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Statistical Theory: A Concise Introduction, 2nd ed.

Felix Abramovich and Ya'acov Ritov, Boca Raton, FL: Chapman & Hall/CRC Press, 2023, xiii + 222 pp., $99.95(H), ISBN 978-1-032-00745-8.

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Statistical Theory: A Concise Introduction, Second Edition by Felix Abramovich and Ya'acov Ritov is an excellent textbook that covers the fundamental concepts of statistical theory with a clear and also a concise approach as well as a rigorous exposition. This book presents a comprehensive and intuitive introduction to foundational statistical concepts (including parameter estimation, confidence intervals, hypothesis testing, asymptotic analysis and Bayesian inference) for students in a one-semester advanced undergraduate or graduate statistical theory course. Additionally, the authors also provide an appendix covering basic probability concepts, making the book even more suitable for self-study.

Compared to the first edition, this second edition has been updated and expanded to include a new material on nonparametric estimation and statistical decision theory, as well as other updates throughout the text. In the same spirit of its predecessor, the authors maintained illustrative examples, exercises (and solutions for selected exercises!), making this book an engaging and relevant reference to a broad audience of undergraduate and graduate students as well as researchers in quantitative disciplines.

Chapter 1 (Introduction) covers key concepts underling classical statistical inference, including the likelihood function and sufficiency. Then, Chapter 2 (Point Estimation), Chapter 3 (Confidence Intervals, Bounds, and Regions), and Chapter 4 (Hypothesis Testing) cover point estimation, confidence intervals, and hypothesis testing in an in-depth fashion, following very closely the well-established tradition of the frequentist paradigm. In this regard, the authors took care to maintain a proper balance between clarity and rigor of exposition. I particularly found examples and exercises very helpful and illuminating all the examples throughout these chapters.

Chapter 5 (Asymptotic Analysis) covers different approaches to convergence of random sequences as well as several asymptotic results, which provides a powerful tool for understanding the behavior of statistical methods as the sample size grows large. Besides classical results such as the Law of Large Numbers and the Central Limit Theorem, this chapter also presents important details about asymptotics in the multi-parameter case, and also, asymptotic properties of M-estimators. I also found very appealing the discussion on score asymptotic tests and confidence regions.

Chapter 6 (Bayesian Inference) introduces Bayesian inference. The authors discuss the basics of Bayesian inference, including prior distributions, posterior distributions, plus all the inferential tools already discussed under the frequentist approach, namely, point and interval estimation, and then, hypothesis testing. I deeply enjoyed this chapter. In my opinion, it enriches the discussion on statistical inference, and also, provides a powerful and flexible framework for statistical modeling. Having considered both paradigms to statistical inference, this chapter takes advantage of such, and throughout the entire exposition discusses advantages and limitations of classical and Bayesian ideas. I celebrate the enthusiasm for considering Bayesian ideas in a frequentist-oriented text, since they constitute the foundation for one of the book's novelties: Decision theory.

Chapter 7 (Elements of Statistical Decision Theory) covers statistical inference tasks as a decision making process. There, I really enjoyed how practitioners are encouraged to take the best data-driven action when faced to uncertainty arising from the data generating process. Among other topics, this chapter discusses the basic concepts of decision theory, such as loss functions, admissibility, minimax and Bayes risks, and also, minimax and Bayes rules. In this regard, the authors did a great job at explaining all of these fundamental concepts.

Finally, the book comes to a nice closure with two remarkable chapters for those readers interested in data analysis tools and underlying data science topics. Thus, Chapter 8 (Linear Models) covers linear regression models that are undoubtedly, as the authors put it, the most important and used class of models. Here, the book offers a compressive introduction to linear regression, analysis of variance, and related topics. Then, Chapter 9 (Nonparametric Estimation) covers nonparametric estimation, a new acquisition for this book edition, by providing flexible approaches to density estimation as well as regression.

Overall, *Statistical Theory: A Concise Introduction*, Second Edition is an excellent textbook that provides a rigorous and comprehensive introduction to statistical theory. This book is even a more valuable resource than its predecessor. The clear and intuitive presentation of concepts, coupled with examples and exercises, makes this book an excellent resource for both students and researchers in quantitative disciplines. This book is highly recommended for anyone seeking a solid foundation in statistical theory, whether as a starting point for further study or as a reference for working with statistical methods.

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