
SPRINGER TEXTS IN STATISTICS

Third Edition

PROBABILITY THEORY

Independence,
Interchangeability,
Martingales

Yuan Shih Chow • Henry Teicher

Probability Theory Independence Interchangeability Martingales Springer Texts Statistics

Alan F. Karr



Probability Theory Independence Interchangeability Martingales Springer Texts Statistics:

Probability Theory Yuan Shih Chow, Henry Teicher, 2012-11-28 Now available in paperback This is a text comprising the major theorems of probability theory and the measure theoretical foundations of the subject The main topics treated are independence interchangeability and martingales particular emphasis is placed upon stopping times both as tools in proving theorems and as objects of interest themselves No prior knowledge of measure theory is assumed and a unique feature of the book is the combined presentation of measure and probability It is easily adapted for graduate students familiar with measure theory as indicated by the guidelines in the preface Special features include A comprehensive treatment of the law of the iterated logarithm the Marcinkiewicz Zygmund inequality its extension to martingales and applications thereof development and applications of the second moment analogue of Wald's equation limit theorems for martingale arrays the central limit theorem for the interchangeable and martingale cases moment convergence in the central limit theorem complete discussion including central limit theorem of the random casting of r balls into n cells recent martingale inequalities Cramér-Lévy theorem and factor closed families of distributions This edition includes a section dealing with U statistic adds additional theorems and examples and includes simpler versions of some proofs Probability Theory Y. S. Chow, H. Teicher, 2012-12-06

Probability theory is a branch of mathematics dealing with chance phenomena and has clearly discernible links with the real world The origins of the subject generally attributed to investigations by the renowned French mathematician Fermat of problems posed by a gambling contemporary to Pascal have been pushed back a century earlier to the Italian mathematicians Cardano and Tartaglia about 1570 Results as significant as the Bernoulli weak law of large numbers appeared as early as 1713 although its counterpart the Borel strong law of large numbers did not emerge until 1909 Central limit theorems and conditional probabilities were already being investigated in the eighteenth century but the first serious attempts to grapple with the logical foundations of probability seem to be Keynes 1921 von Mises 1928 1931 and Kolmogorov 1933 An axiomatic model and measure theoretic framework for probability theory was furnished by Kolmogorov In this so called objective or measure theoretic approach definitions and axioms are so chosen that the empirical realization of an event is the outcome of a not completely determined physical experiment an experiment which is at least conceptually capable of indefinite repetition this notion is due to von Mises The concrete or intuitive counterpart of the probability of an event is a long run or limiting frequency of the corresponding outcome **Probability Theory** Yuan S. Chow, Henry

Teicher, 2012-12-06 Apart from new examples and exercises some simplifications of proofs minor improvements and correction of typographical errors the principal change from the first edition is the addition of section 9.5 dealing with the central limit theorem for martingales and more general stochastic arrays vii Preface to the First Edition Probability theory is a branch of mathematics dealing with chance phenomena and has clearly discernible links with the real world The origins of the subject generally attributed to investigations by the renowned French mathematician Fermat of problems posed by a

gambling contemporary to Pascal have been pushed back a century earlier to the Italian mathematicians Cardano and Tartaglia about 1570 Ore 1953 Results as significant as the Bernoulli weak law of large numbers appeared as early as 1713 although its counterpart the Borel strong law of large numbers did not emerge until 1909 Central limit theorems and conditional probabilities were already being investigated in the eighteenth century but the first serious attempts to grapple with the logical foundations of probability seem to be Keynes 1921 von Mises 1928 1931 and Kolmogorov 1933

Probability Theory Achim Klenke, 2020-10-30 This popular textbook now in a revised and expanded third edition presents a comprehensive course in modern probability theory Probability plays an increasingly important role not only in mathematics but also in physics biology finance and computer science helping to understand phenomena such as magnetism genetic diversity and market volatility and also to construct efficient algorithms Starting with the very basics this textbook covers a wide variety of topics in probability including many not usually found in introductory books such as limit theorems for sums of random variables martingales percolation Markov chains and electrical networks construction of stochastic processes Poisson point process and infinite divisibility large deviation principles and statistical physics Brownian motion stochastic integrals and stochastic differential equations The presentation is self contained and mathematically rigorous with the material on probability theory interspersed with chapters on measure theory to better illustrate the power of abstract concepts This third edition has been carefully extended and includes new features such as concise summaries at the end of each section and additional questions to encourage self reflection as well as updates to the figures and computer simulations With a wealth of examples and more than 290 exercises as well as biographical details of key mathematicians it will be of use to students and researchers in mathematics statistics physics computer science economics and biology

