross in-take rates provide limited insights into what is actually happening, and need to be interpreted with care. However, these rates indicate that the system has the capacity to admit to Grade 1 those children who have reached the legal admission age.

b) Age-specific in-take rate. The advantage of this rate is that it provides a clearer picture of how different age groups gain access to the first level of education. This is because it identifies the number of newly admitted children of a specific age as a percentage of the total number of children of the same age in the population.

Activity 2 will help you to learn how to calculate the age-specific in-take rate.
Activity 2

In NOVANIA there are 364,500 six-year olds and 729,006 seven-year olds in Grade 1 of primary school. Of these 17% six-year olds and 15% seven-year olds are known to be repeating the grade. If the total number of six and seven-year old children in the population is 872,217 and 779,002 respectively, calculate the respective age-specific in-take rates for six-year old and seven-year old children using the following definition:

\[
\text{Age-specific in-take rate (\%)} = \frac{\text{No. of new pupils in Grade 1 of specific age}}{\text{Population of same specific age}} \times 100
\]

One of the prime advantages of the age-specific in-take rate is that, if it is calculated for different age groups over several years in succession, it can give a fairly precise and detailed picture of the conditions of admission of any given cohort - that is of any group of children born in the same year. Activity 3 should help you to understand how such data can be interpreted.

In practically all countries, there is an age at which children are supposed to start school, and this is referred to as the legal age of admission. A special case of the age-specific in-take rate is the one where the net intake rate corresponds to the legal admission age, that is to say, that the number of new pupils of the legal admission age is measured as a percentage of the total number of children of the same age-group within the population.
Activity 3

Table 1 contains age-specific in-take rates of primary level in Country A for the years 2000-2005. Although the legal admission age is six years, it may be noted that children ranging from 5 to 14 years were being admitted to the first grade throughout that period. Use the data in the table to follow the progress of a cohort of children born in 1994. The following questions will help you to do this.

(a) How old would the children in that cohort be in 2000? How old would they be in each of the following years from 2001 to 2005?

(b) What percentage of the cohort was admitted to the first grade of primary education in 2000? What percentage was admitted in each of the following years from 2001 and 2005?

(c) What percentage of the cohort had been admitted to primary education by the end of 2005?

(d) 509,425 new pupils were admitted to the first grade of primary education in 2005, although the population of legal admission age totalled no more than 415,518 children. Explain this.

(e) Calculate the gross in-take rate for 2005 from the figures given above under (d).
Table 1. Age-specific in-take rates to the first grade of primary education in Country A for the period 2000-2005

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<th>Age</th>
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<td>17.7</td>
<td>8.7</td>
<td>5.3</td>
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<td>1.8</td>
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<td>0.5</td>
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<td>41.5</td>
<td>17.1</td>
<td>8.4</td>
<td>5.0</td>
<td>2.8</td>
<td>1.8</td>
<td>0.8</td>
<td>0.5</td>
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<td>40.4</td>
<td>16.9</td>
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<td>1.5</td>
<td>0.8</td>
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<td>42.6</td>
<td>18.6</td>
<td>9.3</td>
<td>5.3</td>
<td>2.9</td>
<td>1.8</td>
<td>0.8</td>
<td>0.5</td>
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<td>32.1</td>
<td>45.5</td>
<td>20.3</td>
<td>9.9</td>
<td>5.6</td>
<td>3.0</td>
<td>1.9</td>
<td>0.8</td>
<td>0.6</td>
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<td>32.9</td>
<td>46.7</td>
<td>20.8</td>
<td>10.1</td>
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<td>3.1</td>
<td>1.9</td>
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<td>36.0</td>
<td>50.0</td>
<td>20.3</td>
<td>10.1</td>
<td>6.0</td>
<td>3.1</td>
<td>1.9</td>
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<td>38.9</td>
<td>52.6</td>
<td>20.8</td>
<td>10.1</td>
<td>6.6</td>
<td>3.1</td>
<td>1.9</td>
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<td>42.6</td>
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<td>6.6</td>
<td>3.1</td>
<td>1.9</td>
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<td>20.8</td>
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<td>1.9</td>
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<td>52.6</td>
<td>63.5</td>
<td>20.8</td>
<td>10.1</td>
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<td>3.1</td>
<td>1.9</td>
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<td>55.5</td>
<td>67.5</td>
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<td>3.1</td>
<td>1.9</td>
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99.8 100.6 100.9 109.5 119.3 122.6

2.1.2 Transition rates

For pupils in the last year of a given level of education, access to the next level of education can depend on a variety of conditions which may differ from country to country, for example:

- Access to the next level of education may be automatic;
- It may be dependent on students achieving a particular level of performance in certain examinations;
- It may be competitive, with the number of places offered being dependent on the number of places available;
- In some countries it may be subject to regional, ethnic or other quotas.

In all cases, the planner needs to be able to measure the transition of pupils from one level to another under the prevailing conditions. For example, one might wish to calculate the transition rate from primary to secondary education, from lower to upper secondary, or from secondary to higher education; also one might calculate transition rates for different groups – from different areas, from different socio-economic backgrounds, or by gender and so on. The transition rate calculates the number of new pupils entering a given level of education as a percentage of the pupils who were, the year before, at the end of the previous level. As with in-take rates, only new pupils entering the next level of education are given consideration; repeaters at this level are eliminated.

Activity 4 should help you to see how such transition rates are calculated.
Activity 4

In NOVANIA there were 660,900 pupils in Grade 1 of secondary education in 2000. Of these 26,308 were known to be repeating the grade. If the number of pupils in the final year of primary education in 1999 was 1,652,160 calculate the rate of transition from primary to secondary education for 1999 using the following definition:

Transition rate from primary to secondary education in 1999 (%)

\[
\text{Transition rate} = \frac{\text{No. of new pupils in form 1 of secondary in year } t}{\text{No. of pupils in final grade of primary in year } t-1} \times 100
\]

2.2 Measuring the education system’s coverage of the school-age population

The gross enrolment rate is an approximate indicator of enrolment in a particular cycle (such as primary or secondary education), for, in identifying the number of children in a given cycle as a proportion of the population of the corresponding school age, it ignores the ages of the children actually in that cycle. Nevertheless, the indicator can provide some useful insights when age-related data is not available. Also, please take note that the gross enrolment rate measures the capacity of the system to admit, in a given cycle, children of a corresponding school age.

The net enrolment rate and the age-specific enrolment rate provide deeper insight into enrolment, but the calculation of either rate, which takes into account the actual ages of pupils in school, depends on whether relevant age-related data is available.

2.2.1 Gross enrolment rates

The gross enrolment rate is the number of pupils in a given educational cycle expressed as a percentage of ‘the population of related school age’. The population of related school age is defined by the legal age of admission to the cycle in question and by its duration in years.

Activity 5 should help you to understand how gross enrolment rates may be calculated and used, and at the same time should give you some insight into their limitations.
Activity 5

Table 2 records the enrolment in primary education in NOVANIA by sex and place of residence in 2000 together with related population figures. Use the data provided to calculate separate gross enrolment rates for: (a) boys; (b) girls; (c) urban residents (capital), and (d) Northern residents (high proportion of Nomad population).

The gross enrolment rate for a given cycle of education:

\[
\text{No. of all pupils enrolled in the cycle regardless of age} = \frac{\text{No. of all pupils enrolled in the cycle regardless of age}}{\text{Population of related school age}} \times 100
\]

Table 2. Enrolment in primary education, together with related school age population figures (6-13), broken down by sex and place of residence, Novania, 2000

<table>
<thead>
<tr>
<th></th>
<th>Enrolment</th>
<th>Population 6-13</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Northern</td>
<td>Capital</td>
</tr>
<tr>
<td>Boys</td>
<td>32,574</td>
<td>79,342</td>
</tr>
<tr>
<td>Girls</td>
<td>15,262</td>
<td>79,269</td>
</tr>
</tbody>
</table>

Because gross enrolment rates ignore the ages of children enrolled within a cycle, it follows that repetition of grades within a cycle increases the gross enrolment rate. In contrast, the rate is reduced by dropouts from a cycle, and the opposing effects of repetition and dropout can make it particularly difficult to interpret gross enrolment rates. For example, a country with a high repetition rate and a high drop-out rate could well have the same gross enrolment rate as a country with no repetitions and no dropouts.

2.2.2 Net enrolment rates

The difference between the net and gross enrolment rate is that in the former case the ages of the pupils to be counted in the cycle are specified, whereas in the latter case all children in the cycle are counted, regardless of age.
Activity 6 should help you to ensure that you know how to calculate this rate.

**Activity 6**

In NOVANIA there were 5,882,626 pupils in Grades 1-8 of primary education in 2000. Of these 3,529,350 were in the 6-13 age groups. This can be compared with 6,713,033 children in the 6-13 age group in the population. Assuming that the legal age of admission to the first level of education was 6, use the information provided to calculate:

(a) the net enrolment rate, and

(b) the gross enrolment rate.

The net enrolment rate for a given cycle of education is:

\[
\text{Net enrolment rate} = \left( \frac{\text{No. of pupils of specified age in the cycle}}{\text{Population of related school age}} \right) \times 100
\]

As seen in Activity 6, where a substantial number of pupils enrolled in primary education are above or below the legal age group, the gross enrolment rate gives a false impression of high enrolment, and the net enrolment rate provides a more accurate guide, since it takes pupils’ ages into account. However, in countries where practically all children enter school at the legal age of admission, and where repeaters are scarce, the number of enrolled pupils who are outside the official age group is likely to be very small. In such cases, gross and net enrolment rates are likely to be very close to each other. The difference between the gross and net enrolment rates may be used as an indicator of the proportion of pupils in a cycle who are outside the legal age group.
Activity 7 will help you to reflect more in-depth on the interpretation of enrolment rates.

Activity 7

Table 3 identifies the gross and net enrolment rates for a number of countries. Use the information provided in Table 3 to answer the following questions:

(a) Which countries appear to enjoy universal primary education?

(b) Do the figures provide a completely fair basis for comparing the extent to which each has progressed towards achieving universal primary education?
Table 3. Enrolment rates for boys and girls in primary education in selected countries, 1990

<table>
<thead>
<tr>
<th>Country</th>
<th>Primary education age group</th>
<th>Enrolment rates for primary education</th>
<th>Gross</th>
<th>Net</th>
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<tbody>
<tr>
<td>Africa</td>
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<td>Botswana</td>
<td>6-13</td>
<td>117</td>
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<td>Egypt</td>
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<td>Ethiopia*</td>
<td>7-12</td>
<td>39</td>
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<td>Lesotho</td>
<td>6-12</td>
<td>107</td>
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<td>Malawi</td>
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<td>100</td>
<td></td>
</tr>
</tbody>
</table>

* 1994  
** 1995

Where a country places total reliance on gross enrolment rates to study enrolment, it is very difficult to determine the extent to which it has achieved universal primary education. In fact, the expression ‘universal primary schooling’ means that all members of the population of primary school age ought to be at school, and the net enrolment rate is a more reliable indicator for monitoring progress towards this objective.

2.2.3 Age-specific enrolment rates

The chief characteristic of the age-specific enrolment rate is that – in contrast to the other two rates – it is not associated with any particular educational cycle. Thus, it places an emphasis on the percentage of young people of a given age or age group enrolled in the education system, regardless of the level or cycle concerned. The difference between the resulting figure and 100 per cent indicates the percentage of young people of a given age group who do not receive any form of education. This rate is a particularly useful indicator in diagnosing enrolment.
Needless to say, calculation of this rate depends on information being available on the age-distribution of pupils throughout the school system, and this is not always the case. Wherever applicable, calculation of the rate is relatively straightforward, as you will see in Activity 8.

**Activity 8**

Of a total population of 43,968 twelve-year olds it was noted that there were 24,616 in primary education and 2,753 in lower secondary education in Country I in 1999. Assuming that the education system provided no other form of education for this age group, calculate the age-specific enrolment rate for twelve-year olds in the country using the following definition:

Age-specific enrolment rate (%)

\[
\frac{\text{No. of pupils of given age in education regardless of the cycle}}{\text{Population of same age}} \times 100
\]

2.3 Measuring the flow of pupils through the education system

In order to trace the flow of pupils through an education system, it is helpful to ask the following question at the beginning of each school year:

What has happened to the pupils enrolled in a particular grade in the previous year?

