CHAPTER 1

FROM STATISTICS TO INDICATORS

1.1 Introduction

This book deals with applications of statistics to the social sciences, including economics and other areas usually styled as 'social', such as sociology, social policy and planning. Examples are drawn mainly from those disciplines, but some applications extend to the natural sciences. The discussion does not stretch to the higher reaches of epistemology, semantics and general philosophy; rather it looks more practically at the purpose of indicators and, from there, to their nature and construction.

Sections 1.2 to 1.4 that follow discuss the statistical derivation of indicators, their structure and typology, and their use in scientific analysis. Then Chapter 2 'Indicator techniques' outlines some of the major statistical techniques and characteristics used for indicators. This material is based on the general statistical textbook literature, to which reference should be made for further detail. In Chapters 3 to 5 particular indicator applications in various fields of economics and social analysis are discussed. There are brief descriptions of some of the major subject matter, and references to sources in the bibliography, but the main emphasis is on identification of the processes involved and on appropriate socioeconomic measurement. Finally, Chapter 6 presents a summary of the main features of indicator analysis.

The bibliography covers some classic texts but concentrates otherwise on a selection of fairly recent titles, which themselves list further references, chosen from the very large literature in the various branches of the social sciences.

1.2 Classification of indicators

The term '*statistics*' is used in the dual sense of numerical facts, which are the basic material for indicators, and of a methodology, which serves as a tool for the construction of indicators. To put it in another way, statistics are the building blocks, which can be assembled in various ways for different indicative purposes. Statisticians distinguish between data, methods and purpose:

> Statistics are numerical statements of facts in any department of inquiry, placed in relation to each other . . . [they are] used for describing and analysing groups or aggregates, too large or complex to be intelligible for simple observation. (Bowley, 1923: 1–2)

Or to quote a more recent textbook:

> By Statistics we mean quantitative data affected to a marked extent by a multiplicity of causes. By Statistical Methods we mean methods specially adapted to the elucidation of [such] data. (Yule and Kendall, 1950: xvi)

We will be concerned with the process of *social quantification*, which goes back to the work of nineteenth-century statisticians like Galton in England and Quetelet in Belgium, or even the poverty studies by Gregory King in 1688. However, it has achieved wider currency only since the 1950s through the social indicator movement. In practice it is not easy to separate the data from their content and purpose.

The word 'statistics' itself was first used in the eighteenth century in Germany, in reference to the workings of the state, and the first volume of the *Journal of the Royal Statistical Society* in 1838–39 refers to facts 'which are calculated to illustrate the conditions and prospects of society'. However, the further development of statistical methods weakened the link between statistical data and their indicative purpose, leading to a division between the work of theoretical statisticians and that of applied statistical analysts. At the Statistical Congress held in Brussels in 1853 the leading statisticians of the day semed more interested in the description of living levels than in tidy rules for the analysis of consumer expenditure. However, subsequent generations of 'Year Book' statisticians and textbook writers became more concerned with the manipulation and presentation of data than with concepts. Only in more recent times have social scientists, including socially aware economists, become concerned about policy targets expressed in statistical form with reference to welfare, environment and similar issues.

Statistical methods are described in many learned papers and textbooks pitched at various levels of comprehension. For the present purpose it will be sufficient to summarise some basic methods and to refer readers to the textbooks for elaboration. The nature of indicators is less discussed in the literature and then mainly in the context of methods. Here we will try to reverse the sequence by concentrating more on the purpose and use of

indicators and only then look at methods of constructing them for set objectives. Progression *from why? to how?* seems such a simple logical procedure in the pursuit of knowledge that it hardly requires further justification. However, with so many protagonists of the reverse procedure of expounding methods with only casual comment on the rationale of their application, indicators have sometimes become forced into unsuitable formats that obscure their meaning.

Some prevailing perceptions about statistics that are relevant to indicators can be briefly summarised as follows:

- Numbers hold a fascination of their own for many people. They become metaphors of phenomena, and they order our thinking into a fixed frame that is seemingly objective in the rigor of its spacing. The symbolic expression of so many kilometres, years or dollars reflects to us the reality of space, time or wealth.
- We must measure to cope with our environment, with the rhythm of nature and with scarce resources.
- Many scientists are so preoccupied with the exactness of methodology that they disregard the uncertainties of underlying concepts and policies.
- Comparisons, expressed numerically, set standards of what has been and can be achieved. Our values are formed not so much by what we have as by what others have in comparison to ourselves. Socioeconomic notions such as production, poverty and work are comprehensible only in relative terms. Economics, described by Alfred Marshall in 1890 as the study of 'mankind in the ordinary business of life', is dominated by assumptions about comparative rules of behaviour such as:

  More is better than Less.
  I am more important than Thou.
  Sooner is better than Later.
  What You have got I need too.
  Rationality sanctifies the greed of Economic Man.

