Stochastic Methods In Economics And Finance

Provides graduate students and practitioners in physics and economics with a better understanding of stochastic processes.
Existing works on stochastic processes belong to a field of abstract mathematics which puts them beyond the scope of the non-specialist. The preoccupations of research mathematicians being more often than not distant from the practical problems of experimental methodology, the needs of practical workers, though real, are not met by the majority of works that. deal with processes. By "practical workers", we mean research scientists in all the different disciplines: Physics, Chemistry, Biology, Medicine, Population, Economics, Organisation, Operational Research etc. Indeed, all scientific research today touches upon complex fields in which deterministic models can be useful for no more than an element ary and simple approximation. The Calculus of Probability although offering some interesting models is still inadequate in many instances, particularly in the study of evolving systems. The practical worker must therefore have at his disposal a set of original and varied stochastic models. These models must not be too general, for in that case not only would their theoretical study prove difficult, but above all the adaptation of such models to an observed system would lead to an estimation of a great number of parameters on the basis of a necessarily restricted sample. This would constitute an insuperable difficulty for the practical scientist. It is therefore essential for him to have at his disposal a varied range of very characteristic models.
Stochastic Methods in Economics and FinanceNorth Holland
With this book, distinguished and notable contributors wish to honor Professor Charles S. Tapiero’s scientific achievements. Although it covers only a few of the directions Professor Tapiero has taken in his work, it presents important modern developments in theory and in diverse applications, as studied by his colleagues and followers, further advancing the topics Tapiero has been investigating. The book is divided into three parts featuring original contributions covering the following areas: general modeling and analysis; applications to marketing, economy and finance; and applications to operations and manufacturing. Professor Tapiero is among the most active researchers in control theory; in the late sixties, he started to enthusiastically promote optimal control theory along with differential games, successfully applying it to diverse problems ranging from classical operations research models to finance, risk and insurance, marketing, transportation and operations management, conflict management and game theory, engineering, regional and urban sciences, environmental economics, and organizational behavior. Over the years, Professor Tapiero has produced over 300 papers and communications and 14 books, which have had a major impact on modern theoretical and applied research. Notable among his numerous pioneering scientific contributions are the use of graph theory in the behavioral sciences, the modeling of advertising as a random walk, the resolution of stochastic zero-sum differential games, the modeling of quality control as a stochastic competitive game, and the development of impulsive control methods in management. Charles Tapiero’s creativity applies both in formulating original issues, modeling complex phenomena and solving complex mathematical problems.
In The Economics of Inaction, leading economist Nancy Stokey shows how the tools of stochastic control can be applied to dynamic problems of decision making under uncertainty when fixed costs are present. Stokey provides a self-contained, rigorous, and clear treatment of two types of models, impulse and instantaneous control. She presents the relevant results about Brownian motion and other diffusion processes, develops methods for analyzing each type of problem, and discusses applications to price setting, investment, and durable goods

purchases."--Pub. desc.

The YUIMA package is the first comprehensive R framework based on S4 classes and methods which allows for the simulation of stochastic differential equations driven by Wiener process, Lévy processes or fractional Brownian motion, as well as CARMA, COGARCH, and Point processes. The package performs various central statistical analyses such as quasi maximum likelihood estimation, adaptive Bayes estimation, structural change point analysis, hypotheses testing, asynchronous covariance estimation, lead-lag estimation, LASSO model selection, and so on. YUIMA also supports stochastic numerical analysis by fast computation of the expected value of functionals of stochastic processes through automatic asymptotic expansion by means of the Malliavin calculus. All models can be multidimensional, multiparametric or non parametric.The book explains briefly the underlying theory for simulation and inference of several classes of stochastic processes and then presents both simulation experiments and applications to real data. Although these processes have been originally proposed in physics and more recently in finance, they are becoming popular also in biology due to the fact the time course experimental data are now available. The YUIMA package, available on CRAN, can be freely downloaded and this companion book will make the user able to start his or her analysis from the first page.

