

Bootstrap Methods And Their Application

Explores the application of bootstrap to problems that place unusual demands on the method. The bootstrap method, introduced by Bradley Efron in 1973, is a nonparametric technique for inferring the distribution of a statistic derived from a sample. Most of the papers were presented at a special meeting sponsored by the Institute of Mathematical Statistics and the Interface Foundation in May, 1990.

"This book fits right into a needed niche: rigorous enough to give full explanation of the power of the S language, yet accessible enough to assign to social science graduate students without fear of intimidation. It is a tremendous balance of applied statistical "firepower" and thoughtful explanation. It meets all of the important mechanical needs: each example is given in detail, code and data are freely available, and the nuances of models are given rather than just the bare essentials. It also meets some important theoretical needs: linear models, categorical data analysis, an introduction to applying GLMs, a discussion of model diagnostics, and useful instructions on writing customized functions. "

—JEFF GILL, University of Florida, Gainesville

Developed by the authors, generalized structured component analysis is an

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alternative to two longstanding approaches to structural equation modeling: covariance structure analysis and partial least squares path modeling. Generalized structured component analysis allows researchers to evaluate the adequacy of a model as a whole, compare a model to alternative specifications, and conduct complex analyses in a straightforward manner. Generalized Structured Component Analysis: A Component-Based Approach to Structural Equation Modeling provides a detailed account of this novel statistical methodology and its various extensions. The authors present the theoretical underpinnings of generalized structured component analysis and demonstrate how it can be applied to various empirical examples. The book enables quantitative methodologists, applied researchers, and practitioners to grasp the basic concepts behind this new approach and apply it to their own research. The book emphasizes conceptual discussions throughout while relegating more technical intricacies to the chapter appendices. Most chapters compare generalized structured component analysis to partial least squares path modeling to show how the two component-based approaches differ when addressing an identical issue. The authors also offer a free, online software program (GeSCA) and an Excel-based software program (XLSTAT) for implementing the basic features of generalized structured component analysis.

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Combining a modern, data-analytic perspective with a focus on applications in the social sciences, the Third Edition of *Applied Regression Analysis and Generalized Linear Models* provides in-depth coverage of regression analysis, generalized linear models, and closely related methods, such as bootstrapping and missing data. Updated throughout, this Third Edition includes new chapters on mixed-effects models for hierarchical and longitudinal data. Although the text is largely accessible to readers with a modest background in statistics and mathematics, author John Fox also presents more advanced material in optional sections and chapters throughout the book. Available with Perusall—an eBook that makes it easier to prepare for class Perusall is an award-winning eBook platform featuring social annotation tools that allow students and instructors to collaboratively mark up and discuss their SAGE textbook. Backed by research and supported by technological innovations developed at Harvard University, this process of learning through collaborative annotation keeps your students engaged and makes teaching easier and more effective. [Learn more.](#)

The field of statistics not only affects all areas of scientific activity, but also many other matters such as public policy. It is branching rapidly into so many different subjects that a series of handbooks is the only way of comprehensively presenting the various aspects of statistical methodology, applications, and

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recent developments. The Handbook of Statistics is a series of self-contained reference books. Each volume is devoted to a particular topic in statistics, with Volume 30 dealing with time series. The series is addressed to the entire community of statisticians and scientists in various disciplines who use statistical methodology in their work. At the same time, special emphasis is placed on applications-oriented techniques, with the applied statistician in mind as the primary audience. Comprehensively presents the various aspects of statistical methodology Discusses a wide variety of diverse applications and recent developments Contributors are internationally renowned experts in their respective areas

An industry insider explains why there is so much bad software—and why academia doesn't teach programmers what industry wants them to know. Why is software so prone to bugs? So vulnerable to viruses? Why are software products so often delayed, or even canceled? Is software development really hard, or are software developers just not that good at it? In *The Problem with Software*, Adam Barr examines the proliferation of bad software, explains what causes it, and offers some suggestions on how to improve the situation. For one thing, Barr points out, academia doesn't teach programmers what they actually need to know to do their jobs: how to work in a team to create code that works reliably