Probability Alan F. Karr, 2012-12-06 This book is a text at the introductory graduate level for use in the one semester or two quarter probability course for first year graduate students that seems ubiquitous in departments of statistics biostatistics mathematical sciences applied mathematics and mathematics While it is accessible to advanced mathematically mature undergraduates it could also serve with supplementation for a course on measure theoretic probability Students who master this text should be able to read the hard books on probability with relative ease and to proceed to further study in statistics or stochastic processes This is a book to teach from It is not encyclopedic and may not be suitable for all reference purposes Pascal once apologized to a correspondent for having written a long letter saying that he hadn't the time to write a short one I have tried to write a short book which is quite deliberately incomplete globally and locally Many topics including at least one of everyone's favorites are omitted among them infinite divisibility interchangeability large deviations ergodic theory and the Markov property These can be supplied at the discretion and taste of instructors and students or to suit particular interests

Statistics for Lawyers Michael O. Finkelstein, Bruce Levin, 2012-12-06 Statistics for Lawyers presents the science of statistics in action at the cutting edge of legal problems A series of more than 90 case studies drawn principally

from actual litigation have been selected to illustrate important areas of the law in which statistics has played a role and to demonstrate a variety of statistical tools. Some case studies raise legal issues that are being intensely debated and lie at the edge of the law. Of particular note are problems involving toxic torts, employment discrimination, stock market manipulation, paternity, tax legislation, and drug testing. The case studies are presented in the form of legal statistical puzzles to challenge the reader and focus discussion on the legal implications of statistical findings. The techniques range from simple averaging for the estimation of thefts from parking meters to complex logistic regression models for the demonstration of discrimination in the death penalty. Excerpts of data allow the reader to compute statistical results, and an appendix contains the authors' calculations.

Statistics in Scientific Investigation Glen McPherson, 2013-03-09. In this book I have taken on the challenge of providing an insight into Statistics and a blueprint for statistical application for a wide audience. For students in the sciences and related professional areas and for researchers who may need to apply Statistics in the course of scientific experimentation, the development emphasizes the manner in which Statistics fits into the framework of the scientific method. Mathematics students will find a unified but non-mathematical structure for Statistics which can provide the motivation for the theoretical development found in standard texts on theoretical Statistics. For statisticians and students of Statistics, the ideas contained in the book and their manner of development may aid in the development of better communications between scientists and statisticians. The demands made of readers are twofold: a minimal mathematical prerequisite which is simply an ability to comprehend formulae containing mathematical variables such as those derived from a high school course in algebra or the equivalent; a grasp of the process of scientific modeling which comes with either experience in scientific experimentation or practice with solving mathematical problems.

An Introduction to Probability and Stochastic Processes Marc A. Berger, 2012-12-06. These notes were written as a result of my having taught a non-measure theoretic course in probability and stochastic processes a few times at the Weizmann Institute in Israel. I have tried to follow two principles. The first is to prove things probabilistically whenever possible without recourse to other branches of mathematics and in a notation that is as probabilistic as possible. Thus, for example, the asymptotics of p_n for large n where P is a stochastic matrix is developed in Section V by using passage probabilities and hitting times rather than say pulling in Perron-Frobenius theory or spectral analysis. Similarly, in Section II the joint normal distribution is studied through conditional expectation rather than quadratic forms. The second principle I have tried to follow is to only prove results in their simple forms and to try to eliminate any minor technical computations from proofs so as to expose the most important steps. Steps in proofs or derivations that involve algebra or basic calculus are not shown; only steps involving say the use of independence or a dominated convergence argument or an assumption in a theorem are displayed. For example, in proving inversion formulas for characteristic functions I omit steps involving evaluation of basic trigonometric integrals and display details only where use is made of Fubini's Theorem or the Dominated Convergence Theorem.

Introduction to Statistics Gottfried E.

