

METU INSTITUTE OF APPLIED MATHEMATICS

Course Title:	Special Topics : Advanced Interest Rate Models
Course Code:	IAM 752
Credit:	3(3-0)
Instructor's Name:	Martin Rainer
Prerequisites:	Elementary knowledge about classical Interest Rate Models (the basic chapters on stochastic interest rate in the textbook of Bjork, or Brigo-Mercurio) and consent of the instructor;
Content:	<p>Stochastic interest rates are an essential ingredient for the modeling of the major financial market of interest and credit and pricing of related instruments and derivatives.</p> <p>This course concentrates some more detailed and refined issues in the modeling of interest rate derivatives. In particular we will consider in detail the LIBOR Market Model and its calibration to cap and swaption markets, the problem of parametrization and calibration of the correlation matrix. We will deal with the major methods for including out-of-the-money options, i.e. different ways of stochastic volatility (locally as a function of the underlying process, volatility as uncertain parameter treated as a random variable, stochastic volatility). We will discuss the major approximations and techniques currently used in order to combine the LIBOR Market Model and stochastic volatility. In particular we will investigate the approaches for the SABR-LIBOR model. Some typical examples for pricing with LIBOR Market Model are given.</p>
Aims:	After this course the participant will have a detailed understanding of different versions of the LIBOR market model, how they can be applied, which of the parameters (volatilities, correlations) can be calibrated to which markets (e.g. caps, swaptions), under which conditions one should calibrate to a market, and what techniques are available for calibration. The advantages and drawbacks of different methods for dealing with stochastic volatility will be understood. In parallel to the theory, hands-on examples will be elaborated by the participants using MATHLAB and Excel.
Learning Outcomes:	At the end of this course, students should know how to price complex interest derivatives with a LIBOR Market Model. The critical judgment towards alternative modeling approaches will be sharpened. The student will also learn how to structure a complex task, such as the application of the LIBOR Market Model. Mathematical knowledge and methodology will be deepened and trained. This course is an important step for participants who wish to do their MSc or PhD thesis in interest rate modeling, and/or wish to prepare for working in the financial industry.

<p>Suggested Textbooks:</p>	<p>Lecture notes will be prepared during the course.</p> <p>Most of the content of this course is covered in:</p> <ul style="list-style-type: none"> • D. Brigo and F. Mercurio, Interest Rate Models, Theory and Practice, 2nd edition, 2006 <p>Further special references will be given during the course.</p>
<p>Outline:</p>	<ul style="list-style-type: none"> • The log-normal LIBOR and swap rate models LFM and LSM (1 week) • Swap rates in the LFM model (1 weeks) • Term structure of volatility and terminal correlations (1 week) • Parametrization and calibration of instantaneous correlations (1 week) • MonteCarlo-Simulation of the LFM for swaption pricing (1 week) • Analytical Approximations for Swaptions (1 week) • Smile and stochastic volatility (1 week) • Uncertain parameter model (1 week) • Calibration of the uncertain parameter LFM (1 week) • The SABR-LFM model (1 week) • Calibration of the SABR-LFM to caps (1 weeks) • Calibration of the SABR-LFM to caps and swaptions (1 weeks) • LFM pricing: the drift-freezing method (1 week) • LFM pricing: early exercise and path dependence (1 week)
<p>Resources:</p>	<ul style="list-style-type: none"> • LaTeX • MATHLAB, Excel