Three possible and mutually exclusive things may have happened to them:

1. They may have been promoted to the next higher grade;
2. They may have repeated their grade;
3. They may have dropped out (i.e. no longer attend school, or have moved to another school system or have died).

Let us take the example of NOVANIA to illustrate the flow of children through the education system. Table 4 indicates the number of pupils and the number of repetitions in the 1st and 2nd grades in two consecutive school years.

From this table, it is observed that in 1999 in Grade 1, there were 295,000 repeaters among the 1,310,000 students enrolled. In Grade 2 in the same year, the total enrolment had fallen to 910,500 of which 100,500 were repeaters and 810,000 were pupils promoted from Grade 1 (910,500 minus 100,500). The number of dropouts at the end of 1998 can be deduced by adding together the 295,000 repeaters from 1998 who are still in Grade 1 in 1999 and the 810,000 students promoted from Grade 1 to Grade 2 in 1999 and subtracting
this total (1,105,000) from the total 1998 enrolment of 1,250,000 – giving us 145,000 dropouts at the end of 1998. In other words the number of dropouts is determined as a ‘residue’.

Table 4. Enrolment and repeaters in Grades 1 and 2 of primary education, Novania, 1999 and 2000

<table>
<thead>
<tr>
<th></th>
<th>Grade 1</th>
<th>Grade 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrolment:</td>
<td>1,250,000</td>
<td>960,000</td>
</tr>
<tr>
<td>of which repeaters</td>
<td>280,000</td>
<td>150,000</td>
</tr>
<tr>
<td>from last year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrolment:</td>
<td>1,310,000</td>
<td>910,500</td>
</tr>
<tr>
<td>of which repeaters</td>
<td>295,000</td>
<td>100,500</td>
</tr>
<tr>
<td>from last year</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1 depicts the three possible eventualities of promotion, repetition and dropout in diagrammatic form:

Figure 1. The three possible eventualities of flow

From this data, you can now calculate three basic flow rates to complement the two flow rates you already studied in part of this Module 2, the admission rate and the transition rate. These 3 basic flow rates are: promotion rate, repetition rate and drop-out rate.

a) Promotion rate:

$$ p_{t}^{1998} = \frac{910,500 \, - \, 100,500}{1,250,000} \times 100 = 64.8\% $$
b) Repetition rate:

\[
\text{Repetition rate } \left( r_{\text{t}} \right) = \frac{\text{No. of pupils repeaters in grade g in year t + 1}}{\text{Total number of pupils in grade g in year t}} \times 100
\]

Example from Table 4:

\[
\text{r}_{1\text{1998}} = \frac{295,000}{1,250,000} \times 100 = 23.6\%
\]

c) Drop-out rate:

\[
\text{Drop-out rate } \left( d_{\text{t}} \right) = \frac{\text{No. of pupils dropping out from grade g in year t}}{\text{Total number of pupils in grade g in year t}} \times 100
\]

Example from Table 4:

\[
\text{d}_{1\text{1998}} = \frac{1,250,000 - (810,000 + 295,000)}{1,250,000} \times 100 = 11.6\%
\]

2.3.1 Using flow rates in educational planning

These three rates are the educational planner’s key instruments in analysing pupil flows from grade-to-grade within an educational cycle. Here are some of the typical questions that you as a planner might ask yourself as you go about your analysis:

- At which grade in the cycle is the repetition (or dropout) rate highest?
- Is the problem in this cycle mainly one of high repetition, or of high dropout?
- What trends can be observed in promotion, repetition and drop-out rates over the past few years?
- Can any prediction be made on the basis of these trends?
- What is the total accumulated loss of pupils through dropout for the entire cycle of primary or secondary education?
- Do boys or girls tend to drop out and repeat more frequently?

Answering such questions presupposes that repetition, promotion and drop-out rates are calculated for each grade, for a number of years in a row, and, if possible, separately for boys and girls. It is important that you feel confident to handle the calculations involved.

Performing Activity 9, pages 20.

Before you attempt it, here is a time-saving suggestion: once you have calculated two of the three rates for any given grade and year, do not bother to calculate the third one. Because promotion, repetition and drop-out rates always add up to 100 per cent, you automatically know the third when you know the other two.
Recognizing the limitations of pupil flow analysis

Pupil flow analysis is now a familiar and widely used technique among educational planners. As you will see in this and the following modules, it has very important ramifications in measuring efficiency and projecting future numbers of pupils enrolled.

There are, however, some recent forms of school organization and teaching innovations which bring the concept of promotion, repetition and drop-out rates into question:

- Experience has shown that repetition can sometimes be overdone and have negative educational effects; consequently, a certain number of countries have introduced automatic promotion policies.
- Accreditation schemes make it possible for dropouts to re-enter at a higher grade, on the basis of what they have learned outside the school system.
- Continuous progress instruction permits pupils to advance at their own pace, and does away with the established grade structure altogether.
- Variable ability grouping breaks down the class/grade pattern in favour of a range of specific disciplines; these comprise pupils of equivalent learning achievements in certain disciplines, regardless of their age or grade.

Within the realm of formal school education, these and similar pedagogic innovations are still the exception. But the emerging field of non-formal education, with its vast variety of structures, demonstrates that there is ample scope for these innovations.

Activity 9 should help you to understand how the flow rates are calculated.

Activity 9

Using Table 5 below as your working data, calculate:

(a) the rate of promotion for grades 1-8 for 1998/99;

(b) the rate of repetition for grades 1-8 for 1998/99;

(c) the rate of dropout for grades 1-8 for 1998/99.

<table>
<thead>
<tr>
<th>Year</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
<th>Grade 5</th>
<th>Grade 6</th>
<th>Grade 7</th>
<th>Grade 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998/1999</td>
<td>945,650</td>
<td>913,912</td>
<td>906,847</td>
<td>1,044,943</td>
<td>1,007,377</td>
<td>882,832</td>
<td>920,376</td>
<td>892,073</td>
</tr>
<tr>
<td>1999/2000</td>
<td>1,085,523</td>
<td>856,664</td>
<td>870,415</td>
<td>889,045</td>
<td>988,999</td>
<td>897,309</td>
<td>775,069</td>
<td>738,708</td>
</tr>
<tr>
<td>of which repeaters coming from 1998/1999</td>
<td>163,018</td>
<td>119,057</td>
<td>108,822</td>
<td>135,455</td>
<td>137,370</td>
<td>73,275</td>
<td>63,506</td>
<td>40,143</td>
</tr>
</tbody>
</table>

Note: In addition, at the end of 1998/99, a total of 851,524 pupils graduated from Grade 8.

Use Table 6 for your answers:

Table 6. Promotion, repetition and drop-out rates in public elementary education in Novania 1998/99

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Promotion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repetition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drop-out</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.3.2 The internal efficiency of a cycle of education

To apply the notion of efficiency to the analysis of pupil flows requires satisfactory answers to the following two questions:

- How do you define the outputs of an education system?
- How do you define the inputs of an education system?
Assessing the outputs of an educational activity

The objectives of an educational activity (i.e., its anticipated output) can obviously be assessed in different ways, depending on the analytical perspective or ideological context.

- Educators will emphasize the acquisition of relevant knowledge, attitudes and skills as the principal objective of schooling.
- Economists will consider human resource development, enhanced productivity and higher lifetime earnings as the main benefits.
- Pupils, most likely, will be interested in passing the final exam successfully and with a minimum of delay.
- Others may put more stress on the transmission of the national cultural heritage and the reinforcement of national identity.

Educational planners seem to take a similarly pragmatic view: they consider the most immediate and important objective is that the maximum number of those pupils who enter an education system or cycle complete it successfully within the prescribed period.

So from the educational planner’s point of view, output of a given education cycle is defined as the number of pupils who successfully complete that cycle.

You will realize immediately that this definition has both advantages and drawbacks. On the positive side, it avoids ambiguities and is “operational” in the sense that educational output becomes an easily measurable quantity.

On the negative side, by equating the purpose of education with the production of graduates, the definition of output takes a very narrow view of education’s role in the economic, social, political and cultural life of society.

Assessing educational inputs

For each year a pupil spends in school, a variety of resources need to be provided: teachers, a school building, a classroom, equipment, school furniture and textbooks. The quantity of these resources rises not only with the number of pupils, but also with the number of years it takes a pupil to complete the cycle in which he is enrolled. Hence, the pupil-year presents a convenient non-monetary way of measuring educational inputs. ‘One pupil-year’ stands for all the resources spent to keep one pupil in school for one year. ‘Two pupil-years’ represent the resources needed to keep one pupil in school for two years, or, alternatively, to keep two pupils in school for one year; and so on.

As pupils proceed through an educational cycle, inputs are defined and measured in terms of pupil-years.

Again, you will note that this definition greatly simplifies matters. It is true to say that the pupil-year is an easily measurable quantity that knows no national boundaries; but it is also a crude, non-monetary measure.

However, it is possible to assess inputs in monetary terms by multiplying the corresponding number of pupil-years by the average cost of a pupil-year in the cycle under consideration. If the results of the cost analysis are sufficiently detailed, one may also calculate input costs using, instead of average costs, the costs specific to each year of the cycle. But this measurement of inputs in monetary terms is only approximate, since some of the cost components do not vary with the number of pupils enrolled in a cycle or in a year of that cycle. A closer approach to reality is obtained by eliminating from the costs all those elements which correspond to fixed expenditure; for example, to a very large extent, administrative costs.
Deriving internal efficiency from outputs and inputs

The terms educational output and educational input having been previously defined in a way that is easily quantifiable, pupil flow through the grade-structure of an educational cycle provides the link between inputs and outputs and the notion of internal efficiency can be derived from it.

A pupil successfully completing a school cycle of, say, six years would require at least six pupil-years to pass through the education cycle (or, as economists would say, the production process) and pass the final exam; it would take at least 12 pupil-years to produce two successful completers, 18 to produce three, etc. In other words, if all goes well and no pupil drops out or has to repeat, the best possible input/output ratio for a school cycle of six years would be 6:1 = 6.

In a school cycle of ‘n’ years, perfect internal efficiency is achieved when inputs relate to outputs as follows:

- 1 unit of output to ‘n’ units of input, or
- 1 successful completer to ‘n’ pupil years.

However, as you are well aware, one never encounters this standard of perfect efficiency in the real world. There are always some pupils who repeat one grade or another, thus adding to the number of pupil years. Even if repetition were abolished, there would still be pupils who drop out before completing the cycle. By doing so, they will have used a number of pupil-years (i.e. the material and human resources which these years represent), without contributing to the output from that cycle. In this manner, the input/output ratio becomes inflated by additional ‘non-productive’ pupil-years, and tends to become higher than it would be under ideal conditions. In other words, internal efficiency declines.

One final point needs to be made before turning to the question of how to calculate the degree of internal efficiency in a given educational cycle. So far ‘internal efficiency’, has been referred to rather than ‘efficiency’ in general. The reason for doing so is that there are indeed two different concepts of efficiency: ‘internal’ and ‘external’. On the one hand, you can have an ‘internally’ efficient educational cycle which turns out successful completers without wasting many pupil-years on dropping out and repeating.

But on the other hand, this same cycle may be ‘externally’ quite inefficient in that the graduates may not at all be what society, the economy, or higher levels of education require. For example, they may be unemployable, too academically oriented, unwilling to work in rural areas, or prone to leave the country. As a planner, you must, therefore, bear in mind that ‘external’ efficiency is not automatically tied to raising the level of ‘internal’ efficiency.
Activity 10 will help you to check your understanding of the concept of internal efficiency.

Activity 10

(a) How are the terms ‘educational output’ and ‘educational inputs’ defined for the purpose of calculating internal efficiency?

(b) What do you see as the main weaknesses of each of these definitions?

2.3.3 Cohort analysis: an analytical device to calculate indicators of internal efficiency

In order to determine the degree of internal efficiency in an actual school cycle, one needs an analytical device that helps to simplify, to a degree, the numerous, overlapping, and complicated movements of pupils. This simplifying device is that of a cohort, a term which educational planners have borrowed from demography.

