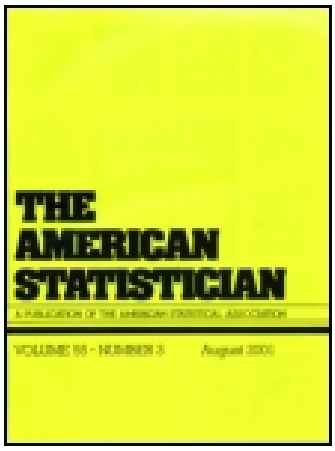

The American Statistician
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/utas20

Reviews of Books and Teaching Materials

Published online: 27 Aug 2015.

To cite this article: (2015) Reviews of Books and Teaching Materials, The American Statistician, 69:3, 244-252, DOI: 10.1080/00031305.2015.1068616

To link to this article: http://dx.doi.org/10.1080/00031305.2015.1068616

Analytic Methods in Sports: Using Mathematics and Statistics to Understand Data from Baseball, Football, Basketball, and Other Sports.

Thomas A. SEVERINI. Boca Raton, FL: Chapman & Hall/CRC Press, 2014, xvi + 238 pp., $59.95 (H), ISBN: 978-1-4822-3701-6.

Analytic Methods in Sports introduces the reader to basic statistical and probabilistic concepts through topics from sports. In the author's words, "the goal of this book is to provide a concise but thorough introduction to the analytic and statistical methods that are useful in studying sports" and "is designed for readers who are comfortable with mathematics but who have no previous background in statistics." The author has succeeded in this goal.

In my opinion, this book is ideally suited to someone who has a keen interest in various sports and mathematics and would like to take their interest to a deeper, more quantitative level. I could also imagine using this book as a supplementary resource in an introductory statistics courses given its trove of interesting examples. A review on Amazon recommends the book for sports bettors, however, this is outside of my domain of expertise.

The book consists of an introductory chapter followed by six chapters with an analytic focus. Each of the latter chapters focus on specific topics ranging from basic descriptive statistics to multiple regression analysis, each of which is generally motivated by specific sports-related scenarios or questions. The author wraps up each chapter with two sections that are useful for a more motivated audience. The penultimate section of each chapter, "Computation," describes how one might implement a few of the chapter's concepts using Microsoft Excel's Analysis ToolPak. The final section of each chapter provides the reader with additional statistical/analytical references in "Suggestions for Further Reading."

To get a better feel for the book's structure, I will describe Chapter 4 on Statistical Methods in minor detail. Following the Introduction, the concept of "Margin of Error" (ME) is explained in Section 4.2 using an example from the National Football League (NFL). Examples from the National Basketball League (NBA) and Major League Baseball (MLB) are used to describe ME for means and proportions, respectively, in Section 4.3. Bootstrapping is introduced in Section 4.4 (NBA and Kevin Durant example), a more detailed example is given in Section 4.5 using NFL quarterback passer ratings. Section 4.6 uses points-per-game data from Kevin Durant and Lebron James (NBA) to illustrate the ME for differences and ratios. Statistical significance is discussed in general (Section 4.7) and in the context of means and proportions (Section 4.8) using examples from MLB. The authors discuss how to adjust for playing conditions (e.g., playing conditions, coaches' decision, etc.) in Section 4.9. I was pleased to see the author highlights the difference between random sampling and most sports data in Section 4.10 (NBA example). This is often overlooked when applying traditional statistical methodology to the sports world. The aforementioned sections on computation and further reading round out the chapter.

My only criticism of the book is the choice of using the Analysis ToolPak in Excel for computation. A choice of R, python, or something similar would be ideal for these types of problems. In addition to data analysis, the motivated readers could use one of the more sophisticated languages to scrape (automated data acquisition) data from the various resources on the author's website.

In summary, the book is extremely well written and includes a multitude of tools for someone interested in quantitative methods in sports. I would highly recommend the book for the audiences described above and, in particular, someone teaching introductory statistics who needs motivating examples for his/her course(s).

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Applied Meta-Analysis for Social Science Research.

Noel A. CARD. New York: The Guilford Press, 2011, xvi + 377 pp., $69.00 (H), ISBN: 978-1-60918-499-5.

Noel Card's *Applied Meta-Analysis for Social Science Research* offers a pragmatic guidance to social science researchers who are interested in conducting meta-analyses to combine and make sense of results from multiple studies on a given research question. The book is organized by the key steps of research synthesis, starting with formulating the research question, searching for and identifying relevant studies for inclusion, coding, and appraising the quality of the included studies, and analyzing, interpreting, and reporting the findings. Given the complexity of meta-analysis, the book discusses in depth several advanced topics including computing effect sizes, estimating and explaining statistical heterogeneity, performing a meta-regression, fitting a fixed-effect, random-effects, or mixed-effects model, as well as conducting a multivariate meta-analysis. The author also discusses threats to the validity of a meta-analysis such as publication bias.

Chapters 1, 2, and 3 provide an overview of the key steps to obtain data needed for a meta-analysis. Specifically, chapter 1 briefly introduces the history, concepts, and terminologies used for meta-analysis. Chapter 2 discusses the types of research questions that can be answered through meta-analysis and how to formulate an answerable research question. Chapter 3 describes the literature search procedure and how to identify studies that meet the inclusion/exclusion criteria. Here, the author emphasizes the importance of conducting a comprehensive literature search to minimize the impact of publication and reporting bias, for example, by searching electronic databases, bibliographical references, as well as unpublished work (e.g., dissertations, conference programs, research registries).

Chapter 4 focuses on how to collect and code data from included studies for use in meta-analysis. It provides examples on the study characteristics to abstract and shares his experience of quality assurance and control procedures.

The remaining of this book, Chapters 5 to 12, is devoted to the analysis and interpretation of results. Chapter 5 provides an in-depth discussion of effect size computation, its standard error, and transformations relating to Pearson correlation coefficient, standardized mean difference, and odds ratio, the three commonly used indices for effect size. Chapter 6 describes the artifact correction, and the arguments for and against its use. The author discusses different corrections for unreliability, imperfect validity, artificial dichotomization, and range restriction. Chapter 7 presents more complicated indices within the framework of univariate meta-analysis such as mean, proportion, standard deviation, and the contrasts of these indices between two groups. This chapter also covers indices from regression models such as regression coefficients, semipartial correlations, and longitudinal change scores.

