Exploration of skills and conceptual knowledge needed for understanding statistics about society: A workshop

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1. Background

This document summarizes a workshop given at the IASE Roundtable held July 19-22, 2016 at the Max Planck Institute for Human Development in Berlin, Germany. The Roundtable was organized by the International Association for Statistical Education (IASE) in collaboration with the ProCivicStat (PCS) project. Information about the conference can be found on the conference website: http://iase-web.org/conference/roundtable16; information about PCS can be found here: http://community.dur.ac.uk/procivic.stat.

The workshop was prepared by the authors as an interim product of PCS, a strategic partnership of the Universities of Durham, Haifa, Ludwigsburg, Paderborn, Porto and Szeged, funded by the ERASMUS+ program of the European Commission. PCS was established in order to contribute to the preparation of young people in Europe and beyond for responsible citizenship, in terms of their ability to be aware of and understand "Civic Statistics", i.e. statistics and quantitative evidence and about key social phenomena that permeate civic life, such as migration, demographic change, crime, employment and poverty. PCS is predicated on the assertion that an understanding of Civic Statistics is essential for adults in democratic societies; however, the comprehension and critical interpretation of Civic Statistics often requires understanding of topics and issues that are different from or go beyond the knowledge gained from regular statistics curricula.

A conceptual framework developed by ProCivicStat assumes that Civic Statistics have the following characteristics: they involve *multivariate phenomena*, i.e., phenomena whose description and understanding involves a number of variables that often are *correlated*; variables *interact*; and they often have *non-linear* relationships. In addition, Civic Statistics often involve data that are *aggregated*, and are made available to the public via multiple channels through the use of *rich texts* and rich and diverse *visualizations,* many of which are *dynamic* or facilitate or expect user *interaction.* Not all characteristics will appear in all presentations of Civic Statistics. Yet, overall, Civic Statistics present unique demands to citizens, if they are to be understood.

PCS partners assert that to equip [young] adults well to face the challenges of an increasingly data-rich world and engage statistics about society, current curricula would benefit from being revised to incorporate some new concepts and methods (see Ridgway, 2015; Engel, Gal, and Ridgway, 2106). Towards that end, PCS works to create new teaching materials and resources for educators working at the high-school level and at the university (post-secondary) level. An early challenge is to map the skills needed to understand presentations of Civic Statistics in a variety of media; this was the focus of the Workshop.

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2. About this workshop

The workshop aim was to familiarize participants with the nature and unique demands of Civic Statistics through "hands on" experiences, and to ask them to reflect on the skills and knowledge needed to critically evaluate the information presented. Towards that end, the authors prepared a booklet with 14 Civic Statistics tasks, i.e., authentic materials (texts and displays) involving concepts or ideas that portray trends and changes in society, and that encapsulate many of the key characteristics of Civic Statistics described in Section 1, coupled with questions about these materials. The materials were sampled from diverse sources, e.g., publications of official statistics agencies, articles in TV, newspapers and web-based news channels, advocacy groups and NGOs, academia, etc. Examples can be viewed at http://community.dur.ac.uk/procivic.stat/index.php/publications/. The tasks were designed to provoke participants' reflections about the statistical knowledge and skills that [young] adults need for civic engagement, and about needed changes or new directions in statistics education. The booklet first showed tasks focused on graphical displays or dynamic data visualizations (and participants could access a URL inside a task, to see it in full), followed by text-based tasks, all taken from a very broad collection, to illustrate a range of real-world demands on citizens, and to provoke participants' thinking.

At the workshop, participants were divided into small groups and asked to:

- Read the tasks assigned to their group,
- Answer specific Analysis questions embedded in each task, reflecting different things that a citizen may wish to understand or know based on the given information,
- Fill in a Task Reflection Form after each task,
- Discuss their thoughts in their small groups.

Task Reflection Forms asked participants to think what knowledge & skills *they* used to understand the materials in the tasks. A *simple* conceptual model (in the form of a cube) – shown in Figure 1 - was used as a starting point to support discussions on the skills and knowledge needed to comprehend and critique the materials presented. Participants were also asked to think about how tasks could be used in instruction.

Thinking and reflection were a critical aspect of the workshop. After the work in small groups described above, all participants engaged in a general discussion and exchanged ideas on the demands of the tasks and the implications for teaching and future directions.