- A cohort is defined as a group of persons who jointly experience a series of events over a period of time.
- A school cohort is defined as a group of pupils who enter the first grade of a given cycle in the same school year and subsequently experience promotion, repetition, dropout or successful completion of the final grade, as the case may be.
- Cohort analysis traces the flow of a group of pupils who enter Grade 1 in the same year and progress through an entire educational cycle.
Using flow diagrams to calculate indicators of internal efficiency

To illustrate cohort analysis in operation, imagine a cohort of, say, 1,000 pupils who enter Grade 1 of a 4-grade cycle in the same year \( t = 1 \). The 1,000 pupils will proceed step-by-step through the cycle, with the exception of some who will drop out at various points along the way, others being held up by one or more repetitions and only a few completing the entire cycle in the minimum time of four years. The flow diagram in Figure 2 illustrates this flow of a cohort through a school cycle. Flow diagrams of this kind are used as a basis for calculating several indicators of the degree of ‘internal efficiency’ in a given educational cycle.

**Figure 2. Example of a flow diagram for a school cycle of 4 grades**

Key:

(a)  
- \( S \) = pupil numbers;
- \( R \) = number of repeaters;
- \( D \) = number of dropouts;
- \( P \) = number promoted;
- \( G \) = successful completers;

(b)  
- \( S^1 \) denotes pupil numbers in year 1 \( (t=1, \ldots, n) \);
- \( S^1 \) denotes pupil numbers in grade 1 \( (g=1, \ldots, 4) \);
- \( S^1 \) accordingly denotes pupil numbers in year 1 \(^1\) and in Grade 1, etc.
Flow diagrams are built on a number of important assumptions:

- That there will be no additional new entrants in subsequent years, other than the original cohort of 1,000 students.
- That at any given grade, the same rates of repetition, promotion, and dropout apply, regardless of whether a pupil has reached that grade directly or after one or several repetitions (i.e. hypothesis of homogeneous behaviour).
- That the number of times any given pupil will be allowed to repeat a grade must be well defined.
- That flow rates for all grades remain unchanged as long as members of the cohort are still moving through the cycle.

To derive true values for all the flow elements included in the flow diagram in Figure 2, planners would require information collected through some sort of individualized data system. Although this has indeed been tried, it is generally too costly and time consuming. As an approximation, one may use the repetition, dropout and promotion rates, as actually recorded in a given year for the different grades of the school cycle whose degree of efficiency one wishes to determine. Using these flow rates, observed in reality, one can now bring to life, as it were, the hypothetical group of 1,000 students who form our ‘cohort’.

The practical example in Table 7 illustrates this:

In Country C, statistics for boys’ enrolment in public primary education in 2006 and 2007 indicated the following situation:

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number enrolled</td>
<td>268,851</td>
<td>221,913</td>
<td>212,901</td>
<td>290,310</td>
<td>213,948</td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number enrolled</td>
<td>282,613</td>
<td>236,346</td>
<td>223,807</td>
<td>207,332</td>
<td>235,120</td>
</tr>
</tbody>
</table>

| Of which repeaters from previous year | 70,965 | 49,788 | 55,435 | 57,077 | 108,900 |

Note: In addition, it is recorded that at the end of 2006, a total of 97,560 pupils graduated successfully at the end of year 5.

Using the data in Table 7, you can readily calculate the yearly rates of promotion, repetition and dropout for boys in public primary education in 2006. (You might like to calculate these rates for yourself before looking at the results).
The results are as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Promotion rate</th>
<th>Repetition rate</th>
<th>Drop-out rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>69.4 %</td>
<td>26.4 %</td>
<td>4.2 %</td>
</tr>
<tr>
<td>2</td>
<td>75.9 %</td>
<td>22.4 %</td>
<td>1.7 %</td>
</tr>
<tr>
<td>3</td>
<td>70.6 %</td>
<td>26.0 %</td>
<td>3.4 %</td>
</tr>
<tr>
<td>4</td>
<td>43.5 %</td>
<td>19.7 %</td>
<td>36.8 %</td>
</tr>
<tr>
<td>5</td>
<td>45.6 %</td>
<td>50.9 %</td>
<td>3.5 %</td>
</tr>
</tbody>
</table>

You can now use these flow rates in conjunction with the flow diagram in Figure 2 to construct (hypothetically, of course) the flow of 1,000 boys who entered primary school in 2006. The resulting flow diagram is given in Figure 3 (the specific assumption being made that only two repetitions are permitted).

Figure 3. Diagram representing the flow of a cohort of 1,000 boys through public primary education in Country C, based on 2006 flow rates.

You may want to calculate the components of the flow diagram in order to test your understanding.

**Computing the wastage rate: an indicator of internal efficiency**

What does this flow diagram tell an educational planner about internal efficiency? If you compare the number of pupil-years spent by the cohort as it flows through the five grades of this cycle with the number of pupils who, between 2010 and 2012, pass Grade 5 as successful completers, you will be able to assess how efficient or inefficient this particular educational process has been.

In a perfectly efficient situation, all 1,000 members of the cohort would have completed the cycle in the ideal time of five years – they would have spent $5 \times 1000 = 5,000$ pupil-years.

Hence the ideal input/output ratio would be:
In reality, however, as Figure 3 shows, only 277 out of the 1,000 cohort members successfully completed the cycle (i.e. 74 in 2010, 107 in 2011 and 96 in 2012). The output from this cycle is, therefore, much less than it could have been; the reason is that high repetition rates inflated the number of pupil-years which the cohort used up:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Pupil years</th>
<th>Pupil years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,000</td>
<td>+264</td>
</tr>
<tr>
<td>2</td>
<td>694</td>
<td>+339</td>
</tr>
<tr>
<td>3</td>
<td>527</td>
<td>+394</td>
</tr>
<tr>
<td>4</td>
<td>372</td>
<td>+351</td>
</tr>
<tr>
<td>5</td>
<td>162</td>
<td>+235</td>
</tr>
</tbody>
</table>

Total for all 5 grades =5,147

Hence, the actual input/output ratio was this:

\[
\text{Actual ratio} = \frac{\text{Input}}{\text{Output}} = \frac{5,147 \text{ pupil years}}{277 \text{ successful completers}} = 18.58
\]

As a final step, you can now calculate the degree of internal efficiency by relating the actual input/output ratio to the ideal input/output ratio. The result, again expressed as a ratio, is commonly called the wastage ratio.

\[
\text{Wastage ratio: WR} = \frac{\text{Actual ratio}}{\text{Ideal ratio}} = \frac{18.58}{5.0} = 3.7
\]

Thus, in 2006, Country C’s public primary education for boys was characterized by a wastage ratio of 3.7. At best, this ratio could have been equal to one. But in reality, many countries have wastage ratios of 1.5, 2.0 or even higher, both in the primary and secondary cycles of their education system. A wastage ratio of 3, for instance, would mean that graduates are being produced in that cycle at three times the ideal cost.
An alternative often used to this calculation of wastage ratio is the efficiency coefficient. It is the reciprocal of the wastage ratio. The official definition and calculation is the following:

The ideal (optimal) number of pupil-years required (i.e. in the absence of repetition and dropout) to produce a number of graduates from a given school-cohort for a cycle or level of education expressed as a percentage of the actual number of pupil-years spent to produce the same number of graduates.

The calculation:
Divide the ideal number of pupil-years required to produce a number of graduates from a given school-cohort for the specified level of education (that is, 5 x 277), by the actual number of pupil-years spent to produce the same number of graduates, and multiply the result by 100.

\[(5 \times 277/5,147) \times 100 = 27\%
\]

Activity 11
Using the data from Table 6 (page 24) on promotion, repetition and dropout rates in public elementary education in Novania:

(a) draw a cohort flow diagram to correspond to the flow rates;

(b) calculate the resulting wastage ratio, and the efficiency coefficient. Comment on the results.

---

4 UIS/UNESCO definition
http://www.uis.unesco.org/ev.php?id=5202_201&id2=BO_TOPIC
Computing the survival rate: an indicator of the education system’s retention capacity

In addition to “the wastage ratio”, there are certain other indicators which can shed much light on the internal efficiency of an education system. They, too, are based on the analytical device of cohort analysis and can be calculated with the help of a flow-diagram.

One of these indicators is the survival rate. It may be vitally important for educational planners to know what proportion of pupils admitted to a cycle of the educational process will reach the 2nd, 3rd, 4th, etc. years of that cycle – right up to the final year. This will give them a rough guide to the retention capacity of the cycle in question.

Once you have drawn up a diagram to indicate the flow of a cohort through a given educational cycle, it should be an easy task to calculate the survival rate.

Regardless of the year of study, the survival rate will be equal to the ratio between:

(a) the sum of the pupils admitted – through promotion – to the relevant year of study in successive years; and

(b) the initial numbers in the cohort.

Using the data from Figure 3, you will see that for Grade 2:

- In 2007, there were 694 pupils promoted.
- In 2008, 183 pupils were promoted.
- In 2009, 49 pupils were promoted.

The total number of pupils promoted in successive years from 2007 to 2009 in Grade 2 was 926.

Survival rate: $\frac{926}{1000} = 92.6\%$

Similarly, the survival rates for Grades 3, 4 and 5 are as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Survival rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>92.6%</td>
</tr>
<tr>
<td>3</td>
<td>87.9%</td>
</tr>
<tr>
<td>4</td>
<td>78.9%</td>
</tr>
<tr>
<td>5</td>
<td>40.6%</td>
</tr>
</tbody>
</table>

The survival rate for the last grade is 40.6%. The system achieves to retain 40.6% of the pupils up to the last grade, but it does not mean that they will all succeed this last grade. Those who succeeded are the outputs: $74 + 107 + 96$. It is a sort of graduation rate but for the initial cohort of 1,000 pupils.
Activity 12

Using the cohort flow diagram you drew in Activity 11, calculate the survival rates for Grades 2-8, in Novania.

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**Computing the average duration of study per graduate**

Another indicator of interest to educational planners, parents and pupils alike is the *ideal duration of study per graduate*. Again, this indicator is easily calculated on the basis of a cohort flow diagram. Each successive batch of graduates is multiplied by the number of years it has taken them to complete the cycle. So, for example, using the data from Figure 3, there were 74 graduates in 2010 who took five years to complete their cycle; 107 graduated in 2011, taking six years and 96 in 2012 who took seven years. These figures are summed up and divided by the total number of graduates.

The *average duration of study per graduate* is equal to:

\[
\frac{(74 \times 5) + (107 \times 6) + (96 \times 7)}{277} = 6.08\text{ years}
\]

**Computing the proportion of total wastage accounted for by dropouts and by repetitions**

There is yet another indicator which may be derived by dividing the total number of pupil-years ‘wasted’ into two proportions: those due to repetitions, and those which can be attributed to dropouts.

Let us first calculate the *proportion of total wastage accounted for by dropouts*: multiply the dropouts at each grade by the grade up to which they have remained in school. Using the data in Figure 3 as an example, in Grade 1 there were 42 dropouts in 2006, 11 in 2007 and 21 in 2008, or a total of 74. For each year, the pupils only remained in school for one year; therefore, the total of 74 is multiplied by 1. For Grade 2, there were 48 dropouts and this total is multiplied by 2 (two years in school), etc. Add up the resulting figures over all the grades and divide that by the total pupil years for all grades (5,147) minus those pupils who graduated successfully, multiplied by 5 (ideal duration of study in order to graduate).
The proportion of total wastage accounted for by dropouts is equal to:

\[
\frac{(74 \times 1) + (48 \times 2) + (90 \times 3) + (384 \times 4) + (128 \times 5)}{5.147 - (277 \times 5)} \times 100 = \frac{2,616}{3,762} \times 100 = 69.5\%
\]

The interpretation of this indicator, in our example, would be that 69.5 per cent of the 3,3762 pupil-years ‘wasted’ were due to dropouts; conversely, the proportion of total wastage accounted for by repetitions would be 30.5 per cent. In public primary education for boys in Country C, repetition is, therefore, a less important source of internal inefficiency than dropout.

