Sabr And Sabr Libor Market Models In Practice With Examples Implemented In Python Applied Quantitative Finance

Analysis, Geometry, and Modeling in Finance: Advanced Methods in Option Pricing is the first book that applies advanced analytical and geometrical methods used in physics and mathematics to the financial field. It even obtains new results when only approximate and partial solutions were previously available. Through the problem of option pricing, the author introduces powerful tools and methods, including differential geometry, spectral decomposition, and supersymmetry, and applies these methods to practical problems in finance. He mainly focuses on the calibration and dynamics of implied volatility, which is commonly called smile. The book covers the Black–Scholes, local volatility, and stochastic volatility models, along with the Kolmogorov, Schrödinger, and Bellman–Hamilton–Jacobi equations. Providing both theoretical and numerical results throughout, this book offers new ways of solving financial problems using techniques found in physics and mathematics.
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.
The South African interest rate market has mainly been focused on vanilla interest rate products and hence can be seen as underdeveloped in this regard when compared, for instance, to the associated equity market. Market participants subscribe this aspect to a lack of demand and sophistication of investors within the market. This is, however, expected to change given the influx of international banks into the South African market over the past couple of years. The current market methodology, for the pricing of vanilla interest rate options in the South African market, is the standard Black model with some mechanism to incorporate interest rate smiles. This mechanism is typically in the form of the SABR model. The most signi cant drawback of this approach is the fact that it models each forward rate in isolation. Hence, there is no way to incorporate the joint dynamics between different forward rates and consequently cannot be used for the pricing of exotic interest rate options. In anticipation of these new market developments, we explore the possibility of calibrating the LIBOR market model to the South African market. This dissertation follows a bottom up approach and hence considers all aspects associated with such an implementation. The work mainly focuses on the calibration to at-the-money interest rate options. A possible extension to the SABR model, while remaining within the LMM framework, is considered in the final chapter. Copyright.
The term Financial Derivative is a very broad term which has come to mean any financial transaction whose value depends on the underlying value of the asset concerned. Sophisticated statistical modelling of derivatives enables practitioners in the banking industry to reduce financial risk and ultimately increase profits made from these transactions. The book originally published in March 2000 to widespread acclaim. This revised edition has been updated with minor corrections and new references, and now includes a chapter of exercises and solutions, enabling use as a course text. Comprehensive introduction to the theory and practice of financial derivatives. Discusses and elaborates on the theory of interest rate derivatives, an area of increasing interest. Divided into two self-contained parts ? the first concentrating on the theory of stochastic calculus, and the second describes in detail the pricing of a number of different derivatives in practice. Written by well respected academics with experience in the banking industry. A valuable text for practitioners in research departments of all banking and finance sectors. Academic researchers and graduate students working in mathematical finance.
Interest Rate Modeling
a Short Ride in Hyperbolic Geometry
Das LIBOR-Market-Modell unter Berücksichtigung stochastischer Volatilitäten
Interest Rate Models - Theory and Practice
A Practical Guide for Quants, Traders and Validators

