Ch 1 Wiener Process Brownian Motion

In an attempt to introduce application scientists and graduate students to the exciting topic of positive definite kernels and radial basis functions, this book presents modern theoretical results on kernel-based approximation methods and demonstrates their implementation in various settings. The authors explore the historical context of this fascinating topic and explain recent advances as strategies to address long-standing problems. Examples are drawn from fields as diverse as function approximation, spatial statistics, boundary value problems, machine learning, surrogate modeling and finance. Researchers from those and other fields can recreate the results within using the documented MATLAB code, also available through the online library. This combination of a strong theoretical foundation and accessible experimentation empowers readers to use positive definite kernels on their own problems of interest.

This book provides a versatile and lucid treatment of classic as well as modern probability theory, while integrating them with core topics in statistical theory and also some key tools in machine learning. It is written in an extremely accessible style, with elaborate motivating discussions and numerous worked out examples and exercises. The book has 20 chapters on a wide range of topics, 423 worked out examples, and 808 exercises. It is unique in its unification of probability and statistics, its coverage and its superb exercise sets, detailed bibliography, and in its substantive treatment of many topics of current importance. This book can be used as a text for a year long graduate course in statistics, computer science, or mathematics, for self-study, and as an invaluable research reference on probabiliity and its applications. Particularly worth mentioning are the treatments of distribution theory, asymptotics, simulation and Markov Chain Monte Carlo, Markov chains and martingales, Gaussian processes, VC theory, probability metrics, large deviations, bootstrap, the EM algorithm, confidence intervals, maximum likelihood and Bayes estimates, exponential families, kernels, and Hilbert spaces, and a self contained complete review of univariate probability.

Actuarial Models: The Mathematics of Insurance, Second Edition thoroughly covers the basic models of insurance processes. It also presents the mathematical frameworks and methods used in actuarial modeling. This second edition provides an even smoother, more robust account of the main ideas and models, preparing students to take exams of the Societ

This is a new book in biomathematics, which includes new models of stochastic non-linear biological systems and new results for these systems. These results are based on the new results for non-linear difference and differential equations in random media. This book contains: -New stochastic non-linear models of biological systems, such as biological systems in random media: epidemic, genetic selection, demography, branching, logistic growth and predator-prey models; -New results for scalar and vector difference equations in random media with applications to the stochastic biological systems in 1); -New results for stochastic non-linear biological systems, such as averaging, merging, diffusion approximation, normal deviations and stability; -New approach to the study of stochastic biological systems in random media such as random evolution approach.

A Primer

Problems and Methods

Proceedings of the Fourth International Conference

Probability for Statistics and Machine Learning

Kernel-based Approximation Methods using MATLAB

Originally published: San Francisco: Holden-Day, Inc., 1962; an unabridged republication of the third (1967) printing.

This book offers a concise introduction to stochastic analysis, particularly the Malliavin calculus. A detailed description is given of all technical tools necessary to describe the theory, such as the Wiener process, the Ornstein-Uhlenbeck process, and Sobolev spaces.

Applications of stochastic cal

Traditionally, non-quantum physics has been concerned with deterministic equations where the dynamics of the system are completely determined by initial conditions. A century ago the discovery of Brownian motion showed that nature need not be deterministic. However, it is only recently that there has been broad interest in nondeterministic and even chaotic systems, not only in physics but in ecology and economics. On a short term basis, the stock market is nondeterministic and often chaotic. Despite its significance, there are few books available that introduce the reader to modern ideas in stochastic systems. This book provides an introduction to this increasingly important field and includes a number of interesting applications.

This book provides an easily accessible, computationally-oriented introduction into the numerical solution of stochastic differential equations using computer experiments. It develops in the reader an ability to apply numerical methods solving stochastic differential equations. It also creates an intuitive understanding of the necessary theoretical background. Software containing programs for over 100 problems is available online.

