Teaching Bits: A Resource for Teachers of Statistics

From the Literature on Teaching and Learning Statistics

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Research and Resources on Teaching and Learning Statistics

“Conceptions of Variation: A Literature Review”

Maria Meletiou (2002), Statistics Education Research Journal [Online], 1, 46-53. (fehps.une.edu.au/F/s/curric/cReading/serj/current_issues/SERJ1(1).pdf)

Summary: There are two parts to this literature review. The first part includes bibliography directly focusing on variation: meaning of variation, role of variation in statistical reasoning, research on conceptions of variation, as well as literature discussing the neglect of variation. The second part lists references belonging to four bodies of literature which, although not having the study of intuitions about variation as their main object of study, do offer rich insights into people’s thinking about variation: literature on sampling and centers, on intuitions about the stochastic, on the role of technology, and on the effect of the formalist mathematics tradition on statistics education.

“Sharing Experiences in the Training of Researchers”

Flavia Jolliffe, et al. (2002), Statistics Education Research Journal [Online], 1, 14-29. (fehps.une.edu.au/F/s/curric/cReading/serj/current_issues/SERJ1(1).pdf)

Summary: This collection of short articles has been written by statistical education researchers who have agreed to share their experiences of training researchers in this area. The contributors come from several different countries and include both those who are relatively new to this field as well as those
who have been working in it for several years. Some of them write about their own experience in becoming a statistical education researcher and some give information and advice about the training of other researchers.

Teaching Ideas and Applications

“Oh My Aching Back! A Statistical Analysis of Backpack Weights”

Jenni Mintz, Jessica Mintz, Katrina Moore, and Kim Schuh (2002), STATS, 34.

Excerpt from Editor’s Column: Carrying backpacks full of books is a daily routine for most students, but carrying too much weight can actually lead to serious health problems. To investigate whether students on their campus tend to carry more than is recommended, four Cal Poly students weighed backpacks of their peers, in relation to students’ body weight, and analyzed the results.

“The Number of Trials Does Matter”

Leslie Aspinwall and James Tarr (2002), Mathematics Teaching in the Middle School, 8, 106-117.

Abstract: This article uses action research items to help students develop the concept of the importance of sample size in statistical analysis.

“Will He Ask Me to the Dance? What Size Do You Want?”

Kris Warloe (2002), Mathematics Teaching in the Middle School, 8, 95.

Abstract: Cartoons involving odds and probability and enlargements are described.

“Data Analysis as the Search for Signals in Noisy Processes”

Clifford Konold and Alexander Pollatsek (2002), Journal for Research in Mathematics Education, 33, 259-289.

Abstract: The idea of data as a mixture of signal and noise is perhaps the most fundamental concept in statistics. Research suggests, however, that current instruction is not helping students to develop this idea, and that though many students know, for example, how to compute means or medians, they do not know how to apply or interpret them. Part of the problem may be that the interpretations we often use to introduce data summaries, including viewing averages as typical scores or fair shares, provide a poor conceptual basis for using them to represent the entire group for purposes such as comparing one group
to another. To explore the challenges of learning to think about data as signal and noise, we examine the "signal/noise" metaphor in the context of three different statistical processes: repeated measures, measuring individuals, and dichotomous events. On the basis of this analysis, we make several recommendations about research and instruction.

“Voting Methods Matter”

Alan Kimber (2002), *Teaching Statistics*, 24, 78-81.

**Summary:** Data from a far from satisfactory election are used to illustrate the effects of changes in voting methods.

“Ducks and Green - An Introduction to the Ideas of Hypothesis Testing”

E. Seier and C. Robe, (2002), *Teaching Statistics*, 24, 82-86.

**Summary:** Testing statistical hypotheses introduces new vocabulary, concepts and a way of thinking that some students might initially find difficult. We provide a simple case that can be used in class as a gentle introduction to the ideas and procedures of hypothesis testing…In a certain species, male ducks have green heads, and females are all grey. The purpose of the green coloring of the male heads is to attract the females. The question is: are female ducks also attracted to the green color of food, for example, in bread?

