

Introduction To Stochastic Processes Second Edition Gregory Lawler

Building upon the previous editions, this textbook is a first course in stochastic processes taken by undergraduate and graduate students (MS and PhD students from math, statistics, economics, computer science, engineering, and finance departments) who have had a course in probability theory. It covers Markov chains in discrete and continuous time, Poisson processes, renewal processes, martingales, and option pricing. One can only learn a subject by seeing it in action, so there are a large number of examples and more than 300 carefully chosen exercises to deepen the reader's understanding. Drawing from teaching experience and student feedback, there are many new examples and problems with solutions that use TI-83 to eliminate the tedious details of solving linear equations by hand, and the collection of exercises is much improved, with many more biological examples. Originally included in previous editions, material too advanced for this first course in stochastic processes has been eliminated while treatment of other topics useful for applications has been expanded. In addition, the ordering of topics has been improved; for example, the difficult subject of martingales is delayed until its usefulness can be applied in the treatment of mathematical finance.

This concisely written book is a rigorous and self-contained introduction to the theory of continuous-time stochastic processes. Balancing theory and applications, the authors use stochastic methods and concrete examples to model real-world problems from engineering, biomathematics, biotechnology, and finance. Suitable as a textbook for graduate or advanced undergraduate courses, the work may also be used for self-study or as a reference. The book will be of interest to students, pure and applied mathematicians, and researchers or practitioners in mathematical finance, biomathematics, physics, and engineering.

This comprehensive guide to stochastic processes gives a complete overview of the theory and addresses the most important applications. Pitched at a level accessible to beginning graduate students and researchers from applied disciplines, it is both a course book and a rich resource for individual readers. Subjects covered include Brownian motion, stochastic calculus, stochastic differential equations, Markov processes, weak convergence of processes and semigroup theory. Applications include the Black–Scholes formula for the pricing of derivatives in financial mathematics, the Kalman–Bucy filter used in the US space program and also theoretical applications to partial differential equations and analysis. Short, readable chapters aim for clarity rather than full generality. More than 350 exercises are included to help readers put their new-found knowledge to the test and to prepare them for tackling the research literature.

A highly readable introduction to stochastic integration and stochastic differential equations, this book combines developments of the basic theory with applications. It is written in a style suitable for the text of a graduate course in stochastic calculus, following a course in probability. Using the modern approach, the stochastic integral is defined for predictable integrands and local martingales; then It's

change of variable formula is developed for continuous martingales. Applications include a characterization of Brownian motion, Hermite polynomials of martingales, the Feynman–Kac functional and the Schrödinger equation. For Brownian motion, the topics of local time, reflected Brownian motion, and time change are discussed. New to the second edition are a discussion of the Cameron–Martin–Girsanov transformation and a final chapter which provides an introduction to stochastic differential equations, as well as many exercises for classroom use. This book will be a valuable resource to all mathematicians, statisticians, economists, and engineers employing the modern tools of stochastic analysis. The text also proves that stochastic integration has made an important impact on mathematical progress over the last decades and that stochastic calculus has become one of the most powerful tools in modern probability theory. —Journal of the American Statistical Association An attractive text...written in [a] lean and precise style...eminently readable. Especially pleasant are the care and attention devoted to details... A very fine book. —Mathematical Reviews

An Introduction to Stochastic Processes and Their Applications

Stochastic Methods in Neuroscience

An Introduction, Second Edition

An Introduction, Third Edition

A Friendly Introduction for Electrical and Computer Engineers

The purpose, level, and style of this new edition conform to the tenets set forth in the original preface. The authors continue with their tack of developing simultaneously theory and applications, intertwined so that they refurbish and elucidate each other. The authors have made three main kinds of changes. First, they have enlarged on the topics treated in the first edition. Second, they have added many exercises and problems at the end of each chapter. Third, and most important, they have supplied, in new chapters, broad introductory discussions of several classes of stochastic processes not dealt with in the first edition, notably martingales, renewal and fluctuation phenomena associated with random sums, stationary stochastic processes, and diffusion theory.

