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Table of Contents

1. Notes and Comments

In this Newsletter we are closing the debate about priority research questions in statistics education, which was started in *SERN* 1(2) with a paper by the Newsletter editors and was followed in *SERN* 2(1) by a number of reactions from statistics educators, with varied research experience and background. We are including a short note in this issue to summarise the main question raised by these colleagues, in the hope that some of you will take over the task of further developing some of these important questions and will contribute a short paper for future issues of the Newsletter.

We are also reproducing a paper by Richard SCHEAFFER, currently President of the American Statistical Association and former Vice President of the IASE in this issue. The paper originally appeared in the *Newsletter of the Section on Statistical Education of the American Statistical Association*, Volume 7, No. 1, Winter 2001 and Dick has kindly agreed to reprint his paper in our Newsletter. We hope that the SERN readers will find it very informative as it provides an excellent perspective on the history and future of statistics education.

An important factor related to learning statistics is students' attitudes, affects and beliefs. Research on the emotional components of statistics education is still very scarce; however, there is now a body of publications that come from mathematics education, education and psychology. We are including a bibliography on Emotional Mathematics that can help researchers in statistics education to enter this field and might be also of interest for statistics teachers and lecturers.

Two main IASE activities are organising statistics education conferences and helping to develop new publications in the area of statistics education. The IASE Round Table Conferences are oriented to organise a collective process of reflection about an educational research problem, and, at the same time to produce a book with the main conclusions and debates about that problem. We are glad to announce the publication of the IASE and ISI book "Training Researchers in the Use of Statistics", that was produced as a consequence of the last Round Table Conference in Tokyo, 2000, a summary of which is included in this Newsletter.

Once again we are approaching the Northern hemisphere Summer where a number of exciting conferences with statistics education sessions will be held. These conferences will provide an excellent opportunity to meet many friends from around the globe and to exchange ideas and experiences. In particular the IASE Invited papers Meetings at the 53 ISI Session in Seoul and the STRL Forum Programs are now in place, thanks to the effort of the organisers and speakers. The IPC and Local ICOTS-6 Committees have also done a great job in the past months and the Scientific Programme for the conference will be announced very soon. We are offering information about these and other forthcoming conferences in this issue.

Notes: Throughout the Newsletter, *IASE* members' names are highlighted in capital letters.

The whole Newsletter is located at the web site: http://www.ugr.es/local/batanero/sergroup.htm

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Statistics Education: Perusing the Past, Embracing the Present, and Charting the Future

Richard L. SCHEAFFER

Acknowledgement: This paper originally appeared in the Newsletter of the Section on Statistical Education of the American Statistical Association, Volume 7, No. 1, Winter 2001. We thank the Education Section of ASA and Dick SCHEAFFER for their agreement to reprint this paper in our SERN newsletter.

Statistics began its emergence 200 years ago to meet needs of science and government, and has enjoyed considerable success in guiding quantitative studies for 100 years. Why, then, is it not considered part of everyone's basic school education? Why is it still among the most despised of college courses? Why has its use not become epidemic in business, industry, and government? Is progress being made to remedy these situations? The answer to the last question is a qualified "yes," but much work remains if statistics is to move to the forefront of quantitative education and practice. Opportunities abound, however, and the future could be bright!

Perusing the Past: Many Parents but No Home

As the recent history and current trends in statistics education have their genesis in the development of the discipline of statistics over the past 200 years, it seems appropriate to review key elements in that development. Education is generally entrenched in tradition, and statistics education is no exception. The problem is that the sciences saw statistics as a useful servant to many but a key component of none, and the traditions that became entrenched had wide enough cracks to allow statistics to fall through.

From the Pharaohs to Napoleon

From the beginning of recorded history to the late eighteenth century, the developments in statistics were few and far between. There were a few glimmers of excitement, to be sure, such as censuses in the Roman Empire, John Graunt's *Observations upon Bills of Mortality* in 1662, John Arbuthnot's 1710 argument in favor of Divine Providence governing births, and the exciting developments in the companion field of probability. Emperors were interested in keeping track of their people, money and key events (such as wars and the flooding of the Nile) but little else in the way of quantitative assessment of the world at large. Quantification was a tremendous problem, as pointed out by historian Theodore Porter.

> As recently as two centuries ago, few people were quantitatively literate. Scientists were a partial exception, but not a very important one, because there were so few of them, and because many even in what we now consider the physical sciences made little use of numbers. As recently as 1800, the most important practitioners of quantification were merchants. The manipulation of quantities was an extraordinarily challenging task in those days when measures often varied from town to town, when there were different measures for different substances... The complexity of measure provided one of the main sources of support for mathematicians in Europe through the eighteenth century. (In Steen, 1997)

In short, many mathematicians earned a living working for government or business doing complicated arithmetic, and this was not all bad.

In the late 1700's, the situation began changing rapidly. It was the Age of Reason, The Enlightenment, in which great mathematicians and scientists worked together to begin developing theoretical as well as practical solutions to the problems of the day. The unifying decimal system was developed in France (and was immediately suspected by the lower classes as a government scheme that would work to their disadvantage). Nations began serious attempts to gather data on their residents (the first United States census being in 1790), an exercise that gave our field its name, and government bureaucracies were born. One of the hallmarks of this period, though, was that mathematicians still gained income by solving arithmetic problems, and so many of the great names of the day had government jobs that allowed them to lend their brilliance to the solution of everyday problems. A case in point is Laplace, "the Newton of France," who worked for the French government in various capacities (once being the Minister of the Interior) and made innovative contributions to the country's census. Data were becoming important, and great minds were thinking about how to collect and use it intelligently.

From Measurement to Statistical Science

The science that held sway above all others around 1800 was astronomy, and the great mathematicians of the day made their scientific contributions in that area. Legendre (least squares), Gauss (normal theory of errors), and Laplace (least squares and the central limit theorem) all were motivated by problems in astronomy, an appropriate science for the Age of Reason. The importance of quantification in the physical sciences is summarized succinctly in Lord Kelvin's dictum, "If you cannot measure, then your knowledge is meager and insubstantial." Serious quantitative work in psychology and the social sciences began, however, in the nineteenth century (the Age of Romance), and by the end of the century that is where the main thrust of statistical thinking had taken hold. In the 1860's Fechner introduced paired comparison and factorial designs for experiments in sensory perception and by the 1890's Galton had laid the foundation for regression and correlation (Stigler, 1986). It took about 100 years to get from least squares to regression analysis, whereas the two topics are now hopelessly intermingled in introductory statistics books. There was, and is, quite a philosophical difference between using least squares to estimate physical parameters of the solar system on the one hand and means of conditional distributions in a theoretical probability model on the other. Statistics is, indeed, subtle!

As statistics moved from least squares to regression, what happened to the mathematicians? Some were still fascinated by statistics, such as Galton's associates Edgeworth and Karl Pearson, but most found homes in the many universities that were established around the world in the Romantic period. As educational opportunities opened up for large segments of populations, mathematicians could find positions that paid them to think about abstract research. No longer did they have to do complicated arithmetic, or statistics, to have a decent income. So, as the number of students taking mathematics courses in colleges and universities increased, the interest of the mathematicians in statistics decreased. In addition, these same mathematicians were dictating to the schools what mathematics a high school student was required to have before entering college. Statistics in the late nineteenth and early twentieth century was becoming the province of the social sciences (Florence Nightingale being one of its proponents) and, after a young geneticist named Ronald A. Fisher took a job at an English agricultural research station in 1919, the biological sciences and agriculture. At the same time, the ever-

increasing demands of industry were producing new fields of engineering, which made use of statistical procedures in research and development and in maintaining quality of manufactured products. Walter Shewhart's control charts (1925) embodied the spirit of the latter. In short, statistics lost a home with the mathematicians and was now spread across the social sciences, the biological sciences, and engineering. Statistics was emerging as a science, but had a troubled childhood; many homes offered a bed, but none would support its maturing to its full potential; this boded ill for statistics education.

From Research Centers to Undergraduate Courses in Universities

The influence of agriculture and Fisher on the maturing of statistics as a discipline cannot be overstated, and this influence permeates statistics education as well. Under Fisher's influence, research centers began springing up in Commonwealth countries, notably India and Australia. These led to educating graduate students in statistics to solve applied problems and to develop new theory, as new problems were being found with great regularity. In the United States, the first graduate programs in statistics were formed in the 1930's and 1940's at land-grant universities such as Iowa State, North Carolina State, and Virginia Polytechnic Institute, followed quickly by more theoretical programs at such universities as North Carolina, Michigan and California at Berkeley.

World War II brought statistics back into the limelight as a very useful methodology for solving problems of importance to industrial productivity and to the success of military campaigns. Not since the Enlightenment Period (the days of Laplace) had so many great minds in the mathematical and physical sciences been directed toward the solution of practical problems. After the war, many retained an interest in statistics and myriad new programs sprang up around the U.S. and around the world. Not all went under the name of "statistics" though, as new names such as operations research, industrial engineering, and management science came into being.

During this period, undergraduate courses in statistics began to appear especially the infamous introductory course that came to be much hated by large numbers of students over many years. This course was typically taught in a mathematics department and based on an outline that was watered down from a graduate-level theory course, covering some probability and the basics of inference (hypothesis testing and confidence intervals) with little on design of studies or analyzing data. The courses on statistical methods were very often taught in the various disciplines using statistics (particularly the social sciences, business, and agriculture). Even with all the success of the discipline during the war years, statistics still had trouble finding a stable home.

From Grand Ideas to Practical Revolutions in the Schools

In the United States, every major effort at curricula reform in the twentieth century had statistics on the list of new topics for emphasis in the schools. Typical of the thinking of the early part of the century is the following 1926 statement from Herbert Slaught, an educator at the University Chicago.

> One of the most significant evidences that the importance of mathematics is permeating the whole fabric of modern life is shown in the recent unparalleled development of the use of statistical methods in the study of quantitative relations in almost every department of investigation. This appears in the simplest form in all the proposed new curricula for the junior high schools. It is emphasized in the reorganized programs for the senior high schools. It is further developed in the enriched courses for college students not only in all the sciences but also in economics, sociology, anthropology, etc., and in most of the effective studies in education. It is indispensable in all laboratories everywhere, whether in the schools or in the factories, in commerce, in big business of every kind. These are phases of mathematics which are gradually growing into the consciousness of the general public and which are capable of recognition and widespread understanding. (Slaught, 1926)

A similar statement came from one of the most highly regarded university teachers of statistics in the first half of the century, Helen Walker of Columbia University.

> More and more the modern temper relies upon statistical method in its attempts to understand and to chart the workings of the world in which we live.
>
> The average man - a phrase which itself is a statistical abstraction - finds that to a certain degree he must think statistically in order to read his newspaper and the current magazines
>
> Any one vitally concerned with the teaching of high school pupils and observant of the rapidly growing public need for some knowledge of quantitative method in social problems must be asking what portions of statistical method can be brought within the comprehension of high school boys and girls, and in what way these can best be presented to them. (Walker, 1931)

In later years others added similar pleas for statistics in the schools. A National Research Council report of 1947 called for introducing elementary statistics into the high school curriculum " as soon as there is a sufficient supply of trained teachers" and W. Edwards Deming in 1948 pointed to the "pressing need for introducing very general courses into the high schools and more widely into in the colleges so that ... future citizens may have the valuable orientation in quantitative thinking about social affairs which statistics affords" (Dutka, 1950). By 1975 however, a National Committee on Mathematics Education reported that "While probability instruction seems to have made some progress, statistics instruction has yet to get off the ground."

Why were these grand plans for statistics never achieved? There are many reasons, of course, among them the lack of interest and preparation of the teachers and the stranglehold that mathematicians held on the mathematics curriculum in the schools. And then there was the lack of a unified voice for statistics! Schools did teach very applied topics, such as business arithmetic, for much of the century but statistics kept falling through the cracks on both the applied and theoretical sides. It took a couple of great turns of events to finally allow statistics too succeed in the schools. One was the emphasis upon data analysis and the other was the development of technology.

Embracing the Present: Revolutions in Data, Technology, and Measurement

Tukey and Technology

John Tukey's admonishment of "Let the data speak" set the tone for a revolution in statistical thinking in the 1970's and 80's. All of a sudden it became respectable to explore data and look at modeling as an interactive process between theory and data (even though this is what good statisticians had done for years). But data exploration is not easy to do by hand, so the companion revolution in the availability of inexpensive and easy to use technology had to accompany it. We should be clear, however, about what Tukey meant by data analysis. To him, it embraces "procedures for analyzing data, techniques for interpreting the results, ways of planning and gathering data, and the machinery of mathematical statistics which apply to analyzing data." Data analysis is part art and part science, and should emphasize "the art of cookery" rather than "cookbookery" (Tukey, 1962).

"In God we trust; all others bring data." As data analysis was becoming acceptable, the idea of collecting data to make objective decisions on all sorts of problems, from the quality of manufactured products to the efficiency of an office, was sweeping much of the world. The spirit of this revolution is captured in David MOORE's remark, "If you don't know what to measure, measure anyway: you'll learn what to measure" (COBB, 1993). This transition in statistical thinking to measurement and data analysis, with the help of easy computation, led to profound changes in the introductory college courses (changes that are still going on) and to the acceptance of a strand in statistics within the K-12 mathematics curriculum.

The NCTM-ASA Joint Committee

In the mid 1980's the Joint Committee between the National Council of Teachers of Mathematics (NCTM) and ASA, organized by Fred Mosteller in 1967, developed a series of booklets on statistics for the middle school and early high school grades. The goal was to show students and teachers how an emphasis on collecting and analyzing data and on simulation of probabilistic events could motivate and illustrate much of the mathematics curriculum while, at the same time, teaching students some important statistical skills. This so called Quantitative Literacy Project (QLP) became quite successful in changing the way many teachers thought about statistics, and became the basis for the statistics strand in NCTM's *Curriculum and Evaluation Standards for School Mathematics* released in 1989.

> Collecting, organizing, describing and interpreting data ... are skills that are increasingly important in a society based on technology and communication. These processes are particularly appropriate for younger children because they can be used to solve problems that are inherently interesting, represent significant applications of mathematics to practical questions, and offer rich opportunities for mathematical inquiry. (NCTM, 1989)

These *Standards* became the blueprint for the revamping of mathematics curricula in most states, and has even influenced some countries outside of the U.S. The QLP and the *Standards* influenced other work, notably the reports of the National Research Council's Mathematical Sciences Education Board.

> Secondary school mathematics should introduce the entire spectrum of mathematical sciences: ... data analysis, probability and sampling distributions, and inferential reasoning. (MSEB, 1990)

The statistics strand has become so widely accepted as part of the K-12 mathematics curriculum that it has become one of the areas covered in the National Assessment of Educational Progress (NAEP), the so-called Nation's report card. Mathematics on the NAEP is defined as the five areas of number sense properties, and operations; measurement; geometry and spatial sense; data analysis, statistics and probability; and algebra and functions. These NAEP definitions also formed the basis for the mathematics portion of the Third International Mathematics and Science Study (TIMSS).

Philosophy and Style of the "New" Statistics

Developed by a team of statisticians and high school teachers, the QLP attempted to capture the spirit of modern statistics and modern ideas of education by following a philosophy that emphasized understanding and communication. That philosophy is outlined in the following steps.

1. Data analysis is central.
2. Statistics is not probability.
3. Resistant statistics should play a large role.
4. There is more than one way to approach a problem in statistics.
5. Real data of interest and importance to the students should be used.
6. The emphasis should be on good examples and building intuition.
7. Students should write more and calculate less.
8. The statistics taught in the schools should be important and useful in its own right, for all students.

This philosophy is best put into classroom practice with a teaching style emphasizing a hands-on approach that engages students to DO an activity, SEE what happens, THINK about what they just saw, and then CONSOLIDATE the new information with what they have learned in the past. This style requires a laboratory in which to experiment and collect data, but the "laboratory" could be the classroom itself; it does not need to be a computer laboratory, although the use of appropriate technology is highly encouraged.

