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Relevant Official Statistics

Some Reflections on Conceptual and Operational Issues

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"A true and accurate knowledge of the number of its subjects is indispensable to a legislative authority, both for assessing its strength in agriculture, trade and defence, and in suiting its measures and its policy thereto. And there is no means by which a government can gain the cardinal advantage of knowing itself and its strength but by counting its subjects."

J. A. von Lantingshausen (1746)

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0. Introduction

Early in my career as an official statistician, I became intrigued by what I viewed to be a paradox: statistics saddled with large, sometimes very large, errors didn't necessarily give rise to correspondingly large social losses (harms). In Dalenius (1952), I suggested an explanation along the following lines:

i. large errors are noticed by the prospective users, who consequently abstain from using the statistics; or
ii. when the statistics are irrelevant, the errors are of no concern.

In debates in recent years about the quality of statistics and especially official statistics, there has been almost complete unanimity that relevance is one of the key properties of good statistics. It appears, however, that there has been and still is considerable unclearness about the meaning of relevance, and hence about how to measure it and how to obtain it.

The prime purpose of this paper is to provide a possible basis for addressing the problem that this unclearness poses. More specifically, my aim is to provide a systematic, coherent and reasonably comprehensive survey of (part of) the pertinent literature.

In the course of writing this paper, I soon found it unfruitful to try to discuss relevance in isolation from other issues of quality. The price – I hope not too high – which I have paid for heeding this experience is that I have had to deal with some important topics rather briefly.

The paper is divided into two parts. In the first part, a *general* conceptual framework is suggested. In the second part, some *specifics* of relevant official statistics are reviewed.

I want to take this opportunity to acknowledge the helpful comments on earlier versions of this paper by Professor William Kruskal and Mr. Anders Christianson, and an unknown referee.

I. A GENERAL CONCEPTUAL FRAMEWORK

1. The Notion of Relevant Statistics

> "...it is often better to have reasonably good solutions of the proper problems than optimum solutions of the wrong problems."
>
> *H. Robbins (1952)*

"Statistics" typically denotes the outcome of a statistical investigation: an experimental or observational study (such as a sample survey or a population census). It is in this sense that "statistics" is often used in debates about "relevant statistics." The definition of "relevant statistics" that this use implies has two important characteristics:

i. first, it is *general* in scope: it is applicable to the full range of statistical investigations, be they based on observational or experimental data, and be they carried out in the context of official statistics production or not; and
ii. second, it is admittedly rather *vague*; this vagueness may, however, be lessened by keeping in mind that the outcome of a statistical investigation is contingent on its *design*: the population(s) studied, the variable(s) measured, and the parameter(s) estimated.

The notion of relevant statistics implies a practical *purpose* to be served by the statistical investigation. This may be expressed as follows: the relevant statistics represent a translation of a real-life problem to a statistical problem, the solution of which will contribute to the solution of the practical problem.

What has just been said is sometimes expressed in terms of statistical decision-making. Thus, there is a problem which has to be addressed: it may be disregarded if it is found to be "not serious", or steps may have

to be taken to cope with it. The choice of the action to take will be based on the outcome of a statistical investigation.

While relevance obviously is a necessary property of the specification of a statistical investigation, it is not sufficient to guarantee a *useful* outcome. The estimate(s) of the parameter(s) of interest must clearly be sufficiently accurate.

In Section 2, I will present five examples of the *general* notion of relevant statistics.

2. Five Simple Examples

In the interest of making the notion of relevant statistics perspicuous, I have deliberately chosen examples from areas outside of official statistics. It is characteristic of these examples that there is a *single* purpose to be served, unlike examples in the realm of official statistics. The discussion here is supplemented by the discussion in Part II.

2.1. Fording a River

A group of tourists in a wilderness must ford a river. Their problem is to find a path which allows them to keep their clothes dry. In this case, they may collect observations on the depth of water for some alternative paths. The (parameter of) relevant statistics would be not the average depth (one may drown in a river, whose average depth is half a foot...), but the maximum depth: that path would be chosen for which the maximum depth is a minimum.

2.2. Weather Forecasts

Weather forecasts are used in agriculture and the aviation industry, to mention but two areas. Obviously, the usefulness of the forecasts depends on their accuracy.

Steinberg (1984) provides a thought-provoking assessment of the forecasts available to domestic airlines in the United States for use in their flight plans. The author states that the resulting flight plans may be based "on observation of the weather 18–24 hours ago." This means that a flight which typically takes 2.5–4 hours may be operating on "yesterday's weather." In times of fast changes in the weather conditions, this means that a flight plan may well be based on statistics which, from the viewpoint of air safety, are not relevant.

