

HOW IMPORTANT IS ACCURACY?

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ABSTRACT

These notes discuss the importance of accuracy within the broader framework of data quality adopted by many statistical agencies."

KEYWORDS: Data quality; accuracy.

1. INTRODUCTION

To the question posed to this Panel there could be a range of answers (Box 1). This is not a panel on questionnaire design so we need not debate the formulation of the question or the adequacy of the answers, but they do illustrate a range of attitudes that could exist towards accuracy. Among some users the concept of accuracy (at least in the way statisticians describe it) may be difficult to appreciate, and the attitude that "any numbers will do" still arises sometimes. For others, accuracy is something to be aware of (pay lip service to?), but not to fuss about. A balanced, and politically correct view is represented by the third answer. The final answer is, of course, what all mathematical statisticians believe!

	<i>Box 1</i>
How important is Accuracy?	
C	Hardly worth worrying about
C	Need to consider, but don't fuss
C	An important consideration in survey design
C	The only thing that matters

The papers we have heard during this Symposium could be divided into two broad categories. The first category we might call *macro level* papers dealing with the overall management of data quality in statistical organisation, balancing its dimensions, and addressing other constraints and considerations that affect the work of such agencies. The second category, *micro level* papers, have dealt with specific applications and ways and means of optimizing aspects of quality, often accuracy, in particular contexts.

2. DEFINITION OF DATA QUALITY

A definition of Data Quality in terms of fitness for use is now widely accepted by statistical agencies. For example, in the European Community's Report from the Leadership Group on Quality (Lyberg et al, 2001) we can read:

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“The bottom line is that the concept of quality in statistical organizations has changed during the last decade. Thus accuracy is no longer the sole measure of quality. Quality is a number of features reflecting user needs. In such a setting quality can be defined along a number of dimensions where accuracy is one. All those dimensions constitute the product quality.”

This implies a multi-dimensional definition of data quality in terms of various attributes of the data. Statistical agencies differ in exactly which attributes of the data they embrace in their definitions of quality, but they are all quite similar.

For example, in Statistics Canada’s Quality Assurance Framework (Statistics Canada, 1997), we have the following:

“...we can define the concept of quality as embracing those aspects of the statistical outputs of a NSO that reflect their fitness for use by clients”

with the aspects or dimensions of quality identified in the Statistics Canada definition being: *relevance; accuracy; timeliness; accessibility; interpretability; and coherence.*

Different lists, and different names for some of the dimensions, can be found in other statistical agencies, but they all include *accuracy*.

Not surprisingly, in these remarks I will make use of the six dimensions included in Statistics Canada’s definition. Very briefly, this list, and the ordering of them, result from the following imaginary line of questioning on the part of a potential user:

Does this information relate to my topic of interest, include the variables I am interested in, and use concepts and definitions that are consistent with my problem? If so, are the variables measured with sufficient accuracy for my purposes? Are the data available in time? Can I obtain the data easily, in the format I want, at a cost I can afford? Having got the data, can I understand them, know their reliability and the methodology behind them? Finally, do they fit in with other related data, are they consistent over time, can I use them in combination with other data sets?

For an elaboration of these dimensions and how they might be managed in a statistical agency, refer to Brackstone (1999, 2000, 2001).