Chapters 8 to 11 describe the steps for combining and comparing effect sizes. Specifically, Chapter 8 thoroughly introduces univariate fixed-effects meta-analysis. It covers the estimation of the mean effect size, its precision, as well as measures of statistical heterogeneity, where both Q and I2 statistics are covered. The author also provides a good example of calculating and interpreting both heterogeneity statistics, and a subsection on the statistical power in testing heterogeneity. In the last subsection, he discusses commonly encountered problems where the key assumptions of meta-analysis are unlikely to hold. Chapter 9 introduces moderator analysis, an important tool to explain statistical heterogeneity. The goal of the moderator analysis is to identify characteristics of the studies that are associated with higher or lower estimated effect sizes. The author introduces how to analyze categorical or continuous moderator before providing a general multiple regression framework. He also introduces structural equation as an alternative approach to moderator analysis. Building upon the fixed-effects model described earlier, chapter 10 covers random-effects meta-analysis and mixed-effects meta-analysis. It contrasts the two models in estimation, inference and associated moderator analysis. The author also introduces a structural equation approach for random and mixed-effects models. He concludes this chapter by discussing considerations in model selections. Chap-

ter 11 discusses a critical form of bias that could negatively affect meta-analysis: publication bias. It provides a nice visual illustration of publication bias and its impacts on distribution of observed effect sizes. The author then describes six approaches to deal with publication bias including moderator analysis, funnel plot, regression analysis, failsafe N, trim-and-fill method, and weighted selection model-based approach. He illustrates how results from these methods should be regarded as a mean of evaluating the robustness of finding from published studies. In Chapter 12, the author introduces several multivariate meta-analysis models including the meta-analytic structural equation modeling approach and the generalized least squares approach.

Card concludes his book by Chapter 13, where he provides concrete, step-by-step guidelines for presenting meta-analytic results. Understanding the goals and the audience for the meta-analysis is the key to effective communication. He provides specific suggestions on each section of a meta-analysis report, and describes how tables and figures can be used to effectively convey the main meta-analytic results. This chapter is completed by 10 common problems in reporting meta-analytic results and how to avoid them.

Although meta-analysis originates and found its permanent place in social science as early as 1970s, it has undergone rapid development in medicine and healthcare research. There is a parallel line of literature on systematic review and meta-analysis methodology in medicine that complements the content of this book. In summary, the author is to be applauded for writing in a friendly and nontechnical style, and organizing the contents in an accessible manner. Technical details and theories are accompanied by illustrative examples and annotated equations. Card shares his extensive personal experience, gives advices, and offers alternative approaches that link to the literature and the field. The book can serve as an excellent handbook for graduate students and researchers wanting to conduct a meta-analysis in social science.

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Foundational and Applied Statistics for Biologists Using R.

Ken A. AHO. CRC Press/Taylor & Francis Group, 2013, xxi + 596 pp., $69.95 (H), ISBN: 978-1-4398-7338-0.

The wide range of applications of statistics in many other disciplines leads to interesting questions about how to teach statistical material to students whose primary interest lies elsewhere. What are the primary learning outcomes we seek to achieve? What background can (and cannot) be safely assumed? What is the relative importance of breadth of exposure to statistical methods and depth of understanding of the methods presented? How does statistics fit into the rest of the curriculum? How important are domain-specific datasets and motivations? Who should teach (or write textbooks for) these courses? Many other questions could be added to the list.

Answers to these questions become even more important when one considers the extreme pressure statistics education is under. Faculty in many of our client disciplines believe that statistics is vitally important in their field and wish they and their students knew more statistics and could apply it more thoughtfully. Yet the amount of time available for focused training in statistics is severely limited. In the United States, most science students take at most one semester of statistics, and the topics covered in that semester fall far short of the breadth of statistical methods used in their disciplines.

There are many indications that our current approaches are not entirely successful. A 2012 proposal in the *Journal of Chemical Education* (Schlotter 2012, subsequently summarized in *Science*, McCartney 2013) presents a disheartened view of the statistics chemistry students are capable of and calls on chemists to develop and integrate a statistics curriculum within the undergraduate chemistry courses. Earlier in the millennium, the influential *Bio 2010: Transforming undergraduate education for future research biologists* (National Research Council 2003) made a more general call to improve training in the mathematical and information sciences for biologists.

Into this context, ecologist Ken Aho presents a book with the challenging goal of introducing a wide range of statistical topics to a biological audience and to do so building upon a solid conceptual foundation.

> Statistical texts and classes within biology curricula generally ignore or fail to instill foundational concepts. ...In this book, I have attempted to bridge the gap between statistical foundations and the myriad statistical applications available to twenty-first century biometrists. (p. xix)

This is made even more challenging by attempting to address a diverse audience: "both introductory and graduate-level biostatistics courses can be taught using this book" (p. xx).

The book is divided into roughly equal halves labeled *Foundations* and *Applications*, but both applications and foundational material are introduced throughout the book. The first section covers discrete and continuous probability models, basic inference, sampling, and experimental design. The second includes a wide range of methods organized into four chapters: Correlation, Regression, Anova, and Tabular Analyses. The coverage is broader than the chapter titles might suggest. The regression chapter, for example, includes sections on multiple regression, robust regression, polynomial regression, weighted regression, power calculation, GLMs, random effects models, nonlinear models, and smoothers.

The pace is brisk, often encyclopedic. The table of contents has nearly as many entries as the book has pages. Most topics are covered in fewer than two pages, many in less than a page. As expected, the examples are nearly all biological. Both the examples and foundational material are amply cited for the reader who wants to know more; the 20-page bibliography includes nearly 500 items.

As the title suggests, R is used throughout the text. The accompanying R package (`asbio`, available on CRAN) includes 89 datasets and more than 250 functions, including nearly 100 that provide point-and-click interfaces, often to some sort of visualization. The `book.menu()` function collects all of these into a menu-driven suite, organized by chapter. Based on a modest sample, it appears that some of these are nicely done, but most perform a specific task (some merely drawing a fixed figure) and are not very flexible. They serve more to illustrate examples from the book than to serve one's own data analyses. An introduction to R and most of the code used to produce figures and analyses in the book are provided as online supplements.

The use of R in many ways matches the style of the book. The goal appears to be to get to as many things as possible rather than to systematically develop students' ability to use R. The book clearly demonstrates the power and flexibility of R to handle a wide range of tasks and analyses, but most of the R code is presented with little or no explanation. In addition, some of the coding choices are baffling, like the frequent reference to variables in data frames by column number rather than by name, and the author's inclination to use dots in the names of functions that are not methods.

Is this the correct approach for teaching biologists statistics? Having been trained in mathematics and statistics, I am not entirely qualified to answer. Likely different biologists would disagree about which statistical topics are most important to include in the statistics curriculum for their students, but I suspect few would be unhappy if their students had mastered the topics selected by Aho, although it would take most students much longer than a semester to learn all of this material.

The level at which things are presented is unusual: higher than the typical Intro Stat or Stat 2 course, but not at the level of an undergraduate "mathematical statistics" course. Unfortunately, this text would be too challenging for most undergraduate biology majors in the U.S., many of whom would lack sufficient background in calculus and comfort with mathematical notation. On the other hand, it is unlikely to be attractive to other disciplines. The foundation is not solid or deep enough to use in an undergraduate mathematical statistics course, and other disciplines would prefer a different set of applications and datasets. The most suitable audience would seem to be the mathematically comfortable biologist who has already had a substantial introduction to statistics and wants to learn more.

