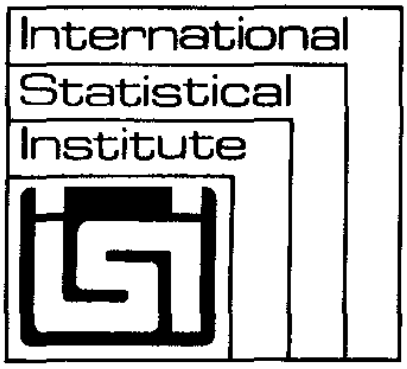
INTERNATIONAL STATISTICAL INSTITUTE

Newsletter



1992 ISI ROUND-TABLE CONFERENCE

INTRODUCING DATA ANALYSIS IN THE SCHOOLS: WHO SHOULD TEACH IT AND HOW?

Lionel Pereira-Mendoza reports on the proceedings of the conference

This conference was convened from 10-14 August, in Lennoxville, Quebec State, Canada. The delegates' brief was to discuss the issues associated with "Introducing Data Analysis in the Schools: Who should teach it and how?" Approximately 20 delegates attended, drawn from 10 countries representing both the developing and the developed world. The conference sessions were organised around short presentations of papers by the delegates, followed by extensive discussions of the implications of the papers for statistical education in general, and for the teaching of Data Analysis in particular.

Over the four days, many issues were addressed. The full version of the conference proceedings, containing copies of the delegates' papers, a summary of the associated discussions, and a series of recommendations arising out of the debate, is expected to be published in June 1993. The following very brief notes give some indication of the range of topics discussed.

First, should the introduction and teaching of data analysis be different in different countries? Many issues relating to the teaching of Data Analysis in a technologically developed society, as distinct from a developing society, were debated. It was stressed that solutions found or proposed for an industrially developed country are not necessarily appropriate for a developing country, where there may be limited access to the relevant technology, and where cultural factors and problems associated with the educational system must be taken into account.

Second, is data analysis an interdisciplinary topic? Data analysis seems to cross disciplinary boundaries. In particular, at the school level it cannot be considered to be just the domain of mathematics or of statistics specialists or of these discipline areas *per se*. Data analysis has a place in all curriculum areas. Given that this is the case, the respective roles of mathematicians, statisticians and other subject specialists is of major concern when one is making proposals about how Data Analysis should be taught. It was felt that this issue may be more crucial in the secondary school, where disciplinary boundaries provide an integral part of the school curriculum.

Third, are there general rules or guidelines for introducing Data Analysis? Also, what advice can be given to practitioners? Here the role of real data plays a prominent role, the delegates feeling this to be an essential component in the effective teaching of Data Analysis. While the group felt that the computer could play a significant role in teaching Data Analysis, this was not felt to be a necessity at the introductory level.

ICME7 QUEBEC, CANADA AUGUST 1992- TOPIC GROUP 15
STATISTICS IN THE SCHOOL AND COLLEGE CURRICULUM

Richard Scheaffer reports

Initial presentations and discussions centred on recent trends (in both content and pedagogy) in the teaching of statistics at the school and college level. The focus then moved to include the teaching of statistics to non-specialist practitioners in research and industrial settings.

At the school level, statistics is becoming integrated into the core mathematics curriculum and is no longer an isolated course for the few. According to Professor David Moore, "statistics should be studied in the schools not primarily for its own sake, but rather because working with data is an excellent means of building and reinforcing essential mathematical constructs". Statistics consists of analysing and describing data, producing data, and inference from data, and Professor Moore advocated that, in teaching these topics, they should be given relative emphases in that order.

His view was that the main thrust should be on data analysis, taught through an exploratory approach emphasising graphical displays. The production of data through planned studies (sample surveys and randomised comparative experiments) is, however, at the heart of statistical practice and this should therefore receive more attention than is usually the case in introductory courses. At the school level, a systematic presentation of formal inference should not be attempted because this is too difficult a topic. Data ("numbers with a context") provide a concrete basis for the development of mathematical ideas and they serve as a way to connect the mathematics to the lives of the students.

The view was expressed that probability should not form the basis for discussing statistics at the school level. Students should be given opportunities to experience and to manipulate random outcomes, and to discover the fact that rules of probability apply only to the long run of events. Then, simulations should be introduced. Combinatorics and axioms should not form part of the discussion at this level.

