A Second Course in Stochastic Processes

High-dimensional Nonlinear Diffusion Stochastic Processes

This book describes the theory of how processes on the unobservable molecular scale give rise to observable effects such as diffusion and electrical noise on the macroscopic or laboratory scale. It puts the modern theory into historical context, and features new applications, statistical mechanics derivations, and the mathematical background of the topic.

An Introduction to Continuous-Time Stochastic Processes

This textbook, now in its fourth 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, it features concrete examples of modeling real-world problems from biology, medicine, finance, and insurance using stochastic methods. No previous knowledge of stochastic processes is required. Unlike other books on stochastic methods that specialize in a specific field of applications, this volume examines the ways in which similar stochastic methods can be applied across different fields. Beginning with the fundamentals of probability, the authors go on to introduce the theory of stochastic processes, the Ito integral, and stochastic differential equations. The following chapters then explore stability, stationarity, and ergodicity. The second half of the book is dedicated to applications to a variety of fields, including finance, biology, and medicine. Some highlights of this fourth edition include a more rigorous introduction to Gaussian white noise, additional material on the stability of stochastic semigroups used in models of population dynamics and epidemic systems, and the expansion of methods of analysis of one-dimensional stochastic differential equations. An Introduction to Continuous-Time Stochastic Processes, Fourth Edition is intended for graduate students taking an introductory course on stochastic processes, applied probability, stochastic calculus, mathematical finance, or mathematical biology. 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. Researchers and practitioners in mathematical finance, biomathematics, biotechnology, and engineering will also find this volume to be of interest, particularly the applications explored in the second half of the book.

High-dimensional Nonlinear Diffusion Stochastic Processes

This book describes the theory of how processes on the unobservable molecular scale give rise to observable effects such as diffusion and electrical noise on the macroscopic or laboratory scale. It puts the modern theory into historical context, and features new applications, statistical mechanics derivations, and the mathematical background of the topic.
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.

Stochastic Processes: 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.

Stochastic Processes and Applications: 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.

Diffusion Processes and Stochastic Calculus: The main purpose of the book is to present, at a graduate level and in a self-contained way, the most important aspects of the theory of continuous stochastic processes in continuous time and to introduce some of its ramifications such as the theory of semigroups, the Malliavin calculus, and the Lyons' rough paths. This book is intended for students, or even researchers, who wish to learn the basics in a concise but complete and rigorous manner. Several exercises are distributed throughout the text; test the understanding of the reader and each chapter ends with bibliographic comments aimed at those interested in exploring the materials further. Stochastic calculus was developed in the 1950s and the range of its applications is huge and still growing today. Besides being a fundamental component of modern probability theory, domains of applications include but are not limited to: mathematical finance, biology, physics, and engineering sciences. The first part of the text is devoted to the general theory of stochastic processes. The author focuses on the existence and regularity results for processes and on the theory of martingales. This allows him to introduce the Brownian motion quickly and study its most fundamental properties. The second part deals with the study of Markov processes, in particular, diffusions. The author's goal is to stress the connections between these processes and the theory of evolution semigroups. The third part deals with stochastic integrals, stochastic differential equations and Malliavin calculus. In the fourth and final part, the author presents an introduction to the new theory of rough paths by Terry Lyons.

Stochastic Expansion for the Diffusion Processes and Applications to Option Pricing: Stochastic Differential Equations and Applications, Volume 1 covers the development of the basic theory of stochastic differential equation systems. This volume is divided into nine chapters. Chapters 1 to 5 deal with the basic theory of stochastic differential equations, including discussions of the Markov processes, Brownian motion, and the stochastic integral. Chapter 6 examines the connections between solutions of partial differential equations and stochastic differential equations, while Chapter 7 describes the Girsanov’s formula that is useful in the stochastic control theory. Chapters 8 and 9 evaluate the behavior of sample paths of the solution of a stochastic differential system, as time increases to infinity. This book is intended primarily for undergraduate and graduate mathematics students.
Probability and Stochastic Processes for Physicists Stochastic processes are widely used for model building in the social, physical, engineering and life sciences as well as in financial economics. In model building, statistical inference for stochastic processes is of great importance from both a theoretical and an applications point of view. This book deals with Fractional Diffusion Processes and statistical inference for such stochastic processes. The main focus of the book is to consider parametric and nonparametric inference problems for fractional diffusion processes when a complete path of the process over a finite interval is observable. Key features: Introduces self-similar processes, fractional Brownian motion and stochastic integration with respect to fractional Brownian motion. Provides a comprehensive review of statistical inference for processes driven by fractional Brownian motion for modelling long range dependence. Presents a study of parametric and nonparametric inference problems for the fractional diffusion process. Discusses the fractional Brownian sheet and infinite dimensional fractional Brownian motion. Includes recent results and developments in the area of statistical inference of fractional diffusion processes. Researchers and students working on the statistics of fractional diffusion processes and applied mathematicians and statisticians involved in stochastic process modelling will benefit from this book.

