Discussion on IPM 71: Educational implications of statistical method and modelling developments in psychometry

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1. General comments

The four presented papers are all very interesting and very diverse and I see three clusters! But variability is the wealth of nature.

The two papers by Stefanutti-Cristante and Delbeke deal with assessment and improvement of teaching psychometry and can be grouped in the same cluster. It is worth noticing that in Stefanutti-Cristante, psychometrics is used as a tool to evaluate psychometric teaching. Delbeke argues that "teaching statistics, psychometrics and formal modeling techniques to psychology students can be based to a large extent on the same principles as those advocated teaching mathematics in primary and secondary education". My feeling is that the methodologies and conclusions which are drawn in these two papers are valid not only for psychometric curricula, but for most others. The title of the session could be understood as the impact of statistics and psychometrics on education and not specifically in psychometric education. Who may contest that "opportunity to learn", "focus on meaning", "motivation and interest" are fundamental not only in learning mathematics or psychology but also in physics, chemistry and why not history etc.? I was not familiar with the theory of Doignon and Falmagne of knowledge spaces, but here again nothing prevents to apply it in other fields than psychometrics. A survey reported by Delbeke states "Only one fourth (among US departments of psychology) rated their graduate students as skilled with psychometric methods and concepts": evaluation of skillness is precisely the topic of Stefanutti-Cristante paper.

The two other papers are very different from the previous ones: Micko gives a stimulating epistemologic discussion on science and its theoretical fictions, useful for predictions and the role of statistics. Nicolau's paper, on the opposite side is far more technical and reports how the teaching of what seems a specific method for clustering variables, provides extremely useful insights on measurement, distance, probabilistic reasoning and statistical tests without hard mathematics.

2. Specific comments and questions

On Nicolau's paper: the distribution of the statistic of interest is obtained by permutation. Permutation tests are well known since Fisher, but now bootstrap resampling seems more fashionable. Is there some reason to prefer permutation to bootstrap?

On Delbeke's paper and more precisely the last paragraph about the use of computers: if use of statistical software is a necessary skill that has to be acquired, the author seems skeptical about computer based learning systems. As one of the conceptors of St@tNet (the french system for learning introductory statistics), my opinion is the following: no computer system can replace a human teacher, and I agree that it is an "ersatz" for distance teaching and overcrowded classrooms. On the other hand, an intelligent use of teachware, greatly helps students who have not a high mathematical level, to understand some difficult concepts through the use of simulation: for instance convergence, approximations, influent observations. But it is necessary that such software be different from an electronic book and includes a great deal of interactivity, such as in the Vestac system developed at Leuven University (Darius, 2000).

On Stefanutti-Cristante's paper: is there a connection between the knowledge space model and item response theory, including Rasch model? Is the assumption that careless error and difficulty parameters are constant over subjects a realistic one?

3. Perspectives

About teaching statistics and other related fields: this session confirms my opinion that evaluation of courses, discussion on the best way of teaching etc., should be done on a scientific basis by true researchers (like in this session) and not by self-proclaimed experts in teaching, as it is too often seen. It is a real problem, since usually researchers have few time to devote to meetings focused on teaching, and the result is that incompetent people have too much influence.

In the four papers, statistics is considered as an auxiliary of science, or as a scientific field. But there is an other use of statistics for business decisions, which is motivated only by looking for the most efficient algorithms. I refer here to "data mining" which offers new perpective to data analysis and is successfully applied to several fields. Of course some could say that it is not science, but the idea that a model is not choosen through a theory but by exploring thousands of possibilities and keeping the one which fits to the data (even if it is a black box), is a new way of doing inference for very large bases (D.Hand): the quality of a model is its predictive capacity, measured on an independent set of observations. For sure, as the case of "diapers and beer" in association rules, one may finally find spurious relationships, but is it so different from multiple comparisons? It is well known, but seldom taught in introductory statistics courses, that the classical theory of tests is not applicable for very large data sets since any hypothesis is rejected.

My belief is that we cannot ignore this new trend, since the risk, as J.Friedman pointed, is that statistics would be taught and done by computer scientists, if statisticians stay with a restrictive view of their field. Data mining has educational implications since it implies new ways for inference, see Hastie and al. for a nice presentation of statistical learning theory.

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