Quantile Processes with Statistical Applications

The Langevin Equation

Effective Dynamics of Stochastic Partial Differential Equations

Tools for Computational Finance

Numerical Solution of Stochastic Differential Equations

Theory and Statistical Applications of Stochastic Processes

The numerical analysis of stochastic differential equations (SDEs) differs significantly from that of ordinary differential equations. This book provides an easily accessible introduction to SDEs, their applications and the numerical methods to solve such equations. From the reviews: "The authors draw upon their own research and experiences in obviously many disciplines... considerable time has obviously been spent writing this in the simplest language possible." --ZAMP

This volume first introduces the mathematical tools necessary for understanding and working with a broad class of applied stochastic models. The toolbox includes Gaussian processes, independently scattered measures such as Gaussian white noise and Poisson random measures, stochastic integrals, compound Poisson, infinitely divisible and stable distributions and processes. Next, it illustrates general concepts by handling a transparent but rich example of a OC teletraffic modelOCO. A minor tuning of a few parameters of the model leads to different workload regimes, including Wiener process, fractional Brownian motion and stable L(r)vy process. The simplicity of the dependence mechanism used in the model enables us to get a clear understanding of long and short range dependence phenomena. The model also shows how light or heavy distribution tails lead to continuous Gaussian processes or to processes with jumps in the limiting regime. Finally, in this volume, readers will find discussions on the multivariate extensions that admit a variety of completely different applied interpretations. The reader will quickly become familiar with key concepts that form a language for many major probabilistic models of real world phenomena but are often neglected in more traditional courses of stochastic processes. Sample Chapter(s). Chapter 1: Preliminaries (367 KB). Contents: Preliminaries: Random Variables: A Summary; From Poisson to Stable Variables; Limit Theorems for Sums and Domains of Attraction; Random Vectors; Random Processes: Random Processes: Main Classes; Examples of Gaussian Random Processes; Random Measures and Stochastic Integrals; Limit Theorems for Poisson Integrals; L(r)vy Processes; Spectral Representations; Convergence of Random Processes; Teletraffic Models: A Model of Service System; Limit Theorems for the Workload; Micropulse Model; Spacial Extensions. Readership: Graduate students and researchers in probability & statist

Diffusive motion--displacement due to the cumulative effect of irregular fluctuations--has been a fundamental concept in mathematics and physics since Einstein's work on Brownian motion. It is also relevant to understanding various aspects of quantum theory. This book explains diffusive motion and its relation to both nonrelativistic quantum theory and quantum field theory. It shows how diffusive motion concepts lead to a radical reexamination of the structure of mathematical analysis. The book's inspiration is Princeton University mathematics professor Edward Nelson's influential work in probability, functional analysis, nonstandard analysis, stochastic mechanics, and logic. The book can be used as a tutorial or reference, or read for pleasure by anyone interested in the role of mathematics in science. Because of the application of diffusive motion to quantum theory, it will interest physicists as well as mathematicians. The introductory chapter describes the interrelationships between the various themes, many of which were first brought to light by Edward Nelson. In his writing and conversation, Nelson has always emphasized and relished the human aspect of mathematical endeavor. In his intellectual world, there is no sharp boundary between the mathematical, the cultural, and the spiritual. It is fitting that the final chapter provides a mathematical perspective on musical theory, one that reveals an unexpected connection with some of the book's main themes.

Serving as the foundation for a one-semester course in stochastic processes for students familiar with elementary probability theory and calculus, Introduction to Stochastic Modeling, Fourth Edition, bridges the gap between basic probability and an intermediate level course in stochastic processes. The objectives of the text are to introduce students to the standard concepts and methods of stochastic modeling, to illustrate the rich diversity of applications of stochastic processes in the applied sciences, and to provide exercises in the application of simple stochastic analysis to realistic problems. New to this edition: Realistic applications from a variety of disciplines integrated throughout the text, including more biological applications Plentiful, completely updated problems Completely updated and reorganized end-of-chapter exercise sets, 250 exercises with answers New chapters of stochastic differential equations and Brownian motion and related processes Additional sections on Martingale and Poisson process Realistic applications from a variety of disciplines integrated throughout the text Extensive end of chapter exercises sets, 250 with answers Chapter 1-9 of the new edition are identical to the previous edition New! Chapter 10 - Random Evolutions New! Chapter 11- Characteristic functions and Their Applications

Bayesian Inference for Stochastic Processes

Actuarial Models

An Elementary Introduction with Applications

Diffusion, Quantum Theory, and Radically Elementary Mathematics. (MN-47)