Ergodic Control of Diffusion Processes Financial engineering has been proven to be a useful tool for risk management, but using the theory in practice requires a thorough understanding of the risks and ethical standards involved. Stochastic Processes with Applications to Finance, Second Edition presents the mathematical theory of financial engineering using only basic mathematical tools.

Stochastic Processes with Applications Stochastic control theory is a relatively young branch of mathematics. The beginning of its intensive development falls in the late 1950s and early 1960s. In that period an extensive literature appeared on optimal stochastic control using the quadratic performance criterion (see references in Wonham [76]). At the same time, Girsanov [25] and Howard [26] made the first steps in constructing a general theory, based on Bellman's technique of dynamic programming, developed by him somewhat earlier [4]. Two types of engineering problems engendered two different parts of stochastic control theory. Problems of the first type are associated with multistep decision making in discrete time, and are treated in the theory of discrete stochastic dynamic programming. For more on this theory, we note in addition to the work of Howard and Bellman, mentioned above, the books by Derman [8], Mine and Osaki [55], and Dynkin and Yushkevich [12]. Another class of engineering problems which encouraged the development of the theory of stochastic control involves time continuous control of a dynamic system in the presence of random noise. The case where the system is described by a differential equation and the noise is modeled as a time continuous random process is the core of the optimal control theory of diffusion processes. This book deals with this latter theory.

Theory and Statistical Applications of Stochastic Processes Based on lectures given by one of the authors with many years of experience in teaching stochastic processes, this textbook is unique in combining basic mathematical and physical theory with numerous simple and sophisticated examples as well as detailed calculations. In addition, applications from different fields are included so as to strengthen the background learned in the first part of the book. With its exercises at the end of each chapter (and solutions only available to lecturers) this book will benefit students and researchers at different educational levels. Solutions manual available for lecturers on www.wiley-vch.de.

Stochastic Models with Applications to Genetics, Cancers, AIDS and Other Biomedical Systems

Stochastic Differential Equations Beginning with the concept of random processes and Brownian motion and building on the theory and research directions in a self-contained manner, this book provides an introduction to stochastic analysis for graduate students, researchers and applied scientists interested in stochastic processes and their applications.

Statistical Inference for Fractional Diffusion Processes This book presents a systematic treatment of Markov chains, diffusion processes and state space models, as well as alternative approaches to Markov chains through stochastic difference equations and stochastic differential equations. It illustrates how these processes and approaches are
applied to many problems in genetics, carcinogenesis, AIDS epidemiology and other biomedical systems. One feature of the book is that it describes the basic MCMC (Markov chain and Monte Carlo) procedures and illustrates how to use the Gibbs sampling method and the multilevel Gibbs sampling method to solve many problems in genetics, carcinogenesis, AIDS and other biomedical systems. Another feature, the book develops many state space models for many genetic problems, carcinogenesis, and other biomedical problems. Contents: Discrete Time Markov Chain Models in Genetics and Biomedical Systems: Stationary Distributions and MCMC in Discrete Time Markov Chains. Continuous Time Markov Chain Models in Genetics, Cancers and AIDS: Absorption Probabilities and Stationary Distributions in Continuous Time Markov Chain Models: Diffusion Models in Genetics, Cancer and AIDS: Symptotic Distributions, Stationary Distributions and Absorption Probabilities in Diffusion Models: State Space Models and Some Examples from Cancer and AIDS: Some General Theories of State Space Models and Applications. Readership: Graduate students and researchers in probability & statistics and the life sciences. Keywords: Stochastic; Genetics; Cancers; AIDS; Biomedical Systems. Reviews: "Its strengths include the large number of models described, many of which have previously been published only in research journals; its clear presentation of many detailed analyses; and good accounts of the biology behind the models." Mathematical Reviews.