**The gross Admission rate to the last grade of primary (previously called completion rate)**

Several indicators try to measure access to primary education and to make sure that all children who have started school complete primary education. Among these is the Gross Intake Ratio to Last Grade of Primary Education (GiRLG), also referred to as completion rate in the past, but it is not the only one. To monitor progress towards the realization of the objective in question, it is thus advisable to define the intake rate in the last year of primary education: this rate must take into account the access of all pupils in the first year of primary school (this access must be universal, i.e. an intake rate of 100%) and the absence of dropouts during primary (survival rate equal to 100% until the last year of primary).

A first indicator proposed to measure these problems is thus the Gross Graduation Ratio (GGR), defined as: The number of graduates regardless of age in a given level or programme expressed as a percentage of the population at the theoretical graduation age for that level or programme.

**Objective**: This is a simple measurement which makes it possible to estimate how many children complete a level of education, and in the case of primary, allows to monitor progress towards the objective of Education for All, which is to reach Universal Primary Education (UPE) by 2015, equivalent to 100% completion rate.

**Method of calculation**: Number of pupils completing (or graduates of) the last year of primary, expressed as a percentage of the total population of the theoretical age at the last grade of primary, and multiplied by 100. In the absence of information on the graduates, the rate is often brought back to the following formula (applied here to the level of primary education):

\[
\frac{\text{Total number of pupils in the last grade of primary education - Repeaters}}{\text{Total population of the theoretical entrance age to the last grade of primary}} \times 100
\]

The Gross Primary Graduation Ratio (GPGR) is calculated using the Gross Intake Ratio to Last Grade of Primary Education (GiRLG): “The total number of new entrants in the last grade of primary education, regardless of age, expressed as a percentage of the total population of the theoretical entrance age to the last grade of primary”.

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5  UIS, www.uis.unesco.org/
Previously, it has been asserted that there are several ways of assessing the situation compared to the achievement of objective 2 of universal primary education. The calculation above is equivalent to the Gross Intake Ratio to Last Grade of Primary Education (GIRLG). This is why it presents the disadvantages of a Gross intake ratio (GIR). Its advantage is that it is relatively easy to calculate.

One can also try to measure progress towards this objective using: - the product of a gross intake ratio in the 1st year combined with the result of a reconstituted cohort; or - the product of a net primary intake rate for a generation together with access in the last year of one cohort. The latter is more precise but requires net intake rates per age over several years.

The most precise measurement would be to calculate over several years a net intake rate in the last year of primary by age (which requires data on the total number of pupils and repeaters by age) and to calculate the completion rate cohort by cohort. But this calculation requires a lot of data which is not always available. This is why the choice will be made on approximate calculations, some of which is presented above.

PART 3. QUALITY AND FINANCE INDICATORS

3.1 Quality indicators

The quality of education and training is considered in all Member States to be a concern of the highest political priority and correspond to the EFA objective 6: improving all aspects of the quality of education and ensuring excellence for all so that recognized and measurable learning outcomes are achieved by all, especially in literacy, numeracy and essential life skills.

These indicators on quality cover three broad areas: attainment levels/education achievement; monitoring of school education; and educational resources and structures. Let’s analyse the most used, quantitative indicators in this area.

a) Pupil - teacher ratio

The pupil/teacher ratio is generally considered an indicator of educational quality called for in the Dakar goals. It could also be included in the group of indicators on the availability of human resources. The pupil/teacher ratio is also an essential element for planning the development of the educational system.

The pupil/teacher ratio alone is too crude a measure to indicate by itself the quality of teaching and learning. It should be added to teachers’ academic qualifications, pedagogical training, experience and status, teaching methods, teaching time, teaching materials and classroom conditions - all factors that affect the quality of teaching and learning.

This is the average number of pupils (students) per teacher at a specific level of education in a given school-year. This indicator is used to measure the level of human resources input in terms of number of teachers in relation to the size of the pupil population. It should normally be used to compare with established national norms on the number of pupils per teacher for each level or type of education.

The values of the pupil-teacher ratios should not exceed national norms which determine the quality of teaching/learning as it is believed that a teacher can pay more attention to individual pupils or students in a smaller class.

Data should be disaggregated by level of education, type of schools (private/public) and geographical location (region, urban/rural).
What are the Quality standards and limitations of this indicator?

Pupil-teacher ratios tend to be more comparable for primary education where there is not yet subject specialization among teachers. Naturally, teaching/learning quality should be considered in the context of differences in teachers' qualifications, pedagogical training, etc., as already mentioned above.

Using the present data collection instruments, it is not possible to ascertain, on the one hand, whether all teaching personnel are included, and on the other hand, whether all persons counted as 'teachers' really have teaching functions. The indicator could be refined by expressing the number of teachers in terms of 'full-time equivalents' (FTE) instead of headcounts so as to take into account the practice of part-time teaching in certain countries, and multiple-shifts in others, which may affect the cross-national comparability of pupil/teacher ratios. Other problems of data collection have also been described by national statisticians, such as the over-reporting of the number of teachers or pupils by the schools, for financial reasons. There may also be difficulties in getting valid measures of these ratios if the education system in a country does not correspond to ISCED\(^6\), for instance when first and second cycles of basic education (ISCED levels 1 and 2) occur in the same school and are thus reported together.

b) Percentage of primary school teachers having the required academic qualifications, and

c) Percentage of primary school teachers who are certified (or trained) to teach according to national standards

Well trained and qualified teachers are essential to implement the Dakar recommendations of providing primary education of good quality. During the recent series of regional workshops organised by the UIS the working conditions of teachers in relation to their qualifications, experience and workload, was highlighted as one of the main issues in need of further study.

In fact the two indicators measure different aspects of teachers' qualifications, with the first indicating the general level of education of the teaching staff, and the second indicator concentrating more on their pedagogical training.

\(^6\) International Standard Classification of Education (ISCED)

d) Percentage of children having reached at least grade 4 of primary schooling who master a set of nationally defined basic learning competencies.

Indicators of learning achievement are necessary to assess the sixth goal. There has been an increasing demand in recent years from both international institutions and national authorities to develop more appropriate methodologies to assess learning achievement.

Defining internationally comparable indicators of learning achievement is a complex task. Statisticians in some countries have questioned what the definition of 'learning competencies' in Indicator 15 is. The data source for this indicator in the EFA 2000 Assessment was usually the UNESCO/UNICEF Monitoring Learning Achievement Project which has not been conducted in all countries and is too costly to repeat frequently in those countries where it is conducted. Clearly, this indicator cannot be asked systematically of all countries through a world survey. Such indicators depend on thorough, well-planned and sound methodological work before the surveys are conducted.

Some simple indicators of achievement could be obtained through examination results at the end of the first education cycle but these would not have cross-national comparability.

Other indicators of the quality of education should be developed, regarding both educational inputs (such as availability of personnel other than teachers, schools and classrooms conditions and facilities, availability of manuals and other pedagogical material).

3.2 Finance indicators

a) Public expenditure on education as percentage of gross domestic product

This is the total public expenditure on education (current and capital) expressed as a percentage of the Gross Domestic Product (GDP) in a given financial year, at the national level. It shows the proportion of a country's wealth generated during a given financial year that has been devoted by government authorities to the development of education.

\[
\text{Total public expenditure on education} \times 100 \div \text{GDP}
\]

The sources are annual financial reports by central or federal governments, state or provincial or regional administrations. Data on GDP are normally available from National Accounts reports from the Bureau of Statistics.

In principle a high percentage of public expenditure on education denotes a high level of attention given to financial investment in education by the government; and vice versa.

_What are the Quality standards and limitations of this indicator?_

Total public expenditure on education should include those incurred by all concerned ministries and levels of administration. Total public expenditure on education refers to all expenditure on education by the central or federal government, state governments, provincial or regional administrations and expenditure by municipal and other local authorities. Central government includes ministerial departments, agencies and autonomous institutions which

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7 UIS, www.uis.unesco.org/
have education responsibilities. The statistics on expenditure should cover transactions made by all departments or services with education responsibility at all decision-making levels.

Limitations: In some instances data on total public expenditure on education refers only to the Ministry of Education, excluding other ministries that spend a part of their budget on educational activities.

Activity 13

In NOVANIA, the total public expenditure on education is 66,197 (KSh million) while the GDP is 984,629 (KSh million), in 2002. Calculate and comment on the indicator for Novania.

b) Public expenditure on education as percentage of government expenditure

This is the total public expenditure on education - current and capital- expressed as a percentage of total government expenditure in a given financial year. It shows the proportion of a government's total expenditure for a given financial year that has been spent on education. It reflects the level of commitment of a government to devote financial resources to the development of its educational system.

\[
\text{Percentage of government expenditure on education} = \left( \frac{\text{Total public expenditure on education incurred by all government agencies or departments in a given financial year}}{\text{Total government expenditure for the same financial year}} \right) \times 100.
\]

The sources are: Annual financial reports prepared by the Ministry of Finance; National accounts reports by the Central Statistical Office and financial reports from the various government departments engaged in education activities especially the Ministry of Education.

This indicator can be disaggregated by level of administration, by geographical location (region, urban/rural), and by purpose of expenditure (emoluments, teaching material, etc.).

A higher percentage of government expenditure on education shows a high level of government investment in education, and vice versa.

What are the Quality standards and limitations of this indicator?

Total public expenditure on education should include those incurred by all concerned ministries and levels of administration. Public expenditure on education as a percentage of government expenditure can never be 100% since the latter includes expenditure on many economic and social sectors, besides education. The fact that the fiscal year and educational year budget periods may be different should also be taken into consideration.
In some instances data on total public expenditure on education refers only to the Ministry of Education, excluding other ministries that spend a part of their budget on educational activities.

Activity 14

In NOVANIA, the Total public expenditure of the Government is 265,850 (KSh million) in 2002. Calculate and comment on the total public expenditure on education as a percentage of total government expenditure.

c) Public current expenditure per pupil (student) as % of GDP per capita

Public current expenditure per pupil (or student) at each level of education, expressed as a percentage of GDP per capita in a given financial year measures the share of per capita income that has been spent on each pupil or student. It helps in assessing a country’s level of investment in human capital development. When calculated by level of education, it also indicates the relative costs and emphasis placed by the country on a particular level of education.

Divide per pupil public current expenditure on each level of education in a given year by the GDP per capita for the same year and multiply by 100.

Sources are: Annual financial reports prepared by the Ministry of Finance; National accounts reports by the Central Statistical Office; Financial reports from various government departments engaged in educational activities especially the Ministry of Education; school register, school survey or census for data on enrolment; population census.

A high percentage figure for this indicator denotes a high share of per capita income being spent on each pupil/student in a specified level of education. It represents a measure of the financial cost per pupil/student in relation to average per capita income.

Public expenditure per pupil as percentage of GDP per capita can exceed 100% (where the GNP per capita is low and/or current spending per pupil is high). This indicator should be based on consistent data on public expenditure that covers all subsidies to both public and private educational institutions. The use of this indicator must take into account the degree of coverage represented by the educational expenditure figure.

This indicator may be distorted by an inaccurate estimation of GDP, current population or enrolment by level of education. The fact that fiscal year and educational year budget periods may be different should also be taken into consideration.
Activity 15

In NOVANIA, the GDP per capita in 2002 is 399 US$, and the Public current expenditure per pupil in Primary level is 60 US$. Calculate and comment on the Public current expenditure per pupil as % of GDP per capita for the primary level.

d) Public expenditure on primary education as a percentage of total public education expenditure

This is the proportion of public spending on education devoted to primary (or basic) education. This indicator allows for assessing the government’s prioritization of primary (or basic) education.

Method of calculation:

\[
\frac{\text{Amount of current government spending devoted to primary (or basic) education}}{\text{Total amount of current spending devoted to education}} \times 100
\]

A higher indicator reflects that the government is giving a higher priority to primary (or basic) education.

This interpretation does, however, need to be qualified by clarifying the nature and coverage of educational expenditure used, which may vary depending on the source of information.

Activity 16

In NOVANIA, the Public expenditure on primary education in 2002 is 34,611 KSh million, and the total public education expenditure is 66,197 KSh million.

Calculate and comment on the Public expenditure on primary education as a percentage of total public education expenditure.
e) Teachers’ remuneration as percentage of public current expenditure on education

Public expenditure devoted to teachers’ remuneration expressed as a percentage of total public current expenditure on education.