Saleha Habibullah reported that project-based teaching and learning of statistics has met with great success at the college level in Lahore. Projects designed and carried out by students have motivated and even excited them about statistics and its uses. These student projects have led to inter-collegiate competitions and exhibitions of statistical work that have been well received throughout the college communities.

According to Anne Hawkins, those who serve as statistical consultants in research institutions and industry also have a role to play in the *in-service* statistical education of their non-specialist clients. Basing her talk on examples drawn from medical research contexts, Anne Hawkins pointed out that consultancy situations can provide good opportunities for this because they involve small groups of highly motivated "students". However, most clients have many misconceptions about statistics and a variable (usually low) level of statistical literacy. In order for the consultancy situation to be used to good effect, the consultant needs to be trained to communicate and to teach. It is also important to re-think the objectives and methodologies of the *initial* training of their non-specialist clients. Rather than providing such non-specialists with a "potted" statistics course, covering a limited range of computational techniques, the emphasis should be on training them in the language and principles of statistics, encouraging them to develop intelligent intuitions about quantitative problems. *In short, this amounts to preparing the non-specialist to consult.* Subsequently, the consultant and consultee will be better able to collaborate efficiently and the client will be more receptive to the specialist statistician's advice, and more appreciative of the rationale behind it. Such a distinction between the purposes of the initial and in-service statistical education of non-specialists will have benefits to the professional standing of statisticians, and will also increase the likelihood of appropriate statistical methods, including newly-developed techniques, being adopted in a wide range of application areas including the biomedical sciences. Often "the tail wags the dog" when non-specialists, anxious to get their work published, are only happy if they can persuade their statistician to use the same techniques adopted by other non-specialists in earlier related publications, irrespective of whether these were originally, or would now be, appropriate.

The idea of concentrating on the teaching of the practitioners has been used with great success in Japanese industry, as reported by Dr Iizuka. These industries are "managed by facts", and all personnel are educated in the statistical way of looking at things. This educational process emphasises statistical sense rather than techniques, application ability rather than systematic knowledge, and problem-oriented rather

than technique-oriented learning. Because the problems encountered come from the real work of the learner, students are more enthusiastic.

Clearly, statistics will continue to play a major role in the mathematical education of students at all levels, serving as a motivator and illustrator of mathematical ideas at one level and as a valuable tool in its own right at another. Continuing attention must therefore be paid to how the subject may be taught effectively, both to specialist and also to non-specialist students.

ICME7 QUEBEC, CANADA AUGUST 1992 - WORKING GROUP 12 PROBABILITY AND STATISTICS FOR THE FUTURE CITIZEN

Flavia Jolliffe reports

The role of technology in teaching probability and statistics.

Prof. David Moore (USA) spoke of the usefulness of videos for distance learning programmes and as a classroom supplement, perhaps as part of a multimedia approach. However, they rarely give a student active experience of statistics and encourage little interaction with other students.

Peter Holmes (UK) and Mike Hammond (UK) described a development project on using databases and spreadsheets in teaching data-handling to pupils aged 11-16. Students in this age group generally find it motivating to work with computers and they quickly learn to cope. Spreadsheets and databases enable students to work with large real data sets and have proved valuable in developing data-handling skills.

Brian Hudson (UK) talked about a curriculum development project which has involved developing a supplement to an existing cross-curricular package which is focused on economic awareness and environmental education. The supplement provides materials for the mathematics classroom for pupils aged 14-16. Written material is supported by data files containing statistics on energy consumption from 1950 to 1988 for a large number of countries.

The first session ended with a general discussion on the use of computers in statistics education. Participants were reminded that a large part of the world has no access, or only very restricted access, to computers. However, graphical and programmable calculators are also important resources which may be more readily available. Although spreadsheets are satisfactory for some problems, it is valuable for students of 16 and over to learn about and to use statistical packages.

Cross-curricular issues and applications of statistics.

Annie Morin (France) talked about statistics and probability for today's French citizen. She emphasized that it is important to train students to be critical and open-minded and to introduce them to the idea of causality and to the notion of risk.

Rheta Rubinstein (Canada) and James Schultz (USA) had been involved with a University of Chicago School Mathematics Project, concerned with integrating statistics into a one year course on mathematical functions for students aged 16 - 17 years. Three topics where links can be made are graphs, transformations, and modelling. Shape and spread are features of both mathematical and statistical graphs. Being able to compare and contrast graphs, possibly after applying transformations, is an important skill.