Designed for Master's students, this practical text strikes the right balance between mathematical rigour and real-world application.
"The three volumes of Interest rate modeling are aimed primarily at practitioners working in the area of interest rate derivatives, but much of the material is quite general and, we believe, will also hold significant appeal to researchers working in other asset classes. Students and academics interested in financial engineering and applied work will find the material particularly useful for its description of real-life model usage and for its expansive discussion of model calibration, approximation theory, and numerical methods."--Preface.
This book offers an introduction to the mathematical, probabilistic and numerical methods used in the modern theory of option pricing. The text is designed for readers with a basic mathematical background. The first part contains a presentation of the arbitrage theory in discrete time. In the second part, the theories of stochastic calculus and parabolic PDEs are developed in detail and the classical arbitrage theory is analyzed in a Markovian setting by means of of PDEs techniques. After the martingale representation theorems and the Girsanov theory have been presented, arbitrage pricing is revisited in the martingale theory optics. General tools from PDE and martingale theories are also used in the analysis of volatility modeling. The book also contains an Introduction to Lévy processes and Malliavin calculus. The last part is devoted to the description of the numerical methods used in option pricing: Monte Carlo, binomial trees, finite differences and Fourier transform.
Modeling and Pricing of Swaps for Financial and Energy Markets with Stochastic Volatilities is devoted to the modeling and pricing of various kinds of swaps, such as those for variance, volatility, covariance, correlation, for financial and energy markets with different stochastic volatilities, which include CIR process, regime-switching, delayed, mean-reverting, multi-factor, fractional, Levy-based, semi-Markov and COGARCH(1,1). One of the main methods used in this book is change of time method. The book outlines how the change of time method works for different kinds of models and problems arising in financial and energy markets and the associated problems in modeling and pricing of a variety of swaps. The book also contains a study of a new model, the delayed Heston model, which improves the volatility surface fitting as compared with the classical Heston model. The author calculates variance and volatility swaps for this model and provides hedging techniques. The book considers content on the pricing of variance and volatility swaps and option pricing formula for mean-reverting models in energy markets. Some topics such as forward and futures in energy markets priced by multi-factor Levy models and generalization of Black-76 formula with Markov-modulated volatility are part of the book as well, and it includes many numerical examples such as S&P60 Canada Index, S&P500 Index and AECO Natural Gas Index.
Stochastic Interest Rates
Modern SABR Analytics
Formulas and Insights for Quants, Former Physicists and Mathematicians
The SABR/LIBOR Market Model
Advanced Methods in Option Pricing
The Best of Wilmott 2
The 2nd edition of this successful book has several new features. The calibration discussion of the basic LIBOR market model has been enriched considerably, with an analysis of the impact of the swaptions interpolation technique and of the exogenous instantaneous correlation on the calibration outputs. A discussion of historical estimation of the instantaneous correlation matrix and of rank reduction has been added, and a LIBOR-model consistent swaption-volatility interpolation technique has been introduced. The old sections devoted to the smile issue in the LIBOR market model have been enlarged into a new chapter. New sections on local-volatility dynamics, and on stochastic volatility models have been added, with a thorough treatment of the recently developed uncertain-volatility approach. Examples of calibrations to real market data are now considered. The fast-growing interest for hybrid products has led to a new chapter. A special focus here is devoted to the pricing of inflation-linked derivatives. The three final new chapters of this second edition are devoted to credit. Since Credit Derivatives are increasingly fundamental, and since in the reduced-form modeling framework much of the technique involved is analogous to interest-rate modeling, Credit Derivatives -- mostly Credit Default Swaps (CDS), CDS Options and Constant Maturity CDS - are discussed, building on the basic short rate-models and market models introduced earlier for the default-free market. Counterparty risk in interest rate payoff valuation is also considered, motivated by the recent Basel II framework developments.
Interest rate traders have been using the SABR model to price vanilla products for more than a decade. However this model suffers however from a severe limitation: its inability to value exotic products. A term structure model à la LIBOR Market Model (LMM) is often employed to value these more complex derivatives, however the LMM is unable to capture the volatility smile. A joint SABR LIBOR Market Model is the natural evolution towards a consistent pricing of vanilla and exotic products. Knowledge of these models is essential to all aspiring interest rate quants, traders and risk managers, as well an understanding of their failings and alternatives. SABR and SABR Libor Market Models in Practice is an accessible guide to modern interest rate modelling. Rather than covering an array of models which are seldom used in practice, it focuses on the SABR model, the market standard for vanilla products, the LIBOR Market Model, the most commonly used model for exotic products and the extended SABR LIBOR Market Model. The book takes a hands-on approach, demonstrating simply how to implement and work with these models in a market setting. It bridges the gap between the understanding of the models from a conceptual and mathematical perspective and the actual implementation by supplementing the interest rate theory with modelling specific, practical code examples written in Python.
Analytical Finance is a comprehensive introduction to the financial engineering of equity and interest rate instruments for financial markets. Developed from notes from the author’s many years in quantitative risk management and modeling roles, and then for the Financial Engineering course at Mälardalen University, it provides exhaustive coverage of vanilla and exotic mathematical finance applications for trading and risk management, combining rigorous theory with real market application. Coverage includes: • Date arithmetic’s, quote types of interest rate instruments • The interbank market and reference rates, including negative rates• Valuation and modeling of IR instruments; bonds, FRN, FRA, forwards, futures, swaps, CDS, caps/floors and others • Bootstrapping and how to create interest rate curves from prices of traded instruments• Risk measures of IR instruments• Option Adjusted Spread and embedded options• The term structure equation, martingale measures and stochastic processes of interest rates; Vasicek, Ho-Lee, Hull-While, CIR• Numerical models; Black-Derman-Toy and forward induction using Arrow-Debreu prices and Newton–Raphson in 2 dimension• The Heath-Jarrow-Morton framework• Forward measures and general option pricing models• Black log-normal and, normal model for derivatives, market models and managing exotics instruments• Pricing before and after the financial crisis, collateral discounting, multiple curve framework, cheapest-to-deliver curves, CVA, DVA and FVA
In recent years, interest-rate modeling has developed rapidly in terms of both practice and theory. The academic and practitioners' communities, however, have not always communicated as productively as would have been desirable. As a result, their research programs have often developed with little constructive interference. In this book, Riccardo Rebonato draws on his academic and professional experience, straddling both sides of the divide to bring together and build on what theory and trading have to offer. Rebonato begins by presenting the conceptual foundations for the application of the LIBOR market model to the pricing of interest-rate derivatives. Next he treats in great detail the calibration of this model to market prices, asking how possible and advisable it is to enforce a simultaneous fitting to several market observables. He does so with an eye not only to mathematical feasibility but also to financial justification, while devoting special scrutiny to the implications of market incompleteness. Much of the book concerns an original extension of the LIBOR market model, devised to account for implied volatility smiles. This is done by introducing a stochastic-volatility, displaced-diffusion version of the model. The emphasis again is on the financial justification and on the computational feasibility of the proposed solution to the smile problem. This book is must reading for quantitative researchers in financial houses, sophisticated practitioners in the derivatives area, and students of finance.