This book analyzes stochastic dynamic systems across a broad spectrum in economics and finance. The major unifying theme is the coherent and rigorous treatment of uncertainty and its implications for describing stochastic processes by the stochastic differential equations of the fundamental models in various fields. Pertinent subjects are interrelated, juxtaposed, and examined for consistency in theoretical and empirical contexts. The volume consists of three parts: Developments in Stochastic Dynamics; Stochastic Dynamics in Basic Economic Growth Models; and Intertemporal Optimization in Consumption, Finance, and Growth. Key topics include: fractional Brownian motion in finance; moment evolution of Gaussian and geometric Wiener diffusions; stochastic kinematics and stochastic mechanics; stochastic growth in continuous time; time delays and Hopf bifurcation; consumption and investment strategies; differential systems in finance and life insurance; uncertainty of technological innovations; investment and employment cycles; stochastic control theory; and risk aversion. The works collected in this book serves to bridge the "old" deterministic dynamics and the "new" stochastic dynamics. The collection is important for scholars and advanced graduate students of economics, statistics, and applied mathematics.

This incorporation of computer use into teaching and learning stochastic processes takes an applications- and computer-oriented approach rather than a mathematically rigorous approach. Solutions Manual available to instructors upon request. 1997 edition.

Mathematical Modeling in Economics and Finance is designed as a textbook for an upper-division course on modeling in the economic sciences. The emphasis throughout is on the modeling process including post-modeling analysis and criticism. It is a textbook on modeling that happens to focus on financial instruments for the management of economic risk. The book combines a study of mathematical modeling with exposure to the tools of probability theory, difference and differential equations, numerical simulation, data analysis, and mathematical analysis. Students taking a course from Mathematical Modeling in Economics and Finance will come to understand some basic stochastic processes and the solutions to stochastic differential equations. They will understand how to use those tools to model the management of financial risk. They will gain a deep appreciation for the modeling process and learn methods of testing and evaluation driven by data. The reader of this book will be successfully positioned for an entry-level position in the financial services industry or for beginning graduate study in finance, economics, or actuarial science.

The exposition in Mathematical Modeling in Economics and Finance is crystal clear and very student-friendly. The many exercises are extremely well designed. Steven Dunbar is Professor Emeritus of Mathematics at the University of Nebraska and he has won both university-wide and MAA prizes for extraordinary teaching. Dunbar served as Director of the MAA's American Mathematics Competitions from 2004 until 2015. His ability to communicate mathematics is on full display in this approachable, innovative text. Stochastic processes are indispensable tools for development and research in signal and image processing, automatic control, oceanography, structural reliability, environmetrics, climatology, econometrics, and many other areas of science and engineering. Suitable for a one-semester course, Stationary Stochastic Processes for Scientists and Engineers teaches students how to use these processes efficiently. Carefully balancing mathematical rigor and ease of exposition, the book provides students with a sufficient understanding of the theory and a practical appreciation of how it is used in real-life situations. Special emphasis is on the interpretation of various statistical models and concepts as well as the types of questions statistical analysis can answer. The text first introduces numerous examples from signal processing, economics, and general natural sciences and technology. It then covers the estimation of mean value and covariance functions, properties of stationary Poisson processes, Fourier analysis of the covariance function (spectral analysis), and the Gaussian distribution. The book also focuses on input-output relations in linear filters, describes discrete-time auto-regressive and moving average processes, and explains how to solve linear stochastic differential equations. It concludes with frequency analysis and estimation of spectral densities. With a focus on model building and interpreting the statistical concepts, this classroom-tested book conveys a broad understanding of the mechanisms that generate stationary stochastic processes. By combining theory and applications, the text gives students a well-rounded introduction to these processes. To enable hands-on practice, MATLAB® code is available online.