The Mathematics of Insurance, Second Edition

High Dimensional Probability

This book concentrates on some general facts and ideas of the theory of stochastic processes. The topics include the Wiener process, stationary processes, infinitely divisible processes, and Ito stochastic equations. Basics of discrete time martingales are also presented and then used in one way or another throughout the book. Another common feature of the main body of the book is using stochastic integration with respect to random orthogonal measures. In particular, it is used for spectral representation of trajectories of stationary processes and for proving that Gaussian stationary processes with rational spectral densities are components of solutions to stochastic equations. In the case of infinitely divisible processes, stochastic integration allows for obtaining a representation of trajectories through jump measures. The Ito stochastic integral is also introduced as a particular case of stochastic integrals with respect to random orthogonal measures. Although it is not possible to cover even a noticeable portion of the topics listed above in a short book, it is hoped that after having followed the material presented here, the reader will have acquired a good understanding of what kind of results are available and what kind of techniques are used to obtain them. With more than 100 problems included, the book can serve as a text for an introductory course on stochastic processes or for independent study. Other works by this author published by the AMS include, Lectures on Elliptic and Parabolic Equations in Holder Spaces and Introduction to the Theory of Diffusion 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

A practical, entry-level text integrating the basic principles of applied mathematics and probability, and computational science.

This eagerly awaited textbook covers everything the graduate student in probability wants to know about Brownian motion, as well as the latest research in the area. Starting with the construction of Brownian motion, the book then proceeds to sample path properties like continuity and nowhere differentiability. Notions of fractal dimension are introduced early and are used throughout the book to describe fine properties of Brownian paths. The relation of Brownian motion and random walk is explored from several viewpoints, including a development of the theory of Brownian local times from random walk embeddings. Stochastic integration is introduced as a tool and an accessible treatment of the potential theory of Brownian motion clears the path for an extensive treatment of intersections of Brownian paths. An investigation of exceptional points on the Brownian path and an appendix on SLE processes, by Oded Schramm and Wendelin Werner, lead directly to recent research themes.

Stochastic Differential Equations In Science And Engineering (With Cd-rom)

Strong Approximations in Probability and Statistics

Random Processes by Example

Non-Parametric Statistical Diagnosis

Change of Time and Change of Measure

Introduction to the Theory of Random Processes

This edition contains more material. The largest addition is a new section on jump processes (Section 1.9). The derivation of a related partial integro differential equation is included in Appendix A3. More material is devoted to Monte Carlo simulation. An algorithm for the standard workhorse of in verting the normal distribution is added to Appendix A7. New figures and more exercises are intended to improve the clarity at some places. Several further references give hints on more advanced material and on important developments. Many small changes are hoped to improve the readability of this book. Further I have made an effort to correct misprints and errors that I knew about. A new domain is being prepared to serve the needs of the computational finance community, and to provide complementary material to this book. The address of the domain is www.compfin.de The domain is under construction; it replaces the website address www . mi. uni koeln.de/numerik/compfin/. Suggestions and remarks both on this book and on the domain are most welcome.

Risk Neutral Pricing and Financial Mathematics: A Primer provides a foundation to financial mathematics for those whose undergraduate quantitative preparation does not extend beyond calculus, statistics, and linear math. It covers a broad range of foundation topics related to financial modeling, including probability, discrete and continuous time and space valuation, stochastic processes, equivalent martingales, option pricing, and term structure models, along with related valuation and hedging techniques. The joint effort of two authors with a combined 70 years of academic and practitioner experience, Risk Neutral Pricing and Financial Mathematics takes a reader from learning the basics of beginning probability, with a refresher on differential calculus, all the way to Doob-Meyer, Ito, Girsanov, and SDEs. It can also serve as a useful resource for actuaries preparing for Exams FM and MFE (Society of Actuaries) and Exams 2 and 3F (Casualty Actuarial Society). Includes more subjects than other books, including probability, discrete and continuous time and space valuation, stochastic processes, equivalent martingales, option pricing, term structure models, valuation, and hedging techniques Emphasizes introductory financial engineering, financial modeling, and financial mathematics Suited for corporate training programs and professional association certification programs

This research monograph provides an introduction to tractable multidimensional diffusion models, where transition densities, Laplace transforms, Fourier transforms, fundamental solutions or functionals can be obtained in explicit form. The book also provides an introduction to the use of Lie symmetry group methods for diffusions, which allows to compute a wide range of functionals. Besides the well-known methodology on affine diffusions it presents a novel approach to affine processes with applications in finance. Numerical methods, including Monte Carlo and quadrature methods, are discussed together with supporting material on stochastic processes. Applications in finance, for instance, on credit risk and credit valuation adjustment are included in the book. The functionals of multidimensional diffusions analyzed in this book are significant for many areas of application beyond finance. The book is aimed at a wide readership, and develops an intuitive and rigorous understanding of the mathematics underlying the derivation of explicit formulas for functionals of multidimensional diffusions.