Noether, 2012-12-06 The introductory statistics course presents serious pedagogical problems to the instructor For the great majority of students the course represents the only formal contact with statistical thinking that he or she will have in college Students come from many different fields of study and a large number suffer from math anxiety Thus an instructor who is willing to settle for some limited objectives will have a much better chance of success than an instructor who aims for a broad exposure to statistics Many statisticians agree that the primary objective of the introductory statistics course is to introduce students to variability and uncertainty and how to cope with them when drawing inferences from observed data Additionally the introductory COurse should enable students to handle a limited number of useful statistical techniques The present text which is the successor to the author's Introduction to Statistics A Nonparametric Approach Houghton Mifflin Company Boston 1976 tries to meet these objectives by introducing the student to the basic ideas of estimation and hypothesis testing early in the course after a rather brief introduction to data organization and some simple ideas about probability Estimation and hypothesis testing are discussed in terms of the two sample problem which is both conceptually simpler and more realistic than the one sample problem that customarily serves as the basis for the discussion of statistical inference Applied Probability Kenneth Lange, 2008-01-17 Despite the fears of university mathematics departments mathematics education is growing rather than declining But the truth of the matter is that the increases are occurring outside departments of mathematics Engineers computer scientists physicists chemists economists statisticians biologists and even philosophers teach and learn a great deal of mathematics The teaching is not always terribly rigorous but it tends to be better motivated and better adapted to the needs of students In my own experience teaching students of biostatistics and mathematical biology I attempt to convey both the beauty and utility of probability This is a tall order partially because probability theory has its own vocabulary and habits of thought The axiomatic presentation of advanced probability typically proceeds via measure theory This approach has the advantage of rigor but it inevitably misses most of the interesting applications and many applied scientists rebel against the onslaught of technicalities In the current book I endeavor to achieve a balance between theory and applications in a rather short compass While the combination of brevity and balance sacrifices many of the proofs of a rigorous course it is still content with supplying students with many of the relevant theoretical tools In my opinion it is better to present the mathematical facts without proof rather than omit them altogether

Time Series Analysis and Its Applications Robert H. Shumway, David S. Stoffer, 2013-03-14 The goals of this book are to develop an appreciation for the richness and versatility of modern time series analysis as a tool for analyzing data and still maintain a commitment to theoretical integrity as exemplified by the seminal works of Brillinger 1981 and Hannan 1970 and the texts by Brockwell and Davis 1991 and Fuller 1995 The advent of more powerful computing especially in the last three years has provided both real data and new software that can take one considerably beyond the fitting of simple time domain models such as have been elegantly described in the landmark work of Box and Jenkins 1970 The present book is designed

to be useful as a text for courses in time series on several different levels and as a reference work for practitioners facing the analysis of time correlated data in the physical biological and social sciences We believe the book will be useful as a text at both the undergraduate and graduate levels An undergraduate course can be accessible to students with a background in regression analysis and might include Sections 1.1.1, 1.8.2, 1.2.9 and 3.1.3, 3.8 Similar courses have been taught at the University of California Berkeley and Davis in the past using the earlier book on applied time series analysis by Shumway 1988 Such a course is taken by undergraduate students in mathematics economics and statistics and attracts graduate students from the agricultural biological and environmental sciences

Statistical Design George Casella, 2008-04-20 Statistical design is one of the fundamentals of our subject being at the core of the growth of statistics during the previous century Design played a key role in agricultural statistics and set down principles of good practice principles that still apply today Statistical design is all about understanding where the variance comes from and making sure that is where the replication is Indeed it is probably correct to say that these principles are even more important today

Regression Analysis Ashish Sen, Muni Srivastava, 2012-12-06 Any method of fitting equations to data may be called regression Such equations are valuable for at least two purposes making predictions and judging the strength of relationships Because they provide a way of empirically identifying how a variable is affected by other variables regression methods have become essential in a wide range of fields including the social sciences engineering medical research and business Of the various methods of performing regression least squares is the most widely used In fact linear least squares regression is by far the most widely used of any statistical technique Although nonlinear least squares is covered in an appendix this book is mainly about linear least squares applied to fit a single equation as opposed to a system of equations The writing of this book started in 1982 Since then various drafts have been used at the University of Toronto for teaching a semester long course to juniors seniors and graduate students in a number of fields including statistics pharmacology engineering economics forestry and the behavioral sciences Parts of the book have also been used in a quarter long course given to Master's and Ph.D. students in public administration urban planning and engineering at the University of Illinois at Chicago UIC This experience and the comments and criticisms from students helped forge the final version