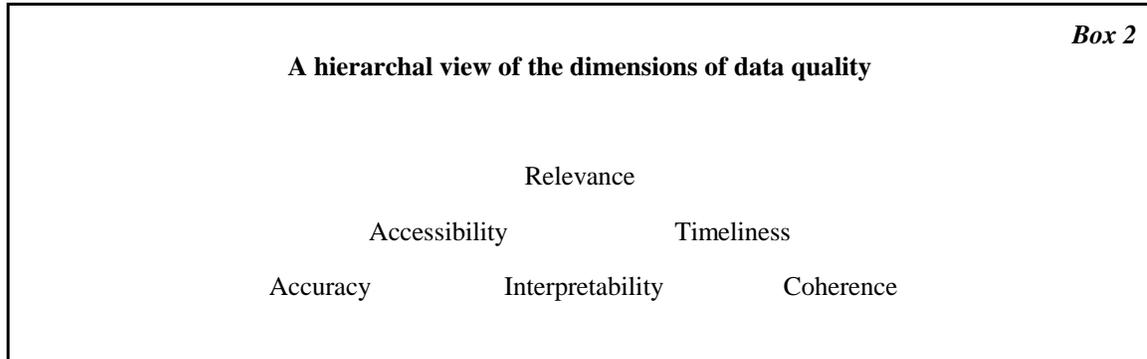
3.THE IMPORTANCE OF ACCURACY

Once one takes a multi-dimensional view of data quality, with *accuracy* as one of those dimensions, the question, *How Important is Accuracy?*, becomes an important issue in the design, implementation and assessment of statistical programs. Implicit in the multidimensional definition of data quality is that failure in any one dimension can cause failure - can cause the data not to be useful. The dimensions are in series, not parallel. In that sense, all dimensions appear equally important. Accuracy is a necessary but not sufficient requirement for fitness for use.

But one can also think of the six dimensions in a hierarchical fashion (Box 2). This view of the six dimensions stresses that:

- (a) without relevance, the other five dimensions are unimportant - perfect information on the wrong topics is not useful;

- (b) given relevance, without timeliness and accessibility the data are not available when they are needed; and so
- (c) only when relevance, timeliness and accessibility are satisfied do accuracy, interpretability and coherence become important.



That view appears to give accuracy a lower status.

Neither of those views would appear to put accuracy on a pedestal - which may be a disappointment to some statisticians. Let's look further.

4.WHY DID WE PICK ON ACCURACY?

But first, why is it *accuracy* that we choose to question and not *timeliness* or *accessibility* for example?

On the negative side:

- C in many surveys we spend a lot of effort and money (some might say a disproportionate amount) on accuracy issues - sometimes we are accused of too much fine-tuning of accuracy;
- C some would assert that many users are not particularly interested in measures of accuracy, and to some extent this is borne out by the level of demand for information on accuracy;
- C we can only measure some aspects of accuracy, so our measures of accuracy are misleading anyway.

On the positive side we could assert that:

- C knowledge of accuracy is crucial to appropriate use of the data
- C we (statistical offices) have a responsibility to educate users about accuracy and provide the information needed to interpret and use accuracy measures;
- C we should be addressing the gaps in our measurement ability, especially with respect to nonsampling error.

5. STATISTICAL ACTIVITIES AND QUALITY

Having enumerated some reasons why accuracy is worth special attention, we will now try to look at each dimension of quality from a different angle - from the angle of the producer of statistics rather than the user. Let's think about which activities in a statistical agency, or which stages of a program's development, primarily affect and influence each aspect of quality. We are trying to consider which stages of the survey process, or which aspects of an agency's infrastructure, influence each dimension of quality.

For this purpose, we consider four key "stages" at which quality characteristics may be determined:

- C program definition and priority setting, i.e. the decisions on which programs will be carried out and within what budget;
- C design and implementation of statistical programs;
- C assessment of the effectiveness of statistical programs and their results;
- C infrastructure of a statistical agency used by individual programs (e.g. field capacity; registers; methodology; common systems; dissemination channels).

The first and last of these items are cross-program or corporate activities; the second and third are program-specific.

Box 3 identifies a primary and secondary stage for each dimension of quality. Before describing this Box, let me hastily insert some caveats. This is a schematic diagram to suggest where the major interactions occur and is not intended to be definitive. Indeed, one could make a case for an entry at some level of strength in almost every cell of this table - every stage is pertinent to some extent to every dimension of quality. Nevertheless, we will review where the strongest interactions occur.

<i>Box 3</i>				
Dimensions of Quality by Statistical Activity				
	Program Definition	Design	Assessment	Infrastructure
Relevance	XXX	X		
Accuracy	X	XXX	X	
Timeliness	X	XXX		
Accessibility		X		XXX
Interpretability		X	XXX	
Coherence		X		XXX

Relevance is largely determined by decisions on which programs are to be carried out, their scope and funding. Judging relevance is largely a cross-program issue - the relevance of a program's outputs depends on what else is available. However, the design stage can also influence relevance significantly through the choice and definition of appropriate variables to measure.

Accuracy and timeliness are mainly design issues, largely determined by trade-offs made as programs are designed and developed. These are the areas where statisticians or methodologists apply their statistical theory and methods to the finding of optimal designs. But accuracy and timeliness that can be achieved through optimal designs are heavily constrained by the budgetary allocations made at the program definition stage, and

the timeliness and accuracy ceilings that these allocations imply. The measurement of the level of accuracy achieved is such a significant task (the measurement of timeliness is trivial) that we have also marked a secondary impact in the Assessment column.

