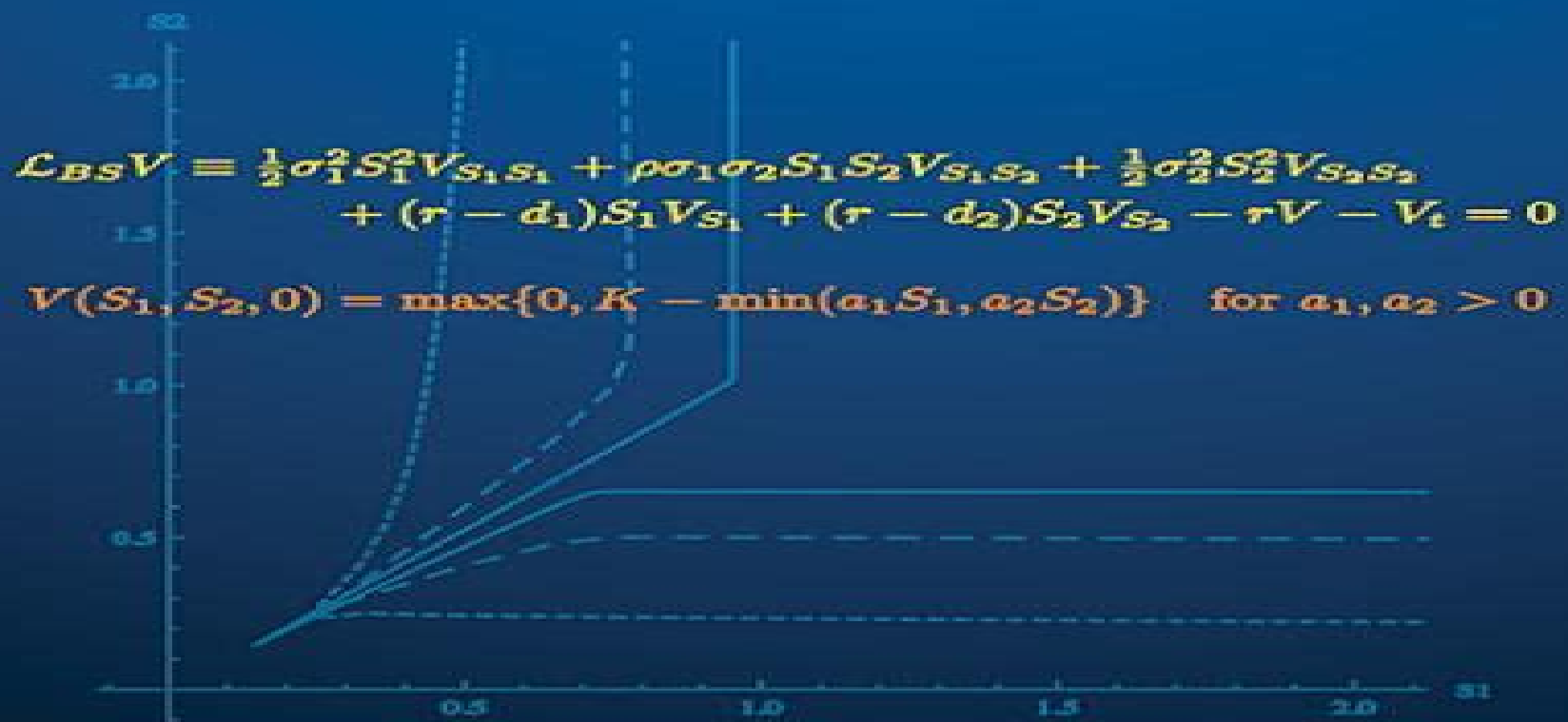


THE TIME-DISCRETE METHOD OF LINES FOR OPTIONS AND BONDS

A PDE Approach



Gunter H. Meyer



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The Time Discrete Method Of Lines For Options And Bonds