  However, such narrow views are now being expanded into more comprehensive, more compassionate attitudes, and a wide range of indicators can help us to understand better the ordinary business of life.
- Numerical symbols set the pace for mathematical manipulation, and they can be retranslated into verbal language without much regard to the logic of the result. That is reflected in statements such as 'We are now three times better off than we were last year', or in regarding output as the equiproportional function of inputs, or in positing that $a + b - b = a$ or that $ab/b = a$. Such shortcut assumptions bypass the complexities of changing context and of synergic effects.

Socioeconomic concepts are usually described in relative or even negative terms (e.g. unemployment, work, living standards, poverty). They are identified with a state or activity within a subjective frame of reference. In economics the debate about economic thought and language, to quote

the title of L.M. Fraser's analytical critique of 1937, has abated with the rise of econometric analysis, which rests on narrow, rigorously defined certainties. Statisticians' choices of what to include or exclude in their counts and how to combine subseries depend largely on practical considerations inherent in the collecting process. Economists look for unambiguous statistics, rather than unambiguous concepts, for their models and will at worst accept series that do not fit well their titles (e.g. underemployment, disposable income). In direct measurement the gap between concept and statistics is sometimes narrowed by means of explanatory footnotes, but it is not so easily bridged in the indirect measurement of welfare, utility and qualitative notions in general.

In the nineteenth century inspired statisticans in Europe (e.g. Quetelet, Engel) and Australia (e.g. Coghlan, Hayter) sometimes interpreted their collections as welfare indicators, but subsequent generations of official statisticians opted for safety when, for the sake of objectivity, they left the interpretation of their collections to other analysts. For instance, the empirical observation that the income elasticity of the demand for food is less than 1 in most countries, expressed in the Engel curve (1857), led to further mathematical analysis of consumer behaviour and contributed to the subsequent development of econometrics (see section 4.9 and Zimmermann, 1932).

Indicators are expressed mainly as:

- statistics in a time series (diachronic) or at a point of time (synchronic);
- comparisons of structural components; or
- comparisons of different entities (e.g. regions, enterprises).

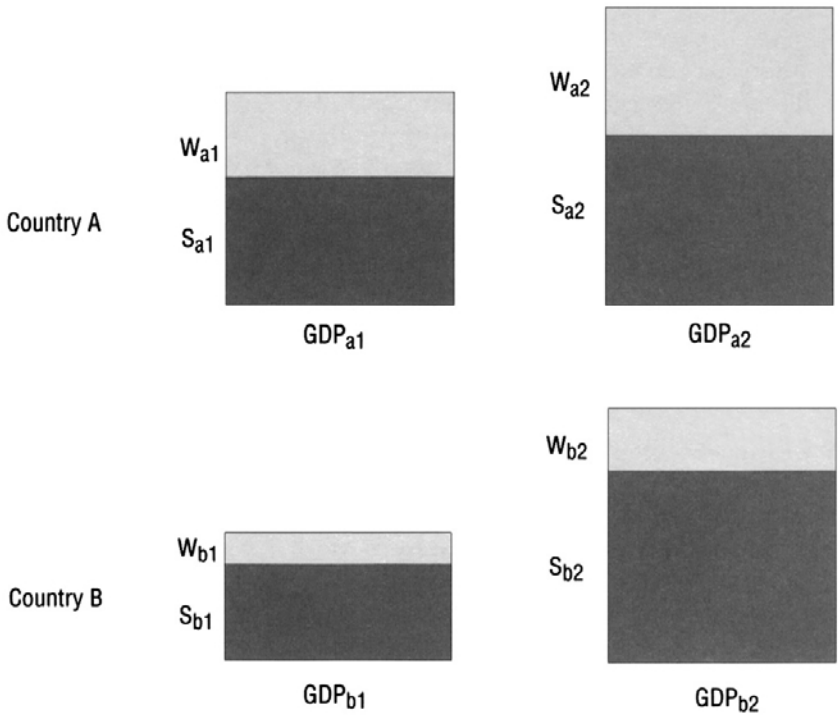
A single statistical datum is not indicative by itself. When we quote a figure for income per head of $\$a$ last year, or a population totalling b million at the end of last year or a literacy rate c% at that time, the figure means nothing until we compare it with corresponding figures for other periods or elsewhere. Figure 1.1, for instance, shows the change in gross domestic product (GDP) for country A between years 1 and 2 and the size of GDP in country A compared with country B. It also shows the structure of GDP, assumed to be made up of wages and surplus, in either country or period:

$$\begin{array}{ccccccc} \text{Wages} & + & \text{Surplus} & = & \text{Expenditure} \\ W & + & S & = & GDP \end{array}$$