College Courses and the Advanced Placement Connection

The same philosophy and style that marks the QLP is recommended by many for the introductory college course. Geoffrey Jowett, one of the great teachers of statistics in New Zealand and England, in his 1990 address to the Third International Conference on Teaching Statistics stated that "A statistics course at a university should have as many laboratory hours as physics or chemistry." In fact, many have offered that the teaching of statistics should resemble the teaching of science more than the traditional teaching of mathematics. Many of the originators and master teachers of statistics courses in this century (William Cochran and Fred Mosteller, to name two) actually made use of laboratory activities long before the advent of computers.

Another Joint Committee, this one between the Mathematics Association of America (MAA) and ASA, put its ideas on teaching statistics, similar to those expressed above, into formal recommendations for the introductory course that have the approval of both named associations. In summary, the recommendations (COBB, 1992) are:

1. Emphasize statistical thinking.
2. More data and concepts; less theory; fewer recipes
3. Foster active learning.

There seems to be a large measure of agreement these days on what content to emphasize in introductory statistics and how to teach the course. As a result, statistics education is making some progress and the introductory course is no longer as hated as it once was (although it is still not as well loved as many would like).

The K-12 strand in statistics and the introductory college course in the subject should both be built around the spirit of modern data analysis, design of studies, measurement, and simulation, with appropriate use of technology. The strand should serve as good background for the course. Realizing the connection between these two, a group of statistics and mathematics educators thought that the college course could, perhaps, be moved into the high school curriculum for good students interested in another option in high school mathematics. The

mechanism for accomplishing this in a way that would establish national standards for the high school course was the Advanced Placement program of the College Board. An AP Statistics course was finally approved and offered for the first time in 1997. In 1999 the exam for this course was given to over 25,000 students in 1,795 high schools across the country.

With a K-12 strand in statistics, an AP Statistics course, and exciting introductory courses in colleges and universities, statistics education has truly come of age. The next step is to enhance undergraduate offerings in statistics so that more college and university students have opportunities to major in the subject or to at least strengthen their backgrounds in the subject for whatever their field of choice might be. The ASA is now planning a project that will address these issues.

Before addressing the future, it seems appropriate to look once more at how the current situation in teaching statistics is connected to the past. The modern instructional methods that emphasize simulation often use randomization procedures to introduce the notion of hypothesis testing. Some may think that is a relatively new idea. Well, that is the way R. A. Fisher though about tests of significance 75 years ago.

> It seems to have escaped recognition that the physical act of randomization, which is necessary for the validity of any test of significance, affords the means ... of assuring the wider hypothesis in which no normality of distribution is applied. (In Box, 1978)

In other words, randomization procedures are the way to go, and they will work without any assumption of normality. The t-test is an approximation to randomization, not the other way around. If Fisher had had a workstation, the history of statistics would have been much different. The more statistics changes to a modern approach that emphasizes data, the more it seems to agree with the old masters' original thoughts on the subject.

Charting the Future: Surmounting the Opportunities

From elementary school to graduate school, from customers to manufacturers, from sports fanatics to health food fanatics, almost everyone seems to be interested in statistics these days. As Pogo would say, "We seem to be confronted with insurmountable opportunity." In boating (an analogy Pogo would appreciate) prudent navigation requires charting a course. Sometimes, however, the channels seen on a map are not open for efficient service because they need to be cleared of debris, widened, or deepened. The same can be said for the channels to be used in charting the course of the future of statistics education.

Clearing Channels of Communication

"Sampling is guessing," says a prominent Senator. "Sampling is no science," says a prominent newspaper columnist. There are, to be sure, legitimate scientific reasons to criticize any particular sampling plan put forth to adjust the Census, but a blanket condemnation of sampling as an invalid scientific procedure shows that there is something fouling up communication channels. "Racial Discrimination and Blood Pressure" is the title of a research article purporting to show that high blood pressure in blacks is caused by discrimination (Satel, 1997). The only problem is that the data do not show this; the social agenda of the researcher got confounded with the science. Communication problem? The recent publicity on the uses of statistical procedures to improve quality of products and services in business and industry (TQM) might lead one to believe that almost all companies use these procedures. Research shows, however, that quality concepts and tools are used extensively by less than half of Fortune 500 companies (Lackritz, 1997). Something is not being communicated clearly. A chemist was heard to remark, "We have discovered neural networks and no longer need statistics." This scientist needs to communicate with someone about both neural networks and statistics.

What is the debris that is blocking the communication channels? Some of it emanates from uncommitted leaders with limited understanding of quantitative issues in business, industry, government (B/I/G) and education. Some comes from a public that is easily swayed by the most recent alarming anecdote. Some comes from a workforce surrounded by technology but, at the same time, afraid of technology and easily swayed by black-box magic. Teachers at all levels need to work on clearing communication channels, even though they are sometimes caught in the middle with little support from either educational leadership or the public. Communication on statistical issues must be improved, if not with this generation of leaders, than with the next, ... or the next.

Broadening Channels of Application

Improved communication among B/I/G and educational systems at both the school and college levels will

require identification of the strengths that unite and the gaps that divide. The principle uniting strength is data - its collection and use to solve real problems. Schoolteachers must be armed with examples that not only motivate students but also convince administrators and school boards that statistics is a valuable and necessary component of the curriculum. While more independent in their decisions about courses and content, colleges and universities need to adjust their offerings to capture the interest of high school students with some statistical experience and to prepare those students for their academic and career goals. B/I/G must help provide motivating and convincing examples of the uses of statistics and work with colleges on improving course content so that college graduates, in whatever field, have an understanding of statistical thinking. All of this communication must take place in a spirit of collegiality and cooperation.

One desirable outcome of the improved communication is to have students at all levels see statistics broadly. This broad view, which must be emphasized in all courses that deal with statistical issues, can be approached by viewing statistics in three inter-related components.

Statistics as number sense: Do I understand what the numbers mean? (seeing data as numbers in context, reading charts, graphs and tables, understanding numerical and graphical summaries of data, etc.)

Statistics as a way of understanding the world: Can I use existing data to help make decisions? (using census data, birth and death rates, disease rates, CPI, ratings, rankings, etc., to describe, decide and defend)

Statistics as organized problem solving: Can I design and carry out a study to answer specific questions? (pose problem, collect data according to a plan, analyze data, and draw conclusions from data)

Graduates of high school or college are expected to be able to read literature related to their personal life or job, understand what they read, and then use what they have learned to make decisions. (That may be what intelligence is all about.) Why should we expect less of them when the "literature" involves data?

Deepening Channels of Content

With statistics courses built around study design, data collection, and data analysis, and with the availability of appropriate technology, serious questions arise as to how content should change to enhance statistical thinking and understanding of concepts over rote use of standard procedures. Those issues are much to complex to fully address here, but a few suggestions will be offered.

Deepen the discussion of exploratory data analysis, using more of the power of revelation, residuals, re-expression, and resistance as recommended by the originators of this approach to data.

Deepen the exposure to study design, separating sample surveys (random sampling, stratification, and estimation of parameters) from experiments (random assignment, blocking, and tests of significant treatment differences).

Deepen the understanding of inferential procedures for both continuous and categorical variables, making use of randomization and resampling techniques.

Should students be exposed to statistical techniques for which they cannot understand (or even see) the derivation or computations? Some say "no" and use this as an argument against introducing transformations, logistic regression, smoothing and density estimation, and other modern topics in the introductory courses. With modern technology which allows many numerical examples to be seen quickly, it is time to rethink this position. Perhaps we should tell students about statistics they way it is practiced, not the way it is stated in textbooks. Wouldn't that help communication up and down the line?

Conclusion

Statistics has it roots in many fields; there is strength in diversity.

Statistics was built on real measurement problems; utility is still its greatest asset.

Statistics is dynamic; that's exciting!!!

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3. Building a Research Agenda for Statistics Education. A response to reactions in SERN 2(1)

Carmen BATANERO, Joan B. GARFIELD, and M. G. OTTAVIANI

Determining the main research questions in statistics education is not an easy task, because there are so many important and unanswered questions relating to the teaching and learning of statistics. Nevertheless, in *SERN* 1 (2) we proposed a list of questions that we considered important to investigate, given the current state of research in statistics education as well as our own ideas and research traditions. We reflected on the diversity of people involved in statistics education research, the difficulties of having access to the literature in this area, and the challenges of training statistics education researchers within different disciplines.

Our short note was complemented in *SERN* 2(1) by reactions from a number of colleagues from different countries who represent different backgrounds and experiences. These differences as well as the interdisciplinary nature of statistics education research were visible in the variety of responses and suggestions in the written responses.

In this rejoinder, we attempt to synthesise the main points raised by the different reactors to whom we are very grateful, as they provided many important complementary ideas. It would be a too big a task to reply in detail to each of the points raised as some of them deserve a full issue of the Newsletter. We are therefore only offering remarks here regarding a few of the main points raised. We plan to focus on some of the remaining topics in future issues of our Newsletter.

Commonalties with other educational areas

Our reactors are in agreement about the difficulty of doing research in statistics education. As stated by CORDANI, even "pure statisticians" recognise the importance of teaching experience and adequate statistics and educational knowledge needed before embarking on research in statistics education.

An important suggestion by BACELAR is to try to find what we have in common with "other areas" education, in particular with mathematics education. We agree that we should not be isolated in the task of building our theoretical frameworks and research methodologies. Indeed much of the research in statistics education comes from people trained in mathematics education, and the theoretical frameworks and methodologies from mathematics education are extremely relevant for research in statistics education (see for example the new Research Handbook in Mathematics and Science Education by Kelley and Lesh). However, we still need to keep the distinctions clear between the types of learning and reasoning processes in the two areas, acknowledging the strong claims made by people such as David MOORE that statistics and mathematics are two different disciplines.

Psychology is another area where researchers in statistics education have looked for related studies, theoretical frameworks and methods. Researchers in the areas of developmental, educational and cognitive psychology all been interested in stochastic reasoning and how it develops and some notable psychological research (e.g., Piaget & Inhelder, 1951; Fischbein, 1975; Kahneman, Slovic, & Tversky, 1982) still continues to provide an important base for statistics education research. However, LECOUTRE & LECOUTRE point out that most of the psychological surveys that studied probability misconceptions induced stereotypical answers and reflected subjects' theoretical knowledge in probability and statistics more than their actual opinions and ways of reasoning. Consequently, these respondents suggest the origin of statistical misconceptions should be studied in greater depth by statistics educators to learn if the biases described by psychologists are fundamental erroneous intuitions, resulting from various everyday-life experiences, or are erroneous interpretations of material that has been taught. A primary objective of any research in statistical education should be to provide an analytic description of the underlying cognitive processes in these misconceptions, with the aim of revealing some *internal coherence* in spontaneous judgement and reasoning.

Interdiciplinarity

Perhaps due to its roots in psychology and education, statistics education has become an interdisciplinary area of knowledge and inquiry. This is a strength and a potential weakness. As pointed out by BRIGHT, our research should continue to be informed by knowledge that has evolved in other disciplines. CORDANI also suggests that we should build on knowledge not just from educational areas, but from a variety of disciplines. A weakness is that people interested in statistics education are often unfamiliar with the work being done in other disciplines, and only see a small portion of the research that happens to be published in journals within their own discipline.

Interdisciplinarity is also apparent in the teaching of statistics from the perspective of exploratory data analysis. In this approach, students may become involved in tasks or projects where they need to pose a problem and collect data. These projects might involve other disciplines such as biology, geography, or the social sciences. BRIGHT suggests that in reasoning about data, the context plays a major role and that knowledge about the context affects students' interpretation of the data. An example of interdisciplinary work is provided by Lajoie (1998) who suggests that the multi-disciplinary context of her project provided a great strength to her study. We think it would be good to recognise the interdisciplinarity of statistics education by forming groups of researchers at institutions who represent different disciplines, to supervise graduate research or to collaborate in faculty research projects.

Different types of students

Another point raised by the respondents is the effect of students' backgrounds and their previous knowledge. We agree with CHADJIPADELIS and ITO in that the teaching of statistics may depend on the type of student audience, and that research questions may be adjusted when investigating students with different educational levels, interests, knowledge and attitudes. The respondents suggest examples of how a different research focus may be appropriate in different situations. Lajoie reminds us that multicultural perspectives in learning and instruction need to be considered in all fields of instruction and, when working towards transferability of research, it is necessary to consider both local and global issues of education.

It is hard to imagine anyone believing that research in statistics education is too limited a topic. On the

contrary when we look at the ICOTS conference programmes we can see the variety of studies in this area. Some focus on teaching at school level, others on undergraduate or postgraduate training, some examine training people at the work place or training official statisticians. Other studies investigate adult literacy in the wider society. JOLLIFFE suggests that in today's world where continuing education and continuing professional development are encouraged, teaching takes place to persons of any age, not just to the young. At the IASE Round Table Conference, where people from around the world met in Tokyo to discuss the training of researchers (see the summary of the book in this issue), it was also apparent that there are a number of educational problems related to researchers' understanding, using and interpreting statistics.

Statistics education research as a process and a product

GLENCROSS suggested that we need to ask ourselves what is research in statistics education and even what is statistics education itself. We agree that this discussion is needed. To get the recognition from other areas, a first step is to be able to identify the characteristics of our emerging discipline.

Another point worth noting is that research is both a process and a product. In our original paper we were mainly concerned about research as a process: the process of doing research in statistics education and the need to assure the quality of this process. However, statistics education as a process is inseparable from the product of that process. An implication from GLENCROSS' response is that we also need start re-organising the product we now have, namely, the existing statistics education research. There is an increasing body of knowledge about statistics education that is, however, spread across countries and disciplines, and is often not easily accessible. Selecting the most important and relevant studies, compiling and organising the results of this selection; making it accessible to researchers is a an important task for the statistics education community.

It is important to remember that Statistical Education Research Newsletter (SERN) was created with the aim of sharing research among statistics educators. There were eight years of printed versions of this newsletter (originally called the Newsletter of the International Study Group for Research in Learning Probability and Statistics) three more years of electronic version of this newsletter, and one year as the IASE SERN. To date, the best compilations of research in statistics education are the chapters by SHAUGHNESSY (1992); SHAUGHNESSY, GARFIELD and Greer (1997), Peard and Borovnick (1997), and books such as Gal and GARFIELD (1997), Lajoie (1998), HAWKINS, Glickman and JOLLIFFE (1992), Borovcnick and Kapadia (1991). In response to the need for a compilation of the most important and relevant research literature, Joan GARFIELD and Beth CHANCE are now beginning work on a new handbook on research in statistics education.

Konold reminds us that we can no longer afford to see the task of "translating" our research for teachers as someone else's job. Making the research product accessible to teachers is even a more difficult task due to the different languages. For example, the statistics education research group at the University of Granada have produced several books for statistics teachers, which are also accessible to South American teachers who share this language (GODINO, BATANERO, & CAÑIZARES, 1987; BATANERO, Navarro-Pelayo, & GODINO, 1994; BATANERO, 2001). The publications of the Schools Council Project (1989) in England, the Inter-IREM Commission in France (1997) or the NCTM in the USA (e.g., Shulte, & Smart, 1981) , the books by Kapadia and Borovckik (1991), Lajoie (1998) and Gal and GARFIELD (1997) are also examples of the kind of literature that teachers can find useful in their daily work, but are limited to readers of French or English. We are sure there are similar books in other languages but it is hard to determine what they are. We need a method to facilitate the collection and cataloguing of these resources so interested teachers may become aware of them

A question that was raised by many responders to our paper is the quality of statistics education research. GLENCROSS suggests that deciding what is a good type of research is not easy and depends on a number of different issues, while LECOUTRE and LECOUTRE speculate that a quality research study in statistical education should incorporate three complementary aspects: normative, descriptive and prescriptive components. While the current state of research in statistics education makes a prescriptive approach difficult, this suggestion should not be forgotten and perhaps deserves continued discussion. We agree that a concern about producing high quality research is crucial in order for statistics education to become a recognised and ultimately mature discipline.

Finally, JOLLIFFE questions who should actually conduct research in statistical education and suggests that little is known about, or has been published on the methodology of statistical education research. We suggest that since a part of this methodology is based on an appropriate uses of statistics methods and statistical reasoning, research in statistics education in fact can contribute to the better use of statistics in our own area of knowledge and has, in this way a recursive character. By improving the teaching, understanding and use of

statistics we can improve statistics education both as a process and as a product. However, we realise that much of the important research in statistics education does not necessarily involve the collection and analysis of quantitative data, and instead gathers qualitative data (e.g., clinical interviews and classroom observations). Many people may be surprised to see statistics educators use qualitative research methods rather than the statistics that they have been trained to use. We acknowledge the importance of both types of methodology and suggest that more attention be paid to the combination of qualitative and quantitative methods in helping us conduct research in statistics education.

