

MATH5985

TERM STRUCTURE MODELLING

The fixed-income market is an important sector of the global financial market on which various interest rate-sensitive instruments, such as: bonds, swaps, swaptions, caps, etc., are traded. The management of interest rate risk, by which we primarily mean the pricing and hedging of interest rate derivatives, is an important and complex issue. It creates a demand for mathematical models capable of covering all sorts of interest rate risks. Due to the somewhat peculiar way in which fixed-income securities are quoted in existing markets, theoretical term structure models are often easier to formulate and analyse in terms of interest rates which are different from the conventional market rates.

The course will give an overview of various concepts of interest rates and will describe the most important interest rate-sensitive contracts. The crucial part of the syllabus is the modelling of various kinds of interest rates and the valuation of interest rate derivatives within the framework of each methodology. In particular, we deal with various classical examples of short-term interest rate models, the Heath-Jarrow-Morton approach to the modelling of instantaneous forward rates, as well as the recently developed “market models”, such as: the BGM model of forward LIBORs and Jamshidian’s model of forward swap rates.

Outline of the course:

1. Fixed-income securities: zero-coupon bonds, yield-to-maturity, yield curve, forward rates, LIBOR and caps, swaps and swaptions.
2. Interest rates: short-term interest rate, spot and forward martingale measure, Merton’s model, Vasicek’s model, CIR model, affine term structure models, HJM methodology, Gaussian HJM model, lognormal model of LIBORs, Jamshidian’s model of forward swap rates.
3. Valuation and hedging of interest rate derivatives: bond options, options on futures, caps, swaptions.

Recommended textbooks:

Marek Musiela and Marek Rutkowski: *Martingale Methods in Financial Modelling*. 2nd edition. Springer, 2004.

Damiano Brigo and Fabio Mercurio: *Interest Rate Models: Theory and Practice*. Springer, 2001.

Phil J. Hunt and Joanne E. Kennedy: *Financial Derivatives in Theory and Practice*. John Wiley, 2000.

Antoon Pelsser: *Efficient Methods for Valuing Interest Rate Derivatives*. Springer, 2000.