Many important statistical concepts receive mention, but most of the claims made are stated with little motivation or explanation (but typically with a reference to the literature). Worse, some of the claims and motivating discussions are not entirely correct. The explanation for the degrees of freedom in a simple linear regression model, for example, does not explain what degrees of freedom

are, but does include the claim that "MSE has $n - 2$ degrees of freedom ... because estimation of two parameters (μ_Y and μ_X) is required to estimate σ^2. (p. 327)" This despite the author clearly emphasizing that the X's are considered fixed in this model (so μ_X is not estimated) and including a later section on models where the X's are not considered to be fixed. Other explanations, whether correct or incorrect, are similarly terse.

The book also generally struggles to give clear and correct definitions and often conflates related but distinct terms. In the foundational material on random variables, for example, random variables are allowed to have nonnumerical values and are often conflated with their pdfs. Discrete prior distributions are conflated with the probabilities of this distribution, which leads to repeatedly referring to the latter as "priors" when there is only one prior distribution being discussed. "Independent outcomes"—whatever that might mean—is repeatedly included in the definition of pdfs for univariate continuous random variables, but the important assumption that the numerator and denominator in the definition of a t-distribution must be independent is omitted.

The order of presentation seems best suited to a reader who knows more than the book claims to presume. In Chapter 3, for example, various distributions are presented and their means and variances discussed, but it is not until Chapter 4 that the moments of a random variable are defined, at which point properties of expectation (such as the expected value of a sum is the sum of expected values) are used without comment or justification. These properties are listed (still without justification) later in the chapter (where covariance appears without definition) and in an Appendix (where the assumption of independence is omitted in the claim that the expected value of a product is the product of expected values).

Laying a more solid foundation may not be the primary concern of the author or of instructors who might select this book. But much of this could easily be improved, is distracting for the knowledgeable reader, and has the potential to confuse the novice. There are genuine and difficult questions about how much foundational material should be included for this audience, about which statements to make with and without presenting a justification, and about how to suitably motivate key definitions and concepts. But the foundation should be correct and its presentation clear and consistent. It is unclear how a foundation that cannot support the type of understanding that the author claims is so important for practical work.

In the end, it seems that this text does a better job of presenting "myriad statistical analyses" than of "instilling foundational concepts." This is unfortunate because both are important. I had a similar response to Whitlock and Schluter (2009), another biostatistics text written by biologists (but at a lower level). The fact that biologists are writing statistics books that have strong points but also disappoint in similar ways indicates that there is some disconnect between the statistical and biological communities regarding how to provide statistical training to biologists.

In a response to McCartney (2013), Davidian and Kutal "applaud the recognition of statistics as a 'core skill'" and "welcome the opportunity to look for ways to meet the statistical needs in the chemistry curriculum through collaborations between statisticians and chemists (Davidian and Kutal 2013)." Similar collaborations are needed between statisticians and educators in a wide range of client disciplines. We have not yet converged on best practices for developing important statistical skills for students in the natural and social sciences. It seems unlikely that we will do so without active collaborations involving both statisticians and other scientists, each of whom have important experience, knowledge, and perspectives to contribute.

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Handbook of Ethics in Quantitative Methodology.

A. T. PANTER and Sonya K. STERBA (eds.). New York: Routledge/Taylor & Francis, 2011, xix + 519 pp., $77.95 (P), ISBN: 978-1-84-872855-4.

Ethical considerations lie at the heart of both statistical practice and scientific conduct. In the academic setting, these considerations are laid out by Section 7009 of the America COMPETES (Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science) Act (42 U.S.C. 1862o–1), which requires that "each institution that applies for financial assistance from the (National Science) Foundation ... describe in its grant proposal a plan to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduate students, graduate students, and postdoctoral researchers participating in the proposed research project." (*https://www.govtrack.us/congress/bills/110/hr2272/text*). In November 2009, the National Institutes of Health (NIH) stipulated that those proposing to train new scientists with the support of federal funds must document their training plans for the responsible conduct of research (RCR) for these trainees. Faculty and post-doctoral scholars who are supported by federal funds must also articulate training plans, and can satisfy this requirement by *teaching* these courses or *providing* this training (*http://grants.nih.gov/grants/guide/notice-files/NOT-OD-10-019.html*). The National Science Foundation (NSF) instituted similar requirements in January 2010 (*http://www.nsf.gov/pubs/policydocs/pappguide/nsf10_1/aag_4.jsp*).

To augment the 35% of universities in the United States that require ethics content for at least some students (for the 2013–2014 year; Lee, McCarty, and Zhang 2015), instructors and faculty in statistics and quantitative sciences may seek books supporting a course that can meet this requirement and address key topics (*http://grants.nih.gov/grants/guide/notice-files/NOT-OD-10-019.html*):

- conflict of interest—personal, professional, and financial
- policies regarding human subjects, live vertebrate animal subjects in research, and safe laboratory practices
- mentor/mentee responsibilities and relationships
- collaborative research including collaborations with industry
- peer review
- data acquisition and laboratory tools; management, sharing, and ownership
- research misconduct and policies for handling misconduct
- responsible authorship and publication
- the scientist as a responsible member of society, contemporary ethical issues in (biomedical) research, and the environmental and societal impacts of scientific research.

One recent book that might be considered is the *Handbook of Ethics in Quantitative Methodology*, co-edited by A. T. Panter and S. K. Sterba (2011). This was compiled to provide "explicit linkage between ethics and methodological practice in the social sciences" (p. 2). The editors model this work on the 1999 revision of the American Statistical Association (ASA) Ethical Code of Professional Practice, articulating the purpose for the *Handbook* as being "...to open up a similar dialog among quantitative psychologists..." (p. 7). The editors have organized the essays in the order that graduate students in quantitative psychology or social sciences might follow in contemplating and making decisions about research designs, data collection, data analysis, and data reporting/publishing as they learn about research and statistics.

Section I of the *Handbook* comprises two chapters, representing the development and evolution(s) of the ASA Ethical Guidelines for Professional Practice (1999) and the ethical code for research/researchers published by the American Psychological Association. Both of these chapters are rich in ethical frameworks, although they do not provide as formal an introduction as would a course dedicated to ethics. Section II is an excerpt from (and has the same title as) the 2012 book, *A Statistical Guide for the Ethically Perplexed* (see below), by Hubert and Wainer. Section III discusses ethical considera-

tions in a variety of design questions, including the selection of outcomes (relating to their measurement properties); sample size planning; choosing randomized experimental or quasi-experimental designs; the choice, uses, and interpretabilities of psychometric (modern and classical measurement theories) models; and program evaluation. Section IV is focused on ethical considerations in the selection, application, and interpretation of a variety of analytic methods (sampling and its incorporation into statistical modeling and the final report of a study; an argument for the use of parameter estimation and confidence intervals instead of the null hypothesis significance test—which is characterized as unethically bad science; ethical issues in the use and interpretability of factor analysis and multilevel modeling; the importance of missingness; and the science and ethics of causal modeling). Section V focuses on issues in and around reporting and communication of findings.

