continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability

Continuous Time Stochastic Control and Optimization with Financial Applications Stochastic Modelling and Applied Probability

continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability form the backbone of many modern quantitative finance techniques. These areas blend advanced mathematical theories with practical financial models to help decision-makers navigate uncertain, dynamic environments. Whether it’s managing a portfolio under risk, pricing complex derivatives, or optimizing investment strategies, the tools developed from continuous-time stochastic control and applied probability offer powerful frameworks to model randomness and optimize outcomes over time.

Understanding these concepts is essential for anyone diving into financial engineering, risk management, or algorithmic trading. In this article, we’ll explore the core ideas behind continuous time stochastic control and optimization, delve into how stochastic modelling is applied in finance, and unpack the role of applied probability in this fascinating intersection of math and finance.

The Essence of Continuous Time Stochastic Control

Continuous time stochastic control is a branch of mathematics that deals with making optimal decisions over time in systems influenced by randomness. Unlike deterministic control, where outcomes are fully predictable, stochastic control acknowledges uncertainty—often modeled through stochastic differential equations (SDEs)—and seeks strategies that adapt as new information unfolds.

In finance, this approach is especially relevant because asset prices, interest rates, and market indices evolve unpredictably. Modeling these dynamics continuously rather than at discrete intervals captures more realistic market behavior and allows for dynamic hedging and portfolio rebalancing.

Key Mathematical Foundations

At its core, continuous time stochastic control leverages:

- **Stochastic Differential Equations (SDEs):** These equations describe the evolution of systems influenced by random noise, typically modeled as Brownian motion. For example, the famous Black-Scholes model uses an SDE to represent stock price movements.

- **Hamilton-Jacobi-Bellman (HJB) Equations:** The HJB equation is a partial differential equation that characterizes the value function representing the best expected outcome achievable from any state. Solving the HJB equation provides the optimal control strategy.

- **Dynamic Programming Principle:** This principle breaks down complex decision-making into simpler subproblems, making it possible to optimize control policies over continuous time horizons.

These mathematical tools enable financial engineers to formulate problems such as: How should an investor allocate wealth between risky and riskless assets over time to maximize expected utility? Or, how can a trader optimally hedge an option given transaction costs and market volatility?

Stochastic Modelling in Finance: Bridging Theory and Practice

Stochastic modelling is the practice of representing uncertain financial variables using probabilistic models. It provides a framework to simulate and predict the behavior of asset prices, interest rates, credit risks, and more. When combined with continuous time stochastic control, it forms a comprehensive approach to optimization under uncertainty.

Applications of Stochastic Models

Financial markets are rife with unpredictability. Stochastic models help quantify this uncertainty, enabling practitioners to:

- **Price Derivatives:** Models like Black-Scholes, Heston, and Merton’s jump-diffusion utilize stochastic processes to value options and other derivatives.

- **Risk Management:** Value at Risk (VaR), Expected Shortfall, and other risk measures rely on stochastic simulations to estimate potential losses.

- **Portfolio Optimization:** Incorporating stochastic models of asset returns allows investors to optimize allocation dynamically, considering changing market conditions.

- **Interest Rate Modelling:** Models such as Vasicek, Cox-Ingersoll-Ross (CIR), and Heath-Jarrow-Morton (HJM) describe the evolution of interest rates with stochastic elements, crucial for fixed income pricing.

Challenges in Stochastic Modelling

While stochastic models are powerful, several practical challenges arise:

- **Model Calibration:** Fitting models to real market data is non-trivial and often requires sophisticated statistical techniques.

- **Computational Complexity:** Solving continuous time control problems and simulating stochastic processes can be computationally intensive.

- **Model Risk:** Overreliance on a particular stochastic model can lead to underestimating risks if the model assumptions are violated.

Despite these challenges, advances in computational methods and machine learning are enhancing model accuracy and applicability.

Applied Probability: The Statistical Backbone of Financial Optimization

Applied probability underpins the theoretical and empirical aspects of continuous time stochastic control and stochastic modelling. It provides the tools to quantify uncertainty, analyze random phenomena, and evaluate the performance of financial strategies.

Role of Applied Probability in Control and Optimization

Applied probability contributes through:

- **Markov Processes:** Many stochastic control problems assume the underlying system is Markovian, meaning future states depend only on the current state, not the history.