Discounting, LIBOR, CVA and Funding
How to Implement Market Models Using VBA
The Mathematics of Interest Rate Derivatives, Markets, Risk and Valuation
Theory and Practice, Second Edition
Financial Derivatives in Theory and Practice
Unifying the Bgm and Sabr Models
This paper uses an extensive set of market data of forward swap rates and swaptions covering 3 July 2002 to 21 May 2009 to identify a two-dimensional stochastic volatility process for the level of rates. The process is identified step by step by increasing the requirement of the model and introduce appropriate adjustments.The first part of the paper investigates the smile dynamics of forward swap rates at their setting dates. Comparing the SABR (with different $ beta$s) and Heston stochastic volatility models informs about what different specifications of the driving SDEs has to offer in terms of reflecting the dynamics of the smile across dates. The outcome of the analysis is that a normal SABR model ($ beta=0$) satisfactorily passes all tests and seems to provide a good match to the market. In contrast we find the Heston model does not.The next step is to seek a model of the forward swap rates (in their own swaption measure) based on only two factors that enables a specification with common parameters. It turns out that this can be done by extending the SABR model with a time-dependent volatility function and a mean reverting volatility process. The performance of the extended (SABR with mean-reversion) model is analysed over several historical dates and is shown to be a stable and flexible choice that allows for good calibration across expiries and strikes. Finally a time-homogeneous candidate stochastic volatility process that can be used as a driver for all swap rates is identified and used to construct a simple terminal Markov-functional type model under a single measure. This candidate process may in future work be used as a building block for a separable stochastic volatility LIBOR market model or a stochastic volatility Markov-functional model.
This book presents a major innovation in the interest rate space. It explains a financially motivated extension of the LIBOR Market model which accurately reproduces the prices for plain vanilla hedging instruments (swaptions and caplets) of all strikes and maturities produced by the SABR model. The authors show how to accurately recover the whole of the SABR smile surface using their extension of the LIBOR market model. This is not just a new model, this is a new way of option pricing that takes into account the need to calibrate as accurately as possible to the plain vanilla reference hedging instruments and the need to obtain prices and hedges in reasonable time whilst reproducing a realistic future evolution of the smile surface. It removes the hard choice between accuracy and time because the framework that the authors provide reproduces today's market prices of plain vanilla options almost exactly and simultaneously gives a reasonable future evolution for the smile surface. The authors take the SABR model as the starting point for their extension of the LMM because it is a good model for European options. The problem, however with SABR is that it treats each European option in isolation and the processes for the various underlyings (forward and swap rates) do not talk to each other so it isn't obvious how to relate these processes into the dynamics of the whole yield curve. With this new model, the authors bring the dynamics of the various forward rates and stochastic volatilities under a single umbrella. To ensure the absence of arbitrage they derive drift adjustments to be applied to both the forward rates and their volatilities. When this is completed, complex derivatives that depend on the joint realisation of all relevant forward rates can now be priced. Contents THE THEORETICAL SET-UP The Libor Market model The SABR Model The LMM-SABR Model IMPLEMENTATION AND CALIBRATION Calibrating the LMM-SABR model to Market Caplet prices Calibrating the LMM/SABR model to Market Swaption Prices Calibrating the Correlation Structure EMPIRICAL EVIDENCE The Empirical problem Estimating the volatility of the forward rates Estimating the correlation structure Estimating the volatility of the volatility HEDGING Hedging the Volatility Structure Hedging the Correlation Structure Hedging in conditions of market stress
Financial modelling Theory, Implementation and Practice with Matlab Source Jörg Kienitz and Daniel Wetterau Financial Modelling - Theory, Implementation and Practice with MATLAB Source is a unique combination of quantitative techniques, the application to financial problems and programming using Matlab. The book enables the reader to model, design and implement a wide range of financial models for derivatives pricing and asset allocation, providing practitioners with complete financial modelling workflow, from model choice, deriving prices and Greeks using (semi-) analytic and simulation techniques, and calibration even for exotic options. The book is split into three parts. The first part considers financial markets in general and looks at the complex models needed to handle observed structures, reviewing models based on diffusions including stochastic-local volatility models and (pure) jump processes. It shows the possible risk-neutral densities, implied volatility surfaces, option pricing and typical paths for a variety of models including SABR, Heston, Bates, Bates-Hull-White, Displaced-Heston, or stochastic volatility versions of Variance Gamma, respectively Normal Inverse Gaussian models and finally, multi-dimensional models. The stochastic-local-volatility Libor market model with time-dependent parameters is considered and as an application how to price and risk-manage CMS spread products is demonstrated. The second part of the book deals with numerical methods which enables the reader to use the models of the first part for pricing and risk management, covering methods based on direct integration and Fourier transforms, and detailing the implementation of the COS, CONV, Carr-Madan method or Fourier-Space-Time Stepping. This is applied to pricing of European, Bermudan and exotic options as well as the calculation of the Greeks. The Monte Carlo simulation technique is outlined and bridge sampling is discussed in a Gaussian setting and for Lévy processes. Computation of Greeks is covered using likelihood ratio methods and adjoint techniques. A chapter on state-of-the-art optimization algorithms rounds up the toolkit for applying advanced mathematical models to financial problems and the last chapter in this section of the book also serves as an introduction to model risk. The third part is devoted to the usage of Matlab, introducing the software package by describing the basic functions applied for financial engineering. The programming is approached from an object-oriented perspective with examples to propose a framework for calibration, hedging and the adjoint method for calculating Greeks in a Libor market model. Source code used for producing the results and analysing the models is provided on the author's dedicated website, http://www.mathworks.de/matlabcentral/fileexchange/authors/246981.