The comparison need not be formal; it can rest on our knowledge of the general statistical situation; so we can at once describe an income per head of \$50 000 as relatively high or a literacy rate of 10% as relatively low. Yet while it is reasonable to argue that an isolated statistical datum has no indicative meaning without being related to some reference series, it can be claimed that no event is independent of other historic or circumstantial events. A single statistic, say a population count of 1 million people, has a history of earlier population sizes and changes and is itself

Figure 1.1 GDP for two countries over two periods

	Year 1			Year 2		
Country	*W*	*S*	*GDP*	*W*	*S*	*GDP*
A	20	30	50	30	40	70
B	10	30	40	20	60	80



a link indicator for future counts. Yet the number by itself, 1 million, is silent; its history is impenetrable without the key furnished by other data. We need statistical series and systems to unlock its indicative content.

Indicators are intermediaries that link statistical observations with social or other phenomena. In semantic terms they are *metadata*—that is, data describing other data. This fits into a so-called *syntactic model*, as proposed by Olenski (1986) and other semiologists, from which it may be concluded that indicators acquire meaning, indeed variable meanings, in their application; they bring amorphous statistics to life.

Concepts in the social sciences are called *soft* if they cannot be defined with the precision of terms used in the physical sciences. The description varies according to the point of view of the user and the purpose to which the concepts are applied. Broad agreement about generalised meaning leaves gaps and overlaps between areas. This applies to major notions such as

health, education and welfare and also to broad economic terms such as 'production', 'trade' and 'income', where precise statistical descriptions cannot hide some indeterminacy in underlying concepts (e.g. in the treatment of non-cash benefits or transfers as part of income, or of household services as production). Indicators, as neutral tools, help to clarify the specifics of concepts in a particular context. We can, for instance, extend the meaning of health statistics beyond morbidity by including the operations of pharmacies as an aspect of health service delivery.

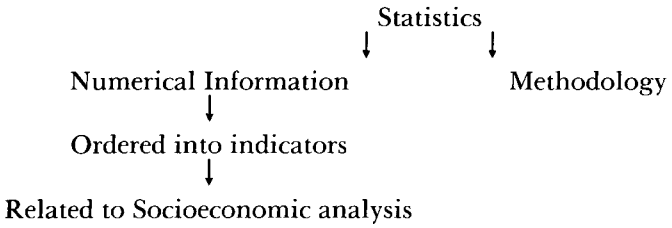
According to Kaplan (1964: 77), specification is part of the process of enquiry itself. We begin with terms that are not specified by the context and build up a conceptual structure from empirical findings, discarding on the way some earlier information and discovering additional sources as we go along. This *instrumentalist approach* is similar to the *method of successive definition* used in physics, or to what has been called a process of *reciprocal illumination* or *successive approximation* (Ridley, 1983: 651). It involves an *iterative learning process* (De Neufville, 1975: 127) in which indicators lead to the specification of concepts. Therefore we can speak of two main functions of statistics:

1 description by summarising information;
2 induction, which involves either generalisation from samples or the formulation of laws based on repeated observation.

We can mention here the hypothesis of *sonic resonance* (Sheldrake, 1988), which suggests that, at least in the natural sciences, all systems are shaped by 'morphic fields' that represent a collective memory around them beyond the genetic encoding of individuals, in contrast to traditional assumptions about mind and matter. This can possibly be extended to the learning process as not being confined to processing statistical indicative information but subject also to the sonic resonance of universal experience. More generally, it can be claimed that no indicator can be abstracted from its historical context.