Provides a comprehensive theory of the approximations of quantile processes as well as some of their statistical applications.

Functionals of Multidimensional Diffusions with Applications to Finance

Degradation Processes in Reliability

Stochastic Analysis

Second Edition

An Introduction to Stochastic Modeling

Probability Theory III

A comprehensive introduction to the core issues of stochastic differential equations and their effective application Introduction to Stochastic Differential Equations with Applications to Modelling in Biology and Finance offers a comprehensive examination to the most important issues of stochastic differential equations and their applications. The author — a noted expert in the field — includes myriad illustrative examples in modelling dynamical phenomena subject to randomness, mainly in biology, bioeconomics and finance, that clearly demonstrate the usefulness of stochastic differential equations in these and many other areas of science and technology. The text also features real-life situations with experimental data, thus covering topics such as Monte Carlo simulation and statistical issues of estimation, model choice and prediction. The book includes the basic theory of option pricing and its effective application using real-life. The important issue of which stochastic calculus, Itô or Stratonovich, should be used in applications is dealt with and the associated controversy resolved. Written to be accessible for both mathematically advanced readers and those with a basic understanding, the text offers a wealth of exercises and examples of application. This important volume: Contains a complete introduction to the basic issues of stochastic differential equations and their effective application Includes many examples in modelling, mainly from the biology and finance fields Shows how to: Translate the physical dynamical phenomenon to mathematical models and back, apply with real data, use the models to study different scenarios and understand the effect of human interventions Conveys the intuition behind the theoretical concepts Presents exercises that are designed to enhance understanding Offers a supporting website that features solutions to exercises and R code for algorithm implementation Written for use by graduate students, from the areas of application or from mathematics and statistics, as well as academics and professionals wishing to study or to apply these models, Introduction to Stochastic Differential Equations with Applications to Modelling in Biology and Finance is the authoritative guide to understanding the issues of stochastic differential equations and their application.

This is a survey of stochastic calculus. The topics covered include: Brownian motion; the Ito integral; stochastic differential equations; Malliavin calculus; the general theory of random processes; and martingale theory.

Change of Time and Change of Measure provides a comprehensive account of two topics that are of particular significance in both theoretical and applied stochastics: random change of time and change of probability law. Random change of time is key to understanding the nature of various stochastic processes, and gives rise to interesting mathematical results and insights of importance for the modeling and interpretation of empirically observed dynamic processes. Change of probability law is a technique for solving central questions in mathematical finance, and also has a considerable role in insurance mathematics, large deviation theory, and other fields. The book comprehensively collects and integrates results from a number of scattered sources in the literature and discusses the importance of the results relative to the existing literature, particularly with regard to mathematical finance. In this Second Edition a Chapter 13 entitled 'A Wider View' has been added. This outlines some of the developments that have taken place in the area of Change of Time and Change of Measure since the publication of the First Edition. Most of these developments have their root in the study of the Statistical Theory of Turbulence rather than in Financial Mathematics and Econometrics, and they form part of the new research area termed 'Ambit Stochastics'.

Stochastic biomathematical models are becoming increasingly important as new light is shed on the role of noise in living systems. In certain biological systems, stochastic effects may even enhance a signal, thus providing a biological motivation for the noise observed in living systems. Recent advances in stochastic analysis and increasing computing power facilitate the analysis of more biophysically realistic models, and this book provides researchers in computational neuroscience and stochastic systems with an overview of recent developments. Key concepts are developed in chapters written by experts in their respective fields. Topics include: one-dimensional homogeneous diffusions and their boundary behavior, large deviation theory and its application in stochastic neurobiological models, a review of mathematical methods for stochastic neuronal integrate-and-fire models, stochastic partial differential equation models in neurobiology, and stochastic modeling of spreading cortical depression.

Stochastic Calculus

Physics of Stochastic Processes

Analytically Tractable Stochastic Stock Price Models

Brownian Motion

Numerical Solution of SDE Through Computer Experiments

How Randomness Acts in Time

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, Ito integration, stochastic analysis, stochastic differential equations, fractional Brownian motion and parameter estimation in diffusion models.

This volume of the Encyclopaedia is a survey of stochastic calculus, an increasingly important part of probability, authored by well-known experts in the field. The book addresses graduate students and researchers in probability theory and mathematical statistics, as well as physicists and engineers who need to apply stochastic methods.

