International Statistical Education Newsletter

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Dr. M.H. Regier, Editor
Editorial Address: ISEN
19577 Misty Lake Drive
Strongville, OH 44136
USA

EDUCATION COMMITTEE

During the Paris session, the I.S.I. Education Committee held a number of meetings at which past activities were reviewed and plans laid out for new and continuing projects. Here is a brief outline of some of its ongoing activities. More detailed reports on these activities, as well as on new directions for the Committee, will appear in a future issue of the Newsletter.

ICOTS 3: STATISTICS FOR ALL

As previously announced, the Third International Conference on Teaching Statistics will take place on 19-24 August, 1990, in Dunedin, New Zealand. Further information, including lists of sessions and addresses of session organizers, may be obtained from the ISI National Correspondent or from: The Secretary, ICOT 3 Local Organizing Committee, Department of Mathematics and Statistics, University of Otago, P.O. Box 56, Dundein, NEW ZEALAND.

VIDEO PROJECT

Phase I of the I.S.I. Statistical Education video project is currently well under way. As described by project director Kenneth Bryson in the June 1989 issue of ISEN, this phase (the feasibility study) consists of testing selected videos by using them in instruction at a number of suitable training sites, followed by evaluations of their performance.

TASK FORCE ON CONFERENCES

The Task Force on Conferences, chaired by Kerstin Vannman, reports preliminary plans for holding the Fourth International Conference on Teaching Statistics in 1994. In addition, the Task Force has plans for a Round Table Conference in 1992, and a special session on Statistical Education during the I.S.I. meetings in Cairo in 1991.

TEACHING STATISTICS AT SCHOOL LEVEL

The Task Force on Teaching Statistics at School Level, chaired by Gottfried Noether, is updating its list of workers in statistical education and collecting information on current school curricula in Statistics in different countries.

REPORTS FROM ROUND THE WORLD

A.S.A. 150

The American Statistical Association held it's 150th anniversary meeting on 6-10 August in Washington, DC. A number of well-attended sessions at this meeting were devoted to topics in statistical education, viewed both in the traditional classroom setting as well as in the workplace and the community at large.

Several speakers addressed the need for developing programs in which statistical training, with emphasis on principles, would be integrated into formal instruction in areas of potential application, such as in the engineering, managerial and biomedical sciences.

The role of computers and calculators in statistical education was discussed, and suggestions were put forth for encouraging the proper use of statistical software while minimizing the risks of misuse. The importance of hand calculations as contributiors to the learning process was debated.

With regard to the teaching of statistics at school level, current efforts at strengthening this component of the mathematics curriculum were described. As they gather momentum, these innovations will in turn have a growing impact on the teaching of entry-level university statistics courses in the future. With its eyes on the future, the 150 years old Association also took a historical look and reviewed the impressive development of statistical education in the U.S.A. during its lifetime.

RESAMPLING STATS: A COMPUTER LANGUAGE AND PROGRAM

RESAMPLING STATS is a simple computer language and program that performs Monte Carlo simulation trials for problems in statistics and probability. With only twenty or so commands, the program mimics the operations used in conducting such trials with coins or spinners (e.g. SHUFFLE randomizes a set of elements), performs arithmetic and logical operations (e.g. SUBTRACT and IF), and does housekeeping (e.g. PRINT). Even 7th graders quickly understand and use it.

The Monte Carlo resampling method skips backward three hundred years to solve *all* problems the way gambling odds were estimated before the invention of probability theory. Recent "bootstrap" work in mathematical statistics provides intellectual foundation, legitimacy, and wide interest.

Resampling is the method of choice for a wide variety of statistical problems encountered in the field — and it is arguably the method of choice for *all* realistic problems. It is *not* a method of teaching students conventional analytical statistics by illustrating theoretical sampling distributions. Resampling breaks with the conventional thinking that dominated until the past decade, rather than being a supplement or an aid to teaching it.

