ROLE OF DATA FOR PROMOTING PUBLIC UNDERSTANDING OF SCIENCE

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ABSTRACT

In this fast moving world, data is the heart and soul of any enterprise. It has become an essential task for organizations around the world to protect their data. To deliver content data in plain language, without losing scientific precision, is indeed a difficult task. The society is a flexible set of tools for understanding and putting to use statistical concepts and data. Science is a critical public investment in our future, a resource with extraordinary dividends. Understanding and using statistical information is not an easy task. Facts and figures reported by statistics do not sound familiar and numeracy itself is not widespread. School systems can be data rich and information poor if they do not understand and manage their data effectively. The task for statisticians is to put existing data into a format that lends itself to answering questions and improving outcomes for the society. Common barriers to transforming data into knowledge in education or society settings often include poorly designed or nonexistent data systems; disorganized record management; moody gatekeepers--data mavericks--who hold back data to preserve power; or personnel who simply fail to ask the right questions of the available data. Fortunately, learning to deal with data does not require an advanced degree in statistics. To turn a body of data into useful information for knowledge-based decision-making at any level, data must be collected, organised, analysed and reflected upon.

Keywords: data, precision, society, statistics, science

OBJECTIVES

The main objectives are to contribute to improving and promoting statistical literacy; to increase the trust of citizens, respondents and users in official public statistics; and to promote the critical use of statistical information in everyday life.

INTRODUCTION

Public understanding of science means the understanding of scientific matters by nonexperts. This cannot of course mean a comprehensive knowledge of all branches of science. It may however include understanding of the nature of scientific methods, including the testing of hypotheses by experiment. It may also include awareness of current scientific advances and their implications. Public understanding of science has become a shorthand term for all forms of outreach by the scientific community, or by others on their behalf (e.g., science writers, museums, event organisers), to the public at large, aimed at improving their understanding. (House of Lords, 2000). It has been argued that the phrase “Public understanding of science” implies a condescending assumption that any difficulties in the relationship between science and society are due entirely to ignorance and misunderstanding on the part of the public; and that, with enough public-understanding activity, the public can be brought to greater knowledge. This approach is inadequate: science cannot ignore the evidence of a decline in trust, and rebuilding trust requires improved communication. The society show a lack of knowledge specifically about the definitions, classifications and methods adopted by statistics, and also a lack of awareness of the reality that statistics are not “facts,” but the result of a production process, of the application of human intelligence and specific techniques to data collection (Best, 2004). So we realized that

before presenting the data we should provide the net, the grid through which the data get their meaning and their significance.

The history of science is rich with examples of data collections that played a crucial part in a scientific revolution, which in turn had a major impact on society. It may truly be said that data are the lifeblood of science.

Managing data and passing useful information can be quite daunting when faced with the potential for inaccurate models and erroneous results. It is important to work with standardized rules that help develop the best possible models to better manage data in a meaningful way. Data forms are as numerous as the transactions they represent. Data can be a list of numbers, text characters, locations, product categories, a specific time, financial histories, travel patterns, or any other figure used to represent an event. For each of these data points, Data Mining can be successfully employed to uncover existing patterns of behaviors that provide insight and offer predictable indicators for future transactions. Asking the right questions, however, is the key to discovering meaningful results that provide a critical level of guidance from the data itself. Valid results are the key to useful analysis techniques that help provide a clear picture of future behavior. Random errors can skew results in unpredictable ways, altering the final analysis and cause significant problems in predictability patterns. (2009 © AGS Analytics LLC)

Scientific information in general and statistical information in particular hit the audience without a familiar pattern, so that the mind is not able to build a scheme using already known information and to represent the world through social and cultural metaphors (Lakoff and Johnson, 1980). This process is necessary for the transition from data that is the quantitative representation of a phenomenon captured in the moment it happens or is produced, to information which is the comprehension and interpretation of data, stemming from the interaction of social actors and the attribution of meaning on the receiving side, to knowledge which is the attribution of value to the information, depending on the perspective of satisfying specific users' needs and using the information in a decision making process.

The United Kingdom has a long history (dating from 1799) of promoting the awareness of science and technology. In 1985, the Royal Society set up a working group to look at the nature and extent of public understanding of science (PUS). One of the outcomes of the resulting *Bodmer Report* was the establishment of the Committee on the Public Understanding of Science (COPUS). In 1993, a White Paper committed the Government to support a campaign aimed at raising public awareness of the contributions of science, engineering and technology.