This is the first book designed to introduce Bayesian inference procedures for stochastic processes. There are clear advantages to the Bayesian approach (including the optimal use of prior information). Initially, the book begins with a brief review of Bayesian inference and uses many examples relevant to the analysis of stochastic processes, including the four major types, namely those with discrete time and discrete state space and continuous time and continuous state space. The elements necessary to understanding stochastic processes are then introduced, followed by chapters devoted to the Bayesian analysis of such processes. It is important that a chapter devoted to the fundamental concepts in stochastic processes is included. Bayesian inference (estimation, testing hypotheses, and prediction) for discrete time Markov chains, for Markov jump processes, for normal processes (e.g. Brownian motion and the Ornstein–Uhlenbeck process), for traditional time series, and, lastly, for point and spatial processes are described in detail. Heavy emphasis is placed on many examples taken from biology and other scientific disciplines. In order analyses of stochastic processes, it will use R and WinBUGS. Features: Uses the Bayesian approach to make statistical Inferences about stochastic processes The R package is used to simulate realizations from different types of processes Based on realizations from stochastic processes, the WinBUGS package will provide the Bayesian analysis (estimation, testing hypotheses, and prediction) for the unknown parameters of stochastic processes To illustrate the Bayesian inference, many examples taken from biology, economics, and astronomy will reinforce the basic concepts of the subject A practical approach is implemented by considering realistic examples of interest to the scientific community WinBUGS and R code are provided in the text, allowing the reader to easily verify the results of the inferential procedures found in the many examples of the book Readers with a good background in two areas, probability theory and statistical inference, should be able to master the essential ideas of this book.

This book is devoted to parameter estimation in diffusion models involving fractional Brownian motion and related processes. For many years now, standard Brownian motion has been (and still remains) a popular model of randomness used to investigate processes in the natural sciences, financial markets, and the economy. The substantial limitation in the use of stochastic diffusion models with Brownian motion is due to the fact that the motion has independent increments, and, therefore, the random noise it generates is “white,” i.e., uncorrelated. However, many processes in the natural sciences, computer networks and financial markets have long-term or short-term dependences, i.e., the correlations of random noise in these processes are non-zero, and slowly or rapidly decrease with time. In particular, models of financial markets demonstrate various kinds of memory and usually this memory is modeled by fractional Brownian diffusion. Therefore, the book constructs diffusion models with memory and provides simple and suitable parameter estimation methods in these models, making it a valuable resource for all researchers in this field. The book is addressed to specialists and researchers in the theory and statistics of stochastic processes, practitioners who apply statistical methods of parameter estimation, graduate and post-graduate students who study mathematical modeling and statistics.

Stochastic Processes

Electromagnetic Scattering from Random Media

Stochastic Biomathematical Models

With Applications to Stochastic Problems in Physics, Chemistry and Electrical Engineering

Risk Neutral Pricing and Financial Mathematics

Modeling, Analysis, and Computation

Strong Approximations in Probability and Statistics presents strong invariance type results for partial sums and empirical processes of independent and identically distributed random variables (IIDRV). This seven-chapter text emphasizes the applicability of strong approximation methodology to a variety of problems of probability and statistics. Chapter 1 evaluates the theorems for Wiener and Gaussian processes that can be extended to partial sums and empirical processes of IIDRV through strong approximation methods, while Chapter 2 addresses the problem of best possible strong approximations of partial sums of IIDRV by a Wiener process. Chapters 3 and 4 contain theorems concerning the one-time parameter Wiener process and strong approximation for the empirical and quantile processes based on IIDRV. Chapter 5 demonstrate the validity of previously discussed theorems, including Brownian bridges and Kiefer process, for empirical and quantile processes. Chapter 6 illustrate the approximation of defined sequences of empirical density, regression, and characteristic functions by appropriate Gaussian processes. Chapter 7 deal with the application of strong approximation methodology to study weak and strong convergence properties of random size partial sum and empirical processes. This book will prove useful to mathematicians and advance mathematics students.

Non-Parametric Statistical Diagnosis

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.

Tools for Computational Finance offers a clear explanation of computational issues arising in financial mathematics. The new third edition is thoroughly revised and significantly extended, including an extensive new section on analytic methods, focused mainly on interpolation approach and quadratic approximation. Other new material is devoted to risk-neutrality, early-exercise curves, multidimensional Black-Scholes models, the integral representation of options and the derivation of the Black-Scholes equation. New figures, more exercises, and expanded background material make this guide a real must-to-have for everyone working in the world of financial engineering.

