

# Seminar “Computational Finance”

## Preliminary Session: Topics

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# Topics – an Overview

## 1. Basics

- stochastic basics
- random numbers
- options, futures, and other derivatives

## 2. Monte-Carlo & Binomial Tree Methods

- Monte-Carlo method
- least square Monte-Carlo method
- binomial and trinomial method

## 3. Black-Scholes PDE

- Black-Scholes PDE (deduction)
- discretization in time and space
- multigrid
- sparse grids
- boundary value problem

## 4. Application & Technologies

- Theta-Calculus & Numerix

(optional topics in grey)

# Topics in Detail: Basics

- **stochastic basics** probability theory, probability distributions (e.g. Gaussian), (geometric) Brownian motion
- **random numbers**  
algorithms for generation of random numbers
- **options, futures, and other derivatives** option pricing, types of financial derivatives (European, American, Asian, Barrier options, risk-factor models)

# Topics in Detail: Monte-Carlo & Binomial Tree Methods

- **Monte-Carlo method**  
simple Monte-Carlo method, quasi Monte-Carlo method, correlations in multi dimensions
- least square Monte-Carlo method
- **binomial and trinomial method**

# Topics in Detail: Black-Scholes PDE

- **Black-Scholes PDE (deduction)**  
deduction of the equation, Ito formula, non-arbitrage principle, transformation to backward time, boundary conditions
- **discretization in time and space**  
forward and backward Euler, Crank-Nicolson, stability; finite differences, finite elements
- **multigrid**
- **sparse grids**  
hierarchical basis, combination technique, direct sparse grid ansatz
- **boundary value problem**  
penalty method, optimization (American options)

# Topics in Detail: Application & Technologies

- **Theta-Calculus & Numerix**

Theta scripts, pricing with ThetaML, software Numerix



# Workload

Tasks for a successful participation:

- write a paper
- write reviews about two papers of other students
- write and give a talk
- participation in all talks (mandatory attendance)

# Time Schedule

- kick-off meeting last week of October
- paper deadline begin of December
- paper review deadline before Christmas holidays
- final paper deadline and talks as block seminar in mid of January

## Distribution of topics:

- send 3 preferred topics (ranked) via email to [benk@in.tum.de](mailto:benk@in.tum.de) and [schraufs@in.tum.de](mailto:schraufs@in.tum.de)
- if you wish on the topic in summer please mention it in the email
- first distribution of topics will be on August 2nd



# Questions?