Masterarbeit aus dem Jahr 2018 im Fachbereich Mathematik - Angewandte Mathematik, Note: 1,0, Technische Hochschule Mittelhessen, Sprache: Deutsch, Abstract: Diese Arbeit befasst sich mit dem SABR-LIBOR-Market-Modell (SABR-LMM). Das SABR-LMM ist ein Zinsstrukturmodell zur Modellierung von Forward-Raten (oder Swap-Raten) und gilt als die natürliche Erweiterung des SABR- und des klassischen LIBOR oder Swap-Market-Modells. Wir wollen mit Hilfe dieses Modells die Preise von Caps, Floors und Swaptions (also von Standardinstrumenten eines Zinsmarktes) aller Laufzeiten und Strikes, d.h. für das gesamte Volatilitätsoberfläche (Surface), mittels eines einzigen Kalibrierungsvorgangs replizieren. Beide Modelle konnten sich bereits alleinstehend in der Praxis als Marktstandard in ihrem jeweiligen Anwendungsbereich etablieren. Das SABR-Modell wird für Standardinstrumente (Plain Vanilla) verwendet, während das LMM bei komplexeren Strukturen zum Einsatz kommt. Ziel dieser Arbeit ist die vollständige theoretische Definition, Implementation sowie Kalibrierung des SABR-LMMs. Darüber hinaus soll gezeigt werden, wie dieses Modell zur Bewertung von Plain Vanilla-Zinsderivaten herangezogen wird, welche als Grundlage für die Bewertung und das Hedging von komplexeren Instrumenten dienen. Die Kalibrierung umfasst dabei insbesondere den Volatilitäts- und Korrelationsprozess. Vor allem letzteres ist kein triviales Unterfangen, da die für die Kalibrierung verwendeten Daten nur wenig bis gar keine Informationen über die in der Modellierung benötigten instantanen Korrelationen beinhalten. Die für die Kalibrierung und Anwendung des Modells benötigten Daten sind die Zinsstrukturkurve, die impliziten Cap-Volatilitäten sowie die impliziten Swaption-Volatilitäten am jeweiligen Bewertungsstichtag.
Interest Rate Derivatives Explained: Volume 2
Foreign Exchange Option Pricing
Novel Methods in Computational Finance
Progress in Industrial Mathematics at ECMI 2014
Manufacturing and Managing Customer-Driven Derivatives
Theory and Practice
Accessible VBA coding for complex financial modelling How to Implement Market Models Using VBA makes solving complex valuation issues accessible to any financial professional with a taste for mathematics. With a focus on the clarity of code, this practical introductory guide includes chapters on VBA fundamentals and essential mathematical techniques, helping readers master the numerical methods to build an algorithm that can be used in a wide range of pricing problems. Coverage includes general algorithms, vanilla instruments, multi-asset instruments, yield curve models, interest rate exotics, and more, guiding readers thoroughly through pricing in the capital markets area. The companion website (http://implementmodinvba.com/) features additional VBA code and algorithmic techniques, and the interactive blog provides a forum for discussion of code with programmers and financial engineers, giving readers insight into the different applications and customisations possible for even more advanced problem solving.. Financial engineers implement models from a mathematical representation of an asset's performance by building a program that performs a valuation of securities based on this asset. How to Implement Market Models Using VBA makes this technical process understandable, with well-explained algorithms, VBA code, and accessible theoretical explanations. Decide which numerical method to use in which scenario Identify the necessary building blocks of an algorithm Write clear, functional VBA code for a variety of problems Apply algorithms to different instruments and models Designed for finance professionals, this book brings more accurate modelling within reach for anyone with interest in the market. For clearer code, patient explanation, and practical instruction, How to Implement Market Models Using VBA is an essential introductory guide.
The Volatility Smile The Black-Scholes-Merton option model was the greatest innovation of 20th century finance, and remains the most widely applied theory in all of finance. Despite this success, the model is fundamentally at odds with the observed behavior of option markets: a graph of implied volatilities against strike will typically display a curve or skew, which practitioners refer to as the smile, and which the model cannot explain. Option valuation is not a solved problem, and the past forty years have witnessed an abundance of new models that try to reconcile theory with markets. The Volatility Smile presents a unified treatment of the Black-Scholes-Merton model and the more advanced models that have replaced it. It is also a book about the principles of financial valuation and how to apply them. Celebrated author and quant Emanuel Derman and Michael B. Miller explain not just the mathematics but the ideas behind the models. By examining the foundations, the implementation, and the pros and cons of various models, and by carefully exploring their derivations and their assumptions, readers will learn not only how to handle the volatility smile but how to evaluate and build their own financial models. Topics covered include: The principles of valuation Static and dynamic replication The Black-Scholes-Merton model Hedging strategies Transaction costs The behavior of the volatility smile Implied distributions Local volatility models Stochastic volatility models Jump-diffusion models The first half of the book, Chapters 1 through 13, can serve as a standalone textbook for a course on option valuation and the Black-Scholes-Merton model, presenting the principles of financial modeling, several derivations of the model, and a detailed discussion of how it is used in practice. The second half focuses on the behavior of the volatility smile, and, in conjunction with the first half, can be used for as the basis for a more advanced course.
This book covers foreign exchange options from the point of view of the finance practitioner. It contains everything a quant or trader working in a bank or hedge fund would need to know about the mathematics of foreign exchange—not just the theoretical mathematics covered in other books but also comprehensive coverage of implementation, pricing and calibration. With content developed with input from traders and with examples using real-world data, this book introduces many of the more commonly requested products from FX options trading desks, together with the models that capture the risk characteristics necessary to price these products accurately. Crucially, this book describes the numerical methods required for calibration of these models – an area often neglected in the literature, which is nevertheless of paramount importance in practice. Thorough treatment is given in one unified text to the following features: Correct market conventions for FX volatility surface construction Adjustment for settlement and delayed delivery of options Pricing of vanillas and barrier options under the volatility smile Barrier bending for limiting barrier discontinuity risk near expiry Industry strength partial differential equations in one and several spatial variables using finite differences on nonuniform grids Fourier transform methods for pricing European options using characteristic functions Stochastic and local volatility models, and a mixed stochastic/local volatility model Three-factor long-dated FX model Numerical calibration techniques for all the models in this work The augmented state variable approach for pricing strongly path-dependent options using either partial differential equations or Monte Carlo simulation Connecting mathematically rigorous theory with practice, this is the essential guide to foreign exchange options in the context of the real financial marketplace. Table of Contents Mathematical Preliminaries Deltas and Market Conventions Volatility Surface Construction Local Volatility and Implied Volatility Stochastic Volatility Numerical Methods for Pricing and Calibration First Generation Exotics – Binary and Barrier Options Second Generation Exotics Multicurrency Options Long-dated FX Options