Applied Stochastic Processes and Control for Jump Diffusions

Evolution of Biological Systems in Random Media: Limit Theorems and Stability

Stochastic Processes and Calculus

with Applications to Neuronal Modeling

Parameter Estimation in Fractional Diffusion Models

Probability Theory and Stochastic Processes

Asymptotic analysis of stochastic stock price models is the central topic of the present volume. Special examples of such models are stochastic volatility models, that have been developed as an answer to certain imperfections in a celebrated Black-Scholes model of option pricing. In a stock price model with stochastic volatility, the random behavior of the volatility is described by a stochastic process. For instance, in the Hull-White model the volatility process is a geometric Brownian motion, the Stein-Stein model uses an Ornstein-Uhlenbeck process as the stochastic volatility, and in the Heston model a Cox-Ingersoll-Ross process governs the behavior of the volatility. One of the author's main goals is to provide sharp asymptotic formulas with error estimates for distribution densities of stock prices, option pricing functions, and implied volatilities in various stochastic volatility models. The author also establishes sharp asymptotic formulas for the implied volatility at extreme strikes in general stochastic stock price models. The present volume is addressed to researchers and graduate students working in the area of financial mathematics, analysis, or probability theory. The reader is expected to be familiar with elements of classical analysis, stochastic analysis and probability theory.

This book is a holistic and self-contained treatment of the analysis and numerics of random differential equations from a problem-centred point of view. An interdisciplinary approach is applied by considering state-of-the-art concepts of both dynamical systems and scientific computing. The red line pervading this book is the two-fold reduction of a random partial differential equation disturbed by some external force as present in many important applications in science and engineering. First, the random partial differential equation is reduced to a set of random ordinary differential equations in the spirit of the method of lines. These are then further reduced to a family of (deterministic) ordinary differential equations. The monograph will be of benefit, not only to mathematicians, but can also be used for interdisciplinary courses in informatics and engineering.

The book represents a conceptual shift away from current thinking in the theory of scattered waves, such that the fluctuations or physical noise inherent in the signals play the primary role in detection and classification. It is intended to radically change the approach to statistical processing of signals that are electromagnetic or wavelike in character.

The ultimate objective of this book is to present a panoramic view of the main stochastic processes which have an impact on applications, with complete proofs and exercises. Random processes play a central role in the applied sciences, including operations research, insurance, finance, biology, physics, computer and communications networks, and signal processing. In order to help the reader to reach a level of technical autonomy sufficient to understand the presented models, this book includes a reasonable dose of probability theory. On the other hand, the study of stochastic processes gives an opportunity to apply the main theoretical results of probability theory beyond classroom examples and in a non-trivial manner that makes this discipline look more attractive to the applications-oriented student. One can distinguish three parts of this book. The first four chapters are about probability theory, Chapters 5 to 8 concern random sequences, or discrete-time stochastic processes, and the rest of the book focuses on stochastic processes and point processes. There is sufficient modularity for the instructor or the self-teaching reader to design a course or a study program adapted to her/his specific needs. This book is in a large measure self-contained.

Introduction to Stochastic Differential Equations with Applications to Modelling in Biology and Finance

Fundamentals and Advanced Topics

Random Differential Equations in Scientific Computing

“Degradation process” refers to many types of reliability models, which correspond to various kinds of stochastic processes used for deterioration modeling. This book focuses on the case of a univariate degradation model with a continuous set of possible outcomes. The envisioned univariate models have one single measurable quantity which is assumed to be observed over time. The first three chapters are each devoted to one degradation model. The last chapter illustrates the use of the previously described degradation models on some real data sets. For each of the degradation models, the authors provide probabilistic results and explore simulation tools for sample paths generation. Various estimation procedures are also developed.

Effective Dynamics of Stochastic Partial Differential Equations focuses on stochastic partial differential equations with slow and fast time scales, or large and small spatial scales. The authors have developed basic techniques, such as averaging, slow manifolds, and homogenization, to extract effective dynamics from these stochastic partial differential equations. The authors’ experience both as researchers and teachers enable them to convert current research on extracting effective dynamics of stochastic partial differential equations into concise and comprehensive chapters. The book helps readers by providing an accessible introduction to probability tools in Hilbert space and basics of stochastic partial differential equations. Each chapter also includes exercises and problems to enhance comprehension. New techniques for extracting effective dynamics of infinite dimensional dynamical systems under uncertainty Accessible introduction to probability tools in Hilbert space and basics of stochastic partial differential equations Solutions or hints to all Exercises

Brownian MotionCambridge University Press