This book provides an accessible introduction to stochastic processes in physics and describes the basic mathematical tools of the trade: probability, random walks, and Wiener and Ornstein–Uhlenbeck processes. It includes end-of-chapter problems and emphasizes applications. An Introduction to Stochastic Processes in Physics builds directly upon early-twentieth-century explanations of the "peculiar character in the motions of the particles of pollen in water" as described, in the early nineteenth century, by the biologist Robert Brown. Lemons has adopted Paul Langevin's 1908 approach of applying Newton's second law to a "Brownian particle on which the total force included a random component" to explain Brownian motion. This method builds on Newtonian dynamics and provides an accessible explanation to anyone approaching the subject for the first time. Students will find this book a useful aid to learning the

unfamiliar mathematical aspects of stochastic processes while applying them to physical processes that he or she has already encountered.

An Introduction to Stochastic Modeling provides information pertinent to the standard concepts and methods of stochastic modeling. This book presents the rich diversity of applications of stochastic processes in the sciences. Organized into nine chapters, this book begins with an overview of diverse types of stochastic models, which predicts a set of possible outcomes weighed by their likelihoods or probabilities. This text then provides exercises in the applications of simple stochastic analysis to appropriate problems. Other chapters consider the study of general functions of independent, identically distributed, nonnegative random variables representing the successive intervals between renewals. This book discusses as well the numerous examples of Markov branching processes that arise naturally in various scientific disciplines. The final chapter deals with queueing models, which aid the design process by predicting system performance. This book is a valuable resource for students of engineering and management science. Engineers will also find this book useful.

This textbook gives a comprehensive introduction to stochastic processes and calculus in the fields of finance and economics, more specifically mathematical finance and time series econometrics. Over the past decades stochastic calculus and processes have gained great importance, because they play a decisive role in the modeling of financial markets and as a basis for modern time series econometrics. Mathematical theory is applied to solve stochastic differential equations and to derive limiting results for statistical inference on nonstationary processes. This introduction is elementary and rigorous at the same time. On the one hand it gives a basic and illustrative presentation of the relevant topics without using many technical derivations. On the other hand many of the procedures are presented at a technically advanced level: for a thorough understanding, they are to be proven. In order to meet both requirements jointly, the present book is equipped with a lot of challenging problems at the end of each chapter as well as with the corresponding detailed solutions. Thus the virtual text - augmented with more than 60 basic examples and 40 illustrative figures - is rather easy to read while a part of the technical arguments is transferred to the exercise problems and their solutions.

Introduction to Stochastic Processes

An Elementary Introduction with Applications

Stochastic Processes in Cell Biology

An Introduction to Stochastic-Process Limits and Their Application to Queues

Introduction to Stochastic Processes with R

This text on stochastic processes and their applications is based on a set of lectures given during the past several years at the University of California, Santa Barbara (UCSB). It is an introductory graduate course designed for classroom purposes. Its objective is to provide graduate students of statistics with an overview of some basic methods and techniques in the theory of stochastic processes. The only prerequisites are some rudiments of measure and integration

theory and an intermediate course in probability theory. There are more than 50 examples and applications and 243 problems and complements which appear at the end of each chapter. The book consists of 10 chapters. Basic concepts and definitions are provided in Chapter 1. This chapter also contains a number of motivating examples and applications illustrating the practical use of the concepts. The last five sections are devoted to topics such as separability, continuity, and measurability of random processes, which are discussed in some detail. The concept of a simple point process on \mathbb{R}^+ is introduced in Chapter 2. Using the coupling inequality and Le Cam's lemma, it is shown that if its counting function is stochastically continuous and has independent increments, the point process is Poisson. When the counting function is Markovian, the sequence of arrival times is also a Markov process. Some related topics such as independent thinning and marked point processes are also discussed. In the final section, an application of these results to flood modeling is presented.

