

An Interactive Text for Very Basic Statistics Courses

A Review of

Interactive Statistics for the Behavioral Sciences, by Pepper Williams, Sunderland, MA: Sinauer, 2004. 386 pp. ISBN 0-87893-930-X. , paperback; \$40.00, Web access only

Reviewed by

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Technology is changing statistics education. Resulting from major technological advances over the past 10 years are inexpensive and powerful desktop computers, increasingly user-friendly statistical packages, and pedagogical opportunities afforded by the Internet. Paralleling developments are vibrant debates regarding how psychologists use statistics to interpret data and the role of statistics education in improving statistical comprehension and competence.

Interactive Statistics for the Behavioral Sciences, in many ways, exemplifies some of these changes. This is not a traditional book. In fact, the text begins with a statement that the book is best read through a Web browser. The browser allows the reader to attempt problems embedded in the text, complete interactive exercises and calculations, and work through review problems. This is an advantage over standard textbooks, even those that are packaged with compact disk supplements. The ability to integrate readings and exercises is a major strength of this approach.

Interactive Statistics for the Behavioral Sciences is not the only product to use an interactive approach. For example, there are both stand-alone texts (e.g., *Cyberstats*, [Utts, 2003](#)) and supplements (e.g., *ActivStats: 2000–2001 release*, [Velleman, 2001](#)) that provide similar instruction. Compared with these texts, this book does not fare well. The interactive examples are not as well developed, the depth and breadth of coverage are less impressive, and the interactive materials are not as visually appealing.

Though this book compares poorly with other interactive products, those products may not be an appropriate comparison, as this text is likely intended for a different audience. This book strikes me as a textbook for the most basic of psychological statistics courses. Perhaps it is more relevant to contrast this book with a title such as *Statistics Without Tears* ([Rowntree, 2004](#)). This type of book provides basic instruction, focusing on a few key procedures with goals of making the learning process as easy, enjoyable, and stress free as possible. In this comparative context, the book performs well but not spectacularly.

Calculations

☰ The primary focus of the text is calculation. There are numerous exercises and calculation tools specific to the text. In addition, the book provides detailed, step-by-step instructions for all major procedures. Students who complete these exercises should come away confident in their ability to calculate statistical values correctly.

☰ The role of calculations in statistics education is an important philosophical issue. Should instructors focus exclusively on calculation, or is a focus on use of statistical software packages more productive? I believe in the value of calculations as a teaching tool. To understand the t test, students should understand every aspect of a formula (e.g., what makes t large, what makes t small). *Interactive Statistics for the Behavioral Sciences* does a good job in providing calculation examples that promote such comprehension. The interactive text provides exercises that allow students to practice calculations and check answers, and it can generate new examples, although they differ only numerically from previous examples. Further, as students receive immediate feedback on their mistakes, learning is enhanced (e.g., [Lovett & Greenhouse, 2000](#)).

☰ Some interactive features, however, may go too far in providing feedback. For example, an analysis of variance (ANOVA) calculation tool provides answers for all phases of the calculation process, from entering data to deriving the F statistic. The tool allows students to click the value of interest and receive the correct answer. When the student does not understand what comes next, they may request the answer. The availability of answers is convenient and prevents students from getting stuck. Unfortunately, this approach may promote hindsight biases (e.g., [Bjork, 1994](#)). *Hindsight bias* refers to the fact that when students are given an answer, they tend to overestimate the likelihood that they would arrive at that answer on their own. This may lead to false confidence in comprehension and a failure to think deeply about problems before checking the answers.

☰ Also at issue are the book's detailed instructions for calculating and making decisions based on t , F , and so on. Using this information, students do not need to think critically about problems. Instead, they follow the steps and come up with the correct answer. Exercises involve calculation of statistical values but require little interpretation. For many complex problems, the only conclusion requested is whether or not to reject the null hypothesis. Similarly, there are few opportunities for students to engage in problems where they must choose a statistical technique to apply to a research question. Calculation practice does not translate to an understanding of interpretation and application, as students only learn what they practice ([Garfield, 1995](#)). Interpretation and application are central to real-world use of statistics. This text does not provide enough material for focusing on these skills.