Sections III and IV could be interesting and important material for a consulting class for graduate, and possibly advanced undergraduate, statistics students. These chapters contextualize the decisions that social scientists are making when they design, analyze, and report their work—and so may be useful preparation for statisticians and quantitative scientists who collaborate with social and biomedical scientists. The first three chapters (plus the introduction) provide some orientation, but can be skipped in favor of chapters 6–14. These nine chapters could be used for a semester course, although they do not flow naturally. The chapters are long and rich; and were written independently. As such, each might *not* be very well covered in a single meeting. These chapters could augment a consulting course, but the *Handbook* would be very difficult to use in a course intended to meet the NIH or NSF requirement for training in RCR. Conflict of interest; mentorship; the identification and reporting of misconduct; intellectual property; and human and animal subject considerations are not addressed; the scientist's role in society is only obliquely addressed in the two chapters of Section I.

A Statistical Guide for the Ethically Perplexed (Hubert and Wainer 2012) has a different purpose. It seeks to provide *motivation* for "the typical first-year graduate student in a social, behavioral, or health-related program who might be struggling with the required statistics sequence" (p. xi). The text contains diverse examples where probabilistic and statistical "reasoning" or argumentation were used—sometimes correctly and many times incorrectly—to demonstrate that statistical literacy is a critical skill for decision making in virtually every facet of nonstatistical life. Importantly, Hubert and Wainer explicitly defined "ethical" for their purposes: ". . .being in accordance with the accepted rules or standards for right conduct that govern the practice of some profession." (p. 1). Moreover, the purpose of the book is to "provide a context where (statistical principles) can be used to reason correctly, and thus, ethically." (p. vii). These two statements underscore the incompatibility of this book with the NIH and NSF requirements for "training in RCR": "ethical" is equivalent to "according to standards of the profession" (not statistics) and "correct reasoning" is equivalent to "ethical reasoning." A course based on this book would not meet RCR training requirements for students *or* faculty.

Neither of these books support RCR training required by NSF or NIH; the *Handbook* might be of interest to the practitioner initiating social science collaborations, while the *Guide* might provide useful ancillary reading in some undergraduate statistics courses. The *Handbook* editors also suggest that journal editors and reviewers might find the book useful, but a much better reference for these readers would be *The Reviewer's Guide to Quantitative Methods in the Social Sciences* (Hancock and Mueller 2010).

An excellent text for a course that meets the NIH and NSF requirements for training is *On Being A Scientist* (*http://www.nap.edu/openbook.php?record_id=12192*), published jointly by the National Academy of Sciences, National Academy of Engineering and Institute of Medicine (3E, 2009). The subtitle of this extremely accessible, very well-written monograph (82 pages) is "A guide to responsible conduct in research" (emphasis added). A critical aspect of this book is that it focuses on the behavior (conduct) of the scientist participating *in* research, rather than appearing to, or actually, focusing on the conduct *of* research. In its preface it is described as providing ". . .an overview of the professional standards of science." It includes at least one case per key topic, with a guide to the discussion of each case in the Appendix. Even the casual reader who is interested in initiating or refreshing their understanding of the key topic areas comprised in "responsible conduct of/in research" would benefit from this book. For the instructor, each case includes 2–4 questions for discussion, and there are several pages of additional resources (e.g., books and articles on each topic; and guides to "the responsible conduct of research"). This monograph would be an excellent starting point for a semester course in "responsible conduct *in* or *of* research," and provides concrete and useful structure that could accommodate auxiliary cases and materials. This book addresses considerations that arise in the practice of science and the NAP website contains the entire book in .pdf form (free to download), with live links to the URLs for the electronic resources to which the booklet refers. Course developers might consider integrating a formal approach to case analysis, which is not described in this book nor in any of its cited resources. Electronic resources for "ethics case analysis" include the College of New Jersey (*http://www.tcnj.edu/~set/mw-steps.htm*); the Penn State School of Nursing includes a grading rubric example for an ethics case analysis (*http://www.personal.psu.edu/faculty/d/x/dxm12/n458/sample_case_rubric.htm*). While many resources are available, most case analysis methods and examples are based on clinical/biomedical cases. Tractenberg et al. (2014) published two semester course syllabi (articulating case analysis instruction and practice) with which this monograph could be used. Such a course would meet/exceed the NIH and NSF requirements for "RCR training."

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A Handbook of Statistical Analyses Using R (3rd ed.).

Torsten HOTHORN and Brian S. EVERITT. Boca Raton, FL: CRC Press, 2014, xxix + 421 pp., $64.95 (P), ISBN: 978-1-4822-0458-2.

A Handbook of Statistical Analysis Using R delivers just what the title promises. In 21 chapters, it covers a lot of statistical ground. Each chapter focuses on a large statistical area (e.g., analysis of variance, linear regression, quantile regression, missing values) and all the chapters have the same general, friendly, well-constructed format.

Each chapter begins with an introduction and discussion of several datasets along with some motivating questions that one might ask of those data. I truly appreciate how grounded in practicality this book is—and the way its chapters are structured really underlines this. Furthermore, all the datasets are interesting and vary widely in subject matter. If nothing else, this book is an excellent source of examples one might use to illustrate a variety of statistical techniques.

Following the data comes an overview of the methods to be covered in the chapter. These overviews are usually extremely terse (by necessity, given the ambitions of the book) but successfully lay out any relevant models and outline any major concepts. I imagine they would serve as decent reminders of things momentarily forgotten more than a source of learning.

Next comes several case-study analyses using the discussed methodology on the discussed data. Usually each dataset illustrates a different aspect of the methodology. The first covered is usually a basic analysis, and the following

case studies introduce how to handle various complications. All R code is provided, along with code to make relevant plots, diagnostic displays, and statistical summaries. There is genuine effort to focus on how to communicate quantitative information and quantitative conclusions throughout; some of the plots are quite complex and quite nice, and the prose walks through how to make them. For example, in Chapter 7, on logistic regression and generalized linear models (GLMs), the authors show how to make a specialized plot function (p. 133), which they then use extensively for the remainder of the section to show how different models fit the raw data.

As a final, cute touch, each chapter concludes with a summary of any findings of a substantive nature resulting from the analyses of the datasets discussed. Such a flourish again reminds us all that statistics is a tool for inquiry, and is empty without this crucial element of reflection and synthesis.

People frequently express concern that books such as this one enable people with little background to analyze data in a dangerous and haphazard manner. While it is true that this book does provide R code in a variety of case studies that might then be used in a recipe-book like manner, it also raises concerns and discusses subtleties with the presented methods. For example, Chapter 13 discusses the necessary assumptions behind longitudinal modeling, including an introduction to the concepts of missing at random versus missing completely at random, which I appreciated. Overall the book seems to adhere to a mantra of "simple yet aware," but it also provides citations and pointers to more complex approaches. In short, it offers a lot of good places to start if one wants to analyze data.