Random sequences; Processes in continuous time; Miscellaneous statistical applications; Limiting stochastic operations; Stationary processes; Prediction and communication theory; The statistical analysis of stochastic processes; Correlation analysis of time-series.

Newly revised by the author, this undergraduate-level text introduces the mathematical theory of probability and stochastic processes. Using both computer simulations and mathematical models of random events, it comprises numerous applications to the physical and biological sciences, engineering, and computer science. Subjects include sample spaces, probabilities distributions and expectations of random variables, conditional expectations, Markov chains, and the Poisson process. Additional topics encompass continuous-time stochastic processes, birth and death processes, steady-state probabilities, general queuing systems, and renewal processes. Each section features worked examples, and exercises appear at the end of each chapter, with numerical solutions at the back of the book. Suggestions for further reading in stochastic processes, simulation, and various applications also appear at the end. Probability spaces and random variables. Expectations and independence. Bernoulli processes and sums of independent random variables. Poisson processes. Markov chains. Limiting Behavior and applications of Markov chains. Potentials, excessive functions, and optimal stopping of Markov chains. Markov processes. Renewal theory. Markov renewal theory. Non-negative matrices.

Introduction to Stochastic Models

An Introduction to Stochastic Processes

Applied Probability and Stochastic Processes

An Introduction to Stochastic Processes in Physics

From Applications to Theory

Stochastic processes are necessary ingredients for building models of a wide variety of phenomena exhibiting time varying randomness. This text offers easy access to this fundamental topic for many students of applied sciences at many levels. It includes examples, exercises, applications, and computational procedures. It is uniquely useful for beginners and non-beginners in the field. No knowledge of measure theory is presumed.

Based on a highly popular, well-established course taught by the authors, Stochastic Processes: An Introduction, Second Edition discusses the modeling and analysis of random experiments using the theory of probability. It focuses on the way in which the results or outcomes of experiments vary and evolve over

time. The text begins with a review of relevant fundamental probability. It then covers several basic gambling problems, random walks, and Markov chains. The authors go on to develop random processes continuous in time, including Poisson, birth and death processes, and general population models. While focusing on queues, they present an extended discussion on the analysis of associated stationary processes. The book also explores reliability and other random processes, such as branching processes, martingales, and a simple epidemic. The appendix contains key mathematical results for reference. Ideal for a one-semester course on stochastic processes, this concise, updated textbook makes the material accessible to students by avoiding specialized applications and instead highlighting simple applications and examples. The associated website contains Mathematica® and R programs that offer flexibility in creating graphs and performing computations.

This definitive textbook provides a solid introduction to discrete and continuous stochastic processes, tackling a complex field in a way that instils a deep understanding of the relevant mathematical principles, and develops an intuitive grasp of the way these principles can be applied to modelling real-world systems. It includes a careful review of elementary probability and detailed coverage of Poisson, Gaussian and Markov processes with richly varied queuing applications. The theory and applications of inference, hypothesis testing, estimation, random walks, large deviations, martingales and investments are developed. Written by one of the world's leading information theorists, evolving over twenty years of graduate classroom teaching and enriched by over 300 exercises, this is an exceptional resource for anyone looking to develop their understanding of stochastic processes.

Computational or mathematical neuroscience is a research area currently of great interest, due to, amongst other factors, rapid increases in computing power, increases in the ability to record large amounts of neurophysiological data, and a realisation amongst both neuroscientists and mathematicians that each can benefit from collaborating with the other. This text will concentrate on the intersection between stochastic dynamics and neuroscience, presenting a series of self-contained chapters on major aspects of noise and neuroscience, each written by an expert in their particular field. These range over Markov chain models for ion channel release, stochastically forced single neurons and population of neurons, statistical methods for parameter estimation, and the numerical approximation these models. Aimed at graduates and researchers in computational neuroscience and stochastic systems, each chapter will give an overview of a particular topic, including its history, important results in the area and future

challenges.

