

**NEWSLETTER OF THE INTERNATIONAL STUDY GROUP
FOR RESEARCH ON LEARNING, PROBABILITY AND STATISTICS**

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THE BEGINNING OF A NEW ERA

This newsletter is the last print copy that will be produced and routinely distributed using regular mail. Beginning next fall, the newsletter will be distributed electronically. Many members have recommended distribution of the newsletter by e-mail and the time has finally come. If any members are not connected to e-mail, please let me know and I should be able to send a few hard copies through the mail.

A roster of all members and their addresses is provided at the end of this newsletter. It is very important that I have current and correct e-mail addresses for all members who wish to remain on the mailing list. Please check the attached membership list and send me any corrections before September 1.

Please note that as of September 1, 1995 I will have a new address: Department of Educational Psychology, 210 Burton Hall, University of Minnesota, Mpls, 55455. I am leaving the General College and moving to the Department of Educational Psychology in the College of Education. For the past eight years the production and distribution of this newsletter has been supported by the General College. I know we all appreciate this support.

Note: Throughout the newsletter, members names are highlighted in bold print.

Carmen Batanero presented two papers at the conference, "Statistical Methods in Mathematics Education, at I.U.F.M. du Caen, January 1995. They are:

"The use of implicative and correspondence analysis for assessing pupils' combinatorial reasoning," by Carmen Batanero, Juan D. Godino, and Virginia Navarro-Pelayo.

Abstract: In this paper we present the results of applying implicative and correspondence analysis to pupils' responses to a questionnaire aimed at assessing combinatorial reasoning in secondary school pupils. We also show the effect of some task variables on pupils' errors, as well as their evolution following the instruction.

"Correspondence analysis as a tool to analyze the relational structure of students' intuitive strategies in judging statistical association," by C. Batanero, A. Estepa, and J.D. Godino.

Summary: The theoretical basis of this paper is the modeling of students' knowledge about a specific subject as a qualitative and systemic construct. Following therefrom, is a discussion about the role of multivariate analysis for studying the structure of this knowledge and for building explanatory models relating its structure to task, cognitive and instructional variables. Correspondence analysis in an empirical study referring to statistical association is used as an example.

Pereira-Mendoza, Lionel. Graphing in the Primary School: Algorithm versus Comprehension. (1995). *Teaching Statistics*, 17 (1), 2-6.

This article examines the role of graphical work in data handling in the early years of schooling. Three components are described and explored as keys to comprehending graphing: the nature of data, alternative representations, and prediction. It is suggested that these components become a central, explicit focus of the curriculum.

Watson, Jane M. "Conditional Probability: Its Place in the Mathematics Curriculum" (1995)_The *Mathematics Teacher* 88 (1), 12-17.

When should conditional probability be introduced in the high school mathematics curriculum? Watson argues that ideas of conditional probability can be introduced earlier in the curriculum (as early as eighth grade) by providing students with examples of conditional statements (such as those appearing in the media) and problem contexts involving independence and two way tables. Conditional statements are viewed as important in developing the logic of conditional probabilities. Advertisements with statements such as "We will give you 50% off the joining fee if you join Dockside Fitness before May 24" appear to be a natural way to introduce the topic and the "if ...then" logic of a conditional statement. Examples of conditional probabilities inherent in sporting statistics are also described (e.g., finding a baseball player's probability of making a hit on a road game). Ideas are offered for how to involve students in examining these ideas in different contexts, gathering data and using the data to formulate different conditional probability statements, and developing the use of language and interpretation of conditional situations in contexts outside of mathematics.

Falk, Ruma. Significance Tests Die Hard: The Amazing Persistence of a Probabilistic Misconception." (1995). *Theory and Psychology*. 5 (1), 75-98.

Abstract: We present a critique showing the flawed logical structure of statistical significance tests. We then attempt to analyze why, in spite of this faulty reasoning, the use of significance tests persists. We identify the illusion of probabilistic proof by contradiction as a central stumbling block, because it is based on a

misleading generalization of reasoning from logic to inference under uncertainty. We present new data from a student sample and examples from the psychological literature showing the strength and prevalence of this illusion. We identify some intrinsic cognitive mechanisms and extrinsic social pressures which help to maintain the illusion. We conclude by mentioning some alternative methods for presenting and analyzing psychological data, none of which can be considered the ultimate method.

