

Teaching Bits: Statistics Education Articles from 2007

Audbjorg Bjornsdottir and Joan Garfield
University of Minnesota

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Over 150 articles and book chapters were published in 2007 that pertained to statistics education. In this column, we will highlight a few of these articles that represent a variety of different journals that include statistics education in their focus. We also provide information about the journal and a link to their website so that abstracts of additional articles may be accessed and viewed.

From *Teaching Statistics*

<http://www.rsscse.org.uk/ts/>

An international journal for teachers that first appeared in 1979 and has been published three times a year ever since.

"Estimating Mortality in War-Time Iraq: A Controversial Survey with Important Lessons for Students"

By Fernando De Maio
Volume 29, Number 2 (2007)

<http://www.blackwell-synergy.com/doi/abs/10.1111/j.1467-9639.2007.00268.x>

Abstract: In teaching introductory quantitative methods in sociology, I have used a controversial survey

of mortality in Iraq before and after the 2003 invasion to highlight to students the power of simple questionnaires, the role of ambiguity in statistics and the place of politics in the framing of statistical results. This brief report summarizes Roberts et al.'s (2004) estimate that the invasion of Iraq resulted in 98,000 (95% CI = 8000 – 194,000) deaths, as well as the intriguing reaction that the survey received in the press. Statistics teachers should find the Roberts et al. study to be an effective way to introduce students to more controversial – and political – aspects of statistical research.

"Assessment of Students' Understanding of Variation"

By Jane M. Watson & Ben A. Kelly

Volume 29, Number 2 (2007)

<http://www.blackwell-synergy.com/doi/full/10.1111/j.1467-9639.2007.00295.x>

Abstract: Several tasks used in research studies are presented with assessment rubrics and examples of the development of student understanding. The tasks focus on students' appreciation of variation in several contexts and illustrate the need to discuss variation in the classroom and to ask students specifically about it during assessment.

"Inference by Eye: Pictures of Confidence Intervals and Thinking About Levels of Confidence"

By Geoff Cumming

Volume 29, Number 2 (2007)

<http://www3.interscience.wiley.com/journal/118539714/abstract>

Abstract: A picture of a 95% confidence interval (CI) implicitly contains pictures of CIs of all other levels of confidence, and information about the p-value for testing a null hypothesis. This article discusses pictures, taken from interactive software, that suggest several ways to think about the level of confidence of a CI, p-values, and what conclusions can be drawn from inspecting a CI.

From *Statistics Education Research Journal*

<http://www.stat.auckland.ac.nz/~iase/publications.php?show=serj#archives/>

SERJ is a peer-reviewed electronic journal of the International Association for Statistics Education (IASE) and the International Statistical Institute (ISI). SERJ is published twice a year and is free.

"Students' achievements in a statistics course in relation to motivational aspects and study behavior"

By Luc Budé, Margaretha W. J. Van De Wiel, Tjaart Imbos, Math J. J. M. Candel, Nick J. Broers, and Martijn P. F. Berger

Volume 6, Number 1 (2007)

[www.stat.auckland.ac.nz/~iase/serj/SERJ6\(1\)_Bude.pdf](http://www.stat.auckland.ac.nz/~iase/serj/SERJ6(1)_Bude.pdf)

Abstract: The present study focuses on motivational constructs and their effect on students' academic achievement within an existing statistics course. First-year Health Sciences students completed a questionnaire that measures several motivational constructs: dimensions of causal attributions, outcome expectancy, affect, and study behaviour, all with respect to statistics. The results showed that when the cause of negative events was perceived as uncontrollable, outcome expectancy was negative. When the cause of negative events was perceived as stable, affect toward statistics was negative. Furthermore, negative affect toward statistics and limited study behaviour led to unsatisfactory achievements. Path analysis (Lisrel) largely confirmed the causal relations in a model that was based on attributional and learned helplessness theories. The consequences of these findings for statistics education are discussed.

"Assessing students' conceptual understanding after a first course in statistics"

By Robert delMas, Joan Garfield, Ann Ooms, and Beth Chance

Volume 6, Number 2 (2007)

[http://www.stat.auckland.ac.nz/~iase/serj/SERJ6\(2\)_delMas.pdf](http://www.stat.auckland.ac.nz/~iase/serj/SERJ6(2)_delMas.pdf)

Abstract: This paper describes the development of the CAOS test, designed to measure students' conceptual understanding of important statistical ideas, across three years of revision and testing, content validation, and reliability analysis. Results are reported from a large scale class testing and item responses are compared from pretest to posttest in order to learn more about areas in which students demonstrated improved performance from beginning to end of the course, as well as areas that showed no improvement or decreased performance. Items that showed an increase in students' misconceptions about particular statistical concepts were also examined. The paper concludes with a discussion of implications for students' understanding of different statistical topics, followed by suggestions for further research.

From *Technology Innovations in Statistics Education*

<http://repositories.cdlib.org/uclastat/cts/tise/>

TISE reports on studies of the use of technology to improve statistics learning at all levels, from kindergarten to graduate school and professional development.