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An introduction to the mathematical theory and financial models developed and used on Wall Street Providing both a theoretical and practical approach to the underlying mathematical theory behind financial models, Measure, Probability, and Mathematical Finance: A Problem-Oriented Approach presents important concepts and results in measure theory, probability theory, stochastic processes, and stochastic calculus. Measure theory is indispensable to the rigorous development of probability theory and is also necessary to properly address martingale measures, the change of numeraire theory, and LIBOR market models. In addition, probability theory is presented to facilitate the development of stochastic processes, including martingales and Brownian motions, while stochastic processes and stochastic calculus are discussed to model asset prices and develop derivative pricing models. The authors promote a problem-solving approach when applying mathematics in real-world situations, and readers are encouraged to address theorems and problems with mathematical rigor. In addition, Measure, Probability, and Mathematical Finance features: A comprehensive list of concepts and theorems from measure theory, probability theory, stochastic processes, and stochastic calculus Over 500 problems with hints and select solutions to reinforce basic concepts and important theorems Classic derivative pricing models in mathematical finance that have been developed and published since the seminal work of

Black and Scholes Measure, Probability, and Mathematical Finance: A Problem-Oriented Approach is an ideal textbook for introductory quantitative courses in business, economics, and mathematical finance at the upper-undergraduate and graduate levels. The book is also a useful reference for readers who need to build their mathematical skills in order to better understand the mathematical theory of derivative pricing models.

This book presents the main applied aspects of stochas tic optimization in economic models. Stochastic processes and control theory are used under optimization to illustrate the various economic implications of optimal decision rules. Unlike econometrics which deals with estimation, this book emphasizes the decision-theoretic basis of uncertainty specified by the stochastic point of view. Methods of ap plied stochastic control using stochastic processes have now reached an exciti~g phase, where several disciplines like systems engineering, operations research and natural reso- ces interact along with the conventional fields such as mathematical economics, finance and control systems. Our objective is to present a critical overview of this broad terrain from a multidisciplinary viewpoint. In this attempt we have at times stressed viewpoints other than the purely economic one. We believe that the economist would find it most profitable to learn from the other disciplines where stochastic optimization has been successfully applied. It is in this spirit that we have discussed in some detail the following major areas: A. Portfolio models in ·:finance, B. Differential games under uncertainty, c. Self-tuning regulators, D. Models of renewable resources under uncertainty, and ix x PREFACE E. Nonparametric methods of efficiency measurement. Stochastic processes are now increasingly used in economic models to understand the various adaptive behavior implicit in the formulation of expectation and its application in decision rules which are optimum in some sense.

Algebraic, differential, and integral equations are used in the applied sciences, en gineering, economics, and the social sciences to characterize the current state of a physical, economic, or social system and forecast its evolution in time. Generally, the coefficients of and/or the input to these equations are not precisely known be cause of insufficient information, limited understanding of some underlying phe nomena, and inherent randonmess. For example, the orientation of the atomic lattice in the grains of a polycrystal varies randomly from grain to grain, the spa tial distribution of a phase of a composite material is not known precisely for a particular specimen, bone properties needed to develop reliable artificial joints vary significantly with individual and age, forces acting on a plane from takeoff to landing depend in a complex manner on the environmental conditions and flight pattern, and stock prices and their evolution in time depend on a large number of factors that cannot be described by deterministic models. Problems that can be defined by algebraic, differential, and integral equations with random coefficients and/or input are referred to as stochastic problems. The main objective of this book is the solution of stochastic problems, that is, the determination of the probability law, moments, and/or other probabilistic properties of the state of a physical, economic, or social system. It is assumed that the operators and inputs defining a stochastic problem are specified.

Dedicated to the Russian mathematician Albert Shiryaev on his 70th birthday, this is a collection of papers written by his former students, co-authors and colleagues. The book represents the modern state of art of a quickly maturing theory and will be an

essential source and reading for researchers in this area. Diversity of topics and comprehensive style of the papers make the book attractive for PhD students and young researchers.

This book presents basic stochastic processes, stochastic calculus including Lévy processes on one hand, and Markov and Semi Markov models on the other. From the financial point of view, essential concepts such as the Black and Scholes model, VaR indicators, actuarial evaluation, market values, fair pricing play a central role and will be presented. The authors also present basic concepts so that this series is relatively self-contained for the main audience formed by actuaries and particularly with ERM (enterprise risk management) certificates, insurance risk managers, students in Master in mathematics or economics and people involved in Solvency II for insurance companies and in Basel II and III for banks.