Garfield, Joan. "Research Report: Research Papers at ICOTS 4." (1995) *Teaching Statistics*, 17 (1), 29-31.

The Fourth International Conference on Teaching Statistics, held in Marrakech, Morocco in July 1994, provided an opportunity for researchers around the world to gather and share information on their current work. Nineteen papers presented in sessions designated "Research on teaching and learning statistics and probabilistic concepts" reported on studies conducted in more than a dozen countries on students at all educational levels. This report summarizes the research papers, grouped into five categories: empirical studies exploring students' conceptions of probability, theoretical papers on teaching and learning statistics and probability, assessment of student learning, the use of computers in teaching statistics and probability, and data analysis.

Garfield, Joan. How students learn statistics. (1995). *International Statistical Review*. 63, (1), 25-34.

Research in the areas of psychology, statistical education, and mathematics education is reviewed and the results applied to the teaching of college-level statistics courses. The argument is made that statistics educators need to determine what it is they really want students to learn, to modify their teaching according to suggestions from the research literature, and to use assessment to determine if their teaching is effective and if students are developing statistical understanding and competence.

Gal, Iddo. Will our students be statistically literate? (1995). *Connections*. National Center on Adult Literacy, May 1995, 14-15.

One key of adult literacy education is to empower students and enable them to become more informed citizens. Many adult educators only briefly touch on the topic of statistics, teaching fragmented topics in isolation, which is not likely to contribute much to the students' ability to make sense of the statistical information. This column describes interpretive skills and dispositional aspects involved in developing adults' statistical literacy, and suggests ways to help adult students to become statistically literate.

Biehler, Rolf. Towards requirements for more adequate software tools that support both learning and doing statistics. (1995). Revised and extended version of a paper presented at ICOTS 4. Occasional Paper 157, Institut für Didaktik der Mathematik der Universität Bielefeld.

This paper is based on the following rank order (with descending priority);

- student tools* whose learning and use can be integrated into an introductory course
- resources of data and meta-data*
- microworlds* (a good but limited selection)
- further resources* (electronic books, multimedia resources)
- tutorial shells*

Teachers' meta-tool functions should be included at all levels.

Biehler, Rolf and Steinbring, Heinz. Explorations in Statistics. Stem-and-Leaf, Boxplots: Concepts, Justifications, and Experience in a Teaching Experiment. Elaborated English version of a paper written in German, published in 1991.

Abstract: How can ideas, techniques, and applications taken from Exploratory Data Analysis (EDA) enrich mathematics instruction? How do students and teachers respond to ideas of EDA? How must EDA be transformed in order to reach a pedagogically useful position in the mathematics curriculum within general education? The paper describes some results of a teaching experiment concerning ideas of EDA. It was explored how basic new displays such as stem-and-leaf and boxplots can be taught and learned and how they have to be regarded in the context of more traditional statistical displays and newer computer supported displays. A new structuring of the cognitive tool kit for elementary data analysis is sketched.

Sullivan, Mary McGowan. Analysis of Conceptual Understanding in Undergraduate Descriptive Statistics Across Learning Style and Gender after Student-Centered Activity-Oriented Instruction. (1995). Doctoral Dissertation, University of Massachusetts, Lowell.

This descriptive study analyzed conceptual understanding in descriptive statistics among 249 undergraduate students after an instructional program which decreased the time spent on lecture and added activities, small group collaboration, and discussion that responded to students' varied learning styles. Additionally, the researcher interviewed and observed 16 students chosen on the basis of learning style and gender. Results indicate that a student-centered, activity-oriented curriculum may support a broad range of students in developing their conceptual understanding in descriptive statistics.

Lajoie, Susanne. *Reflections on Statistics: Agendas for Learning, Teaching and Assessment in K-12.* Lawrence Erlbaum. (In preparation).

This forthcoming book includes chapters written by several members of the study group. Here is a list of the contributors and their chapter titles:

Susanne Lajoie and Thomas Romberg, Introduction

George Bright, Graphical representations: Helping students interpret data.

Susan Friel, TEACH-STAT: A model for professional development in data analysis and statistics for teachers K-6.

Iddo Gal, Assessing statistical knowledge as it relates to students' interpretations of data.

