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Interest Rate Models - Theory and Practice Interest Rate Modeling Interest Rate Models Theory and Practice Consistency Problems for Heath-Jarrow-Morton Interest Rate Models Interest Rate Modeling for Risk Management: Market Price of Interest Rate Risk (Second Edition) Interest Rate Modeling: Post-Crisis Challenges and Approaches Stochastic Interest Rate Modeling With Fixed Income Derivative Pricing (Third Edition) Interest Rate Models Interest Rate Modelling Interest Rate Models: an Infinite Dimensional Stochastic Analysis Perspective An Elementary Introduction to Stochastic Interest Rate Modeling Modeling the Term Structure of Interest Rates Interest Rate Modeling Interest Rate Derivatives Explained: Volume 2 Interest Rate Modeling An Elementary Introduction to Stochastic Interest Rate Modeling Interest Rate Models on Lie Groups Interest Rate, Term Structure, and Valuation Modeling Interest-Rate Option Models Interest Rate Modelling in the Multi-Curve Framework Interest Rate Risk Models Estimating Parameters of Short-Term Real Interest Rate Models Stochastic Interest Rates Interest Rate Modelling The New Interest Rate Models Elementary Introduction To Stochastic Interest Rate Modeling, An (2nd Edition) Term-Structure Models Interest-Rate Option Models Modelling Interest Rates Vasicek and Beyond Dynamic Term Structure Modeling Discrete-Time Continuous-State Interest Rate Models Interest Rate Modelling in the Multi-Curve Framework Interest Rate Models Implied Volatility Interest Rate Models for Pricing Zero Coupon Bond Options Efficient Methods for Valuing Interest Rate Derivatives Advanced Fixed Income Analysis Modeling the Term Structure of Interest Rates Real Options Valuation Interest Rate Models, Asset Allocation and Quantitative Techniques for Central Banks and Sovereign Wealth Funds

This book presents the mathematical issues that arise in modeling the interest rate term structure by casting the interest-rate models as stochastic evolution equations in infinite dimensions. The text includes a crash course on interest rates, a self-contained introduction to infinite dimensional stochastic analysis, and recent results in interest rate theory. From the reviews: "A wonderful book. The authors present some cutting-edge math." -- WWW.RISKBOOK.COM 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. Designed for Master's students, this practical text strikes the right balance between mathematical rigour and real-world application. This paper presents a one-factor and a two-factor arbitrage-free interest rate models with parsimonious implied volatility functions. The models are empirically tested on the entire swaption surface in three currencies (US dollar, Euro, and Japanese yen) over a 5-year period. They are shown to be robust in explaining the swaption values, and the implied volatility functions are shown to exhibit a three-factor movement in all three currencies. The results show that the observed swaption prices incorporate the market conditional expectations of the correlations of the key interest rates and the stochastic process of the yield curve, and the interest rate models should be calibrated to such market information to provide accurate relative valuation. Further this paper describes a modeling approach that has important implications on hedging interest rate derivatives dynamically taking the stochastic volatility risks into account. "Overall this book provides an excellent summary of the state of knowledge of term structure modelling. It combines a solid academic background with the practical experience of someone who works in the financial sector." Alan White and John Hull, A-J Financial Systems, Canada The modelling of exotic interest-rate options is such an important and fast-moving area, that the updating of the extremely successful first edition has been eagerly awaited. This edition re-focuses the assessment of various models presented in the first edition, in light of the new developments of modelling imperfect correlation between financial quantities. It also presents a substantial new chapter devoted to this revolutionary modelling method. In this second edition, readers will also find important new data dealing with the securities markets and the probabilistic/stochastic calculus tools. Other changes include: a new chapter on the issues arising in the pricing of several classes of exotic interest-rate instruments; and insights from the BDT and the Brennan and Schwartz approaches which can be combined into a new class of "generalised models". Further details can be found on the links between mean-reversion and calibration for important classes of models. Following the financial crisis dramatic market changes, a new standard in interest rate modelling emerged, called the multi-curve framework. The author provides a detailed analysis of the framework, through its foundations, evolution and implementation. The book also covers recent extensions to collateral and stochastic spreads modelling. This book introduces the mathematics of stochastic interest rate modeling and the pricing of related derivatives, based on a step-by-step presentation of concepts with a focus on explicit calculations. The types of interest rates considered range from short rates to forward rates such as LIBOR and swap rates, which are presented in the HJM and BGM frameworks. The pricing and hedging of interest rate and fixed income derivatives such as bond options, caps, and swaptions, are treated using forward measure techniques. An introduction to default bond pricing and an outlook on model calibration are also included as additional topics.This third edition represents a significant update on the second edition published by World Scientific in 2012. Most chapters have been reorganized and largely