Accessibility is primarily an infrastructure issue with its dependence on the channels that the agency has to disseminate data to its various audiences, and its data access policies. Within individual programs the design of particular program outputs can be considered a design issue.

Interpretability is primarily a matter of assessment and documentation, with the measurement of accuracy an important contributor to this factor. The design stage determines how these assessments will be carried out and what measures need to be built into the statistical program itself to allow this assessment.

Coherence rests on the infrastructure of standards for both content and methods. The use of standards concepts and variables facilitates coherence in the content of programs and in what is measured, while the use of common frames, methods and systems enable these concepts to be measured in consistent ways. The design stage is important in determining how these standards will be applied in individual programs.

What conclusions can be drawn from this schematic review? For overall quality management the table highlights the importance of program determination to relevance, the crucial role of design to accuracy and timeliness, the need for infrastructure to assure accessibility and coherence, and the role of assessment in achieving interpretability.

Also of note is the design column. Most of this conference has been about design. Design is the stage where accuracy, timeliness and cost considerations must be weighed and balanced, with concerns for relevance, interpretability and coherence also significant. This is why it was natural to focus on Accuracy in this session.

6. CREDIBILITY

There is another aspect of data that may be more important than accuracy. That is credibility. Credibility, i.e. the degree to which data are trusted by users may be partly a function of accuracy, but even more a function of the producing agency's reputation, which in turn may be partly dependent on its ability to produce accurate data over a long period of time.

Blatant inaccuracy is a threat to credibility. In part that is why statistical agencies get so concerned about editing out illogical anomalies in responses. Furthermore, inaccuracy in one series can undermine the credibility of other perfectly good series. But most inaccuracy is not blatant or visible. Only the producing agency can tell how accurate are the data, and even it often does not have the full picture.

We cannot manage accuracy without measuring accuracy. The problems of measuring accuracy are well-known and have been exposed again at this Symposium. We need to continue our efforts in addressing this issue - fellow panellists will have something to say on this.

But even with what we do know about accuracy, there is a second area for attention. What guidance do we give users in using information about accuracy?. For standard errors we can suggest confidence intervals, for example, but for other measures: response rates, coverage measures, are we doing enough to help users take account of this information in their use of the data - beyond just saying "use with caution"? It was encouraging to see efforts in this direction emerging in some papers at this Symposium.

7. CONCLUSION

So what is the answer to the question, you may ask. This is a panel discussion, not a paper, so I don't have to reach a conclusion. But let me end anyway with a few summary remarks.

Accuracy is not sufficient to make data fit for use. Even if we were able to provide good measures of accuracy, reflecting nonsampling as well as sampling error, we must pay attention to other dimensions of quality or our effort on accuracy is wasted.

But *accuracy* is necessary for fitness for use. We cannot compensate for accuracy by strength in other dimensions. In the long-term accuracy is a determinant of credibility, and credibility is a survival issue for a statistical agency. Accuracy is central to the Design stage of a program, and with the "Methodological Perspective" in the title of this Symposium, it is Design that is the focus of interest here. But the best that can be achieved in Design is largely constrained at the Program definition stage when objectives are set and budgets are allocated - so accuracy considerations have to be very clearly on the table when program definition decisions are being made.

REFERENCES:

- Brackstone, Gordon (1999). "Managing Data Quality in a Statistical Agency", *Survey Methodology*, Vol. 25, No. 2, pp 139-149, December 1999.
- Brackstone, Gordon (2000). "Managing Data Quality at Statistics Canada", Proceedings of the Statistical Quality Seminar, KNSO & IMF, Jeju, Korea, December 2000.
- Brackstone, Gordon (2001). "Managing Data Quality: The Accuracy Dimension", prepared for the International Conference on Quality in Official Statistics, Stockholm, Sweden, May 2001.
- Lyberg, Lars et al (2001). Report from the Leadership Group on Quality, presented at the International Conference on Quality in Official Statistics, Stockholm, Sweden, May 14-15, 2001.
- Statistics Canada (1997). "An Outline of Statistics Canada Quality Assurance Framework". Internal Document. December 1997.