This book addresses selected practical applications and recent developments in the areas of quantitative financial modeling in derivatives instruments, some of which are from the authors' own research and practice. It is written from the viewpoint of financial engineers or practitioners, and, as such, it puts more emphasis on the practical applications of financial mathematics in the real market than the mathematics itself with precise (and tedious) technical conditions. It attempts to combine economic insights with mathematics and modeling so as to help the reader to develop intuitions. Among the modeling and the numerical techniques presented are the practical applications of the martingale theories, such as martingale model factory and martingale resampling and interpolation. In addition, the book addresses the counterparty credit risk modeling, pricing, and arbitraging strategies from the perspective of a front office functionality and a revenue center (rather than merely a risk management functionality), which are relatively recent developments and are of increasing importance. It also discusses various trading structuring strategies and touches upon some popular credit/IR/FX hybrid products, such as PRDC, TARN, Snowballs, Snowbears, CCDS, and credit extinguishers. While the primary scope of this book is the fixed-income market (with further focus on the interest rate market), many of the methodologies presented also apply to other financial markets, such as the credit, equity, foreign exchange, and commodity markets. Contents:Theory and Applications of Derivatives Modeling:Introduction to Counterparty Credit RiskMartingale Arbitrage Pricing in Real MarketThe Black – Scholes Framework and ExtensionsMartingale Resampling and InterpolationIntroduction to Interest Rate Term Structure ModelingThe Health – Jarrow – Morton FrameworkThe Interest Rate Market ModelCredit Risk Modeling and PricingInterest Rate Market Fundamentals and Proprietary Trading Strategies:Simple Interest Rate ProductsYield Curve ModelingTwo-Factor Risk ModelThe Holy Grail — Two-Factor Interest Rate ArbitrageYield Decomposition ModelInflation Linked Instruments ModelingInterest Rate Proprietary Trading Strategies Readership: Advanced readers who work or are interested in the fixed-income market. Keywords:CVA;Credit Valuation Adjustment;Counterparty Credit;BGM Model;HJM Model;RS Model;Martingale;Derivatives Modeling;Martingale Resampling;Orthogonal Exponential Spline;Stat Arb;Nonexploding Bushy Tree;NBT;PRDC;TARN;Snowball;Snowbear;CCDS;Credit ExtinguisherReviews: “ This state of the art text emphasizes various contemporary topics in fixed income derivatives from a practitioner's perspective. The combination of martingale technology with the author's expert practical knowledge contributes hugely to the book's success. For those who desire timely reporting straight from the trenches, this book is a must. ” Peter Carr, PhD Director of the Masters in Math Finance Program Courant Institute, NYU “ It is quite obvious that the authors have significant practical experience in sophisticated quantitative analysis and derivatives modeling. This real world focus has resulted in a text that not only provides clear presentations on modeling, pricing and hedging derivatives products, but also provides more advanced material that is usually found only in research publications. This book has innovative ideas, state of the art applications, and contains a wealth of valuable information that will interest academics, applied quantitative derivatives modelers, and traders. ” Peter Ritchken Kenneth Walter Haber Professor Department of Banking and Finance, Weatherhead School of Management, Case Western Reserve University “ Written by two experienced production Quants, this book contains a wealth of practical methods and useful insights that have been tried and tested. In addressing new tasks, most Quants worry about best practice. Along with specialist published papers, etc, this book is a must to help calibrate judgment. Presently one of the dozen select math-finance books that really should be on one's shelf! ” Alan Brace University of Technology Sydney School of Finance and Economics Key Features:Covers various advanced interest rate models, such as the HJM framework, Markovian HJM models (multi-factor RS model in particular), and BGM models, as well as counterparty credit pricing models. It also touches upon some credit models, such as the Copula model, the factor model, and risky market model for credit spreadAddresses various practical applications of modeling, such as martingale arbitrage modeling under real market situations (such as using the correct risk-free interest rate, revised put-call parity, defaultable derivatives, and hedging in the presence of the volatility skew and smile, as well as brief discussions on secondary model calibration for handling the un-hedgeable variables, models for pricing and models for hedging)Presents practical numerical algorithms for the model implementation, such as martingale interpolation and resampling for enforcing discrete martingale relationships in situ in numerical procedures, modeling of the volatility skew, and a nonexploding bushy tree (NBT) technique for efficiently solving non-Markovian models, such as the multi-factor BGM market model, under the backward induction frameworkIntroduces the basics of the interest rate market, including various yield curve modeling, such as the well known Orthogonal Exponential Spline (OES) model, as well as proprietary trading strategies, stat arb in particular
With Smile, Inflation and Credit
A General Asymptotic Implied Volatility for Stochastic Volatility Models
The Volatility Smile
Analysis, Geometry, and Modeling in Finance
PDE and Martingale Methods in Option Pricing
Pricing, Calibration and Hedging for Complex Interest-Rate Derivatives
Featuring contributions from industry and academia, this volume includes chapters covering a diverse range of theoretical and empirical aspects of actuarial science and quantitative finance, including portfolio management, derivative valuation, risk theory and the economics of insurance. Developed from the First International Congress on Actuarial Science and Quantitative Finance, held at the Universidad Nacional de Colombia in Bogotá in June 2014, this volume highlights different approaches to issues arising from industries in the Andean and Carribean regions. Contributions address topics such as Reverse mortgage schemes and urban dynamics, modeling spot price dynamics in the electricity market, and optimizing calibration and pricing with SABR models.
The SABR closed-form formula (Hagan et. al 2002) is the standard for smile-consistent pricing in the swaption market. Here we address the issue of turning SABR assumptions into a consistent and arbitrage-free term structure model in the BGM/Libor Market Model framework. We compute the joint dynamics followed by Libor rates and stochastic volatility of SABR kind under the general pricing measures used for interest rate derivatives, and we observe that the volatility dynamics is non-standard. Based on the analysis of the equation found, we develop and justify theoretically a few approximations aimed at making these no-arbitrage dynamics compatible with the use of the SABR closed-form formula. Then the formulas developed above are confronted both with alternative numerical implementations and with market data. We verify that the formulas for no-arbitrage corrections are acceptably precise, maintain good fitting, and produce regular Libor parameters. Finally we verify that the no-arbitrage corrections to the volatility dynamics make the out-of-calibration-sample prices implied by the model closer to market quotations, compared to prices implied by a trivial multivariate SABR neglecting such corrections.
This book on Interest Rate Derivatives has three parts. The first part is on financial products and extends the range of products considered in Interest Rate Derivatives Explained I. In particular we consider callable products such as Bermudan swaptions or exotic derivatives. The second part is on volatility modelling. The Heston and the SABR model are reviewed and analyzed in detail. Both models are widely applied in practice. Such models are necessary to account for the volatility skew/smile and form the fundament for pricing and risk management of complex interest rate structures such as Constant Maturity Swap options. Term structure models are introduced in the third part. We consider three main classes namely short rate models, instantaneous forward rate models and market models. For each class we review one representative which is heavily used in practice. We have chosen the Hull-White, the Cheyette and the Libor Market model. For all the models we consider the extensions by a stochastic basis and stochastic volatility component. Finally, we round up the exposition by giving an overview of the numerical methods that are relevant for successfully implementing the models considered in the book.
Providing the most up-to-date tools and techniques for pricing interest rate and credit products for the new financial world, this book discusses pricing and hedging, funding and regulation, and interpretation, as an essential resource for quantitatively minded practitioners and researchers in finance.
Financial Modelling
No-Arbitrage Dynamics for a Tractable SABR Term Structure Libor Model
Credit, Funding and Capital Valuation Adjustments
The LIBOR Market Model and Beyond
Stochastic Volatility for Interest Rate Derivatives
With Examples Implemented in Python