Building a scientific discipline

A main goal for statistics education researchers should be to build a scientific discipline, that is, an organised body of knowledge that can contribute to improved teaching and learning of statistics. Konold remarks that a single study is unlikely to have much of an impact on this practice and that we need to more broadly about programs of research that continue to investigate a particular problem. A review of the research literature illustrates this concern, as there appears to be few programs of research that build on prior research and reveal new information on a particular research question. Instead, it too often appears that once a problem has been studied in a single experiment, there is no replication or subsequent studies to build on those results.

Konold cautions researchers to carefully review the existing research when preparing a paper or designing an experiment. Unfortunately, too often a research study or paper does not refer to previous research on that topic (beyond a few references), and some authors appear to only include references that do not provide background and substance, and suggest that author has conducted their research in ignorance of prior work on that topic. We agree with Konold that little progress can be made in establishing a recognised research community until we become more familiar with what other people are doing, across the disciplines and around the world. With the availability of Internet and electronic communication, and the detailed information provided in these newsletter which are stored on the IASE *SERN* website, there should be no excuse for minimal and incomplete research reviews. Groups such as the Statistical Education Research Group and the PME stochastics group can help connect researchers around the world so that no one needs work in isolation. We encourage readers of this response who are not IASE members to join the IASE and the IASE SERG and to share with us their own research and publications, which we will report in future editions of *SERN.*

The role of theory

A scientific discipline includes theoretical frameworks and concepts. Our reactors have very different views about the role of theory and research. These views can be classified into three areas as described below:

1. A group of reactions suggest our theoretical models should be taken from psychology and education; or more specifically, from mathematics education. JOLLIFFE argues that to some extent statistical education research arises from research in psychology and mathematics education and can build on this foundation. Pratt reflect on the psycho-pedagogical models that can help us understand the development of statistical reasoning, and how these models might be used to both to facilitate cognitive development and to explain the teaching and learning of statistics.

2. Another set of responders suggest we need to build models that are specific to statistics thinking and learning. Konold believes we should be working to develop and then build on theories that are specific to statistical thinking as it develops in classrooms. PFANNKUCH suggests that we need new ways to conceptualise the intellectual methods and reasoning of the statistical discipline. This may evolve as more statistics education research attempts to focus on and to understand the connections between statistical thinking, learning and teaching.

3 Other responders offer a more eclectic approach. BRIGHT considers it important to reflect on the theoretical perspectives and research techniques for any research base that we use, but does not think we need not to be restricted by using the same frameworks. GLENCROSS suggests that we need to tolerate diversity of theories (as well as methodologies, practices, and interests) in statistics education.

It is clear that the topic of theoretical frameworks and background for research is an important and controversial one, and we are perhaps not yet ready to provide a definitive statement on this topic. However, there are some recent papers that propose specific theoretical models for different aspect s of statistical learning and competencies (see WILD and PFANNKUCH, 2000, and Gal, In press). MCLEAN (2001), in discussing statistical modelling, suggests that it is important to remember that a model is only “true” internally, and that the purpose in creating any model is to achieve some understanding of the working of a particular phenomena and

hence to gain some control over it. Therefore either general or specific theoretical frameworks that might be useful to explain a given phenomena or to organise a particular research study are appropriate only if correctly used and interpreted. It is also important to understand the limits of the model, what it can do and what it cannot do, and to recognise that each model is limited.

The foundations of statistics

An underlying problem that affects both the teaching of statistics and research in this area is that there are some controversial topics about which there is not a general consensus among statisticians. Statistical concepts may be entangled with philosophical questions about the nature of knowledge and how a new finding is supported by empirical data. Statistics concepts are often combined with questions regarding causality or induction that have been the topic of philosophical debates for years.

Such is the case of inference, where there are philosophical controversies about how we can justify inductive reasoning as well as different theoretical approaches to statistics. Some of these continuing debates began with Fisher, Neyman, Pearson and the members of Bayesian school about what we mean by "significant result", if it is possible to derive the probability of a hypothesis, what is the nature of this probability, and how it relates to empirical data. Today this debate still continue (Harlow, Mulaik & Steiger, 1987; BATANERO, 2000). Most people who teach statistics, tend to ignore these debates and offer their students only one position (either classical or Bayesian), without informing their students that there are other possible alternatives.

CORDANI suggests that these controversies affect research as well as teaching, since the way we see statistics influence the type of questions we pose about the teaching of statistics. This also affects our research methods, in some cases, affecting the way hypotheses are stated, data are analysed, and results interpreted.

Looking forward

The set of responses published in our January issue of *SERN* raise additional research questions beyond those included in our original position paper . We have not commented on all of the questions raised, but we hope that our readers will consider them as they think about conducting research on a particular topic in statistics education.

As stated in our paper, an important role of IASE is to promote statistics education research. BACELAR suggests that more scientific meetings should help promote the sharing of research, to continue the work of IASE conferences. We encourage more people to become involved in helping to co-ordinate this, by serving on organising committees, reviewing proposals, and suggesting speakers.

Konold suggests in addition to formal presentations at scientific meetings, people need to form small research groups where they can read and discuss papers and possibly provide support or collaboration in their research. Discussing and sharing ideas is not restricted by physical distance, as electronic communication gather together people from distant areas. Many of us have participated in collaborative research group with colleagues who live very far away. The PME Stochastic group and the small research forums now sponsored by IASE (SRTL-1 and SRTL-2) also offer the opportunities for collaborative groups to form to share results and plan future studies. Finally, we hope the SERN newsletter will continue to be used as a way to establish links among those who have common interests and research lines in statistics education.

To complement the information provided in our newsletter, JOLLIFFE is designing an international survey of research on pedagogic issues in statistics and operational research,. She will be collaborating with Susan STARKINGS and Mike FULLER. We are glad to offer them the support of SERN and the Stated_list in this important project.

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4. *IASE* **Members**

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Corinne has been teaching statistics for more than 10 years now in two business schools belonging to the Paris Chamber of Commerce and Industry, after been a high school mathematics teacher for 12 years. She is a professor at NEGOCIA, affiliated professor at ESCP-EAP (European school of management), and a member of CIEAEM and of SFDS (Société française de statistique). Her doctoral dissertation subject was the link between mathematics and reality. Part of it was published in French in *Educational Studies in Mathematics* (special issue on teaching and learning mathematics in context (vol 39, 1-3, 1999) and in English in a collective book published by Kluwer in 2000: *Education in mathematics for the workplace*, (Bessot and Ridgeway, eds). In the past two

years Corinne has been involved in a research project on learning statistics with technology. The second phase of the project (the evaluation of the impact of a multimedia tool on the learning process) was presented at ICME Tokyo last summer. She is now working on the third phase (the construction of an e-learning environment and its evaluation).

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Richard studied Economics and Mathematics Computation, with specialisation in Statistics at the University of Prague, where he has been working for different periods since 1975. He was associate professor (1992-97) at this university and professor since 1998. He is Head of the Department of Statistics and Probability since 1992 at the Faculty of Economics, Prague and Dean of the Faculty of Computation and Statistics. He teaches statistics including time series analysis, expert courses in statistics, econometrics, statistics and insurance. He worked for the Ministry of Planning of the Czech Rep (1976-87) and the Technical University Liberec, Department of Informatics. He is member of the Scientific Board at the Faculty of Informatics and Statistics, University of Economics.

Richard has been Chairman of the commission for doctoral theses at the University of Economics, Member of the Statistical Board of the Czech Republic, Member of the Association de Comptabilité Nationale, Paris. He has developed expert activities for the Czech Statistical Office, French-Czech Management Institute, Chamber of the Czech Auditors and Institute of the Association of Accountants. His research interests include analysis and forecasting in economic time series, National accounting, exploratory data analysis and statistical methods in marketing research. He recently accepted the role of IASE National Correspondent in the Czech Republic and as such he is willing to help our association in serving as a link with statistics educators in his country.

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Mohamed got a Diploma of “Ingénieur d’Application de la Statistique” at the INSEA, Rabat, a Master in Statistics and a Ph.D. in Biostatistics at the Univeristy of Michigan. Since 1974 he has been teaching sampling techniques, survey methodology, statistical inference, linear models and multivariate analyses. His areas of interest include survey methodology, sampling design, questionnaire design, training of field personnel, field data gathering, and data processing, using SPSS. He is currently working on 4 study-projects:

1. National survey on micro and small enterprises. He is elaborating the survey methodology and sampling design, training of field personnel, supervising field data gathering in some regions and supervising data processing.
2. Panel survey design relating to private company customers “Lydec” in charge of water and electricity distribution in the biggest city of Morocco “Casablanca”. As the Project director, he is elaborating the survey methodology and the sampling design.
3. National survey on tourism. As the Project director, he is elaborating the survey methodology and the sampling design, training of field personnel, supervising field data gathering in some regions and supervising data processing.
4. The National survey on Housing. He is elaborating the survey methodology and sampling design, training of field personnel and supervising data processing.

Mohamed recently accepted the role of IASE National Correspondent in Morocco and as such he is willing to help our association in serving as a link with statistics educators in his country.

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Zamalia is a Ph.D. Lecturer of Statistics and Research Methods at the MARA Institute of Technology, where she has been involved with research activities for the past 10 years. She is teaching at the Faculty of Information Technology and Quantitative Sciences and heading the Research Unit. There are four departments in the Faculty and Statistics is one of them. Within the Statistics Department, there are three areas: Quantitative Methods, Operational Research and Management Science and Applied Statistics. Zamalia is the only faculty member with the interest in statistics education in her department and her interest is mainly in the innovation of teaching statistics, the learning process and the outcome as a result of the innovation process. She is doing a lot of teaching experiments and trying out different methods of teaching with her own students. She teaches probability, statistics and research methodology to civil engineers, statistics and business to computing students, with about 80 students in three different study backgrounds and teaching for 16 hours per week plus research activities.

She is mainly involved in research activities, which are not specifically related to statistics education. Her recent publication related to Statistics Education is: Investigating Patterns of Interview Conversations using Qualitative Data Analysis (QDA), multidimensional scaling and cluster analysis. This was part of her Ph.D. thesis whereby she conducted interviews with teachers and lecturers in Scotland investigating factors that affect students' difficulties in understanding basic statistical concepts and factors that affect teachers/lecturers' difficulties in teaching some of the concepts.

Andile MJI
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Andile is currently in charge of the daily running of the Research Resource Centre of the University of Transkei. He has been performing a consulting role to three students (1 MEd. and 2 Gender Studies) who are currently analysing their data. All three have absolutely no understanding of statistics whatsoever and so the going is extremely slow because every step they take is explained in detail. In fact, initially they expected him to tell them what they were to do with their data. Andile presented a paper in the recent IASE Round Table Conference held in Tokyo and has been invited together with Michael GLENCROSS to provide an African perspective on teaching statistical consulting skills at ICOTS-6 in Durban. Andile is currently involved in a longitudinal study (on its 3rd year) in which he is investigating the understanding of probability by first year statistics students.

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Ioannis is a primary school teacher. He served in primary schools of Greece for a period over than 10 years and lately is working at the School of Education of the Aristotle University of Thessaloniki, where, he has recently started doctoral studies in the area of " Statistics in Education" in Greece, focusing on the elementary education sector. His interests generally concern everything that has to do with the teaching of statistics and probability in primary education.

Irma MOLINA VEGA
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Irma has a Master's degree in Mathematics Statistics, a Diploma in Quality Management and a Bachelor in Education. She is collaborating in research projects in biomedical sciences and food technology and is

responsible for Pedagogical Co-ordination at the Institute of Mathematical Statistics in Valdivia. She teaches statistics in the School of Biochemistry, School of Journalism, and Acoustic Engineering, and biometry in the Bachelor of Sciences. Her engagement with the co-operative work lead her to strength the teaching and she is intending to optimise the Institute resources and capacities. She is establishing international relationships with expert statistics educators to collaborate in the quality of training, capability and diffusion of applied statistics to foster the development of professionals and organisations in the region. She is trying to make the Institute a leader organisation in the teaching, research and application of statistics in the Southern part of Chile by: a) supporting collaborative research in applied statistics; b) providing the training, research, design, process, analysis and interpretation needs of public and private institutions in the region to support their management.

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Dave SAVILLE, a biometrician working in agricultural research in New Zealand, has been working with Graham Wood (Massey University, NZ) on an alternative geometric way of thinking about linear models (i.e., t-tests, analysis of variance, regression, and so on). This involves a direct geometric route to the p-value for each test. Examples are hidden away in an appendix of SAVILLE and Wood (1996), so Dave and Graham are currently trying to publish a paper introducing the ideas to a wider audience (Wood and SAVILLE, 2001). Dave has also recently written a paper describing his series of workshops for agricultural researchers (SAVILLE, 2001). In addition, he and a scientist friend have prepared a single-page (double-sided-A4) summary which links all those simple statistical terms (sd, n, sem, sed, lsd, CV%, CI) and their usage on graphs (SAVILLE and Rowarth, 1997); this has proved very popular. References to his work are included in the section on short references.

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5. Brief News

Hipótesis Alternativa. The IASE Newsletter for Venezuela now on the web

The IASE National Correspondent for Venezuela, Audy SALCEDO is editing an electronic Newsletter written in the Spanish language with the aim of making the IASE and its activities more accesible to Spanish speaking people. *Hipótesis Alternativa* includes part of the materials published in *SERN,* which are translated by Audy as well as IASE news and local news of interest to statistical educators. Audy is distributing this newsletter by e-mail and now Hipótesis Alternativa is also located on the Internet at http://www.ugr.es/~batanero/Hipotesis.htm. Those interested in submitting information or in receiving the newsletter, please contact Audy at <pearson@cantv.net>.

ISI-54 Berlin 2003 - Proposals Welcome for the IASE Scientific Programme

The IASE Programme Committee for ISI-54, under the chair of Gilberte SCHUYTEN, starts their work in preparing the scientific programme for the Berlin 2003 ISI Session. All IASE members are urged to submit proposals for invited paper meetings to the IASE Programme Committee. These proposals should be sent to <Gilberte.schuyten@rug.ac.be>.

A Project for Pedagogical Development at the Institute of Statistical Mathematics, Valdivia, Chile

Coordination: *Irma MOLINA Vega*
Participants*: Andrea BÁEZ H.; Víctor Figueroa A.; Heriberto Figueroa S.; Juan Carlos Miranda C.; Luis Ojeda S.; Sergio Parra A.; Osvaldo Rojas Q.; Luis Romo K.*

This Project is intended to formalise and reinforce the individual efforts of the Institute lectures to improve the teaching of statistics and to share criteria in the teaching of statistical topics. The Project includes the following

aims:

- Updating the Institute lecturers in the use of available sotware;
- organising a system for retrieving and using Internet resources;
- exchanging didactic strategies that were effective for particular statistical topics in the courses taught;
- building a data base with examples for didactical purposes;
- preparing presentations; books, support materials that can be used in the statistical training of Austral University students;
- building a file with assesment task and results and trying assessment strategies that are supported by statistical criteria;
- maintaining a Didactical Information System to asess the academic management of the different courses.

Some activities carried out in this Project include:

1. Analysis of EPI-INFO 2000 and its use in teaching. Coordination: Sergio Parra.
2. Evaluation of Statgraphics, at the XXVII Jornadas Nacionales de Estadística. Coordination Irma MOLINA, Osvaldo Rojas and Víctor Figueroa.
3. Use of Arc View, Excel and Power Point. Lecturer: Gastón Vergara. Coordination: Osvaldo Rojas and Andrea Báez
4. Evaluation of Statistica. Coordination: Víctor Figueroa.
5. Revision of Cart and Epimap and applications to Nutricional Monitoring Coordination Irma MOLINA
6. Workshop on Teaching methodologies in statistics education. Carmen BATANERO, October, 2000. Coordination: Irma MOLINA and Víctor Figueroa.
7. Conference on "Interactive statistics", Martha ALIAGA, October, 2000.
8. Workshop on ·Teaching descriptive statistics Coordination: Irma MOLINA, January, 2001.