rewritten with additional details and supplementary solved exercises. New graphs and simulations based on market data have been included, together with the corresponding R codes.This new edition also contains 75 exercises and 4 problems with detailed solutions, making it suitable for advanced undergraduate and graduate level students. Managerial decision-making during the lifetime of a project can have im portant implications on project handling and its contribution to shareholder value. Traditional capital budgeting methods (in particular methods based on net present value) fail to capture the role of managerial degrees of free dom and therefore tend to lead to a systematic undervaluation of the project. In contrast, the real options approach to investment analysis characterizes decision-making flexibility in terms of (real) option rights which can be eval uated analogously to financial options using contingent-claims pricing tech niques widely used in capital markets. The research carried out by Marcus Schulmerich analyzes real options for n-constant and stochastic interest rates versus constant interest rates. Analyzing stochastic interest rates in the context of real options valuation is of particular relevance given their long time to maturity which makes them more vulnera ble to interest rate risk than short-term financial options. To date, there has not been a comprehensive review of this issue in the academic literature. The fact that interest rates have fiuctuated widely over the recent years further highlights the need for studying this issue. As interest rate markets continue to innovate and expand it is becoming increasingly

important to remain up-to-date with the latest practical and theoretical developments. This book covers the latest developments in full, with descriptions and implementation techniques for all the major classes of interest rate models-both those actively used in practice as well as theoretical models still 'waiting in the wings'. Interest rate models, implementation methods and estimation issues are discussed at length by the authors as are important new developments such as kernel estimation techniques, economic based models, implied pricing methods and models on manifolds. Providing balanced coverage of both the practical use of models and the theory that underlies them, Interest Rate Modelling adopts an implementation orientation throughout, making it an ideal resource for both practitioners and researchers. The last two decades have seen the development of a profusion of theoretical models of the term structure of interest rates. This study provides a general overview and a comprehensive comparative study of the most popular ones among both academics and practitioners. It also discusses their respective advantages and disadvantages in terms of bond and/or interest rate contingent claims continuous time valuation or hedging, parameter estimation, and calibration. Finally, it proposes a unified approach for model risk assessment. Despite the relatively complex mathematics involved, financial intuition rather then mathematical rigour is emphasised throughout. The classification by means of general characteristics should enable the understanding of the different features of each model, facilitate the choice of a model in specific theoretical or empirical circumstances, and allows the testing of various models with nested as well as non-nested specifications. Modeling the Term Structure of Interest Rates provides a comprehensive review of the continuous-time modeling techniques of the term structure applicable to value and hedge default-free bonds and other interest rate derivatives. 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. 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Praise for Dynamic Term Structure Modeling "This book offers the most comprehensive coverage of term-structure models I have seen so far, encompassing equilibrium and no-arbitrage models in a new framework, along with the major solution techniques using trees, PDE methods, Fourier methods, and approximations. It is an essential reference for academics and practitioners alike." --Sanjiv Ranjan Das Professor of Finance, Santa Clara University, California, coeditor, Journal of Derivatives "Bravo! This is an exhaustive analysis of the yield curve dynamics. It is clear, pedagogically impressive, well presented, and to the point." --Nassim Nicholas Taleb author, Dynamic Hedging and The Black Swan "Nawalkha, Beliaeva, and Soto have put together a comprehensive, up-to-date textbook on modern dynamic term structure modeling. It is both accessible and rigorous and should be of tremendous interest to anyone who wants to learn about state-of-the-art fixed income modeling. It provides many numerical examples that will be valuable to readers interested in the practical implementations of these models." --Pierre Collin-Dufresne Associate Professor of Finance, UC Berkeley "The book provides a comprehensive description of the continuous time interest rate models. It serves an important part of the trilogy, useful for financial engineers to grasp the theoretical underpinnings and the practical implementation." --Thomas S. Y. Ho, PHD President, Thomas Ho Company, Ltd, coauthor, The Oxford Guide to Financial Modeling Interest rate modeling and the pricing of related derivatives remain subjects of increasing importance in financial mathematics and risk management. This book provides an accessible introduction to these topics by a step-by-step presentation of concepts with a focus on explicit calculations. Each chapter is accompanied with exercises and their complete solutions, making the book suitable for advanced undergraduate and graduate level students.This second edition retains the main features of the first edition while incorporating a