“Assessment: New Ways of Pupil Evaluation Using Real Data”

Peter Holmes (2002), *Teaching Statistics*, 24, 87-89.

**Summary:** Typically, external assessment of school statistics concentrates on lower-level skills. This article discusses how use of the real data of ‘CensusAtSchool’ makes it possible to devise questions and activities that assess deeper levels of understanding, as described in Bloom’s Taxonomy of Cognitive Learning.

“A Probability Model for Golf Putting”

Andrew Gelman and Deborah Nolan (2002), *Teaching Statistics*, 24, 93-95.

**Summary:** We derive a model, using trigonometry and the Normal distribution, for the probability that a golf putt is successful. We describe a class activity in which we lead the students through the steps of examining the data, considering possible models, constructing a probability model and checking the fit. The model is, of necessity, oversimplified, a point which the class discusses at the end of the demonstration.
“Classifying Data Displays within Assessment of Displays found in Popular Software”

Robert Goldman and John McKenzie, Jr. (2002), *Teaching Statistics*, 24, 96-101.

**Summary:** This article provides a scheme for classifying data tables and graphs and then uses this scheme to organize and assess the tables and graphs found in three commonly used software packages: Microsoft Excel, Minitab and SPSS. The classification and assessment is of one-, two-, and three-dimensional displays.

“Determining the Mean Center of the Population of the United States”

Dennis Ippolito (2002), *Mathematics Teacher*, 95(7), 526-530.

**Summary:** The mean center of the population is the point at which the country would balance if it were flat and if every person weighed the same amount. The mean center of the population of the United States has shifted west in the last two hundred years. This article speculates on ways that the mean center of the population of the country might be determined using trigonometry and statistics.

“Teacher Course Evaluations and Students Grades: An Academic Tango”

Valen Johnson (2002), *Chance* [Online], 15. ([www.stat.duke.edu/chance/153.johnson.pdf](http://www.stat.duke.edu/chance/153.johnson.pdf))

**Summary:** The topic of this article is the biasing effect that faculty grading practices have on SETs (student evaluations of teaching).

“What is the Significance of a Kiss?”

Mary Richardson, Phyllis Curtiss, and John Gabrosek (2002), *STAR Library* [Online]. ([www.starlibrary.net/activities/richardson_curtiss_gabrosek2002.htm](http://www.starlibrary.net/activities/richardson_curtiss_gabrosek2002.htm))

**Abstract:** This article describes an interactive activity illustrating general properties of hypothesis testing and hypothesis tests for proportions. Students generate, collect, and analyze data. Through simulation, students explore hypothesis testing concepts. Concepts illustrated are: interpretation of p-values, type I error rate, type II error rate, power, and the relationship between type I and type II error rates and power. This activity is appropriate for use in an introductory college or high school statistics course.

“Histogram Sorting”

Joan Garfield (2002), *STAR Library* [Online]. ([www.starlibrary.net/activities/garfield2002.htm](http://www.starlibrary.net/activities/garfield2002.htm))
Abstract: This activity provides students with 23 histograms representing distributions with differing shapes and characteristics. By sorting the histograms into piles that seem to go together, and by describing those piles, students develop awareness of the different versions of particular shapes (for example, different types of skewed distributions, or different types of normal distributions), that not all histograms are easy to classify, that there is a difference between models (normal, uniform) and characteristics (such as skewness and symmetry).

“Rectangularity”

Mary Richardson, Phyllis Curtiss, John Gabrosek, and Diann Reischman (2002), STAR Library [Online]. (www.starlibrary.net/activities/richardson_curtiss_gabrosek_reischman2002.htm)

Abstract: This article describes an interactive activity illustrating sampling distributions for means, properties of confidence intervals, properties of hypothesis testing, confidence intervals for means, and hypothesis tests for means. Students generate and analyze data and through simulation explore these concepts. The activity is completed in three parts. The three parts of the activity can be used in sequence or they can be used individually as “stand alone” activities. This allows the educator flexibility in utilizing the activity. Part I illustrates the sampling distribution of the sample mean. Part II illustrates confidence intervals for the population mean. Part III illustrates hypothesis tests for the population mean. This activity is appropriate for use in an introductory college or high school AP statistics course.