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and can be maintained by somebody other than the original authors. As the size and complexity of commercial software have grown, the gap between academic computer science and industry has widened. It's an open secret that there is little engineering in software engineering, which continues to rely not on codified scientific knowledge but on intuition and experience. Barr, who worked as a programmer for more than twenty years, describes how the industry has evolved, from the era of mainframes and Fortran to today's embrace of the cloud. He explains bugs and why software has so many of them, and why today's interconnected computers offer fertile ground for viruses and worms. The difference between good and bad software can be a single line of code, and Barr includes code to illustrate the consequences of seemingly inconsequential choices by programmers. Looking to the future, Barr writes that the best prospect for improving software engineering is the move to the cloud. When software is a service and not a product, companies will have more incentive to make it good rather than "good enough to ship."

Take an exhilarating journey through the modern revolution in statistics with two of the ringleaders.

Empirical process techniques for independent data have been used for many years in statistics and probability theory. These techniques have proved very

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useful for studying asymptotic properties of parametric as well as non-parametric statistical procedures. Recently, the need to model the dependence structure in data sets from many different subject areas such as finance, insurance, and telecommunications has led to new developments concerning the empirical distribution function and the empirical process for dependent, mostly stationary sequences. This work gives an introduction to this new theory of empirical process techniques, which has so far been scattered in the statistical and probabilistic literature, and surveys the most recent developments in various related fields. Key features: A thorough and comprehensive introduction to the existing theory of empirical process techniques for dependent data * Accessible surveys by leading experts of the most recent developments in various related fields * Examines empirical process techniques for dependent data, useful for studying parametric and non-parametric statistical procedures * Comprehensive bibliographies * An overview of applications in various fields related to empirical processes: e.g., spectral analysis of time-series, the bootstrap for stationary sequences, extreme value theory, and the empirical process for mixing dependent observations, including the case of strong dependence. To date this book is the only comprehensive treatment of the topic in book literature. It is an ideal introductory text that will serve as a reference or resource for classroom use

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in the areas of statistics, time-series analysis, extreme value theory, point process theory, and applied probability theory. Contributors: P. Ango Nze, M.A. Arcones, I. Berkes, R. Dahlhaus, J. Dedecker, H.G. Dehling, Praise for the Second Edition “This book should be an essential part of the personal library of every practicing statistician.”—Technometrics Thoroughly revised and updated, the new edition of Nonparametric Statistical Methods includes additional modern topics and procedures, more practical data sets, and new problems from real-life situations. The book continues to emphasize the importance of nonparametric methods as a significant branch of modern statistics and equips readers with the conceptual and technical skills necessary to select and apply the appropriate procedures for any given situation. Written by leading statisticians, Nonparametric Statistical Methods, Third Edition provides readers with crucial nonparametric techniques in a variety of settings, emphasizing the assumptions underlying the methods. The book provides an extensive array of examples that clearly illustrate how to use nonparametric approaches for handling one- or two-sample location and dispersion problems, dichotomous data, and one-way and two-way layout problems. In addition, the Third Edition features: The use of the freely available R software to aid in computation and simulation, including many new R

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programs written explicitly for this new edition New chapters that address density estimation, wavelets, smoothing, ranked set sampling, and Bayesian nonparametrics Problems that illustrate examples from agricultural science, astronomy, biology, criminology, education, engineering, environmental science, geology, home economics, medicine, oceanography, physics, psychology, sociology, and space science Nonparametric Statistical Methods, Third Edition is an excellent reference for applied statisticians and practitioners whose seek a review of nonparametric methods and their relevant applications. The book is also an ideal textbook for upper-undergraduate and first-year graduate courses in applied nonparametric statistics.