complete revision of the text as well as additional exercises with their solutions, and a new introductory chapter on credit risk. The stochastic interest rate models considered range from standard short rate to forward rate models, with a treatment of the pricing of related derivatives such as caps and swaptions under forward measures. Some more advanced topics including the BGM model and an approach to its calibration are also covered. Filling a gap in the literature caused by the recent financial crisis, this book provides a treatment of the techniques needed to model and evaluate interest rate derivatives according to the new paradigm for fixed income markets. Concerning this new development, there presently exist only research articles and two books, one of them an edited volume, both being written by researchers working mainly in practice. The aim of this book is to concentrate primarily on the methodological side, thereby providing an overview of the state-of-the-art and also clarifying the link between the new models and the classical literature. The book is intended to serve as a guide for graduate students and researchers as well as practitioners interested in the paradigm change for fixed income markets. A basic knowledge of fixed income markets and related stochastic methodology is assumed as a prerequisite. This book provides an overview of the models that can be used for valuing and managing interest rate derivatives. Split into two parts, the first discusses and compares the traditional models, such as spot- and forward-rate models, while the second concentrates on the more recently developed Market models. Unlike most of his competitors, the author's focus is not only on the mathematics: Antoon Pelsser draws on his experience in industry to explore a host of practical issues. This ultimate guide contains an excellent blend of theory and practice This comprehensive guide covers various aspects of model building for fixed income securities and derivatives. Filled with expert advice, valuable insights, and advanced modeling techniques, Interest Rate, Term Structure, and Valuation Modeling is a book that all institutional investors, portfolio managers, and risk professionals should have. John Wiley & Sons, Inc. is proud to be the publisher of the esteemed Frank J. Fabozzi Series. Comprising nearly 100 titles-which include numerous bestsellers—The Frank J. Fabozzi Series is a key resource for finance professionals and academics, strategists and students, and investors. The series is overseen by its eponymous editor, whose expert instruction and presentation of new ideas have been at the forefront of financial publishing for over twenty years. His successful career has provided him with the knowledge, insight, and advice that has led to this comprehensive series. Frank J. Fabozzi, PhD, CFA, CPA, is Editor of the Journal of Portfolio Management, which is read by thousands of institutional investors, as well as editor or author of over 100 books on finance for the professional and academic markets. Currently, Dr. Fabozzi is an adjunct Professor of Finance at Yale University's School of Management and on the board of directors of the Guardian Life family of funds and the Black Rock complex of funds. This paper examines an alternative approach to interest rate modeling, in which the nonlinear and random behavior of interest rates is captured by a stochastic differential equation evolving on a curved state space. We consider as candidate state spaces the matrix Lie groups; these offer not only a rich geometric structure, but -- unlike general Riemannian manifolds -- also allow for diffusion processes to be constructed easily without invoking the machinery of stochastic calculus on manifolds. After formulating bilinear stochastic differential equations on general matrix Lie groups, we then consider interest rate models in which the short rate is defined as linear or quadratic functions of the state. Stochastic volatility is also augmented to these models in a way that respects the Riemannian manifold structure of symmetric positive-definite matrices. Methods for numerical integration, parameter identification, pricing, and other practical issues are addressed through examples. Interest Rate Modeling for Risk Management presents an economic model

which can be used to compare interest rate and perform market risk assessment analyses. The key interest rate model applied in this book is specified under real-world measures, and the result is used as to generate scenarios for interest rates. The book introduces a theoretical framework that allows estimating the market price of interest rate risk. For this, the book starts with a brief explanation of stochastic analysis, and introduces interest rate models such as Heath-Jarrow-Morton, Hull-White and LIBOR models. The real-world model is then introduced in subsequent chapters. Additionally, the book also explains some properties of the real-world model, along with the negative price tendency of the market price for risk and a positive market price of risk (with practical examples). Readers will also find a handy appendix with proofs to complement the numerical methods explained in the book. This book is intended as a primer for practitioners in financial institutions involved in interest rate risk management. It also presents a new perspective for researchers and graduates in econometrics and finance on the study of interest rate models. The second edition features an expanded commentary on real world models as well as additional numerical examples for the benefit of readers. • Practical guide for asset-liability managers faced with the decision as to whether to build or buy a financial model • Topics include modeling cash flows, net investment income versus net portfolio value, projections of interest