Michèle Breton, Hatem Ben-Ameur



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Time-discrete Method Of Lines For Options And Bonds, The: A Pde Approach Gunter H Meyer, 2014-11-27 Few financial mathematical books have discussed mathematically acceptable boundary conditions for the degenerate diffusion equations in finance In The Time Discrete Method of Lines for Options and Bonds Gunter H Meyer examines PDE models for financial derivatives and shows where the Fichera theory requires the pricing equation at degenerate boundary points and what modifications of it lead to acceptable tangential boundary conditions at non degenerate points on computational boundaries when no financial data are available Extensive numerical simulations are carried out with the method of lines to examine the influence of the finite computational domain and of the chosen boundary conditions on option and bond prices in one and two dimensions reflecting multiple assets stochastic volatility jump diffusion and uncertain parameters Special emphasis is given to early exercise boundaries prices and their derivatives near expiration Detailed graphs and tables are included which may serve as benchmark data for solutions found with competing numerical methods

The Time-Discrete Method of Lines for Options and Bonds Gunter H. Meyer, 2014-11-27 Few financial mathematical books have discussed mathematically acceptable boundary conditions for the degenerate diffusion equations in finance In The Time Discrete Method of Lines for Options and Bonds Gunter H Meyer examines PDE models for financial derivatives and shows where the Fichera theory requires the pricing equation at degenerate boundary points and what modifications of it lead to acceptable tangential boundary conditions at non degenerate points on computational boundaries when no financial data are available Extensive numerical simulations are carried out with the method of lines to examine the influence of the finite computational domain and of the chosen boundary conditions on option and bond prices in one and two dimensions reflecting multiple assets stochastic volatility jump diffusion and uncertain parameters Special emphasis is given to early exercise boundaries prices and their derivatives near expiration Detailed graphs and tables are included which may serve as benchmark data for solutions found with competing numerical methods

The Numerical Solution of the American Option Pricing Problem Carl Chiarella, Boda Kang, Gunter H. Meyer, 2014-10-14 The early exercise opportunity of an American option makes it challenging to price and an array of approaches have been proposed in the vast literature on this topic In The Numerical Solution of the American Option Pricing Problem Carl Chiarella Boda Kang and Gunter Meyer focus on two numerical approaches that have proved useful for finding all prices hedge ratios and early exercise boundaries of an American option One is a finite difference approach which is based on the numerical solution of the partial differential equations with the free boundary problem arising in American option pricing including the method of lines the component wise splitting and the finite difference with PSOR The other approach is the integral transform approach which includes Fourier or Fourier Cosine transforms Written in a concise and systematic manner Chiarella Kang and Meyer explain and demonstrate the advantages and limitations of each of them based on their and their co workers experiences with these approaches over the years

Contents Introduction The Merton and Heston Model for a Call American Call Options under Jump Diffusion Processes American Option Prices under Stochastic Volatility and Jump Diffusion Dynamics OCo The Transform Approach Representation and Numerical Approximation of American Option Prices under Heston Fourier Cosine Expansion Approach A Numerical Approach to Pricing American Call Options under SVJD Conclusion Bibliography Index About the Authors