An Introduction to Continuous-Time Stochastic Processes: This book gives an introduction to the basic theory of stochastic calculus and its applications. Examples are given throughout the text, in order to motivate and illustrate the theory and show its importance for many applications in e.g. economics, biology, and physics. The basic idea of the presentation is to start from some basic results (without proofs) in the easier cases and develop the theory from there, and to concentrate on the proofs of the easier cases which, nevertheless, are often sufficiently general for many purposes, in order to be able to reach quickly the parts of the theory which is most important for the applications. For the 6th edition the author has added further exercises and, for the first time, solutions to many of the exercises are provided. Apart from several minor corrections and improvements, based on useful comments from readers and experts, the most important change in the corrected 5th printing of the 6th edition is in Theorem 10.1.9, where the proof of part b has been corrected and rewritten. The corrected 5th printing of the 6th edition is forthcoming and expected in September 2010.

Brownian Motion: This book provides a rigorous yet accessible introduction to the theory of stochastic processes. A significant part of the book is devoted to the classic theory of stochastic processes. In turn, it also presents proofs of well known results, sometimes together with new approaches. Moreover, the book explores topics not previously covered elsewhere, such as distributions of functionals of diffusions stopped at different random times, the Brownian local time, diffusions with jumps, and an invariance principle for random walks and local times. Supported by carefully selected material, the book showcases a wealth of examples that demonstrate how to solve concrete problems by applying theoretical results. It addresses a broad range of applications, focusing on concrete computational techniques rather than on abstract theory. The content presented here is largely self-contained, making it suitable for researchers and graduate students alike.

An Introduction to Continuous-Time Stochastic Processes: This book seeks to bridge the gap between the parlance, the models, and even the notations used by physicists and those used by mathematicians when it comes to the topic of probability and stochastic processes. The opening four chapters elucidate the basic concepts of probability, including probability spaces and measures, random variables, and limit theorems. Here, the focus is mainly on models and ideas rather than the mathematical tools. The discussion of limit theorems serves as a gateway to extensive coverage of the theory of stochastic processes, including, for example, stationarity and ergodicity, Poisson and Wiener processes and their trajectories, other Markov processes, jump-diffusion processes, stochastic calculus, and stochastic differential equations. All these conceptual tools then converge in a dynamical theory of Brownian motion that compares the Einstein–Smoluchowski and Ornstein–Uhlenbeck approaches, highlighting the most important ideas that finally led to a connection between the Schrödinger equation and diffusion processes along the lines of Nelson’s stochastic mechanics. A series of appendices cover particular details and calculations, and offer concise treatments of particular thought-provoking topics.
Stochastic Processes and Applications to Mathematical Finance This book uses a distinctly applied framework to present the most important topics in stochastic processes, including Gaussian and Markovian processes, Markov Chains, Poisson processes, Brownian motion and queueing theory. The book also examines in detail special diffusion processes, with implications for finance, various generalizations of Poisson processes, and renewal processes. It contains numerous examples and approximately 350 advanced problems that reinforce both concepts and applications. Entertaining mini-biographies of mathematicians give an enriching historical context. The book includes statistical tables and solutions to the even-numbered problems at the end.

Stochastic Processes in Physics and Chemistry Annotation This book is one of the first few devoted to high-dimensional diffusion stochastic processes with nonlinear coefficients. These processes are closely associated with large systems of Ito's stochastic differential equations and with discretized-in-the-parameter versions of Ito's stochastic differential equations that are nonlocally dependent on the parameter. The latter models include Ito's stochastic integro-differential, partial differential and partial integro-differential equations. The book presents the new analytical treatment which can serve as the basis of a combined, analytical -- numerical approach to greater computational efficiency. Some examples of the modelling of noise in semiconductor devices are provided.

Stochastic Analysis and Diffusion Processes The third edition of Van Kampen's standard work has been revised and updated. The main difference with the second edition is that the contrived application of the quantum master equation in section 6 of chapter XVII has been replaced with a satisfactory treatment of quantum fluctuations. Apart from that throughout the text corrections have been made and a number of references to later developments have been included. From the recent textbooks the following are the most relevant. C.W. Gardiner, Quantum Optics (Springer, Berlin 1991) D.T. Gillespie, Markov Processes (Academic Press, San Diego 1992) W.T. Coffey, Yu.P. Kalmykov, and J.T. Waldron, The Langevin Equation (2nd edition, World Scientific, 2004) Comprehensive coverage of fluctuations and stochastic methods for describing them. A must for students and researchers in applied mathematics, physics and physical chemistry.