This indicator measures the share of teachers’ remuneration within public current expenditure on education, in relation to spending on administration, teaching materials, scholarships, etc. Divide public current expenditure devoted to teachers’ remuneration in a given financial year by the total public current expenditure on education for the same financial year and multiply by 100.

Sources are: Annual financial reports prepared by the Ministry of Finance; National Accounts reports by the Central Statistical Office and financial reports from the various government departments engaged in education activities especially the Ministry of Education.

This indicator can be disaggregated by level of education and by level of administration (central, regional, local government).

A higher percentage of public current expenditure devoted to teachers’ remuneration denotes the preponderance of spending on teachers’ compensation to the detriment of spending on administration, teaching materials, scholarships, etc.

In many instances data on total public current expenditure on education covers only the Ministry of Education, excluding other ministries that spend a part of their budget on educational activities. It may sometimes be difficult to account for the share of remuneration of educational personnel who share their hours between teaching and other tasks.

Activity 17

In NOVANIA, the total public current expenditure on education in 2003 is 38,280 KSh million, and the teachers’ remuneration is 31,017 KSh million.

Calculate and comment on the Teachers’ remuneration as percentage of public current expenditure on education.
Summary of indicators

Participation & Efficiency
- Gross in-take rate
- Age specific in-take rate
- Transition

Coverage
- Gross enrolment rate
- Net enrolment rate
- Age specific enrolment rate

Flow of pupils through the system
- Promotion rate
- Repetition rate
- Dropout rate
- Cohort analysis
  - Wastage rate
  - Efficiency coefficient
- Survival rate
- Average duration of study per graduate

Quality
- Pupil-teacher ratio
- % of teachers having the required academic qualifications
- % or teachers certified (or trained) according to national standards
- % of children having reached at least grade 4 of primary schooling who master a set of nationally defined basic learning competencies.
Finance

- Public expenditure on education as percentage of gross domestic product
- Public expenditure on education as percentage of government expenditure
- Public current expenditure per pupil (student) as % of GDP per capita
- Public expenditure on primary education as a percentage of total public education expenditure
- Teachers’ remuneration as percentage of public current expenditure on education
List of formulas

Gross in-take rate

\[
\text{No. of new pupils in Grade 1} \times 100 \\
\text{Population of legal admission age}
\]

Age-specific in-take rate

\[
\text{No. of new pupils in Grade 1 of specific age} \times 100 \\
\text{Population of same specific age}
\]

Net in-take rate

\[
\text{No. of new pupils in Grade 1 of the legal admission age} \times 100 \\
\text{Population of same specific age}
\]

Transition rate from primary to secondary education

\[
\text{No. of new pupils in form 1 of secondary in year } t \times 100 \\
\text{No. of pupils in final grade of primary in year } t - 1
\]

The gross enrolment rate for a given cycle of education

\[
\text{No. of all pupils enrolled in the cycle} \times 100 \\
\text{Population of related school age}
\]
The net enrolment rate for a given cycle of education

\[
\frac{\text{No. of pupils of specified age in the cycle}}{\text{Population of related school age}} \times 100
\]

Age-specific enrolment rate

\[
\frac{\text{No. of pupils of given age in education}}{\text{Population of same specific age}} \times 100
\]

Promotion rate

\[
\frac{\text{No. of pupils promoted to grade } g + 1 \text{ in year } t + 1}{\text{Total number of pupils in grade } g \text{ in year } t} \times 100
\]

Repetition rate

\[
\frac{\text{No. of pupils repeaters in grade } g \text{ in year } t + 1}{\text{Total number of pupils in grade } g \text{ in year } t} \times 100
\]

Drop-out rate

\[
\frac{\text{No. of pupils dropping out from grade } g \text{ in year } t}{\text{Total number of pupils in grade } g \text{ in year } t} \times 100
\]
### Wastage ratio

<table>
<thead>
<tr>
<th>Actual input/output ratio</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal input/output ratio</td>
<td></td>
</tr>
</tbody>
</table>

### The gross Admission rate to the last grade of primary (completion rate)

<table>
<thead>
<tr>
<th>Total number of new pupils in the last grade of primary education</th>
<th>X 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population of the theoretical entrance age to the last grade of primary</td>
<td></td>
</tr>
</tbody>
</table>

### Public expenditure on education as percentage of gross domestic product

<table>
<thead>
<tr>
<th>Total public expenditure on education</th>
<th>x 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td></td>
</tr>
</tbody>
</table>

### Public expenditure on education as percentage of government expenditure

<table>
<thead>
<tr>
<th>Total public expenditure on education incurred by all government agencies or departments in a given financial year</th>
<th>x 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total government expenditure for the same financial year)</td>
<td></td>
</tr>
</tbody>
</table>

### Public expenditure on primary education as a percentage of total public education expenditure

<table>
<thead>
<tr>
<th>Amount of current government spending devoted to primary (or basic education)</th>
<th>X 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total amount of current spending devoted to education</td>
<td></td>
</tr>
</tbody>
</table>
Once data is organized, a number of interesting summary observations can be made. Combining individual scores to form a smaller number of characteristics makes it easier to display the data and to grasp their meaning. However when scores are grouped, some information is lost. There is no single way of grouping individual scores.

The role of measures of central tendency is to present a number that summarizes what is characteristic of the observations. The role of measures of variation is to express quantitatively to what extent scores in a group are scattered or clustered together.

Graphs and tables are also important tools to analyse the situation (current, trends, disparities); basic rules should be known about their selection and use.

Unit Objective:
To introduce basic statistical measures and tools that allow for analysing the system, its evolution and disparities.

Unit content:
- Measures of central tendency;
- Measures of variability;
- Measures of evolution and disparities;
- Cause-effect relationship;
- Tables and graphs.

This presentation will focus on tools that allow for further assessing aspects of access, internal efficiency, quality, equity and expenditure.

Expected learning outcomes:
Upon completion of Unit 2 you should be able to:
- calculate and interpret the basic statistics for descriptive analysis;
- analyze the evolution of variables and disparities in the educational system;
- use graphs and tables as support tools for analysis as well as for communication.

Timeframe:
- The study time required for this unit is approximately 8 hours per week.
Activities:

- You will have to prepare self-evaluation activities through this Unit.
- At the end of the Unit, you will prepare, based on a given framework, a report with your national data.
PART 1. GENERAL INTRODUCTION

Given the large number of tasks performed by the stakeholders in the educational system, the field of application for data processing is very wide. It ranges from the detailed statistical analysis of disaggregated data (for studying distribution, comparing averages, medians, standard deviations and identifying and analyzing the link between two variables, etc.) to the study of more aggregated data (for making projections, simulations, etc.). In this unit, you will be looking at the tools that are most frequently used for the analysis of central values, dispersion and evolution.

Finally, an important question comes naturally to mind at this stage: how can the results produced be used to present and communicate information most effectively? This unit will describe in detail the way in which the presentation and communication of information can be improved to contribute effectively to the debate on education. From the presentation of tables, graphs, through the choice of the reference period, into the style of text, you will explore several issues related to information analysis and communication.

PART 2. DESCRIPTIVE ANALYSIS

Let’s begin the data analysis with the help of common statistical measures: mode, median and mean. These measures (Central measures) allow us:

- to grasp an overall idea;
- to compare between different distributions.

Mode, median, and mean are called “measures of central tendency” (the numbers that describe the “centre” of the data distribution).

2.1 Mode

The mode is the most frequently occurring data (most frequently repeating) in the distribution. It is the measure of central tendency for the qualitative AND quantitative variables.

One often needs to know where the highest value of a specific resource is in a set of administrative units. In Novania, for example, one may wonder which region presents the highest number of classrooms that is typical in the distribution of classrooms.
Table 1. Number of Classrooms in Novania

<table>
<thead>
<tr>
<th>Regions</th>
<th>Classrooms frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal</td>
<td>10 064</td>
</tr>
<tr>
<td>Central</td>
<td>27 455</td>
</tr>
<tr>
<td>South-East</td>
<td></td>
</tr>
<tr>
<td>Novoto (Cap)</td>
<td>40 889</td>
</tr>
<tr>
<td>Lake</td>
<td>51 507</td>
</tr>
<tr>
<td>Wanga</td>
<td>21 299</td>
</tr>
<tr>
<td>Novanza</td>
<td>34 197</td>
</tr>
<tr>
<td>Northern</td>
<td>1 590</td>
</tr>
<tr>
<td>Novania</td>
<td>191 088</td>
</tr>
</tbody>
</table>

Lake is the region presenting the highest number of classrooms. Therefore the mode is “Lake”.

Note: A distribution can have more than one mode. In this case, it is called a multi-modal distribution.

2.2 Mean

You are already familiar with this. It is the average of a series of values – for example the score mean of a set of pupils is the sum of all the scores of the pupils divided by the total number of pupils. A quick calculation of the mean of classrooms per region in Novania gives us:

\[ 191,088 \div 7 = 27,298 \]

Therefore, the average number of classrooms per region is 27,298.

Mean is the sum of the data, divided by the total number of the data N:

\[ \overline{X} = \frac{\sum_{i=1}^{N} X_i}{N} = \frac{X_1 + X_2 + ... + X_N}{N} \]
Activity 1 should allow you to check your understanding of the mean calculation, in particular for mean of ratios.

**Activity 1**

Please use the data in Table 2 for the Coastal region in Novania. Calculate the pupil-classroom for the region, and the mean of enrolment and classroom per district in this region.

<table>
<thead>
<tr>
<th>District</th>
<th>Enrolment</th>
<th>Classrooms</th>
<th>Pupil-classroom ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63,978</td>
<td>973</td>
<td>65.8</td>
</tr>
<tr>
<td>2</td>
<td>124,660</td>
<td>2,153</td>
<td>57.9</td>
</tr>
<tr>
<td>3</td>
<td>62,131</td>
<td>1,366</td>
<td>45.5</td>
</tr>
<tr>
<td>4</td>
<td>107,538</td>
<td>2,409</td>
<td>44.6</td>
</tr>
<tr>
<td>5</td>
<td>62,736</td>
<td>1,779</td>
<td>35.3</td>
</tr>
<tr>
<td>6</td>
<td>16,249</td>
<td>493</td>
<td>33</td>
</tr>
<tr>
<td>7</td>
<td>23,877</td>
<td>891</td>
<td>26.8</td>
</tr>
</tbody>
</table>

Region |
-------|
461,169| 10,064 |

| Mean per district in the Region | ? | ? |
2.3 Median

The median is less often used than the mean, but within certain cases of data distribution, taking only the mean can lead to a serious decline in credibility and can certainly be misleading. Find below, the explanation of the measure.

When data are arranged in the increasing order, the median is the number that separates them in two equal groups. The median is the centre of the distribution.

Note: At least 50% of the data must be smaller than the median and at least 50% of the data must be bigger or equal to the median.

Procedures for finding the median

a) Arrange the data in the increasing order;

b) If the number of data N is an odd number, the median is the number situated at the middle of the distribution:

   distribution: 15, 16, 17, 21, 23  
   \[ N = 5 \]
   \[ \text{median} = \text{?} \]

c) If the number of data N is an even number, the median is the number at the half-way of the two numbers at the centre:

   distribution: 13, 14, 17, 21, 23, 29  
   \[ N = 6 \]
   \[ \text{median} = \text{?} \]

Procedures for finding the median for a grouped data:

a) Prepare a cumulative frequency table;

b) If the total number of data is odd, then the median is the \((N+1)/2\)nd datum;

c) If the total number is even, then use the \((N/2)\) th and \((N/2+1)\) th data;

d) In our example: \( N = 26 \), therefore the median is located between 13th \((N/2)\) and 14th \((N/2+1)\) data;

e) And both 13th and 14th data are situated in the interval of age 6.

---

\[ ^{8} \text{It is: 17} \]
\[ ^{9} \text{It is: } \frac{17 + 21}{2} = 19 \]
Now that the meaning of this statistic is clearer, you can think of it as just another central measure. The mean is equal to 6.2 and the median to 6!

However, there are other cases in which these values can differ greatly; hence it is important to know which of these is the most appropriate measure in order to meet your information requirement.

