

# MATH5965

## DISCRETE TIME FINANCIAL MODELLING

We first provide an overview of the most important kinds of financial contracts that are traded either on exchanges or over-the-counter between financial institutions and their clients. In particular, we discuss options of European and American style, futures contracts and forward contracts.

Next, we introduce the basic ideas of arbitrage pricing within the set-up of a one-period model. In the next step, we analyse the valuation and hedging of European and American options and general contingent claims in the framework of the classic Cox-Ross-Rubinstein binomial model of the stock price.

Finally, we present a general theory of arbitrage free discrete time models of spot and futures markets. In particular, we prove the so-called *fundamental theorems of asset pricing* (FTAP) for finite models of security markets. The first FTAP establishes the equivalence between the no-arbitrage property of a security market model and the existence of a martingale measure. The second FTAP shows that the model completeness can be characterised in terms of the uniqueness of a martingale measure.

*Outline of the course:*

1. An introduction to financial derivatives.
2. The Cox-Ross-Rubinstein binomial model.
3. Finite models of security markets in discrete time.

*Recommended textbooks:*

Marek Musiela and Marek Rutkowski: *Martingale Methods in Financial Modelling*. Springer-Verlag, Berlin Heidelberg New York, Second edition, 2005.

John C. Hull: *Options, Futures, and Other Derivatives*. Prentice-Hall, Englewood Cliffs, 1997.

Martin W. Baxter and Andrew Rennie: *Financial Calculus. An Introduction to Derivative Pricing*. Cambridge University Press, Cambridge, 1997.

Steven E. Shreve: *Stochastic Calculus for Finance I. The Binomial Asset Pricing Model*. Springer, 2004.

Stanley R. Pliska: *Introduction to Mathematical Finance: Discrete Time Models*. Blackwell Publishers, Oxford, 1997.

Hans Föllmer and Alexander Schied: *Stochastic Finance. An Introduction in Discrete Time*. De Gruyter, 2000.