Stochastic Processes The 33rd Bernoulli Society Conference on Stochastic Processes and Their Applications was held in Berlin from July 27 to July 31, 2009. It brought together more than 600 researchers from 49 countries to discuss recent progress in the mathematical research related to stochastic processes, with applications ranging from biology to statistical mechanics, finance and climatology. This book collects survey articles highlighting new trends and focal points in the area written by plenary speakers of the conference, all of them outstanding international experts. A particular aim of this collection is to inspire young scientists to pursue research goals in the wide range of fields represented in this volume.

Theory and Statistical Applications of Stochastic Processes Practical introduction for advanced undergraduate or beginning graduate students of applied mathematics, developed at the University of Oxford.

Stochastic Processes with Applications to Finance This book is concerned with the theory of stochastic processes and the theoretical aspects of statistics for stochastic processes. It combines classic topics such as construction of stochastic processes, associated filtrations, processes with independent increments, Gaussian processes, martingales, Markov properties, continuity and related properties of trajectories with contemporary subjects: integration with respect to Gaussian processes, Itô integration, stochastic analysis, stochastic differential equations, fractional Brownian motion and parameter estimation in diffusion models.

Thinking Probabilistically This book develops systematically and rigorously, yet in an expository and lively manner, the evolution of general random processes and their large time properties such as transience, recurrence, and convergence to steady states. The emphasis is on the most important classes of these processes from the viewpoint of theory as well as applications, namely, Markov processes. The book features very broad coverage of the most applicable aspects of stochastic processes, including sufficient material for self-contained courses on random walks in one and multiple dimensions; Markov chains in discrete and continuous times; including birth-death processes; Brownian motion and
diffusions, stochastic optimization, and stochastic differential equations. This book is for graduate students in mathematics, statistics, science and engineering, and it may also be used as a reference by professionals in diverse fields whose work involves the application of probability.

Elements of Random Walk and Diffusion Processes This book is concerned with the theory of stochastic processes and the theoretical aspects of statistics for stochastic processes. It combines classic topics such as construction of stochastic processes, associated filtrations, processes with independent increments, Gaussian processes, martingales, Markov properties, continuity and related properties of trajectories with contemporary subjects: integration with respect to Gaussian processes, Malliavin integration, stochastic analysis, stochastic differential equations, fractional Brownian motion and parameter estimation in diffusion models.

Stochastic Processes in Cell Biology This volume contains the contributions to a conference that is among the most important meetings in financial mathematics. Serving as a bridge between probabilists in Japan (called the Itô School and known for its highly sophisticated mathematics) and mathematical finance and financial engineering, the conference elicits the very highest quality papers in the field of financial mathematics.

Theoretical and Applications of Stochastic Processes Stochastic processes are an essential part of numerous branches of physics, as well as in biology, chemistry, and finance. This textbook provides a solid understanding of stochastic processes and stochastic calculus in physics, without the need for measure theory. In avoiding measure theory, this textbook gives readers the tools necessary to use stochastic methods in research with a minimum of mathematical background. Coverage of the more exotic Levy processes is included, as is a concise account of numerical methods for simulating stochastic systems driven by Gaussian noise. The book concludes with a non-technical introduction to the concepts and jargon of measure-theoretic probability theory. With over 70 exercises, this textbook is an easily accessible introduction to stochastic processes and their applications, as well as methods for numerical simulation, for graduate students and researchers in physics.

Stochastic Analysis and Applications The first comprehensive account of controlled diffusions with a focus on ergodic or 'long run average' control.

Inference for Diffusion Processes Stochastic processes and diffusion theory are the mathematical underpinnings of many scientific disciplines, including statistical physics, physical chemistry, molecular biophysics, communications theory and many more. Many books, reviews and research articles have been published on this topic, from the purely mathematical to the most practical. This book offers an analytical approach to stochastic processes that are most common in the physical and life sciences, as well as in optimal control and in the theory of filtering of signals from noisy measurements. Its aim is to make probability theory in function space readily accessible to scientists trained in the traditional methods of applied mathematics, such as integral, ordinary, and partial differential equations and asymptotic methods, rather than in probability and measure theory.

