Session A3

The Use of Calculators and Computers

Organiser: Arthur Engel   (Frankfurt, Germany)

Invited Speakers: Arthur Engel   (Frankfurt, Germany)
                      Gary Kader   (Boone, North Carolina, USA)

Contributed Papers: Reishin Nakamura   (Nagoya-city, Japan)
                      Peter Schwanenberg   (St Augustin, Germany)
                      Teck-Wong Soon   (Singapore)

Abstract and   John McKenzie Jr and William Furman   (Wellesley,
Short Presentation: Massachusetts, USA)
                      Giitiro Suzuki   (Tokyo, Japan)

Introduction

The PC can be used in statistics in two fundamentally different ways. First, it can be used as an extremely versatile tool which enables us to do considerably better what we have always been doing. This is a software problem. A cleverly produced software package can do much to overcome the appalling preparation of teachers in teaching statistics. On the other hand, the PC can also be used to supersede classical statistics. This replacement can be achieved in two ways. Firstly, considerably more problems can be solved exactly, for which previously only asymptotic results were available. For the most important statistical problems, at least in school statistics, simple recurrences can be derived and translated into recursive and iterative programs. They provide exact solutions instead of asymptotic relations (which cannot be proved in school and often must be communicated to students by rules of thumb). On the other hand, there is no reason to do any problem exactly. For every problem that can be solved exactly there is a simulation counterpart which solves the problem approximately. This approximation is better than the classical results based on asymptotic relations. What is more, by simulation we can solve vastly more problems than can be solved exactly. Here the computer is used as a universal simulator.

Of the papers in this session, only the paper by Arthur Engel is devoted to the second point of view of rendering classical statistics unnecessary, and thus simplifying the subject considerably. But it requires a tiny bit of programming skill. This is still needed for the next few years, although it would be easy to write programs for standard statistical problems for students without these skills. But if you can program you can also tackle problems nobody has ever thought of.

The other use of the PC is well illustrated by the paper of Gary Kader. He describes SIM-PAC, a three-year NSF project (1987-1990). SIM-PAC is an acronym for SIMULATIONS IN MATHEMATICS - PROBABILITY AND COMPUTING. Aims of the project are to develop, test, and evaluate instructional strategies for the teaching and learning of probability via computer simulations, including the PC-software. Background, rationale, goals, and objectives, and many examples, are described in great detail. Two examples are illustrated by means of the PC-output.

In the interval between ICOTS 2 and ICOTS 3 statistics teachers have discovered spreadsheets as a very useful and versatile tool. While at ICOTS 2 no mention was made of this tool, at ICOTS 3 literally dozens of papers gave substantial space to spreadsheets. Spreadsheets are covered by the paper of Teck-Wong Soon. Their popularity is due to their wide availability, user-friendliness, reasonable price, and ease of applications with templates and macros. This makes them highly suitable for teaching and demonstration of basic statistical concepts. Their use in more advanced topics like Markov Chains is not touched in the paper.

After describing deficiencies in statistical packages, Peter Schwanenberg lists seven important points for producing and judging of statistical software for teaching. The more points satisfied, the better. No existing software satisfies all of the requirements, although some are coming close.

Almost every high school in Japan has about two dozen PC's. The most effective subject for their use is mathematics, especially statistics. (In Japan as well as in many other countries, statistics is a part of mathematics.) Since older teachers are not familiar with PC's, easy-to-use packages should be made available. A working group at the Institute of Statistical Mathematics, Tokyo, started to produce study material of textbook-type to assist teachers. It carefully follows the content of standard textbooks, and is aimed at average and below-average students. At present the packages cover only the most fundamental concepts of standard textbooks. User-friendly manuals are being prepared. Further details can be obtained from Giitiro Suzuki, the author of the last paper.

Just how important the efforts of Suzuki and his group are, is shown by the paper of Reishin Nakamura, the only high school teacher in Session A3 to give a talk. It shows the results of a diligent and courageous teacher, who has the best equipment available, but is completely on his own, with little advice from a professional group. He is forced to make his own judgement of what are the important concepts in statistics, and devise activities around these concepts.

A final paper in the session was supposed to focus on the calculator in teaching statistics, but the speaker was unable to attend the Conference. However, the abstract of a paper on this theme by McKenzie and Furman, originally scheduled in B8, has been included in its place. Calculators decreased in importance between ICOTS 2 and ICOTS 3. But in the past year they had a new boost through the new generation of cheap (US$75 or less) graphing calculators. There is no reason why a future calculator should not have the power of a PC. But the small screen is a permanent handicap. To avoid this they should have the size of a book. There are indications that the calculator is indeed heading in this direction (Atari-Portfolio), but then it will lose its biggest advantage, the cheap price.