2.3. Selling Standing Forest

A forest comprising an unknown total of T cubic feet of timber is for sale at the price of D dollars per cubic feet. The problem facing the seller and the buyer is: what is T? The relevant statistics here would be an estimate of this total T. For a detailed analysis of this example from the viewpoint of statistical decision theory, reference is given to Blythe (1945).

2.4. Blood Test for Drunken Driving

A driver suspected of driving under the influence of alcohol may be subjected to a blood test such as the following: three samples of blood are taken and analyzed for alcohol content, yielding the observations x_1, x_2, and x_3. The mean x of these observations is then computed. Depending on the value of x, the judiciary takes a certain action.

2.5. Comparing Medical Treatments

The problem is to choose between two treatments, T_1 and T_2, of patients with some well-diagnosed disease. Coping with this problem calls for an experiment, the outcome of which would indicate which treatment, if any, is superior as measured by the rate of recovery.

3. Relevant Statistics and Statistical Theory

> "...I have already indicated what statistics, regarded as a subject, is about. *It is concerned with things we can count...our arithmetic is useless unless we are counting the right things...*"
>
> *M. S. Bartlett (1962)*

> "...when the right thing can only be measured poorly, it tends to cause the wrong thing to be measured, only because it can be measured well."
>
> *J. W. Tukey (1976)*

The lack of relevance of some statistical investigations has occasionally been viewed as evidence of certain shortcomings in the training of applied statisticians. Thus, it has been argued that:

i. too little, if any, attention is paid to relevance in courses and textbooks on statistics; and/or
ii. statistical theory is too limited in scope by not dealing with relevance.

In this section, I will dwell on the second-mentioned point.

In my view, the criticism of statistical theory just alluded to reflects a basic misunderstanding of what statistical theory is, viz. a theory for making inferences about properties of random variables. The theory is indeed mathematical and abstract; it does not deal with things in the real world. Hence, it does not deal with relevance.

Parenthetically, I mention here that the notion of "relevant information" plays an important role in statistical theory. Thus following Fisher (1948), statistics may be regarded as "the study of methods for the reduction of data" (op. cit. p. 1), that is for replacing any given body of data by a few numerical values, i.e. estimates. In doing so, we want to express "all the *relevant* information" contained in the data by these estimates (op. cit. p. 6). "Relevant information" as used by Fisher, is a concept different from relevant statistics as conceived of here.[2]

As discussed in Neyman (1952), what makes statistical theory applicable to problems in the real world is the possibility of establishing a *correspondence* between the theory and the real world, which provides a translation from the theory to the real world and vice versa.[3] Thus, statistics regarded as a subject has become "the servant of all the sciences", "the technology of the scientific method." It is that role that may be in need of strengthening in the teaching of statistics.

II. RELEVANT OFFICIAL STATISTICS

> "...many...statisticians themselves fail to understand that the collection of statistics can be justified only if the figures gathered are used..."
>
> *S.A. Rice and C.L. Dedrick (1951)*

> "Statistics must have purpose."
>
> *P. C. Mahalanobis (1956)*

4. Preamble to Part II

Official statistics production around the world has, in the last few decades, been the subject of numerous government investigations and intense discussions at statistical meetings (such as the sessions of the International Statistical Institute). To a large extent, these

[2] I note parenthetically that in information science, thought of as subject "concerned with problems arising in communication of knowledge in general" (Saracevic (1976), p. 86), considerable attention has been paid to the notion of 'relevance'. It appears, however, that the discussion is not relevant to the theme of this paper!

[3] What has just been said applies, of course, in principle to *all* theory. Geometry is a case in kind. The 'points', 'lines', 'angles', etc. in geometry have their counterparts in the real world; the correspondence between geometry (= the theory) and the real world (= the ground, say) is the basis of e.g. surveying and mapping!

investigations and discussions have focused on the *means*: centralized vs. decentralized statistics systems, use of administrative records, and use of computers, to mention but three.

The *ends* of official statistics production have, in comparison, received rather scanty attention. There is especially a marked shortage of treatises which reflect efforts to systematize the topics, including topics pertinent to the subject of this Part II.

Guided by my aim – as stated in the Introduction – of providing a systematic, coherent and reasonably comprehensive survey of the literature, I have chosen to organize my discussion under the following four headings:

A. Official Statistics Production
B. Special-Purpose Statistics
C. General-Purpose Statistics
D. Setting Statistical Priorities

A. OFFICIAL STATISTICS PRODUCTION

5. Bases for Official Statistics Production

It is a universally accepted principle that a nation's government has an obligation to produce certain fundamental statistics and make the statistics generally available.

