Option Pricing And Portfolio Optimization Modern Methods Of Financial Mathematics Graduate Studies In Mathematics

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Robust Portfolio Optimization and Management World Scientific Publishing Company
Understanding and working with the current models of financial markets requires a sound knowledge of the mathematical tools and ideas from which they are built. Banks and financial houses all over the world recognize this and are avidly recruiting mathematicians, physicists, and other scientists with these skills. The mathematics involved in modern finance springs from the heart of probability and analysis: the Ito calculus, stochastic control, differential equations, martingales, and so on. The authors give rigorous treatments of these topics, while always keeping the applications in mind. Thus, the way in which the mathematics is developed is governed by the way it will be used, rather than by the goal of optimal generality. Indeed, most of the purely mathematical topics are treated in extended ``excursions'' from the applications into the theory. Thus, with the main topic of financial modelling and optimization in view, the reader also obtains a self-contained and complete introduction to the underlying mathematics. This book is specifically designed as a graduate textbook. It could be used for the second part of a course in probability theory, as it includes an applied introduction to the basics of stochastic processes (martingales and Brownian motion) and stochastic calculus. It would also be suitable for a course in continuous-time finance that assumes familiarity with stochastic processes. The prerequisites are basic probability theory and calculus. Some background in stochastic processes would be useful, but not essential. Especially useful for students seeking a lively introduction to Ito calculus. --Short Book Reviews, International Statistical Institute

Brownian Motion Calculus Springer Science & Business Media
Each financial crisis calls for — by its novelty and the mechanisms it shares with preceding crises — appropriate means to analyze financial risks. In Extreme Financial Risks and Asset Allocation, the authors present in an accessible and timely manner the concepts, methods, and techniques that are essential for an understanding of these risks in an environment where asset prices are subject to sudden, rough, and unpredictable changes. These phenomena, mathematically known as “ jumps ” , play an important role in practice. Their quantitative treatment is generally tricky and is sparsely tackled in similar books. One of the main appeals of this book lies in its approachable and concise presentation of the ad hoc mathematical tools without sacrificing the necessary rigor and precision. This book contains theories and methods which are usually found in highly technical mathematics books or in scattered, often very recent, research articles. It is a remarkable pedagogical work that makes these difficult results accessible to a large readership. Researchers, Masters and PhD students, and financial engineers alike will find this book highly useful. Contents:IntroductionMarket FrameworkStatistical Description of MarketsL é vy ProcessesStable Distributions and ProcessesLaplace Distributions and ProcessesThe Time Change FrameworkTail DistributionsRisk BudgetsThe Psychology of RiskMonoperiodic Portfolio ChoiceDynamic Portfolio ChoiceConclusion Readership: Researchers, graduate students and financial engineers in the field of mathematical and quantitative finance. Key Features:This book offers an excellent synthesis of the academic literature in a clear, ordered, and intuitive wayThe continuous-time theory of the choice of portfolio is exposed with particular care when asset dynamics are modeled with processes admitting a jump component. This is a technically difficult topic that is tackled here with a lot of clarityThe collated works in this book facilitates access to the most recent techniques, making it user-friendly for readersKeywords:L é vy Process;Extreme Risks;Risk Management;Portfolio Management;Asset AllocationReviews: “ A pedagogical work of updated financial models using L é vy processes. Very well written, very well explained and argued with examples and appropriate simulations. Recommended to academics, researchers and PhD students, slightly less to practitioners. ” Zentralblatt MATH

An Introduction to Exotic Option Pricing Springer Nature
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.

Option Pricing, Interest Rates and Risk Management CRC Press

ABSTRACT: Our study developed novel approaches to solving and analyzing challenging problems of financial engineering including options pricing, market forecasting, and portfolio optimization. We also make connections of the portfolio theory with general deviation measures to classical portfolio and asset pricing theories. We consider a problem faced by traders whose performance is evaluated using the VWAP benchmark. Efficient trading market orders include predicting future volume distributions. Several forecasting algorithms based on CVaR-regression were developed for this purpose. Next, we consider assumption-free algorithm for pricing European Options in incomplete markets. A non-self-financing option replication strategy was modelled on a discrete grid in the space of time and the stock price. The algorithm was populated by historical sample paths adjusted to current volatility. Hedging error over the lifetime of the option was minimized subject to constraints on the hedging strategy. The output of the algorithm consists of the option price and the hedging strategy defined by the grid variables. Another considered problem was optimization of the Omega function. Hedge funds often use the Omega function to rank portfolios. We show that maximizing Omega function of a portfolio under positively homogeneous constraints can be reduced to linear programming. Finally, we look at the portfolio theory with general deviation measures from the perspective of the classical asset pricing theory. We derive pricing form of generalized CAPM relations and stochastic discount factors corresponding to deviation measures. We suggest methods for calibrating deviation measures using market data and discuss the possibility of restoring risk preferences from market data in the framework of the general portfolio theory.