- **Martingale Theory:** Martingales are fundamental in option pricing and hedging, ensuring no-arbitrage conditions and fair game properties.

- **Large Deviations and Limit Theorems:** These concepts help assess the likelihood of rare events, crucial for stress testing and risk assessment.

- **Stochastic Calculus:** Tools such as Itô’s lemma enable manipulation of stochastic integrals and differentiation, essential for deriving control policies.

Integrating applied probability with stochastic control allows for rigorous formulation and solution of optimization problems under uncertainty.

Examples of Financial Problems Using Applied Probability

- **Optimal Consumption and Portfolio Selection:** Determining how an investor should consume and invest over time to maximize expected utility.

- **Optimal Stopping Problems:** Deciding the best time to exercise an American option or liquidate an asset.

- **Risk-Sensitive Control:** Designing strategies that account not only for expected returns but also for variability and downside risks.

In these scenarios, the probabilistic framework ensures strategies are robust against the randomness inherent in financial markets.

Integrating Continuous Time Stochastic Control with Financial Applications

Financial applications benefit immensely from the synergy of continuous time stochastic control, stochastic modelling, and applied probability. The integration facilitates more realistic and adaptive decision-making frameworks.

Portfolio Optimization Under Continuous Time Framework

One of the quintessential applications is in portfolio management. Investors face the challenge of allocating assets dynamically in response to market changes and personal goals. Continuous time models, such as the Merton portfolio problem, model an investor’s wealth using stochastic differential equations influenced by portfolio choices.

The optimization objective often involves maximizing expected utility of terminal wealth or consumption over time. The solution involves solving an

HJB equation derived from dynamic programming, yielding optimal investment and consumption policies.

Risk Management and Hedging Strategies

Hedging involves mitigating the risk of adverse price movements in financial instruments. Continuous time stochastic control allows traders to adjust hedge positions dynamically in response to evolving market states. This is particularly important when markets are incomplete or when transaction costs exist.

For example, delta hedging in option pricing uses continuous trading strategies derived from stochastic calculus and control theory to neutralize risk.

Algorithmic Trading and Execution

In high-frequency trading, decisions must be made rapidly and continuously. Stochastic control models help design optimal execution algorithms that minimize market impact and transaction costs while maximizing trade efficiency.

Applied probability techniques estimate the likelihood of market events, while stochastic models forecast price dynamics, enabling adaptive control policies.

Practical Tips for Applying These Concepts in Finance

- **Start with Simplified Models:** Begin with classical models like Black-Scholes or Merton's problem to build intuition before tackling more complex frameworks.

- **Leverage Numerical Methods:** Analytical solutions to HJB equations are rare; numerical techniques like finite difference methods, Monte Carlo simulations, and machine learning-based approximations are invaluable.

- **Incorporate Realistic Constraints:** Consider transaction costs, liquidity constraints, and model uncertainty to ensure practical relevance.

- **Stay Informed on Market Data:** Regularly calibrate models with updated data to maintain accuracy.

- **Combine with Data-Driven Approaches:** Hybrid methods blending stochastic control with reinforcement learning can enhance performance in complex environments.

Emerging Trends and Future Directions

The landscape of continuous time stochastic control and financial applications is evolving rapidly. Some exciting directions include:

- **Deep Reinforcement Learning:** Combining stochastic control theory with neural networks to solve high-dimensional control problems in finance.

- **Robust Control:** Developing strategies that perform well under model ambiguity and adversarial scenarios.

- **Stochastic Control with Jumps:** Incorporating sudden market shocks and discontinuities using jump processes for more accurate modelling.

- **Multi-Agent and Game-Theoretic Models:** Addressing interactions among multiple market participants through stochastic differential games.

These advancements promise to deepen the impact of stochastic modelling and applied probability in financial decision-making.

Exploring continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability reveals a rich tapestry of theory and practice. From the elegant mathematics of stochastic calculus to the practical challenges of trading and risk management, this field continues to be a cornerstone of quantitative finance, guiding how we understand and navigate uncertainty in financial markets.

Frequently Asked Questions

What is continuous time stochastic control and how is it applied in finance?

Continuous time stochastic control involves optimizing decision-making processes over time in the presence of uncertainty modeled by stochastic processes. In finance, it is used for portfolio optimization, option pricing, and risk management by modeling asset prices and interest rates as continuous stochastic processes.