Which statistics are considered fundamental for a specific nation will depend upon its political system, stage of economic development, etc. In most democratic nations – Sweden is one example – the official statistics is the major source of the social information needed:

i. by government, commercial enterprises, and research scholars, to determine the state of affairs and to provide the means of preserving this state, if desirable, or to change it; and
ii. by the people at large, to make the government subject to democratic accountability, to give but one example.

6. The Tasks of an Official Statistics System

The design of an official statistics system must take into account society's need for fundamental statistics and the key functions of the system.

6.1. The Needs

Arrow (1957) – where the focus is on the government's need for statistics for economic policy – distinguishes three types of statistics needed:

i. *sequential statistics*: "...a snapshot of the economy sufficiently detailed to make reasonably good forecasts" (p. 527);
ii. *computational statistics:* "... a system of signals for correcting mistakes" (p. 528); and
iii. *cumulative statistics*: "to help increase the understanding of economic principles" (p. 529); an important role may be played by time series.

Clearly, the usefulness (and hence relevance) of these types of statistics is not limited to economic policy; the discussion is applicable to other areas as well (social policy, etc.) and also to non-governmental needs.

6.2. The Key Functions of the Statistical System

In Tukey (1949), four major functions of an official statistics system are identified:

i. *the reporting function:* this calls for providing those in charge of some policy with the necessary statistics;
ii. *the analytic function*: this is to provide an objective basis for comparing alternative policies (to facilitate choosing among them), and to forecast the needs for new statistics (as in the case of a change of policy);
iii. *the consulting function*: this should help in choosing the best among methods already developed; and
iv. *the research function*: this should develop new methods when needed.

7. Two Standard Formats for Official Statistics

The subsequent discussion of relevant official statistics will be carried out separately for 'special-purpose statistics' and 'general-purpose statistics'[4].

This organization of the discussion should not be interpreted to imply that there is a sharp distinction in kind between special-purpose statistics and general-purpose statistics; there isn't. The organization has been chosen, rather, because it helps to elucidate the meaning of relevant official statistics.

B. SPECIAL-PURPOSE STATISTICS

8. The Notion of Special-Purpose Statistics

"Special-purpose statistics" is the outcome of a specification which reflects one or several *specific* purposes; an instance is "programmatical statistics", that is statistics used to monitor some government program. Clearly, the definition of relevant statistics (see Section 1 above) is applicable. These purposes, which are identified and analyzed in preparation for the specification, are typically rather narrow. It goes without saying that special-purpose statistics, once available, may find additional uses – especially, special-purpose statistics may find "informative uses" of a general nature.

In the realm of official statistics production, much special-purpose statistics is generated by legislation developed to deal with specifically defined problems. As discussed in Duncan (1978), the legislated activities "frequently generate programme-related statistics describe the problem being addressed by the programme and the impact of the programme on improving the condition of the specific target group" (p. 106.).

It is clear that production of special-purpose statistics competes for funds with that of general-purpose statistics!

9. Examples of Special-Purpose Statistics

The following three examples supplement the discussion in Section 8.

9.1. Example No. 1

In Sweden "objective crop-yield surveys" have been carried out annually since the early 1950's. Since 1961, these surveys have served the purpose of the government's crop-insurance scheme; the current design reflects this special purpose (Statistics Sweden, 1983b, p. 7). Thus, the statistics is "programme-related."

9.2. Example No. 2

In a developing country, a poor yield of some major grain may spell a famine, if it cannot be supplemented by imports. Making the arrangement for imports may be a time-consuming task. The problem facing the government is thus to find out early what the yield situation is. To this end, a sample survey may be carried out at the time of the harvest to estimate the yield.

9.3. Example No. 3

In the late 1930's and early 1940's, a survey program for measuring the level of unemployment was carried out in the United States. The scope of this program was eventually broadened; since 1943, it has been known as 'The Current Population Survey'.

This program illustrates the point that one and the same data collection operation – in this case interviews with a large household sample – may serve to provide statistics for more than one purpose.

[4] Statistics Sweden (1983a) makes a distinction between "instrumental uses" and "informative uses" of statistics. Mention may also be made of Hopper (1984), according to which "information is processed data, intelligence is processed information."