A hands-on guide to using R to carry out key statistical practices in educational and behavioral sciences research Computing has become an essential part of the day-to-day practice of statistical work, broadening the types of questions that can now be addressed by research scientists applying newly derived data analytic techniques. Comparing Groups: Randomization and Bootstrap Methods Using R emphasizes the direct link between scientific research questions and data analysis. Rather than relying on mathematical calculations, this book focus on conceptual explanations and the use of statistical computing in an effort to guide readers through the integration of design, statistical methodology, and

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computation to answer specific research questions regarding group differences. Utilizing the widely-used, freely accessible R software, the authors introduce a modern approach to promote methods that provide a more complete understanding of statistical concepts. Following an introduction to R, each chapter is driven by a research question, and empirical data analysis is used to provide answers to that question. These examples are data-driven inquiries that promote interaction between statistical methods and ideas and computer application. Computer code and output are interwoven in the book to illustrate exactly how each analysis is carried out and how output is interpreted. Additional topical coverage includes: Data exploration of one variable and multivariate data Comparing two groups and many groups Permutation tests, randomization tests, and the independent samples t-Test Bootstrap tests and bootstrap intervals Interval estimates and effect sizes Throughout the book, the authors incorporate data from real-world research studies as well as chapter problems that provide a platform to perform data analyses. A related Web site features a complete collection of the book's datasets along with the accompanying codebooks and the R script files and commands, allowing readers to reproduce the presented output and plots. Comparing Groups: Randomization and Bootstrap Methods Using R is an excellent book for upper-undergraduate and graduate level courses

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on statistical methods, particularly in the educational and behavioral sciences. The book also serves as a valuable resource for researchers who need a practical guide to modern data analytic and computational methods. Ranked Set Sampling is one of the new areas of study in this region of the world and is a growing subject of research. Recently, researchers have paid attention to the development of the types of sampling; though it was not welcome in the beginning, it has numerous advantages over the classical sampling techniques. Ranked Set Sampling is doubly random and can be used in any survey designs. The Pakistan Journal of Statistics had attracted statisticians and samplers around the world to write up aspects of Ranked Set Sampling. All of the essays in this book have been reviewed by many critics. This volume can be used as a reference book for postgraduate students in economics, social sciences, medical and biological sciences, and statistics. The subject is still a hot topic for MPhil and PhD students for their dissertations. This book provides a compact introduction to the bootstrap method. In addition to classical results on point estimation and test theory, multivariate linear regression models and generalized linear models are covered in detail. Special attention is given to the use of bootstrap procedures to perform goodness-of-fit tests to validate model or distributional assumptions. In some cases, new methods are

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presented here for the first time. The text is motivated by practical examples and the implementations of the corresponding algorithms are always given directly in R in a comprehensible form. Overall, R is given great importance throughout. Each chapter includes a section of exercises and, for the more mathematically inclined readers, concludes with rigorous proofs. The intended audience is graduate students who already have a prior knowledge of probability theory and mathematical statistics.

Applying Contemporary Statistical Techniques explains why traditional statistical methods are often inadequate or outdated when applied to modern problems. Wilcox demonstrates how new and more powerful techniques address these problems far more effectively, making these modern robust methods understandable, practical, and easily accessible. Highlights:

- * Assumes no previous training in statistics
- * Explains when and why modern methods provide more accurate results
- * Provides simple descriptions of when and why conventional methods can be highly unsatisfactory
- * Covers the latest developments on multiple comparisons
- * Includes recent advances in risk-based methods
- * Features many illustrations and examples using data from real studies
- * Describes and illustrates easy-to-use s-plus functions for applying cutting-edge techniques

"The book is quite unique in that it offers a lot of up-to-date statistical

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tools. No other book at this level comes close in this aspect." Xuming He
-University of Illinois, Urbana

Statistics is a subject of many uses and surprisingly few effective practitioners. The traditional road to statistical knowledge is blocked, for most, by a formidable wall of mathematics. The approach in *An Introduction to the Bootstrap* avoids that wall. It arms scientists and engineers, as well as statisticians, with the computational techniques they need to analyze and understand complicated data sets.

This book describes an array of power tools for data analysis that are based on nonparametric regression and smoothing techniques. These methods relax the linear assumption of many standard models and allow analysts to uncover structure in the data that might otherwise have been missed. While McCullagh and Nelder's *Generalized Linear Models* shows how to extend the usual linear methodology to cover analysis of a range of data types, *Generalized Additive Models* enhances this methodology even further by incorporating the flexibility of nonparametric regression. Clear prose, exercises in each chapter, and case studies enhance this popular text.