This is the third edition of the text. A few chapters are new, and this shows somewhat. One of the new chapters, on Bayesian analysis, is a fairly strange yet interesting foray into a Bayesian approach—but it does not discuss more widely known approaches of hierarchical models, nor the all-important role of Markov chain Monte Carlo (MCMC). I would look for a survey of Bayesian statistics elsewhere. The other new chapters (on quantile regression and missing value imputation) are quite nice, but not quite as easy to follow or as cleanly put together as the older chapters. This, I suppose, demonstrates the strength of revision over time.

The book comes hand-in-hand with an R package, HSAUR3, with all the data and the code used in the text. The book is thus fully reproducible. Overall, it provides a great way for a statistician to get started doing a wide variety of things in the R environment. It would be particularly useful, then, for working statisticians looking to change their software. The book cites all the relevant packages one might need, which is quite nice for those attempting to navigate the vast array of packages freely available, and is quite clear in its presentation of the code. Between this and the datasets, it makes for quite a valuable and enjoyable reference.

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Introduction to Probability.

Joseph K. BLITZSTEIN and Jessica HWANG. Boca Raton, FL: CRC Press, Taylor & Francis Group, 2014, xv + 580 pp., $99.95 (H), ISBN: 978-1-4665-7557-8.

Joe Blitzstein has taught Statistics 110: Probability every year at Harvard University since 2006, and *Introduction to Probability* is the textbook that has grown out of this course. Unique in its conceptual approach and its incorporation of simulations in R, this book is a welcome addition to the vast collection of probability textbooks currently available.

Intended for a one-semester undergraduate course in probability, the book assumes the reader is proficient in calculus. Additionally, some familiarity with set theory and matrix algebra is assumed. An appendix that briefly covers prerequisite material is included, as well as an appendix on the R programming language.

From the very start, the authors emphasize the importance and extensive applicability of the study of probability, including examples in statistics, physics, biology, computer science, meteorology, gambling, political science, medicine, and even "life" (p. 2)! Examples throughout the book cover a wide range of applications, including Google PageRank and Markov chain Monte Carlo. The authors stress conceptual understanding of probability, without sacrificing the mathematical rigor of the subject. Focus is on problem-solving strategies and statistical thinking instead of mathematical proofs.

The topics covered in the book follow a fairly traditional order, starting with the probability axioms and combinatorics. Chapter 2 introduces conditional probability and Bayes' rule, including a section titled "Pitfalls and paradoxes" (Section 2.8), which highlights the common confusion of the inverse, in which the probability of A given B is confused with the probability of B given A, as well as Simpson's paradox and confounding variables. The authors move on to random variables and distributions, covering discrete distributions in detail in Chapters 3 and 4 before moving on to continuous distributions in Chapter 5. Chapter 6 is devoted to moments, and joint distributions are introduced in Chapter 7. Transformations and conditional expectation are the subjects of the next two chapters, and then the central limit theorem and other asymptotic results are covered in Chapter 10. The authors end with a few chapters on stochastic processes, including Markov chains, Markov chain Monte Carlo, and Poisson processes.

Each chapter ends with a "Recap" section, followed by an "R" section, then "Exercises." The "Recap" sections not only summarize the key concepts in each chapter, but also build a visual conceptual map of the ideas in each chapter, building on this same diagram in later chapters. These conceptual diagrams are just one of the abundant visualizations that are provided throughout the book to demonstrate important concepts. Particularly useful are the authors' choices of plots used to demonstrate bivariate distributions in Chapter 7.

The "R" sections at the end of each chapter are one of this textbook's most distinctive contributions. Simulation is a powerful tool for learning probability concepts, and the authors take full advantage of this fact. For example, Chapter 1 ends with a simulation of the classic Birthday problem in R. Later chapters introduce the built-in probability distribution R functions, and make use of these functions for further simulations.

The authors have a talent for predicting typical student stumbling blocks, and addressing them before they occur with "Biohazards" comments, preceded by the traditional biohazard symbol (since "making such mistakes can be hazardous to one's health!" (p. 3)). These comments aim to strengthen students' intuition about probability, which can often be counterintuitive. Often, the authors will point out a common mistake within an example, then explain why such a mistake might occur and why it is incorrect. Additionally, the authors sometimes present several different ways of solving the same problem, which exposes the reader a larger set of problem-solving strategies.

At times, the book has the potential to lose nonnative English speakers, with a variety of terms seemingly created by the authors and a wide array of metaphors. For example, the authors introduce a "pebble world" analogy for a sample space, and return to this analogy throughout the textbook (p. 3). "Adam's law" and "Eve's law" are introduced in Chapter 9, which are the authors' names for the two main conditional expectation and conditional variance theorems (p. 395, 401). The reader must keep track of these new names throughout the textbook, as the authors refer back to such topics as the "fundamental bridge" (p. 151) or "LOTUS" (law of the unconscious statistician) (p. 156).

The companion website for this textbook, *stat110.net*, offers supplemental materials to the textbook. There are more than 600 exercises in the textbook, and 250 of these exercises have detailed solutions available on the website. The website offers additional handouts and practice problems and exams, as well as over 30 video lectures available on YouTube or iTunes U. The book is also available as an electronic book.

Overall, *Introduction to Probability* offers a fresh perspective on the traditional probability textbook. Its sections on simulation in R, emphasis on common student mistakes and misconceptions, story-like presentation, and illuminating visualizations, provide a comprehensive well-written textbook that I would consider using in my own probability course.

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Multilevel Modeling Using R.

W. Holmes FINCH, Jocelyn E. BOLIN, and Ken KELLEY. Boca Raton, FL: CRC Press, 2014, xiii + 216 pp., $49.95 (P), ISBN: 978-1-4665-1585-7.

Multilevel Modeling Using R attempts to be a good introductory handbook for analyzing multilevel data. It is pitched at a fairly nontechnical level, provides the specific R commands necessary to run an analysis, and provides some pointers for going further. Mainly the book gives examples of how to run commands in the `lme4` and `nlme` packages to analyze several standard models. Unfortunately, however, various errors and problems undermine these aims.

Books that teach people just how to run code and read the output are sometimes accused of being dangerous. This is one reason I always enjoy discussions of how to visualize and summarize data in such texts; it helps mitigate this danger. *Multilevel Modeling* does this, to some degree, even including an entire chapter on plotting hierarchical data. Unfortunately, however, this chapter does not extend to plotting sample trajectories for time series or other exploratory or diagnostic plots, which is a missed opportunity. Another way to mitigate the danger of cookbook-style texts is to have discussions of how to detect problems such as model misfit. Here, again, *Multilevel Modeling* falls somewhat short: While occasionally present, diagnostics and similar concerns do not feature prominently enough in the text, in my view. In fact, on page 100 the authors go so far as to claim that hierarchical linear modeling (HLM) models can avoid complex techniques for handling missing data—which is true only under a correct model specification or assumptions on missingness, neither of which are discussed.

