BOOK REVIEW


Since its first appearance in 2001, *Fundamentals of Modern Statistical Methods* has received a great deal of attention and become an introductory book on the subject. It is a well-written and neatly organized book that introduces modern robust statistical methods, especially robust estimation and hypothesis testing methods. The book describes practical problems using conventional statistical techniques, and discusses the importance of modern tools. It offers a look at the most basic robust methods in different research scenarios in a relatively simple and easy-to-understand way. It uses simple and direct language, applied examples, and many graphic illustrations to present and motivate ideas and methods. This makes the book not only a handbook for applied researchers who need to conduct reasonable and interpretable data analysis, but also a good textbook for non-statistics students and statistics undergraduate students. This is the only book on the subject written for this audience to my knowledge.

Professor Wilcox begins by citing three inspiring and motivating quotes from three great men that match the theme of the book. These quotes are extremely encouraging to all of us who devote ourselves to scientific research.

The logical organization of the book noticeably stands out. The book leads with a brief introductory chapter. The remaining 11 chapters are loosely divided into two parts. Part I (Chap. 2 through Chap. 7) explains why standard methods can be highly misleading, and conversely why robust methods are especially advanced. Part II (Chap. 8 through Chap. 12) presents the most basic robust methods for dealing with the problems described in Part I.

Part I starts by introducing classical statistical concepts. Chapters 3 through 5 then describe problems using conventional statistical analysis. This description is very informative because it prepares non-statisticians for understanding the advantages of modern methods. Chap. 6 introduces the idea of bootstrapping, which is the foundation of many widely used robust methods. Part I ends with an outline of the most striking problem with standard statistical methods: small departures from normality greatly affecting standard methods based on normal theories. Unfortunately, many applied researchers make assumptions that do not hold true in practice. For example, one of the most common assumptions is that the distribution from which observations are sampled is normal. In fact, distributions are rarely normal. If the observations are sampled from a heavy-tailed distribution like the Cauchy distribution, the sample variance can be very large. That is, the probability of observing a value far from the mean in either direction is far greater than it would be for the normal distribution.

Part II presents some basic robust methods designed for dealing with the problems found in Part I, including robust measures of location, methods for comparing independent groups, methods for comparing dependent groups, robust measures of correlations, robust regression, and some non-parametric methods. These methods are particularly useful for health and social science research.

Professor Wilcox provides a lot of numeric examples to illustrate the algorithms and methods within the book. That is, the general formulae are followed by plugging in numbers and calculating the numbers “by hand.” These examples make the stories less abstractive and more concrete for non-statistics students.
This new edition includes a few interesting topics that did not appear in the first edition. Inferences based on sample medians and their differences from sample means and sample trimmed means are emphasized more than they were in the first edition. Added sections compare medians in a few chapters (see Sects. 5.9, 6.4, and 9.8). These emphases are quite important because readers may assume that the median can be treated as the 50% trimmed mean, and hence, inferences based on trimmed means can be generalized to the median. However, this generalization is highly inaccurate. In fact, the asymptotic standard error of the median is difficult to compute for a non-normal distribution even with large sample sizes (Hampel et al., 1986). Directly applying methods generated from the trimmed means is unsatisfactory. Therefore, providing separate sections to discuss inferences based on the median is desired.

Regression is another topic that Professor Wilcox has elaborated. In this edition, two types of bootstrapping-based regression methods are added in Chap. 6. The supplements on bootstrap techniques are extremely useful for deriving robust estimates of standard errors and confidence intervals of a point estimator; e.g., mean, median, proportion, and regression coefficient. A few more regression problems are discussed in Chap. 11. Some common robust smoothers aimed at estimating the shape of the regression line in a relatively flexible manner are introduced. Robust improvements on the classic ANCOVA method to compare regression lines are discussed. Also provided are suggestions on choosing a regression method in different scenarios.

Issues such as robust measures of effect size and comparison of dependent groups are also discussed in the new edition (see Sects. 9.9 through 9.11). In addition, some new simulation studies and results are added to make the conclusions more illustrative and convincing. The graphs in this new edition are more instructive and visually appealing.

The summary section at the end of each chapter provides students with an easy access to the chapter’s key points. I would have liked to see an exercise section after each chapter as well, even if all computations can be done using software programs now. These exercises would help students better understand the statistical concepts and how they are used in real-world applications.

I also support Professor Wilcox’s recommendation of the free statistical software, R, to implement methods described in the book. R is powerful and flexible, and allows users to write their own packages for applying newly developed methods. To my knowledge, there is no statistical software that implements most of the methods described in the book, since many of the methods are relatively new. Professor Wilcox has an R library that carries all methods in the book. This library is available at his website http://www-rcf.usc.edu/~rwilcox/. Professor Wilcox has also written another book, Introduction to Robust Estimation and Hypothesis Testing, that integrates the detailed algorithms and R implementations so that readers can connect statistical concepts with practical examples using R. Instructors can use this more comprehensive book as a reference in addition to Fundamentals of Modern Statistical Methods to guide the students’ homework and lab assignments.

Overall, this book is a state-of-the-art introduction to robust methods in estimation and hypothesis testing. It provides insights and more methodological options in statistical analysis for students and applied researchers. I look forward to seeing Fundamentals of Modern Statistical Methods pave the way for more modern robust methods that can be widely used in real-world applications.

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References