Theory, Models, and Applications to Finance, Biology, and Medicine

Adventures in Stochastic Processes

Stochastic Processes and Applications

Diffusion Processes, the Fokker-Planck and Langevin Equations

With Special Reference to Methods and Applications

This book presents a concise treatment of stochastic calculus and its applications. It gives a simple but rigorous treatment of the subject including a range of advanced topics, it is useful for practitioners who use advanced theoretical results. It covers advanced applications, such as models in mathematical finance, biology and engineering. Self-contained and unified in presentation, the book contains many solved examples and exercises. It may be used as a textbook by advanced undergraduates and graduate students in stochastic calculus and financial mathematics. It is also suitable for practitioners who wish to gain an understanding or working knowledge of the subject. For mathematicians, this book could be a first text on stochastic calculus; it is good companion to more advanced texts by a way of examples and exercises. For people from other fields, it provides a way to gain a working knowledge of stochastic calculus. It shows all readers the applications of stochastic calculus methods and takes readers to the technical level required in research and sophisticated modelling. This second edition contains a new chapter on bonds, interest rates and their options. New materials include more worked out examples in all chapters, best estimators, more results on change of time, change of measure, random measures, new results on exotic options, FX options, stochastic and implied volatility, models of the age-dependent branching process and the stochastic Lotka-Volterra model in biology, non-linear filtering in engineering and five new figures. Instructors can obtain slides of the text from the author.

Brownian motion is one of the most important stochastic processes in continuous time and with continuous state space. Within the realm of stochastic processes, Brownian motion is at the intersection of Gaussian processes, martingales, Markov processes, diffusions and random fractals, and it has influenced the study of these topics. Its central position within mathematics is matched by numerous applications in science, engineering and mathematical finance. Often textbooks on probability theory cover, if at all, Brownian motion only briefly. On the other hand, there is a considerable gap to more specialized texts on Brownian motion which is not so easy to overcome for the novice. The authors' aim was to write a book which can be used as an introduction to Brownian motion and stochastic calculus, and as a first course in continuous-time and continuous-state Markov processes. They also wanted to have a text which would be both a readily accessible mathematical back-up for contemporary applications (such as mathematical finance) and a foundation to get easy access to advanced monographs. This textbook, tailored to the needs of graduate and advanced undergraduate students, covers Brownian motion, starting from its elementary properties, certain

distributional aspects, path properties, and leading to stochastic calculus based on Brownian motion. It also includes numerical recipes for the simulation of Brownian motion.

Introduction to Stochastic Processes CRC Press

This “lucid, masterfully written introduction to an often difficult subject . . . belongs on the bookshelf of every student of statistical physics” (Dr. Brian J. Albright, Applied Physics Division, Los Alamos National Laboratory). This book provides an accessible introduction to stochastic processes in physics and describes the basic mathematical tools of the trade: probability, random walks, and Wiener and Ornstein-Uhlenbeck processes. With an emphasis on applications, it includes end-of-chapter problems. Physicist and author Don S. Lemons builds on Paul Langevin’s seminal 1908 paper “On the Theory of Brownian Motion” and its explanations of classical uncertainty in natural phenomena. Following Langevin’s example, Lemons applies Newton’s second law to a “Brownian particle on which the total force included a random component.” This method builds on Newtonian dynamics and provides an accessible explanation to anyone approaching the subject for the first time. This volume contains the complete text of Paul Langevin’s “On the Theory of Brownian Motion,” translated by Anthony Gythiel.