"The Introductory Statistics Course: A Ptolemaic Curriculum?"

George W. Cobb

Volume 1, Number 1 (2007)

<http://repositories.cdlib.org/uclastat/cts/tise/>

Abstract: As we begin the 21st century, the introductory statistics course appears healthy, with its emphasis on real examples, data production, and graphics for exploration and assumption-checking. Without doubt this emphasis marks a major improvement over introductory courses of the 1960s, an improvement made possible by the vaunted "computer revolution." Nevertheless, I argue that despite broad acceptance and rapid growth in enrollments, the consensus curriculum is still an unwitting prisoner of history. What we teach is largely the technical machinery of numerical approximations based on the normal distribution and its many subsidiary cogs. This machinery was once necessary, because the conceptually simpler alternative based on permutations was computationally beyond our reach. Before computers statisticians had no choice. These days we have no excuse. Randomization-based inference makes a direct connection between data production and the logic of inference that deserves to be at the core of every introductory course. Technology allows us to do more with less: more ideas, less technique. We need to recognize that the computer revolution in statistics education is far from over.

"On Getting More and Better Data Into the Classroom"

By William Finzer, Tim Erickson, Kirk Swenson, and Matthew Litwin

Volume 1, Number 1 (2007)

<http://repositories.cdlib.org/uclastat/cts/tise/>

Abstract: The authors' work to develop capabilities for getting data into the data analysis software Fathom is described. Heuristics of detecting data on a web page allow drag and drop of a URL into a document. A collaboration with the Minnesota Population Center makes possible sampling from census microdata from 1850 through 2000. With direct support for Vernier sensors, students can build a model during the process of realtime data collection. Finally, a survey capability makes it easy for teachers and students to create simple data entry forms hosted on a web site such that the collated data is instantly downloadable for data analysis in Fathom. By taking some of the drudgery out of gathering data, these capabilities carry implications for teaching and curriculum development; namely that students should have experience throughout their learning with data that they individually have chosen to explore. It is argued that the skills they gain by engaging in exploratory data analysis with self-chosen and self-generated data are critically important in our data-driven society and not yet adequately supported in K-14 learning.

From *International Statistical Review*

<http://isi.cbs.nl/isr.htm>

A journal of the International Statistical Institute that provides a comprehensive view of work in statistics, over the whole spectrum of the statistical profession.

Virtual Experiments and Their Use in Teaching Experimental Design"

By Paul L. Darius, Kenneth M. Portier and Eddie Schrevens

Volume 75, Number 3 (2007)

<http://www.blackwell-synergy.com/doi/abs/10.1111/j.1751-5823.2007.00028.x>

Abstract: The ability to design experiments in an appropriate and efficient way is an important skill, but students typically have little opportunity to get that experience. Most textbooks introduce standard general-purpose designs, and then proceed with the analysis of data already collected. In this paper we explore a tool for gaining design experience: computer-based virtual experiments. These are software environments which mimic a real situation of interest and invite the user to collect data to answer a research question. Two prototype environments are described. The first one is suitable for a course that deals with screening or response surface designs, the second one allows experimenting with block and row-column designs. They are parts of a collection we developed called ENV2EXP, and can be freely used over the web. We also describe our experience in using them in several courses over the last few years.

Note: there are several additional papers in the issue that discuss this article.

From *Mind, Culture, and Activity*

<http://www.informaworld.com/smpp/title~db=all~content=g794885280~tab=summary>.

MCA is an interdisciplinary, international journal devoted to the study of the human mind in its cultural and historical contexts.

"Interactive and historical processes of distributing statistical concepts through work organization."

By Rogers Hall, Ken Wright, Kren Wieckert

Volume 14, Issue 1 and 2 (2007)

<http://www.informaworld.com/smpp/content~content=a787992309~db=all~order=page>

Abstract: In this article, we analyze interactive processes through which research groups and their

statistical advisors insert new (for researchers) statistical concepts into existing research practice. Through processes of talk-in-interaction (speaking, gesture, and inscription), they assemble specimens, research workers, devices, algorithms, and texts, in alternative representations of future work. Alternate assemblies are compared, edited, and projected into future activity, in clients' projects and in publications, where they are viewed over a longer project history. As achievements of local interaction, assemblies have an interactive structure that builds from, and contrasts with, accounts of historically prior practice, involves joint imagination of new combinations of human judgment, with technology (e. g., statistical algorithms), and includes deliberate efforts to evaluate and edit future work activity. Speakers animate orders of work as laminar, narrative structures that deploy time, place, and human/technical agency in consequentially different ways. These alternative assemblies are produced during conversations in which client research projects have been disrupted or suspended in the hope of finding a better way to work in the future. In this sense, learning about new technical concepts that will be realized at a collective level of analysis is anticipated and given structure in local processes of interaction. We conclude with a discussion of how technical concepts are extended in scope and meaning as they are distributed through work organization.

