Batanero, C. (Ed.), Training Researchers in the Use of Statistics, 379-382.

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DISCUSSION

The four papers presented in this session deal with the problems of training of statisticians in consulting skills, training of researchers in the use of statistics, and enhancing interaction between statisticians and researchers. There is no doubt that the scope of areas of applications of statistics is expanding, and owing to a rapid progress in information and computer technologies and to the widespread use of friendly computer software, the use of statistical methods for data analysis has become common in research work in fields different from statistics and in practical work in industry and government.

There is a general agreement that the interaction and communication between statisticians and researchers is very important. Statisticians who will be consulted by researchers in other fields or by practitioners require consulting skills. Client researchers or practitioners who will deal with data need a basic knowledge and understanding of statistics and statistical thinking.

Take the example of medical doctors. A medical practitioner who is specialised in internal medicine, surgery, ophthalmology, or dermatology must have studied all areas of medical science before becoming a specialist or a practitioner in specific fields of medicine. However good he or she is at medical discipline and techniques, he or she may not be regarded as a good physician by patients if he or she lacks a good ability to communicate with patients. Likewise, to be a good statistician, he or she must have good communication skills to listen to clients, understand their problems and be able to give appropriate explanations and advice.

Programmes for training statisticians in consulting skills, and training researchers in other fields in the use of statistics and in how to consult with statisticians are then essential. The authors of the four papers presented in this session agree on the importance of these matters, although the current state of approaches to training varies from country to country.

When considering statistical consultations, there will be different categories of clients. These include doctorate students, researchers in fields different from statistics, and practitioners working in industry or the government who deal with data. There may be variations in the statistical backgrounds of the clients.

Fields of interest and the problems clients face also vary. In areas such as medical and pharmaceutical sciences, agricultural science, engineering, sociology and psychology, the clients may be concerned with experimental design, sampling design, data collection, data scrutiny, data processing, and data analysis, and in each of these phases problems may arise. On the other hand, in the fields of economics or demography where data might have already been aggregated, clients will usually handle published official statistics or micro-data from censuses and sample surveys. In this case, one may be interested in the method of data collection, the concepts and definitions used, the reliability of data, and the method of data analysis. When clients use a certain statistical method, they should understand the underlying assumptions and limitations of the method and interpret the results correctly.

Belli's paper presents the interesting results of an electronic survey of 106 US departments. I agree that in order for statisticians to be able to communicate effectively with researchers and practitioners, they should have good consulting skills. I noted that some US universities have statistical consulting laboratories or centres, and such units are also a forum for interaction between statistician and researcher from diverse fields. I would like to know more about the formal course on consulting, and who give the courses and what their qualifications are. What is the impact of the development of computer and information sciences on statistics education in the US universities? Is statistics education in the universities in decline or is it expanding?

The paper by Godino, Batanero and Gutiérrez Jáimez presented a proposal to organise Workshop of Statistical Consultancy and to establish Statistical Consultancy Units in the university faculties. This proposed scheme will in future cover different areas of discipline where needs arise. Target areas may be quite diverse, and I wonder what the qualifications for tutors of these workshops will be.

Jolliffe's paper focuses on two aspects of training: on courses in statistics for researchers, and on the consulting process.

The situation in Japan

I should like to explain the present situation in Japan with regard to statistical consulting. There is, I believe, no formal course for training statisticians in consulting and communication skills. Such skills are usually acquired through practice and experience.

In official statistics, there is a reference unit in the Statistics Bureau open to the public. This unit acts as a clearing-house of official statistics, and attracts many clients including laypersons as well as researchers who are interested in the use of official statistics, and gives them advice on sources and nature of data, how to use the data and other relevant technical matters.

The Institute of Statistical Mathematics has an information centre for consultation. The Institute receives many requests from outside for statistical help and consultation. The centre will refer the clients to appropriate statisticians by matching the problem areas and the area of interest of respective statisticians. This consulting process is working well.

In the universities there is no formal statistical consulting unit. The researchers or practitioners may sometimes approach professors in statistics in the faculty for help and consultation. Thus the statistical consultation usually takes place on a personal basis, depending on the area of interest of professors.

Training of researchers in other fields is also important. The Statistical Training Institute attached to the Statistics Bureau of Japan offers various courses to those employees of the central and local governments who are engaged in statistical work or data analysis. The core course of six months offers intensive curricula from theory to applications. The Institute of Statistical Mathematics organises three or four tutorial programmes a year on different subjects. The programmes provide a forum where researchers and practitioners can become acquainted with new and useful statistical methods.

