ASSESSING LEARNING BY STUDENT'S OWN EXAMINATION TASKS. EXPERIENCES FROM RESEARCH COURSES IN BIOSTATISTICS

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PhD students and others from all kinds of disciplines have the need for statistical learning and understanding in common. For that reason, research courses in research method and biostatistics are open for all kinds of participants, which mean that a large variety of applied topics are represented in each course. The participants are commonly involved in the research process on different stages, some of them having only a research topic, others have collected all data. Furthermore there is also a variation in opinion about statistics, not regarding the need for statistics but the concerns about the demand for mathematical skills etc. The heterogeneity of the participants' research fields and experience in research is a real challenge in teaching but also in assessment of learning. However, a common issue is that all participants are highly motivated as they need knowledge and understanding in statistical thinking and literacy. The aim of this paper is to present the experiences of an examination approach in which the participants get the opportunity to formulating their own examination tasks based on own research problems and to solve them. This approach not only improved the participants' learning and understanding, but good statistical practice was also implemented the research group as a whole.

INTRODUCTION

The concept statistics is used in various contexts which is a source of different prejudices of the value of statistical knowledge in the research process. For example, official statistics refers to data bases of variables important for society, but provides also population based data for researchers, and sampling issues. Applied statistics is a necessary tool in study design and data analysis in most research topics, and statistics, or statistical science, is a scientific subject of its own.

There is an ongoing methodological development of statistical methods applicable to research questions of various complexities, not only due to theoretical developments of statistical methods but also because of the access to computer intensive methods that can handle multivariate problems. Liu and Agresti (2005) stated in a review paper regarding statistical methodological development of methods for ordinal data analysis that the main challenge now is to make the novel methods better known and used, in order to increase the quality and validity of analyses and of scientific conclusions.

My experience from research in life sciences is that the preference for traditional methods is stronger than the willingness to use novel statistical methods, even when the traditional methods are inappropriate or wrong (Svensson, 2001a, Svensson, 2002). This is a behaviour that is detrimental to the scientific quality of the study. Furthermore, the general accessibility to statistical software could also be serious disadvantage of the quality of applied research when methods and results are used without enough statistical knowledge (Altman, 1994; Svensson, 2001a). Altman has reviewed the statistical quality of papers published in high ranked journals and concluded that a majority (about 80%) of papers had inadequate statistical methods and conclusions. He recommends statisticians to take the responsibility and offer journal to reviewing papers. (Altman, 1991; Altman, 1998) It is also a prerequisite to inform and teach statistics and statistical literacy to non-statisticians in order to improve the quality of research.

PhD students from all kinds of disciplines have the need for statistical learning and understanding in common. They are often open to new statistical methods, but also tied to the supervisor's preference to statistical methods (Svensson, 2001a, Svensson, 2002). In order to meet the demand for learning about performing good research, I arrange research courses in scientific methods and biostatistics open for all kinds of participants, which means that a large variety of applications and types of studies are represented in each course. The outline of such a course was reported at ICOTS 5 (Svensson, 1998a; Svensson 1998b). The participants used to be

involved in the research process on different stages; some of them having only a research topic others have already collected all data. Furthermore there is also a variation in opinion about statistics, not regarding the need for statistics but concerns about the requirements of mathematical skills etc. The heterogeneity of the participants' research fields and experience in research is a real challenge in teaching. A common issue, though, is that all participants are highly motivated as they want knowledge and understanding in statistical thinking and literacy.

The aim of this paper is to present some experiences of an examination approach in which the participants get the opportunity to formulating their own examination tasks based on own research and solve them. The examination approach of extended courses of biostatistics is also mentioned.

TEACHING PRACTICAL BIOSTATISTICS.

The main characteristics of my courses are that they are designed for multi-professional PhD students, and preferably for research groups including the supervisors. The outline of the course and the experiences from courses involving research groups have been reported at previous ICOTS meetings (Svensson, 1998a; 1998b; 2002). This paper will focus at the link between the teaching approach and the assessment of student learning and the impact of these issues on the quality of research.

The key features of a basic course in practical biostatistics is that:

- It is *multi-professional*, and when students of statistics also take a course on biostatistics at the same time, most lectures, except the most theoretical ones, are joint with the non-statisticians', in order to train the statisticians to transform their theoretical based statistical knowledge to practical statistical understanding and use.
- It is *interactive*, which means that the methodological and statistical methods were applied to specific research questions when relevant.
- It involves the *design issues*, especially the *measurement process* (Svensson, 1998b). Identification of important variables of a study, their operational definitions, and the measurement properties of data are comprehensively discussed. The choice of statistical methods for description and analysis depends on the properties of data. For example, the statistical methods for ordered categorical data differ completely from the methods useful for quantitative data (Svensson, 2001a; Svensson, 2001b, Svensson 2002).
- It involves the *choice of statistical methods* for description and analysis of the participants' research questions.
- It involves *review of scientific papers* from the participants' field of interest. The participating statisticians must then cooperate with the PhD students from the applied research fields for gaining a mutual understanding of the content of the paper.