An Introduction to Stochastic Processes with Applications to Biology, Second Edition

Stochastic-Process Limits

An Introduction to Stochastic Differential Equations

An Introduction to Stochastic Modeling

Introduction to Stochastic Calculus with Applications

The objective of this book is to introduce the elements of stochastic processes in a rather concise manner where we present the two most important parts – Markov chains and stochastic analysis. The readers are led directly to the core of the main topics to be treated in the context. Further details and additional materials are left to a section containing abundant exercises for further reading and studying. In the part on Markov chains, the focus is on the ergodicity. By using the minimal nonnegative solution method, we deal with the recurrence and various types of ergodicity. This is done step by step, from finite state spaces to denumerable state spaces, and from discrete time to continuous time. The methods of proofs adopt modern techniques, such as coupling and duality methods. Some very new results are included, such as the estimate of the spectral gap. The structure and proofs in the first part are rather different from other existing textbooks on Markov chains. In the part on stochastic analysis, we cover the martingale theory and Brownian motions, the stochastic integral and stochastic differential equations with emphasis on one dimension, and the multidimensional stochastic integral and stochastic equation based on semimartingales. We introduce three important topics here: the Feynman-Kac formula, random time transform and Girsanov transform. As an essential application of the probability theory in

classical mathematics, we also deal with the famous Brunn-Minkowski inequality in convex geometry. This book also features modern probability theory that is used in different fields, such as MCMC, or even deterministic areas: convex geometry and number theory. It provides a new and direct routine for students going through the classical Markov chains to the modern stochastic analysis.

This textbook, now in its third edition, offers a rigorous and self-contained introduction to the theory of continuous-time stochastic processes, stochastic integrals, and stochastic differential equations. Expertly balancing theory and applications, the work features concrete examples of modeling real-world problems from biology, medicine, industrial applications, finance, and insurance using stochastic methods. No previous knowledge of stochastic processes is required. Key topics include: Markov processes Stochastic differential equations Arbitrage-free markets and financial derivatives Insurance risk Population dynamics, and epidemics Agent-based models New to the Third Edition: Infinitely divisible distributions Random measures Levy processes Fractional Brownian motion Ergodic theory Karhunen-Loeve expansion Additional applications Additional exercises Smoluchowski approximation of Langevin systems An Introduction to Continuous-Time Stochastic Processes, Third Edition will be of interest to a broad audience of students, pure and applied mathematicians, and researchers and practitioners in mathematical finance, biomathematics, biotechnology, and engineering. Suitable as a textbook for graduate or undergraduate courses, as well as European Masters courses (according to the two-year-long second cycle of the "Bologna Scheme"), the work may also be used for self-study or as a reference. Prerequisites include knowledge of calculus and some analysis; exposure to probability would be helpful but not required since the necessary fundamentals of measure and integration are provided. From reviews of previous editions: "The book is ... an account of fundamental concepts as they appear in relevant modern applications and literature. ... The book addresses three main groups: first, mathematicians working in a different field; second, other scientists and professionals from a business or academic background; third, graduate or advanced undergraduate students of a quantitative subject related to stochastic theory and/or applications." -Zentralblatt MATH

Stochastic processes occur in a large number of fields in sciences and engineering, so they need to be understood by applied mathematicians, engineers and scientists alike. This work is ideal for a first course introducing the reader gently to the subject matter of stochastic processes. It uses Brownian motion since this is a stochastic process which is central to many applications and which allows for a treatment without too many technicalities. All chapters are modular and are written in a style where the lecturer can "pick and mix" topics. A "dependence chart" will guide the reader when.

This book develops the theory of continuous and discrete stochastic processes within the context of cell biology. A wide range of biological topics are covered including normal and anomalous diffusion in complex cellular environments, stochastic ion channels and excitable systems, stochastic calcium

signaling, molecular motors, intracellular transport, signal transduction, bacterial chemotaxis, robustness in gene networks, genetic switches and oscillators, cell polarization, polymerization, cellular length control, and branching processes. The book also provides a pedagogical introduction to the theory of stochastic process - Fokker Planck equations, stochastic differential equations, master equations and jump Markov processes, diffusion approximations and the system size expansion, first passage time problems, stochastic hybrid systems, reaction-diffusion equations, exclusion processes, WKB methods, martingales and branching processes, stochastic calculus, and numerical methods. This text is primarily aimed at graduate students and researchers working in mathematical biology and applied mathematicians interested in stochastic modeling. Applied probabilists and theoretical physicists should also find it of interest. It assumes no prior background in statistical physics and introduces concepts in stochastic processes via motivating biological applications. The book is highly illustrated and contains a large number of examples and exercises that further develop the models and ideas in the body of the text. It is based on a course that the author has taught at the University of Utah for many years.