In the industry sector, the Japanese Standards Association and the Japanese Federation of Science and Technology both organise many statistical seminars and courses on statistical techniques useful to industry. These contribute to the advancement of statistical capabilities of the staff working in quality management and production

processes in industry. On-the-job training and in-company training are also common.

During the annual meeting of the Japanese Statistical Society, two tutorial seminars are organised on newly developed areas of statistics, and these sessions are attended by many researchers and practical statisticians as well as statisticians in different fields. Topics of this year's tutorial seminar were "non-linear multivariate analysis" and "finance engineering and statistical analysis".

Theoretical statisticians must have some areas of application of statistics that they are interested in. By studying problems arising from the real world, they can discover and develop new theories and methods, and thus contribute to the development of statistics. So consultation and collaboration with researchers and practitioners who have problems sometimes lead to new area of statistical research. Although statisticians can give advice on statistical problems of a general nature, they cannot always cope with the problem in specific areas that are unfamiliar to them.

Nowadays one can find many textbooks on statistics authored by non-statisticians, mostly by experts in computing. Those books are written in a friendly way, focusing on how to use statistical tools rather than statistical theories or statistical thinking. They are easy to read for non-statisticians. They seldom touch upon underlying assumptions behind the statistical methods or limitations of the methods. The worst thing is that they do not discuss problems with the quality of the data that are going to be analysed. Here is a danger of misusing statistical tools. Training of researchers in statistics emphasising conceptual aspects and statistical thinking is thus needed.

Training in communication and consultation skills of statisticians will be very useful and effective for doctoral students or potential researchers. Training in statistics of researchers in other fields is also needed. Interaction between statisticians and the other groups will be beneficial to all.

However, the problems that researchers or practitioners face in the real world, say, in official statistics or in industry, are so complex that collaboration of experts in related fields is absolutely essential.

Take as an example the treatment of missing data in a census or a survey conducted by the government statistical office. In order to find out appropriate models and develop rational, workable methods, the Statistics Bureau here established a small research group consisting of theoretical statisticians, demographers, a sociologist, and experts familiar with data collection and data processing of real large-scale statistical surveys or censuses. Similar small groups are formed for other problems.

This type of consultation process is useful for both academic members and practitioners. For academic statisticians and researchers, this forum provides a good opportunity to become acquainted with complex problems in the real world. For practitioners working in the Statistics Bureau, it provides a valuable chance to learn new developments of statistical theory and practice.

Consultation processes in a similar form exists in the interaction between academia and industry. For instance, the pharmaceutical field is one of the most successful and active areas of statistical consultation or collaborative statistical research. Such collaborations are common in this field. Pharmaceutical firms themselves organise in-house training courses for their researchers in new statistical methodologies. Quite a few researchers working in the pharmaceutical firms always attend scientific sessions on medical and pharmaceutical topics in the annual meeting of our statistical society.

Collaborative research efforts in improving quality of products are carried out in the motor industry and some other industries, as well. Academic statisticians in quality management will play a major role in the project.

At the Institute of Statistical Mathematics, most statisticians are engaged in theoretical research as well as in research in application areas. There are many collaborative research projects involving statisticians and researchers in other fields from other universities and research institutes. These collaborative research projects thus provide forums for interaction between statisticians and researchers from different institutions.

As mentioned by Belli, Jolliffe and Godino, Batanero and Gutiérrez Jáimez, statistical consultation of statisticians will definitely be beneficial to client researchers, but it is often not appreciated by statisticians as it has no novelty and is merely an application of the existing theory or method. Even if the statistician's advice or contribution is essential to the substance of the research, the statistician's role in the research is often not appreciated properly.

The future of statistics education

Shia discussed the future of statistical education and suggested the idea of an electronic school. He suggested that the function of such an e-school should cover not only the e-book and video education, but also consultation and the services of a data warehouse. I am sure that databases to be constructed for these purposes will be very useful if they can serve to solve problems in the real world as well as for research work. Shia also suggested Internet surveys should be included in the function of an e-school. I could not get his idea clearly. Are such Internet surveys for statistics education purposes or for solving real problems?

Anyway, the world, particularly the environment surrounding statistics, is changing rapidly. To be benefited by new technologies, we need to strengthen international co-operation and the IASE can play an important role in this.

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