JOURNAL OF FORENSIC SCIENCES

J Forensic Sci, November 2011, Vol. 56, No. 6
doi: 10.1111/j.1556-4029.2011.01925.x
Available online at: onlinelibrary.wiley.com

BOOK REVIEW

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Review of: *Essential Mathematics and Statistics for Forensic Science*

REFERENCE: Adam C. Essential mathematics and statistics for forensic science. Hoboken, NJ: Wiley-Blackwell, 2010, 354 pp.

I had seen this book advertised in some of Wiley-Blackwell's brochures and was quite curious both about the quality of the book and about its intended audience and purpose. Having now read the book, I give it generally high marks in terms of quality, but I remain fuzzy regarding the book's intended audience and purpose. The Preface clearly indicates that the book is intended to "…fill a gap on the bookshelves by embracing the distinctive body of mathematics that underpins forensic science…" (p. 1), and that, the intended audience is primarily undergraduate students as well as "some postgraduate programmes in forensic science" (p. 2). My fuzziness remains because I do question whether this book could sustain a course, or at least part of a course, on quantitative methods in forensic science at the undergraduate or graduate student level. There is a long history, at least in the U.S., of "farming out" training in quantitative methods to statistics and mathematics departments, and occasionally to behavioral sciences departments. While students taking courses outside of forensic science programs are unlikely to be exposed to, for example, the multiplication of likelihood ratios to present the evidentiary basis for expert testimony, it is also true that they are more likely to receive training that is time-tested.

While I found large sections of Adam's book to be excellent, I would have difficulty teaching from this book, and I suspect students would have difficulty learning from it for five principal reasons. First, the graphics are not particularly strong. Second, the frequentist material is difficult to follow for the uninitiated, because concepts such as when to use one- versus two-tailed tests are not explained at an intuitive level. Third, the book still has students referring to tables of critical values, rather than getting probability values on-line, for example, at http://www.danielsoper.com/statcalc3/ or through software packages. Fourth, the book generally ignores the many free tools available on the web such as "R" for statistics and graphics (http://www.r-project.org/) and wxMaxima (http://andrejv.github.com/wxmaxima/) for algebra and calculus. Finally, while the Preface notes that the "book has been devised deliberately without the inclusion of calculus" (p. xi), I think this was a mistake. While facility with calculus should not be a prerequisite for an "essential mathematics and statistics" book, completely ignoring the calculus removes part of the conceptual basis for understanding many of the methods.

The book is organized into 11 chapters of which the first four can be considered the "mathematics" section and the remaining seven chapters the "statistics" section. Chapter 1 contains introductory information, including molarity calculations that I must admit I have not looked at since that last undergraduate chemistry course so many years ago. Chapters 2 and 3 deal with various functions and equations, while Chapter 4 is on trigonometric methods. Chapter 5 on graphs bridges the two major sections of the book. Some of the material in this chapter appears quite dated to me, for example, the presentation of a bar chart and a pie chart where a dot chart would be more appropriate. Chapter 6 on "the statistical analysis of data" is short and falls short in at least one area. In a section on probability density functions, Adam incorrectly refers to a probability histogram as a probability density histogram. "Density" and "histogram" are incompatible terms because the former refers to a continuous function while the later refers to a "binned" distribution. He then states that if the intervals are made "increasingly small," then the histogram will tend to a continuous curve, which is the "probability density distribution." In statistics, a "distribution function" is a cumulative function ($F(x) = \Pr[X \leq x]$). The simplest way to understand a probability density function is to understand that it integrates to one. At the least, Adam could have shown graphs of some probability density functions, particularly examples where individual point densities are above 1.0, as they are in, for example, Figure 9.3. Chapters 7 and 8 are on probability while Chapter 9 is on "comparison and confidence." Chapter 9 shows some material in equations that would be best supplemented with graphics, such as the presentation of the two-tailed concept. Chapter 10 on "computation and calibration" is likely to confuse the student. The "computation" title is really a reference to calculating "propagation of errors." Rather than looking at error on a linear scale, this material would be easier to understand in terms of variances. Adam refers to "quadrature," a term usually reserved for numerical integration, but which he uses when stating that the total error is equal to the square root of the sum of squared errors. It would be simpler to just state that the total variance is equal to the sum of variances for two independent variables (indeed, the basis for ANOVA, a topic not covered in this book). The closing chapter on the "significance of evidence" is a good introduction to the probabilistic presentation of evidence with particular emphasis on the use of likelihood ratios.

To summarize, I think this is a useful book, but I would be reluctant to recommend it as a text for an undergraduate class. Perhaps, its best use is to supplement a broader-based text that is more in-line with a traditional introductory statistics course.

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