Readership Post graduates Researchers in finance and applied mathematics with interest in numerical methods for American option pricing mathematicians physicists doing applied research in option pricing Key Features Complete discussion of different numerical methods for American options Able to handle stochastic volatility and or jump diffusion dynamics Able to produce hedge ratios efficiently and accurately **Numerical Methods in Computational Finance** Daniel J. Duffy, 2022-03-14 This book is a detailed and step by step introduction to the mathematical foundations of ordinary and partial differential equations their approximation by the finite difference method and applications to computational finance The book is structured so that it can be read by beginners novices and expert users Part A Mathematical Foundation for One Factor Problems Chapters 1 to 7 introduce the mathematical and numerical analysis concepts that are needed to understand the finite difference method and its application to computational finance Part B Mathematical Foundation for Two Factor Problems Chapters 8 to 13 discuss a number of rigorous mathematical techniques relating to elliptic and parabolic partial differential equations in two space variables In particular we develop strategies to preprocess and modify a PDE before we approximate it by the finite difference method thus avoiding ad hoc and heuristic tricks Part C The Foundations of the Finite Difference Method FDM Chapters 14 to 17 introduce the mathematical background to the finite difference method for initial boundary value problems for parabolic PDEs It encapsulates all the background information to construct stable and accurate finite difference schemes Part D Advanced Finite Difference Schemes for Two Factor Problems Chapters 18 to 22 introduce a number of modern finite difference methods to approximate the solution of two factor partial differential equations This is the only book we know of that discusses these methods in any detail Part E Test Cases in Computational Finance Chapters 23 to 26 are concerned with applications based on previous chapters We discuss finite difference schemes for a wide range of one factor and two factor problems This book is suitable as an entry level introduction as well as a detailed treatment of modern methods as used by industry quants and MSc MFE students in finance The topics have applications to numerical analysis science and engineering More on computational finance and the author s online courses see www.datasim.nl *Financial Instrument Pricing Using C++* Daniel J. Duffy, 2018-09-05 An integrated guide to C and computational finance This complete guide to C and computational finance is a follow up and major extension to Daniel J Duffy s 2004 edition of *Financial Instrument Pricing Using C* Both C and computational finance have evolved and changed dramatically in the last ten years and this book documents these improvements Duffy focuses on these developments and the advantages for the quant developer by Delving into a detailed account of the new C 11 standard and its applicability to computational finance Using de

facto standard libraries such as Boost and Eigen to improve developer productivity Developing multiparadigm software using the object oriented generic and functional programming styles Designing flexible numerical algorithms modern numerical methods and multiparadigm design patterns Providing a detailed explanation of the Finite Difference Methods through six chapters including new developments such as ADE Method of Lines MOL and Uncertain Volatility Models Developing applications from financial model to algorithmic design and code through a coherent approach Generating interoperability with Excel add ins C and C CLI Using random number generation in C 11 and Monte Carlo simulation Duffy adopted a spiral model approach while writing each chapter of Financial Instrument Pricing Using C 2e analyse a little design a little and code a little Each cycle ends with a working prototype in C and shows how a given algorithm or numerical method works Additionally each chapter contains non trivial exercises and projects that discuss improvements and extensions to the material This book is for designers and application developers in computational finance and assumes the reader has some fundamental experience of C and derivatives pricing HOW TO RECEIVE THE SOURCE CODE Once you have purchased a copy of the book please send an email to the author dduffyATdatasim nl requesting your personal and non transferable copy of the source code Proof of purchase is needed The subject of the mail should be C Book Source Code Request You will receive a reply with a zip file attachment

Numerical Methods in Finance Michèle Breton,Hatem

Ben-Ameur,2005-12-05 GERAD celebrates this year its 25th anniversary The Center was created in 1980 by a small group of professors and researchers of HEC Montreal McGill University and of the Ecole Polytechnique de Montreal GERAD s activities achieved sufficient scope to justify its conversion in June 1988 into a Joint Research Centre of HEC Montreal the Ecole Polytechnique de Montreal and McGill University In 1996 the U versite du Quebec a Montreal joined these three institutions GERAD has fifty members professors more than twenty research associates and post doctoral students and more than two hundreds master and Ph D students GERAD is a multi university center and a vital forum for the devel ment of operations research Its mission is defined around the following four complementarily objectives The original and expert contribution to all research fields in GERAD s area of expertise The dissemination of research results in the best scientific outlets as well as in the society in general The training of graduate students and post doctoral researchers The contribution to the economic community by solving important problems and providing transferable tools