Essentials of Stochastic Processes

Introduction to Stochastic Processes, Second Edition

An Introduction to Probability and Stochastic Processes

Introduction To Stochastic Processes

Probability and Stochastic Processes

From the reviews: "The material is self-contained, but it is technical and a solid foundation in probability and queuing theory is beneficial to prospective readers. [... It] is intended to be accessible to those with less background. This book is a must to researchers and graduate students interested in these areas." ISI Short Book Reviews

Emphasizing fundamental mathematical ideas rather than proofs, Introduction to Stochastic Processes, Second Edition provides quick access to important foundations of probability theory applicable to problems in many fields. Assuming that you have a reasonable level of computer literacy, the ability to write simple programs, and the access to software for linear algebra computations, the author approaches the problems and theorems with a focus on stochastic processes evolving with time, rather than a particular emphasis on measure theory. For those lacking in exposure to linear differential and difference equations, the author begins with a brief introduction to these concepts. He proceeds to discuss Markov chains, optimal stopping, martingales, and Brownian motion. The book concludes with a chapter on stochastic integration. The author supplies many basic, general examples and provides exercises at the end of each chapter. New to the Second Edition: Expanded chapter on stochastic integration that introduces modern mathematical finance Introduction of Girsanov transformation and the

Feynman-Kac formula Expanded discussion of Itô's formula and the Black-Scholes formula for pricing options New topics such as Doob's maximal inequality and a discussion on self similarity in the chapter on Brownian motion Applicable to the fields of mathematics, statistics, and engineering as well as computer science, economics, business, biological science, psychology, and engineering, this concise introduction is an excellent resource both for students and professionals.

Stochastic Processes and Models provides a concise and lucid introduction to simple stochastic processes and models. Including numerous exercises, problems and solutions, it covers the key concepts and tools, in particular: random walks, renewals, Markov chains, martingales, the Wiener process model for Brownian motion, and diffusion processes, concluding with a brief account of the stochastic integral and stochastic differential equations as they arise in option-pricing. The text has been thoroughly class-tested and is ideal for an undergraduate second course in probability.

Unlike traditional books presenting stochastic processes in an academic way, this book includes concrete applications that students will find interesting such as gambling, finance, physics, signal processing, statistics, fractals, and biology. Written with an important illustrated guide in the beginning, it contains many illustrations, photos and pictures, along with several website links. Computational tools such as simulation and Monte Carlo methods are included as well as complete toolboxes for both traditional and new computational techniques.

Theory for Applications

Stochastic Processes

Stochastic Processes and Models

An Introduction to Stochastic Processes, Etc. (Second Edition.).

A First Course in Stochastic Processes

Based on a well-established and popular course taught by the authors over many years, Stochastic Processes: An Introduction, Third Edition, discusses the modelling and analysis of random experiments, where processes evolve over time. The text begins with a review of relevant fundamental probability. It then covers gambling problems, random walks, and Markov chains. The authors go on to discuss random processes continuous in time, including Poisson, birth and death processes, and general population models, and present an extended discussion on the analysis of associated stationary processes in queues. The book also explores reliability and other random processes, such as branching, martingales, and simple epidemics. A new chapter describing Brownian motion, where the outcomes are continuously observed over continuous time, is included. Further applications, worked examples and problems, and biographical details have been added to this edition. Much of the text has been reworked. The appendix contains key results in probability for reference. This concise, updated book makes the material accessible, highlighting simple applications and examples. A solutions manual with fully worked answers of all end-of-chapter problems, and Mathematica® and R programs illustrating many processes discussed in the book, can be downloaded from crcpress.com.