C. GENERAL–PURPOSE STATISTICS

10. The Notion of General-Purpose Statistics

It is characteristic of general-purpose statistics that it is designed to serve many, typically rather broad purposes, all of which may not be identified and analyzed prior to the development of the specification. Clearly, there is no sharp borderline between special-purpose statistics and general-purpose statistics. If special-purpose statistics may be viewed as "tailor-made" statistics, general-purpose statistics may be viewed as "ready-made" statistics.

It is important to realize that general-purpose statistics must *not* be thought of as "no-purpose statistics": it serves more than broad informative uses!

11. Examples of General-Purpose Statistics

The periodic censuses of population, housing, agriculture, business, etc. taken in most countries are pertinent examples of the production of general-purpose statistics. Other examples are provided by non-recurrent censuses and surveys.

The statistics thus produced serve as social information: each census, etc. provides a 'snapshot' of some aspect of the nation. In the terminology of Arrow (1957), these statistics serve as sequential statistics.

I will illustrate this use by an example which dates back to the beginning of this century; it appears, however, modern in its spirit. In Sandler (1911), pp. 23–26, the author focused on the changes of the age distribution of the Swedish population from 1751 to 1906. Largely as a result of the selective forces of the emigration in the second half of the nineteenth century, the age distribution became, in the words of the author (p. 26), "extremely unfavorable." The emigration had been expected to improve the living conditions for those who stayed in Sweden; but in fact, the emigration worsened their living conditions! Thus, in 1906, there was (relative to the average for the period 1751–1875) a shortage of some 125 000 people 20–50 years of age, those who Sandler called "the producers." At the same time, there was an excess of some 150 000 people over 65 years of age, "the consumers." Sandler viewed this situation as "one of our greatest economic problems" (p. 26), viz. the problem of old-age care.

By the same token, general-purpose statistics may serve as computational statistics. As an example, statistics about higher education today suggests – in my view – that the training of statisticians in Sweden is facing a serious crisis!

D. SETTING STATISTICAL PRIORITIES

12. The Theme of Section D

In Sections B and C, I have tried to review the meaning of 'relevant statistics' in the particular area of official statistics and to clarify this term; in short, these two sections provide some understanding of *what* relevant official statistics signifies.

In this Section D, I will focus on *how* to identify the relevant statistics corresponding to the users' needs and then decide *which* statistics to produce.

13. The Users' Main Responsibility

If the statistical system is to produce the social information *needed* (in the sense discussed in Section A), these needs must be identified.

The users have a heavy responsibility in this respect. Thus, it is incumbent upon them to specify the problems to the solution of which the statistics is expected to contribute. This is, to be sure, no simple task.

The basis for identifying the needs for statistics in some area would ideally be a model of the prevailing problem situation. The relevant statistics would then be the statistical studies needed to estimate this model.

This approach may, however, prove to be too demanding. A less demanding approach would call for preparing a 'statistics catalogue' comprising answers to two lists of questions. One list would comprise 'enumerative questions,' that is, questions of the type: "How many?", "How often?", etc. The other list would comprise 'analytical questions,' that is, questions of the type: "Which mechanisms generated this population?". For a discussion of these types of questions, see Deming (1950).

It is important to realize that it is not necessary and may not even be desirable that the users try to clarify their needs for statistics by suggesting some design.

Endeavors to clarify the needs for statistics may be guided by considerations of uses made of statistics in previous years. It is imperative, however, to realize that such a procedure may generate a *vicious circle*: if past statistics were not sufficiently satisfactory, it may prove detrimental to make them play a role in the formulation of today's program for official statistics production.

14. The Statisticians' Two Roles

> "Until the purpose is stated, there is no right or wrong way of going about the survey...."
>
> *W. E. Deming (1950)*

It is generally agreed that official statisticians must take the main responsibility for the producer-oriented tasks, such as the design of a census or survey and the assessment of the accuracy of the outcomes. The consensus that there is in this respect is in fact typically reflected in the actual division of labor.

By the same token, the prevailing division of labor suggests in many cases the role that statisticians may play when it comes to developing a program of relevant official statistics. In my view, statisticians *should* take part in setting the statistical priorities, and especially in the creation of a statistics catalogue as discussed in Section 13. Doing so will enhance their understanding of the problems to be addressed by the users of the statistics; such an understanding is crucial to the efficient design of the procedures for collecting and processing the data.

Moreover, statisticians *should* take part in the user-oriented analysis. A most important contribution – but not the only one – they can make here is to see to it that the users pay proper attention to the limitations of the statistics.

15. Four Basic Difficulties

The problem of developing a program of relevant official statistics amounts to setting statistical priorities, that is, to answering the following three related questions:

i. what resources should be spent on the program?
ii. on which statistics should these resources be spent?
and
iii. how should the resources be allocated between different statistics?