Juarez-Lincoln-Marti International Education

The Juarez-Lincoln-Marti International Education Project is dedicated to providing faculty development to Mexican and Ibero American universities, especially public and provincial institutions, as well as to strengthening mutual knowledge and a better understanding between American and Ibero American faculty and students.

The Juarez-Lincoln-Marti was founded in 1994, as the SUNY-Mexico Exchange Project. Under this name it functioned between 1994 and 1998 when its Director, Dr. Jorge ROMEU, took early retirement from SUNY. Since its inception in 1994, the Juarez Lincoln Marti Project established contacts with multiple Mexican universities and research centers, donated several boxes with dozens of mathematics and science textbooks and other teaching materials to several universities, maintained two email information lists (for Academics and researchers) and found scholarships that allowed Mexican faculty to attend the SUNY CIT Conferences for Instructional Technology (CIT). For the CIT2001 you can find more information in their web page http://snycorva.cortland.edu/~matresearch/ and http://osx.tc.suny.edu/cit/cit2001/index.html

A Funded Project To Develop A Statistics Education Web Server In Spanish Language

Carmen BATANERO and her colleagues at the University of Granada (M. Jesús CAÑIZARES, Juan D. GODINO, Luis SERRANO, Juan J. ORTIZ and Angustias VALLECILLOS) have been funded to develop a 3- year Research Project by the Spanish Ministry of Education and Culture. The aim is to improve and develop the group's Internet page (http:/www. ugr.es/local/batanero/). After all the members of the group finished their doctoral dissertation in statistics or in statistics education they are now trying to produce survey works about research in statistics education. The aim is to make these materials available to teachers and researchers.

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6. Summaries of Publications by *IASE* Members

Alexander, l., JOHNSON, R., & Weiss, J. (2001). Exploring Zipf's law. *Teaching Mathematics and its Applications,*

17(4), 155-158. Zipf's Law, that word rank times word frequency in most texts is roughly a constant, may be empirically verified by students using software provided by the authors. Such investigations help students value the connection between mathematics and other disciplines.

Barbella, P. & SIEGEL, M. (2001). Exploring a queueing problem through human simulation. *Teaching Statistics,* 23 (1), 4-7. A classroom activity where the students actively simulate different queueing systems is described. Analysis of waiting times gives insight into the structure of queueing systems and the issues to be considered in comparing them.

BATANERO, C. (2001). *Didáctica de la Estadística* (Didactics of Statistics). Granada: Departamento de Didáctica de la Matemática. ISBN: 84-699-4295. This is a book that I wrote for my students in the course "Didactics of Statistics", an optional subject in the Major of Statistics Sciences and Techniques at the University of Granada. In trying to reflect about the didactic training of statisticians and mathematicians, who have a solid and updated background in statistical techniques, I needed to specify what didactical knowledge is, which are the components of this knowledge, and how can we make it useful and interesting to future teachers of statistics. This book tries to provide an answer to these questions and it is organised in 5 chapters: 1) Current situation and future perspectives for statistics education: 2) Epistemological foundations. 3) Research on statistical reasoning and learning difficulties. 4) The statistics curricula. 5) Examples of projects for the statistics classroom. This last chapter tries to contextualise statistics in the more general research process and can serve as an example to develop a statistics course based on the use of projects at secondary school level. The book is available on the Internet at http://www.ugr.es/local/batanero/

Connor, D., DAVIES, N., & HOLMES, P. (2000). Census at school. *Teaching Statistics,* 22(3), 66-69.This article covers the development of an ambitions Internet-based project to conduct a simple census of the schoolchildren of England and Wales linked to the 2001 UK National Census.

DAHL, H. (2001). How many excellent grades should be tolerated. *Teaching Statistics,* 23 (1), 24-25. This article describes an example that can be used to convey the ideas of testing hypotheses.

Dassonville, P., & HAHN, C. (2000). The use of a multimedia tool in teaching factor analysis to business school students. Is there a statistical significant improvement ? Paper presented at *ICME-9*. Teaching factor analysis to non scientific audience is not easy. These methods should be taught with rigor so that students develop the capacity of interpreting correctly the results of the statistical analysis. But it can not be taught in a too theoretical way because it would be rejected by students who often have a difficult relationship with mathematics. Development of technology, especially multimedia, allowed to consider conception of new pedagogical tools that could improve learning. But we know that human mediation is an essential part of the process of knowledge construction. So, the question of the position of such tools in a pedagogical programme is still fundamental. It is why the Paris Chamber of Commerce and Industry supported a research project on learning Principal Components Analysis (PCA). The first step of this project was to create a multimedia tool. The second step was to evaluate the efficiency of the tool. In our presentation, we will first say a few words about teaching of statistics in French Business schools. Then describe shortly the pedagogical programme we experimented at Ecole Supérieure de Commerce de Paris (ESCP), integrating the multimedia tool. Then we will present the main results of the evaluation of this tool's efficiency we conducted in 1998/99.

Dassonville, P., & HAHN, C. (2000). The multimedia tool: a transitional medium between the mathematician's culture and the professional's culture in teaching PCA in a business school. In Ahmed, Kraemer, & Williams (Eds.), *Cultural Diversity in Mathematics Education*. Horwood. Two kinds of mathematical applications are taught in business schools : statistics and data analysis (mostly used for marketing) and models in financial markets. We will here consider the first of these subjects and discuss the case of Factor analysis (Principal Components Analysis, PCA). This method is widely used in marketing but it is difficult because you need to have good bases in linear algebra and calculus. In France, business school students are no longer able to reach these levels, so PCA is less frequently taught in statistics courses. It is mostly reduced to the presentation of some « recipes» by the marketing teacher using professional software. But the complexity of PCA, hidden behind the apparent simplicity of graphical representations summarising analyses, leads to many errors in the workplace. We believe that there is an intermediary way of teaching PCA, between the « deep mathematical » approach and the «marketing recipes » approach. This consists of a strict conceptual approach based on graphical representations. It integrates a

multimedia tool that allows the students a strong autonomy for experimentation and the possibility of simulation by using dynamic representations.

HUNT, N., & Tyrrell, S. (2000). Learning statistics on the Web. *Teaching Statistics,* 22(3), 85-90.This article discusses the use of the Internet in teaching and learning statistics, and describes how interactive spreadsheets can be integrated with Web-based resources

JOHNSON, R. W. (2001). Investigating randomness via simulation using the TI-83. *Teaching Statistics,* 23 (1), 27-31. Most students do not have a good grasp of the consequences of randomness. Simulating random phenomena with unexpected outcomes sparks student interest and discussion when presenting probability topics in class. TI-83 programs for selected random phenomena are available from the author.

JONES, G. A., Thornton, C, A., Langrall, C. W., Mooney, E. S., Perry, B., & Putt, I. J. (2001). A framework for characterizing children's statistical thinking. *Mathematical Thinking and Learning*, 269- 309. Based on a review of research and a cognitive development model (Biggs & Collis, 1991), we formulated a framework for characterizing elementary children's statistical thinking and refined it through a validation process. The 4 constructs in this framework were describing, organizing, representing, and analyzing and interpreting data. For each construct, we hypothesized 4 thinking levels, which represent a continuum from idiosyncratic to analytic reasoning. We developed statistical thinking descriptors for each level and construct and used these to design an interview protocol. We refined and validated the framework using data from protocols of 20 target students in Grades 1 through 5. Results of the study confirm that children's statistical thinking can be described according to the 4 framework levels and that the framework provides a coherent picture of children's thinking, in that 80% of them exhibited thinking that was stable on at least 3 constructs. The framework contributes domain-specific theory for characterizing children's statistical thinking and for planning instruction in data handling.

LECOUTRE, B., LECOUTRE, M. P., & Poitevineau, J. (In press). Uses, abuses and misuses of significance tests. Won't the Bayesian choice be unavoidable? *International Statistical Review.* The current context of the "significance test controversy" is first briefly discussed. Then experimental about the use of the null hypothesis significance tests by scientific researchers are applied statisticians are presented. The misuses of these tests are reconsidered as judgmental adjustments revealing researchers' requirements towards statistical inference. Lastly alternative methods are considered. Consequently we automatically ask ourselves Won't the Bayesian choice be unavoidable?

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7. Recent Dissertations

Gómez-Chacón, I. M. (1997). *Procesos de aprendizaje en matemáticas con poblaciones de fracaso escolar en contextos de exclusión social. Las influencias afectivas en el conocimiento de las matemáticas [Mathematics learning processes in populations with school failure in context of social exclusion].* Ph.D., Universidad Complutense de Madrid, España. Supervisor: Arturo de la Orden.

The relevance that affective factors for education and, in particular, for the learning of mathematics is a theme that periodically emerges from different approaches. It appears for example in the seventies in the studies of women's mathematical learning obstacles (e.g., Fennema y Sherman, 1976) and in studies with University students and adult education. In mathematics education the stronger alternative paradigm arose in the nineties, detached from evolutive cognitive and under the umbrella of more recent works in cognitive psychology and socio- constructivism (McLeod, 1988, 1992, Goldin, 1988, etc.). Research was focused on the blockages in the processes of solving problems. Three basic descriptors of the affective domain received special attention (emotions, attitudes and beliefs) and several dimensions of the problem solvers emotional state were specified: size, direction, length and conscience level). The greater emphasis given to emotions is due to the fact that affective factors arise from emotional responses to the interruption of problem solving plans. This research pays special attention to individual solvers and laboratory situations. Other authors such as Walkerdine (1988), Nimier (1988, 1993), Taylor (1989), Evans (1999) used psychoanalytical approaches and post-structural ideas to interpret students' and teachers' affective reactions.

In the last decade, the reconceptualization of affective domain has two essential goals: trying to consolidate a theoretical framework and taking into account the learning social context (Gómez-Chacón, 1997, 2000). Our work is focused on the study of affective blockages in problem solving and in mathematical activity and on the description of emotional episodes of students in the classroom (Gómez-Chacón, 2000, 2001). We try to detect the person's affective reactions in his/her socio cultural context. In this way some learning blockages are explained by feelings and attitudes that reinforce the structure and origins of beliefs (global affect). Some examples are emotional reactions defined by the social group, and value given and beliefs associated to different ways of mathematical knowledge. In research on affects, attitudes are generally measured with scales and questionnaires and emotional reactions were studied by observing the subject when solving a problem. Less frequently affective reactions in the classroom (natural setting). when students develop mathematical activity in interaction with other classmates are studied (COBB, Yackel y Wood, 1989). The contextualization of these reactions in social reality and the study of the origin of affective reactions and of the relationships among these, cultural conventions, and social beliefs and representations are still more scarce. This requires a wide base of knowledge about the students' sociocultural context in and out of the school.

Students (teachers) continuously receive messages about what the meaning of knowing mathematics and the social meaning of learning mathematics is. Student's self-concept is related to attitudes, perspective of mathematical world, and social identity and has a strong influence in their views of mathematics. In considering social identity we take into account social symbolic relationships (Gómez-Chacón, 1997, 1998, 1999) and in this level we can understand how social values of different ways of knowledge can influence mathematical cognition in a global interpretation of each subject's global affect. In our work (Gómez-Chacón, 1997, 1999, in press) we propose a model to analyse interactions between cognition and affect in the learning of mathematics. This model not only describes emotional reactions and its origin, but also their changes and the subject's evolution. Some important dimensions are described and how to incorporate them into the analysis of data from students with low achievement are shown. A lot of work has still to be done in integrating the affective approach in teaching and learning situations.

Mastracci, M. (2000). *Attitudes and beliefs of students regarding statistics: a case study in the Faculty of Statistics Sciences, University of Rome "La Sapienza", Italy*. Laurea thesis, Supervisor: Maria Gabriella OTTAVIANI

The Survey of Attitudes Towards Statistics (SATS) version(1) was given in October 1999 to 172 students of the Laurea course in Statistics and Actuarial Sciences at the Faculty of Statistics Sciences, University of Rome "La Sapienza". In the sample there were 62 students in the course of Statistics (first year), 30 in the course of Demography (second year), 46 in the course of Multivariate Statistics Analysis (third year) and 34 in the course of Risk Theory (forth year). All these courses were taught in the first semester and are compulsory. The items of the questionnaire were complemented with a set of supplementary variables concerning the student's school degree (clasical, scientific, technical, ….), the number of the statistics exams passed and their respective scores.

The 28 items of the SATS were analysed with principal component analysis. The component structure was interpreted as follows: difficulty and professional value (2nd component), everyday life value and cognitive competence (3rd component), affects (4th component). Although most students admit that statistics is difficult they think they have cognitive competence to study statistics and that their professional knowledge of statistics will help them to find a job. Statistics do not cause stress to students and they do not feel scared by this discipline. Attitude and beliefs regarding statistics change according to the kind of pre-university education, in particular scientific studies favour attitudes towards statistics. The more exams students pass the more self confident they are. The highest marks they get the more positive affect is. In general the interviewed students showed a positive attitude towards the discipline and the Faculty, that does not stress them too much. But we need to take into account that most of them chose the course in Statistics and Actuarial Sciences because of their interest in the discipline. Therefore, well motivated students are fundamental for a statistics course to be successful.

From the methodological point of view, the questionnaire was robust enough. Notwithstanding the particular set of students, it maintains most of the features presented in (1) and the presence of supplementary variables succeeded in giving evidence to the characteristics of this set of students.

(1) Gal, I., Ginsburg, L., &. SCHAU, C. (1997). Monitoring attitudes and beliefs in statistics education. In I. Gal, & J. B. GARFIELD (Eds.), *The Assessment Challenge in Statistics Education.* Amsterdam: IOS Press.

8. THE EMOTIONAL DIMENSION IN MATHEMATICS EDUCATION: A BIBLIOGRAPHY

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There are more theoretical developments on affective variables (goals, attitudes, feelings etc.) than practical suggestions for everyday work in the classroom, although some works by Lafortune, St-Pierre (1994), and Gómez-Chacón (2000) offer these proposals. To introduce the points described in the summary of my doctoral dissertation, I will present a bibliography that has been divided into categories to facilitate its use.

General aspects of the affective dimension in Mathematics: Global overviews, general topics about affective dimensions in mathematics:

1. Buxton, L. (1981). *Do you panic about maths? Coping with maths anxiety*. London: Heinemann Educational Books.
2. Forgasz, H. J. (1995). *Learning mathematics: affect, gender, and classroom factors*. Ph.D. Monash University, Australia.
3. Gómez-Chacón, I. M. (1996). The sociocultural context of learning and affective issues in mathematics education. Short Presentations. *Proceedings of 8th International Congress on Mathematical Education.* ICME 8. (pp. 443). Sevilla: Organising Committee.
4. Gómez-Chacón, I. M. (1997). La alfabetización emocional en educación matemática: actitudes, emociones y creencias [Emotional literacy in mathematics education: attitudes, emotions and beliefs]. *UNO*, 13, 7-22.
5. Gómez-Chacón, I. M. (1997). *Procesos de aprendizaje en matemáticas con poblaciones de fracaso escolar en contextos de exclusión social. Las influencias afectivas en el conocimiento de las matemáticas. [Mathematics learning processes in populations with school failure in context of social exclusion].* Unpublished Ph.D. Universidad Complutense, Madrid.
6. Gómez-Chacón, I. M. (1998). ¿Es la actividad matemática algo emocional? [Is mathematical activity something emotional?] *Gaceta de la Real Sociedad Matemática Española, 1(3*), 415-423.
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11. Gomez-Chacon, I. M. (In press). *Affective influences in the knowledge of mathematics. Educational Studies in Mathematics.*
12. Hart, L. E. (1989). Describing the affective domain: saying what we mean. In D. B. McLeod, & V. M. Adams (Eds.), *Affect and mathematical problem solving: A new perspectitve* (pp. 37- 48). New York: Springer.
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14. Lafortune, L. (1992). *Dimension affective en mathématiques*. Mont-Royal, Québec: Spirale.
15. Mandler, G. (1989a). Affect and learning: Causes and consequences of emotional interactions. In D. B. McLeod, & V. M. Adams (Eds), *Affect and mathematical problem solving: A new perspectitve* (pp. 3-19). New York: Springer.
16. Mandler, G. (1989b). Affect and learning: reflections and prospects. In D. B. McLeod, & V. M. Adams (Eds.),

Affect and mathematical problem solving: A new perspective (pp. 237-244). New York: Springer.