The arithmetic mean is the measure most often proposed to represent the distribution, since it is the only one which takes all the values of the distribution into account. So it uses more information from the distribution than the others; however, it is affected by extreme values and can thus give the impression that the situation is not quite what it appears to be.

To illustrate this, let us study a district which is examining teachers’ salaries and finds the following information: 50 teachers earn 30,000; 50 others earn 100,000; and 10 teachers are paid 780,000. The average salary is 130,000. It is pulled upwards by the 9 per cent in the top wage bracket. The median shows that half the teachers earn less than 100,000. Therefore, in a case such as this one, you will find that the median is an important additional piece of information.

Mean is like the balance point of a “see-saw”
### Table 4. Comparison of Characteristics of Mode, Median, and Mean

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Measure of Central Tendency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mode</td>
</tr>
<tr>
<td>Application in advanced statistics</td>
<td>Little</td>
</tr>
<tr>
<td>Use in behavioural research</td>
<td>Seldom</td>
</tr>
<tr>
<td>For describing what is &quot;typical&quot; in strongly skewed distributions</td>
<td>Good</td>
</tr>
<tr>
<td>Unique value for the distribution</td>
<td>Maybe</td>
</tr>
<tr>
<td>Ease of calculation</td>
<td>Yes in ordered scores</td>
</tr>
</tbody>
</table>

### Activity 2

This activity should help you to verify your understanding of the central measures. Explore the data in Table 5 on the pupils in the last year of primary (6th grade) in region X, through the central measures.
Table 5. Score distribution of pupils in 6th grade of primary, region X

<table>
<thead>
<tr>
<th>Score</th>
<th>Pupils</th>
<th>Percentage</th>
<th>Cumulative percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>11</td>
<td>25</td>
<td>3.6</td>
<td>3.8</td>
</tr>
<tr>
<td>12</td>
<td>111</td>
<td>15.8</td>
<td>19.6</td>
</tr>
<tr>
<td>13</td>
<td>175</td>
<td>24.9</td>
<td>44.5</td>
</tr>
<tr>
<td>14</td>
<td>174</td>
<td>24.8</td>
<td>69.3</td>
</tr>
<tr>
<td>15</td>
<td>125</td>
<td>17.8</td>
<td>87.1</td>
</tr>
<tr>
<td>16</td>
<td>61</td>
<td>8.7</td>
<td>95.7</td>
</tr>
<tr>
<td>17</td>
<td>24</td>
<td>3.4</td>
<td>99.1</td>
</tr>
<tr>
<td>18</td>
<td>5</td>
<td>0.7</td>
<td>99.9</td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>0.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>703</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

2.4 Mesures of variability

Information about central values is indeed not sufficient, as one can see in the example below:

<table>
<thead>
<tr>
<th>School A</th>
<th>School B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age = 12</td>
<td>Mean Age = 12</td>
</tr>
<tr>
<td>Median Age = 12</td>
<td>Median Age = 12</td>
</tr>
</tbody>
</table>

The two schools are very different, in terms of distribution!

Let us now analyze the “spread” of the distribution by calculating the measures of variability:

It expresses quantitatively the extent to which scores in a group scatter about or cluster together.

It is a summary description of their “spread”.

You may analyze the results of 6th grade pupil’s scores. Their average score is 13.8; the most frequent score (mode) is 13 and half of the pupils score is less than 13. But what is the score
variation among these children? One needs more information on the score differences than is given by the score central measures. What is the actual score distribution, especially as compared to the average? In the same way, if it is important to know the average value of the pupils per class, the distribution of this ratio (the different values it takes between regions for example) is as essential for analysis of the situation. Below you will find an indication of how you might respond to these questions.

2.4.1 Range

- The range is the difference between the highest and the lowest score.
- The range is a distance.
- It is easily determined by two scores.
- It tells nothing about what happens in between.

Taking enrolment rates, for example, one could apply the range measure by saying that the regional net enrolment rates of a country range from 45 to 78% – a range value of 33 points.

2.4.2 Inter Quartiles

Let us hypothesize that there are 12 regions. You already know the median that divides your ranked distribution in 2 equal parts. Imagine now that you divided your distribution in 4 equal parts instead of 2 parts. A quartile (Q) is the 3 values that separate your 4 ranked subsets.

“The inter-quartile range (IQR), also called the mid-spread, middle fifty and middle of the #s, is a measure of statistical dispersion, being equal to the difference between the third and first quartiles. The inter-quartile range is a more stable statistic than the (total) range, and is often preferred to the latter statistic.

The inter-quartile range is the most commonly used inter percentile range. Since 25% of the data is less than or equal to the first quartile and 25% is greater than or equal to the third quartile, the IQR is expected to include about half of the data. The IQR has the same units as the data.” 10

The analysis can be done for example on the scores of students in secondary level, looking by region at the inter quartile range, that is, which score did half of students obtain? (the other half being the 2 extreme lower and higher values). Another type of analysis could also use the quartile distribution in order to analyse an education item according to family income quartile in Country A.

Example of calculation

- Data Set: 6, 47, 49, 15, 42, 41, 7, 39, 43, 40, 36.
  The same, but ranked, data Set: 6, 7, 15, 36, 39, 40, 41, 42, 43, 47, 49
  Q1 (first quartile) = 15
  Q2= 40
  Q3= 43

- Another ranked Data Set: 7, 15, 36, 39, 40, 41
  Q1= 15
  Q2= 37.5 = (39+36)/2
  Q3= 40

Activity 3

This activity should help you to verify your understanding of the dispersion measures. Explore the same data from region x on Activity 2 and the data from region y in the table 6, through the dispersion measures.

Table 6. Score distribution of pupils in 6th grade of primary, region y

<table>
<thead>
<tr>
<th>Score</th>
<th>Pupils</th>
<th>Percentage</th>
<th>Cumulative percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>5</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>10</td>
<td>60</td>
<td>9.2</td>
<td>9.9</td>
</tr>
<tr>
<td>11</td>
<td>53</td>
<td>8.1</td>
<td>18.0</td>
</tr>
<tr>
<td>12</td>
<td>102</td>
<td>15.6</td>
<td>33.6</td>
</tr>
<tr>
<td>13</td>
<td>130</td>
<td>19.9</td>
<td>53.5</td>
</tr>
<tr>
<td>14</td>
<td>123</td>
<td>18.8</td>
<td>72.3</td>
</tr>
<tr>
<td>15</td>
<td>63</td>
<td>9.6</td>
<td>82.0</td>
</tr>
<tr>
<td>16</td>
<td>46</td>
<td>7.0</td>
<td>89.0</td>
</tr>
<tr>
<td>17</td>
<td>42</td>
<td>6.4</td>
<td>95.4</td>
</tr>
<tr>
<td>18</td>
<td>30</td>
<td>4.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>654</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>
PART 3. MEASURES ON EVOLUTION AND DISPARITIES

Statistical measures on distributions such as age, scores, or classrooms availability has been studied. The analysis allows for underlining disparities through regions, groups of pupils or schools, etc. An important issue is also measuring the disparities between genders, and will be covered in this part.

Furthermore, the analysis is a snapshot covering a school year. Another approach is to study changes: How have the constituent parts of the system evolved over time? Have teacher qualifications or pupils' achievement improved over the last five years? How has the condition of school buildings altered in the last ten years? So on and so forth.

3.1 Absolute comparison

When studying change in a variable over time, first you calculate its absolute growth, the simple difference between the two values. It is rather a simple matter to measure the deviation between net enrolment rates between two periods in either absolute or relative terms. For example, the absolute difference between the net enrolment rates for 1980 (25.2%) and 2000 (60.8%) is 35.6 (that is, 60.8 - 25.2).

Activity 4

(a) What is the difference in the number of teachers between years 1995 and 1996?

(b) Is the difference between the years 1996-1997 the same as the years 1997-1998?

(c) What is the total change in the number of teachers from year 1995 to 2000? Complete table 7
Table 7. Evolution of the number of teachers

<table>
<thead>
<tr>
<th>Year</th>
<th># of teachers</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>75</td>
<td></td>
</tr>
</tbody>
</table>

3.2 Relative comparison

If one takes the same example as above, the relative magnitude of the deviation is shown by comparing the absolute deviation with the first of the two enrolment rates. Doing this it will be seen that the net enrolment rate for 2000 is 2.41 times greater than the net enrolment rate in 1980 (that is, 60.8 ÷ 25.2).

Is the size of the relative change the same between the years 1996-1997 and the years 1997-1998?

Table 8. Evolution of the number of teachers

<table>
<thead>
<tr>
<th>Year</th>
<th># of teachers</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>1997</td>
<td>65</td>
<td>5</td>
</tr>
<tr>
<td>1998</td>
<td>60</td>
<td>-5</td>
</tr>
<tr>
<td>1999</td>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td>2000</td>
<td>75</td>
<td>5</td>
</tr>
</tbody>
</table>
3.2.1 Calculating Annual Growth Rate

The absolute difference that appears over a year, at t+1, is compared to the value in the beginning of the year t; this rate is known as an annual growth rate. It is an important measure of the evolution of a situation.

\[
\text{Annual growth rate} = \frac{\#\text{in year}_{t+1} - \#\text{in year}_t}{\#\text{in year}_t} \times 100(\%)
\]

Study the table more carefully on the evolution of the number of teachers, in particular between 1996 and 1998. Beware of increases and decreases that are not symmetrical.

Table 9. Evolution of the number of teachers and growth rate

<table>
<thead>
<tr>
<th>Year</th>
<th># of teachers</th>
<th>Change</th>
<th>Growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>60</td>
<td>10</td>
<td>20.0%</td>
</tr>
<tr>
<td>1997</td>
<td>65</td>
<td>5</td>
<td>8.3%</td>
</tr>
<tr>
<td>1998</td>
<td>60</td>
<td>-5</td>
<td>-7.7%</td>
</tr>
<tr>
<td>1999</td>
<td>70</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>75</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

- Between 1996-1997, increase =

\[
\frac{65 - 60}{60} \times 100 = \frac{5}{60} \times 100 = 8.3(\%)
\]

8.3% of increase

- Between 1997-1998, decrease =

\[
\frac{60 - 65}{65} \times 100 = \frac{-5}{65} = -7.7(\%)
\]

7.7% of decrease.

(See complete results below)
3.2.2 How to synthesize a series of annual growth rates?

If you have to give a summary of the evolution over several years, be careful not to simply add several annual growth rates! Look at the concrete example below:

What is the size of relative change between the years 1998 and 2000?

Table 10. Evolution of the number of teachers and growth rate

<table>
<thead>
<tr>
<th>Year</th>
<th># of teachers</th>
<th>Change</th>
<th>Growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>60</td>
<td>10</td>
<td>20.0%</td>
</tr>
<tr>
<td>1997</td>
<td>65</td>
<td>5</td>
<td>8.3%</td>
</tr>
<tr>
<td>1998</td>
<td>60</td>
<td>-5</td>
<td>-7.7%</td>
</tr>
<tr>
<td>1999</td>
<td>70</td>
<td>10</td>
<td>16.7%</td>
</tr>
<tr>
<td>2000</td>
<td>75</td>
<td>5</td>
<td>7.1%</td>
</tr>
</tbody>
</table>

Growth rates do not add up!!!

The change between 1998 and 1999 is: 16.7%

The change between 1999 and 2000 is: 7.1%

If one finds the sum of the above results, 23.8. is obtained.

But actually...

Change between 1998 and 2000 is:

\[
\frac{75 - 60}{60} \times 100 = 25\% 
\]

Why? The answer is in the base of the calculation.

What is the base of calculation?

The base is different.

\[
\frac{70 - 60}{60} \times 100(\%) = 16.7(\%)
\]

\[
\frac{75 - 70}{70} \times 100(\%) = 7.1(\%)
\]

And the 2 years change is : 75 – 70 + 70 – 60 = 75 – 60, but divided by 60, the value in the beginning of the period!!
Do not forget that the base of the calculation of a growth rate is the value of the beginning of the period studied.

Activity 5 should allow you to strengthen your understanding of the growth rates.

Activity 5

Look again at the table on teacher evolution. Compared to the years 1995-1996, the growth rates in the years 1996-1997 has DROPPED from 20.0% to 8.3%. Is the number of teachers decreasing?