rates, and volatility A guide for asset-liability managers and other investment professionals who are faced with the decision of whether to build or buy a financial model to measure, monitor, and help manage their institution's risk exposure. It reviews the evolution of interest rate risk models and evaluates the state-of-the-art models in use. Includes Modeling cash flows; modeling the term structure; OAS technology; net interest income versus net portfolio value; build versus buy analysis; practical methods for deriving input assumptions; prepayment rates; deposit decay rates; projections of interest rate and volatility. The aim of this study is to compare the performance of the four interest rate models (Vasicek Model, Cox Ingersoll Ross Model, Ho Lee Model and Black Derman Toy Model) that are commonly used in pricing zero coupon bond options. In this study, 1-5 years US Treasury Bond daily data between the dates June 1, 1976 and December 31, 2009 are used. By using the four interest rate models, estimated option prices are compared with the real observed prices for the begining work days of each months of the years 2007 and 2008. The models are then evaluated according to the sum of squared errors. Option prices are found by constructing interest rate trees for the binomial models based on Ho Lee Model and Black Derman Toy Model and by estimating the parameters for the Vasicek and the Cox Ingersoll Ross Models. This paper sheds light on a narrow but crucial question in finance: What should be the parameters of a model of the short-term real interest rate? Although models for the nominal interest rate are well studied and estimated, dynamics of the real interest rate are rarely explored. Simple ad hoc processes for the short-term real interest rate are usually assumed as building blocks for more sophisticated models. In this paper, parameters of the real interest rate model are estimated in the broad class of single-factor interest rate diffusion processes on U.S. monthly data. It is shown that the elasticity of interest rate volatility—the relationship between the volatility of changes in the interest rate and its level—plays a crucial role in explaining real interest rate dynamics. The empirical estimates of the elasticity of the real interest rate volatility are found to be about 0.5, much lower than that of the nominal interest rate. These estimates show that the square root process, as in the Cox-Ingersoll-Ross model, provides a good characterization of the short-term real interest rate process. Bond markets differ in one fundamental aspect from standard stock markets. While the latter are built up to a finite number of trade assets, the underlying basis of a bond market is the entire term structure of interest rates: an infinite-dimensional variable which is not directly observable. On the empirical side, this necessitates curve-fitting methods for the daily estimation of the term structure. Pricing models, on the other hand, are usually built upon stochastic factors representing the term structure in a finite-dimensional state space. Written for readers with knowledge in mathematical finance (in particular interest rate theory) and elementary stochastic analysis, this research monograph has threefold aims: to bring together estimation methods and factor models for interest rates, to provide appropriate consistency conditions and to explore some important examples. Growth in the derivatives market has brought with it a greater volume and range of interest rate dependent products. These products have become increasingly innovative and complex to price, requiring sophisticated market models that capture the full dynamics of the yield curve. A study of the evolution of interest rate modelling theory places these models in the correct mathematical context, allowing appreciation of their key assumptions, concepts and implications. The book guides the practitioner through the derivation and implementation of a variety of models that account for the characteristics and irregularities of observed term structures. A title suitable for researchers who aim to get acquainted with the new trends in the interest rate models and to practitioners with a need to use increasingly sophisticated tools to price exotic claims consistently with the information on the underlying variables that is provided by the market in terms of plain vanilla quotes. A comprehensive collection that looks at the development of interest-rate models from since 1992. Interest rate modeling and the pricing of related derivatives remain subjects of increasing importance in financial mathematics and risk management. This book provides an accessible introduction to these topics by a step-by-step presentation of concepts with a focus on explicit calculations. Each chapter is accompanied with exercises and their complete solutions, making the book suitable for advanced undergraduate and graduate level students. This second edition retains the main features of the first edition while incorporating a complete revision of the text as well as additional exercises with their solutions, and a new introductory chapter on credit risk. The stochastic interest rate models considered range from standard short rate to forward rate models, with a treatment of the pricing of related derivatives such as caps and swaptions under forward measures. Some more advanced topics including the BGM model and an approach to its calibration are also covered. "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. Following the financial crisis dramatic market changes, a new standard in interest rate modelling emerged, called the multi-curve framework. The author provides a detailed analysis of the framework, through its foundations, evolution and implementation. The book also covers recent extensions to collateral and stochastic spreads modelling. 