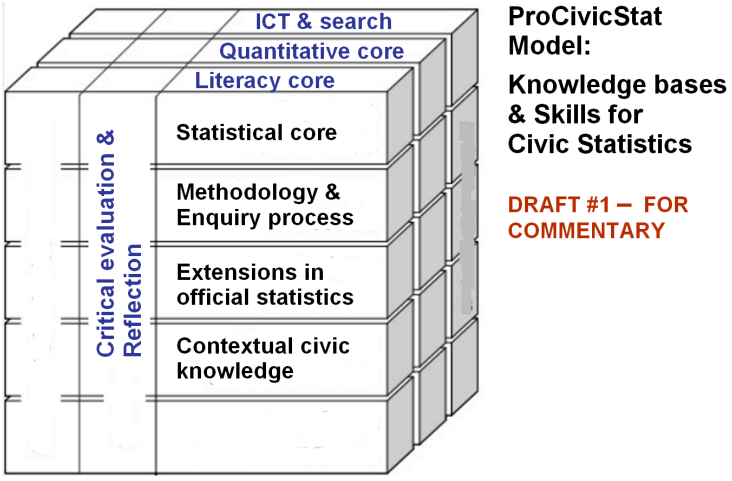


Figure 1: A representation of knowledge and skills necessary to understand Civic Statistics (note: This early model was shown at the workshop, but has now been revised and expanded)

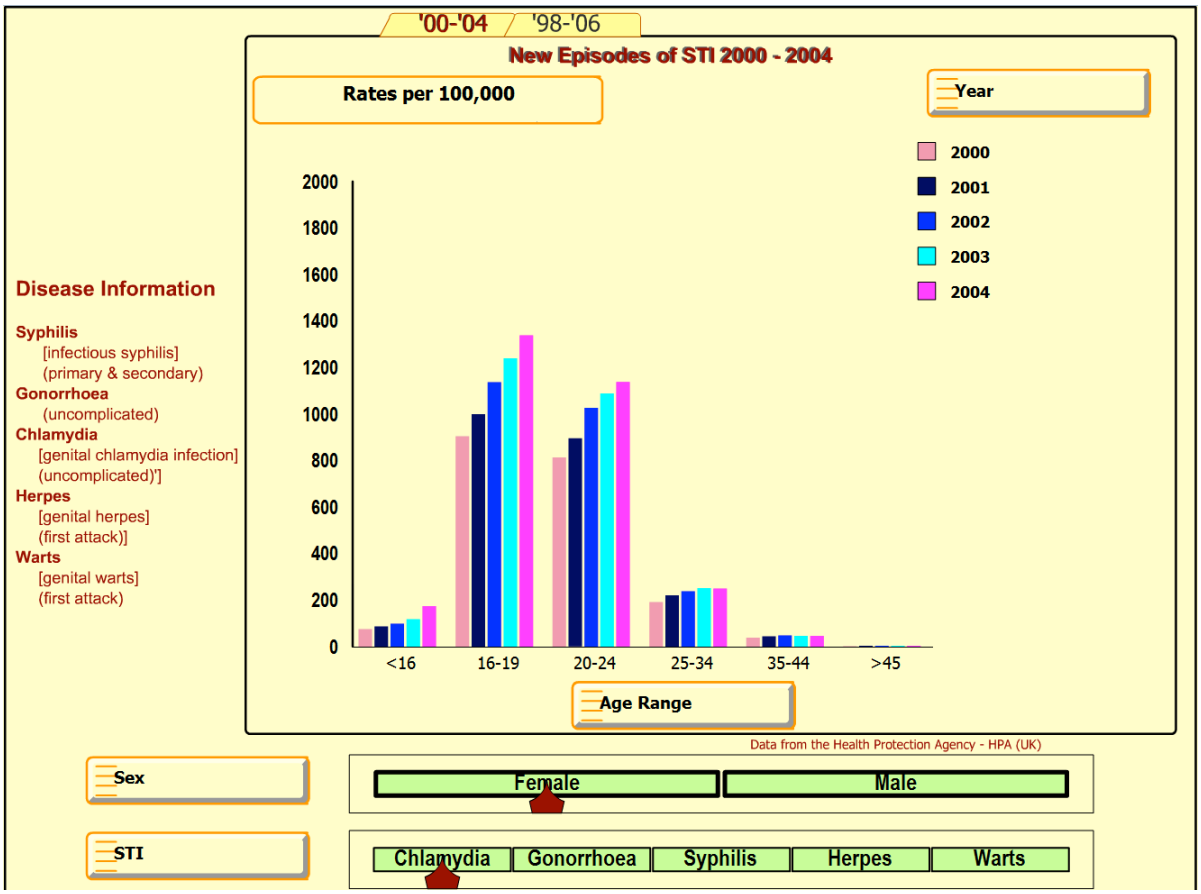
3. Examples of Civic Statistics tasks and their analysis

To illustrate the above ideas, we present two examples from the Task Booklet.

