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# DISCUSSION: HOW TECHNOLOGY AFFECTS THE TRAINING OF RESEARCHERS

As is generally recognised, the rapid progress of information technology typically represented by the Internet has had a tremendous effect on areas as various as industry, education and social science.

I shall start this discussion with some general comments about the essential factors of information in messages involving two different players namely sender and receiver of the message. While the sender wants to transmit rapidly a large amount of information with as low cost as possible, the receiver wants to get the most valuable and newest information for himself. The modern bilateral communication tool has successfully bridged these gaps between them by constructing visual and compressive technologies.

In the educational area the sender of information is a teacher and the receivers are students in the classroom where special kinds of communication beyond the usual conversation levels are requested, focusing on how to effectively learn contents of subjects. One major problem for the classroom teaching rests with the teacher who has to develop his or her own techniques and ability to communicate adequately.

At the present stage of statistical education, personal computers have entered providing splendid ability for computation and access to Internet technology, which can instantly transmit a huge amount of information to the whole world. With respect to this point it should be noted that these functions of personal computers correspond perfectly to the quantitative analysis and large data processing evident in statistical analyses.

## 1. OVERVIEW OF PAPERS

In this session we have five papers and among them three are directly related to the application of information technology.

First, Galmacci's paper summarises valuable and fruitful information and teaching materials on statistics education by referring to homepages, electronic journals, statistics agencies, electronic books and software archives mainly produced by statisticians and statistics educators. The importance of this kind of work is increasing so much by the day that researchers and consultants are hard pressed to keep up with advancing studies. This paper should be recognised as a pioneering contribution in this respect.

In Stangle's paper, special attention is paid to two questions, why Internet-based instruction, and why the Bayesian paradigm. In designing an Internet course for medical researchers, these questions occupy essential positions for constructing progressive interaction between simulation demonstration by the Internet and the decision side of

Bayesian statistics. Bayesian statistics especially plays an important role in building user- oriented image processes, carrying out visual and sophisticated changes of a posterior distribution according to the choice of prior distribution and the likelihood based on the sample data. But, in order to get optimal decisions, there remain crucial problems and we have to construct a payoff or loss table reflecting medical situations. There are have great expectations of further development according to the author's discussion.

On the topic of teaching biostatistics to medical personnel with the aid of computer technology, Lee concludes from a sample survey that the new teaching method of utilising Internet facilities has comparative advantages over the traditional way in health science courses in Korea National Open University. It should be added, however, that the traditional way of keeping close contact between teachers and students by using handy graphic calculators exhibits considerable effectiveness at least in the primary stages of training.

At this stage I am reminded of the time in the meeting, when I displayed several applets in the *Journal of Statistics Education* v.6, n.3, presented by W. West and T. D. Ogden, which by one click operation, show the effect of changing width intervals in histograms, the effect of influential points in regression and the effect of the number of trials on limit theorem. Many participants expressed strong doubt about the effectiveness of these images for teaching undergraduate students. In addition to these direct uses of the Internet, the Internet has the additional use of permitting communication among students through e-mail and promoting co-operation in learning statistics. The Internet will become the most powerful tool for better teaching and learning in the near future.

In his paper Professor Shimada warns students against blind reliance on software packages and emphasises the importance of finding a suitable model with its solution for given situations. Today we have a lot of software packages so well organised and sophisticated that we can not easily rewrite or improve them without expert knowledge. As the paper shows, it may be profitable enough for undergraduate students even though established software packages have a risk of leading to incorrect conclusions. But for graduate students or researchers it becomes important to develop new models corresponding to given situations. At this point the paper shows the specific results in which the parameters of the proposed model are successfully estimated with some additional processing.

The issues addressed by MacDonald have implications for training and the skills needed by social science researchers when they consider undertaking research using official statistical micro data in New Zealand. The following points will support the argument of this paper: First, as decentralisation is taking place in every area, many social science researchers are becoming concerned about local or special field studies that need the use of official micro data. In general, statistical acts are preventing them free usage of such micro data and in addition it needs very complicated treatment. It takes a long time for a researcher to get permission to use official statistics for private purposes. They are also not likely to understand the environment of micro data and the state sector in the course of study.

Secondly, since the rapid development of network systems has changed modern industrial society structurally, many social scientists need to analyse these new mechanisms with official micro data. They need a new kind of statistical micro data reflecting new trends. At the same time, the necessity of a new kind of official data is becoming greater. Even local governments also are responsible for providing such

official micro data. In all these respects the paper contributes to establishing practical and educational principles for researchers to share official micro data.

## 2. TRAINING OF RESEARCHERS IN JAPAN

Finally I would like to include some comments on the situation of Japanese statistics education partly because this meeting is being held in Tokyo. Since the Japanese school system has been regulated by the Ministry of Education teachers and schools have not been able to teach much statistics. Therefore, when we talk about improving for statistics education, most of our concerns have likely fallen into the area of system-regulated strategies, such as how to get the contents of statistics included into the guideline of the Ministry of Education, or how to mix statistics with mathematics in university entrance examinations in order to make statistics more important in the teaching of natural sciences. In addition to these organisational limitations, we have another handicap for promoting statistics education, that is, no university has had a department of statistics.

So we have left the education of statistics to private and official sectors. Consequently, each statistics researcher has had little opportunity or encouragement to present his or her experiences that may be useful for better teaching. However, now we are looking forward to a decentralised society and the information industry, which needs the concentration of hard efforts of young researchers. Considering this background, I would like to proclaim that this meeting will help establish a new trends in Japanese statistics education.

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