Several circumstances contribute to make this task difficult! First, official statistics is, by and large, a public good; there is no free market which provides an economic decision. Second, too little is known about the uses made of the statistics and likewise about the impact of inadequate or nonexistent statistics. Third, the users span a broad spectrum with respect to their opportunities to influence the development of the statistical program: the government can clearly exercise more influence than non-government bodies

(including research institutes), which in turn can exercise more influence than individual researchers. Fourth, and most important, there is no one specific decision-making methodology!

16. Benefit-Cost Analysis

In recent years, there has been a growing appreciation of the potential of benefit-cost analysis[5] in setting statistical priorities. It is characteristic of benefit-cost analysis that it calls for estimating the benefits and costs of alternative actions (such as alternative statistical programs) and choosing that action (program) which maximizes net benefits (gross benefits minus costs). Especially, a "Panel on Methodology for Statistical Priorities" established by the Committee on National Statistics (in the U. S. National Research Council) made the following recommendation in its report, as summarized in Savage (1976): "The assignment of priorities among statistical packages and programs should involve explicit considerations of anticipated benefits and costs."

16.1. Four Illustrative Operations

The essence of benefit-cost analysis viewed as a methodology for setting statistical priorities may – with a considerable simplification – be discussed in terms of four model operations.

Operation No. 1
The major current and potential societal problems – economic, social, etc. as the case may be – are listed in a 'problem catalogue' comprising the set of problems
$P = \{ p_1,\ldots p_i,\ldots p_M \}$, the P-set.

Operation No. 2
These problems are analyzed in terms of the statistics needed to deal with them. This creates a 'statistics catalogue' comprising the set of relevant statistics:
$S = \{s_1,\ldots s_j,\ldots s_N\}$, the S-set; typically $M>N$.
While in general there will be a correspondence between the elements of these two sets, there may be one or more elements in the P-set for which there is no corresponding element in the S-set.

Operation No. 3
The S-set – possibly after some reorganization of its elements into a few subject-matter categories (such as demographic statistics, social statistics, etc.) – is chosen to serve as a first approximation to the statistics program.

Operation No. 4
Finally, this approximate statistics program is assessed from the points of view of benefits and costs. It may prove necessary to make program cuts to keep the program within the allowed budget, and it may prove advantageous to move resources from one type of statistics (for example, to reduce the volume of data collected) to another. Or it may prove desirable to exploit data in existing administrative records rather than collecting new data, even if this would reduce accuracy.

16.2. Three Specific Difficulties

To be sure, benefit-cost analysis is associated with several *specific* methodological difficulties. I will point to three here:

i. the statistics are not "a final product or an end in itself but a tool for use in planning and implementing substantive programmes" (U. N. Statistical Office, 1984, p.68). Especially, it may prove to be "extremely difficult to determine precisely how statistical data actually enters into the planning

[5] A more common term is cost-benefit analysis. Minimizing cost minus benefit (cost-benefit) is, of course, equivalent with maximizing benefit minus cost (benefit-cost).

process or how decisions would be affected in the absence of these data" (ibid., p. 68);

ii. the loss caused by choosing the wrong program is not exclusively monetary and hence, is difficult to quantify; and

iii. the set of alternative statistics programs is typically too large to be specified in detail; it may be necessary to consider some selected programs.

16.3. Applications

Three applications, which preceded the recommendation referred to in the beginning of this section, are Hayami and Peterson (1972), Jabine and Schwartz (1975), and Redfern (1974). A recent example is Federal Trade Commission (1981), which is discussed in some detail in Savage (1984).

While it is generally realized that benefit-cost analysis is no panacea in rational decision-making, experience indicates that it may serve well by sharpening understanding of the consequences of alternative actions and focusing attention on the *value* of an action and the possible social and economic consequences of alternative courses of action.

17. The Objectivity Issue

The use of benefit-cost analysis – or for that matter any other methodology for setting statistical priorities – obviously results in a program for official statistics production which reflects the relative power of various users.

It has been argued – in Sweden and elsewhere – that as a consequence the program decided upon may not provide an objective picture of the nation's state of affairs. Especially – in a democracy – the ruling party may unduly promote the production of such statistics as would reflect favorably on its performance; this could be achieved by suppressing the production of statistics which would reflect unfavorably on its performance, or by changing definitions of basic quantities.

One possible way to deal with this objectivity issue would be as follows. In the total budget for official statistics production, a certain amount of money is made available to the minority party/parties to produce statistics to supplement the program promoted by the party in power.

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