RESAMPLING STATS is not offered as a complete substitute for analytic methods, however. It can be an underpinning to help students understand analytic methods better, especially useful for the introduction to statistics of mathematically–disadvantaged students. (The method is in no way intellectually inferior to analytic methods; it is logically satisfactory as well as intuitively compelling.) In any case, it is a functional and easily–learned alternative for those in academia and business who can use statistics in their work but who will never study conventional analytic methods to the point of practical mastery.

Until recently, resampling methods lived a shadow life. Technical articles by Meyer Dwass in 1957, and J. H. Chung and D. A. S. Fraser in 1958 applied sampling methods to Fisherian randomization tests. Starting in 1967, I taught students ranging from graduate school to middle school a systematic procedure for carrying out resampling for all problems, while also teaching them conventional methods in parallel (see *The Mathematics Teacher*, April, 1969). A broad variety of problems — including Efron's bootstrap — are described in my *Basic Research Methods in Social Science* (1969, third edition with Paul Burstein, 1985). The computer language was created in about 1972 for the mainframe computer, but was difficult pedagogically because it was not interactive. Then in the late 1970's, Efron analyzed the bootstrap, gave legitimacy to resampling, and aroused the interest of mathematical statisticians.

Under the supervision of Kenneth Travers and me at the University of Illinois, Carolyn Shevokas and David Atkinson explored the method in Ph.D. theses, working with experimental and control groups of junior college and four–year college students. Both found that with resampling methods — even without computer simulation — students produce more correct answers to numerical problems than do students taught with conventional methods. Furthermore, attitude tests as well as teacher evaluations showed that students enjoyed the subject much more and were much more enthusiastic about it than conventional methods.

Even seventh–graders, taught by a variety of instructors, invent for themselves sound approaches to all classes of problems dealt with in standard texts in statistics and probability. Watching high–school boys and girls re–invent from scratch the resampling version of Fisher's randomization test, for example, is an exciting drama. Within six or nine hours of instruction students are generally able to handle problems usually dealt with only in advanced courses.

To illustrate: You walk into class and immediately ask: "What are the chances that basketball player Magic Johnson, who averages 49 percent success in shooting, will miss 9 of the next 10 shots?" A variety of amusing suggestions ensue, such as "Go watch Magic," and "Try it yourself on the court." "Excellent ideas, but not wholly practical at the moment," you say. "What else?"

Soon someone suggests flipping a coin. This leads to important discussion about whether the 50–50 coin is a good approximation, and whether ten coins flipped once give the same answer as one coin flipped ten times. Soon someone suggests taking actual samples of coin flips, and the instructor deputizes that student to supervise the class. The instructor writes the procedure on the board as the class invents it. Estimates are produced. And the estimates are evaluated in the light of the important and now–obvious idea of sampling variability.

The instructor then whips the cover off the computer and suggests doing the task faster, more accurately, and more pleasurably. The following commands do the job:

REPEAT 100	obtain a hundred simulation trials
GENERATE 10 1,100 A	generate 10 numbers randomly between 1 and 100
COUNT A 1,51 B	count the number of misses in the trial
SCORE B Z	record the result of the trial
END	end the repeat loop for a single trial
COUNT Z 9,10 K	count the number of trials with 9 or 10 misses
DIVIDE K 100 L	compute the proportion with 9 o. 10 misses

Then the instructor asks: "If you see Magic Johnson miss 9 of 10 shots, should you think that he is in a slump?" Now the probability problem has become a problem in statistical inference. And with proper interpretation the same computer program is seen to yield the appropriate answer.

The disk, available for the Apple and IBM PC, includes the problem–solving simulation program, an introductory tutorial, sample problems and solutions, and a manual. A textbook intended for students at any level above middle school, with chapters that help instructors develop classroom methods, is also available to the teacher or interested student.

Members of ISI may have a free copy of the material on disk, along with copies of the articles mentioned above. The Resampling Project asks that in return you send us your reactions. We welcome any suggestions for cooperative research on classroom experience and computer–program development.

Julian L. Simon
Resampling Project
University of Maryland
110 Primrose Street
Chevy Chase, Md. 20815, USA
301–951–0922

Project Contact:
Peter Bruce
703–522–2713