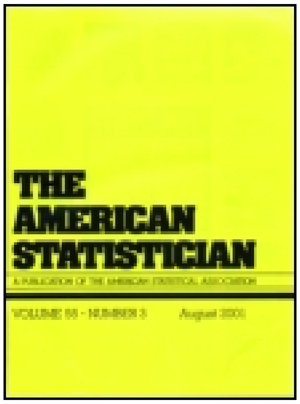

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Statistical Graphics Procedures by Example—Effective Graphs Using SAS.

Sanjay MATANGE and Dan HEATH. Cary, NC: SAS® Publishing, xii + 357 pp., $53.95 (P), ISBN: 978-1-60764-762-1.

At first glance, it seems odd to find a text of more than 330 pp. devoted to three SAS® procedures that are focused not on analytics but on creating visualizations. However, a careful reading shows just how many details there are in the SAS graphic procedures that need to be discussed. Sanjay Matange and Dan Heath of SAS provide an in-depth look at the PROC SGPLOT, PROC SGPANEL, and PROC SGSCATTER procedures in this text that could equally serve as a teaching instrument or a quick tutorial for producing high-quality visuals within the SAS system. The text is easy to read and serves as a useful resource for individuals who need to add analytics to their data visuals or those who wish to use options to create the most professional visualization possible in SAS.

The text is laid out into 16 chapters and starts with a general introduction of data-based visualizations and an overview of the text. Chapter 2 gives a description of each procedure involving the basic syntax and utilization of each of the three procedures. Chapter 3 then gives a brief description of the different graph types available, and while much of the focus is on commonly used visuals (scatterplots, histograms, boxplots, bar charts, etc.) there is also early discussion of domain specific visuals (such as vector plots or step plots). Early on, the authors provide a nice resource in the form of a table that illustrates exactly which graph types can be combined within each of the procedures. This visual serves as an early indication of the complexity and possibility of layered visuals that the SG procedures can produce.

Chapter 4 brings readers into the basics of creating each of these plots with easy to recognize and access SAS code. Chapters 5, 6, and 7 look at bivariate association style plots first focusing on two quantitative metrics, followed by one quantitative versus one categorical, and finally two categorical variable visuals. At the book's half-way point, things switch over from general "how to make this style of graph" to "how to make a more professional or appealing graph." Chapter 8 deals with topics such as legends and insets that help to explain technical aspects of visuals better, while Chapter 9 deals with annotations and attributes which help the reader to understand the message being conveyed by the visual.

After dealing with paneling of graphs in Chapter 10 and creating scatterplot matrices in Chapter 11 the book hits its real stride with Chapters 12 and 13 (arguably the most valuable in the text). Chapter 12 delves into specific visuals commonly used in the health and life sciences and provides terrific examples (with code) of a Forest Plot for meta-analysis and an Adverse Event Timeline for drug development studies. Similarly, Chapter 13 provides business and other industry style graphs such as Stock Plots and Social Network Graphs. The book ends with the last three chapters devoted to style guides, ODS, and exporting graphics which all focus on getting these visuals out of SAS and into some other reporting mechanism.

It is clear from the book's layout that the authors wished to have an example-based reference style text for those working with SAS and wanting to have a go-to resource for creating stunning professional visuals. However, there is also a secondary avenue for this kind of text, while the text is not written for newcomers to the SAS system, this text would make an excellent supplement to an introductory course on SAS coding. For instructors in statistics and biostatistics who are being asked to design courses that introduce SAS coding to students *not* majoring in the statistical sciences, one issue is in teaching an effective course and an introduction into programming to individuals who have a limited statistical background. The examples in this text are clear enough and the content focused enough that it might be possible to use many of these examples to illustrate the nuances of SAS coding without spending much time on discussing analytics. Instructors could create examples that deal with data importing, managing, and cleaning while simultaneously teaching code that provides meaningful output and do so without having to spend time discussing statistical theory. There has been a growing call for such coursework for students in public health, health information management, informatics, and other areas.

The text does have some room for improvement; the authors point out early on that a limitation in the text is the use of grayscale visualizations. That point comes across multiple times in the text when the reader is faced with an excellent graphic and wonders how it could be made better with color. While the use of color would likely cause a major increase in the cost of the text, it might seem like a good idea for Matange and Heath to explore a color e-book version of the text with enhanced visualizations. This may be especially helpful for programmers who wish to copy and modify code that is in the text. Also, the text uses a variety of examples but generally refers to the same SAS datasets over and over again. In addition to a traditional index, the authors may want to consider an example index so that readers who see a particular appealing visualization can explore other visuals that were created in other places in the book with the same dataset.

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Statistical Theory: A Concise Introduction.