Focusing on recent advances in option pricing under the SABR model, this book shows how to price options under this model in an arbitrage-free, theoretically consistent manner. It extends SABR to a negative rates environment, and shows how to generalize it to a similar model with additional degrees of freedom, allowing simultaneous model calibration to swaptions and CMSs. Since the SABR model is used on practically every trading floor to construct interest rate options volatility cubes in an arbitrage-free manner, a careful treatment of it is extremely important. The book will be of interest to experienced industry practitioners, as well as to students and professors in academia. Aimed mainly at financial industry practitioners (for example quants and former physicists) this book will also be interesting to mathematicians who seek intuition in the mathematical finance.
This book presents a collection of papers emphasizing applications of mathematical models and methods to real-world problems of relevance for industry, life science, environment, finance and so on. The biannual Conference of ECMI (the European Consortium of Mathematics in Industry) held in 2014 focused on various aspects of industrial and applied mathematics. The five main topics addressed at the conference were mathematical models in life science, material science and semiconductors, mathematical methods in the environment, design automation and industrial applications, and computational finance. Several other topics have been treated, such as, among others, optimization and inverse problems, education, numerical methods for stiff pdes, model reduction, imaging processing, multi physics simulation, mathematical models in textile industry. The conference, which brought together applied mathematicians and experts from industry, provided a unique opportunity to exchange ideas, problems and methodologies, bridging the gap between mathematics and industry and contributing to the advancement of science and technology. The conference has included a presentation of EU-Maths-In (European Network of Mathematics for Industry and Innovation), a recent joint initiative of ECMI and EMS. The proceedings from this conference represent a snapshot of the current activity in industrial mathematics in Europe, and are highly relevant to anybody interested in the latest applications of mathematics to industrial problems.
This book, first published in 2000, addresses pricing and hedging derivative securities in uncertain and changing market volatility.
We show a particular case of joint calibration of the Libor Market Model (LMM) to market-quoted implied cap and swaption volatilities using a linear-exponential parameterization. We also create a Monte Carlo vanilla swaption-pricing engine using the model in the first part of the paper. In the second part of the paper, an attempt will be made to incorporate the dynamics of the volatility skew for caplets though implementation of stochastic volatility SABR model.
Modern Pricing of Interest-Rate Derivatives
Quantitative Analysis, Derivatives Modeling, and Trading Strategies
Asymptotic Chaos Expansions in Finance
Interest Rate and Credit Pricing
Theoretische Definiton, Implementation und Kalibrierung des SABR-LMMs
Calibration of Libor Market Model to Caps and Swaptions Market Volatilities
Thorough, accessible coverage of the key issues in XVA XVA - Credit, Funding and Capital Valuation Adjustments provides specialists and non-specialists alike with an up-to-date and comprehensive treatment of Credit, Debit, Funding, Capital and Margin Valuation Adjustment (CVA, DVA, FVA, KVA and MVA), including modelling frameworks as well as broader IT engineering challenges. Written by an industry expert, this book navigates you through the complexities of XVA, discussing in detail the very latest developments in valuation adjustments including the impact of regulatory capital and margin requirements arising from CCPs and bilateral initial margin. The book presents a unified approach to modelling valuation adjustments including credit risk, funding and regulatory effects. The practical implementation of XVA models using Monte Carlo techniques is also central to the book. You'll also find thorough coverage of how XVA sensitivities can be accurately measured, the technological challenges presented by XVA, the use of grid computing on CPU and GPU platforms, the management of data, and how the regulatory framework introduced under Basel III presents massive implications for the finance industry. Explores how XVA models have developed in the aftermath of the credit crisis The only text to focus on the XVA adjustments rather than the broader topic of counterparty risk. Covers regulatory change since the credit crisis including Basel III and the impact regulation has had on the pricing of derivatives. Covers the very latest valuation adjustments, KVA and MVA. The author is a regular speaker and trainer at industry events, including WBS training, Marcus Evans, ICBI, Infoline and RISK If you're a quantitative analyst, trader, banking manager, risk manager, finance and audit professional, academic or student looking to expand your knowledge of XVA, this book has you covered.
A guide to the validation and risk management of quantitative models used for pricing and hedging Whereas the majority of quantitative finance books focus on mathematics and risk management books focus on regulatory aspects, this book addresses the elements missed by this literature--the risks of the models themselves. This book starts from regulatory issues, but translates them into practical suggestions to reduce the likelihood of model losses, basing model risk and validation on market experience and on a wide range of real-world examples, with a high level of detail and precise operative indications.
Manufacturing and Managing Customer-Driven Derivatives Manufacturing and Managing Customer-Driven Derivatives sheds light on customer-driven derivative products and their manufacturing process, which can prove a complicated topic for even experienced financial practitioners. This authoritative text offers up-to-date knowledge and practices across a broad range of topics that address the entire manufacturing, pricing and risk management process, including practical knowledge and industrial best practices. This resource blends quantitative and business perspectives to provide an in-depth understanding of the derivative risk management skills that are necessary to adopt in the competitive financial industry. Manufacturing and managing customer-driven derivative products have become more complex due to macro factors such as the multi-curve environments triggered by the recent financial crises, stricter regulatory requirements of consistent modelling and managing frameworks, and the need for risk/reward optimisation. Explore the fundamental components of the derivatives business, including equity derivatives, interest rates derivatives, real estate derivatives, and real life derivatives, etc. Examine the life cycle of manufacturing derivative products and practical pricing models Deep dive into a wide range of customer-driven structured derivative products, their investment or hedging payoff features and associated risk exposures Examine the implications of changing regulatory standards, which can increase costs in the banking sector Discover practical yet sophisticated product analysis, quantitative modeling, infrastructure integration, risk analysis, and hedging analysis Gain insight on how banks should handle complex derivatives products Manufacturing and Managing Customer-Driven Derivatives is an essential guide for quants, structurers, derivatives traders, risk managers, business executives, insurance industry professionals, hedge fund managers, academic lecturers, and financial math students who are interested in looking at the bigger picture of the manufacturing, pricing and risk management process of customer-driven derivative transactions.
We consider the valuation of collateralized derivative contracts such as bond option or Caplet contracts. We allow for posting different collaterals such as securities or cash for the derivatives and its hedges. The pricing is based on modeling the joint evolution of collateral rate and the spread between collaterals.The Hull-White models are applied to collateral rate and spread to generate the closed pricing formula for zero coupon bond option. We also derive the pricing formula for Caplet under the Libor Market model and SABR model framework.
Analytical Finance: Volume II
Modeling and Pricing of Swaps for Financial and Energy Markets with Stochastic Volatilities
Understanding and Managing Model Risk