Another concern I have with the text is *Multilevel Modeling* shows different ways of coding the exact same thing without remark, which could be confusing to the novice reader. The most prominent example of this is that the book uses two packages (`lme4` and `nlme`) for fitting HLMs instead of one. I would have liked to at least seen a discussion of when to use one package or another, but, other than a mention of `lme4` not handling correlation structure for residuals on page 96, and a few other remarks scattered throughout the text, little guidance is given. Perhaps it would have been better to just use the more recent `lme4` package throughout. There are other consistency concerns as well. For example, different ways of making the same plots are used at the beginning of the book and toward the end. There is no need for such redundancy.

I appreciate that in tutorial books much of the technical detail is potentially omitted by necessity, but I believe such books should still include a careful presentation of the core concepts and major concerns. Some of the explanations of such technical detail are a little too terse in this text. For example, in the R community, one area of confusion with HLM packages is the calculation of p-values. In particular, the `lme4` refuses to provide any (for good reasons). This is acknowledged in *Multilevel Modeling*, but is not fully explained. Instead a Bayesian approach to calculate nominal p-values is presented without much context. There is no discussion of what these nominal p-values mean in a frequentist view, and earlier p-values from `nlme` are presented without comment. Furthermore, there are several references to parameters being random throughout the text, which alludes to a Bayesian framework, but without any explicit discussion of that framework. I worry that this could confuse many. (A final chapter does present a more fully Bayesian approach, but I found it to be unclear and at odds with my understanding.)

Many of these concerns may be due the book being a first edition. Also because of this, there are many typos, formatting issues, and errors. For example, there are spaces between the underscores for variable names (e.g., p. 116) and between the double-equals in the R code (e.g., p. 112), both of which could cause a great deal of distress to a novice R user. Many of the plots have empty rectangles instead of points, which I expect is a printing error. There are also some strange math displays, such as on page 47. Some of the plots do not agree with the text, such as a q-q plot on page 20 where points clearly outside the 95% band are presented as showing decent fit. A discussion on inner class correlation does not make it clear whether group size does or does not play a role, with some equations presented with no explanation.

In terms of using the R language, most of the code is fairly straightforward, although there are some strange stylistic aspects. For example, new variables are not stored in their parent dataframes on page 54 and the code for handling missing observations on page 109 seems somewhat baroque. Generally, however, the various commands are explained in detail. There is also some help with data manipulation, which is nice to see in an introductory book.

Overall, the book could potentially be improved a great deal by a second edition. As it stands, it could help someone transitioning to R from some other software to analyze data as they were accustomed. It is easy enough to find very specific things in the text; for example, two and three level models are separately discussed and listed in the table of contents, and specific code is given for each. I can imagine that this could be helpful, and thus the book might be a bit more friendly a tutorial than the traditional R resources such as package vignettes.

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The Norm Chronicles: Stories and Numbers About Danger and Death.

Michael BLASTLAND and David SPIEGELHALTER. New York: Basic Books, 2014, xx + 358 pp., $16.99 (P), ISBN: 978-0-465-08570-5.

The Norm Chronicles is a statistics book directed at a general audience. It has the ambitious goal of making the concept of "risk" graspable to a scientifically interested reader, covering both conceptual/statistical and behavioral/psychological perspectives. This intention is in itself admirable, and the authors deserve much credit for it.

The question that naturally arises is whether this book succeeds in captivating its reader's interest and furthering statistical and scientific literacy; whether it carries the danger of spreading misunderstanding about statistics of which there is truly enough already; or whether it is just one of the many books that a reader will put aside after a few chapters, and forget about ever having looked at it. In my opinion, *The Norm Chronicles* can be either, depending on the reader's expectations and prior knowledge.

As the catchy subtitle "stories and numbers about danger and death" indicates, as well as the choice of calling the book a chronicle, the driving narrative instrument is arguably the most powerful one in human history—stories and anecdotes (statisticians will likely grasp the built-in irony of this). The stories loosely follow, from birth to death, the lives of a trinity of protagonists: Prudence, the personification of irrational fear and avid consumer of quack remedies; an army of isomorphic daredevils called Kevin, Kelvin, Kevlin and so on; and the eponymous (and possibly androgynous) Norm who has the oxymoronic properties of (A) being average in any respect and (B) basing every decision on pure reason.

The book consists of chapters from "1. The Beginning" to "27. The End" with names such as "15. Transportation," "8. Sex," "23. Surgery," or "4. Nothing," each treating a different topic of risk in the public perception. Every chapter starts with some anecdote from the (semi-)fictional lives of the protagonists, thematizing an everyday instance of the topic covered, continuing with a series of collected statistical facts and a discussion. The chapters can be read and appreciated in any order, with the exception of the first ones that are required for understanding the rest due to concepts introduced there.

Narrative-wise, the stories are rather quirky and humoristically entertaining, most notably when medicine students drop an upright piano on a professor of social cognition Kevin. Unfortunately, Prudence, Norm, and the Kevins are rather stereotypical in their roles; they do not gain much profile over the course of narration, remaining colorless clowns of their own, implausible kind. While the authors say in the last chapter that the three protagonists are meant to be facets of every human being, they rarely interact with each other—usually only one appears per chapter—nor do they debate their views on life, reconcile, or show signs of character progression. The only major exception is when Norm recognizes his own absurdity at the very end. If the book would have had only a little bit more of Terry Pratchett whose characters are able to transport deep and serious topics with ease by being likeable, humorous and believable, or a little bit more of Platon whose vivid dialogues prevent the reader from choosing a side and instead allow them to see multiple and possibly new sides of an argument—I think much potential has been squandered here. On a related note, when reading about multiple Ke(l|v)*ins in the first chapter, I was convinced that their narrative destiny was to die over the course of the book in gruesome, hilarious, and statistically unexpected ways. As that never happened (even the

piano misses), I really wondered why there had to be such a confusing multitude of them.

The scientific content consists, mostly, of a series of facts and statistics that are tied to the chapters' theme and loosely relate to the stories and anecdotes. For example, chapter "8. Drugs" starts with Prudence drinking tea and one of the Kevins taking drugs, then an overview of the history of mind-altering substances and their perception in the public, then a list and discussion of statistics regarding drug use in the general population and the associated risks. In all chapters, the presented facts are well researched, every relevant claim in the book is backed up by a careful selection of citations (which a random check indicates to be scientifically appropriate). This is rather impressive since proper citation work is very rare for a book of nonfiction, and furthermore the sheer number of facts collated from different sources is huge.

One ingenious tool the authors use to make the numbers on expected risk graspable to the reader is the so-called micromort, the quantity originally defined by Ronald A. Howard (1984) as a one-in-a-million chance of death, and the related concept of a microlife, the infinitesimal loss of 30 min of life expectancy, introduced by one of the authors, David Spiegelhalter (2012); the micromort and the microlife constitute the main form of information throughout the book. The two wheels of fortune on the cover illustrate well which kind of information is presented—the bottom left one displays the average number of micromorts associated with the activity (per event/per year), the top right wheel displays the loss/gain of microlives (per event/per day). Especially seeing this kind of information collated in a directly comparable way makes the statistical parts of the book a very enjoyable read for the scientifically educated and scientifically interested reader (I would suspect exactly the type who also likes to read random pages on Wikipedia).

