Official Statistics Production: the past, the present, the future

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NTTS
New Techniques and Technologies for Statistics

an international scientific conference on

the impact of new technologies on statistical collection, production, and dissemination

Science & technology go hand in hand
The origin of my talk:
“The Canada Census Incident”

The Government of Canada made Statistics Canada abandon “the long form” (systematic one-in-five households) for detailed 2011 census information,

and replace it with a voluntary National Household Survey (1/3 of all households)

High degree of abstention (nonresponse) expected.
The Canada Census Incident

The Government says: Respect the right of Canadians to refuse to divulge personal information.
The Statisticians complain: Accuracy will suffer.
The Users complain: Time series breaks; unreliable information about many groups in society.
The Canada Census Incident

With the new methodology, Canada’s population will be shown as richer, better educated, more conservative than it is, at the expense of accurate information about small and disadvantaged groups.
The Canada Census Incident

Question arising:
Can non-statisticians tell professional statisticians how statistics of national importance should be produced?

Of similar kind:
Can ordinary people tell surgeons how brain surgery, for example, should be carried out?
Questions arising

• Could it be that official statistics production is so elementary, so lacking in firm theory that common sense is all that is required?

• Information of unknown or doubtful accuracy, produced against better knowledge, is it nevertheless preferable to high quality information conforming to highest of standards?

• Is official statistics production scientific? If yes, to what extent?
The Canada Census Incident

it actually happened – regrettably
Outline of my talk

Five brief comments:
1. Official statistics and scientific principles.
2. Statistical science vis-à-vis official statistics production.
3. Official statistics: a fragmented field
4. Survey methodology versus survey theory
5. Where are we going? The future of official statistics
1. Official statistics and scientific principles.

A main objective of an NSI: Deliver high quality statistics in high demand by users.

The NSI:s – some at least - pride themselves in “scientific principles”

Statistics Sweden: “The statistics produced rely on a scientific foundation”
1. Official statistics and scientific principles.

There is not one unified (comprehensive) theory for official statistics.

Article by Robert Groves (1987) titled:
Survey research is a methodology without a unifying theory
1. Official statistics and scientific principles.

No unifying theory for official statistics.
If statistics production could point to a firm solid theory, enjoying the prestige that recent major scientific break-throughs bring, there would be no room for a Canada Census Incident.
1. Official statistics and scientific principles.

Many observers (in high places) see official statistics production as a bundle of *techniques* with some theory here and there.

Statisticians are seen as technicians, “number-crunchers”
1. **Official statistics and scientific principles.**

NSIs also recognize the absence of unifying theory.

Statistics Canada (1998): Survey Methodology is
“a collection of practices, backed by some theory and empirical evaluation, among which practitioners have to make sensible choices in the context of a particular application”
1. Official statistics and scientific principles.

On the NTTS web site:

“Official statistics methodology aims at providing methods for each step of the statistical value chains”
1. Official statistics and scientific principles.

The cited article by Groves (1987):

“A theory of surveys would unite social science concepts with the statistical properties of survey estimates” (i.e., accuracy; bias and variance)
2. **Statistical science vis-à-vis statistics production**

A central idea in *statistical science*, as taught in many universities:

From a part (the sample), make statements about the whole (the population), with the aid of *probability*.

This is *statistical inference*

Statements - significant differences, confidence intervals - at stated level of probability
2. **Statistical science vis-à-vis statistics production**

A central question in *statistical science*:

“How far from the truth; “how close”

The theory had its heyday in the 1930’s and 1940’s.
2. **Statistical science vis-à-vis statistics production**

*Official statistics production* gives us

“numbers about the population”

as opposed to

“inference about the population”

in the sense of *Statistical science*

The usual concepts (confidence statements, etc.) are not operational in official statistics.
2. Statistical science vis-à-vis statistics production

At this point of my presentation, some listeners start to feel uncomfortable:
“What do you mean we don’t make inferences?”