Stochastic processes are powerful tools for the investigation of reliability and availability of repairable equipment and systems. Because of the involved models, and in order to be mathematically tractable, these processes are generally confined to the class of regenerative stochastic processes with a finite state space, to which belong: renewal processes, Markov processes, semi-Markov processes, and more general regenerative processes with only one (or a few) regeneration staters). The object of this monograph is to review these processes and to use them in solving some reliability problems encountered in practical applications. Emphasis is given to a comprehensive exposition of the analytical procedures, to the limitations in volved, and to the unification and extension of. the models known in the literature. The models investigated here assume. that systems have only one repair crew and that no further failure can occur at system down. Repair and failure rates are general ized step-by-step, up to the case in which the involved process is regenerative with only one (or a few) regeneration state(s). Investigations deal with different kinds of reliabilities and availabilities for series/parallel structures. Preventive main tenance and imperfect switching are considered in some examples.

The aim of this special issue is to publish original research papers that cover recent advances in the theory and application of stochastic processes. There is especial focus on applications of stochastic processes as models of dynamic phenomena in various research areas, such as queuing theory, physics, biology, economics, medicine, reliability theory, and financial mathematics. Potential topics include, but are not limited to: Markov chains and processes; large deviations and limit theorems; random motions; stochastic biological model; reliability, availability, maintenance, inspection; queueing models; queueing network models; computational methods for stochastic models; applications to risk theory, insurance and mathematical finance.

Applied Stochastic Models and Control for Finance and Insurance presents at an introductory level some essential stochastic models applied in economics, finance and insurance. Markov chains, random walks, stochastic differential

equations and other stochastic processes are used throughout the book and systematically applied to economic and financial applications. In addition, a dynamic programming framework is used to deal with some basic optimization problems. The book begins by introducing problems of economics, finance and insurance which involve time, uncertainty and risk. A number of cases are treated in detail, spanning risk management, volatility, memory, the time structure of preferences, interest rates and yields, etc. The second and third chapters provide an introduction to stochastic models and their application. Stochastic differential equations and stochastic calculus are presented in an intuitive manner, and numerous applications and exercises are used to facilitate their understanding and their use in Chapter 3. A number of other processes which are increasingly used in finance and insurance are introduced in Chapter 4. In the fifth chapter, ARCH and GARCH models are presented and their application to modeling volatility is emphasized. An outline of decision-making procedures is presented in Chapter 6. Furthermore, we also introduce the essentials of stochastic dynamic programming and control, and provide first steps for the student who seeks to apply these techniques. Finally, in Chapter 7, numerical techniques and approximations to stochastic processes are examined. This book can be used in business, economics, financial engineering and decision sciences schools for second year Master's students, as well as in a number of courses widely given in departments of statistics, systems and decision sciences.

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.

The theory of controlled processes is one of the most recent mathematical theories to show very important applications in modern engineering, parti cularly for constructing automatic control systems, as well as for problems of economic control. However, actual systems subject to control do not admit a strictly deterministic analysis in view of random factors of various kinds which influence their behavior. Such factors include, for example, random noise occurring in the electrical

system, variations in the supply and demand of commodities, fluctuations in the labor force in economics, and random failures of components on an automated line. The theory of con trolled processes takes the random nature of the behavior of a system into account. In such cases it is natural, when choosing a control strategy, to proceed from the average expected result, taking note of all the possible variants of the behavior of a controlled system. An extensive literature is devoted to various economic and engineering systems of control (some of these works are listed in the Bibliography). is no text which adequately covers the general However, as of now there mathematical theory of controlled processes. The authors ofthis monograph have attempted to fill this gap. In this volume the general theory of discrete-parameter (time) controlled processes (Chapter 1) and those with continuous-time (Chapter 2), as well as the theory of controlled stochastic differential equations (Chapter 3), are presented.