How does the Hamilton-Jacobi-Bellman (HJB) equation relate to stochastic control problems?

The Hamilton-Jacobi-Bellman equation is a partial differential equation that characterizes the value function of a stochastic control problem. It provides a necessary condition for optimality and is fundamental in deriving optimal strategies in continuous time stochastic control and optimization.

What are some common stochastic processes used in financial modeling within stochastic control frameworks?

Common stochastic processes include Brownian motion (Wiener process), geometric Brownian motion for asset prices, Ornstein-Uhlenbeck processes for interest rates, and jump-diffusion processes to capture sudden market movements.

How does stochastic control theory help in portfolio optimization?

Stochastic control theory provides a framework to dynamically adjust portfolio allocations over time in response to evolving market conditions and uncertainties, aiming to maximize expected returns or utility while controlling risk.

What role does applied probability play in continuous time stochastic control for financial applications?

Applied probability offers the mathematical foundation for modeling randomness and uncertainty in financial systems, enabling the formulation and solution of stochastic control problems through tools like martingales, Markov processes, and measure theory.

Can you explain the concept of stochastic differential equations (SDEs) in this context?

Stochastic differential equations describe the evolution of random processes over continuous time, incorporating both deterministic trends and stochastic noise. They are essential for modeling asset prices and other financial variables in stochastic control problems.

What are some practical challenges in applying continuous time stochastic control models in finance?

Challenges include model misspecification, computational complexity of solving high-dimensional HJB equations, estimation of model parameters from noisy data, and dealing with market frictions such as transaction costs and liquidity constraints.

How has machine learning impacted continuous time stochastic control and optimization in finance?

Machine learning techniques, especially reinforcement learning, have provided new methods for approximating solutions to complex stochastic control problems where traditional analytical or numerical methods are infeasible, enabling more adaptive and data-driven financial decision-making.

Additional Resources

Continuous Time Stochastic Control and Optimization with Financial Applications Stochastic Modelling and Applied Probability

continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability represents a critical intersection of advanced mathematics, probability theory, and financial engineering. This multifaceted domain addresses decision-making processes within uncertain, dynamic environments, where randomness evolves continuously over time. The integration of stochastic control theory with optimization techniques offers a robust framework to model, analyze, and solve complex problems in finance, such as portfolio optimization, risk management, and derivative pricing.

The sophistication of these methods derives from continuous time stochastic processes—most notably Brownian motion—and their capacity to realistically simulate market behavior and asset price dynamics. Applied probability underpinning these models provides the mathematical rigor needed to handle the inherent uncertainty and randomness, while stochastic control offers strategies to optimize performance criteria in the presence of such uncertainty. This article explores the theoretical foundations, practical applications, and emerging trends in continuous time stochastic control and optimization, especially within financial contexts, highlighting the synergy between stochastic modelling and applied probability.

Foundations of Continuous Time Stochastic Control

Continuous time stochastic control is a branch of control theory where the system dynamics are influenced by stochastic processes that evolve continuously rather than in discrete steps. Unlike deterministic control systems, where future states are precisely predictable, stochastic control acknowledges and incorporates the randomness inherent in many real-world systems.

At its core, the mathematical modeling often involves stochastic differential equations (SDEs), which describe the evolution of system states under both deterministic controls and random shocks. The classical example is the controlled diffusion process, typically modeled as:

$$ dX_t = b(X_t, u_t) dt + \sigma(X_t, u_t) dW_t $$

where X_t represents the state variable, u_t is the control process, b and σ are drift and diffusion coefficients respectively, and W_t denotes a standard Brownian motion.

The objective in stochastic control is to determine an optimal control u^*_t that maximizes or minimizes a performance functional, often expressed as an expected cumulative reward or cost over a time horizon. The complexity arises because the future evolution of X_t depends on both the control and the stochastic noise, requiring sophisticated analytical and numerical methods.

Dynamic Programming and the Hamilton-Jacobi-Bellman Equation

A cornerstone of continuous time stochastic control is the dynamic programming principle, which breaks down the optimization problem into smaller subproblems. This approach leads to the Hamilton-Jacobi-Bellman (HJB) partial differential equation, a nonlinear PDE whose solution yields the value function representing the optimal cost or reward.