Reply: Statistics production does use statistical theory, in various “bits and pieces” also profits from theory from other sciences but it does not make inferences
2. **Statistical science vis-à-vis statistics production**

I am a theoretical statistician. Here, I am asking myself some questions; sharing with you a perspective on values that we all hold as statisticians.
2. **Statistical science vis-à-vis statistics production**

Franchet and Nanopoulos (1997) article titled *Statistical science and the European statistical system: expectations and perspectives*

“The methodology of official statistics is a notion that has to be distinctly understood from the notion of methodology in mathematical statistics”

“The probabilistic formalism ... of mathematical statistics have offered official statistics the necessary framework for its scientific foundation.”
2. **Statistical science vis-à-vis statistics production**

I see a discrepancy between

the principles of statistical science

and

the stark reality of today’s official statistics practice
3. Official statistics: a fragmented field

*Fragmentation* (of a field of knowledge) is a concept in philosophy of science. Two of its aspects:

(a) Competing theories within the field creates divisions

(b) “Piecemeal theory” develops within a field that should be more unified


David Bohm (1917-1992), quantum physicist
3. Official statistics: a fragmented field

There is fragmentation when divisions arise in a more or less arbitrary fashion without any regard for a wider context

Ref: B&P p. 15
3. Official statistics: a fragmented field

A sign of fragmentation is the emergence of separate groups of investigators, held together by common interest in a certain (limited) question.

A group of people get together and work on the same problem, under a trademark name.

Examples in official statistics:

Imputation, Nonresponse weighting, Editing and data cleaning, Small area estimation, and so on.
3. Official statistics: a fragmented field

As time goes by, problem areas arise in a science, some become more and more “burning”, engender a phase of development.

Theory develops within narrow sub-fields, pieces of theory, specializations inside the broader field, highly specific areas of knowledge, subcultures.

So it is with statistics production: It has come to rely on “a collection of practices, backed by some theory”
3. Official statistics: a fragmented field

Some official statistics subcultures:

In data treatment:
- Small area estimation
- Nonresponse weighting
- Imputation
- Editing and data cleaning

In data delivery:
- Response burden
- Respondent motivation
- Confidentiality
3. Official statistics: a fragmented field

These are among topics suggested for papers at this conference.

Active groups, networks, exist in each of these narrow specializations.

Is this good, in the long run? Where will it take us?
How do outsiders view our field?
3. Official statistics: a fragmented field

“Long range connections between the ideas is of crucial importance in the continued development of a field, and they cannot be dealt with in terms of narrow specializations” (Ref: B&P p. 71)

Regrettable; but is there an alternative?
4. **Survey theory versus Survey methodology**

Taking a history of science perspective.

We need a distinction:

**Survey methodology** – the collection of practices for statistics production

vs.

**Survey (sampling) theory** – a mathematical field, rooted in a central idea of statistical science:

From a part, make inference to the whole
Survey theory

- is mathematical
- the best of it has (over the years) had tremendous impact on practice
- taught only in few universities

Illustration: IASS jubilee commemorative volume 2001 (Landmark papers in Survey Statistics): 19 papers, almost all mathematical
Survey theory

A division within Survey Theory is:

• Design-based (probability sampling) theory, from 1930’s

• Model–based theory, from 1970’s, as in Small area estimation.
Survey theory

Classical (design-based) writers & pioneers:
  W.G. Cochran, W.E. Deming, M. H. Hansen,

They were mathematicians
  with a keen understanding
  of the practical aspects of surveys.
Survey theory

Cochran, Deming, Hansen: Pioneers

“A theoretical statistician is one who guides his practice with theory. The theoretical statistician is the practical man, as he has a better guide for practice than the errors of his forefathers. Statistical theory shows how mathematics, judgement and substantive knowledge work together.” (Deming, 1960)
Survey theory

Look through their classical books from around 1960!

Survey methodology: The term is not there!
Imputation, small area estimation, editing: Also not there!
Nonresponse: Barely mentioned
Survey methodology

Had you asked Cochran or Deming or Hansen around 1955, they would not have known what “survey methodology” means.

Survey methodology is a “post-modern term”, necessitated largely by need to handle administratively the many problems arising in modern computerized, large scale data collection from increasingly un-cooperative human populations.
In the classical era, 1940’s to 60’s,

*Survey theory* did exist.