---

Applying growth rate to calculate the changes

The growth rate is very useful as you saw for analysing past evolution. Furthermore, it is also used to estimate a future value. Applying the same or an estimate growth rate to the number of pupils of this year will give you an estimation of the number of pupils next year. Or if you only have the current growth rate of an indicator, with its past value, this calculation will allow you to know the current value.

If the growth rate of the number of teachers between years 2000-2001 was 20%, what was the number of changes? What was the total number of teachers in year 2001?

\[
75 \times \frac{20\%}{100\%} = 75 \times 0.2 = 15 \\
75 + 15 = 90
\]

Table 11. Evolution of the number of teachers and growth rate

<table>
<thead>
<tr>
<th>Year</th>
<th># of teachers</th>
<th>change</th>
<th>Growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>60</td>
<td>10</td>
<td>20.0%</td>
</tr>
<tr>
<td>1997</td>
<td>65</td>
<td>5</td>
<td>8.3%</td>
</tr>
<tr>
<td>1998</td>
<td>60</td>
<td>-5</td>
<td>-7.7%</td>
</tr>
<tr>
<td>1999</td>
<td>70</td>
<td>10</td>
<td>16.7%</td>
</tr>
<tr>
<td>2000</td>
<td>75</td>
<td>5</td>
<td>7.1%</td>
</tr>
</tbody>
</table>
3.2.3. Growth rate and the multiplier coefficient

The growth index ascribes the value of 100 for the first year of the period under review. Values for subsequent years can be obtained by a simple calculation;

Table 12. Calculation of the multiplier coefficient

<table>
<thead>
<tr>
<th>The base</th>
<th>The change</th>
<th>The result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>100%</td>
<td>20%</td>
</tr>
<tr>
<td>Ratio</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Raw Data</td>
<td>75</td>
<td>15</td>
</tr>
</tbody>
</table>

75 \times 0.2 = 15
75 + 15 = 90

15 is equivalent to 0.2 when 75 is 1.

These two equations can be combined:

\[
75 \times (1 + 0.2) = 90
\]

20% increase means the base number has been multiplied by 1.2

If the same rate continues another year...

Year 2001

\[
75 \times (1 + 0.2) = 90
\]

Year 2002

\[
90 \times (1 + 0.2) = 108
\]

This is equivalent to:

\[
75 \times (1 + 0.2) \times (1 + 0.2) = 108
\]

or

\[
75 \times (1 + 0.2)^2 = 108
\]

How about for 5 years?

For 2 years

\[
75 \times (1 + 0.2)^2 = 108
\]

For 5 years

\[
75 \times (1 + 0.2)^5 = 186.6
\]

Thus, you have the annual growth rate and the past values, but if you want the value of the last year of the period; the general definition will be:

\[
\text{Value (year m)} = \text{Value (year n)} \times (1 + r)^{m-n}
\]

with \( r \) = annual growth ratio
3.2.4 Average annual growth rate

The opposite problem can be confronted where you have the value of your statistic at the end of the period, and in fact you want to know the value of the annual growth rate for the period, thus an average growth rate. Another case is where you want to give an average value of the growth, even if you have the details of each yearly growth rate.

The latter case is our predicament. What was the average annual growth rate between the years 1995 and 2000?

Table 13. Evolution of the number of teachers and growth rate

<table>
<thead>
<tr>
<th>Year</th>
<th># of teachers</th>
<th>change</th>
<th>Growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>60</td>
<td>10</td>
<td>20.0%</td>
</tr>
<tr>
<td>1997</td>
<td>65</td>
<td>5</td>
<td>8.3%</td>
</tr>
<tr>
<td>1998</td>
<td>60</td>
<td>-5</td>
<td>-7.7%</td>
</tr>
<tr>
<td>1999</td>
<td>70</td>
<td>10</td>
<td>16.7%</td>
</tr>
<tr>
<td>2000</td>
<td>75</td>
<td>5</td>
<td>7.1%</td>
</tr>
</tbody>
</table>

\[
r = \left(\frac{(m-n)}{\sqrt[\text{m}]{X_m} - \sqrt[\text{n}]{X_n}} - 1\right) \times 100(\%)
\]

Where:

\(n\): starting year

\(m\): ending year

\(X_n\): quantity in year \(n\)

\(X_m\): quantity in year \(m\)

\[
\left(\sqrt[50]{75} - 1\right) \times 100(\%) = (\sqrt[\sqrt{1.5}]{1.5} - 1) \times 100(\%)
\]

\[
= (1.084 - 1) \times 100(\%) = 0.084 \times 100(\%) = 8.4(\%)
\]

The number of teachers presented a very irregular evolution of increase and decrease during the period 1995-2000, with an average annual growth rate of 8.4% during the same period.
Activity 6

Based on the statistical tools given above, analyse the evolution of the primary enrolment (in 1000s) in Novania:


<table>
<thead>
<tr>
<th>Year</th>
<th>Enrolment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>5,456</td>
</tr>
<tr>
<td>1992</td>
<td>5,530</td>
</tr>
<tr>
<td>1993</td>
<td>5,429</td>
</tr>
<tr>
<td>1994</td>
<td>5,557</td>
</tr>
<tr>
<td>1995</td>
<td>5,536</td>
</tr>
<tr>
<td>1996</td>
<td>5,598</td>
</tr>
<tr>
<td>1997</td>
<td>5,765</td>
</tr>
<tr>
<td>1998</td>
<td>5,920</td>
</tr>
<tr>
<td>1999</td>
<td>5,868</td>
</tr>
<tr>
<td>2000</td>
<td>5,883</td>
</tr>
</tbody>
</table>
3.3 Gender disparities

There are 3 ways to analyze the gender disparities, regardless of the indicator selected. If one chooses a simple indicator of school participation, the gross enrolment ratio (GER), one can study:

i. the current female enrolment ratio as compared with the male enrolment ratio;

ii. the implied, absolute, gender gap; it is here the difference between the male and the female enrolment ratios;

iii. the gender ratio, here defined as the ratio between the female and the male enrolment ratios, and designated as the gender parity index (GPI). In the most frequent cases where male enrolment ratios are higher than the female enrolment ratios, the GPI varies between 0 (maximum gender disparity) and 1 (gender parity). However, in many developed countries and some other countries in Latin America and the Caribbean and in Southern Africa female ratios exceed male ratios. In these cases the gender parity index (F/M) exceeds 1. In both cases – there is disparity in favour of men or a disparity in favour of women but, the principle remains that the closer the index to the unity, the lower the gender disparity.

Absolute gender gaps versus relative gender disparities

The absolute gender gap M - F and the gender parity index F/M depict disparities in different ways. Both may be interesting depending on the context of the analysis.

Activity 9 conveys a broad picture of female and male enrolment ratios in primary and secondary education and the implied gender gap and gender parity index by region. Disparities in favor of women are indicated by a negative value of the gender gap and by a value exceeding 1 of the gender parity index. You will see how to highlight these disparities differently.

---

PART 4. CAUSE-EFFECT RELATIONSHIPS

The following situation is encountered all too often. A report shows the trend of indicator A then, of indicator B. The report links the two trends and almost concludes – or even asserts – that one is caused by the other! This is not necessarily true. Another element, C, or indeed several other factors, might be influencing both A and B.

Cause-effect relationships require greater skill to analyze. For instance, a technical report indicates a rise in national achievement levels (national-exam results) which coincides with a change in curriculum or teaching methods in the educational system. Decision-makers will tend to conclude that if, on average, exam results have improved, it is due to better achievement and indeed better education quality. This is a very common example of how a wrong assessment of cause-effect relationships can lead policy-makers to reach the wrong conclusions about the effectiveness of past efforts and about the foundation of future courses of action. The factor (or factors) behind the better marks might be quite different: relaxing standards on the part of examiners, new weight distribution given to the subjects, and so forth.

The ways of avoiding this dangerous pitfall are to develop indicator systems that are more consistent and systemic and to do research. Equally important, is the training of those who produce the information, as they understand the complex processes at work in the system and know how they interact.

One could elaborate even further with still more examples. This paper will not emulate Darrell Huff, in saying that statistics are ‘as much an art as a science’, but in light of what has been presented, we can stress how important it is to ensure their accuracy and reliability.

Activity 7

Look closely at the three graphs below (Figures, 1, 2, 3) on (1) promotion rates as a function of teacher gender; (2) teacher distribution by gender and by zone; and (3) promotion rates by zone. Can you conclude on the basis of this information that female teachers get better results?

---

Figure 1. Promotion rate by teacher’s sex, Region A

Figure 2. Teachers by sex and by zone, Region A

Figure 3. Promotion rate by zone, Region A
PART 5. TABLES AND GRAPHS

Once the data has been processed, the results or a synopsis of the outcomes are communicated using tables, charts, graphs and the like to facilitate optimal communication of the information. Different types of tables/graphs are developed.

Several simple suggestions on ways of presenting tables that will help the reader to grasp and understand the information rapidly are given below. It is important not to “remain passive when confronted with tables of data, merely being satisfied with the first type of presentation which springs to mind: different images have to be compared, various combinations of variables tried, and the most meaningful means of expression sought. The most useful information needs to be emphasized and the most convincing elements highlighted and arranged in such a way as to promote retention.”

5.1 Tables

One basic rule is to convey a maximum of information in as few data as possible. In a report aimed at decision-makers, the number of indicators is – and must remain – limited. Tables and graphs should not be redundant but complementary.

A few elementary principles can be applied to improve the format of a table so that it can help the reader better grasp and take in the information:

- Tables should not be overloaded – it is better to include an extra table;
- Measurement units must be clearly stipulated;
- Decimal places tend to encumber tables and should be kept to a suitable number;
- The different sections of the table can be separated by lines to make the table more readable;
- Totals must be shown;
- For statistics to be compared, place them side by side in the same table (and not in different tables);
- Tables must be numbered in sequence;
- Always give the date of the data clearly;
- State the definition of the data, especially when the definition changes throughout the series (draw attention to the change by using a footnote or other device) – for instance, an enrolment rate might cover a given number of schools up to 1994, when another type of school is included, thereby changing the numbers; or else, there might be a change in the length of primary schooling.

---

5.1.1 Relative frequency distribution

This table shows the scores and the proportion or percent of the total number of cases that they represent.

Table 15. Distribution of scores

<table>
<thead>
<tr>
<th>Scores</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>95-99</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>90-94</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>85-89</td>
<td>15</td>
<td>30%</td>
</tr>
<tr>
<td>80-84</td>
<td>10</td>
<td>20%</td>
</tr>
<tr>
<td>75-79</td>
<td>10</td>
<td>20%</td>
</tr>
<tr>
<td>70-74</td>
<td>6</td>
<td>12%</td>
</tr>
<tr>
<td>65-69</td>
<td>4</td>
<td>8%</td>
</tr>
<tr>
<td>60-64</td>
<td>2</td>
<td>4%</td>
</tr>
</tbody>
</table>

n= 50 100%

5.1.2 Cumulative percentage frequency distribution

The table shows the percentage of cases lying above the lower exact limit of each class interval.

Table 16. Distribution of scores and cumulative %

<table>
<thead>
<tr>
<th>Scores</th>
<th>Frequency</th>
<th>Cum Freq</th>
<th>Cum % Freq</th>
</tr>
</thead>
<tbody>
<tr>
<td>95-99</td>
<td>1</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>90-94</td>
<td>2</td>
<td>3</td>
<td>6%</td>
</tr>
<tr>
<td>85-89</td>
<td>15</td>
<td>18</td>
<td>36%</td>
</tr>
<tr>
<td>80-84</td>
<td>10</td>
<td>28</td>
<td>56%</td>
</tr>
<tr>
<td>75-79</td>
<td>10</td>
<td>38</td>
<td>76%</td>
</tr>
<tr>
<td>70-74</td>
<td>6</td>
<td>44</td>
<td>88%</td>
</tr>
<tr>
<td>65-69</td>
<td>4</td>
<td>48</td>
<td>96%</td>
</tr>
<tr>
<td>60-64</td>
<td>2</td>
<td>50</td>
<td>100%</td>
</tr>
</tbody>
</table>

n= 50
5.2 Graphs

Graphs can serve to present a substantial part of the information, making it easily understandable. When should a graph be used in preference to a table? There is no across-the-board answer to this question. Neither is there any satisfactory technique. However, a few common-sense recommendations can be made.