We shall return later to the conversion of statistics into indicators, but note here a caution about the process of the specification of concepts, known as *conceptualisation*, or, in related terms, of the *reification* or *concretisation* of abstract notions. The search for meaning should not be attempted by a haphazard choice of possibly related statistics fed into the computer for factorising or other complex multivariate analysis, to produce a uniform series or vector that represents the abstract notion on a single even scale. The perils of such methods have been well illustrated by Gould (1983) in chronicling attempts to create concepts of intelligence during and since the last century. They have reflected personal, political and social bias as well as the ambiguity of the statistical methods employed, in their efforts to grade persons by hereditary or environmental factors. In other words, concepts cannot be mechanically-mathematically constructed without evidence that supports the objective logic of every successive step.

The merging relation between statistics and indicators can be demonstrated with the following sequence:



This relation can be summarised by describing indicators as *purposeful statistics.*

1.3 Operation and structure

As previously suggested, much of our thinking is anchored in comparisons. These may reflect aspirations to some ideal of virtue or harmony, but more often they are related to other people and situations in the past, present or expected future. Indicators provide a guide for expressing such comparisons in systematic scale marks. A single datum, in time or space, comes to life when related to others that indicate direction or relative magnitude. What usually matter most are simple relations, or changes in such relations, of the more-or-less type, even if expressed with mathematical precision. This relative nature of indicators calls for attention when choosing the indicator base (e.g. population of certain ages or status, production by provenience). Indicators with fixed scales are familiar in daily life (e.g. hands of a clock, markings on a thermometer, lines of a weather map). Economists use indicators to delineate the working of the economy, and other social scientists apply them to societal analysis. These examples supplement the dictionary definitions that describe an indicator as something (or somebody) that *points out.* Indicators describe what has happened, is happening or may happen; they categorise and superimpose a calculus on events. Different systems of indicators can be applied to a given set of data (e.g. metric or non-metric) or mixed bundles of indicators to abstract notions such as welfare or safety.

Pointing out can refer simply to directions (e.g. by a car trafficator, weather vane or a litmus test), or symbolically to the threat of global catastrophe (e.g. the clock on the cover of the *Bulletin of Atomic Scientists,* which stood at 10 minutes to midnight at the end of 1990), or to on-off choices of the yes-no type. More frequently, however, we are presented with a spectrum or with degrees of change where a scaled mode is appropriate for indicators. The classification of indicators can be based on various criteria of contents and objectives, and the catalogue below is directed particularly towards socioeconomic processes:

(A) Direct-objective type
  (A.1) Single variable concept
  (A.2) Combined-fixed concept
  (A.3) Combined-dynamic concept

(B) Indirect-derived
  (B.1) Binary signals
  (B.2) Complex subjective

Direct-objective indicators may be based on single series (e.g. school enrolments) or more-or-less homogeneous aggregates (e.g. value of mineral production). Sometimes they require standardisation by differential weights (e.g. calorific value of fuels). Alternatively, a fixed concept can be built up from heterogeneous components that are summed up by number or value (e.g. tonnage and value of exports). That means prior agreement on aggregation and excludes controversy (i.e. dialectical argument) about the inclusion or exclusion of any item.

For open or dynamic concepts (e.g. health, quality of life) the indicators themselves help to define the notion and acquire the dual role of specification and signal. Starting off with a vague concern, the process of selecting and testing data will show their relevance to the target notion; or to express the procedure in indicative jargon, indicators through an iterative learning process exercise a heuristic function in determining the epistemology of social–economic concerns.

Indirect-derived indicative conclusions can emerge from signals of movement or from *proxy series* that are related to the main series (e.g. economic cycles and suicides).

The distinction between subjective and objective indicators cuts across the above classification. It can be applied both to what is being measured and to how it is done. The term '*objective*' is usually applied to the mode of assessment that is based on external evidence that is independent of the reporter, such as the series published by official statistical agencies where objectivity becomes identified with factual evidence. *Subjective* indicators are judgemental, often in mode and in concept, and reflect perceptions or opinions. They can be expressed in simple yes-no terms or divided into intermediary steps of the none-little-enough-a lot type.

The indicators mentioned so far are objective in the sense of being based on circumstantial evidence that is external to and independent of the reporting person or institution. Typical here are the official statisticians' series where objectivity is identified with factual evidence. Against that we have subjective indicators based on judgemental evidence from the persons concerned. They reflect perceptions or opinions by those close to the issue in question, which yield a broader band of answers than a factual enquiry. Examples are surveys and opinion polls about perceived life values and other issues.