“Is Human Height Bimodal?”

Mark Schilling, Ann Watkins, and William Watkins (2002), The American Statistician, 56, 223-229.

Abbreviated Abstract: The combined distribution of heights of men and women has become the canonical illustration of bimodality when teaching introductory statistics. But is this example appropriate? This article investigates the conditions under which a mixture of two normal distributions is bimodal. We suggest reasons why histograms of height nevertheless often appear bimodal.

“Beyond Traditional Statistical Methods”

William Duckworth and W. Robert Stephenson (2002), The American Statistician, 56, 230-233.

Abbreviated Abstract: Today’s courses in statistical methods, for the most part, focus on the same methods that were taught 30 years ago. The actual practice of statistics has moved beyond these traditional statistical methods. Modern methods - including dynamic graphics, nonlinear estimation, resampling, and other simulation-based inference methods - are being used by many scientists and engineers. However, these methods generally are not included in courses in statistical methods, especially at the undergraduate level. This article discusses the development of a collection of instructional modules, built around actual applications from science and engineering. The modules are intended as a resource for instructors to experiment with and explore the use of modern statistical methodology in undergraduate statistics methods courses.
“You Can Load a Die, But You Can’t Bias a Coin”

Andrew Gelman and Deborah Nolan (2002), *The American Statistician*, 56, 308-311.

**Abstract:** Dice can be loaded - that is, one can easily alter a die so that the probabilities of landing on the six sides are dramatically unequal. However, it is not possible to bias a coin flip - that is, one cannot, for example, weight a coin so that it is substantially more likely to land “heads” than “tails” when flipped and caught in the hand in the usual manner. Coin tosses can be biased only if the coin is allowed to bounce or be spun rather than simply flipped in the air. We describe a student activity with dice and coins that gives empirical evidence to support this property, and we use this activity when we teach design of experiments and hypothesis testing in our introductory statistics courses.

“Case Study Based Instruction of DOE and SPC”

James Brady and Theodore Allen (2002), *The American Statistician*, 56, 312-315.

**Abstract:** There is abundant evidence that most practicing engineers fail to consistently apply formal data collection and analysis techniques. We describe a case-based instructional approach designed to reinforce lecture material and motivate students to apply what they have learned. The approach is illustrated with an exercise based on an actual case study of increasing yields for manufacturing electronic components.

Reviews

**Book Review:** *Statistics for People Who (Think They) Hate Statistics*, by Neil Salkind (2000), Sage Publications.

Neil Sheldon (2002), *Teaching Statistics*, 24, 106.

**Selected Quotes:** “I was (genuinely) hoping for better, as the aim expressed in the title is a good one. However, the book is irritating from the outset with its Homer Simpson language. It is disconcertingly full of statistical recipes with instructions to ‘plug in the numbers’. And worst of all, large chunks of the book are highly misleading or just plain wrong. ... I would not let this book fall into the hands of my students. It could cause permanent damage.”

**Book Review:** *SPSS for Windows Made Simple (Release 10)*, by Paul Kinnear and Colin Gray (2000), Psychology Press.

Clare Morris (2002), *Teaching Statistics*, 24, 107-108.
Selected Quotes: “For once, a book entitled ‘made simple’ which lives up to its promise! This excellent volume, an updating of texts by the same authors covering earlier releases of SPSS, not only makes the full capability of SPSS easily accessible to the novice, but also gives a good introduction to the statistical ideas underlying many of the procedures...A wide range of users could benefit from the use of this book, whether as a course text, a self-instructional tool, or a reference for researchers wishing to make use of SPSS... I would strongly recommend this book to anyone who needs to teach statistics via the medium of SPSS.”

Book Review: *Understanding Statistical Concepts Using S-Plus*, by Randall Schumacker and Allen Akers (2001), Lawrence Erlbaum Associates, Inc.

Ulric Lund (2002), *The American Statistician*, 56, 249-250.