Felix ABRAMOVICH and Yaácov RITOV. Boca Raton, FL: Chapman & Hall/CRC Texts in Statistical Science, 2013, xv + 224 pp., $69.95 (H), ISBN: 9781439851845.

This book is designed to serve as the textbook for a one-semester statistical theory course for advanced undergraduates in statistics, and upon inspection it shows itself to be a refreshing presentation of the required topics. Those of us who have taught such a course for many years, using texts such as Casella and Berger (2002) supplemented by classics such as Stuart and Ord (1999) or Lehmann and Casella (1998), understand the frustration in trying to cover so much important material in a single semester. Several years ago, the department opened its first-year graduate course to upper-level undergraduates and non-Ph.D. students, requiring a modification of presentation, resulting in an ongoing quest for appropriate textbooks. "Undergraduate" texts such as Hogg, McKean, and Craig (2012), while at about the right mathematical level, also have too much material to cover in-depth. And of course the numerous, almost popular-level books are just not at the right level, despite including calculus-based approaches; see, for example, Navidi (2010) or Hogg and Tanis (2010). Having generally had good experiences with books with the CRC imprint, in hope and trepidation I opened Abramovich and Ritov's text.

It is going to raise many an eyebrow to see topics such as likelihood, sufficiency, minimal sufficiency, completeness, and the exponential class of distributions presented primarily in the introduction! This approach works, however, and provides an important way of thinking to the student when covered in this manner. Shock is good in some cases. After an expert statement of what statistics is, and the introduction of some canonical examples that are used throughout the text, we are immediately introduced to likelihood and sufficiency. The authors' explanation of minimal sufficiency and completeness is quite insightful and constructive. They conclude their introduction with a concise discussion of the exponential class, including a curved exponential example.

Point estimation is presented in Chapter 2, beginning with maximum likelihood estimation (MLE) (including the nonregular case) and the method of moments. We are then introduced to mean squared error as a goodness of estimation measure, preparing the reader for chapter 7 that covers squared-error loss and decision theory. The authors present a good discussion of the decomposition into bias and variance. This raises the point of unbiasedness, which then leads to Fisher information and the information inequality. They present a good discussion and several examples of Rao-Blackwellization, which illustrate the point, and which make the subsequent Lehmann–Scheffé theorem easy to follow.

Confidence sets are covered beginning with a nice discussion, leading to the additive-type intervals before pivots are introduced. Although I prefer to teach hypothesis testing first, which provides the constructive likelihood ratio test inversion methodology, outside of asymptotic techniques we tend to resort to pivots as well, so this is not a limitation. Abramovich and Ritov do an excellent job with simultaneous confidence regions and the Bonferroni methods, a topic that is not commonly covered given the press of subject matter in competing texts.

The hypothesis testing/critical region problem is introduced well, with motivation provided by error probability analysis. They gently present the Neyman–Pearson lemma, although I was surprised they did not use the generalized version with the randomized test function to handle the discrete case; in fact, test functions were not mentioned. *P*-values, the power function, most powerful tests, the likelihood ratio tests, and the difficulty in finding uniformly most powerful tests were well explained. The proof of the distribution of the *p*-value under H_0 was left as an exercise for the reader (but with solution in Appendix B). The chapter contains good examples, and concludes with an adroit exposition on sequential Wald testing.

The authors handle asymptotic analysis in Chapter 5 by introducing three modes of convergence of sequences of random variables, the weak law of large numbers (including Khinchin), and consistency. For motivation, they provide several examples of distributional convergence, including Poisson, exponential, and extreme value distributions, before presenting the iid central limit theorem, and the Berry–Esseen bound for finite variance problems. After handling the plug-in theorem and asymptotic normality of MLE, they provide a good discussion and nice examples for the Wald and Wilks tests/confidence intervals. They address the geometry of confidence regions in the multiparameter case for exact and asymptotic tests, as well as goodness-of-fit tests.

The next two chapters address Bayesian analysis and elements of statistical decision theory. The Bayesian philosophy itself is well presented, as are the necessary topics such as choice of prior, calculation of posterior, point estimation/credible sets, and hypothesis testing. The examples are good. The decision theory chapter covers loss function optimality, risk, admissibility, minimaximality, etc. Many motivating concepts are explained using Bayesian illustrations, Bayes' estimators, and rules (tests). As in most treatments of decision theory, the choice of loss function remains that of the decision maker.

The final chapter on linear models is a handy collection of results, intuition, and examples of use of the standard linear model. In it, Abramovich and Ritov concisely develop the least-square solutions and, with an appropriate distributional assumption, the MLE for β and $\sigma_\varepsilon{}^2$, Fisher information/Cramer–Rao lower bound, confidence intervals for the coefficients and predictions, etc. They consistently provide geometrical insights and excellent examples. The chapter concludes with a brief overview of one-way and two-way analysis of variance.