Modern computer-intensive statistical methods play a key role in solving many problems across a wide range of scientific disciplines. Like its bestselling predecessors, the fourth edition of *Randomization, Bootstrap and Monte Carlo Methods in Biology* illustrates a large number of statistical methods with an emphasis on biological applications. The focus is now on the use of

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randomization, bootstrapping, and Monte Carlo methods in constructing confidence intervals and doing tests of significance. The text provides comprehensive coverage of computer-intensive applications, with data sets available online. Features Presents an overview of computer-intensive statistical methods and applications in biology Covers a wide range of methods including bootstrap, Monte Carlo, ANOVA, regression, and Bayesian methods Makes it easy for biologists, researchers, and students to understand the methods used Provides information about computer programs and packages to implement calculations, particularly using R code Includes a large number of real examples from a range of biological disciplines Written in an accessible style, with minimal coverage of theoretical details, this book provides an excellent introduction to computer-intensive statistical methods for biological researchers. It can be used as a course text for graduate students, as well as a reference for researchers from a range of disciplines. The detailed, worked examples of real applications will enable practitioners to apply the methods to their own biological data.

The statistical bootstrap is one of the methods that can be used to calculate estimates of a certain number of unknown parameters of a random process or a signal observed in noise, based on a random sample. Such situations are common in signal processing and the bootstrap is especially useful when only a small sample is available or an analytical analysis is too cumbersome or even impossible. This book covers the foundations of the bootstrap, its properties, its strengths and its limitations. The authors focus on bootstrap signal detection in Gaussian and non-Gaussian interference as well as bootstrap model selection. The theory developed in the book is supported by a number of useful practical examples written in MATLAB. The book is aimed at graduate students and engineers, and includes applications to

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real-world problems in areas such as radar and sonar, biomedical engineering and automotive engineering.

Volume III includes more selections of articles that have initiated fundamental changes in statistical methodology. It contains articles published before 1980 that were overlooked in the previous two volumes plus articles from the 1980's - all of them chosen after consulting many of today's leading statisticians.

This book will be the first on NPI and will provide an introduction to and overview of, the approach's current state of the art. It will be a self-contained treatment of the subject, introducing it to readers, and leading them on to a more advanced and specialist understanding. The Author compares and contrasts NPI theory with classical statistical theory, pointing out the ways in which NPI can enhance current research in areas ranging from operations research to engineering and artificial intelligence. After the initial introductory chapter, the book provides a series of chapters outlining the use of NPI in specific settings, e.g. for real-valued random quantities or for multinomial data. This will be followed by chapters detailing further applications in statistics, providing examples such as NPI for statistical quality and process control, reliability and operations research, with a variety of examples such as maintenance and replacement problems, queuing situations and risk reliability inferences. The foundations and ideas behind NPI will be presented along with an examination and comparison of more traditional approaches of classical and Bayesian statistics, providing further insights into the advantages of NPI. Future directions and the accommodation of multivariate data will also be discussed.

The book provides a compact reference guide to many key aspects of the bootstrap. It

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explores bootstrap methods, with an introductory chapter that also addresses other resampling methods and their broad range of applications (e.g. time series). The individual chapters focus on estimation, confidence intervals and hypothesis testing.

This book contains 30 selected, refereed papers from an international conference on bootstrapping and related techniques held in Trier 1990. The purpose of the book is to inform about recent research in the area of bootstrap, jack-knife and Monte Carlo Tests. Addressing the novice and the expert it covers as well theoretical as practical aspects of these statistical techniques. Potential users in different disciplines as biometry, epidemiology, computer science, economics and sociology but also theoretical researchers should consult the book to be informed on the state of the art in this area.

Time Series: A First Course with Bootstrap Starter provides an introductory course on time series analysis that satisfies the triptych of (i) mathematical completeness, (ii) computational illustration and implementation, and (iii) conciseness and accessibility to upper-level undergraduate and M.S. students. Basic theoretical results are presented in a mathematically convincing way, and the methods of data analysis are developed through examples and exercises parsed in R. A student with a basic course in mathematical statistics will learn both how to analyze time series and how to interpret the results. The book provides the foundation of time series methods, including linear filters and a geometric approach to prediction. The important paradigm of ARMA models is studied in-depth, as well as frequency domain methods. Entropy and other information theoretic notions are introduced, with applications to time series modeling. The second half of the book focuses on statistical inference, the fitting of time series models, as well as computational facets of forecasting. Many time series of interest

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are nonlinear in which case classical inference methods can fail, but bootstrap methods may come to the rescue. Distinctive features of the book are the emphasis on geometric notions and the frequency domain, the discussion of entropy maximization, and a thorough treatment of recent computer-intensive methods for time series such as subsampling and the bootstrap. There are more than 600 exercises, half of which involve R coding and/or data analysis. Supplements include a website with 12 key data sets and all R code for the book's examples, as well as the solutions to exercises.