Selected Quotes: “Instructors of introductory statistics courses may find some of the S-Plus scripts useful for in-class demonstrations, and students learning the basics of the S programming language may benefit from the authors’ explanations of the script files. Students might also appreciate that S-Plus is being used as the conceptual instruction tool, and can also be used to perform statistical analysis, thereby not requiring them to learn multiple programs. However, in light of (certain) misgivings (some of the scripts files are no longer functional using the most recent version of S-Plus; numerous conceptual inaccuracies, or at least misleading typographical errors), instructors should be cautious about giving students free reign with this text, as it is likely to cause confusion with some important statistical concepts.”

Book Review: *Contemporary Business Statistics with Microsoft Excel*, by David Anderson, Dennis Sweeney, and Thomas Williams (2001), South Western.

John Walker (2002), *The American Statistician*, 56, 250.

Selected Quotes: “(This text) is a condensed version of the authors’ popular Statistics for Business and Economics (SBE) series. It appears suitable for a one-term introductory course, while the larger SBE would support a two-term course sequence...The authors have done a good job of writing a book suitable for a one-term course. Some important topics in business statistics have been omitted or drastically shortened (multiple regression coverage is brief and rudimentary; no coverage of nonparametric methods or time-series) but full coverage is not possible in a book of this size and scope. (If) you must use Excel as the analysis software in your course, (this text) does it well with thorough integration of Excel throughout.”

Book Review: *Statistical Consulting*, by Javier Cabrera and Andrew McDougall (2002), Springer-Verlag.

C.M. Anderson-Cook, *The American Statistician*, 56, 329.

Selected Quotes: “Since a large fraction of statisticians use their trade by interacting with non-statisticians working on applied problems, this book should have broad appeal. The authors have
developed a diverse and readable book that tackles many aspects of consulting in good proportion. It describes the consulting process and common statistical methodologies, strategies of effective communication skills, and provides a broad range of case studies as a means of gaining consulting-related experience. It illustrates what information consultant needs to obtain from the client, and what motivates those needs… Overall, this book is a valuable resource for statistical consultants, both beginning and established. As an instructor of a statistical consulting class, this is a prime candidate for use as a stand-alone textbook in my course, since it contains a desirable balance of materials with statistical methodology, oral and written communication skills, and rich case studies…Although there are other books that effectively tackle the individual aspects describe above, this book seems to be the one most ideally suited to teaching a well-rounded statistics course at the undergraduate or graduate level.”

Book Review: *A Handbook of Statistical Analyses using SAS* (2nd ed.), by Geoff Der and Brian Everitt (2002), Chapman and Hall/CRC.

Ghanshyam Gupta (2002), *The American Statistician*, 56, 334-335.

**Selected Quotes:** “(This text) provides a concise but simple manual for using SAS. It has put thousands of pages of SAS manuals into less than 400 pages of a paperback. Of course, it cannot be as exhaustive as a set of manuals from SAS Institute, but it does cover a large amount of material with examples in a simple language that should encourage the use of SAS… (The) handbook introduces SAS programming through a number of datasets of varied complexity, makes the datasets suitable for analysis through programming statements, and then uses SAS procedures for analysis. SAS procedures, and the resulting outputs are properly explained, and suggestions for appropriate analyses are provided where necessary. Overall, I consider this an excellent handbook for a beginning SAS user. Statisticians and non-statisticians can both benefit from this book.”

Software Review: *Teach/Me Data Analysis* CD: Single User Edition, by Hans Lohninger (1999), Springer-Verlag.

Marjorie Bond (2002), *The American Statistician*, 56, 335-336.

**Selected Quotes:** “(This) software claims to be ‘a development system for Web-based lectures and courses. It can be used to deploy teaching material either on CD-Rom, or within a local area network, or even over the Internet’. It does not claim to be a software package that alone provides all needed material or instruction. This is good because, alone, the software package can be confusing and baffling. Although it has some intriguing aspects such as its interactive examples and ‘MindMap,’ its overall lack of clarity and difficult usage makes it such that I would not recommend it.”

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