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Attitudes: Concept, components, intervention (confidence, anxiety) research and assessment tools. In addition to (1), (2), (4), (8), (9), (18), (20), (21):

22. Aiken, L. R., Jr (1970). Attitudes toward mathematics. *Review of Educational Research,* 40, 551-596.
23. Aiken, L.R. Jr. (1974). Two scales of attitude toward mathematics, *Journal for Research in Mathematics Education*, 5, 67-71.
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39. McCallon, E. L., & Browmn, J. B. (1971). A semantic differencial instrument for measuring attitude toward mathematics, *Journal for Experimental Education*, 39, 69-72.
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Emotions: Emotions, emotional reactions in mathematics activity; affective factors in learning mathematics; why emotional reactions towards mathematics and its learning; types of research, research methodology and conceptions about emotional reactions. In addition to (3), (5), (6), (7), (8), (9), (10), (11), (18), (20), (30), (33), (35):

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9. Training Researchers in the Use of Statistics
A new book published by the IASE and the ISI

There is no doubt that the training of researchers in the use of statistics is very important to improve the quality of empirical research and to foster technical and economical development. However, since the logic of statistical inference is difficult to grasp, its use and interpretation are not always adequate and have been criticised for nearly 50 years. Within the International Association for Statistical Education it was felt that there was an educational problem at the root of this dilemma and a *Round Table Conference on The Training of Researchers in the Use of Statistics* was organised at the Institute of Statistical Mathematics in Tokyo, August 7-11, 2000.

The present book includes the works and discussions at the Conference and it is one of a series of publications resulting from the International Statistical Institute and International Association for Statistical Education Round Table Conferences. The Tokyo conference was not an isolated event, but a part of a long international collaborative process, which started in 1997, when the IASE Executive Committee decided the topic for this particular Round Table Conference and later nominated Carmen Batanero to organise its scientific committee. In early 1998 the Scientific Committee was in place and they started to produce a Discussion Document describing the aims of the conference and suggesting the main points to be discussed. Members of the Scientific Committee and the IASE Executive Committee met during the ICOTS-V Conference in Singapore, August 1998 to revise the document.

The Discussion Document, which is reprinted in Part I of this book, was published in the *Newsletter of the International Study Group for Research in Statistics Education* and located at the Conference web site in October, 1998. Shorter versions were also published in the *ISI Newsletter*, *Teaching Statistics* and *IASE Review*. From October 1998 to November 1999, a Call for papers for the conference was announced through the IASE and ISI publications, and through a number of statistics and mathematics education journals; its theme attracted wide interest on the part of statisticians and statistics educators. Proposals for paper presentations were solicited for November1999 by the Scientific Committee.

The IASE organised a refereeing process with the participation of specialists from different countries to assure fairness and quality in the process of reviewing and selecting the papers to be presented at the conference among the many proposals received. The authors of each accepted proposal were required to complete a preliminary paper by May 1, 2000. These preliminary papers were then put on the web, so that those attending the Round Table Conference could download and read the papers of the various presenters before the actual meeting. The Scientific Committee classified the papers accepted in a number of categories to produce the conference programme and invited some additional participants (both statisticians and statistics educators) to act as reactors for every set of related papers.

The conference was sponsored by the IASE and the ISI, the Institute of Statistical Mathematics in Tokyo and the Japan Statistical Society. The 48 participants who met during five days, included professional and official statisticians, lecturers, researchers and statistics educators with experience in teaching, research or consultancy in different areas of application. The participants represented different countries of the five continents, as well as developed and developing countries. At the conference, the papers were presented and debated and, after the conference, a summary of the discussions was sent to the authors who were given some additional time and were asked to produce a revision of the papers, taking into account the suggestions and discussions held.

As a result of this process we are happy to present today this set of contributions. “Training Researchers in the Use of Statistics” is not a simple topic. In this book the reader will find various analysis of the problems related to this training, and a number of views of ways in which some of these problems might be solved: The controversies on the use of statistics in research; the researchers' attitudes towards statistics; the challenges set by technology; the particular needs of training in specific research fields; the problems of communication among

statisticians and researchers are just a few examples of didactical problems that are discussed.

The book is organised in six parts. After the introductory section, which contains the materials related to the conference, several chapters offer a broad view of the didactical problems related to the training of researchers: Part 2 describes the problems related to the training of researchers in particular statistical topics. In Part 3 the challenges set by technology and how this affects the training of researchers is discussed. Part 4 deals with the particular training needs of researchers in areas such as education, social sciences, medicine or biology. International successful experiences to solve challenging problems in the training of researchers are described in Part 5 and Part 6 discusses the didactical problems that underlay statistical consultation. A final chapter presents a synthesis of the main conclusions in the Conference.

The themes and ideas that emerge from these papers should be considered as suggestions for further research more than as definitive answers. There are so many unanswered questions about what the best ways of training future and current researchers are, about how can we change their views and attitudes towards statistics and about how best we can collaborate with them best. We hope this book will serve as a starting point for other lecturers, researchers and statistics educators to reflect on the statistical training of researchers in empirical sciences, to change their teaching approaches, to improve the interest to collaborate in applied research and to start new didactical research on some of the problems described.

Book reference:
Training Researchers in the Use of Statistics
IASE Round Table Conference, Tokyo 2000
Edited by Carmen BATANERO, ISBN 90-73592-19-4
Published by: International Association for Statistical Education, International Statistical Institute
Available from: ISI Permanent Office, 428 Prinses Beatrixlaan, PO Box 950, 2270 AZ Voorburg, The Netherlands

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10. Other Publications of Interest

Deshpande, M. N. (2000). Intransitive dice revisited *Teaching Statistics* 22(3), 80. Intransitive dice were discussed in a previous article, following a competition in the journal. A further interesting result is presented here.

du Feu, C. (2001) A new least-squares regression model. *Teaching Statistics,* 23 (1), 17-19. This article describes simple apparatus for classroom demonstration of fitting a least-squares regression line.

Edwards, A. W. F. (2000). Gilbert's sine distribution *Teaching Statistics* 22(3), 70-71. The sine distribution introduced by the astronomer G.K.Gilbert in 1892 is revived as an interesting example of an elementary continuous distribution suitable for teaching purposes.

Ellenberg, J. E. (2000). Statisticians' significance. *Journal of the A S A,* 95 (1). 449. Statisticians are often not recognized at a level appropriate to their contributions. Moreover, statistical methods of analysis may be receiving more recognition than statisticians themselves. This article considers several measures of the recognition of our profession and explores why recognition is important not only to the individual statistician, but also to the health and prosperity of our profession.

Farnsworth, D. L. (2000). The case against histograms. *Teaching Statistics,* 22(3), 81-84. A homework assignment used to show students that histograms can be misleading.

Hodgson, T., & Burke, M. (2000). On simulation and the teaching of statistics. *Teaching Statistics* 22(3), 9-11.The use of simulation as an instructional tool can promote a deep conceptual understanding of statistics *and* lead to misunderstanding. Teachers need to be aware of the misconceptions that can arise as a result of simulation and carefully structure classroom activities so as to derive the benefits of this powerful instructional tool.

Jackman, S. (2001). Learning about the normal distribution with a graphics calculator. *Teaching Statistics,* 23(1), 13-16. This article describes how a graphics calculator can be used by students who are learning about

the Normal distribution. It also discusses the implications of replacing the use of statistical tables.

Leti, G. (2000). The birth of statistics and the origins of the new natural science, *Metron,* 58, 3-4.Statistics as a method to provide a quantitative knowledge and collective phenomena and as a social science was born from the fusion of three main currents of thought. These emerged in three different European countries during the 17th century: descriptive statistics in Germany, political arithmetics in England and in France, where the usefulness of statistical surveys was promoted and thus their aim to determine their methodology. Seventeenth century France was also responsible for devising the probability theory, which soon proved to be an indispensable mathematical tool in the field of statistics.

Throughout the same century, thanks to the efforts of Galileo Galilei, Isaac Newton and various other scientists the new natural science was being forged. The calculation machine was invented and the foundations of modern mathematics were laid with the introduction of analytical geometry and infinitesimal analysis and probability theory. Although the new natural science and statistics were related to two different worlds - natural phenomena on the one hand, and matters of State and society on the other - they nonetheless shared several common or at any rate similar features.

The processes leading to the birth and development of these two sciences involved the same set of factors and principles and were stirred by the same needs and demands. Each could emerge thanks to the scientific worth accorded during the 1600's to the tools and instruments invented by man to overcome its limits. The new natural science came into being thanks to the invention and application to scientific ends of various tools which, by compensating for man's limit senses, permitted a new approach to the study of natural phenomena. Similarly the introduction of statistics surpassed the human mind's inability to quantitatively perceive and understand collective phenomena (originally limited to matters concerning the State and society).

Both the new natural sciences and statistics shared the same inductive empirical method, where the quantitative observation of facts and their theoretical elaboration by mathematics are inseparably linked. Apart from the scientific goals set, both sciences pursued practical aims, thus adopting a functional attitude to the reality under observation. The aim of science was to dominate nature to the benefit of mankind. The aim of statistics was good government and public interest.

Italy in the 1600's was a leader in the natural sciences. This can be attributed to the many discoveries made by Galileo and his disciples. Italy also boasted the first scholars of modern mechanics, optics, astronomy as well as geography, medicine and botany. Italians, however, made little or no contribution to the origins and development of statistics, despite being forerunners in the field.

The reasons why Italians failed to make an active contribution to the budding social sciences could lie with the Counter-reformation and Inquisition. Both were responsible for curbing the country's intellectual freedom. The time was fraught with danger for any Italian scientist who attempted to challenge tradition and focus anew on the surrounding reality. Thus, a catholic scientist in Italy had no option but to avoid any clash with the ecclesiastical authorities and dedicate himself to a study of natural sciences. These were looked on more leniently, as no challenge was made of existing Church doctrine. Any digression into other fields was to be discouraged. In such a climate any impulse to venture into the more risky area of scientific investigation of human nature was quickly quenched.

Pratt. D. (2000). Making sense of the total of two dice *Journal for Research in Mathematics Education*, 31(5). 602-625. Many studies have shown that the strategies used in making judgements of chance are subject to systematic bias. Concerning chance and randomness, little is known about the relationship between the external structuring resources, made available for example in a pedagogic environment, and the construction of new internal resources. In this study I used a novel approach in which young children articulated their meanings for *chance* through their attempts to "mend" possibly broken computer-based stochastic gadgets. I describe the interplay between informal intuitions and computer-based resources as the children constructed new internal resources for making sense of the total of 2 spinners and 2 dice.

Prieto Martínez, J. J. (2000). Sobre las ideas y conceptos de calculo de probabilidades en los adolescentes (Ideas and concepts of probability calculus at secondary level students). *Boletin - Sociedad "Puig Adam" de Profesores de Matematicas*, 54, 46-57. What are the ideas and concepts that teenagers learn in secondary schools about probability? The research has been performed with 17 and 18 year old students from 10 secondary schools from the centre of Madrid. They are preparing for entrance into the University

(Selectividad L.O.G.S.E.). The test consists of 8 questions about what they have learned. The research results show what probability concepts are easier and more difficult for the teenagers. Therefore, the research informs the teacher about what probability concepts should be treated more carefully in class.

Reschenhofer, E. (2001). The bimodality principle. *Journal of Statistics Education,* 9(1). In statistics courses, students often find it difficult to understand the concept of a statistical test. An aggravating aspect of this problem is the seeming arbitrariness in the selection of the level of significance. In most hypothesis-testing exercises with a fixed level of significance, the students are just asked to choose the 5% level, and no explanation for this particular choice is given. This article tries to make this arbitrary choice more appealing by providing a nice geometric interpretation of approximate 5% hypothesis tests for means. Usually, we want to know not only whether an observed deviation from the null hypothesis is statistically significant, but also whether it is of practical relevance. We can use the same geometrical approach that we use to illustrate hypothesis tests to distinguish qualitatively between small and large deviations.

Revak, M. E., & Porter, D. B. (2001). The toothless bathing beauty and the t-test. *Teaching Statistics,* 23 (1), 22-23. A simple and amusing class experiment is used to introduce many ideas of descriptive and inferential statistics.

Rodd, M. M. (2000). Let me tell your fortune. Probability is an emotional issue. *Mathematics in School*, 29(1), 28-29. The following classroom activities are intended to help students become aware of the persuasive power of canny use of estimated probabilities. The question 'When does the fortune teller have most power over her intended client?' brings out the relationship between probability estimate and emotional leverage and would be suitable for class discussion.

Spurrier, J. D. (2001). A capstone course for undergraduate statistics majors. *Journal of Statistics Education*, 9(1). This article discusses a capstone course for undergraduate statistics majors at the University of South Carolina. The course synthesizes lessons learned throughout the curriculum and develops students' nonstatistical skills to the level expected of professional statisticians. Student teams participate in a series of inexpensive laboratory experiments that emphasize ideas and techniques of applied and mathematical statistics, mathematics, and computing. They also study modules on important nonstatistical skills. Students prepare written and oral reports. If a report is not of professional quality, the student receives feedback and repeats the report. All students leave the course with a better understanding of how the pieces of their education fit together and with a firm understanding of the communication skills required of a professional statistician.

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12. Information on Past conferences

11.1. Nouvelles Demarches Dans L'enseignement De La Statistique Et Des Probabilites, November, 29, 2000, Paris, University "Pole Léonard deVinci"

Marie BERRONDO AGRELL <marieagrell@teacher.com>

"New tendencies in teaching probability and statistics" was the subject of a meeting that was held in Paris-La Defense at the new University "Pole Léonard de Vinci" on the 29th of November 2000. Around 30 University lecturers met in a lively meeting.

Mr. Felix Rosenfeld presented a fascinating history of statistics and statistics teaching in France and the most important European countries. Mr. Rosenfeld was himself teaching assistant of Darmois and Borel in 1938 and he was responsible for free French government statistics during the Second World War and after this he was responsible for statistics in Indochina until France left the country. Working for a number of banks and teaching institutions, he had the opportunity if meeting a number of eminent statisticians around the world and participating in scientific conferences, thus favouring a climate of intellectual exchange.

Mrs Marie BERRONDO-AGRELL, explained some ideas to make understanding of probability easier. She developed some ideas from her books with Jacqueline Fourastié, where she generalises Grunbaum formulae and Venn diagrams, and then uses graph theory in her analysis. The bases of probability calculus, including conditional probability and random variables is then made evident, in agreement with Borel quotation" probability calculus is one of the most interesting and easier branches of mathematics".

Michel Tenenhau, author of several data analysis books published by Dunod, was in charge of

demonstrations of the usefulness of SPSS. An application in the comparison of data from two groups of lecturers was made in a very interesting presentation.

11.2. OZCOTS-3 Statistical Education Workshop, Dec 5- 6, 2000

School of Mathematical Sciences Swinburne University of Technology

Brian PHILLIPS

By now, OZCOTS is becoming a tradition among Australian statistics educators. Along two days a number of presentations and workshops were held at the School of Mathematical Sciences, Swinburne, Australia. The summaries of presentations, powerpoint files and other information are available from the IASE web page - Below we include summaries of presentations and a list of workshops.

Sunmmaries of presentations

1. *Statistics in Psychology*, Chair: Geoff CUMMING.

Bruce Thompson. *Where the Social Sciences are Headed: Away from NHST, Toward Effect Sizes and Replicability Evidence*. The American Psychological Association (APA) Task Force on Statistical Inference recently issued its report. The report was published in the *American Psychologist*, but also is available on-line at: ttp://www.apa.org/journals/amp/amp548594.html The Task Force also emphasized, "Always provide some effect-size estimate when reporting a p value" (p. 599, emphasis added). Later the Task Force also wrote, _Always_ present effect sizes for primary outcomes.... It helps to add brief comments that place these effect sizes in a practical and theoretical context.... We must stress again that reporting and interpreting effect sizes in the context of previously reported effects is essential to good research. (p. 599, emphasis added) Thus, editors at 13 journals now formally "require" effect size reporting: Career Development Quarterly; Contemporary Educational Psychology; Educational and Psychological Measurement; Journal of Agricultural Education; Journal of Applied Psychology; Journal of Consulting & Clinical Psychology; Journal of Early Intervention; Journal of Experimental Education; Journal of Learning Disabilities; Language Learning; Measurement and Evaluation in Counseling and Development; The Professional Educator; and Research in the Schools. The presentation will explore where the social sciences seem to be headed as regards effect size reporting and replicability evidence (e.g., the bootstrap). It appears that the field is deemphasizing statistical significance tests.