Modeling with MATLAB, @Risk, or VBA John Wiley & Sons

This dissertation, "Asset Pricing, Hedging and Portfolio Optimization" by Jun, Fu, ??, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. Abstract: ?Starting from the most famous Black-Scholes model for the underlying asset price, there has been a large variety of extensions made in recent decades. One main strand is about the models which allow a jump component in the asset price. The first topic of this thesis is about the study of jump risk premium by an equilibrium approach. Different from others, this work provides a more general result by modeling the underlying asset price as the ordinary exponential of a L'vy process. For any given asset price process, the equity premium, pricing kernel and an equilibrium option pricing formula can be derived. Moreover, some empirical evidence such as the negative variance risk premium, implied volatility smirk, and negative skewness risk premium can be well explained by using the relation between the physical and risk-neutral distributions for the jump component. Another strand of the extensions of the Black-Scholes model is about the models which can incorporate stochastic volatility in the asset price. The second topic of this thesis is about the replication of exponential variance, where the key risks are the ones induced by the stochastic volatility and moreover it can be correlated with the returns of the asset, referred to as leverage effect. A time-changed L'vy process is used to incorporate jumps, stochastic volatility and leverage effect all together. The exponential variance can be robustly replicated by European portfolios, without any specification of a model for the stochastic volatility. Beyond the above asset pricing and hedging, portfolio optimization is also discussed. Based on the Merton (1969, 1971)'s reduced portfolio optimization and the delta hedging problem, a portfolio of an option, the underlying stock and a risk-free bond can be optimized in discrete time and its optimal solution can be shown to be a mixture of the Merton's result and the delta hedging strategy. The main approach is the elasticity approach, which has initially been proposed in continuous time. In addition to the above optimization problem in discrete time, the same topic but in a continuous-time regime-switching market is also presented. The use of regime-switching makes our market incomplete, and makes it difficult to use some approaches which are applicable in complete market. To overcome this challenge, two methods are provided. The first method is that we simply do not price the regime-switching risk when obtaining the risk-neutral probability. Then by the idea of elasticity, the utility maximization problem can be formulated as a stochastic control problem with only a single control variable, and explicit solutions can be obtained. The second method is to introduce a functional operator to general value functions of stochastic control problem in such a way that the optimal value function in our setting can be given by the limit of a sequence of value functions defined by iterating the operator. Hence the original problem can be deduced to an auxiliary optimization problem, which can be solved as if we were in a single-regime market, which is complete. DOI: 10.5353/th_b4819934 Subjects: Capital assets pricing model He

Numerical Methods in Finance and Economics Springer Science & Business Media

This textbook aims to fill the gap between those that offer a theoretical treatment without many applications and those that present and apply formulas without appropriately deriving them. The balance achieved will give readers a fundamental understanding of key financial ideas and tools that form the basis for building realistic models, including those that may become proprietary. Numerous carefully chosen examples and exercises reinforce the student’s conceptual understanding and facility with applications. The exercises are divided into conceptual, application-based, and theoretical problems, which probe the material deeper. The book is aimed toward advanced undergraduates and first-year graduate students who are new to finance or want a more rigorous treatment of the mathematical models used within. While no background in finance is assumed, prerequisite math courses include multivariable calculus, probability, and linear algebra. The authors introduce additional mathematical tools as needed. The entire textbook is appropriate for a single year-long course on

introductory mathematical finance. The self-contained design of the text allows for instructor flexibility in topics courses and those focusing on financial derivatives. Moreover, the text is useful for mathematicians, physicists, and engineers who want to learn finance via an approach that builds their financial intuition and is explicit about model building, as well as business school students who want a treatment of finance that is deeper but not overly theoretical.