This text introduces engineering students to probability theory and stochastic processes. Along with thorough mathematical development of the subject, the book presents intuitive explanations of key points in order to give students the insights they need to apply math to practical engineering problems. The first seven chapters contain the core material that is essential to any introductory course. In one-semester undergraduate courses, instructors can select material from the remaining chapters to meet their individual goals. Graduate courses can cover all chapters in one semester.

An introduction to stochastic processes through the use of R Introduction to Stochastic Processes with R is an accessible and well-balanced presentation of the theory of stochastic processes, with an emphasis on real-world applications of probability theory in the natural and social sciences. The use of simulation, by means of the popular statistical freeware R, makes theoretical results come alive with practical, hands-on demonstrations. Written by a highly-qualified expert in the field, the author presents numerous examples from a wide array of disciplines, which are used to illustrate concepts and highlight computational and theoretical results. Developing readers' problem-solving skills and mathematical maturity, Introduction to Stochastic Processes with R features: Over 200 examples and 600 end-of-chapter exercises A tutorial for getting started with R, and appendices that contain review material in probability and matrix algebra Discussions of many timely and interesting supplemental topics including Markov chain Monte Carlo, random walk on graphs, card shuffling, Black-Scholes options pricing, applications in biology and genetics, cryptography, martingales, and stochastic calculus Introductions to mathematics as needed in order to suit readers at many mathematical levels A companion website that includes relevant data files as well as all R code and scripts used throughout the book Introduction to Stochastic Processes with R is an ideal textbook for an introductory course in stochastic processes. The book is aimed at undergraduate and beginning graduate-level students in the science, technology, engineering, and mathematics disciplines. The book is also an excellent reference for applied mathematicians and statisticians who are interested in a review of the topic.

An excellent introduction for computer scientists and electrical and electronics engineers who would like to have a good, basic understanding of stochastic processes! This clearly written book responds to the increasing interest in the study of systems that vary in time in a random manner. It presents an introductory account of some of the important topics in the theory of the mathematical models of such systems. The selected topics are conceptually interesting and have fruitful application in various branches of science and technology.

Introduction to Stochastic Integration

Brownian Motion

Stochastic Processes and Calculus

An Introduction to Continuous-Time Stochastic Processes

These notes were written as a result of my having taught a "nonmeasure 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.

Applied Probability and Stochastic Processes, Second Edition presents a self-contained introduction to elementary probability theory and stochastic processes with a special emphasis on their applications in science, engineering, finance, computer science, and operations research. It covers the theoretical foundations for modeling time-dependent random phenomena in these areas and illustrates applications through the analysis of numerous practical examples. The author draws on his 50 years of experience in the field to give your students a better understanding of probability theory and stochastic processes and enable them to use stochastic modeling in their work. New to the Second Edition Completely rewritten part on probability theory—now more than double in size New sections on time series analysis, random walks, branching processes, and spectral analysis of stationary stochastic processes Comprehensive numerical discussions of examples, which replace the more theoretically challenging sections Additional examples, exercises, and figures Presenting the material in a student-friendly, application-oriented manner, this non-measure theoretic text only assumes a mathematical maturity that applied science students acquire during their undergraduate studies in mathematics. Many exercises allow students to assess their understanding of the topics. In addition, the book occasionally describes connections between probabilistic concepts and corresponding statistical approaches to facilitate comprehension. Some important proofs and challenging examples and exercises are also included for more theoretically interested readers.