The HJB equation encapsulates the trade-off between immediate costs and future payoffs, allowing decision-makers to derive feedback control policies that adapt dynamically to the state of the system. In financial applications, solving the HJB equation is crucial for determining optimal investment strategies under uncertainty.

Financial Applications: Optimization and Risk Management

The intersection of continuous time stochastic control and financial applications is especially pronounced in portfolio optimization, derivative pricing, and risk management. The unpredictable nature of financial markets with continuous fluctuations makes these tools indispensable.

Portfolio Optimization in Continuous Time

One of the earliest and most influential models in this area is the Merton problem, formulated by Robert C. Merton in the 1970s. This paradigm models an investor’s wealth as a continuous time stochastic process influenced by investment decisions and market returns, with the goal of maximizing expected utility of terminal wealth.

Key features of continuous time portfolio optimization include:

- Modeling asset prices as stochastic processes, typically geometric Brownian motion.
- Incorporating consumption and rebalancing strategies over continuous time.
- Balancing expected returns with risk, often quantified by variance or other risk measures.

The solution involves solving the HJB equation associated with the investor’s optimization problem, resulting in explicit or numerical optimal policies. These models have evolved to include considerations such as transaction costs, stochastic volatility, and multi-asset portfolios.

Stochastic Modelling for Derivative Pricing

Continuous time stochastic control also plays a vital role in pricing and hedging derivative securities. The Black-Scholes-Merton framework, which revolutionized options pricing, is predicated on modeling the underlying asset as a continuous stochastic process and employing risk-neutral valuation.

Further advancements incorporate stochastic volatility models, jump-diffusions, and regime-switching processes to capture market realities more accurately. Control techniques assist in managing hedging strategies dynamically, minimizing risk exposure as markets fluctuate.

Applied Probability: The Backbone of Stochastic Modelling

Applied probability provides the theoretical framework necessary to interpret and solve stochastic control problems. It encompasses measure theory, martingale theory, and Markov processes, all of which are essential for rigorous modeling of uncertain systems in continuous time.

Martingales and Measure Changes

Martingale theory is fundamental to modern financial mathematics. It allows the transformation of probability measures to risk-neutral ones, enabling the fair pricing of derivatives and the formulation of optimal control policies under alternative probability frameworks.

Girsanov’s theorem, a pivotal result in applied probability, facilitates the change of measure by adjusting the drift of stochastic processes while preserving their probabilistic structure. This technique is instrumental in both pricing and control problems.

Markov Processes and Filtering

Many stochastic control problems assume Markovian dynamics, where future states depend solely on the current state, not the entire history. This property simplifies analysis and computation, making it possible to apply dynamic programming effectively.

In practical financial applications, partial observations lead to filtering problems where the true state is hidden or noisy. Stochastic filtering, an applied probability method, estimates the underlying state from observed data, enabling more informed control decisions.

Computational Techniques and Challenges

Despite the elegant theoretical framework, continuous time stochastic control problems are often analytically intractable, especially in high-dimensional or non-linear settings. Computational methods thus play a critical role.

Numerical Solutions to the HJB Equation

Several numerical schemes exist for solving the HJB equation, including finite difference methods, finite element methods, and spectral methods. Each has trade-offs in terms of accuracy, stability, and computational cost.

In recent years, machine learning techniques, particularly deep reinforcement learning, have emerged as promising tools to approximate value functions and optimal policies without explicit PDE solutions. These data-driven approaches can handle complex, high-dimensional control problems that traditional methods struggle with.

Monte Carlo Simulations

Monte Carlo methods are invaluable for simulating stochastic processes and estimating expected values in optimization problems. Variance reduction techniques and quasi-Monte Carlo methods enhance efficiency and accuracy, making these simulations practical for real-world financial applications, such as risk assessment and scenario analysis.

Emerging Trends and Future Directions

The field of continuous time stochastic control and optimization with financial applications continues to evolve rapidly. Integration with big data analytics, artificial intelligence, and real-time processing is opening new horizons.

Recent research explores robust control methods that account for model uncertainty, an essential consideration given the limitations of any stochastic model. Moreover, the advent of cryptocurrencies and decentralized finance introduces novel stochastic dynamics and control challenges.

The interplay between stochastic modelling, applied probability, and optimization remains fundamental to advancing quantitative finance. As markets grow more complex and data-rich, the demand for sophisticated, adaptable stochastic control frameworks is likely to increase, driving innovation at this critical nexus of mathematics and finance.