In a world dominated by uncertainty, modeling and understanding the optimal behavior of agents is of the utmost importance. Many problems in economics, finance, and actuarial science naturally require decision makers to undertake choices in stochastic environments. Examples include optimal individual consumption and retirement choices, optimal management of portfolios and risk, hedging, optimal timing issues in pricing American options, and investment decisions. Stochastic control theory provides the methods and results to tackle all such problems. This book is a collection of the papers published in the Special Issue "Applications of Stochastic Optimal Control to Economics and Finance", which appeared in the open access journal Risks in 2019. It contains seven peer-reviewed papers dealing with stochastic control models motivated by important questions in economics and finance. Each model is rigorously mathematically funded and treated, and the numerical methods are employed to derive the optimal solution. The topics of the book's chapters range from optimal public debt management to optimal reinsurance, real options in energy markets, and optimal portfolio choice in partial and complete information settings. From a mathematical point of view, techniques and arguments of dynamic programming theory, filtering theory, optimal stopping, one-dimensional diffusions and multi-dimensional jump processes are used.

Renewable energy resources have been rapidly integrated into power systems in many parts of the world, contributing to a cleaner and more sustainable supply of electricity. Wind and solar resources also introduce new challenges for system operations and planning in terms of economics and reliability because of their variability and uncertainty. Operational strategies based on stochastic optimization have been developed recently to address these challenges. In general terms, these stochastic strategies either embed uncertainties into the scheduling formulations (e.g., the unit commitment [UC] problem) in probabilistic forms or develop more appropriate operating reserve strategies to take advantage of advanced forecasting techniques. Other approaches to address uncertainty are also proposed, where operational feasibility is

ensured within an uncertainty set of forecasting intervals. In this report, a comprehensive review is conducted to present the state of the art through Spring 2015 in the area of stochastic methods applied to power system operations with high penetration of renewable energy. Chapters 1 and 2 give a brief introduction and overview of power system and electricity market operations, as well as the impact of renewable energy and how this impact is typically considered in modeling tools. Chapter 3 reviews relevant literature on operating reserves and specifically probabilistic methods to estimate the need for system reserve requirements. Chapter 4 looks at stochastic programming formulations of the UC and economic dispatch (ED) problems, highlighting benefits reported in the literature as well as recent industry developments. Chapter 5 briefly introduces alternative formulations of UC under uncertainty, such as robust, chance-constrained, and interval programming. Finally, in Chapter 6, we conclude with the main observations from our review and important directions for future work.

Statistical inference carries great significance in model building from both the theoretical and the applications points of view. Its applications to engineering and economic systems, financial economics, and the biological and medical sciences have made statistical inference for stochastic processes a well-recognized and important branch of statistics and probability. The class of semimartingales includes a large class of stochastic processes, including diffusion type processes, point processes, and diffusion type processes with jumps, widely used for stochastic modeling. Until now, however, researchers have had no single reference that collected the research conducted on the asymptotic theory for semimartingales. Semimartingales and their Statistical Inference, fills this need by presenting a comprehensive discussion of the asymptotic theory of semimartingales at a level needed for researchers working in the area of statistical inference for stochastic processes. The author brings together into one volume the state-of-the-art in the inferential aspect for such processes. The topics discussed include: Asymptotic likelihood theory Quasi-likelihood Likelihood and efficiency Inference for counting processes Inference for semimartingale regression models The author addresses a number of stochastic modeling applications from engineering, economic systems, financial economics, and medical sciences. He also includes some of the new and challenging statistical and probabilistic problems facing today's active researchers working in the area of inference for stochastic processes.

