Session B3

Computers and Computing in Statistics Courses

Organiser:	Gordon Smyth (Brisbane, Australia)
Invited Speakers:	Adrian Bowman (Glasgow, Scotland) Don McNeil (Sydney, Australia) Henk Tijms (Amsterdam, The Netherlands)
Contributed Papers:	Glenys Bishop (Gold Coast, Australia) Ann Brandwein and Lloyd Rosenberg (New York, USA) Gianfranco Galmacci and Maria Pannone (Perugia, Italy) Alan Lee and George Seber (Auckland, New Zealand) Robin Lock (Canton, New York, USA) Brian Murphy, G A Bartlett, Jane Klobas and Grant Keady (Perth, Australia) Robin Reich (Fort Collins, Colorado, USA) and Loukas Arvanitis (Gainesville, Florida, USA) Alan Stent and Lynn McAlevey (Dunedin, New Zealand) Douglas Stirling (Palmerston North, New Zealand) Elliot Tanis (Holland, Michigan, USA)
Abstracts and Short Presentations:	Noel Crockett (Sydney, Australia) Robert Cruise (Loma Linda, California, USA) and Jerome Thayer (Berrien Springs, Michigan, USA) Neville Davies (Nottingham, England) and Andrew Tremayne (Sydney, Australia) Murray Jorgensen (Hamilton, New Zealand) Richard Lehman (Lancaster, Ohio, USA) Michael Meyer (Pittsburgh, Pennsylvania, USA) Clifford Wagner (Middletown, Pennsylvania, USA)

Introduction

Roles of computers in teaching: There are at least three roles that computers play in teaching statistics. The first is as electronic blackboard, providing dynamic and large-scale illustrations of theoretical results in probability and statistics. The features

of the computer used here are its ability to simulate realisations of probability distributions and its ability to display graphics. The second role is as data analysis tool, enabling instructors to use real data in class and in student assignments. Material taught in this way approximates very closely to actual statistical practice, and exposure to the software used is likely to be of interest in itself to budding applied statisticians. The third role is as electronic examination paper and marker, presenting questions and marking the answers, and keeping records for student assessment. All three roles are represented in the papers here.

Overviews: Bowman, Meyer (abstract only), and Lehman (short presentation) give, in different ways, overviews of the uses of computers. Bowman describes the British Computers in Teaching Initiative, and gives details of the computer-illustrated texts and information centre projects. The dissemination of information on the use of computers in teaching statistics is in fact the brief of the CTI Centre set up in Glasgow. Meyer celebrates the rich computing environment at Carnegie-Mellon University. At the conference he gave a stimulating talk on how interactive workstation graphics have impacted undergraduate data analysis. Lehman summarises the results of a survey of "computer intensive" universities and colleges in the USA, and concludes reassuringly that the computing has not been added at the expense of statistical content.

Simulation: Nearly half of the papers are concerned with the electronic blackboard role of computers; all of these describe software written specifically for teaching, and most make extensive use of simulation. Tijms emphasises the benefits of graphics and student interaction in presenting simulations of the law of large numbers, random walks, and the central limit theorem. Tanis requires only a uniform random number generator to illustrate a number of intriguing probability equalities involving e and π. Wagner (short presentation) emphasises the generality of the central limit theorem by allowing students to draw arbitrary probability functions freehand with a mouse. Stirling, in two papers, stresses the importance of showing students the sample-to-sample variability in standard displays such as scatterplots, and shows how interactive graphical displays can be used to present statistical models more clearly than can be done with either formulae or static pictures. Stent and McAlevey and Brandwein and Rosenberg use the popular Lotus 1-2-3 spreadsheet program as a platform, in both cases building up histograms and other displays within the spreadsheet itself rather than using graphics. Bowman, Brandwein and Rosenberg, Stirling, and Bishop have in fact all written large teaching programs with many modules. Bishop uses the authoring language cT, and illustrates her software with an interactive linear regression tutorial. Bowman points out the value of step-by-step construction, and gives examples of animated stem-and-leaf plots and nonparametric tests. Reich and Arvanitis stand apart from all the other authors in being based in a specialised application, in their case that of forest sampling.

The third role of computers is represented by the abstracts of Crockett and Cruise and Thayer, which show that computer-based question and answer systems can be a useful solution in the face of very large student numbers and few staff. Crockett argues that such a system can also provide feedback on student understanding and assist with assessment.

Data analysis: Other papers consider computers as data analysis tools, and here the emphasis is more on statistical methodology rather than probability. McNeil points out that database concepts are fundamental to a broader view of statistics. Galmacci and

Pannone introduce in their SUSAM package the elements of expert systems. Lee and Seber describe the development at Auckland University of statistics courses for non-mathematical students which are package based, and the role these courses have in the general statistics curriculum. Lock uses real data to teach the practical matters of data analysis and model building, and cites three favourite data sets as examples. At the conference, Lock moderated a "data exchange" at which participants swapped stimulating data sets and demonstrated software. Murphy, Bartlett, Klobas and Keady argue the pedagogic value of having students program simple statistical formulae for themselves in a spreadsheet. To cater for more realistic problems, they have created a fully featured statistical package by porting their own already powerful program to a graphical spreadsheet environment. In a shorter presentation, Davies and Tremayne argue the importance of graphics and ease of use in making a congenial and motivating computing environment and, for business students, the importance of being able to export high quality graphical output directly into a commercial word processing package. Jorgensen, in an abstract, discusses macros for fitting nonlinear regression models interactively, and points out that the popular teaching program MINITAB is a suitable platform.