However, it must be said that in parts the selection of presented facts is very troubling, in the sense that the authors appear to selectively miss presentation of facts that would be practically relevant to decisions in the readers' everyday lives. To name three examples:

Chapter "18. Transportation" (and a small part of "5. Accidents'') talks broadly about the statistics of accidents for planes, trains, and on the roads; it talks about the development of road deaths over time and the psychological differences in risk perception between driving and being a passenger. But it does not explain how respecting speed limits, wearing a safety belt, or not drinking reduces the risk of death—for the driver and for others.

Chapter "6. Vaccination" talks about the history of vaccination and then continues with a discussion that at best one could call convoluted, at worst outright misleading. It fails to do what the book seems to have been building up to—namely, to give an exact number of micromorts avoided. The main empirical argument in favor of vaccination is that this quantity is big: a fatality attributable to say measles of roughly one in 100–1000 (=1000–10,000 micromorts) in an unvaccinated population greatly exceeds the fatality of measles vaccination, which is below 1 in 100.000 (=less than 10 micromorts). While the case fatality of measles appears, one waits in vain for the argument to be clearly presented. Instead, one reads fluffy sentences of the type "this makes reliable numbers about the disease risks that you face as an individual impossible to calculate," which is a contextual half-truth, and sentences such as "But there is no denying that vaccines can have side effects" that may mislead the reader, similarly to the unclear discussion that ensues.

Chapter "8. Sex" talks broadly about the risks of contracting a sexually transmitted infection (STI) depending on social factors, sexual orientation, sexual practices, and personal risk perception. It also explicitly presents numbers regarding AIDS/the HI virus. Protection is briefly mentioned, but it is not clearly said that proper use of condoms effectively prevents transmission of the HI virus and greatly reduces risk of STI, nor are the relevant statistics presented—even though the chapter would have provided the perfect opportunity to do so, including an explanation of how an empirical argument in favor of protection can be obtained from the numbers.

The above issue of omitting vital information is in my opinion not only a missed opportunity to enlighten the reader about empirical argumentation and scientific reasoning, but outright dangerous. A reader who is not familiar with the numbers omitted—and that may mean the vast majority of potential readers—will completely miss out on these crucial facts. Even worse—but consistent with the omissions—the authors say in chapter "27. Judgment Day": "We don't know how to use data to tell them [the protagonists, and by extension the reader] how to live." In the following, this turns into an argument for philosophical and scientific relativism—even though the authors explicitly claim it is not (p. 310. As a side note, I often wonder about the phenomenon of people announcing a strange thing they say by saying that they are not saying it. "I'm not a racist but," "I don't believe in conspiracy theories but," etc.).

As if all the scientific facts presented previously were just like a pretty afternoon tea, the numbers being an entertaining cross-word puzzle framed by a little bit of pseudo-intellectual, idle chit-chat—but this is disastrously wrong.

Statistics *is* the quantitative part of science, which *does exactly know* how to use data to tell the factually wrong from factual truth, and the empirically decidable from the philosophically disputable. In this pragmatic sense, statistics *is very well able* to tell one how to live, given personal philosophical and ethical beliefs—and *is* in fact, by definition of what science constitutes, the *only* way to reliably do so.

It is not subject to philosophical interpretation how many people die (in expectation and on average) on the roads when there is no speed limit—statistics and empiricism tell that the matter of belief lies in whether their deaths are worth the personal freedom of driving at the speed one likes.

It is not subject to philosophical interpretation how often having unprotected sex leads to illness and death of either partner—statistics and empiricism tell that the matter of belief lies in whether not using a condom is worth these risks.

It is not subject to philosophical interpretation how many children die when they are not vaccinated—statistics and empiricism tell that the matter of belief lies in whether their deaths are worth the personal freedom of not having them vaccinated.

The authors opine that this is not the case by saying that "the objective numbers can't be separated from subjective perception" (p. 310, paragraph 2), confounding one of the principal tenets of modern empiricism, namely, that knowledge is always tentative, with a crude type of subjective relativism that is maybe best paraphrased by "every interpretation of the data is correct in its own, special way." This belief is, technically and philosophically, not even wrong. From a pragmatic perspective it is a heap of nonsense—especially since a reader who is not a philosopher may easily read this as that the numbers do not really matter—therefore getting the completely wrong impression that statistics is arbitrary anyway, thus practically useless.

To summarize, I think that *The Norm Chronicles* can offer a varying experience depending on the expectations to it, as said in the beginning. A reader who is not seeking life advice and who is scientifically educated may have an excellent time going through all the collated facts. A casual reader may be entertained by the facts and the humorous stories, and/or be put off after a while by the flat characters and the numbers raining from the skies at constant pace. A reader who is—deliberately or unintentionally—seeking answers to everyday questions such as "should I use a condom" or "should I vaccinate my children'' (this is the type of reader to which the cover text seems to try to appeal) may experience or cause an unexpected loss of microlives and scientific literacy.

I am honestly sad that I have to say this last bit, since I think that *The Norm Chronicles* could have easily been one of the books that the world really needs—considering how public discussions, especially regarding sensitive topics such as protection during sex or vaccination, are often lacking empirical reason; and considering how the endeavor to convey a proper empirical argument to the public can be quixotic in the presence of people shouting around their random beliefs.

David Spiegelhalter should be familiar with this phenomenon, at least since the "Paul the Octopus" affair of 2010. Thus, it might be realistic to hope for a second edition that provides a more careful treatment of the parts that could be considered life advice, and where the questionable relativism is replaced by a clear explanation of the importance of statistics for practical decision making.

Until then, to the reader of this review who is looking for an entertaining vector of empiricism and scientific reasoning to gift-wrap, I would recommend Ben Goldacre's (2008) excellent book *Bad Science* (which in reality is, of course, about good science, and entirely Kevin-free).

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Randomised Response-Adaptive Designs in Clinical Trials.

Anthony C. ATKINSON and Atanu BISWAS. Boca Raton, FL: CRC Press, 2013, xvi + 323 pp., $94.95 (H), ISBN: 978-1-58488-693-8.

In recent decades, the so-called adaptive design of clinical trials has received increasing attentions, in both methodology and implementation. In drug development, adaptive designs often consider a prospectively planned opportunity for modification of one or more specified aspects of the study design and hypothesis based on analysis of data collected on subjects in the study (Food and Drug Administration 2010). One particularly important consideration arises with randomized response-adaptive designs with adaptive treatment allocation of patients in clinical trials. In *Randomised Response-Adaptive Designs in Clinical Trials* (2013), two leading experts in the field, Drs. Anthony Atkinson and Atanu Biswas, provide an excellent textbook on this important topic. In general, the book is well written, is easy to navigate, and is definitely consistent with the high quality of other books in Monographs on Statistics and Applied Probability series by CRC Press.