Bootstrap Methods and Their Application Cambridge University Press

The jackknife and bootstrap are the most popular data-resampling methods used in statistical analysis. The resampling methods replace theoretical derivations required in applying traditional methods (such as substitution and linearization) in statistical analysis by repeatedly resampling the original data and making inferences from the resamples. Because of the availability of inexpensive and fast computing, these computer-intensive methods have caught on very rapidly in recent years and are particularly appreciated by applied statisticians. The primary aims of this book are (1) to provide a systematic introduction to the theory of the jackknife, the bootstrap, and other resampling methods developed in the last twenty years; (2) to provide a guide for applied statisticians: practitioners often use (or misuse) the resampling methods in situations where no theoretical confirmation has been made; and (3) to stimulate the use of the jackknife and bootstrap and further developments of the resampling methods. The theoretical properties of the jackknife and bootstrap methods are studied in this book in an asymptotic framework. Theorems are illustrated by examples. Finite sample properties of the jackknife and bootstrap are mostly investigated by examples and/or empirical simulation

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studies. In addition to the theory for the jackknife and bootstrap methods in problems with independent and identically distributed (Li.d.) data, we try to cover, as much as we can, the applications of the jackknife and bootstrap in various complicated non-Li.d. data problems. A comprehensive introduction to bootstrap methods in the R programming environment Bootstrap methods provide a powerful approach to statistical data analysis, as they have more general applications than standard parametric methods. An Introduction to Bootstrap Methods with Applications to R explores the practicality of this approach and successfully utilizes R to illustrate applications for the bootstrap and other resampling methods. This book provides a modern introduction to bootstrap methods for readers who do not have an extensive background in advanced mathematics. Emphasis throughout is on the use of bootstrap methods as an exploratory tool, including its value in variable selection and other modeling environments. The authors begin with a description of bootstrap methods and its relationship to other resampling methods, along with an overview of the wide variety of applications of the approach. Subsequent chapters offer coverage of improved confidence set estimation, estimation of error rates in discriminant analysis, and applications to a wide variety of hypothesis testing and estimation problems, including pharmaceutical, genomics, and economics. To inform readers on the limitations of the method, the book also exhibits counterexamples to the consistency of bootstrap methods. An introduction to R programming provides the needed preparation to work with the numerous exercises and applications presented throughout the book. A related website houses the book's R subroutines, and an extensive listing of references provides resources for further study. Discussing the topic at a remarkably practical and accessible level, An Introduction to Bootstrap Methods with

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Applications to Risk is an excellent book for introductory courses on bootstrap and resampling methods at the upper-undergraduate and graduate levels. It also serves as an insightful reference for practitioners working with data in engineering, medicine, and the social sciences who would like to acquire a basic understanding of bootstrap methods.

Statistical methods book, with code on supporting website.

INTRODUCTION 1) Introduction In 1979, Efron introduced the bootstrap method as a kind of universal tool to obtain approximation of the distribution of statistics. The now well known underlying idea is the following: consider a sample X of X_1, \dots, X_n independent and identically distributed (i.i.d.) random variables (r.v.'s) with unknown probability measure (p.m.) P . Assume we are interested in approximating the distribution of a statistical functional $T(P)$ the empirical counterpart of the functional $T(P)$, where $P_n := \frac{1}{n} \sum_{i=1}^n \delta_{X_i}$ is the empirical p.m. Since in some sense P_n is close to P when n is large, $P_n \rightarrow P$ in LLd. from P and builds the empirical p.m. if one samples X_1^*, \dots, X_m^* m times from P_n conditionally on P_n then the behaviour of $T(P_m^*)$ should imitate that of $T(P)$ when n and m get large. This idea has led to considerable investigations to see when it is correct, and when it is not. When it is not, one looks if there is any way to adapt it.