SABR and SABR LIBOR Market Models in Practice
Actuarial Sciences and Quantitative Finance
XVA

In this paper, we derive a general asymptotic implied volatility at the first-order for any stochastic volatility model using the heat kernel expansion on a Riemann manifold endowed with an Abelian connection. This formula is particularly useful for the calibration procedure. As an application, we obtain an asymptotic smile for a SABR model with a mean-reversion term, called lambda-SABR, corresponding in our geometric framework to the Poincare hyperbolic plane. When the lambda-SABR model degenerates into the SABR-model, we show that our asymptotic implied volatility is a better approximation than the classical Hagan-al expression. Furthermore, in order to show the strength of this geometric framework, we give an exact solution of the SABR model with beta=0 or 1. In a next paper, we will show how our method can be applied in other contexts such as the derivation of an asymptotic implied volatility for a Libor market model with a stochastic volatility.

The Team at Wilmott is very proud to present this compilation of Wilmott magazine articles and presentations from our second year. We have selected some of the very best in cutting-edge research, and the most illuminating of our regular columns. The technical papers include state-of-the-art pricing tools and models. You'll notice there's a bias towards volatility modelling in the book. Of course, it's one of my favourite topics, but volatility is also the big unknown as far as pricing and hedging is concerned. We present research in this area from some of the best newcomers in this field. You'll see ideas that make a mockery of 'received wisdom,' ideas that are truly paradigm shattering - for we aren't content with a mere 'shift.' We know you'll enjoy it! The Best of Wilmott will return again next year...

