

# STOCHASTIC NUMERICAL METHODS OF FINANCE

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## Objectives:

The aim of this course is to present various numerical methods used in modern Quantitative Finance. It develops further mathematical concepts, techniques and intuition necessary for modern financial modelling, derivative pricing and risk management. This subject provides the foundations for a sufficiently rigorous understanding of advanced numerical and statistical methods in finance. Emphasis will be laid on developing skills that allow students deal with numerical questions related to models involving stochastic differential equations for pricing and hedging complex financial products. Questions of numerical stability and convergence will be discussed in detail.

## Reference Book:

The course will be based on the 2010 Springer book:

*“Numerical Solution of Stochastic Differential Equations with Jumps in Finance”*

by Platen and Bruti-Liberati, Springer Verlag, ISBN 0172-4568; ISBN 978-3-642-12057

**The chapters covered and a brief description of their content are listed below:**

Chapter	Summary
Ch 4: Stochastic Expansions	Presents stochastic Taylor expansions and their application.
Ch 5-8: Scenario Simulation	Introduces strong discrete time approximations for stochastic differential equations for the application in scenario simulation. Jump diffusions are covered.
Ch 11-14: Monte Carlo Simulation	Presents modern techniques for Monte Carlo simulation of stochastic differential equations in finance.
Ch 16: Variance Reduction Techniques	Describes a range of powerful methods that permit significant variance reductions in Monte Carlo simulation.
Ch 14: Numerical Stability	The propagation of errors is analysed and stability regions are discussed.

<b>Topics that can be presented by participants:</b>	
Ch 17: Trees and Markov Chains	A convergence result for tree based methods is presented. The advantages and disadvantages of tree methods are analysed.
Ch 17: Partial Differential Equations	Describes the relationship of finite difference methods with other numerical methods for partial differential equations.
Ch 2: Exact Simulation of Solutions of SDEs	Describes the exact and almost exact simulation of solutions of stochastic differential equations.
Ch 10: Filtering in Finance	Introduces into the filtering of hidden quantities that are modelled by Markov chains and diffusions.

### **Comments:**

The course will be presented in the above sequence of topics. The detailed scheduling of the lectures will depend on the exact number of lectures, their length and the feedback from the participants. Exercises will be given and solutions will be made available. The presented numerical methods will be demonstrated in examples. Participants can select some topics from chapters that are not covered.