Megan Clark (New Zealand) described a research project looking at how the context in which problems are set affects students' performance. She presented results relating to two first-year university statistics courses; one for students majoring in mathematics, physical sciences and engineering; and one for those majoring in biological sciences, social sciences, commerce and medicine. The same topics were taught in both courses. Results suggested that it was easier for females to do well on the latter course.

Glyn Davies (UK) talked about the project on Data Handling in the UK National Curriculum. He suggested that data handling be practical, investigational, real, purposeful, appropriate, cross-curricular, and enjoyable! Points made in the discussion were that curriculum design is difficult. An adult's model for what works with children may be wrong; children do not always get the intended learning experience.

Teaching probability and statistics in developing countries.

Andi Nasoetion (Indonesia) spoke about statistics at school level in Indonesia. At present, 25% of the population over the age of 25 have had no schooling and only 1% have had any higher education. An increase in participation rates in education has made necessary a change in approaches to teaching. He outlined problems arising from the belief that the

"soft" sciences do not require mathematics.

Aziz Lazraq (Morocco) reported that in his country, apart from an introductory probability course in the last year of school for science students, probability and statistics is not taught at school level. The one undergraduate statistics course has no computer work and graduates have difficulty in obtaining jobs. On the other hand there are twenty-five undergraduate courses in computer science which include at least one statistics module. Aziz Lazraq made the following recommendations for opening up opportunities: (1) give computer training in software development and the use of packages (2) use real-life examples (3) increase the awareness within industry of statistical techniques.

Parul Deoki (Fiji) described some of the problems in teaching probability at the University of the South Pacific, a regional university serving twelve developing island nations with different educational systems, languages, and cultures. English, the medium of statistical instruction, is a foreign language for the students. There are some distance learning courses, but students living in some remote islands do not have electricity, which limits the possible modes of instruction. Students from some islands are unfamiliar with cards and dice, and some even have difficulty in distinguishing between the outcomes "Head" and "Tail" in tossing a coin. Also, students' prior beliefs and superstitions affect their learning of probability.

In Pakistan, Saleha Habibullah reported, statistics is not taught at school, but there are courses at higher levels. Until recently, practical work consisted of long numerical examples to be solved with the aid of calculators, but a new scheme requires students to perform experiments.

Current and future trends in teaching probability and statistics.

Jan de Lange (Holland) talked about developing a critical attitude in the teaching of statistics. He gave examples of ways in which politicians and others interpret and manipulate graphs. He suggested that students might be asked to explain how to use a data set to justify two conflicting views such as "the defence budget is increasing" and "the defence budget is decreasing".

Gail Burrill (USA) based her talk on her experience with the Quantitative Literacy project, demonstrating the way in which, in a data-driven curriculum, connections can be made with algebra, geometry, trigonometry, and functions.

Peter Wilder (UK) concentrated on modelling with probability. Modern technology enables pupils to explore randomness easily, because they can build their own computer models of random processes and compare the results with their predictions.

ANNOUNCEMENTS

The International Association for Statistical Education (IASE), the newly established section of the ISI, will be recruiting Founder Members until August 1993. Membership is open to all who share an interest in promoting and developing statistics through education and training. Annual membership is £24 (£12 for members in developing countries) and is associated with various concessions for the purchase of relevant statistical education publications. Institutional membership is also available. Further particulars and application forms are obtainable from Daniel Berze, IASE, c/o ISI, 428 Prinses Beatrixlaan, PO Box 950, 2270 AZ, Voorburg, The Netherlands (tel: +31-70-3375737, fax: +31-70-3860025, e-mail: isi@cs.vu.nl).

Founder members of IASE will be invited to contribute ideas for the policies and programmes of IASE, and also to assist in shaping the programmes for the following IASE conferences:

First Scientific Meeting of IASE

The scientific programme of the 49th ISI Session (Florence, 25 August - 2 September 1993) includes as a satellite meeting the First Scientific Meeting of IASE. This will be held in Perugia, Italy, 23-24 August. The meeting will include invited addresses and contributed papers on statistical education, and a session of resolutions on the Association's future programme, tasks and strategies. To receive the first circular please contact Professor G Cicchitelli, Dipartimento di Scienze Statistiche, Via A Pascoli, 06100 Perugia, Italy (fax: +39-75-43242, e-mail: statli@ipguniv.earn).

Fourth International Conference on Teaching Statistics (ICOTS-4)

This conference will be held in Marrakech, Morocco, 25-30 July 1994. For details see the News and Notes section of this issue of Teaching Statistics (page 32).