By giving a detailed account of bootstrap methods and their properties for dependent data, this book provides illustrative numerical examples throughout. The book fills a gap in the literature covering research on re-sampling methods for dependent data that has witnessed vigorous growth over the last two decades but remains scattered in various statistics and econometrics journals. It can be used as a graduate level text and also as a research monograph for statisticians and econometricians.

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This book on statistical methods was first published in 1997 and has code on a supporting website.

A comprehensive, practical treatment for professionals In less than two decades, the bootstrap has grown from an obscure object of theoretical study to a widely used resampling method with broad applications in numerous real-world situations. *Bootstrap Methods: A Practitioner's Guide* provides an introduction to the bootstrap for readers who have professional interest in these methods but do not have a background in advanced mathematics. It offers reliable, authoritative coverage of the bootstrap's considerable advantages as well as its drawbacks. This book updates classic texts in the field by presenting results on improved confidence set estimation, estimation of error rates in discriminant analysis, and applications to a wide variety of hypothesis testing and estimation problems. To alert readers to the limitations of the method, it exhibits counterexamples to the consistency of bootstrap methods. This book also makes connections between more traditional resampling methods and bootstrap. Outstanding special features of *Bootstrap Methods* include: * The most extensive and detailed bootstrap bibliography available, including more than 1,600 references * Discussions enlivened with stimulating topics such as data mining * Historical notes at the end of each chapter * Examples and explanations of when and why bootstrap is not effective *Bootstrap Methods* is a serious, useful, and unparalleled practical guide for professionals in engineering, the sciences, clinical medicine, and applied statistics.

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This accessible textbook and supporting web site use Excel (R) to teach introductory econometrics.

"This book is. . . clear and well-written. . . anyone with any interest in the basis of quantitative analysis simply must read this book. . . well-written, with a wealth of explanation. . ." --Dougal Hutchison in Educational Research Using real data examples, this volume shows how to apply bootstrapping when the underlying sampling distribution of a statistic cannot be assumed normal, as well as when the sampling distribution has no analytic solution. In addition, it discusses the advantages and limitations of four bootstrap confidence interval methods--normal approximation, percentile, bias-corrected percentile, and percentile-t. The book concludes with a convenient summary of how to apply this computer-intensive methodology using various available software packages.

A practical and accessible introduction to the bootstrap method—newly revised and updated Over the past decade, the application of bootstrap methods to new areas of study has expanded, resulting in theoretical and applied advances across various fields. Bootstrap Methods, Second Edition is a highly approachable guide to the multidisciplinary, real-world uses of bootstrapping and is ideal for readers who have a professional interest in its methods, but are without an advanced background in mathematics. Updated to reflect current techniques and the most up-to-date work on the topic, the Second Edition features: The addition of a second, extended bibliography

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devoted solely to publications from 1999–2007, which is a valuable collection of references on the latest research in the field A discussion of the new areas of applicability for bootstrap methods, including use in the pharmaceutical industry for estimating individual and population bioequivalence in clinical trials A revised chapter on when and why bootstrap fails and remedies for overcoming these drawbacks Added coverage on regression, censored data applications, P-value adjustment, ratio estimators, and missing data New examples and illustrations as well as extensive historical notes at the end of each chapter With a strong focus on application, detailed explanations of methodology, and complete coverage of modern developments in the field, *Bootstrap Methods, Second Edition* is an indispensable reference for applied statisticians, engineers, scientists, clinicians, and other practitioners who regularly use statistical methods in research. It is also suitable as a supplementary text for courses in statistics and resampling methods at the upper-undergraduate and graduate levels. "This book focuses on the practical aspects of modern and robust statistical methods. The increased accuracy and power of modern methods, versus conventional approaches to the analysis of variance (ANOVA) and regression, is remarkable. Through a combination of theoretical developments, improved and more flexible statistical methods, and the power of the computer, it is now possible to address problems with standard methods that seemed insurmountable only a few years ago"--

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