Batanero, C. (Ed.), Training Researchers in the Use of Statistics, 319-322.

Printed in Granada, Spain.

DISCUSSION

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Going through the four papers of this session has been very interesting for me as I have found many points to reflect on.

1.TEACHING AND SOCIO-ECONOMIC CONTEX

I would like to begin by putting in evidence how statistics and its teaching are connected with the socio-economic and political situation of a country**.** This may disconcert some of us, but we cannot deny that this is once more testified by some of the papers presented in this session.

Wei's paper, after remembering us that China is in the stage of transferring from planning economy to market economy, shows how this evolution is also influencing statistics. In fact he observes that: the more developed the economy and society become, the more statistics methods are widely used. In practice this means that if in the past the focus was on the training of the official statisticians for government planning with economic statistics majors offered by most of Chinese Universities and colleges, in the future the official statisticians have to be trained also in sampling surveys techniques and the system of national accountancy, while statisticians have to be trained for enterprises and companies too.

A big change in statistics education and training has taken place also in Latin America. There, in the 80's, the end of the military régimes has lead to the global reorganisation of the countries of the area, consequently to the necessity of socio-economic quantitative information and, by this, to the increase in the number and quality of applied statisticians to support the changes.

When the development of a country becomes more favourable towards society at large and its economy, this requires a better knowledge of statistical methods which allows us to look into huge systems of observations on collective socio-economic and health phenomena that new technology allows to collect and memorise easily. Wei's paper about China, Batista's paper about Latino-America and Ospina's paper about Colombia are all in this line.

2.TRAINING OF PROFESSIONALS

The four papers also claim consequently for a process of education/training of professional statisticians able to handle data, from their collection to their analysis and interpretation. Wei underlines that the aim of statistical training is not only to teach some new methods, but also to increase the trainee's abilities in their practice. Batista's paper notes that the teaching of statistical methods is disruptive when it is separated

from those particular research methods belonging to the substantive discipline statistics to which it has to be applied

This is the consequence of the fact that the utilisation of statistical techniques referred to different areas is quite diverse as Ospina notes, and that interactions and discussions of applied statisticians and researchers of the substantive fields are a learning experience for all the people involved in quantitative research, as Bangdiwala suggests.

3. TEACHING AND PRACTICE OF STATISTICS

However, what seems to be very difficult is to create a correct "equilibrium" among the teaching and the practice of statistics. Wei observes at the end of his paper *that the student and the trainee do not have enough time and chance to practice what they have learned in the class*. Ospina, putting in evidence the needs of changing in the undergraduate Statistics programs in Colombia, says that what is urgent is *an increase in contact with the external world.*

Batista's paper may in some way help us to grasp the core of the problem. The authors note that statistical methods and methodological research are usually taught separately, while the future neo-professionals are asked to do the synthesis of the two fields. In my opinion the reasons for this are many. Scientists in some way are conservative. In the choice among training a user of statistical methods or a researcher in statistics – particularly devoted to develop new methods –, often without being aware of this, university teachers prefer to think that they are training a researcher in statistics.

On the contrary, society needs good users of statistics, able to join statistical methods and the research methods of the substantive discipline requiring their intervention, and thus able to choose the correct method to solve the correct problem. As Bangdiwala suggests*: The statisticians must also appreciate the nuances of the field of application if they are to collaborate efficiently.*

All of this is also put in evidence in Ospina's claims for the necessity of a good equilibrium among mathematics, statistics, computation and area of application (by the way, referring to the situation of Colombia, I wonder how and why an undergraduate student has to change his/her mind and become a passionate statistician after 4 semesters of full immersion in mathematics, according to the curriculum referred to in the paper).

4. TECHNOLOGY

Other problems for the education/training of statisticians come from the computer and the big changes due to the advance of technology. If a student or a trainee has the possibility to utilise or to be exposed only to a specific software, able to develop only particular kinds of statistical methods, this is obviously a limit "per sè" to the possibility of other methods to be presented and utilised (Batista).

Again if statistical courses and computer courses are separately offered and the textbooks are edited and published separately, the students and trainees cannot solve the problems and questions using the computer skilfully, as is noticed by Wei. But something worse may occur. Ospina remembers that computer programs in some situations give the false sense that statistical professional assistance is not needed. And

more clearly according to Bangdiwala: Given the potential abuses of statistical methods made easy by the proliferation of statistical software readily available, the potential danger to the profession from the ill-trained casual user is great. Thus, an educated consumer is the best client for our statistical profession (Bangdiwalla, 2001). In these words we not only see what the problem is but also its possible solution.

5. THE STATISTICAL PROFESSION

In fact, let me say that while, obviously, Bangdiwala says *our* statistical profession, referring to the activity of biostatisticians and clinical epidemiology, I think it is possible to endorse a little change in his phrase and agree with the idea that "an educated consumer is the best client for *the* statistical profession". In fact, another peculiar point emerging from these papers is the difficulty that statisticians have to face to have their profession and skills recognised in the university institutions, in the society at large and in the workplace. In my view the problem has at least two corners: the feeble position in the academy of the statisticians who are interested in the application of statistics to substantive disciplines and the poor statistical knowledge that people in charge in industries, factories and institutions have.

6. OVERVIEW OF PAPERS

I personally think that all the points I was struck by when reading these very interesting papers are problems we share in every country, no matter if it is a developed or a developing one. No doubt in an international perspective it is also important to keep in mind this kind of "classification", as there may be more than one way by which different countries may help each other to promote statistical education and training. Also from this point of view the four papers presented are very rich in proposals and examples.

In China, what seems the core of the problem is the vastness of the country that disconcerts everyone's is thinking on it. Obviously this gives a stronger sense to find and test possible alternative patterns to be used in training the large number of statisticians and applied statisticians needed by the country.

In Colombia, an international committee suggested by the ASA acted as an evaluator of the Colombian program in the view of giving international accreditation of the local undergraduate and graduate programs. This Committee has helped to examine the situation and from the paper it is as if, in Colombia, statistics teaching and training suffer from problems that are common to many Universities in the world: too much importance is given to mathematical statistics and to academy goals in comparison with the attention that should be given to a more instrumental use of statistics needed by the country's situation.

The International Clinical Epidemiology Network project, originally funded by the Rockfeller Foundation, was aimed to establish Clinical Epidemiology Units as centres for excellence in various countries so that local well-trained clinical researchers would study the health problems faced in those countries. The main problem the project seems to have to face is the "brain drain", also at national level, due to the fact that biostatisticians are very much in demand but there are far too few of them. The

consequence is that well-trained biostatisticians are inclined to leave the Centre where they have been trained, thus impoverishing the institution itself.

In Latino-America, the PRESTA project offers an example of how some European Universities with the sponsorship of the European Community have tried to fill the gap between the available statistical methods and their effective and potential users. The idea has been to utilise a co-operating strategy aiming at creating links among European and Latino America universities, to enhance co-operation both within Latino American universities and between Latino-American universities and their public national institutions. All of this has produced a local horizontal co-operative net of 10 countries in the area, insuring different geographical and institutional presence. This project enlightens the importance of the local contributions and the capability to produce synergy among local participants to the project.

What I have learned from these papers, on this matter, is the importance of the comprehension and attention which must be given to the local situations and the necessity to enhance statistics, its concepts and methods, making a correct and intelligent use of local human resources, tools and equipment. All of this is a challenge that needs time and energy to be faced because, as some authors have noticed, whatever applied field is on the ground, the creation of a "critical mass" of well-trained statisticians is required to obtain results that remain and grow in time.

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