Part of the implicit "fine print" of this book is that the first month of material is presented in Appendix A, which includes some basic probability theory, random variables, functions of random variables, distribution theory, univariate parametric families, and some linear algebra projection theory applied to statistics. The second appendix contains solutions to selected exercises in the text, from the good collection of exercises at the end of each chapter. Offered without solution are many thought questions scattered throughout the text.

Overall, there are some quirks, as there would be if any of us wrote such a book. For example, the authors disclaim use of measure theory, but in their introduction for minimal sufficiency they have no qualms about presenting an equivalence class explanation. This, like measure theory, will likely lose most engineers. Similarly, some of their treatment of the Hat projection matrix uses geometric concepts from linear algebra; this works, but it is a bit more rigorous than the rest of the text. Most of the multivariate versions of the topics are asterisked as more advanced. They do not present almost sure convergence, but they do use convergence in *p*th mean. They do not present the Rao (Score) test. And, although I do not begrudge another author's notation, their moment notation uses the "backward" $\mu_2 = E(Y^2)$, versus the aesthetically superior (in our opinion) $\mu_2 = \mu\prime_2 - \mu\prime_1^2$. Their distributional notation is fine with $f_\theta \in \mathcal{F}_\theta,\ \theta \in \Theta$ and $f_Y(y;\theta)$.

As teachers of theoretical statistics, we can use a new approach, which this text offers. The book does not aspire to be a compendium of applied techniques, nor a presentation of all the important theoretical developments in these last few centuries. It will be a helpful resource for teachers of mathematical statistics who are looking for an outline of teaching material and useable depth. Their material attains a workable syllabus, which can be easily augmented with the teacher's preferred emphasis. This volume will make a solid contribution to any theoretical statistics instructor's collection due to its convenient size, its scope of coverage, judicious use of examples, and clarity of exposition.

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Understanding Advanced Statistical Methods.

Peter H. Westfall, and Kevin S. S. Henning. Boca Raton, FL: CRC Press, 2013, xxv + 543 pp., $79.95 (H), ISBN: 978-1-4665-1210-8.

This book is designed to replace the prevailing conventional two-course sequence for many academic majors that consists of elementary statistics followed by advanced research methods. Its primary audience is upper-division undergraduates and graduate students from any major area of study. The book emphasizes applications and has a wealth of examples from the social and economic sciences, biological and medical sciences, and physical and engineering sciences. A previous course in statistics is not necessary. The authors claim it can also serve as the text for a lower-division course to satisfy a mathematics general education requirement. The prerequisites are algebra, functions and graphs, and familiarity with spreadsheet software such as Microsoft Excel (the use of dedicated statistical software is encouraged but not required). Calculus is used but is not a prerequisite; the book employs a self-contained "just-in-time" approach to explain mathematical topics such as derivatives and integrals when discussing continuous distributions and expected value, and optimization when discussing maximum likelihood.

The book is similar in approach to Rice (2007) but integrates this approach more intensely throughout the text. The authors' motivation for writing the book is to remove the gap in understanding that they claim often exists between the first elementary statistics course and the advanced research methods course, with the gap in understanding caused primarily by a formulaic approach to sophisticated topics in the latter course. This book contains just as many formulas as other statistics texts, but with intuitive, engaging, insightful, and irreverent explanations ("We have the famous historical figure R. A. Fisher to blame for the $pv \le 0.05$ rule of thumb, which we call *extremely* ugly because it is so overused and abused by researchers") the authors strive mightily to part the curtain that hides the fundamentals of statistical thinking from most students. The authors take very seriously the word *Understanding* in the book's title.

The book has 20 chapters that cover the usual topics, and more, in an undergraduate/graduate math stat text; it is suitable for a fast-paced semester course offered to serious students. The "and more" refers to the strong emphasis throughout the book on thoughtful applications in a wide variety of disciplines. To support this emphasis, each chapter has a generous number of exercises that extend the chapter content and illustrate discipline-specific applications; end-chapter vocabulary lists and formula summaries are also included for each chapter. Chapter 1 is the most important chapter in the book; it explains the statistical science paradigm and the authors' *DATA/data* approach, *Nature* → *Design and measurement* → *DATA*, that contrasts with the more conventional population/sample model. Briefly, *DATA* include all possible values that could be produced by the process (not the population) being studied, while *data* denote the values observed in a particular study. While on the surface the difference appears to be only semantic, there is a real difference resulting from the authors' *model produces data* approach as opposed to the traditional *data produces model*.