WAY FORWARD

The following are the suggested way forward of promoting the understanding of science through data:

1. Data Accuracy

Data accuracy is the foundation dimension of data quality. If the data is wrong, the other dimensions matter little. Accuracy refers to whether the data correctly records the business object or event it represents. It has two requirements: it must be the right value and it must represent the value in a consistent form with all other representations of the same value. For the past few decades, the issue of missing data due to any forms of human error had contributed to the cause of inaccurate data. Aladeniyi et el (2009) proposed some new techniques which are in perfect agreement with some existing methods of solving missing data. These techniques $\sum \log x_i / n$ and $1/\sqrt{\bar{x}_i}$ proved to handle more efficiently the problem of missing data when the data set is small; in

any multivariate data set; and goodness of fit is best when missing values are randomly distributed.

2. Statistical Literacy

Citizens at large have no familiarity with the language and the concepts of statistics, with the result that often they are not able to understand precisely the meaning of the figures measuring economic and social phenomena, even if the decisions of people, business and administrations are growingly based on statistics. Freedom of access to statistical information is a way to attenuate information asymmetries (Stiglitz, 1981) and contribute to the progress of a democratic knowledge society, but is ineffective if citizens are not literate, i.e., if they lack the tools to read, understand and analyse statistics; these tools are acquired in school and in lifelong learning, with an interaction between different subject matters and between theory and practice. This set of tools is necessary to professional users (to statisticians, but also to biologists, physicians, sociologists, economists …), and the gap is being bridged at the curricular level. But we think that this is not enough: it needs to be a shared asset, to accustom people to rational and informed decision making. The hypertext makes an effort to develop critical awareness in the use of statistical information, that is the ability to discriminate between reliable and quality-certified statistical information (like official statistics tries to produce) and the results of polls (where the methods used in the production process are seldom disclosed).

3. Increasing the trust in statistics

Official statistics deals with issues sharing a public character *per se* (health, education, environment …) or relevant from the viewpoint of public information (economic output, energy, credit …) (Stiglitz, 1999). Here, too, the mention of the National statistical plan is important: statistical surveys included in the plan are the result of a complex programming exercise and reflect a national priority (even if it includes statistics required by international agreements and European Union regulations), respect established quality rules and, in most cases, are compulsory for the respondents. In a democracy, establishing (*ex ante*) which statistical information is to be collected is an assurance of its relevance (*ex post*), because it identifies the issues and subjects that the majority of people want to be informed about. A central feature of official statistics is indeed its quality and, as a consequence, the underlying organization of statistical production. Quality and relevance are the pillars of trust in public statistics. On one hand, the quality of the production process and of the products and services disseminated to the public – where official statistics still has an edge, even if its monopoly on statistical information is over –play an important role in establishing trust (Economic Secretary to the Treasury, 1998). On the other hand, the actual use of data and the awareness of users contribute in augmenting it: when information is plentiful, the usual inverse relationship between scarcity and worth is not valid. On the contrary, familiarity and reputation come into play. Users value most the information coming from a source that, in the past, has proved of being trustworthy, dependable, able to provide relevant and good-quality information based on shared standards.

4. Critical use of statistical information in everyday life

Statistics are often perceived as an annoyance: they entail transparency in decision making, they force to compare wishes with constraints, they unveil announcements and promises without a follow-up, they allow the evaluation and control of policies and actions. Dandekar (1977), as a president of the *National sample survey organization* in India, noticed already in the seventies

that when policy makers find that the statistical data disagree with their opinions, they tend not to trust the evidence or, if more sophisticated, asks for additional data and details. If literacy is the capability of expressing oneself and understanding, so as to be able to relate with other people and eventually administrations, statistical numeracy is the ability to understand, appreciate and use simple symbolical expressions (numbers and charts).

CONCLUSION AND RECOMMENDATIONS

To turn a body of data into useful information for knowledge-based decision-making at any level, data must be collected, organised, analysed and reflected upon as follows:

i) the importance of science for the future development of the information society, and
ii) the needs of the scientific community from that information society as necessary for the advancement of science and for the benefit of society as a whole.

To engage in activities, which promote public understanding of science, so it may play a more meaningful role in society's decision-making and governance.

Given the substantial investment in data collection and its importance to society, it is equally important that data are used to the maximum extent possible. Data that were collected for a variety of purposes may be useful to science. Legal foundations and societal attitudes should foster a balance between individual rights to data and the public good of shared data.

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