The Statistical Analysis of Discrete Data Thomas J. Santner, Diane E. Duffy, 2012-12-06 The Statistical Analysis of Discrete Data provides an introduction to current statistical methods for analyzing discrete response data The book can be used as a course text for graduate students and as a reference for researchers who analyze discrete data The book's mathematical prerequisites are linear algebra and elementary advanced calculus It assumes a basic statistics course which includes some decision theory and knowledge of classical linear model theory for continuous response data Problems are provided at the end of each chapter to give the reader an opportunity to apply the methods in the text to explore extensions of the material covered and to analyze data with discrete responses In the text examples and in the problems we have sought to include interesting data sets from a wide variety of fields including

political science medicine nuclear engineering sociology ecology cancer research library science and biology Although there are several texts available on discrete data analysis we felt there was a need for a book which incorporated some of the myriad recent research advances Our motivation was to introduce the subject by emphasizing its ties to the well known theories of linear models experimental design and regression diagnostics as well as to describe alternative methodologies Bayesian smoothing etc the latter are based on the premise that external information is available These overriding goals together with our own experiences and biases have governed our choice of topics

A Mathematical Introduction to Fluid Mechanics Alexandre J. Chorin, Jerrold E. Marsden, 2013-11-27 Mathematics is playing an ever more important role in the physical and biological sciences provoking a blurring of boundaries between scientific disciplines and a resurgence of interest in the modern as well as the classical techniques of applied mathematics This renewal of interest both in research and teaching has led to the establishment of the series Texts in Applied Mathematics TAM The development of new courses is a natural consequence of a high level of excitement on the research frontier as newer techniques such as numerical and symbolic computer systems dynamical systems and chaos mix with and reinforce the traditional methods of applied mathematics Thus the purpose of this textbook series is to meet the current and future needs of these advances and encourage the teaching of new courses TAM will publish textbooks suitable for use in advanced undergraduate and beginning graduate courses and will complement the Applied Mathematical Sciences AMS series which will focus on advanced textbooks and research level monographs

Preface This book is based on a one term course in fluid mechanics originally taught in the Department of Mathematics of the University of California Berkeley during the spring of 1978 The goal of the course was not to provide an exhaustive account of fluid mechanics nor to assess the engineering value of various approximation procedures

The Bayesian Choice Christian P. Robert, 2013-04-17 From where we stand the rain seems random If we could stand somewhere else we would see the order in it T Hillerman 1990 Coyote Waits Harper Collins New York This book stemmed from a translation of a French version that was written to supplement the gap in the French statistical literature about Bayesian Analysis and Decision Theory As a result its scope is wide enough to cover the two years of the French graduate Statistics curriculum and more generally most graduate programs This book builds on very little prerequisites in Statistics and only requires basic skills in calculus measure theory and probability Intended as a preparation of Ph D students this book goes far enough to cover advanced topics and modern developments of Bayesian Statistics complete class theorems the Stein effect hierarchical and empirical modelings Gibbs sampling etc As usual what started as a translation eventually ended up as a deeper revision because of the comments of French readers of adjustments to the different needs of American programs and also because my perception of things has slightly changed in the meantime As a result this new version is quite adequate for a general graduate audience of an American university

Fundamentals of Mathematical Statistics Hung T. Nguyen, Gerald S. Rogers, 2012-12-06 This is the first half of a text for a two semester

course in mathematical statistics at the senior graduate level for those who need a strong background in statistics as an essential tool in their career To study this text the reader needs a thorough familiarity with calculus including such things as Jacobians and series but somewhat less intense familiarity with matrices including quadratic forms and eigenvalues For convenience these lecture notes were divided into two parts Volume I Probability for Statistics for the first semester and Volume II Statistical Inference for the second We suggest that the following distinguish this text from other introductions to mathematical statistics 1 The most obvious thing is the layout We have designed each lesson for the U S 50 minute class those who study independently probably need the traditional three hours for each lesson Since we have more than the U S again 90 lessons some choices have to be made In the table of contents we have used a to designate those lessons which are interesting but not essential INE and may be omitted from a general course some exercises and proofs in other lessons are also INE We have made lessons of some material which other writers might stuff into appendices Incorporating this freedom of choice has led to some redundancy mostly in definitions which may be beneficial