Optimization Methods in Finance Cambridge University Press

Traditional finance theory has addressed portfolio optimization and option pricing problems assuming specific price dynamics for securities. In this thesis we address these problems without assuming specific price dynamics. We consider the problem of determining bounds on the price of an option based on observable prices of other options and the no-arbitrage assumption. This problem has been solved for the case of European options of a single maturity. We find exact bounds on the price of European options, when options of multiple maturities are given. We also find exact bounds if the payoff function on the option is a piecewise linear function of the price of the underlying security. We solve a similar problem in a two dimensional case. The methods developed for two-dimensional case are applicable to the multiple dimensional case, however the number of variables grows exponentially with the dimension. We also investigate how the optimal bounds in the one-dimensional case change, if, in addition to the set of observable prices, there is a condition on the variance of the underlying asset. We derive closed form expressions for the tight upper bound on the variance and propose a polynomial time algorithm for obtaining the lower bound. In the portfolio allocation problem we prove that for large time horizons, there exists a myopic policy which leads to a distribution of the terminal wealth with the property that the probability of underperforming any other policy tends to zero as the horizon tends to infinity. Finally, we address the problem of maximizing a mean-variance function of the terminal wealth in the multiperiod case. For general price dynamics of securities we propose a monte-carlo based method for the solution which is polynomial in the number of securities.

Quantitative Finance with Python Academic Press

The book gives a systematical presentation of stochastic approximation methods for models of American-type options with general pay-off functions for discrete time Markov price processes. Advanced methods combining backward recurrence algorithms for computing of option rewards and general results on convergence of stochastic space skeleton and tree approximations for option rewards are applied to a variety of models of multivariate modulated Markov price processes. The principal novelty of presented results is based on consideration of multivariate modulated Markov price processes and general pay-off functions, which can depend not only on price but also an additional stochastic modulating index component, and use of minimal conditions of smoothness for transition probabilities and pay-off functions, compactness conditions for log-price processes and rate of growth conditions for pay-off functions. The book also contains an extended bibliography of works in the area. This book is the first volume of the comprehensive two volumes monograph. The second volume will present results on structural studies of optimal stopping domains, Monte Carlo based approximation reward algorithms, and convergence of American-type options for autoregressive and continuous time models, as well as results of the corresponding experimental studies.

Essays in Honour of Manfred Gilli Walter de Gruyter

Now in its fifth edition, Derivatives and Internal Models provides a comprehensive and thorough introduction to derivative pricing, risk management and portfolio optimization, covering all relevant topics with enough hands-on, depth of detail to enable readers to develop their own pricing and risk tools. The book provides insight into modern market risk quantification methods such as variance-covariance, historical simulation, Monte Carlo, hedge ratios, etc., including time series analysis and statistical concepts such as GARCH Models or Chi-Square-distributions. It shows how optimal trading decisions can be deduced once risk has been quantified by introducing risk-adjusted performance measures and a complete presentation of modern quantitative portfolio optimization. Furthermore, all the important modern derivatives and their pricing methods are presented; from basic discounted cash flow methods to Black-Scholes, binomial trees, differential equations, finite difference schemes, Monte Carlo methods, Martingales and Numeraires, terms structure models, etc. The fifth edition of this classic finance book has been comprehensively reviewed. New chapters/content cover multicurve bootstrapping, the valuation and hedging of credit default risk that is inherently incorporated in every derivative—both of which are direct and permanent consequences of the financial crises with a large impact on our understanding of modern derivative valuation. The book will be accompanied by downloadable Excel spread sheets, which demonstrate how the theoretical concepts explained in the book can be turned into valuable algorithms and applications and will serve as an excellent starting point for the reader's own bespoke solutions for valuation and risk management systems.

Option Pricing and Estimation of Financial Models with R Springer Science & Business Media

This textbook provides an introduction to financial mathematics and financial engineering for undergraduate students who have completed a three- or four-semester sequence of calculus courses. It introduces the theory of interest, discrete and continuous random variables and probability, stochastic processes, linear programming, the Fundamental Theorem of Finance, option pricing, hedging, and portfolio optimization. This third edition expands on the second by including a new chapter on the extensions of the Black-Scholes model of option pricing and a greater number of exercises at the end of each chapter. More background material and exercises added, with solutions provided to the other chapters, allowing the textbook to better stand alone as an introduction to financial mathematics. The reader progresses from a solid grounding in multivariable calculus through a derivation of the Black-Scholes equation, its solution, properties, and applications. The text attempts to be as self-contained as possible without relying on advanced mathematical and statistical topics. The material presented in this book will adequately prepare the reader for graduate-level study in mathematical finance.