This book showcases a subclass of hereditary systems, that is, systems with behaviour depending not only on their current state but also on their past history; it is an introduction to the mathematical theory of optimal control for stochastic difference Volterra equations of neutral type. As such, it will be of much interest to researchers interested in modelling processes in physics, mechanics, automatic regulation, economics and finance, biology, sociology and medicine for all of which such equations are very popular tools. The text deals with problems of optimal control such as meeting given performance criteria, and stabilization, extending them to neutral stochastic difference Volterra equations. In particular, it contrasts the difference analogues of solutions to optimal control and optimal estimation problems for stochastic integral Volterra

equations with optimal solutions for corresponding problems in stochastic difference Volterra equations. Optimal Control of Stochastic Difference Volterra Equations commences with an historical introduction to the emergence of this type of equation with some additional mathematical preliminaries. It then deals with the necessary conditions for optimality in the control of the equations and constructs a feedback control scheme. The approximation of stochastic quasilinear Volterra equations with quadratic performance functionals is then considered. Optimal stabilization is discussed and the filtering problem formulated. Finally, two methods of solving the optimal control problem for partly observable linear stochastic processes, also with quadratic performance functionals, are developed. Integrating the author's own research within the context of the current state-of-the-art of research in difference equations, hereditary systems theory and optimal control, this book is addressed to specialists in mathematical optimal control theory and to graduate students in pure and applied mathematics and control engineering.

In Part I, the fundamentals of financial thinking and elementary mathematical methods of finance are presented. The method of presentation is simple enough to bridge the elements of financial arithmetic and complex models of financial math developed in the later parts. It covers characteristics of cash flows, yield curves, and valuation of securities. Part II is devoted to the allocation of funds and risk management: classics (Markowitz theory of portfolio), capital asset pricing model, arbitrage pricing theory, asset & liability management, value at risk. The method explanation takes into account the computational aspects. Part III explains modeling aspects of multistage stochastic programming on a relatively accessible level. It includes a survey of existing software, links to parametric, multiobjective and dynamic programming, and to probability and statistics. It focuses on scenario-based problems with the problems of scenario generation and output analysis discussed in detail and illustrated within a case study.

The field of stochastic processes is essentially a branch of probability theory, treating probabilistic models that evolve in time. It is best viewed as a branch of mathematics, starting with the axioms of probability and containing a rich and fascinating set of results following from those axioms. Although the results are applicable to many areas, they are best understood initially in terms of their mathematical structure and interrelationships. Applying axiomatic probability results to a real-world area requires creating a probability model for the given area. Stochastic processes were first studied rigorously in the late 19th century to aid in understanding financial markets and Brownian motion. These subjects originally had an application emphasis, the first on queueing and congestion in data networks and the second on modulation and detection of signals in the presence of noise. It has become increasingly clear that the mathematical development is applicable to a much broader set of applications in engineering, operations research, physics, biology, economics, finance, statistics, etc. Stochastic Processes and their Applications emphasizes on the theory and applications of stochastic processes. It is concerned with concepts and techniques, and is oriented towards a broad spectrum of mathematical, scientific and engineering interests. Characterization, structural properties, inference and control of stochastic processes are covered.

When I wrote the book Quantitative Sociodynamics, it was an early attempt to make methods from statistical physics and complex systems theory fruitful for the modeling and understanding of social phenomena. Unfortunately, the ?rst edition appeared at a quite prohibitive price. This was one reason to make these chapters available again by a new edition. The other reason is that, in the meantime, many of the methods discussed in this book are more and more used in a variety of different ?elds. Among the ideas worked out in this book are: 1 • a statistical theory of binary social interactions, • a mathematical formulation of social ?eld theory, which is the basis of social 2 force models, • a microscopic foundation of evolutionary game theory, based on what is known today as 'proportional imitation rule', a stochastic treatment

of interactions in evolutionary game theory, and a model for the self-organization of behavioral 3 conventions in a coordination game. It, therefore, appeared reasonable to make this book available again, but at a more affordable price. To keep its original character, the translation of this book, which 1 D. Helbing, Interrelations between stochastic equations for systems with pair interactions. Ph- icaA 181, 29–52 (1992); D. Helbing, Boltzmann-like and Boltzmann-Fokker-Planck equations as a foundation of behavioral models. PhysicaA 196, 546–573 (1993). 2 D. Helbing, Boltzmann-like and Boltzmann-Fokker-Planck equations as a foundation of beh- ioral models. PhysicaA 196, 546–573 (1993); D.