Containing many results that are new, or which exist only in recent research articles, Interest Rate Modeling: Theory and Practice, 2nd Edition portrays the theory of interest rate modeling as a three-dimensional object of finance, mathematics, and computation. It introduces all models with financial-economical justifications, develops options along the martingale approach, and handles option evaluations with precise numerical methods. Features Presents a complete cycle of model construction and applications, showing readers how to build and use models Provides a systematic treatment of intriguing industrial issues, such as volatility and correlation adjustments Contains exercise sets and a number of examples, with many based on real market data Includes comments on cutting-edge research, such as volatility-smile, positive interest-rate models, and convexity adjustment New to the 2nd edition: volatility smile modeling; a new paradigm for inflation derivatives modeling; an extended market model for credit derivatives; a dual-curved model for the post-crisis interest-rate derivatives markets; and an elegant framework for the xVA.

SABR and SABR LIBOR Market Models in PracticeWith Examples Implemented in PythonSpringer

Asset Pricing Under General Collateralization

Term Structure and Volatility Modelling

ICASQF, Bogotá, Colombia, June 2014

The Libor Market Model and Its Calibration to the South African Market

In the Presence of Counterparty Credit Risk for the Fixed-Income Market

Derivatives in Financial Markets with Stochastic Volatility

Stochastic instantaneous volatility models such as Heston, SABR or SV-LMM have mostly been developed to control the shape and joint dynamics of the implied volatility surface. In principle, they are well suited for pricing and hedging vanilla and exotic options, for relative value strategies or for risk management. In practice however, most SV models lack a closed form valuation for European options. This book presents the recently developed Asymptotic Chaos Expansions methodology (ACE) which addresses that issue. Indeed its generic algorithm provides, for any regular SV model, the pure asymptotes at any order for both the static and dynamic maps of the implied volatility surface. Furthermore, ACE is programmable and can complement other approximation methods. Hence it allows a systematic approach to designing, parameterising, calibrating and exploiting SV models, typically for Vega hedging or American Monte-Carlo. Asymptotic Chaos Expansions in Finance illustrates the ACE approach for single underlyings (such as a stock price or FX rate), baskets (indexes, spreads) and term structure models (especially SV-HJM and SV-LMM). It also establishes fundamental links between the Wiener chaos of the instantaneous volatility and the small-time asymptotic structure of the stochastic implied volatility framework. It is addressed primarily to financial mathematics researchers and graduate students, interested in stochastic volatility, asymptotics or market models. Moreover, as it contains many self-contained approximation results, it will be useful to practitioners modelling the shape of the smile and its evolution.

In this short note, using our geometric method introduced in a previous paper, we derive an asymptotic swaption implied volatility at the first-order for a general stochastic volatility Libor Market Model. This formula is useful to quickly calibrate a model to a full swaption matrix. We apply this formula to a specific model where the forward rates are assumed to follow a multi-dimensional CEV process correlated to a SABR process. For a caplet, this model degenerates to the classical SABR model and our asymptotic swaption implied volatility reduces naturally to the Hagan-al formula cite{sab}. The geometry underlying this model is the hyperbolic manifold $ HH^{n+1}$ with n the number of Libor forward rates.

A Practitioners Guide

Theory, Implementation and Practice with MATLAB Source