Surveys in Stochastic Processes Presents an important and unique introduction to random walk theory. Random walk is a stochastic process that has proven to be a useful model in understanding discrete state discrete-time processes across a wide spectrum of scientific disciplines. Elements of Random Walk and Diffusion Processes provides an interdisciplinary approach by including numerous practical examples and exercises with real-world applications in operations research, economics, engineering, and physics. Featuring an introduction to powerful and general techniques that are used in the application of physical and dynamic processes, the book presents the connections between diffusion equations and random motion. Standard methods and applications of Brownian motion are addressed in addition to Levy motion, which has become popular in random searches in a variety of fields. The book also covers fractional calculus and introduces percolation theory and its relationship to diffusion processes. With a strong emphasis on the relationship between random walk theory and diffusion processes, Elements of Random Walk and Diffusion Processes features Basic concepts in probability, an overview of stochastic and fractional processes, and elements of graph theory. Numerous practical applications of random walk across various disciplines, including how to model stock prices and gambling, describe the statistical properties of genetic drift, and simplify the random movement of molecules in liquids and gases. Examples of the real-
world applicability of random walk such as node movement and node failure in wireless networking, the size of the Web in computer science, and polymers in physics. Plentiful examples and exercises throughout that illustrate the solution of many practical problems. Elements of Random Walk and Diffusion Processes is an ideal reference for researchers and professionals involved in operations research, economics, engineering, mathematics, and physics. The book is also an excellent textbook for upper-undergraduate and graduate level courses in probability and stochastic processes, stochastic models, random motion and Brownian theory, random walk theory, and diffusion process techniques.

Controlled Diffusion Processes. Diffusion processes are a promising instrument for realistically modelling the time-continuous evolution of phenomena not only in the natural sciences but also in finance and economics. Their mathematical theory, however, is challenging, and hence diffusion modelling is often carried out incorrectly, and the according statistical inference is considered almost exclusively by theoreticians. This book explains both topics in an illustrative way which also addresses practitioners. It provides a complete overview of the current state of research and presents important, novel insights. The theory is demonstrated using real data applications.

An Introduction to Stochastic Processes with Applications to Biology. Algebraic methods in markov chains; Ratio theorems of transition probabilities and applications; Sums of independent random variables as a markov chain; Order statistics, poisson processes, and applications; Continuous time markov chains; Diffusion processes; Compounding stochastic processes; Fluctuation theory of partial sums of independent identically distributed random variables; Queueing processes.

Stochastic Differential Equations and Diffusion Processes. This volume attempts to exhibit current research in stochastic integration, stochastic differential equations, stochastic optimization and stochastic problems in physics and biology. It includes information on the theory of Dirichlet forms, Feynman integration and the Schrodinger's equation.

Stochastic Modelling of Reaction-Diffusion Processes. An introductory text providing the reader with a thorough background to the rich world of applications of stochastic processes.

Stochastic Processes with Applications. 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.

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

Applied Stochastic Processes Stochastic processes have wide relevance in mathematics both for theoretical aspects and for their numerous real-world applications in various domains. They represent a very active research field which is attracting the growing interest of scientists from a range of disciplines. This Special Issue aims to present a collection of current contributions concerning various topics related to stochastic processes and their applications. In particular, the focus here is on applications of stochastic processes as models of dynamic phenomena in research areas certain to be of interest, such as economics, statistical physics, queuing theory, biology, theoretical neurobiology, and reliability theory. Various contributions dealing with theoretical issues on stochastic processes are also included.

Stochastic Processes Being a systematic treatment of the modern theory of stochastic integrals and stochastic differential equations, the theory is developed within the martingale framework, which was developed by J.L. Doob and which plays an indispensable role in the modern theory of stochastic analysis. A considerable number of corrections and improvements have been made for the second edition of this classic work. In particular, major and substantial changes are in Chapter III and Chapter V where the sections treating excursions of Brownian Motion and the Malliavin Calculus have been expanded and refined. Sections discussing complex (conformal) martingales and Kahler diffusions have been added.

Stochastic Processes for Physicists 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.

Physics of Stochastic Processes This book introduces the theory of stochastic processes with applications taken from physics and finance. Fundamental concepts like the random walk or Brownian motion but also Levy-stable distributions are discussed. Applications are selected to show the interdisciplinary character of the concepts and methods. In the second edition of the book, a discussion of extreme events ranging from their mathematical definition to their importance for financial crashes was included. The exposition of basic notions of probability theory and the Brownian motion problem as well as the relation between conservative diffusion processes and quantum mechanics is expanded. The second edition also enlarges the treatment of financial markets. Beyond a presentation of geometric Brownian motion and the Black–Scholes approach to option pricing as well as the econophysics analysis of the stylized facts of financial markets, an introduction to agent based modeling approaches is given.

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