Display 1 is taken from the SMART Centre website at Durham University, UK. It shows a screen shot of a visualization regarding trends in sexually transmitted diseases in the UK, over several years and in different age groups. You can see and *interact* with a *dynamic* version of this visualization at this URL: www.dur.ac.uk/resources/smart.centre/Freeware/STI_GUM_update1.swf The sliders at the bottom can be used to explore trends over time for different diseases or for males and females separately. Variable names can be dragged to different locations to create different graphs, and enable exploration of a range of functional relationships.

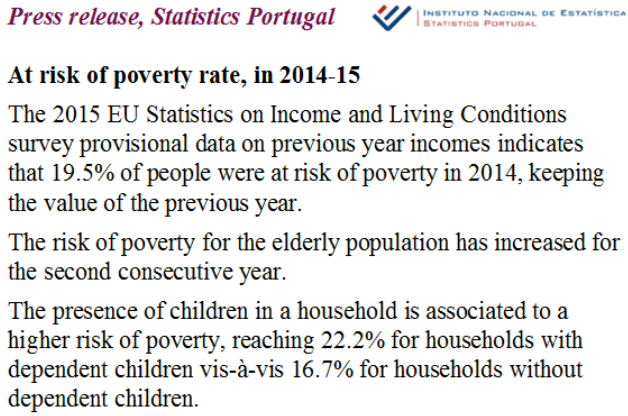
But before you continue, please ask yourself: Which characteristics of Civic Statistics and of the factors listed earlier and in the model in Figure 1 are illustrated by this visualization?

Display 1: Incidence of new episodes of sexually transmitted diseases in England and Wales



The visualization in Display 1 illustrates several characteristics and demands of Civic Statistics, such as the multivariate and dynamic nature of Civic Statistics, and the use of aggregations, or presence of interactions between variables. It also illustrates the importance of skills related to several of the facets in the conceptual model shown in Figure 1, both regarding the handling of dynamic visualizations, and understanding both the statistical and contextual information in them.

Display 2: News about poverty - press release from an official statistics agency



Press release, Statistics Portugal INSTITUTO NACIONAL DE ESTATÍSTICA STATISTICS PORTUGAL

At risk of poverty rate, in 2014-15

The 2015 EU Statistics on Income and Living Conditions survey provisional data on previous year incomes indicates that 19.5% of people were at risk of poverty in 2014, keeping the value of the previous year.

The risk of poverty for the elderly population has increased for the second consecutive year.

The presence of children in a household is associated to a higher risk of poverty, reaching 22.2% for households with dependent children vis-à-vis 16.7% for households without dependent children.

Display 2 is an excerpt from a somewhat longer (1-page) press release of an official statistics agency. Despite being brief, it illustrates several of the characteristics of Civic Statistics, for instance it shows how the level of poverty cannot be described or understood by itself, without involving additional variables, such as age or the number of children in a household, how statistics change over time, and how text is a primary reporting medium.

The sample displays also illustrate the need for adults to be able to critically reflect on the origin (provenance) and quality of data, and how variables or social phenomena are defined and measured. For instance, in the case of sexually transmitted diseases, these data are national data collected from clinics – but people have to choose to go to a clinic before they appear in the data set, affecting representativeness of the data. Also, the data shown are several years old hence users have to worry about another aspect of representativeness that relates to time and not sampling.

4. Importance and Outcomes

The professional literature in statistics education is lagging behind on the issues targeted by this Workshop, given the richer range of modalities in which statistical information on social issues reaches the public, and the unique nature and demands of "Civic Statistics" tasks as described by ProCivicStat. The current content of traditional statistics courses does not prepare students for this brave new world, and a reform both of curricula and teaching methods is necessary if we are to provide appropriate experiences for our students and prepare them to engage with Civic Statistics. This reform needs to be based on a firm conceptualization of the domain, a challenging topic on which PCS partners continue to work.

The Workshop was a source of useful ideas and will help the revision of our conceptual framework. Future work will integrate the individual knowledge and skill components identified by each group into a revised conceptualization of the domain of Civic Statistics. We believe (and written feedback supports the idea) that the Workshop was valuable to participants. We hope that the Workshop contributed to enriching the personal understanding of researchers and educators regarding skills that need to be developed; we plan to circulate a revised conceptual framework to participants.

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5. References

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