From *International Electronic Journal of Mathematics Education*

<http://www.iejme.com/032007/main.htm>

Special Issue on Statistics Education

"Year 11 Students' Informal Inferential Reasoning: A Case Study about the Interpretation of Box Plots"

By Maxine Pfannkuch

Volume 2, Number 3 (2007)

<http://www.iejme.com/032007/d3.pdf>

Abstract: Year 11 (15-year-old) students are not exposed to formal statistical inferential methods. When drawing conclusions from data, their reasoning must be based mainly on looking at graph representations. Therefore, a challenge for research is to understand the nature and type of informal inferential reasoning used by students. In this paper two studies are reported. The first study reports on the development of a model for a teacher's reasoning when drawing informal inferences from the comparison of box plots. Using this model, the second study investigates the type of reasoning her students displayed in response to an assessment task. The resultant analysis produced a conjectured hierarchical model for students' reasoning. The implications of the findings for instruction are discussed.

"Exploring Connections between Sampling Distributions and Statistical Inference: an Analysis of Students' Engagement and Thinking in the Context of Instruction Involving Repeated Sampling"

By Luis A. Saldanha and Patrick W. Thompson

Volume 2, Number 3 (2007)

<http://www.iejme.com/032007/d9.pdf>

Abstract: Construing a collection of values of a sample statistic as a distribution is central to developing a coherent understanding of statistical inference. This paper discusses key developments that unfolded over three consecutive lessons in a classroom teaching experiment designed to support a group of high school students in developing such a construal. Instruction began by engaging students in activities that focused their attention on the variability among values of a common sample statistic. There occurred a critical shift in students' attention and discourse away from individual values of the statistic and toward a collection of such values as a basis for inferring the value of a population parameter. This was followed by their comparisons of such collections and by the emergence and application of a rule for deciding whether two such collections were similar. In the repeated application of their decision rule students structured these collections as distributions. We characterize aspects of these developments in relation to students' classroom engagement, and we explore evidence in students' written work that points to how instruction shaped their conceptions.

From *Journal for Research in Mathematics Education*

http://my.nctm.org/eresources/journal_home.asp?journal_id=1

JRME promotes and disseminates disciplined scholarly inquiry into the teaching and learning of mathematics at all levels, including research reports, book reviews, and commentaries.

"Toward a Conceptualization of Statistical Knowledge for Teaching"

By Randall E. Groth

Volume 38, Number 5 (2007)

http://my.nctm.org/eresources/article_summary.asp?URI=JRME2007-11-427a&from=B

Abstract: The purpose of this article is to sketch a hypothetical descriptive framework of statistical knowledge for teaching. Because statistics is a discipline in its own right rather than a branch of mathematics, the knowledge needed to teach statistics is likely to differ from the knowledge needed to teach mathematics. Doing statistics involves many primarily nonmathematical activities, such as building meaning for data by examining the context and choosing appropriate study designs to answer questions of interest. Although there are differences between mathematics and statistics, the two disciplines do share common ground in that statistics utilizes mathematics. This connection suggests that existing research on mathematical knowledge for teaching can help inform research on statistical

knowledge for teaching.

From *Educational Studies in Mathematics*

<http://www.springer.com/education/mathematics+education/journal/10649>

ESM presents new ideas and developments of major importance to practitioners working in the field of mathematical education. It reflects both the variety of research concerns within the field and the range of methods used to study them.

"The Role of Cognitive Conflict in Developing Students' Understanding of Average"

By Jane Watson

Volume 65, Number 1 (2007)

<http://www.ingentaconnect.com/content/klu/educ/2007/00000065/00000001/00009043>

Abstract: Two strands of research motivate this study. One is the interest in school students' development of understanding of the concept of average, historically part of the mathematics curriculum and prominent in the statistics curriculum introduced in the early 1990s. The other is the belief of some educators that students learn meaningfully when experiencing cognitive conflict that challenges incorrect or incomplete understandings. This study presented 58 students in Grades 3, 6, and 9 with a series of questions about the concept of average. After initial levels of response were observed, students were presented with alternative responses on video from other school students and asked to choose which best resolved the task at hand. Initial responses confirmed the levels of understanding in an earlier study based on the same questions. Responses after the experience of cognitive conflict were either at the same level as before or higher, with no student finally agreeing with a lower level response. The results are compared with longitudinal change in relation to average and change resulting from cognitive conflict in relation to other areas of chance and data. Implications of the research are considered.

In addition to the journal articles listed above, an important book was published in 2007 that contains many chapters by various authors.

Thinking with Data

Edited by Marsha C. Lovett, Priti Shah

<http://www.thinking-and-reasoning-arena.com/books/Thinking-With-Data-isbn9780805854213>

The chapters in *Thinking with Data* are based on presentations given at the 33rd Carnegie Symposium on Cognition. The book is organized in three sections:

- Part I focuses on the concepts of uncertainty and variation and on how people understand these ideas in a variety of contexts.
- Part II focuses on how people work with data to understand its structure and draw conclusions from data either in terms of formal statistical analyses or informal assessments of evidence.
- Part III focuses on how people learn from data and how they use data to make decisions in daily and professional life.

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