Subjective indicators can be formulated in simple binary terms of the more-less or better-worse signal type, and these can be further subdivided by intermediary steps (e.g. none-a little-enough-a lot), or by Maslow's hierarchical classification of five levels of human needs, or by Cantril's *self-anchoring scale* in which people express their degree of satisfaction in ten grades. From there it is only a small step to *cardinalise* such *ordinal*

grading by way of assumed (not necessarily equal) step intervals, which convert them to indicators of the (A.1) type. Subjective indicators are occasionally used in economics (e.g. for housing or work satisfaction) and more widely applied in other social sciences.

The relation of subjectivity to *social facts* has been discussed in the sociological literature (e.g. Turner and Martin, 1984: part 2), as has been the link between cardinal and ordinal scaling (e.g. McKennell in Strumpel, 1973). As far as indicative measurement is concerned, the claim to objectivity for any social statistics is dubious due to the essential subjectivity of the selection and presentation process. We must also avoid confusion between *what* is being measured and *how* it is being measured:

	Mode of measurement:	
	Subjective	Objective
Concept: Subjective	(a)	(b)
Objective	(c)	(d)

For instance, we can look at the incidence of disability reflected in an outside indicator by taking the number of invalid pensioners and the cash paid to them, as per (d); or we can take the number from a census that asks people to self-enumerate their specific disabilities, as per (b); or the census can ask whether people feel themselves to be disabled in a general way, as per (a); or it can ask people in receipt of invalid pensions to grade themselves by severity of disablement, as per (c).

In a general way the objective-subjective distinction is often more a matter of form than of substance. All objective-type indicators carry a subjective value load inherent in the process of the collection, selection and presentation of statistics, and subjective-type indicators borrow objective modes of grouping, ranking and partitioning the data. For practical purposes a classification of indicators as shown in Table 1.1, on the lines of the division into objective types, will be sufficient, but it will help in understanding the nature of indicators to consider some other classifications.

We can look at interrelations within the statistical base and between components. This is important for establishing correlations within and between indicator elements (e.g. the connection between production and trade via high technology; auto-correlation between infant mortality and life expectancy; the role of elasticities of substitution in a cost-of-living index). However, such interrelations are too variable and uncertain to serve as *a priori* for classification.

Georgescu-Roegan (1971: 43) draws a distinction between *numerical* (anthropomorphic) and *dialectical* (not uniquely defined) concepts, which in many ways corresponds to our division into (A) and (B) types. In a different approach a division is drawn between *instrumental* indicators, which serve as a means to an end, and *definitive* indicators, which refer directly to their purpose. Mukherjee (1975: 89), for instance, distinguishes between statistics as the *constituent variables* of an indicator and statistics

Table 1.1 Some direct objective-type indicators

Factor	Single variable	Combined variables	
		Fixed concept	Dynamic concept
Production	Single product, houses	Factory, mine buildings	National output
Transport	Car registrations, train mileage	Motor vehicle registrations	Transport index
Trade	Product sales, export item	Group sales, total exports	Total demand, balance of payments
Transfers	Tax by type, government expenditure by type	Tax revenue, public expenditure	Tax burden, welfare spending
Finance	Bank deposits	Money supply	Flow of funds
Income	Wages, pensions	Earnings	Personal income
Labour	Employment, hours worked	Labour force participation	Labour market, time use
Population	Births, deaths	Natural increase	Market growth
Environment	Urban areas	Open space	Pollution index
Health	Hospital beds	Death rates	Healthiness index
Education	Teacher numbers	Teacher ratios	Educational status
Quality of life	Holiday length, suicides	Achievement of set goals	Multiple scale index
Culture	Attendances at concerts	Music appreciation index	Multiple scale index
Human rights	Imprisonment of protesters	Number of gaolings	Multiple scale index

as the *contingent variables* that it seeks to indicate. The contingent variables become *societal* indicators when they refer to a societal condition (e.g. state of the education system), as distinct from *social* indicators, which apply this state to differential human relationships (e.g. access to higher education). The number of persons employed/unemployed can be regarded as an instrumental or constituent indicator for the description of the labour market or the burden of unemployment, but it can also be regarded as a definite or contingent indicator.

On somewhat similar lines Johnstone (1981) distinguishes between *variables*, which particularise different facets of society, and *indicators*, which combine conceptually related variables for an overview. He describes them as basic units in theory development.

Looking beyond their internal classification, indicators can be considered as part of an information system that links observers with the dynamics of the world around them and helps them to understand it. Like language, indicators have in the first place an intermediary (instrumental) task, and again like language they rise beyond their function as a medium to that of shaping the message. With language the selection and presentation of