Quantitative Sociodynamics presents a general strategy for interdisciplinary model building and its application to a quantitative description of behavioural changes based on social interaction processes. Originally, the crucial methods for the modeling of complex systems (stochastic methods and nonlinear dynamics) were developed in physics but they have very often proved their explanatory power in chemistry, biology, economics and the social sciences. Quantitative Sociodynamics provides a unified and comprehensive overview of the different stochastic methods, their interrelations and properties. In addition, it introduces the most important concepts from nonlinear dynamics (synergetics, chaos theory). The applicability of these fascinating concepts to social phenomena is carefully discussed. By incorporating decision-theoretical approaches a very fundamental dynamic model is obtained which seems to open new perspectives in the social sciences. It includes many established models as special cases, e.g. the logistic equation, the gravity model, some diffusion models, the evolutionary game theory and the social field theory, but it also implies numerous new results. Examples concerning opinion formation, migration, social field theory; the self-organization of behavioural conventions as well as the behaviour of customers and voters are presented and illustrated by computer simulations. Quantitative Sociodynamics is relevant both for social scientists and natural scientists who are interested in the application of stochastic and synergetics concepts to interdisciplinary topics.

?This book aims to further develop the theory of stochastic functional inclusions and their applications for describing the solutions of the initial and boundary value problems for partial differential inclusions. The self-contained volume is designed to introduce the reader in a systematic fashion, to new methods of the stochastic optimal control theory from the very beginning. The exposition contains detailed proofs and uses new and original methods to characterize the properties of stochastic functional inclusions that, up to the present time, have only been published recently by the author. The work is divided into seven chapters, with the first two acting as an introduction, containing selected material dealing with point- and set-valued stochastic processes, and the final two devoted to applications and optimal control problems. The book presents recent and pressing issues in stochastic processes, control, differential games, optimization and their application in finance, manufacturing, queueing networks, and climate control. Written by an award-winning author in the field of stochastic differential inclusions and their application to control theory, This book is intended for students and researchers in mathematics and applications; particularly those studying optimal control theory. It is also highly relevant for students of economics and engineering. The book can also be used as a reference on stochastic differential inclusions. Knowledge of select topics in analysis and probability theory are required.

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.

"This book presents a balanced blend of pure finance and contract theory in the presence of risk, alternative forms of information structures,

and static and dynamic frameworks. In particular, it provides an introduction to the use of stochastic methods in financial economics and finance. The following topics are covered: financial risk and asset pricing and asset returns under alternative contractual arrangements, portfolio choice, individual behavior towards risk, general equilibrium under uncertainty in discrete and continuous time settings, indivisibilities and nonconvexities in a general equilibrium context, contract theory, mechanism design and principal-agent relationships in partial and general equilibrium contexts, credit markets, and option pricing."

This research monograph presents results to researchers in stochastic calculus, forward and backward stochastic differential equations, connections between diffusion processes and second order partial differential equations (PDEs), and financial mathematics. It pays special attention to the relations between SDEs/BSDEs and second order PDEs under minimal regularity assumptions, and also extends those results to equations with multivalued coefficients. The authors present in particular the theory of reflected SDEs in the above mentioned framework and include exercises at the end of each chapter. Stochastic calculus and stochastic differential equations (SDEs) were first introduced by K. Itô in the 1940s, in order to construct the path of diffusion processes (which are continuous time Markov processes with continuous trajectories taking their values in a finite dimensional vector space or manifold), which had been studied from a more analytic point of view by Kolmogorov in the 1930s. Since then, this topic has become an important subject of Mathematics and Applied Mathematics, because of its mathematical richness and its importance for applications in many areas of Physics, Biology, Economics and Finance, where random processes play an increasingly important role. One important aspect is the connection between diffusion processes and linear partial differential equations of second order, which is in particular the basis for Monte Carlo numerical methods for linear PDEs. Since the pioneering work of Peng and Pardoux in the early 1990s, a new type of SDEs called backward stochastic differential equations (BSDEs) has emerged. The two main reasons why this new class of equations is important are the connection between BSDEs and semilinear PDEs, and the fact that BSDEs constitute a natural generalization of the famous Black and Scholes model from Mathematical Finance, and thus offer a natural mathematical framework for the formulation of many new models in Finance.