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. 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. Containing many results that are new or exist only in recent research articles, Interest Rate Modeling: Theory and Practice 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 app This textbook is written as an accessible introduction to interest rate modeling and related derivatives, which have become increasingly important subjects of interest in financial mathematics. The models considered range from standard short rate to forward rate models and include more advanced topics such as the BGM model and an approach to its calibration. An elementary treatment of the pricing of caps and swaptions under forward measures is also provided, with a focus on explicit calculations and a step-by-step introduction of concepts. Each chapter is accompanied with exercises and their complete solutions, making this book suitable for advanced undergraduate or beginning graduate-level students. An accessible, first-rate overview of interest rate dependent options for traders and institutional investors Until now market professionals seeking to exploit the profit potential of interest rate dependent options were forced to hunt through esoteric journals for a crumb or two of practical knowledge about their use. This accessible book narrows the information gap. Written in easy-to-follow, non-technical language, it logically reviews all the most commonly used interest rate option models, showing how each one can be applied and implemented for specific market applications. DR. RICARDO REBONATO (London, England) is head of Research, Debt Capital Markets at Barclays de Zoete Wedd Ltd. Each new chapter of the Second Edition covers an aspect of the fixed income market that has become relevant to investors but is not covered at an advanced level in existing textbooks. This is material that is pertinent to the investment decisions but is not freely available to those not originating the products. Professor Choudhry’s method is to place ideas into contexts in order to keep them from becoming too theoretical. While the level of mathematical sophistication is both high and specialized, he includes a brief introduction to the key mathematical concepts. This is a book on the financial markets, not mathematics, and he provides few derivations and fewer proofs. He draws on both his personal experience as well as his own research to bring together subjects of practical importance to bond market investors and analysts. Presents practitioner-level theories and applications, never available in textbooks Focuses on financial markets, not mathematics Covers relative value investing, returns analysis, and risk estimation Changing interest rates constitute one of the major risk sources for banks, insurance companies, and other financial institutions. Modeling the term-structure movements of interest rates is a challenging task. This volume gives an introduction to the mathematics of term-structure models in continuous time. It includes practical aspects for fixed-income markets such as day-count conventions, duration of coupon-paying bonds and yield curve construction; arbitrage theory; short-rate models; the Heath-Jarrow-Morton methodology; consistent term-structure parametrizations; affine diffusion processes and option pricing with Fourier transform; LIBOR market models; and credit risk. The focus is on a mathematically straightforward but rigorous development of the theory. Students, researchers and practitioners will find this volume very useful. Each chapter ends with a set of exercises, that provides source for homework and exam questions. Readers are expected to be familiar with elementary Itô calculus, basic probability theory, and real and complex analysis. This edited volume contains essential readings for financial analysts and market practitioners working at Central Banks and Sovereign Wealth Funds. It presents the reader with state-of-the-art methods that are directly implementable, and industry 'best-practices' as followed by leading institutions in their field. The field of financial mathematics has developed tremendously over the past thirty years, and the underlying models that have taken shape in interest rate markets and bond markets, being much richer in structure than equity-derivative models, are particularly fascinating and complex. This book introduces the tools required for the arbitrage-free modelling of the dynamics of these markets. Andrew Cairns addresses not only seminal works but also modern developments. Refreshingly broad in scope, covering numerical methods, credit risk, and descriptive models, and with an approachable sequence of opening chapters, Interest Rate Models will make readers--be they graduate students, academics, or practitioners--confident enough to develop their own interest rate models or to price nonstandard derivatives using existing models. The mathematical chapters begin with the simple binomial model that introduces many core ideas. But the main chapters work their way systematically through all of the main developments in continuous-time interest rate modelling. The book describes fully the broad range of approaches to interest rate modelling: short-rate models, no-arbitrage models, the Heath-Jarrow-Morton framework, multifactor models, forward measures, positive-interest models, and market models. Later chapters cover some related topics, including numerical methods, credit risk, and model calibration. Significantly, the book develops the martingale approach to bond pricing in detail, concentrating on risk-neutral pricing, before later exploring recent advances in interest rate modelling where different pricing measures are important.

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