



Mathematical Statistics

Lawrence M. Leemis. Lighting Source, La Vergne, TN, 2020, 518 pp., \$66.86,
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BOOK REVIEW

Mathematical Statistics, by Lawrence M. Leemis. La Vergne, TN: Lighting Source, 2020, 518 pp., \$66.86, ISBN: 978-0-9829-1746-5.

As a sister book of the book *Probability* by the same author, this book is supposed to be the second course in a mathematical statistics sequence of classes. The readers should have learned calculus and completed a calculus-based course in probability. As with most mathematical statistics textbooks, point estimations, interval estimation, and hypothesis testing are the core concepts. This book is particularly written for students who would have their first exposure to mathematical statistics, so the author carefully selected his materials and had focused on the understanding of statistics such as the sample mean and sample variance being also random variables as well. R is used throughout the text for graphics, computation, and Monte Carlo simulation. The homework is comprehensive. From all these aspects, this book has a similar style as the other book of *Probability* by the same author.

The book's organization is deceptively simple: it only has four chapters. Chapter 1, almost 100 pages, is about random sampling. Chapter 2, another 100 pages, is about point estimation. Chapter 3, 135 pages, is about interval estimation. Chapter 4, 133 pages, is about hypothesis testing. This "simple" structure makes the four pillars of mathematical statistics very clear to readers who first learn the topic. Within each chapter, just like in the book *Probability*, each concept is presented in detail and in multiple aspects. And when calculation is involved, enough middle steps are preserved so readers can easily follow the steps.

One notable example is the presentation of the hypothesis testing. Not like many other textbooks that start with proven methods such as the Z-test, this book introduces the big picture first, and this big picture

includes "a hunch": it presents in the very beginning a clear outline of the 12 steps for hypothesis testing, starts with "a hunch, or theory, concerning a problem of interest," then moves to the second step "translate the theory into a question concerning an unknown parameter theta," then "state the null hypothesis of theta." ... Then technical explanation of many of these steps is given in detail. The type 1 and type 2 errors are also presented right along with this 12-step outline. What is more, strange (i.e., idiosyncratic) forms of hypothesis testing are presented! It concerns three brothers, Chico, Harpo, and Groucho. Each of them comes up with their own testing statistics, e.g., $x_1 + x_2$, $\min(x_1, x_2)$, or $\max(x_1, x_2)$, where x_1 and x_2 are random samples of size 2 from a uniform distribution $U(0, \theta)$. Is $\theta = 5$, or $\theta = 2$? Is this an allusion to the three little pigs? Nonetheless, this is a hilarious example that very effectively instructs the technical details of hypothesis testing, but also revives this "ancient" technique that tells readers that, in using the proven hypothesis testing methods, we actually have made choices (i.e., each of the three brothers' proposals have pros and cons, in terms of the type 1 and type 2 errors), and there are always new ideas possible.

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