ASSESSMENT OF STUDENTS LEARNING

The courses are interactive and since the statistical methods learned are applied to the participants' research problems when appropriate, and the follow-up discussions are not only a part of the learning process but also a step-wise examination procedure.

The communication skills of the participating students of statistics are self-acting assessed. If they fail to understand the applied problems, they could not perform the measurement process, the literature review and the PhD students could not perform the tasks regarding statistical literacy, i.e. the interpretation of statistical documentation and judgements on the appropriateness of the statistical methods used.

In the final examination the PhD students are offered to replace some of the examination problems by problems related to their own research. Topics for formulation of own examination

problems are: the measurement process, study design, descriptive statistics, statistical problem solving, analysis, interval estimation, interpretation and scientific documentation.

The statisticians have to solve an applied research problem regarding a data set from a PhD student with additional requirements concerning data screening, theoretical statistical motivations, and suggestion of possible alternative methods of description and analysis.

EXTENDED COURSE IN PRACTICAL BIOSTATISTICS

The use of questionnaires and subjective assessments by rating scales is very common in life sciences, and many PhD students need a deeper knowledge of statistical methods for evaluation of data from subjective assessments on rating scales. Additional to the basic courses in practical biostatistics and to the joint research courses in rating scale data analysis (Svensson, 2001a). PhD students in clinical or behaviour sciences can attend an extended course in practical biostatistics provided that they are going to analyse data for a scientific paper. The lectures are focused at statistical methods for evaluation of data from questionnaires and rating scales, but other types of complex statistical approaches can be included, when needed.

The examination task is to complete all methodological and statistical parts of a scientific paper, which includes design issues and the statistical problem solving, including statistical description and analysis, must be of high quality.

EXPERIENCES GAINED FROM ASSESSING LEARNING BY STUDENT'S OWN EXAMINATION TASKS.

In my previous presentations at ICOTS meetings I have described my teaching approaches to arrange joint research courses, involving statisticians and non-statisticians and/or PhD students, research groups and supervisors (Svensson, 1998a, 1998b, 2001a, 2002).

The PhD students appreciate the possibility of formulating their own examination problems, and this task is the ultimate assessment of learning. Most of the students' problems have been much more comprehensive than have my examination problems. It is amazing to experience the satisfaction of students doing more demanding examination tasks than required, and they appreciated the possibility of learning good statistical practice by doing so in their own research.

For me, as a teacher, this interactive approach to assessment of learning is demanding and strenuous, but above all very stimulating. My reward is to experience the increasing awareness among the participants of the possibilities and limitations of statistical methods. They develop respect and sense of responsibility regarding data management and analysis as the results could be used for evidence based medicine, rehabilitation and other decisions in society.

This approach not only improved the participants' learning and understanding, but good statistical practice was also implemented to the research group as a whole. Irrespective of the opinion of non-traditional statistical methods the members of the research group have to accept good statistical performance in at least one paper, especially as they often wanted to be co-authors of the research paper.

Another result of this approach to assess learning is that good statistical practice is published in various journals representing different disciplines, which is one way of marketing statistical methods (Altman, 1998, Liu & Agresti, 2005). A few examples are given in Table one below.

Table 1
Examples of published examination papers of various disciplines written by participants in research courses of Biostatistics.

Paediatric ophthalmology	Hellström et al., 1997; Hellström et al.1998
Paediatric radiology	Müller et al., 2000
Occupational therapy	Gosman-Hedström & Svendsson, 2000, Claesson&Svensson, 2001, Dahlin-Ivanoff et al, 2001
Paediatrics	Berntson & Svensson, 2001; Berg, 2002
Social work	Starke&Svensson, 2001
Radiology	Svensson et al, 2002a, 2002b.
Immunology	Lagging et al., 2002; Westin et al. 2002
Nursing research	Forsberg et al, 2002
Neuropsychology	Engman et al., 2004
Physiotherapy	Lund et al., 2005

REFERENCES

Altman, D.G. (1991). Practical statistics for medical research. London; Chapman & Hall.

Altman, D.G. (1994). The scandal of poor medical research. *British Medical Journal, 308,* 283-284.

Altman, D.G. (1998). Statistical reviewing for medical journals. *Statistics in medicine,* 17, 2661-2674.

Berg, S., Trollfors, B., Hugosson, S., Fernell, E.& Svensson, E.(2002). Long-term follow-up of children with bacterial meningitis with emphasis on behavioural characteristics. *European Journal of Pediatrics, 161,* 330-336.

Berntson, L. & Svensson, E. (2001). Pain assessment in children with JCA; a matter of scale and rater. *Acta Paediatrica, 90,* 1131-1136.

Claesson. L. & Svensson, E. (2001). Measures of order consistency between paired ordinal data: application to the functional independence measure and Sunnaas index of ADL. *Journal of Rehabilitation Medicine, 33,* 1-8.