Theory and application of a variety of mathematical techniques in economics are presented in this volume. Topics discussed include: martingale methods, stochastic processes, optimal stopping, the modeling of uncertainty using a Wiener process, Itô's Lemma as a tool of stochastic calculus, and basic facts about stochastic differential equations. The notion of stochastic ability and the methods of stochastic control are discussed, and their use in economic theory and finance is illustrated with numerous applications. The applications covered include: futures, pricing, job search, stochastic capital theory, stochastic economic growth, the rational expectations hypothesis, a stochastic macroeconomic model, competitive firm under price uncertainty, the Black-Scholes option pricing theory, optimum consumption and portfolio rules, demand for index bonds, term structure of interest rates, the market risk adjustment in project valuation, demand for cash balances and an asset pricing model.

In this 2007 book, the authors reconceptualize existing macroeconomics by treating equilibria as statistical distributions, not as fixed points. Bayesian analysis of complex models based on stochastic processes has in recent years become a growing area. This book provides a unified treatment of Bayesian analysis of models based on stochastic processes, covering the main classes of stochastic processing including modeling, computational, inference, forecasting, decision making and important applied models. Key features: Explores Bayesian analysis of models based on stochastic processes, providing a unified treatment. Provides a thorough introduction for research students. Computational tools to deal with complex problems are illustrated along with real life case studies Looks at inference, prediction and decision

making. Researchers, graduate and advanced undergraduate students interested in stochastic processes in fields such as statistics, operations research (OR), engineering, finance, economics, computer science and Bayesian analysis will benefit from reading this book. With numerous applications included, practitioners of OR, stochastic modelling and applied statistics will also find this book useful.

Stochastic Methods for Flow in Porous Media: Coping with Uncertainties explores fluid flow in complex geologic environments. The parameterization of uncertainty into flow models is important for managing water resources, preserving subsurface water quality, storing energy and wastes, and improving the safety and economics of extracting subsurface mineral and energy resources. This volume systematically introduces a number of stochastic methods used by researchers in the community in a tutorial way and presents methodologies for spatially and temporally stationary as well as nonstationary flows. The author compiles a number of well-known results and useful formulae and includes exercises at the end of each chapter. * As never seen before: * Balanced viewpoint of several stochastic methods, including Greens' function, perturbative expansion, spectral, Feynman diagram, adjoint state, Monte Carlo simulation, and renormalization group methods * Tutorial style of presentation will facilitate use by readers without a prior in-depth knowledge of Stochastic processes * Practical examples throughout the text * Exercises at the end of each chapter reinforce specific concepts and techniques * For the reader who is interested in hands-on experience, a number of computer codes are included and discussed

Stochastic Economics: Stochastic Processes, Control, and Programming presents some aspects of economics from a stochastic or probabilistic point of view. The application of stochastic processes to the theory of economic development, stochastic control theory, and various aspects of stochastic programming is discussed. Comprised of four chapters, this book begins with a short survey of the stochastic view in economics, followed by a discussion on discrete and continuous stochastic models of economic development. The next chapter focuses on methods of stochastic control and their application to dynamic economic models, with emphasis on those aspects connected especially with the theory of quantitative economic policy. Some basic operational problems of applying stochastic control, particularly in economic systems and organizations for problems such as dynamic resource allocation, growth planning, and economic coordination are considered. The last chapter is devoted to stochastic programming, paying particular attention to the decision rule theory of operations research under the chance-constrained model and a method of incorporating reliability measures into a systems reliability model. This book will be of interest to economists, statisticians, applied mathematicians, operations researchers, and systems engineers.