Understanding and Building Financial Intuition Option Pricing and Portfolio OptimizationModern Methods of Financial Mathematics

Portfolio optimization problems with transaction costs have been widely studied by both financial economists and financial engineers through various approaches. In this paper, we propose the following approach. In analogy to American option pricing, we study the problem through the Finite Element Method (FEM) combined with an optimization method: We set up a buy-and-hold problem and then we find an optimal set of trades to move to an optimal portfolio whenever the current portfolio is far from the ideal. Local Discontinuous Galerkin (LDG) FEM is used to solve the partial differential equation (PDE) associated with the buy-and-hold problem. Coupled with the Runge-Kutta method for time discretization, this method is local with respect to spatial variable, can be used to achieve any order of accuracy and is explicit in the semi-discrete Ordinary Differential Equation (ODE) form. Also it is amendable to parallel computing. In this paper we give error bounds for the LDG method, with which we establish overall bounds for the portfolio optimization problem and prove the convergence of this method.

Modern Risk Management CRC Press
A comprehensive overview of weak convergence of stochastic processes and its application to the study of financial markets. Split into three parts, the first recalls the mathematics of stochastic processes and stochastic calculus with special emphasis on contiguity properties and weak convergence of stochastic integrals. The second part is devoted to the analysis of financial theory from the convergence point of view. The main problems, which include portfolio optimization, option pricing and hedging are examined, especially when considering discrete-time approximations of continuous-time dynamics. The third part deals with lattice- and tree-based computational procedures for option pricing both on stocks and stochastic bonds. More general discrete approximations are also introduced and detailed. Includes detailed examples.
Numerical Methods and Optimization in Finance Springer
Brownian Motion Calculus presents the basics of Stochastic Calculus with a focus on the valuation of financial derivatives. It is intended as an accessible introduction to the technical literature. A clear distinction has been made between the mathematics that is convenient for a first introduction, and the more rigorous underpinnings which are best studied from the selected technical references. The inclusion of fully worked out exercises makes the book attractive for self study. Standard probability theory and ordinary calculus are the prerequisites. Summary slides for revision and teaching can be found on the book website.
An Introduction Using R Springer Science & Business Media
In answer to the intense development of new financial products and the increasing complexity of portfolio management theory, Portfolio Optimization and Performance Analysis offers a solid grounding in modern portfolio theory. The book presents both standard and novel results on the axiomatics of the individual choice in an uncertain framework, contains a precise overview of standard portfolio optimization, provides a review of the main results for static and dynamic cases, and shows how theoretical results can be applied to practical and operational portfolio optimization. Divided into four sections that mirror the book's aims, this resource first describes the fundamental results of decision theory, including utility maximization and risk measure minimization. Covering both active and passive portfolio management, the second part discusses standard portfolio optimization and performance measures. The book subsequently introduces dynamic portfolio optimization based on stochastic control and martingale theory. It also outlines portfolio optimization with market frictions, such as incompleteness, transaction costs, labor income, and random time horizon. The final section applies theoretical results to practical portfolio optimization, including structured portfolio management. It details portfolio insurance methods as well as performance measures for alternative investments, such as hedge funds. Taking into account the different features of portfolio management theory, this book promotes a thorough understanding for students and professionals in the field.
Decision Support System for Portfolio Optimization Springer
A detailed, multi-disciplinary approach to investment analytics Portfolio Construction and Analytics provides an up-to-date understanding of the analytic investment process for students and professionals alike. With complete and detailed coverage of portfolio analytics and modeling methods, this book is unique in its multi-disciplinary approach. Investment analytics involves the input of a variety of areas, and this guide provides the perspective of data management, modeling, software resources, and investment strategy to give you a truly comprehensive understanding of how today's firms approach the process. Real-world examples provide insight into analytics performed with vendor software, and references to analytics performed with open source software will prove useful to both students and practitioners. Portfolio analytics refers to all of the methods used to screen, model, track, and evaluate investments. Big data, regulatory change, and increasing risk is forcing a need for a more coherent approach to all aspects of investment analytics, and this book provides the strong foundation and critical skills you need. Master the fundamental modeling concepts and widely used analytics Learn the latest trends in risk metrics, modeling, and investment strategies Get up to speed on the vendor and open-source software most commonly used Gain a multi-angle perspective on portfolio analytics at today's firms Identifying investment opportunities, keeping portfolios aligned with investment objectives, and monitoring risk and performance are all major functions of an investment firm that relies heavily on analytics output. This reliance will only increase in the face of market changes and increased regulatory pressure, and practitioners need a deep understanding of the latest methods and models used to build a robust investment strategy. Portfolio Construction and Analytics is an invaluable resource for portfolio management in any capacity.
Stochastic Approximation Methods John Wiley & Sons
This thesis summarizes most of my recent research in the field of portfolio optimization. The main topics which I have addressed are portfolio problems with stochastic interest rates and portfolio problems with defaultable assets. The starting point for my research was the paper "A stochastic control ap proach to portfolio problems with stochastic interest rates" (jointly with Ralf Korn), in which we solved portfolio problems given a Vasicek term structure of the short rate. Having considered the Vasicek model, it was obvious that I should analyze portfolio problems where the interest rate dynamics are gov erned by other common short rate models. The relevant results are presented in Chapter 2. The second main issue concerns portfolio problems with default able assets modeled in a firm value framework. Since the assets of a firm then correspond to contingent claims on firm value, I searched for a way to easily deal with such claims in portfolio problems. For this reason, I developed the elasticity approach to portfolio optimization which is presented in Chapter 3. However, this way of tackling portfolio problems is not restricted to portfolio problems with default able assets only, but it provides a general framework allowing for a compact formulation of portfolio problems even if interest rates are stochastic.
An Introduction to Mathematical Finance with Applications Springer Science & Business Media
This book introduces machine learning methods in finance. It presents a unified treatment of machine learning and various statistical and computational disciplines in quantitative finance, such as financial econometrics and discrete time stochastic control, with an emphasis on how theory and hypothesis tests inform the choice of algorithm for financial data modeling and decision making. With the trend towards increasing computational resources and larger datasets, machine learning has grown into an important skillset for the finance industry. This book is written for advanced graduate students and academics in financial econometrics, mathematical finance and applied statistics, in addition to quants and data scientists in the field of quantitative finance. Machine Learning in Finance: From Theory to Practice is divided into three parts, each part covering theory and applications. The first presents supervised learning for cross-sectional data from both a Bayesian and frequentist perspective. The more advanced material places a firm emphasis on neural networks, including deep learning, as well as Gaussian processes, with examples in investment management and derivative modeling. The second part presents supervised learning for time series data, arguably the most common data type used in finance with examples in trading, stochastic volatility and fixed income modeling. Finally, the third part presents reinforcement learning and its applications in trading, investment and wealth management. Python code examples are provided to support the readers' understanding of the methodologies and applications. The book also includes more than 80