A nonmeasure theoretic introduction to stochastic processes. Considers its diverse range of applications and provides readers with probabilistic intuition and insight in thinking about problems. This revised edition contains additional material on compound Poisson random variables including an identity which can be used to efficiently compute moments; a new chapter on Poisson approximations; and coverage of the mean time spent in transient states as well as examples relating to the Gibb's sampler, the Metropolis

algorithm and mean cover time in star graphs. Numerous exercises and problems have been added throughout the text.

This book presents various results and techniques from the theory of stochastic processes that are useful in the study of stochastic problems in the natural sciences. The main focus is analytical methods, although numerical methods and statistical inference methodologies for studying diffusion processes are also presented. The goal is the development of techniques that are applicable to a wide variety of stochastic models that appear in physics, chemistry and other natural sciences. Applications such as stochastic resonance, Brownian motion in periodic potentials and Brownian motors are studied and the connection between diffusion processes and time-dependent statistical mechanics is elucidated. The book contains a large number of illustrations, examples, and exercises. It will be useful for graduate-level courses on stochastic processes for students in applied mathematics, physics and engineering. Many of the topics covered in this book (reversible diffusions, convergence to equilibrium for diffusion processes, inference methods for stochastic differential equations, derivation of the generalized Langevin equation, exit time problems) cannot be easily found in textbook form and will be useful to both researchers and students interested in the applications of stochastic processes.

An Introduction to Stochastic Processes with Applications to Biology

An Introduction to Stochastic Processes with Applications to Biology, Second Edition presents the basic theory of stochastic processes necessary in understanding and applying stochastic methods to biological problems in areas such as population growth and extinction, drug kinetics, two-species competition and predation, the spread of epidemics, and the genetics of inbreeding. Because of their rich structure, the text focuses on discrete and continuous time Markov chains and continuous time and state Markov processes. New to the Second Edition A new chapter on stochastic differential equations that extends the basic theory to multivariate processes, including multivariate forward and backward Kolmogorov differential equations and the multivariate Itô's formula The inclusion of examples and exercises from cellular and molecular biology Double the number of exercises and MATLAB® programs at the end of each chapter Answers and hints to selected exercises in the appendix Additional references from the literature This edition continues to provide an excellent introduction to the fundamental theory of stochastic processes, along with a wide range of applications from the biological sciences. To better visualize the dynamics of stochastic processes, MATLAB programs are provided in the chapter appendices.

These notes provide a concise introduction to stochastic differential equations and their application to the study of financial markets and as a basis for modeling diverse physical phenomena. They are accessible to non-specialists and make a valuable addition to the collection of texts on the topic. --Srinivasa Varadhan, New York University This is a handy and very useful text for studying stochastic differential equations. There is enough mathematical detail so that the reader can benefit from this introduction with only a basic background in mathematical analysis and probability. --George Papanicolaou, Stanford University This book covers the most important elementary facts regarding stochastic differential equations; it also describes some of the applications to partial differential equations, optimal stopping, and options pricing. The book's style is intuitive rather than formal, and emphasis is made on clarity. This book will be very helpful to starting graduate students and strong undergraduates as well as to others who want to gain knowledge of stochastic differential equations. I recommend this book

enthusiastically. --Alexander Lipton, Mathematical Finance Executive, Bank of America Merrill Lynch This short book provides a quick, but very readable introduction to stochastic differential equations, that is, to differential equations subject to additive "white noise" and related random disturbances. The exposition is concise and strongly focused upon the interplay between probabilistic intuition and mathematical rigor. Topics include a quick survey of measure theoretic probability theory, followed by an introduction to Brownian motion and the Ito stochastic calculus, and finally the theory of stochastic differential equations. The text also includes applications to partial differential equations, optimal stopping problems and options pricing. This book can be used as a text for senior undergraduates or beginning graduate students in mathematics, applied mathematics, physics, financial mathematics, etc., who want to learn the basics of stochastic differential equations. The reader is assumed to be fairly familiar with measure theoretic mathematical analysis, but is not assumed to have any particular knowledge of probability theory (which is rapidly developed in Chapter 2 of the book).