Modeling, Stochastic Control, Optimization, and Applications George Yin,Qing Zhang,2019-07-16 This volume collects papers based on invited talks given at the IMA workshop in Modeling Stochastic Control Optimization and Related Applications held at the Institute for Mathematics and Its Applications University of Minnesota during May and June 2018 There were four week long workshops during the conference They are 1 stochastic control computation methods and applications 2 queueing theory and networked systems 3 ecological and biological applications and 4 finance and economics applications For broader impacts researchers from different fields covering both theoretically oriented and application intensive areas were invited to participate in the

conference It brought together researchers from multi disciplinary communities in applied mathematics applied probability engineering biology ecology and networked science to review and substantially update most recent progress As an archive this volume presents some of the highlights of the workshops and collect papers covering a broad range of topics

Handbook of Computational Economics Karl Schmedders, Kenneth L. Judd, 2013-12-31 Handbook of Computational Economics summarizes recent advances in economic thought revealing some of the potential offered by modern computational methods With computational power increasing in hardware and algorithms many economists are closing the gap between economic practice and the frontiers of computational mathematics In their efforts to accelerate the incorporation of computational power into mainstream research contributors to this volume update the improvements in algorithms that have sharpened econometric tools solution methods for dynamic optimization and equilibrium models and applications to public finance macroeconomics and auctions They also cover the switch to massive parallelism in the creation of more powerful computers with advances in the development of high power and high throughput computing Much more can be done to expand the value of computational modeling in economics In conjunction with volume one 1996 and volume two 2006 this volume offers a remarkable picture of the recent development of economics as a science as well as an exciting preview of its future potential Samples different styles and approaches reflecting the breadth of computational economics as practiced today Focuses on problems with few well developed solutions in the literature of other disciplines Emphasizes the potential for increasing the value of computational modeling in economics

Finite Difference Methods in Financial Engineering Daniel J. Duffy, 2013-10-28 The world of quantitative finance QF is one of the fastest growing areas of research and its practical applications to derivatives pricing problem Since the discovery of the famous Black Scholes equation in the 1970 s we have seen a surge in the number of models for a wide range of products such as plain and exotic options interest rate derivatives real options and many others Gone are the days when it was possible to price these derivatives analytically For most problems we must resort to some kind of approximate method In this book we employ partial differential equations PDE to describe a range of one factor and multi factor derivatives products such as plain European and American options multi asset options Asian options interest rate options and real options PDE techniques allow us to create a framework for modeling complex and interesting derivatives products Having defined the PDE problem we then approximate it using the Finite Difference Method FDM This method has been used for many application areas such as fluid dynamics heat transfer semiconductor simulation and astrophysics to name just a few In this book we apply the same techniques to pricing real life derivative products We use both traditional or well known methods as well as a number of advanced schemes that are making their way into the QF literature Crank Nicolson exponentially fitted and higher order schemes for one factor and multi factor options Early exercise features and approximation using front fixing penalty and variational methods Modelling stochastic volatility models using Splitting methods Critique of ADI and Crank Nicolson schemes when they work and when

they don't work Modelling jumps using Partial Integro Differential Equations PIDE Free and moving boundary value problems in QF Included with the book is a CD containing information on how to set up FDM algorithms how to map these algorithms to C as well as several working programs for one factor and two factor models We also provide source code so that you can customize the applications to suit your own needs

Novel Methods in Computational Finance Matthias Ehrhardt, Michael Günther, E. Jan W. ter Maten, 2017-09-19 This book discusses the state of the art and open problems in computational finance It presents a collection of research outcomes and reviews of the work from the STRIKE project an FP7 Marie Curie Initial Training Network ITN project in which academic partners trained early stage researchers in close cooperation with a broader range of associated partners including from the private sector The aim of the project was to arrive at a deeper understanding of complex mostly nonlinear financial models and to develop effective and robust numerical schemes for solving linear and nonlinear problems arising from the mathematical theory of pricing financial derivatives and related financial products This was accomplished by means of financial modelling mathematical analysis and numerical simulations optimal control techniques and validation of models In recent years the computational complexity of mathematical models employed in financial mathematics has witnessed tremendous growth Advanced numerical techniques are now essential to the majority of present day applications in the financial industry Special attention is devoted to a uniform methodology for both testing the latest achievements and simultaneously educating young PhD students Most of the mathematical codes are linked into a novel computational finance toolbox which is provided in MATLAB and PYTHON with an open access license The book offers a valuable guide for researchers in computational finance and related areas e g energy markets with an interest in industrial mathematics