Joanna Leeman, Sue FINCH, & Geoff CUMMING, *Researcher's judgements about data, and implications for education.* We will present the findings of a Web-based investigation in which psychology and medical researchers who were authors of a recent journal article, and ANZstat members (applied statisticians) were invited by email to participate. The interactive website asked researchers to choose from a collection of statistical analyses relating to a research study vignette from which they were to draw conclusions. Participants were asked questions such as: "Which information would you like in order to evaluate the findings?", "What does this information tell you", and "You are planning to publish the study's findings. What would you conclude...?". Specific focus was placed on the use and interpretation of t-tests and confidence intervals. Clear group differences in the choice and use of statistical information to draw conclusions from data emerged between psychological and medical researchers and applied statisticians. Whether a relationship exists between the type of information chosen and the kind and quality of conclusion drawn is currently being investigated. The study raises some concern over statistics education in psychology where one statistical method continues to dominate.

Sue FINCH, Geoff CUMMING, Jenny Williams, Lee Palmer, Elvira J. Griffith, Chris Alders, Jamie Anderson, & Olivia Goodman. *A case study of reform in psychology: Implications for statistics education*. We have described the need for reform of statistical practice in the social sciences in our previous presentations to Ausicots. Reformers have recommended using visual displays and reporting confidence intervals in preference to routine reliance on null hypothesis significance testing. A natural case study of this kind of reform has arisen in the psychological literature. In 1993 Geoffrey Loftus, the incoming editor of Memory and Cognition, a prestigious international journal, recommended that authors report results using visual

displays with error bars in preference to hypothesis testing. Loftus argued that visual representation should "obviate the need for" classical testing. In a three phase study, we investigated the success of Loftus' reform. First we examined statistical practices in articles published in Memory and Cognition from 1990 to 2000. Second we examined the statistical practices of authors who published in Memory and Cognition under Loftus' editorship (1994 to 1997). For these authors, we compared papers published under Loftus with papers published elsewhere. Third we surveyed these authors via email to ask about their views on Loftus' reform. In brief, less than half the authors followed Loftus' guidelines although this was a substantial increase from before 1993. We report further on the results of this case study. Several educational issues are raised by the difficulties researchers appear to have had in meeting Loftus' reform recommendations. Statistical education for psychologists should emphasize using visual aids for exploring and interpreting data from a wide range of research designs.

Fiona Fidler, & Sue FINCH. *Students' Understanding of Confidence Intervals: Descriptive or Inferential statistic?* Many members of the movement to reform data analysis in Psychology have argued that Confidence Intervals (CIs) should replace or supplement Null Hypothesis Significance Testing (NHST). One of the arguments offered in support of this change is that CIs are more intuitive than NHST and therefore unlikely to be frequently misinterpreted. More specifically, some reformers have made explicit claims that CIs are easier to teach and easier for students to understand. Many reformers are confident about the benefits a change from the confusing and contradictory NHST to simple CIs would have for Psychology, yet there is a striking absence of empirical work addressing these claims. This is a surprising contrast to the large amount of data collected on misconceptions related to NHST. In this paper I report preliminary empirical investigations of students' understanding of CIs which seriously challenge these reformers' claims. We surveyed undergraduate (1st and 3rd year) students at the University of Melbourne and at La Trobe university (phase 1, N = 175, phase 2, N = 167). Our results suggest that students have a tendency to interpret the CI as a descriptive, rather than an inferential statistic. For example, a surprising number of student responses (on some measures almost 40%, on others over 80%) indicate that the CI is a plausible range of values for the sample mean. Other responses define the CI as the range, or truncated range, of individual scores. In this paper I will report these results and discuss potential implications for reform in psychology and statistics education more generally.

Geoff CUMMING. *Inference by eye (IBI): Simulations for building intuitions.* In the context of the statistical reform debate, confidence intervals (and error bars generally) have been widely recommended for use in addition to -- or in place of -- significance testing. For example, all contributors to the book 'What if there were no significance tests?' advocated more widespread use of confidence intervals. However there has been remarkably little study of how researchers think about confidence intervals or error bars. We have evidence that many researchers use error bars for interpretation poorly if at all. A particularly interesting aspect is the variation in confidence interval and error bar practices across disciplines; research is likely to identify corresponding differences in understanding. I will demonstrate some Excel simulations designed to build better intuitions about the meaning of error bars, confidence intervals, and the links with significance testing, and will suggest some 'Rules of Eye' to guide how we should use and read error bars. Use of such tools in education should help the next generation of researchers have better bar understanding and better bar skills.

2. *General Issues in Statistics Education.* Chair: Kay LIPSON

Brian PHILLIPS. *IASE activities in 2000.* 2000 has been a very busy one for the IASE. This year there have been a number of wonderful statistical education events around the world in which the IASE has been involved. In particular I have participated in the Statistical Society of Australia's Statistical Education workshop in Adelaide, the ICME-9 conference in Makuhari, near Tokyo, Japan where the IASE organised a topic group on The Teaching and Learning of Statistics, the IASE Round Table Conference on Training Researchers in the Use of Statistics held at The Instiitute of Statistical Mathematics, Tokyo and the Jubilee Celebrations of the International Statistical Education Centre at the Indian Statistic Institute both in Delhi and Calcutta where I represented the IASE. Also members have been very busy with planning future meetings, in particular for future activities including those related to the ISI conference in Seoul in 2001 and ICOTS-6 which will be held in Durban in 2002. I will give a report on these activities and give some thoughts on where statistical education may be headed.

Stephen R Clarke. *Promoting Statistics in Society.* With declining interest from Secondary School students in mathematical based subjects, it is important that researchers and teachers take every opportunity to

promote the applications of statistics to the wider community. The author has been successful in gaining widespread publicity for his research into sport in the press, radio and television. This has ranged from articles in technical magazines on particular research results, weekly predictions in the daily press and television, regular articles on research results in the national press, comments on current affairs issues in radio and television news, maintenance of a popular web site, a segment on a scientific television show, and several guest appearances on top rating television and radio talk shows. This publicity has promoted the statistics profession as well as the author's institution to possible users and financiers of the research, future students and the general public. Similar publicity is possible for many staff research or student projects. Examples and strategies to be employed will be discussed.

John TRURAN, & Anne Arnold. *Teaching Consulting: Learning to Listen and Learning to Answer.*This paper describes a project given to naïve students in a "service" statistics course which demonstrated many important principles of con-sulting. Consulting in statistics is usually deferred until at least near the end of a first degree, but this paper uses a modification of the "PPDAC" model of statistical practice to show that some aspects can be effectively taught to beginning students, and that such an approach has several bene-fits not found in more tradit-ional approaches to show-ing the relevance of statistical theory. After assessing the project in several ways, we have concluded that the project was of great value for showing the major-ity of students what the consulting process is, but highlighted their need for much better written communication skills. Suggestions are made for improving the form of presentation to place more emphasis on all stages of the PPDAC model.

Patrick Tobin. *Teaching Forecasting and Time Series*.

3.Examples from Health and the Internet. Chair: Julie Pallant

Daniel J. McCarty. *Epidemiology of Diabetes: an applied approach to teaching health statistics.* Many statistical courses place a great deal of emphasis on mastering specific statistical methods. While this is important, students often have a difficult time applying these methods correctly when faced with actual data or study hypotheses. Presenting the epidemiology of specific diseases (such as diabetes) provides an excellent opportunity to teach applied health statistics. The approach begins with presenting and discussing the burden of disease, epidemiological characteristics, and disease aetiology. Given this basic knowledge, students can then be asked to formulate a research question and choose an appropriate and efficient epidemiological study design. Finally, students can discuss which specific statistical tests can be used for hypothesis testing. Formal lectures are supplemented with critical review of the medical literature to evaluate the appropriateness of published study designs and data analysis. This applied approach of teaching health statistics provides students with the opportunity to formulate an appropriate study question and to choose the most appropriate methodology and statistical methods. We have used these teaching methods for the past several years for the second year subject in Advanced Epidemiological Methods at Swinburne. I will present an example of one of the lectures and discussions used in this class.

Sharon Copeland-Smith *Using the internet to help teach Health Statistics.* How can you use the internet to help deliver courses in statistics? Sharon has combined her background in health and online strategy to introduce the internet into teaching health statistics. She will share with you some of the ways you can use the internet to: · Illustrate points with 'real life' examples· Tap into resources (data sources, journals) · Generally enhance student computer skills Although this presentation will focus on some of the ways the internet was used to teach health statistics, examples from other areas will also be used. These examples will help you to imagine what might be possible for future health statistics courses. The presentation will also cover some general trends, drivers and benefits of online education. There will be lots of colourful examples and practical tips to take away

Ian Gordon and Sue FINCH *Learning statistics through WWW-based material using local research projects.* Learning about real data and the context in which it was collected can enrich the learning experience of statistics students. A number of books have published real data sets, with varying levels and quality of background information. The World Wide Web is an environment which has made dissemination of such material easier, and, potentially, richer in style and content. We describe work in progress which uses consulting projects of the Statistical Consulting Centre, as the basis for educational material which illustrates theory taught in statistics courses. The material is intended to be used by lecturers in the setting of projects or exercises. Most projects will be suitable for use at all levels of undergraduate study,and some will be at postgraduate level. A student looking at one of the case studies will find some or all of the

following: background material, photographs, diagrams, descriptions of the design and the data, videos of the researcher and statistician discussing various aspects, graphs, questions regarding the design and analysis, references to articles, and downloadable data files (Excel and Minitab). The visual style of the material is simple and accessible; good visual representations of the data are used, to model good practice for students. We will demonstrate two of the case studies. The key educational goal is deeper learning, through exposure to and engagement with real contexts for statistics, with some of the complexity and depth often lacking in traditional examples and exercises.

4. Other Issues in Statistics Education.Chair: Kerrie Cullis

Rodney CARR. *How to avoid checking assum*ptions. Most statistical tests require that certain assumptions be met for the results of the analysis (p-values, confidence intervals, etc) to be accurate and reliable. Of course all textbooks remind us about the need to check these assumptions, and essentially all have sections for "large samples", or have questions with ".... assuming that the population is normally distributed ...." or remind the reader to carry out an analysis of the residuals. But there is another approach that, in most cases, avoids most problems - we need to look carefully at the data and use appropriate summary measures in the first place. This talk is intended to demonstrate the power of this approach. It might be preaching to the converted, but the idea does not seem to be emphasized in books enough, at least, and there seem to be far too many analyses done with only summary data, or that don't have the scatterplot drawn before fitting the regression line.

Geoff Robinson. *Selling A Course On Experimentation.* For several years, I have been offering a training course on experimentation. It has lots of activities involving soap bubbles, play doh, a catapult, dice, duplo carts, paper gyrocopters and other excuses for adults to pretend that they are still at kindergarten. I do spend some time explaining how to interpret data analyses, but virtually no time explaining how to conduct data analyses. Computers are not used. The goals and content of this course will be discussed. This course has been difficult to sell because statistics is seen as being primarily about data analysis. I argue that statistics is primarily about variation and uncertainty, with data analysis being perhaps the most important but not the only tool for quantifying variation and reducing uncertainty. When statistics is regarded as being about variation and uncertainty it seems hard to reconcile its treatment as part of mathematics. What are we going to do about our image of ourselves and about our public image?

Andy Reid and Taylor Nelson Sofres.*Radio positioning and segmentation- an example of statistics in practice.* The audience for radio formats continues to fragment around the world due to the increase in new broadcasting licenses. A critical programming decision is the segmentation, targeting and positioning of the radio station. This study extends the knowledge of the use of market segmentation to program decision making. The specific objective is to examine whether different music preferences exist amongst listeners aged 25 to 54 in a major Australian city who listen to radio to hear popular music. The study examines the ratings of potential radio music listeners to ten music montages. Each montage consisted of four songs considered to reflect ten music styles. Listeners were chosen at random and interviewed by telephone. Boxplots of the rating of enjoyment of each montage revealed that the music styles appealed to different age groups and gender. The results of a non-hierarchical K-mean cluster analysis produced a four-cluster solution. Listeners were divided into four segments according to their music preference for “rock/alternative” music, “non-jarring older pop” music, “old and new music with grunt” and “old and new music that’s non-jarring”. Profiling of each cluster revealed different demographic and gender preferences for each segment. The clusters appear to be a useful guide to assist radio management in decisions regarding music preferences. Further analysis is required to establish the robustness of the clusters. Moreover, other statistical techniques may also be appropriate to assist in the segmentation of music radio listeners. This talk will be of interest to teachers of statistics to see how some statistical procedures are used in the market place.

Workshops:

1. Rodney CARR, *Using Excel for Teaching and Learning Statistics*
2. Robyn PIERCE & Lyn Roberts, *Share the student experience of on-line learning*.
3. Tim ERICKSON. *Fathom Workshop* .
4. Rodney CARR, *Using Excel in your Statistics lessons.*

11.3. JOCLAD 2001, Porto, Portugal 8-10 February. Thematic Session: Teaching and Training in Statistics and Data Analysis

Helena BACELAR-NICOLAU

A thematic session on teaching statistics and data analysis was organise by Helena BACELAR-Nicolau, a JOCLAD 2002, Porto February, 8-10, 2001. The following papers were presented at the session:

- Gilbert SAPORTA, CNAM, Paris <saporta@cnam.fr>. *Teaching statistics with internet: available resources and the st@tnet project;*
- Henrique Garcia Pereira, IST, Lisboa <hpereira@alfa.ist.utl.pt>. A 'A*nálise de dados' como instrumento de reflexividade e transdisciplinaridade* [Data analysis as a tool for reflection and transdisciplinarity]*;*
- Paulo Gomes, INE, Porto <paulo.gomes@ine.pt>. *Novo paradigma para o ensino e aprendizagem da Estatística por recurso às novas tecnologias* [New paradigm for teaching and learning statistics with the help of new technologies]*;*
- Helena BACELAR-NICOLAU, UL, Lisboa <hbacelar@fc.ul.pt>. *Research in statistical and data analysis education.*

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14. Forthcoming Conferences

CabriWorld 2001, Montreal, June 14-17, 2001

The *CabriWorld* conference will take place in Montreal fron June 14th to 17th 2001 and will be organized collectively with the GRMS and the UQAM in association with the university of Grenoble and the Leibniz Laboratory. You will be able to attend to an international conference allowing you to learn or to deepen your knowledge with the Cabri-Geometry software. All the information concerning this conference is available on the CabriWorld's official web site. Verify updates! www.cabriworld.net

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Mathematical Literacy In The Digital Era. Research And Classroom Practice Towards A New Conception Of Mathematics For All, 4-10 July 2001

Our society that is more and more formatted by mathematics set up more and stronger demands for mathematical competencies. in the community of mathematics education there are conflicting debates about the consequences of the obvious fact that the mathematical knowledge and skills taught in schools are no longer compatible with those of the mathematised society. a big number of pupils and adults risk missing the opportunity for autonomously and competently acting in the digital era. The goal of cieaem 53 conference in rhodes is to engaged all participants, the teachers as well as the researchers, in mutually "revisiting" their common references and their different practices with a perspective for the needed innovation to be undertaken for the years to come.

ConferenceThemes:

1. The relationship between the research on mathematical literacy and the improvement of teaching and learning mathematics
2. The transformation of the new competencies into curricula and learning materials, in the context of the new social demands
3. The challenge of the research on the professional education of teachers and on the possible innovations of classroom practice on national and international levels
4. The possibilities, limits and risks of the information and communication technologies in supporting mathematical literacy

5. Mathematical literacy and differential education: the question of cultural diversity and social equity.

More information is avaiable from F. Kalavassis, University of the Aegean, Department of Pre-school Education, Dimokratias 1, 85100 Rhodes, Greece, http://www.rhodes.aegean.gr/cieaem53, <cieaem53@rhodes.aegean.gr>.