Dahlin-Ivanoff, S., Sonn, U. & Svensson, E.(2001). Development of an ADL instrument targeting elderly persons with age-related macular degeneration. *Disability and Rehabilitation, 23,* 69-79.

Engman, E., Andersson-Roswall, L., Svensson, E. & Malmgren, K.(2004). Non-parametric evaluation of memory changes at group and individual level following temporal lobe resection for pharmaco-resistant partial epilepsy. *Journal of Clinical and Experimental Neuropsychology, 26,* 943-954.

Forsberg, A., Bäckman, L. & Svensson, E.(2002). Liver transplant recipients' ability to cope during the first 12 months after transplantation – a prospective study. *Scandinavian Journal of Caring Sciences, 16,* 345-352.

Gosman-Hedström, G., Svensson E. (2000). Parallel reliability of the Functional Independence Measure and the Barthel ADL index. *Disability and Rehabilitation, 22,* 702-715.

Hellström, A., Hård, A.L, Niklasson, A., Svensson, E.& Jacobsson, B. (1998).Abnormal retinal vascularisation in preterm children as a general vascular phenomenon. *The Lancet, 352,* 1827.

Hellström. A., Svensson, E.& Strömland, K. (1997). Eye size in healthy Swedish children and in children with fetal alcohol syndrome. *Acta Ophthalmologica Scandinavica, 75,* 423-428.

Liu, I. & Agresti, A.(2005).The analysis of ordered categorical data: An overview and a survey of recent development. *TEST, 14,* 1-73.

Lagging, L.M., Westin, J., Svensson, E., Aires, N., Dhillon, A.P., Lindh, M., Wejstål,R. & Norkrans, G.(2002). Progression of fibrosis in untreated patients with Hepatitis C virus infection. *Liver, 22,* 136-144.

Lund. I., Lundeberg, T., Sandberg, L., Norrbrink Budh, C., Kowalski, J. & Svensson, E.(2005). Lack of interchangeability between visual analogue and verbal rating pain scales: a cross sectional description of pain etiology groups. BMC Medical Research Methodology, 5,31 doi:10.1186/1471-2288-5-31 http://www.biomedcentral.com/1471-2288/5/31

Müller, L., Bergström, T., Hellström, M., Svensson, E.& Jacobsson, B.(2000). Standardized ultrasound method for assessing detrusor muscle thickness in children. *The Journal of Urology*, *164*, 134-138.

Starke, M. & Svensson, E. (2001) Construction of a global assessment scale of family function, using a questionnaire. *Social Work in Health Care*, *34*, 131-142.

Svensson, E. (1998a). Teaching biostatistics to clinical research groups. In L. Pereira-Mendoza, L. Seu Kea, T. Wee Kee, & W. K. Wong (Eds.), *Proceedings of the Fifth International Conference on Teaching Statist*ics (pp. 289-294). Singapore: International Statistical Institute.

Svensson E. (1998b). Teaching the measurement process in biostatistics. In L. Pereira-Mendoza, L. Seu Kea, T. Wee Kee, & W. K. Wong (Eds.), *Proceedings of the Fifth International Conference on Teaching Statistics* (pp. 1257- 1262). Singapore: International Statistical Institute.

Svensson, E. (2001a). Important considerations for optimal communication between statisticians and medical researchers in consulting, teaching and collaborative research –with a focus on the analysis of ordered categorical data. In: Batanero C. Ed. Training researchers in the use of statistics. Granada: *International Association for Statistical Education*, 23-35.

Svensson, E. (2001b) Guidelines to statistical evaluation of data from ratings scales and questionnaires. *Journal of Rehabilitation Medicin*e, *33*, 47-48.

Svensson, E. (2002). Teaching statisticians and applied researchers statistical methods for analysis of data from rating scales. Experiences from joint research courses in rating scale data analysis. In: Phillips B, ed. Developing a statistically literate society. *CD of the Proceedings of the Sixth International Conference on Teaching Statistics*, 7 - 12 July, 2002,Cape Town, South Africa (ISBN: 085590 782 7) International Association for Statistical Education, International Statistical Institute.

Svensson, M.H., Svensson, E. & Hellström, M.(2002a). Bowel wall visualisation at CTcolonography. *Acta Radiologica*, *43*, 87-95.

Svensson, M.H., Svensson,E., Lasson, A.& Hellström, M.(2002b). Patient Acceptance of CT Colonography and Conventional Colonoscopy: Prospective Comparative Study in Patients with or Suspected of Having Colorectal Disease. *Radiology*, *222*, 337-345.

Westin, J., Lagging, L.M., Spak, F., Aires, N., Svensson, E., Lindh,M., Dhillon, A.P., Norkrans, G. & Wejstål, R. (2002).Moderate alcohol intake increases fibrosis progression in untreated patients with hepatitis C virus infection. *Journal of Viral Hepatitis*, *9*, 235-241.