The book starts with an introduction (Chapter 0) overviewing a number of clinical trial examples to be discussed in later chapters, as well as the basic concept, advantages, and controversies of randomized response-adaptive designs (Chapter 1). Following these conceptual introductions, Chapter 2 surveys methods for normally distributed outcomes and formally introduces fundamental concepts such as randomization and covariate balance, as well as the metrics that can be used to compare strategies. The book then naturally expands to more important methods and response-adaptive designs for binary outcomes (Chapter 3), continuous outcomes (Chapter 4), and binary/continuous longitudinal outcomes (Chapter 5). Methods for randomization and balance over treatment allocation, as well as various important optimum response-adaptive designs are further expanded to incorporate covariates in Chapter 6 and Chapter 7. Chapter 8 further considers the optimal response-adaptive designs with constraints, which aim to balance two conflicting objectives in clinical trials: the need to improve the precision of estimated treatment effects (statistical optimality) and skewing the allocation of treatment toward better outcomes (ethics). While the book largely takes a frequentist perspective, Chapter 9 also briefly surveys some recent development including Bayesian adaptive designs and group-sequential adaptive designs.

In summary, the authors provide a well-structured and clearly presented textbook on randomized response-adaptive designs. Depending on the reader's familiarity of the topic, she may choose to start from the very beginning to gradually comprehend the entire presentation, or refer directly to particular chapter(s) for a more targeted review. Because the book offers a well-balanced mix of practical applications and theoretical results, a wide range of readers, from graduate students to applied statisticians with solid mathematical background will find the book useful. Readers may find the authors' emphasis on the use of simulation methods to compare methods particularly useful. This being said, this book does not provide a hands-on tutorial for software designed for specific methods and designs. Instead, it focuses on explaining the mathematics behind various methods and designs so that the readers can understand how they work and why different behaviors arise under different scenarios. As this book largely takes a frequentist perspective, those looking for a more comprehensive summary of the filed may wish to use it in conjunction with another more Bayesian sources.

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Statistics in Action: A Canadian Outlook.

Jerald F. LAWLESS (ed.). Boca Raton, FL: CRC Press, 2014, xxiii + 360 pp., $99.95 (H), ISBN: 978-1-4822-3623-1.

Statistics in Action is a volume of interesting and highly accessible articles published by the Statistical Society of Canada to celebrate 2013, the International Year of Statistics (*http://www.statistics2013.org*). Its purpose is to show the extraordinary diversity of statistical techniques in the modern world, from applications in the physical sciences, technology, medicine, public health, through the social and behavioral sciences, economics, business, and finance. In spite of the breath of its application, the influence of statistics is often overlooked by political leaders and the public. This volume makes an effort to highlight contributions of Canadian statisticians and is intended to complement such books as *Past, Present, and Future of Statistical Science* (Chapman & Hall/CRC, 2014), a volume commissioned by the Committee of Presidents of Statistical Societies (COPSS) for its 50th anniversary and the International Year of Statistics.

There are several unique features of this book. The first is captured by the subtitle "A Canadian Outlook." The book reviews the development of statistics as a discipline in Canada (Chapter 1) and the substantial contributions to the discipline of statistics made by Canadians working at Statistics Canada (Chapter 2), at other Canadian agencies, and at universities both in Canada and abroad. It also covers topics that have particular importance to Canadians, including, for example, environmental issues such as endangered species and climate change; healthcare issues such as survival times after organ transplantation or onset of dementia and genetic factors associated with human diseases; and agricultural issues such as forecasting crop yields. Above all, the authors have done a remarkable job of describing the current state of their art and bringing the reader to the cutting edge of research in a way that is understandable even to those readers without a specialization in statistics.

The book begins by tracing the development of statistics as a discipline in Canada, followed by a review of some major contributions to survey methodology made at Statistics Canada. This is followed by an explanation of the role of functional data analysis in understanding the growth of children. Chapter 4 concerns the important topic of modeling dependence through copulas, and how using models with unsuitable tail dependence was linked to the 2008 financial crisis. One message is that seemingly unglamorous models for dependence among investments and loan and insurance contracts really do matter, in this case critically.

Chapters 5, 6, and 7 concern computer-intensive techniques for handling data: how a few important variables can be found among a proliferation of possible factors, how Markov chain Monte Carlo (MCMC) samplers can be optimized, and how we can study complex phenomena such as volcanic eruptions or climatic variation using large-scale computer models. Chapters 8 and 9 describe how Bayesian statistical methods are used to look for genetic factors associated with human diseases or traits.

Chapters 10 through 14 concern problems in medicine and public health. For example, Chapter 11 describes a study that evaluates the safety and efficiency of zoledronic acid for treating malignant bone disease arising from a range of primary cancers. Measurements of two markers were taken while subject were enrolled in the study to determine the prognostic value of the marker measurements and how they vary over time and with treatment. The author concludes that marker values can play an important role in understanding disease processes, evaluating treatment effects and predicting the course of disease, and thereby guiding therapy.

Chapter 12 concerns data from a Canadian study on health and aging, and deals with the progression of dementia among elderly Canadians. Commonly, when cases are identified with a cross-sectional survey, the survival times are both censored and length-biased. The study included a follow-up 5 years later

for those subjects who had originally been determined to be dementia-free. The article discusses adjustments to the nonparametric estimates of the survivor function of persons with dementia to remove this bias. This corrected survivor function is then used to determine an adjustment to the estimated incidence of dementia.

Chapter 13 discusses the use of *Scientific Registry of Transplant Recipients* data to assess the effect of using *Expanded Criterion Donor* (ECD) kidneys. Kidney transplants have been demonstrated to be superior to kidney dialysis in terms of patient survival but the continuing shortage of suitable kidneys has prompted the use of ECD kidneys that are more available but associated with somewhat poorer outcomes after transplant. The authors' objective is to compare higher-risk ECD kidneys with conventional therapy. The analysis indicates that mortality with ECD kidney transplant is significantly reduced over the conventional therapy.

Chapter 14 deals with an issue of rapidly increasing interest among healthcare administrators and the general public: oversight of the health care process through measurement and monitoring of outcomes. Because of the inherent uncertainty in these outcomes, ideas are borrowed from statistical process control, but with the added challenge of careful risk-adjustment.

Chapter 15 discusses the application of statistical methods in finance. Chapter 16 covers another topic of extreme importance in the internet age: the methods used in e-commerce to make personalized recommendations, similar to those used by Netflix for recommending films. The remaining chapters deal with such diverse topics as methods for estimating the size of populations of fish stocks and endangered species as well as methods for assessing climate change and forecasting crop yields.

A fundamental characteristic of the twenty-first century will be an explosive growth in the volume of data and how it is used. Statistics lies at the center of this enterprise. This book provides a glimpse into the past, present, and future uses of data, how data impact the lives of Canadians and others, and the role that Canadian statisticians have had and will continue to have in data analysis.

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