25th PME conference, 12 - 17 July, 2001, Utrecht, The Netherlands

Utrecht is located in the heart of The Netherlands and has about a quarter of a million inhabitants. The city is regarded as a wonderful place in which to live. Foreign influences have had a great impact on the history of the town.The conference dates are 12-17 July 2001. Following the PME25 Conference, a SUMMER SCHOOL will be organized by the Freudenthal Institute.The theme for the PME 25 Conference will be "25 years of PME: Past and Future Challenges".

Plenary speakers

- Paulo Abrantes . *Revisiting the goals and the nature of mathematics for all in the context of a national curriculum*
- Martin Hughes. *Linking home and school mathematics*
- Jan de Lange
- Gilah Leder. *Pathways in Mathematics towards Equity: A 25 year journey*
- Erna Yackel. *Explanation, Justification and Argumentation in Mathematics Classrooms*

Plenary panel : *25 years of PME: Past and Future Challenges*. Coordinator: Catherine Sackur. Panelists: Alan Bell, Fred Goffree, Andrea Peter-Koop, Jorge T. da Rocha Falcão

Research Forums:

1. Potential and pitfalls of technology tools in learning mathematics. Co-ordinato rs: Carolyn Kieran and Rina Hershkowitz
2. Early algebra. Co-ordinator: Janet Ainley
3. Comparative views of mathematics goals and achievements.Co-ordinator: Tom Romberg
4. The Research Group on Mathematics Education at Dortmund University in the spotlight. Co-ordinator: Heinz Steinbring
5. Realistic Mathematics Education Research: Leen Streefland's work continues. Co-ordinator: Norma Presmeg

Discussion Groups

- Imagery and affect in mathematical learning
- Stochastical thinking, learning and teaching. Co-ordinators: John Truran, Jenny Way, James Nicholson, and Mario Barra. Web site <ujaen.es/huesped/stochastics/>
- The importance of matching research questions and methodology to the reality of researcher's live
- Theory of embodied mathematics
- The Psychology of computer science education

Further information: http://www.fi.uu.nl/pme25 or contact Marja van den Heuvel-Panhuizen University of Utrecht, Freudenthal Institute Utrecht, The Netherlands. Email: <m.vandenheuvel@fi.uu.nl>

15th Latinoamerican Meeting of Mathematics Education - RELME 15 Buenos Aires (Argentina), July 16- 20, 2001

The Latinoamerican Committee of Mathematics Education (CLAME) started at the X Centroamerican and Caribean Meeting on Training Teachers and Research in Mathematics Education, Puerto Rico, 1996. It was

made evident the lack of spaces to share experiences in Spanish language and in this sense, RELME aims to orient his action to benefit the school system in Latino America. Colloaborative projects will define and consolidate the process of strenghening mathematics education, with a plorality of approaches and a respect to the educational traditions in the different countries members of RELME.

Activities include plenary lectures, personal presentaions, posters, discussion groups, short courses and workshops. Topics include: Advanced mathematical thinking; numerical thinking; algebraic thinking; stochastic thinking; theoretical and methodological paradigms, curricular development and training teachers- More information is available from ccrespo@sinectis.com.ar or the web pages http://webs.sinectis.com.ar/ccrespo http://www.cinvestav.mx/clame

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The Fifth International Conference on Technology in Mathematics Teaching August 6 - 9, 2001, University of Klagenfurt, Austria

Working groups

- Visualization and computer animation, Gert Kadunz, <gert.kadunz@uni-klu.ac.at>;
- Systems dynamics and systems thinking, Günther Ossimitz, <guenther.ossimitz@uni-klu.ac.at>;
- Continued professional development, Ed Laughbaum, <elaughba@math.ohio-state.edu>;
- Probability simulators and data analysis programmes, Manfred Borovcnik, <manfred.borovcnik@uni-klu.ac.at>;
- Dangers and limitations of the use of technology.

website http://www2.ifi.uni-klu.ac.at/ictmt5/

SRTL-2 The Second International Research Forum on Statistical Reasoning, Thinking, and Literacy, Armidale, Australia, August 15-20, 2001

The second in a series of International Research Forums, being offered under the umbrella of the Statistical Education Research Group of the International Association for Statistical Education, is to be held in Australia in August 2001. This Forum is sponsored by the Centre for Cognition Research in Learning and Teaching and the School of Curriculum Studies at the University of New England ; the International Association for Statistical Education and the University of Minnesota. This gathering offers an opportunity for a small, interdisciplinary group of researchers from around the world to meet for a few days to share their work, discuss important issues, and initiate collaborative projects. The topic of the Forum will be Statistical Reasoning, Thinking and Literacy. One outcome of the Forum will be the publication of a book summarizing the work presented, discussions conducted, and issues emerging from this gathering. Presentations at the SRTL-2 Forum should focus on:

- What does research on SRTL tell us about learning and teaching of statistics? What are the cognitive, socio-cognitive, or developmental aspects of learning SRTL in different age/grade levels?
- What theoretical frameworks and methodologies are appropriate for researching SRTL? What types of qualitative and quantitative research studies are needed to help us better understand these ways of processing information and to help promote them in educational settings? Particularly, how do we collect, use and analyze video material for research on SRTL?
- What are the implications of research into SRTL for learning goals, curriculum design, and assessment?

SRTL-2 Advisory Committee: Dani BEN-ZVI (Weizmann Institute of Science, Israel), Joan GARFIELD (University of Minnesota, USA) and Chris READING (University of New England, Australia), Janet Ainley (University of Warwick, UK), Iddo Gal (University of Haifa, Israel), John Pegg (UNE, Australia), and Brian

PHILLIPS (Swinburne University of Technology, Australia).

Participants: Arthur Bakker, Rolf BIEHLER, Don Bentley, Dani BEN-ZVI, Rolf BIEHLER, Beth CHANCE, Jose Luis Cortina, Bob DelMas, Mark Earley, Joan GARFIELD, Sharon Gunn, Ruth Heaton, Graham JONES, Katie Makar, Bill Mickelson, Jonathon MORITZ, John Pegg, Maxine PFANNKUCH, Chris READING, Mike SHAUGHNESSY, Pat Thompson and Jane WATSON

Workin Group Topics: Reasoning about Data and Distribution, Reasoning about Variability and Sampling, Reasoning about Comparing Distributions, Reasoning about Bivariate data, Reasoning about Sampling Distributions

SRTL-2 Website: http://www.beeri.org.il/srtl/

An International Conference on *New Ideas in Mathematics Education*
North Queensland, Australia,Aug 19-24, 2001

Following the success of our first International Project Conference next to the pyramids in Cairo in 1999 and our second conference in the historic splendour of Jordan in 2000, we invite you in 2001 to attend our very special third conference where the Great Barrier Reef meets the Tropical Rainforest! The time and place were deliberately chosen to encourage teachers and mathematics educators from around the world to communicate with each other about the challenges and opportunities offered by New Ideas in Mathematics Education. The conference will feature:

- Sponsorship by *The Mathematics Education Into The 21st Century Project, The Third World Forum*, *The Hong Kong Institute of Education* & *Ansett Australia.*
- Full support from the Australian Association of Mathematics Teachers and the local Cairns Branch of the Queensland Association of Mathematics Teachers.
- Plenary Speakers including Gail BURRILL, (USA - former President of the NCTM), Doug Clarke (Australia) Rudiger Vernay & Regina Puscher (Germany), Roberto Baldino (Brazil) and Hanan Innabi (Jordan).
- Working Groups with innovative contributions in important areas of Mathematics, Statistics and Computer Education, including Gender Issues & Multicultural education.
- Two special day programmes for local primary and secondary teachers.

The Local Organising Committee is chaired by Rob Money, immediate Past President of the Mathematical Association of Victoria, assisted by Ken Payne, President of the Cairns Branch of QAMT

The International Programme Committee is chaired by Dr. Alan Rogerson, co-coordinator (with Professor Fayez Mina) of the *Mathematics Education into the 21st Century Project*.

For full registration information please email: arogerson@vsg.edu.au

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12.2. IASE Satellite Conference on Statistical Literacy

IASE Satellite Conference on Statistical Literacy

Seoul, Korea, 21-22 August, 2000

http://www.swin.edu.au/maths/iase/statlit.html

This satellite conference on statistical literacy is jointly organised by the IASE and the Korean

Statistical Society and will immediately precede the ISI session in Seoul. It will give the opportunity for people to enjoy presentations given by people who have a special interest in statistical literacy. There will be a number of invited speakers, as well as the opportunity for others to give contributed presentations.The presentations are planned to include discussions of the main components in statistical literacy and the relevance of statistical literacy in the general education of citizens.

The approach will be non-technical, suitable for a non-specialist audience who would like to learn how to make better use of probability and statistical ideas in their everyday and working lives in areas in which chance and risk is involved. This meeting is intended to be of interest to a wide cross section of society including teachers, educational administrators, researchers in statistical education and in probabilistic reasoning and others who want to gain a better grasp of statistics in general and who would like to broaden their knowledge of statistics applications. It should also be of interest to people wishing to understand more about risk in making investments and gambling, by those concerned with interpreting sociological, economical, political, scientific or educational reports, predicting sports results, by policy makers, journalists, health professionals and others from the general population.

Location: Convention and Exhibition Center (COEX), Seoul, Korea

Program times:

- Tuesday August 21: 9.00 am - 5.30 pm, Conference Dinner: 7.30 pm
- Wednesday August 22: 9.00 am - 12.30 pm

Programme committee:

Brian PHILLIPS (Australia) (Chair), Professor Yong Goo Lee, (Korea) (Local organiser),

Tae Rim LEE (Korea), Carmen BATANERO (Spain), Larry WELDON (Canada)

More information: See web page: http://www.swin.edu.au/maths/iase/statlit.html

Contacts:

Professor Yong Goo Lee, Department of Applied Statistics, Chung Ang University, Seoul, 156-756, Korea, Tel : +82-2-820-5503, Fax : +82-2-816-8079, Email : leeyg@cau.ac.kr

Brian PHILLIPS, School of Mathematical Sciences, Swinburne University of Technology, PO Box, 218, Australia, 3122, Phone: +61 3 9214 8288, Fax: +61 3 9819 0821, E-mail: bphillips@swin.edu.au

Abstracts of Presentations (Compiled by Brian PHILLIPS)

1. David S. MOORE. *Statistical Literacy and Statistical Competence* . Statisticians consider themselves not just technical experts, but keepers of modes of reasoning that all educated people should understand. What should everyone know about statistical thinking? That's statistical literacy. What should someone who works with data now and then in her job remember from the statistics course she took 5 years ago? That's statistical competence. Rapid change, especially in technology, has broadened what statisticians should offer their various publics. This informal talk offers one opinion on the nature of statistical literacy and statistical competence.

2. Stephen R Clarke. *Can statistics demonstrate a Home advantage in the Olympic games?* .A simple statistical study investigates home advantage in the Olympic games. Although using only Secondary School mathematics, the results of the study gained widespread publicity with almost 20 radio, television and newspaper articles. However, even in an apparently straight forward analysis as this, there are many statistical traps that await the careless analyst. The increasing number of events, changes in the general level of sports performance of particular countries, boycotts can all affect results. By using the final medal tallies of competing countries at all modern Olympic games, we investigate the number and percentage of available gold and total medals each country has won. Home advantage can be evaluated by comparing the home and away performances of host countries in various ways. The talk will illustrate some principles of good analysis and display of data, and hopefully convince the audience of the large advantage the host nation enjoys.

3. Saleha Naghmi HABIBULLAH. *'KISC' and 'CODAK': An Indirect yet Effective way of Promoting Statistical*

Thinking in the General Community of Students and Teachers. Our present system of statistical education at the undergraduate level in PAKISTAN carries the old tradition of the "conventional lecture' format and the textbook-oriented approach. Passive acceptance of statistical definitions and formulae motivate students to indulge in rote memorization rather than enabling them to associate statistical concepts with real, everyday life . Eversince 1985, the Department of Statistics at Kinnaird College for Women, Lahore has been engaged in projects and programmes aimed at enhancing the teaching and learning of Statistics, and enabling the students to apply statistical concepts and methodology to real world problems. These include a large number of small - scale sample surveys carried out by undergraduate students, statistical competitions for students of various institutions, and workshops for teachers. The Kinnaird Inter-collegiate Statistical Competition (KISC) and the Competition Of Data Analysis At Kinnaird (CODAK) are two competitions which invite students to collect and analyze small pieces of data and to present their findings in the form of colourful and attractive posters. KISC and CODAK thus culminate in a beautiful exhibition of statistical posters which contributes to the promotion of statistical thinking among students and teachers of various subjects, parents and other people. This paper will present salient features of KISC and CODAK, including feedback received from the general community of students and teachers. A point of interest is that, eversince l998, pre-selection of the CODAK posters is carried by eight to ten faculty - members of Kinnaird College who teach subjects OTHER than statistics. This activity adds another dimension to the enhancement of statistical thinking among non-statisticians.

4. Juan D. GODINO and Carmen BATANERO. *Training Teachers To Teach Probability* .In this paper we describe some of the reasons why teaching probability is difficult for mathematics teachers, describe the contents needed in the didactical preparation of teachers to teach probability and present examples of activities to carry out this training.

5. James NICHOLSON. *Outcomes of a teaching experiment* . This paper will report on the outcomes of a teaching experiment undertaken as part of a Masters Dissertation using some of the materials being developed for use in A-level Statistics. The materials will now form an extension to the DISCUSS program. Examples of the materials and teacher and student evaluations both of these particular materials and of the broader issues of the use of simulations to build conceptual understanding will be given.

6. Larry WELDON. *Probability in the First Service Course.* This paper suggests a way to include probability ideas in an introductory "service" course in statistics. Many modern service courses focus on data analysis and inference to the exclusion of exposure to the consequences of randomness in real life. It is argued here that a very elementary understanding of probability is all that is required to understand some important features of sports, lotteries, education, investment, medicine, politics, and insurance. For students taking only one course in statistics, these "randomness" topics are more useful than confidence intervals and hypothesis tests, and time saved on a reduction of formal inference procedures can be reallocated to randomness phenomena. This randomness material can complement some descriptive data analysis, to provide a really useful introductory course in statistics.

6. Elizabeth Taylor. *The Graphical Presentation of Data in Every Day Life.* We encounter charts, graphs, and tables almost everyday. They accompany articles in newspapers and magazines; they appear in books, including textbooks for students at all educational levels. They may be used in television news stories and in advertising. In order to interpret CORRECTLY the data presented, readers must be alert to the underlying methods used to collect and present the data. In my presentation, I will review some general principles of statistical methods, data presentation, and interpretation. I will use examples for a variety of common sources in order to convey practical techniques.

7. Ricardo Aravena, Guido del Pino and Pilar Iglesias. Explora*: A Chilean Science and Technology Outreach Program in Probability and Statistics.* Research in teaching statistics is very recent in Chile (see Iglesias and Icaza, 2001). A great impulse has been provided by the Chilean educational reform, which was initiated bout in the last five years. This reform included, for the first time, a significant Statistics contents at the high school level (see del Pino et.al, 1996). On the other hand, other institutions, like the National Committee for Research and Technology (Conicyt) became more involved in scientific outreach programs. The main such program is called Explora (explore in Spanish). It finances fairly small projects and the main clients are the children. The aim of this work is to discuss our experience with the Explora-Conicyt projects Randomness, Science and Society I and II. The project was aimed at year 10 and 11 students, reaching about 200 of them, coming from 20 different schools. The project consists of three modules: Statistics and Media, Exploratory Analysis, and Probability. The first module develops common sense and critical spirit for reading

information from the media. The next two modules involve lecturing, activities, written materials and carrying out group projects. The second module formalizes ideas from the first module, introducing the concepts through xperimentation by the students. Written materials make heavy use of cartoons relating the concepts with everyday life. Interpretations are emphasized and mathematical language is avoided as far as possible. The last module deals with probability, taking an empirical approach, involving both physical experiments and simulations. Since the project was replicated a second year, there was a good opportunity for improvement. In both years the students were able to develop statistical projects, most of which related to social issues. Only in the second year were the students able to create probability games, which were part of an exhibit. To accomplish this, the mathematical content was heavily reduced and the use of a simulation package was emphasized. The skills that the students acquired with a minimal amount of tutoring were truly amazing. On the average, students seemed to have fewer learning difficulties than their teachers, who helped coordinating the students from each school.