Coverage and Accuracy

☰ This book covers descriptive statistics, z , t , one-factor between- and within-subjects ANOVA, correlation, chi-square, and simple linear regression. Multifactor ANOVA and multiple regression receive a brief mention but no substantial coverage. It is my impression that this is simply not enough information for most psychological statistics courses. Knowledge of t and one-factor ANOVA no longer afford students the ability to understand materials from most outlets in psychology. Whether instructors choose to cover these topics in

their courses or not, it is essential that students have a reference that covers this material.

☰ Another issue in statistics education is the role of theory. A good text weaves theory with application, regularly reminding the student of the theory behind the analyses, focusing on assumptions, pitfalls, and limitations. In general, more theory usually means a text designed for a more advanced audience. Less theory means a more approachable text. This book is light on theory but does a reasonable job of presenting major concepts such as the Central Limit Theorem (CLT). However, there are some areas where the author excludes theoretical information that I view as central to establishing a foundation of statistical competence. To give just one example, the text ignores conditional probabilities. Understanding of null hypothesis testing is limited without knowledge of conditional probability.

☰ A major topical omission is effect size estimates. According to the *Publication Manual of the American Psychological Association* ([American Psychological Association, 2001](#)), “for the reader to fully understand the importance of your findings, it is almost always necessary to include some index of effect size or strength of relationship in your Results section (p. 25). Given this stance and the increasing number of outlets requiring effect size presentation, it is imperative for statistics textbooks to provide detailed instruction in this area.

☰ For the most part, the presentation of material in the book is accurate. However, when discussing hypothesis testing, the book should present material more carefully. The author presents a well-reasoned view of hypothesis testing that warns against using simple reject/do not reject hypothesis-testing decisions. Unfortunately, the author encourages students to “think of a p value as an indicator of the strength of an effect” (p. 129). This implies that a small probability is equivalent to a large effect size. Encouraging this thinking promotes the false belief that probability is inversely related to effect size (cf. [Nickerson, 2000](#)). This encouragement, combined with the absence of effect size coverage, may promote faulty statistical reasoning. Deeper coverage of statistical power (and effect sizes) would be beneficial in clarifying these issues.

Examples

☰ One challenging aspect of any psychological statistics course is teaching statistics to students who are more interested in topical areas of psychology. It is uncommon to encounter students who become psychology majors because of an interest in statistics. Statistics instruction can tap topical interests and make instruction relevant by using exciting psychological examples and highlighting how the investigators applied statistics in the research process. Unfortunately, the examples this book provides are disappointing. Most examples are fictitious and many are not relevant to psychology or other behavioral science fields. Problems and examples based on real research contexts can be valuable tools for promoting and assessing statistical reasoning ([Garfield & Chance, 2000](#)). Unfortunately, there are few, if any, examples of actual research found in this text.

What Tools?

☰ This book includes a series of calculation tools that perform useful tasks, such as sorting a

set of numbers from highest to lowest, calculating F statistics, and providing probability values. These tools are helpful, valuable, and well integrated, as they are designed specifically for the text.

☰ However, this presents another important philosophical question: Is it better to create new tools or to use those tools already developed? I support the latter strategy. Students who learn to use a spreadsheet (e.g., Microsoft Excel or Lotus 1-2-3) and a major statistical package (e.g., SPSS, SAS, Minitab) come away with valuable skills. The text's tools do few things that cannot be accomplished with a spreadsheet or statistical package. I recognize that authors and publishers may choose the former strategy as it increases a book's marketability. I prefer the latter strategy as it increases *students'* marketability.

Interactive Supplements



☰ The interactive materials that accompany the text are genuinely beneficial to student learning, especially for difficult-to-teach concepts. For most supplements, one can search the Internet and find similar, but freely available, applets addressing the same concepts. To give just two examples, the [Rice Virtual Lab in Statistics \(n.d.\)](#) provides a CLT applet that is similar to the book's activity, and an outlier exercise owes a debt to one developed by Webster [West \(1996\)](#). The similarities between the materials above and in this book are troubling, as the author does not reference any of these sources. I do not mean to suggest that the author took the work of others. However, the interactive exercises in this text clearly build on the work of others. Given the generosity of the applet authors in providing free materials, I believe that references to these materials are necessary.

Conclusions

☰ Ultimately, evaluation of *Interactive Statistics for the Behavioral Sciences* depends on the goals of the instructor's statistics course. If the goal of the course is in-depth understanding of a wide range of statistical procedures common to psychological research, then this text is not a good fit. However, if course goals are limited to teaching students how to calculate values correctly, then this text is a good option.

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