A graph can easily be used to show the general trend of the indicators (hence it is particularly well suited to time series); it can show at a glance several attributes of the data. However a graph should not be used if the variations in the chosen indicator are slight and therefore hardly visible.

Several options are available concerning the way in which a graph is presented, for example with Excel. Your choice will depend on the information you wish to highlight. Common sense will help you to strike a happy medium between ‘overdoing’ and ‘under doing’ the presentation.

- As with tables, avoid overloading graphs so as to keep them easy to read.
- Choose the most appropriate scale, taking into account page size and the effect on gradients, which can change considerably. You do not have to start the axes at the origin; however, if you want to bring out comparisons with other graphs, the visual impact depends on the scales used and you will distort the interpretation if you do not use the same scale. An example of how a change in scales changes the perception of the information is given below.

Two different graphic presentations of the same data

![Two different graphic presentations of the same data](image)

Finally, the choice of the period to be covered is also an essential component of data analysis (See figures below). If the value of an indicator or a statistic tends to vary erratically, there will of course be discussions over the choice of the first year to be represented. Obviously, this will depend on the purpose of the document; but a broad, overall view of the phenomenon is often useful even though it might need to be accompanied by a more focused view of recent developments.

The 3 graphs below present the evolution of the gross enrolment rates in a country with different scales.

---

Activity 8

At a glance, what is your comment on the situation for each graph? Which one would you choose to use in your review report for the Minister?

a) Histogram

A histogram is a graph which consists of a series of rectangles, each of which represents the frequencies (or relative frequencies) of scores in one of the class intervals of the tabled distribution.

It is a graph often used due to the facility to read and understand the information being described.
b) Bar graph

Similar to the above graph, bar graphs feature spaces between the bars, but should be a better choice when plotting qualitative data. These spaces between the rectangles suggest discontinuity of the categories.

![Bar Graph]


c) Frequency polygon

This graph represents the midpoints of intervals in the histogram and connects them with each other. It can be useful when the graph contains data on several populations.

![Frequency Polygon]
d) Pie chart

It is a circle divided in several parts. This graphic shows the contribution of each category to the total of categories, usually in percentage. It corresponds to the values of one series.

![Pie chart example](image)

**Teacher age level**

- 50-54: 5%
- 55-60: 5%
- 25-29: 5%
- 30-34: 10%
- 35-39: 30%
- 40-44: 15%


e) Combined graph or two axis graph

A combined graph results from the juxtaposition of 2 or 3 different types of graphs. When you have 2 series with very different values in the same graph, it is important to show them through different axis, as illustrated in the graphs below.

![Combined graph example 1](image)

**Number of pupils and teachers at primary level**

![Combined graph example 2](image)

**Number of pupils and teachers at primary level**

- Pupils
- Teachers
f) The 3 Dimension graph

The 3D graph may be more dynamic, more attractive to the reader. But be careful with the 3D presentation: it can be difficult, if not misleading, to read this type of graph in some cases. The example below shows that the values, which are easily readable in the first 2D graph, are less easy to read in the second graph.
g) Scattered graph

This interesting and powerful graph allows for combining many variables. It shows the correlation between these variables. Nevertheless it is a little difficult to be read by non technicians and therefore needs to be accompanied by a note explaining how to read it. For example here:

Note: Southern Asia presents disparities in favour of boys, with a 103% boy enrolment rate and an 80% girl enrolment rate.

Activity 9 should help you to strengthen your knowledge on the use of graphs for data analysis and communication.

Activity 9

The table of indicators on disparities between boys and girls (Table x below) was presented in four different ways. What items does each graph emphasize more particularly?
Table 17. Male and female gross enrolment rate (GER) and gender disparities, by region, 1992

<table>
<thead>
<tr>
<th>Gross Enrolment Rates, 1992</th>
<th>Primary Education</th>
<th></th>
<th>Secondary Education</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (%)</td>
<td>Female (%)</td>
<td>Absolute gap (M-F, in percentage points)</td>
<td>Gender parity index F/M</td>
</tr>
<tr>
<td></td>
<td>Male (%)</td>
<td>Female (%)</td>
<td>Absolute gap (M-F, in percentage points)</td>
<td>Gender parity index F/M</td>
</tr>
<tr>
<td>WORLD TOTAL</td>
<td>103.8</td>
<td>93.2</td>
<td>10.6</td>
<td>0.90</td>
</tr>
<tr>
<td>Developing countries</td>
<td>104.4</td>
<td>92.2</td>
<td>12.2</td>
<td>0.88</td>
</tr>
<tr>
<td>of which:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>79.6</td>
<td>66.7</td>
<td>12.9</td>
<td>0.84</td>
</tr>
<tr>
<td>Arab States</td>
<td>97.9</td>
<td>80.2</td>
<td>17.7</td>
<td>0.82</td>
</tr>
<tr>
<td>Latin America/Caribbean</td>
<td>110.2</td>
<td>106.1</td>
<td>4.1</td>
<td>0.96</td>
</tr>
<tr>
<td>Eastern Asia/Oceania</td>
<td>117.1</td>
<td>111.6</td>
<td>5.5</td>
<td>0.95</td>
</tr>
<tr>
<td>Southern Asia</td>
<td>101.4</td>
<td>80.2</td>
<td>21.2</td>
<td>0.79</td>
</tr>
<tr>
<td>Developed countries</td>
<td>100.0</td>
<td>99.5</td>
<td>0.5</td>
<td>1.00</td>
</tr>
</tbody>
</table>


Figure 4. Primary education: male and female GER, by region, 1992

Figure 5. Primary education: male and female GER, by region, 1992 (in descending order of female GER)

Figure 6. Primary education: gaps between male and female GER (in percentage points), by region, 1992 (in descending order of gaps)
Figure 7. Primary education: male and female GER, by region, 1992

- Disparities in favour of girls
- Disparities in favour of boys

Regions:
- Sub-Saharan Africa
- Arab States
- Southern Asia
- Eastern
- Latin America/Carrib.
Group Report

The objective of this final activity of the module is to produce an outline of an indicators report using the methodological and technical elements necessary for the analysis and communication of information. This activity will be assessed and will be 30% of your total score for this module.

Group assignment: Identifying and analyzing indicators on the functioning of Novania’s education system.

The scope of an education system’s objective can be very broad. It is necessary to translate general objectives into more specific objectives, in order to define results associated with the latter. Once these stages have been completed, the planner can propose indicators that allow the monitoring of the education system’s functioning, as a function of decision-makers’ concerns:

(i) One important educational policy objective of Novania is to improve quality of education;

(ii) Based on the statistics given throughout Module 2 and the data that will be sent to you a few weeks before the end of the module, present and justify the corresponding indicators necessary to analyze the situation in relation to this objective; (20/100);

(iii) Prepare a synthetical indicator report (analytical text, graph and table) allowing the decision-makers to analyse the situation (2 pages maximum (80/100).

How to proceed for the indicator report?

It is advised that you read the examples shown in the Practical Guide (Sauvageot, 1997) again. The below example has also been given on the presentation of an individual page of an indicators report.

An example

One of the policy objectives of a country is to increase the number of women teachers. One of the indicators selected to measure the situation, at the regional level, is the percentage of women out of the total number of teachers. Let us suppose that you have the following table on Excel:
Tables and graphs

Then, look for a form of presentation of a table and graph which meets the criteria of an indicators report for decision-makers, easy to interpret and relevant to the objective of increasing the number of women teachers.

Graph x: Percentage of female teachers, Primary, 1999-2000

<table>
<thead>
<tr>
<th>Region</th>
<th>Females</th>
<th>Males</th>
<th>Total</th>
<th>% Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63</td>
<td>181</td>
<td>244</td>
<td>25.82</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>36</td>
<td>38</td>
<td>7.69</td>
</tr>
<tr>
<td>3</td>
<td>40</td>
<td>84</td>
<td>124</td>
<td>33.86</td>
</tr>
<tr>
<td>4</td>
<td>226</td>
<td>1334</td>
<td>1560</td>
<td>23.17</td>
</tr>
<tr>
<td>5</td>
<td>179</td>
<td>427</td>
<td>506</td>
<td>35.42</td>
</tr>
<tr>
<td>6</td>
<td>47</td>
<td>289</td>
<td>336</td>
<td>13.93</td>
</tr>
<tr>
<td>7</td>
<td>37</td>
<td>81</td>
<td>118</td>
<td>31.18</td>
</tr>
<tr>
<td>8</td>
<td>381</td>
<td>639</td>
<td>1020</td>
<td>37.25</td>
</tr>
<tr>
<td>9</td>
<td>188</td>
<td>848</td>
<td>1034</td>
<td>17.89</td>
</tr>
<tr>
<td>10</td>
<td>270</td>
<td>1553</td>
<td>1823</td>
<td>14.73</td>
</tr>
<tr>
<td>11</td>
<td>3895</td>
<td>10435</td>
<td>14330</td>
<td>27.18</td>
</tr>
<tr>
<td>12</td>
<td>174</td>
<td>246</td>
<td>420</td>
<td>41.43</td>
</tr>
<tr>
<td>13</td>
<td>8</td>
<td>101</td>
<td>109</td>
<td>7.34</td>
</tr>
<tr>
<td>14</td>
<td>234</td>
<td>778</td>
<td>1010</td>
<td>23.17</td>
</tr>
</tbody>
</table>

Presentation of the analytical text and the figures

Any graph or table related to the indicator has to be inserted into the text.

Using the basic analysis and communication techniques that have been described during the module, you should be able to draw up a document/report similar to the one proposed on the following page.

The technical note, which has been integrated into each page in this particular indicators report, could also be presented in an annex.
Percentage of female teachers

With respect to our objectives X and Y (here, the link with your national objectives could be explained if necessary), it is of interest to measure the participation rate of female teachers. In 1999-2000, this participation rate remains low, at 26.5% of the teaching body. Out of 6,111 women, 5,132 of them are to be found scattered across 4 different regions of the country, i.e. the regions 4, 8, 10 and 11.

This represents 84% of the total number of female teachers. Enormous disparities of numbers exist between the various regions. The number of female teachers varies between 7.3% in region 13 to 41.4% in region 12. Furthermore, there is a very low level of female participation in the region 2 zone.

Table 1: Percentage of female teachers, Primary, 1999-2000

<table>
<thead>
<tr>
<th>Region</th>
<th>Females</th>
<th>Total</th>
<th>% Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>8</td>
<td>109</td>
<td>7.3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>39</td>
<td>7.7</td>
</tr>
<tr>
<td>10</td>
<td>270</td>
<td>1833</td>
<td>14.7</td>
</tr>
<tr>
<td>9</td>
<td>186</td>
<td>1034</td>
<td>18.0</td>
</tr>
<tr>
<td>6</td>
<td>47</td>
<td>236</td>
<td>19.9</td>
</tr>
<tr>
<td>14</td>
<td>234</td>
<td>1010</td>
<td>23.2</td>
</tr>
<tr>
<td>1</td>
<td>63</td>
<td>244</td>
<td>25.8</td>
</tr>
<tr>
<td>11</td>
<td>3895</td>
<td>14330</td>
<td>27.2</td>
</tr>
<tr>
<td>5</td>
<td>179</td>
<td>606</td>
<td>29.5</td>
</tr>
<tr>
<td>4</td>
<td>586</td>
<td>1920</td>
<td>30.5</td>
</tr>
<tr>
<td>7</td>
<td>37</td>
<td>118</td>
<td>31.4</td>
</tr>
<tr>
<td>3</td>
<td>48</td>
<td>132</td>
<td>36.4</td>
</tr>
<tr>
<td>8</td>
<td>381</td>
<td>1020</td>
<td>37.4</td>
</tr>
<tr>
<td>12</td>
<td>174</td>
<td>420</td>
<td>41.4</td>
</tr>
</tbody>
</table>

Graph 1: Percentage of female teachers, Primary, 1999-2000

Technical note

Field: Teachers-Pedagogical support

Source: D.O.P. Mode of calculation: \( \frac{\text{female teachers}}{\text{total number of teachers}} \times 100 \)