*Survey methodology* did not exist - as a term
Survey methodology

Today, in the 2010’s,

Survey methodology is:

“A collection of practices,” each lending a certain support to one of the steps in statistics production

• Methods for each process in “the statistical value chain”
• Is nevertheless extremely valuable
• Is systematically taught in very few places
  (JPSM is a model)
Survey methodology

List of courses in survey methodology (JSPM) each supported by some theory

Data collection modes, Response behaviour, Interviewing, Pretesting, Concern for data provider e.g., Response burden, Confidentiality

Also: Imputation, Nonresponse weighting, Classification, Editing, Small area estimation
Survey methodology

The scientific underpinnings for survey methodology stem not only from statistical science, derives important elements also from

(Cognitive) Psychology,
Sociology (of interaction, of intergroup relations),
Political science

and not in the least,

Computer science
Survey theory vs. Survey methodology

The history of science perspective:

To *survey theory* (as in the days of Cochran, Deming, Hansen) has become attached a balloon of practices and techniques, necessitated by the complexity of modern times;

This has given us modern *survey methodology*
The teaching

Statistical science taught in many universities
Survey (sampling) theory taught in very few universities
Survey methodology and official statistics production taught systematically in few places,
but practiced in many
Can a statistician deliver?

is the title of an article in


with 16 discussions

and a rejoinder by the authors,

R. Platek and C.E. Särndal

Can a statistician fulfill his/her promise (to society)
to deliver reliable data?
Can a statistician deliver?

The 16 discussants:

- Some say: of course we cannot have a perfect theory for statistics production; the process is too complex.
- Others say: “the glass is more than half full”
Can a statistician deliver?

We (Richard Platek and I) found that many admit, if only reluctantly, that there is no way of measuring accuracy in official statistics.

- We emphasized (perhaps too much) the statistical science view, its objective to make “valid inferences to the population”
- We did not point out that probability, the cornerstone of *statistical science*, is too limited a basis for *official statistics*
Can a statistician deliver?

Official statistics has “outgrown” statistical science

Probability, the fundamental concept for *statistical science*

is “too narrow” as an instrument for *official statistics*
Can we deliver?

Probability plays little or no role when people look at “published numbers” they see them as “the truth”

Franchet and Nanopoulos (1997), in: Statistical science and the European statistical system

“Very often, almost always, statistical results are presented as the pure truth, expressed through exact figures .. No confidence intervals are given, no methods of estimation are presented and no tests of significance are operated”
5. Where are we going?

Back to my “questions arising”:

- Is official statistics production so elementary, so lacking in firm coherent framework, that common sense is all that is required?

- Information of unknown or doubtful accuracy produced against better knowledge, is it nevertheless preferable to high quality information conforming to highest of standards?

- Is official statistics production scientific? If yes, to what extent?
5. Where are we going?

The NSI needs a protective armour, a shield for its mission to “produce official statistics” for the nation.

In the past, this was not necessary - the NSI was the unchallenged supreme instance of statistical competence - there was trust.

Today, the NSI is vulnerable.
5. Where are we going?

The NSI needs a shield for its ways of doing

Why? Because there is

- competition, from sometimes less trustworthy competitors
- pressures from "high places"
- demands for more and more data on more and more things
- scarcity of resources

Despite all this, the statistical high authority (the NSI) must demonstrate firm, competent delivery
5. Where are we going?

Today the NSI’s protection is:

Reference to “a bundle of techniques”
in “the statistical value chain”
with “some theory here and there”
(from statistical and other sciences)

A weak protection in my opinion.
5. Where are we going?

The protective armour for a serious producer of official statistics (an NSI) is not a unifying theory of surveys (there is none), but a bundle of techniques called survey methodology.

It is too easy to poke holes in that defence, by anyone who so chooses, e.g., the government.
5. Where are we going?

My hope for the future: That we be better able to demonstrate that sound, unifying, comprehensive theory can be brought in support of “accurate and useful information”

A danger lies in a more or less uncontrolled growth, an expanding balloon of “a collection of practices”, a fuzzy constellation without sharp contours (that is, more and more fragmentation)
5. Where are we going?

The NSI cannot give concrete evidence of their (perhaps superior) quality & higher accuracy

Information of unknown or doubtful accuracy, produced against better knowledge, is that nevertheless preferable to quality information conforming to the highest of standards?

This question, it seems to me, lies at the heart of the Canada Census Incident. Not many are asking that question.
5. Where are we going? OPT

Statistics Canada can *produce numbers* with the new National Household Survey, but they cannot give evidence of “closeness to the truth”