9. Nick Broers. *From Propositional Knowledge To Conceptual Understanding Of Elementary Statistics.* Applied statistics, as taught to students in a wide variety of academic disciplines, is considered by many as a difficult subject. Following a course in elementary statistics, students are able to demonstrate a basic knowledge of statistical concepts and ideas, but often fail to apply this knowledge to concrete problems. From research in cognitive psychology, we know that the organization of knowledge starts with the mental storage of basic propositions, such as definitions of concepts and simple principles. A certain amount of conceptual understanding is reached when the student succeeds in relating these basic propositions into meaningful knowledge structures known as cognitive schemata. The task faced by any teacher in statistics, is to enable the student to form such schemata. Research has shown that the formation of such schemata is stimulated when students, confronted with a statistical problem that requires the application of their propositional knowledge, actively try to explain the solution of the problem to themselves. By doing so they forge links between basic propositions and chart possible hiatus in their knowledge, prompting further and more directed study. We have examined the use of concept maps and wholly or partially worked out problems as teaching techniques that aim to enhance the formation of schemata by stimulating such self-explanations, and will argue that especially the latter technique may offer valuable opportunities in this respect.

10. Brian Phillips. *Teaching statistics in the 2000's and the IASE.* Statistics is now an important part of the education of students in many disciplines and is used by an increasing number of people both in the workplace and in their daily lives. In fact it is likely that statistics is studied by more students at post-secondary level than any other topic and there is an increasing interest in the teaching and learning of statistics at elementary and secondary levels. As students from virtually every discipline now have to take at least one statistics course, many without a high level of mathematics, the methods used have moved from heavily mathematical based approaches to methods which are easier to comprehend. The emphasis has moved from theory and computations to comprehension and interpretation. Many packages and demonstrations have been developed to assist with this task and, with the advent of the internet, great changes are occurring in the way in which courses can be delivered to students. This talk will give an overview of some of these changes, and will discuss the IASE's plans to help meet future challenges, especially in the area of statistics literacy.

11. Kay LIPSON. Workshop: *Bringing Real World Statistical Practice into the Classroom using the Graphics Calculator*. As the teaching of statistics at secondary school level becomes increasingly common, strategies for effective teaching become increasingly important, particularly in the light of the potential offered by cheap and affordable graphics calculators. The graphic calculator with powerful statistical capabilities are now in common use in the secondary classroom. Merely using the calculator to replicate the previous methods of teaching statistics, which were constrained by the then available technology (pencil and paper), is educationally indefensible. In this hands-on workshop it will be demonstrated how the graphics calculator can be used to bring the statistics of the real world into the everyday classroom and change, fundamentally and for the better, the way statistics is taught and learnt in our schools. Futhermore, as technology enables the practice of real world statistical analysis with authentic data which is not possible in a purely pencil and paper environment, this participatory workshop models the behaviour of a practicing statistician.

12. Beth CHANCE and Roxy PECK. *Workshop -- Statistics of Illumination*. As numerical information permeates more and more of our daily lives, it is increasingly important for everyone to acquire a

fundamental understanding of ideas and skills related to statistics and data analysis. This workshop will help participants to better understand statistical thinking; through a series of hands-on activities addressing fundamental statistical concepts such as variability, association, and significance. These activities can also be directly adapted for use with statistics students at a wide variety of ages. The session will model how to focus on active learning, conceptual understanding, real data, and effective use of technology in statistics education.

13. Kyung Byun. *Using Microsoft Excel to predict the Olympic High Jump Record.* Sport is a marvellous tool for teaching statistical techniques and can turn an otherwise uninteresting subject for some into an exciting and challenging experience. This paper reviews the predictions made for the Sydney 2000 Olympic event in high jump and makes further predictions for the Athens 2004 games. A simple mathematical model is derived based on previous Olympic data, enabling the prediction of the likely outcome for the next Olympic high jump competition for both men and women.

International Statistical Institute, 53rd Session Seoul, Korea, 22–29 August, 2001

It is a great pleasure for Korean statisticians to host the 53rd Session of the International Statistical Institute(ISI) which will be held in Seoul from 22 to 29 August 2001 under the auspices of the Korean Government and the National Statistical Office (NSO), the Korean Statistical Society and Korean Statistical Association.

The National Organising Committee has the pleasure and honour to invite all members of ISI and its Sections as well as non-members to attend this 53rd Session. In preparation for this conference, arrangements for convenient and comfortable facilities are being made for all participants as well as for a wide variety of social events and cultural tours that will hopefully leave everyone with fond and lasting memories of their visit to Korea.

Information: ISI Permanent Office, Prinses Beatrixlaan 428, P.O. Box 950, 2270 AZ Voorburg, The Netherlands. Tel.: +31–70–337–5737; Fax: +31–70–386–0025; E-mail: isi@cbs.nl *or* visit the Session website at http://www.nso.go.kr/isi2001

IASE Sessions: Lionel Pereira-Mendoza lpereira@nie.edu.sg is co-ordinating our section of the programme. There will also be a number of contributed paper sessions on Statistics Education

IASE Organised SESSIONS

55. Forum: IASE and Statistics Education in Developing Countries Organizer: Maria-Gabriella OTTAVIANI, <ottavian@pow2.sta.uniroma1.it>*

1. Munir Ahmad. On fifty years of university and pre-university teaching in pakistan
2. Ana Silvia Haedo. An overview on the teaching of statistics at schools and university in Argentina.
3. Youri Ivanov. Selected aspects of education in statistics in Russia.
4. Koffi Guessan. ENSEA, 40 ans au service de al formation des statisticiens en Afrique.

56. Undergraduate Level Statistics Programmes Organizer: Shen Shir Ming, <smshen@hkuspace.hku.hk>

1. Ann-Lee Wang. Teaching birth and death processes.
2. Tony W. K. Fung .Teaching undergradate statistics using forensic examples.
3. Susan Starkings. The pre-requisite knowledge required by students starting data analysis classes at university.
4. C. R. Rao. Developing curriculum of undergraduate courses in statistics: Indian and American experiences

- Discussant: J. L. Rosenburger

57. The Future of Statistics Education Research Organizer: Joan GARFIELD, < jbg@maroon.tc.umn.edu>

1. Carmen BATANERO and Juan D. GODINO (SPAIN) Developing New Theoretical Tools In Statistics Education Research
2. Flavia JOLLIFFE(UK) An International Survey Of Research In Statistical Education
3. Beth Chance and Joan GARFIELD (U.S.A.) New Approaches To Gathering Data On Student Learning For Research

- Discussants - Gilberte SCHUYTEN and Maria-Gabriella OTTAVIANI

58. Research on Teaching Statistics at School and University Levels. Organizer: Susan Starkings, <starkisa@sbu.ac.uk>

1. Silio Rigatti Luchini, Maria Pannone and Anna Maria Milto. New strategies for teaching statistics in schools.
2. Dani-Ben Zvi. Junior high school students construction of global views of data presentations.
3. James Nicholson. Supporting statistics teaching and learning at a-level using computer based materials.

- Discussant: Flavia JOLLIFFE

59. Undergraduate Statistics Education in Non-Statistics Degree Programmes Organizer: Elisabeth Svensson, <elisabeth.svensson@esa.oru.se>

1. Abhaya Indrayan. Teaching statistical principles and methods in medical applications
2. Kerstin Wiklander. Teaching statistics in pre-clinical and pharmaceutical departments
3. Carol Joyce Blumberg. Is there life after introductory statistics?

- Discussant: P.K.ITO (Japan)

60. Continuing Statistics Education in the Workplace Organizer: Carol J. Blumberg, <cblumberg@winona.edu>

1. W. Robert Stephenson. Statistical education outreach = unlimited learning
2. Kenneth J. Koehler and William N. Venables. The role of the software system in continuing statistical education.
3. Elizabeth A. Taylor. The challenges for providers of international statistical training

- Discussants: Rene H. M. Slmuders and Ryoichi Shimizu

61. Postgraduate Training of Statisticians. Organizer: Gilberte SCHUYTEN,< Gilberte.SCHUYTEN@rug.ac.be>

1. Seymour Geisse. Observation on graduate program in statistics II: Directions for the future
2. David Griffiths
3. Yuki Miura
4. Discussants: Raoul Depoutot and Els Goetghebeur

JOINT IASE SESSIONS

10. Technology in Statistical Education (Joint with IASC) Organizer: Tae Rim Lee, <trlee@av9500.knou.ac.kr>

1. Jungjin Lee(Korea): jjlee@stat.soongsil.ac.kr
2. Marta Bilotti ALIAGA(USA)
3. Kay LIPSON(Australia)
4. Sakurai Naoko(Japan)

- Discussants: Masakasu Murakami and Joongkweon Shon

11. Women's Contributions to Leadership in Statistical Educatio. Joint with CWS. Organizer: Martha ALIAGA <aliaga@umich.edu>

1. Pilar L. Iglesias And Gloria Icaza. Leadership in research on teaching and learning Statistics
2. Shyamala Nagaraj and Ann- Lee Wang. Women's role in shaping future directions in statistical education
3. Tae Rim Lee. The role of the internet in statistical education, my contribution in South Korea
4. Elsa C. Servy. Women as statistical educators

- Discussants: Mary H. Reiger Mary Gray

14. The Role of Official Statistics in University Curriculum Joint with IAOS. Organizer: Reiner Staeglin, <rstaeglin@diw.de>*

1. Carmen Feijoo. An approach to the teaching of social accounts in the Brazilian university curricula.
2. Erkki Pahkinen Risto Lehtonen. Master's program in statistics as a platform for co-operation between university and official statistics
3. Official statistics in German university education. Sibylle Schmerbach.

- Discussants: Ada van Krimpen, Ernst Stadlober

15. Education and the Internet & Effective Structures for the Net Joint with IAOS. Organizer: Brian PHILLIPS, <bphillips@swin.edu.au>*

1. Larry Weldon. Teaching Data Analysis with Online Access to Official Statistics
2. Photis Nanopoulos. Distance Learning: Eurostat Activities
3. Carl Lee. Classroom Experiences in Using the Net for Teaching
4. John Pidgeon. Educational Use of Official Statistics in Australia and Vietnam

- Discussant: Ada Van Krimpen

32nd European Mathematical Psychology Group Meeting September 25- 29, 2001 Lisbon, Portugal

The 32nd European Mathematical Psychology Group Meeting will be held at the Faculdade de Psicologia e de Ciências da Educação, Universidade de Lisboa (FPCE-UL), Lisbon, Portugal, and is organized jointly by the Laboratório de Estatística e Análise de Dados (LEAD/FPCE-UL) and the Associação Portuguesa de Classificação e Análise de Dados (CLAD).

Objective of the meeting

Mathematical Psychology concerns the development of quantitative models and theories, and testing them against empirical data. Mathematical Psychology draws upon mathematical and statistical methods, computer simulation, and formal logic to develop theories e.g. perception and sensation, psychophysics, memory and learning, decision making, problem solving and thinking, motor behavior, emotion and motivation, and social behavior.

The first EMPG meeting was held in Paris in 1971. The preceding EMPG meetings were organized in Padova (1996), Nijmgen (1997), Keele (1998), Mannheim (1999) and in Graz (2000). Following the success of these meetings, it was decided in Graz to organize the 32nd European Mathematical Psychology Group Meeting in Lisbon, Portugal. In the EMPG-2001 all topics of Mathematical Psychology are welcome. Particular attention will be paid to the following:

- Response Time Models for Elementary Cognitive Processes;
- Models of Preference and Choice Behavior;
- Foundations of the Theory of Measurement;
- Testing and Comparison of Quantitative Models;
- Neural Network Models;
- Teaching and Training Mathematical Psychology in an Interdisciplinary and International Context as well as interdisciplinary related areas.

General Information

Location: Laboratório de Estatística e Análise de Dados (LEAD), Faculdade de Psicologia e de Ciências da Educação da Universidade de Lisboa (FPCE-UL), Alameda da Universidade, 1649-013 Lisboa, Portugal
E-mail: empg2001@fpce.ul.pt. Web page : http://correio.cc.fc.ul.pt/~cladlead/EMPG01.html

Chair: Prof. Dr. Helena BACELAR-Nicolau, LEAD / FPCE-UL, e-mail: hbacelar@fc.ul.pt

Deadlines

- Submission of abstracts: June 15, 2001
- Early Registration: June 15, 2001
- Notification of acceptance: June 30, 2001

VIII CLAPEM November, 12-16, 2001, at the University of Havana, Cuba.

The VIII Latinamerican Congress in Probability and Mathematical Statistics, sponsored by the Bernoulli Society and the International Center in Mathematics and Applied Mathematics, will be held in November 12-16, 2001, at the University of Havana, Cuba. For more information please visit the web site www.uh.cu/eventos/clapem/ehome.htm or contact Gonzalo Perera (Chairman Program Committee) gperera@fing.edu.uy or Pablo Olivares (Chairman Local Organizing Committee) clapem@matcom.uh.cu

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EARCOME 2002 - SEACME 9, June 2002

The second ICMI-EARCOME (East Asia Regional Conference on Mathematics Education) is to be held in Singapore in June 2002. This conference, also designated as the Ninth Southeast Asian Conference on Mathematics Education or SEACME 9, has been officially recognized as an ICMI Regional Conference. It will be hosted by the National Institute of Education, Nanyang Technological University, Singapore and the Association of Mathematics Educators, Singapore. Information can be obtained from EARCOME 2002, Division of Mathematics, National Institute of Education,469 Bukit Timah Road,Singapore 259756, Republic of Singapore <earcome2@nie.edu.sg>.

The Sixth International Conference on Teaching Statistics

Durban, South Africa,7 - 12 July 2002

IPC Website: http://www.beeri.org.il/icots6/

LOC Website: http://icots.itikzn.co.za/

ICOTS 6

The preparations for the Sixth International Conference on Teaching Statistics (ICOTS-6) are well under way. The Conference is organized by the International Association for Statistical Education (IASE), the International Statistical Institute (ISI) and the South African Statistical Association (SASA). ICOTS-6 will take place in Durban (South Africa) from July 7 – 12, 2002. The major aim of ICOTS-6 is to provide the opportunity for people from around the world who are involved in statistical education to exchange ideas and experiences, to discuss the latest development in teaching statistics and to expand their network of statistical educators. The conference will include keynote speakers, invited speakers, contributed papers, workshops and forums, demonstration lessons, roundtable sessions, poster sessions, book and software displays, hands-on computer sessions and many opportunities for the communication and exchange of experiences and ideas. As the conference theme for ICOTS-6 is "Developing a statistically literate society", special sessions on statistical literacy are planned. These will include keynote speakers on statistical literacy and sessions and discussions of the role of statistics in a number of everyday contexts. By now, all invited speakers have received their formal invitation from their Session Organizers, and submitted the abstracts of their suggested presentations. The ICOTS-6 Executive will post the abstracts in the ICOTS-6 IPC Website http://www.beeri.org.il/icots6/, as well as in the second announcement, due in July 2001.

In ICOTS-6 we shall offer the option of a full paper *refereeing process* for those who desire it. Papers for refereed publication will be reviewed by three referees selected from a panel of peers approved by the ICOTS-6 International Program Committee (IPC). The IPC believes that the refereeing process provides a mechanism for peer review and critique and so contributes to the overall quality of statistics education research and teaching. More details about the refereeing process, as well as the general authors' instructions, can be viewed in the ICOTS-6 IPC Website under *Announcements*. We have also posted in the Website preliminary information regarding registration fees, accommodation, travel and tours. The conference registration fees will be set as low as possible simply to cover costs. IASE member early registration is expected to be less than 350 US Dollars. Full details should be available by the end of April 2001. Further details will be also provided in the South African Local Organizing Committee (LOC) Website http://icots.itikzn.co.za/.

Important deadlines

Proposals can still be submitted for the following:

1. For *contributed papers*: *refereed* - until Oct. 1, 2002; *non-refereed* - until Jan. 1, 2002 (contact: Susan Starkings, starkisa@sbu.ac.uk).
2. For *posters*, until Feb. 1, 2002 (contact: Andrew I. Dale, dale@scifs1.und.ac.za).
3. For *demonstrations*, *forums* and *special sessions*, until Feb. 1, 2002 (contact: Maria-Gabriella OTTAVIANI, mariagabriella.ottaviani@uniroma1.it).

For further details please contact:

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