Optimization Kenneth Lange, 2013-03-09 Finite dimensional optimization problems occur throughout the mathematical sciences The majority of these problems cannot be solved analytically This introduction to optimization attempts to strike a balance between presentation of mathematical theory and development of numerical algorithms Building on students skills in calculus and linear algebra the text provides a rigorous exposition without undue abstraction Its stress on convexity serves as bridge between linear and nonlinear programming and makes it possible to give a modern exposition of linear programming based on the interior point method rather than the simplex method The emphasis on statistical applications will be especially appealing to graduate students of statistics and biostatistics The intended audience also includes graduate students in applied mathematics computational biology computer science economics and physics as well as upper division undergraduate majors in mathematics who want to see rigorous mathematics combined with real applications Chapter 1 reviews classical methods for the exact solution of optimization problems Chapters 2 and 3 summarize relevant concepts from mathematical analysis Chapter 4 presents the Karush Kuhn Tucker conditions for optimal points in constrained nonlinear programming Chapter 5 discusses convexity and its implications in optimization Chapters 6 and 7 introduce the MM and the EM algorithms widely used in statistics Chapters 8 and 9 discuss Newton's method and its offshoots quasi Newton algorithms and the method of conjugate gradients Chapter 10 summarizes convergence results and Chapter 11 briefly surveys convex programming duality and Dykstra's algorithm From the reviews An excellent imaginative and authoritative text on the difficult topic of modeling the problems of multivariate outcomes with different scaling levels different units of analysis and different study designs simultaneously Biometrics March 2005 As a textbook Optimization does provide a valuable introduction to an important branch of applicable mathematics Technometrics August 2005 I found Optimization to be an extremely engaging textbook the text is ideal for graduate students or researchers beginning research on optimization

problems in statistics There is little doubt that someone who worked through the text as part of a reading course or specialized graduate seminar would benefit greatly from the author's perspective

Journal of the American Statistical Association December 2005 **Maximum Entropy and Bayesian Methods Garching, Germany 1998** Wolfgang von der Linden, Volker Dose, Rainer Fischer, Roland Preuss, 2012-12-06

In 1978 Edwin T Jaynes and Myron Tribus initiated a series of workshops to exchange ideas and recent developments in technical aspects and applications of Bayesian probability theory The first workshop was held at the University of Wyoming in 1981 organized by C R Smith and W T Grandy Due to its success the workshop was held annually during the last 18 years Over the years the emphasis of the workshop shifted gradually from fundamental concepts of Bayesian probability theory to increasingly realistic and challenging applications The 18th international workshop on Maximum Entropy and Bayesian Methods was held in Garching Munich Germany 27-31 July 1998 Opening lectures by G Larry Bretthorst and by Myron Tribus were dedicated to one of the pioneers of Bayesian probability theory who died on the 30 of April 1998 Edwin Thompson Jaynes Jaynes revealed and advocated the correct meaning of probability as the state of knowledge rather than a physical property This interpretation allowed him to unravel longstanding mysteries and paradoxes Bayesian probability theory the logic of science as E T Jaynes called it provides the framework to make the best possible scientific inference given all available experimental and theoretical information We gratefully acknowledge the efforts of Tribus and Bretthorst in commemorating the outstanding contributions of E T Jaynes to the development of probability theory

Applied Multivariate Data Analysis J.D. Jobson, 2012-12-06

A Second Course in Statistics The past decade has seen a tremendous increase in the use of statistical data analysis and in the availability of both computers and statistical software Business and government professionals as well as academic researchers are now regularly employing techniques that go far beyond the standard two semester introductory course in statistics Even though for this group of users short courses in various specialized topics are often available there is a need to improve the statistics training of future users of statistics while they are still at colleges and universities In addition there is a need for a survey reference text for the many practitioners who cannot obtain specialized courses With the exception of the statistics major most university students do not have sufficient time in their programs to enroll in a variety of specialized one semester courses such as data analysis linear models experimental design multivariate methods contingency tables logistic regression and so on There is a need for a second survey course that covers a wide variety of these techniques in an integrated fashion It is also important that this second course combine an overview of theory with an opportunity to practice including the use of statistical software and the interpretation of results obtained from real data

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