Fixed Income and Credit Risk

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Hours: 35

Course objectives

The course aims to explore the latest advancements in term structure modeling for pricing and hedging interest rate derivatives. Emphasis will be placed on both the theoretical and practical implementation of models, as well as on the suitability of various approaches for addressing complex valuation and hedging challenges. These include interest rate options, equity-linked fixed-income securities, and structured products. Special attention will also be given to credit risk issues, particularly the assessment of counterparty credit risk. By the end of the course, participants will have a clear and comprehensive understanding of the methodologies for pricing and hedging interest rate options. While the course is quantitatively oriented, it also includes extensive discussions on financial and practical considerations. Model implementation utilizing the new dynamic functionalities of Microsoft Excel 365 will be provided.

Syllabus

1. Introduction to Fixed Income World.
2. Review of Basic elements of financial math and Interest Rate Conventions.
3. Building Blocks: Zero-coupon Bonds, Coupon Bonds, LIBOR, FRA, New Benchmarks.
4. Pricing Floating Rate Notes.
5. Pricing Interest Rate Swaps.
6. Yield Curve Stripping: the Bootstrapping Procedure. Interpolating the yield curve: parametric and non-parametric methods.
7. Measuring Interest Rate risk: Level, Shift and Curvature factors.
8. Interest Rate Options: Caps, Swaptions and Bond Options.
9. The Black Model and the volatility surface
9. Allowing for negative rates: Bachelier and Shifted Black model.
10. Pricing structured products
11. The change of numeraire and pricing of interest rate derivatives.
12. Short rate models. Merton, Vasicek, CIR.
13. The Heath-Jarrow-Morton (HJM) Model. Gaussian HJM Models. Multivariate HJM models.
14. Comparing different Term Structure Models: Market Models, Short Rate Models, HJM.
15. Lab session: Yield curve stripping, Calibration of short rate models; Pricing Floating Rate Notes;
16. Counterparty Credit Risk: Recovery ratio and Default/survival probability, Pricing a risky zero coupon bond; Pricing risky coupon bonds
17. Estimating default probability using bonds and CDS
18. Credit value adjustment for derivatives: Unilateral and Bilateral adjustment. Wrong-way-risk.
19. Mitigating counterparty exposure: Netting & Collateral

Software needed

Microsoft Excel 365: Familiarity with the dynamic functionalities of Excel is required. Tutorials on these features will be provided to the class prior to the start of the course, and their use is mandatory for this course.

Prerequisites

Good knowledge of: financial calculus (compounding conventions, concepts of discount factor, bond pricing, yield to maturity, duration, convexity); basic derivatives (forwards and options) and their pricing (cash and-carry & Black-Scholes formula); stochastic calculus (Brownian motion and its properties, Ito's lemma, ABM & GBM, isometry property of the Brownian motion, martingale, Girsanov Theorem).

Textbook and course material

1. Lecture Slides
2. Brigo, D. and F. Mercurio, Interest Rate Models - Theory and Practice: With Smile, Inflation and Credit, Springer Finance, 2nd ed, 2007.
3. Veronesi P., Fixed Income Securities: Valuation, Risk, and Risk Management, Wiley, 2009. **4.** Ballotta, Laura and Fusai, Gianluca and Marena, Marina, A Gentle Introduction to Default Risk and Counterparty Credit Modelling (July 30, 2016). Available at SSRN
   http://ssrn.com/abstract=2816355 or

   A complete suggested reading list will be distributed at the beginning of the course

Exam type

The exam will consist of the following components:

1. **Quizzes**: A 10-minute quiz at the beginning of each lecture, graded on a scale of 0-30. These quizzes will contribute 30% to the final grade.
2. **Written Examination**: An open-book written exam, including Excel applications and theoretical questions, will be held at the end of the course. This will account for 40% of the final grade.
3. **Take-Home Homework**: Compulsory group take-home assignments will contribute 30% to the final grade.