mathematical and programming exercises, with worked solutions available to instructors. As a bridge to research in this emergent field, the final chapter presents the frontiers of machine learning in finance from a researcher's perspective, highlighting how many well-known concepts in statistical physics are likely to emerge as important methodologies for machine learning in finance.

The Statistical Mechanics of Financial Markets John Wiley & Sons

This 4-Volume-Set, CCIS 0251 - CCIS 0254, constitutes the refereed proceedings of the International Conference on Informatics Engineering and Information Science, ICIEIS 2011, held in Kuala Lumpur, Malaysia, in November 2011. The 210 revised full papers presented together with invited papers in the 4 volumes were carefully reviewed and selected from numerous submissions. The papers are organized in topical sections on e-learning, information security, software engineering, image processing, algorithms, artificial intelligence and soft computing, e-commerce, data mining, neural networks, social networks, grid computing, biometric technologies, networks, distributed and parallel computing, wireless networks, information and data management, web applications and software systems, multimedia, ad hoc networks, mobile computing, as well as miscellaneous topics in digital information and communications.

American-Type Options American Mathematical Soc.

"Quantitative Finance with Python: A Practical Guide to Investment Management, Trading and Financial Engineering bridges the gap between the theory of mathematical finance and the practical applications of these concepts for derivative pricing and portfolio management. The book provides students with a very hands-on, rigorous introduction to foundational topics in quant finance, such as options pricing, portfolio optimization and machine learning. Simultaneously, the reader benefits from a strong emphasis on the practical applications of these concepts for institutional investors. Features. Useful as both a teaching resource and as a practical tool for professional investors. Ideal textbook for first year graduate students in quantitative finance programs, such as those in master's programs in Mathematical Finance, Quant Finance or Financial Engineering. Includes a perspective on the future of quant finance techniques, and in particular covers some introductory concepts of Machine Learning. Free-to-access repository with Python code available at www.routledge.com/ 9781032014432"--

Alternative Investments and Strategies World Scientific

This book represents the refereed proceedings of the Eighth International Conference on Monte Carlo (MC)and Quasi-Monte Carlo (QMC) Methods in Scientific Computing, held in Montreal (Canada) in July 2008. It covers the latest theoretical developments as well as important applications of these methods in different areas. It contains two tutorials, eight invited articles, and 32 carefully selected articles based on the 135 contributed presentations made at the conference. This conference is a major event in Monte Carlo methods and is the premiere event for quasi-Monte Carlo and its combination with Monte Carlo. This series of proceedings volumes is the primary outlet for quasi-Monte Carlo research.