Mathematical Reviews, 2008

Capacity Options for Revenue Management Rolf Hellermann, 2006-10-07 This book proposes capacity options as a flexible alternative air cargo contract type and illustrates how capacity can be priced through option contracts The analysis is accomplished by means of an analytical multivariate optimization model under price and demand uncertainty A case study using data from a leading German carrier illustrates the financial potential Finally the author shows how capacity option contracts integrate into the context of air cargo revenue management

Portfolios of Real Options Rainer Brosch, 2008-03-29 Valuing portfolios of options embedded in investment decisions is arguably one of the most important and challenging problems in real options and corporate finance in general Although the problem is common and vitally important in the value creation process of almost any corporation it has not yet been satisfactorily addressed It is key for any corporation facing strategic resource allocation decisions be it a pharmaceutical firm valuing and managing its pipeline of drugs a telecom company having to select a set of technological alternatives a venture capital or private equity firm investing in a portfolio of ventures or any company allocating resources Portfolios of real options typically interact such that the value of the whole differs from the sum of the separate parts Thus one must address and value the particular configuration of options embedded in a specific situation taking into

account the configuration of other options already present in the portfolio which in turn depends on the correlation structure among the various underlying assets and the strategic dependencies among the options themselves e.g. mutual exclusivity, strategic additivity, compoundness, complementarity etc. In that sense, optimal decisions also depend on past option exercise decisions by management and organizational capabilities put in place in the past.

Market-Conform Valuation of Options Tobias Herwig, 2006-03-12 1 1 The Area of Research In this thesis we will investigate the market conform pricing of newly issued contingent claims. A contingent claim is a derivative whose value at any settlement date is determined by the value of one or more other underlying assets e.g. forwards, futures, plain vanilla or exotic options with European or American style exercise features. Market conform pricing means that prices of existing actively traded securities are taken as given and then the set of equivalent martingale measures that are consistent with the initial prices of the traded securities is derived using no arbitrage arguments. Sometimes in the literature other expressions are used for market conform valuation: smile consistent valuation or fair market valuation that describe the same basic idea. The seminal work by Black and Scholes 1973, BS and Merton 1973 mark a breakthrough in the problem of hedging and pricing contingent claims based on no arbitrage arguments. Harrison and Kreps 1979 provide a firm mathematical foundation for the Black-Scholes-Merton analysis. They show that the absence of arbitrage is equivalent to the existence of an equivalent martingale measure. Under this measure the normalized security price process forms a martingale and so securities can be valued by taking expectations. If the securities market is complete then the equivalent martingale measure and hence the price of any security are unique.

The Economic Organisation of a Financial System Edwin H. Neave, 1990-12-06 This book develops a descriptive theory of a financial system's organisations and functions. It uses an institutional economics framework to reconcile different approaches including neo-classical financial theory and managerial finance. It will be useful for anyone who wishes to study a qualitative economic theory of financial system activity.

ERDA Energy Research Abstracts United States. Energy Research and Development Administration, 1977

Probability and Finance Glenn Shafer, Vladimir Vovk, 2005-02-25 Provides a foundation for probability based on game theory rather than measure theory. A strong philosophical approach with practical applications. Presents in depth coverage of classical probability theory as well as new theory.

Dynamic Inventory Management in Reverse Logistics Rainer Kleber, 2007-02-02 The integration of product recovery into regular production processes enables new opportunities for cost savings. In case of a dynamic planning situation for instance when dealing with seasonality or the product life cycle new motives for keeping stock arise. The work aims to identify those motives and to describe their effects by using methods of optimal control theory.

Options Markets George M. Constantinides, A. G. Malliaris, 2001

Scientific and Technical Aerospace Reports, 1994

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