Susanne Lajoie, Nancy Lavigne, Steven Munsie, and Tara Wilkie. Monitoring student progress in statistics.

Daniel Schwartz, Susan Goldman, and the Cognition and Technology group at Vanderbilt. Using anchored instruction to realign situated and mathematical understandings: The case of sampling in real world constructs.

Kathleen Metz, Emergent concepts of chance and probability in primary grade children.

Sharon Derry, Joel Levin, Helen Osana, and Melanie Jones. Statistical Gaming.

Jeffrey Horvath and Richard Lehrer. Children's development of models of chance: The effects of notation and conversation.

James Landwehr, Richard Scheaffer, and Ann Watkins. What every high school graduate should know about statistics.

Gail Burrill and Thomas Romberg, Statistics and probability for the middle grades: Examples from mathematics in context.

Listed below are the Table of Contents and Abstracts for Volume 3, Number 1, of the electronic *Journal of Statistics Education*.

Jon E. Anderson and J. David Dayton, "Instructional Regression Modules Using XLISP-STAT"

ABSTRACT: XLISP-STAT is free statistical software available for a variety of computing platforms. This article presents XLISP-STAT programs and explanations for three kinds of educational modules relevant to an applied regression course: new mouse modes, regression surface displays, and dynamic simulations for the sampling distribution of an estimated regression coefficient. These modules can be incorporated into laboratory sessions or lectures to demonstrate topics like case diagnostics, visualizing multiple regression, and the impact of distributional assumptions on the sampling distribution of an estimated regression coefficient. The structure of the modules can be easily modified by instructors to include additional topics.

Clifford Konold, "Issues in Assessing Conceptual Understanding in Probability and Statistics"

ABSTRACT: Research has shown that adults have intuitions about probability and statistics that, in many cases, are at odds with accepted theory. The existence of these strongly-held ideas may explain, in part, why learning probability and statistics is especially problematic. One objective of introductory instruction ought to be to help students replace these informal conceptions with more normative ones. Based on this research, items are currently being developed to assess conceptual understanding before and after instruction.

Kieran Mathieson, David P. Doane, and Ronald L. Tracy, "A Program for Visualizing Comparisons Between Two Normal Distributions"

ABSTRACT: This paper describes one program in the Teaching Statistics Visually (TSV) project. TSV supports inductive learning in introductory undergraduate applied statistics courses. The program (1) helps teach concepts rather than analyze data, (2) focuses on one module in a statistics course, (3) relies on visualization rather than formulas, (4) is easy to use, (5) is flexible, supporting different learning levels, and (6) is easy to manage, requiring commonly available resources and incorporating special features to simplify classroom use. A prototype version of the program "Comparing Two Normal Distributions" is included with this paper. The reader is invited to experiment with the program and to send comments and suggestions for improvement to the authors.

R. Romero, A. Ferrer, C. Capilla, L. Zunica, S. Balasch, V. Serra, and R. Alcover, "Teaching Statistics to Engineers: An Innovative Pedagogical Experience"

ABSTRACT: In recent years, the growing consciousness of the importance of statistics in the training of engineers has been accompanied in the western world by an increasing dissatisfaction with the teaching of statistics in universities. Within the framework of the Educational Innovation Project (PIE) of the Polytechnic University of Valencia, a group of teachers in the Department of Statistics introduced an innovation project beginning in 1989. This project has entailed a complete restructuring of the syllabus, as well as the teaching methodology. In this paper we explain different aspects of this project, emphasizing the important role of computer resources and the satisfactory results obtained.

Teaching Bits: A Resource for Teachers of Statistics

ABSTRACT: This column features "bits" of information sampled from a variety of sources that may be of interest to teachers of statistics. Joan Garfield abstracts information from the literature on teaching and learning statistics, while Laurie Snell summarizes articles from the news and other media that may be used with students to provoke discussions or serve as a basis for classroom activities or student projects

ABSTRACT: This article demonstrates the use of two datasets as an aid in teaching polynomial and nonlinear regression. The data were gathered by Galileo during his studies of falling bodies and projectiles. In analyzing and discussing these data, students are challenged to give thought to parsimony, independent and dependent variables, and the importance of understanding the scientific nature of the experiment. The opportunities for class discussion are especially rich in this understandable and real experiment, particularly when coupled with graphical analysis.