Continuous Time Stochastic Control And Optimization With Financial Applications Stochastic Modelling And Applied Probability

continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability: *Continuous-time Stochastic Control and Optimization with Financial Applications* Huyên Pham, 2009-05-28 Stochastic optimization problems arise in decision-making problems under uncertainty, and find various applications in economics and finance. On the other hand, problems in finance have recently led to new developments in the theory of stochastic control. This volume provides a systematic treatment of stochastic optimization problems applied to finance by presenting the different existing methods: dynamic programming, viscosity solutions, backward stochastic differential equations, and martingale duality methods. The theory is discussed in the context of recent developments in this field, with complete and detailed proofs, and is illustrated by means of concrete examples from the world of finance: portfolio allocation, option hedging, real options, optimal investment, etc. This book is directed towards graduate students and researchers in mathematical finance, and will also benefit applied mathematicians interested in financial applications and practitioners wishing toknow more about the use of stochastic optimization methods in finance.

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continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability: Stochastic Optimization in Insurance Pablo Azcue, Nora Muler, 2014-06-19 The main purpose of the book is to show how a viscosity approach can be used to tackle control problems in insurance. The problems covered are the maximization of survival probability as well as the maximization of dividends in the classical collective risk model. The authors consider the possibility of controlling the risk process by reinsurance as well as by investments. They show that optimal value functions are characterized as either the unique or the smallest viscosity solution of the associated Hamilton-Jacobi-Bellman equation; they also study the structure of the optimal strategies and show how to find them. The viscosity approach was widely used in control problems related to mathematical finance but until quite recently it was not used to solve control problems related to actuarial mathematical science. This book is designed to familiarize the reader on how to use this approach. The intended audience is graduate students as well as researchers in this area.

continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability: Stochastic Methods for Pension Funds Pierre Devolder, Jacques Janssen, Raimondo Manca, 2013-03-04 Quantitative finance has become these last years a extraordinary field of research and interest as well from an academic point of view as for practical applications. At the same time, pension issue is clearly a major economical and financial topic for the next decades in the context of the well-known longevity risk. Surprisingly few books are devoted to application of modern stochastic calculus to pension analysis. The aim of this book is to fill this gap and to show how recent methods of stochastic finance can be useful for to the risk management of pension funds. Methods of optimal control will be especially developed and applied to fundamental problems such as the optimal asset allocation of the fund or the cost spreading of a pension scheme. In these various problems, financial as well as demographic risks will be addressed and modelled.

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Jianfeng Zhang, 2017-08-22 This book provides a systematic and accessible approach to stochastic differential equations, backward stochastic differential equations, and their connection with partial differential equations, as well as the recent development of the fully nonlinear theory, including nonlinear expectation, second order backward stochastic differential equations, and path dependent partial differential equations. Their main applications and numerical algorithms, as well as many exercises, are included. The book focuses on ideas and clarity, with most results having been solved from scratch and most theories being motivated from applications. It can be considered a starting point for junior researchers in the field, and can serve as a textbook for a two-semester graduate course in probability theory and stochastic analysis. It is also accessible for graduate students majoring in financial engineering.

continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability: New Models And Methods In Dynamic Portfolio Optimization Lijun Bo, Xiang Yu, 2025-06-04 This book presents some new models and methods in the context of dynamical portfolio optimization. It encapsulates the authors' recent progress in their research on several interesting, featured issues of dynamic portfolio optimization problems with default contagion, tracking benchmark, consumption habit, and reinforcement learning.These models include the default contagion model with infinite regime-switching under complete information and partial information; portfolio optimization model with consumption habit formation; optimal tracking model; extended Merton's problem with relaxed benchmark tracking and reinforcement learning of tracking portfolio.The methods for addressing these problems are by developing the monotone dynamical system, martingale representation theorem under partial information, quadratic BSDE with jumps, duality method, decomposition-homogenization technique of Neumann problem, stochastic flow, and q-function learning with state reflection.For the sake of the reader's convenience, preliminary knowledge on stochastic analysis and stochastic control are summarized in Chapters 2 and 3, which also serve as a brief basic introduction to the theory of SDEs, BSDEs, and the theory of optimal stochastic control.The book will be a good reference for graduate students and researchers working on stochastic control and mathematical finance. The reader may pursue some presented research problems and be inspired to formulate and study other new and interesting problems in dynamic portfolio optimization and beyond.

continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability: Numerical Methods for Stochastic Control Problems in Continuous Time Harold Kushner, Paul G. Dupuis, 2013-11-27 Changes in the second edition. The second edition differs from the first in that there is a full development of problems where the variance of the diffusion term and the jump distribution can be controlled. Also, a great deal of new material concerning deterministic problems has been added, including very efficient algorithms for a class of problems of wide current interest. This book is concerned with numerical methods for stochastic control and optimal stochastic control problems. The random process models of the controlled or uncontrolled stochastic systems are either diffusions or jump diffusions. Stochastic control is a very active area of research and new problem formulations and sometimes surprising applications appear regu larly. We have chosen forms of the models which cover the great bulk of the formulations of the continuous time stochastic control problems which have appeared to date. The standard formats are covered, but much emphasis is given to the newer and less well known formulations. The controlled process might be either stopped or absorbed on leaving a constraint set or upon first hitting a target set, or it might be reflected or projected from the boundary of a constraining set. In some of the more recent applications of the reflecting boundary problem, for example the so-called heavy traffic approximation problems, the directions of reflection are actually discontin uous. In general, the control might be representable as a bounded function or it might be of the so-called impulsive or singular control types.

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continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability: Econophysics of Order-driven Markets Frédéric Abergel, Bikas K Chakrabarti, Anirban Chakraborti, Manipushpak Mitra, 2011-04-06 The primary goal of the book is to present the ideas and research findings of active researchers from various communities (physicists, economists, mathematicians, financial engineers) working in the field of Econophysics, who have undertaken the task of modelling and analyzing order-driven markets. Of primary interest in these studies are the mechanisms leading to the statistical regularities (stylized facts) of price statistics. Results pertaining to other important issues such as market impact, the profitability of trading strategies, or mathematical models for microstructure effects, are also presented. Several leading researchers in these fields report on their recent work and also review the contemporary literature. Some historical perspectives, comments and debates on recent issues in Econophysics research are also included.

continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability: *Stochastic Optimal Control in Infinite Dimension* Giorgio Fabbri, Fausto Gozzi, Andrzej Święch, 2017-06-22 Providing an introduction to stochastic optimal control in infinite dimension, this book gives a complete account of the theory of second-order HJB equations in infinite-dimensional Hilbert spaces, focusing on its applicability to associated stochastic optimal control problems. It features a general introduction to optimal stochastic control, including basic results (e.g. the dynamic programming principle) with proofs, and provides examples of applications. A complete and up-to-date exposition of the existing theory of viscosity solutions and regular solutions of second-order HJB equations in Hilbert spaces is given, together with an extensive survey of other methods, with a full bibliography. In particular, Chapter 6, written by M. Fuhrman and G. Tessitore, surveys the theory of regular solutions of HJB equations arising in infinite-dimensional stochastic control, via BSDEs. The book is of interest to both pure and applied researchers working in the control theory of stochastic PDEs, and in PDEs in infinite dimension. Readers from other fields who want to learn the basic theory will also find it useful. The prerequisites are: standard functional analysis, the theory of semigroups of operators and its use in the study of PDEs, some knowledge of the dynamic programming approach to stochastic optimal control problems in finite dimension, and the basics of stochastic analysis and stochastic equations in infinite-dimensional spaces.

continuous time stochastic control and optimization with financial applications stochastic modelling and applied probability: Probability and Analysis in Interacting Physical Systems Peter Friz, Wolfgang König, Chiranjib Mukherjee, Stefano Olla, 2019-05-24 This Festschrift on the occasion of the 75th birthday of S.R.S. Varadhan, one of the most influential researchers in probability of the last fifty years, grew out of a workshop held at the Technical University of Berlin, 15–19 August, 2016. This volume contains ten research articles authored by several of Varadhan's former PhD students or close collaborators. The topics of the contributions are more or less closely linked with some of Varadhan's deepest interests over the decades: large deviations, Markov processes, interacting particle systems, motions in random media and homogenization, reaction-diffusion equations, and directed last-passage percolation. The articles present original research on some of the most discussed current questions at the boundary between analysis and probability, with an impact on understanding phenomena in physics. This collection will be of great value to researchers with an interest in models of probability-based statistical mechanics.

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