OTHER PUBLICATIONS OF INTEREST

The Section on Statistical Education of the American Statistical Association recently produced its first newsletter, edited by Carol Joyce Blumberg, Joan Garfield, and Tom Moore. This first issue contains brief articles on recent conferences, events such as the new undergraduate data analysis contest, and overviews on the ASA Office of Education, the International Association for Statistical Education, internet resources for teaching statistics, and current journals and newsletters. The second issue will be distributed in July.

The following review by J. Laurie Snell appeared in CHANCE News:

Statistics as Principled Argument. by Robert P. Abelson, Lawrence Erlbaum Associates, Hillsdale, NJ, 1995

In the preface of this new book, Abelson suggests students learn to do the statistical analysis for a study but do not learn what he calls the "narrative" part for the study. "Ask a student the question, 'If your study were reported in the newspaper, what would the headline be?' and you are likely to receive in response a rare exhibition of incoherent mumblings." Pursuing the headline question he arrived at the thesis of his book: "The purpose of statistics is to organize a useful argument from quantitative evidence, using a form of principled rhetoric".

The book discusses the many issues involved in making valid arguments. The author assumes the reader is familiar with elementary probability, standard tests such as the t tests, analysis of variance, and simple issues of research design that might be presented in a first statistics course. The first 5 chapters review basic statistical concepts in an informal manner with no formulas and always from the point of view of using them to make proper arguments. Chapters 6 through 10 discuss more general topics, such as meta-analyses, again from the point of view of making valid statistical arguments.

In all cases the ideas are illustrated in terms of studies, mostly taken from Abelson's own field of research, experimental social psychology. One of Abelson's theses is that problems chosen for study should be interesting. Consistent with this, he chooses interesting examples.

Reed, Margaret, and Garven, Frances (1995). "Minitab Menus - Do They Help or Hinder?". *Teaching Statistics*, 17 (1), 22-25.

Summary: A comparison of the levels of difficulty experienced by students in the use of Minitab through its menu interface and its command language showed no advantage in using the menus.

Vere-Jones, David. "The Coming of Age of Statistical Education" (1995). *International Statistical Review*, 63,(1), 3-23.

Summary: This paper outlines developments in statistical education in the period preceding the formation of the International Association for Statistical Education (IASE) 1991, and takes a tentative look at the future. The first section reviews the history of the ISI's Statistical Education Committee from its setting up in 1948 to the birth of the IASE in 1991. The second section attempts to identify some of the underlying factors contributing to the rapid growth of interest in statistical education during the last two decades or so. The third section gives a personal view of some of the issues the IASE may have to confront during its first few years of existence.

Subjective Probability, Edited by George Wright and Peter Ayton, (1994), West Sussex, England: John Wiley and Sons.

Drawing on perspectives from several disciplines, this collection of papers presents a broad ranging view of subjective probability in order to stimulate a reconceptualization of the base issues related to this topic. There are four major sections of the book. "Background" provides an overview of the philosophical and statistical foundations of subjective probability (e.g., Probability, Uncertainty, and the Practice of Statistics). "Studies in the Psychological Laboratory" describes the theory and research in cognitive and developmental psychology (e.g., Ambiguous Probabilities and the Paradoxes of Expected Utility). "Accuracy of Probability Judgments" focuses on theories and models that allow assessment of the quality of probability estimates (e.g., Subjective Probability Accuracy Analysis), and "Real World Studies" reviews judgments of subjective probability in decision making contexts (e.g., The Rationality of Gambling: Gamblers' Conceptions of Probability, Chance and Luck).

Special Section on CATS Symposium on Modern Interdisciplinary University Statistics Education, (1995). *American Statistician*, 49, 1, 1-23.

This section reprints seven of the first eight papers from the 1993 symposium on Modern Interdisciplinary University Statistics Education organized by the Committee on Applied and Theoretical Statistics (CATS) of the National Research Council. The symposium focused on what changes in statistics education are needed to (1) incorporate interdisciplinary training into the upper-undergraduate, graduate and postdoctoral statistics programs, (2) bring the upper-undergraduate and graduate statistics curricula up to date, and (3) improve apprenticing of statistics graduate and postdoctoral students and appropriately reward faculty mentors.

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