Datenkontrollblatt zur Veranstaltung Fortgeschrittene Themen der Finanzmathematik: Computational Finance

Veranstaltungsgrunddaten

Veranstaltungsnr.	3236 L 371	**Veranst. SWS**	2.0
Veranstaltung	Fortgeschrittene Themen der Finanzmathematik: Computational Finance	**Semester**	SS 2018
		Erwart. Teil.	
Kurztext		**Max. Teil.**	
Veranst.-Art	Vorlesung	**Hyperlink**	http://www.math.tu-berlin.de/~papapan
Belegpflicht			
Studienjahr			

Veranstaltungstermine, Räume und Personal

Mo	16:00 - 19:00	wöchentl	18.06.2018 - 19.06.2018	MA 742
Mo	16:00 - 19:00	Einzel	25.06.2018 - 25.06.2018	MA 742
Mo	16:00 - 19:00	wöchentl	02.07.2018 - 03.07.2018	MA 742
Mo	16:00 - 19:00	Einzel	09.07.2018 - 09.07.2018	MA 742
Fr	16:00 - 19:00	Einzel	29.06.2018 - 29.06.2018	MA 744
Fr	16:00 - 19:00	Einzel	13.07.2018 - 13.07.2018	MA 744

Personen

Antonis Papapantoleon
Christian Bayer

Studiengänge

Einordnung Vorlesungsverzeichnis

Zuordnung zu Prüfungen

Einrichtungen

Institut für Mathematik

Hyperlinks

Inhalt

In mathematical finance, the prices of derivatives such as options can be represented as expectations of random variables, obtained from stochastic models of the underlying asset. Usually, explicit formulas for the prices are not available, i.e. the expectations cannot be computed explicitly. Therefore, numerical approximations play an important role in the finance industry. There are three general approaches to the numerical calculation of expected values.

(1) By the law of large numbers, sample averages converge to the expected value of a random variable if the sample size goes to infinity. This observation leads to Monte-Carlo simulation and its variants like Quasi Monte-Carlo simulation. It requires a method to simulate from the distribution of the underlying random variable. While exact simulation is usually not possible, approximate simulation methods (e.g. Euler approximations of SDEs) are widely available. Therefore, Monte-Carlo simulation is a very general approach to approximate option prices.

(2) If the underlying model is a Markovian model (e.g. given by an SDE), the option price satisfies a PDE, the Kolmogorov-backward equation. Therefore, one can compute the option price by solving the PDE numerically using the finite-difference or finite-element approach. Apart from regularity and (too) exotic path-dependence, the applicability of PDE-based approximation methods is mainly limited by the dimension of the underlying ("curse of dimensionality").

(3) If explicit densities are available, expectations can be written as (low-dimensional) integrals. The density, however, is usually not known explicitly, and even if it is known, direct quadrature (i.e. numerical approximation) of the integral might not lead to a competitive numerical method. However, in many important cases (e.g. Lévy or affine processes), the Fourier transform of the density (corresponding to the characteristic function of the underlying random variable) is explicitly known, thus allowing to calculate the option price using Fourier methods.

In this course, we present the above mentioned approaches. Additionally, we will also present an example of an approach specifically developed for the pricing of American options. More precisely, the content of the course will be a selection of the following:

- SDEs & Finance, a reminder (including Lévy processes, Ito-formula, Kolmogorov backward equation)
- Pseudo random numbers (random number generation on the computer)
- Basics of Monte Carlo simulation
- Quasi Monte Carlo
- Monte-Carlo simulation of diffusion models: weak and strong approximations, order of the Euler scheme
- Monte-Carlo simulation of jump models (diffusion plus finite activity jumps; pure jump models such as VG and CGMY)
- Solving a PDE using finite differences (various finite difference schemes, in particular Crank-Nicolson)
- Option pricing with Fourier methods
- Pricing American options (a la Longstaff & Schwarz)

Bemerkung

Diese Lehrveranstaltung wird mit 5 ECTS Leistungspunkte bewertet.

Literatur

- D. Filipovic, Term-Structure Models: A Graduate Course, Springer, 2009.
- P. Glasserman: Monte Carlo Methods in Financial Engeneering, Springer 2003.
- P. E. Kloeden and E. Platen, Numerical Solution of Stochastic Differential Equations, Springer, 3rd ed., 1999.
- M. Musiela and M. Rutkowski, Martingale Methods in Financial Modelling, Springer, 2nd ed., 2005.
- R. Seydel, Tools for Computational Finance, Springer, 4th ed., 2009.
- S. E. Shreve, Stochastic Calculus for Finance. II, Springer, 2004. Continuous-time models.

Voraussetzung

Sound knowledge of stochastics and finance as acquired from the courses "Probability Theory I & II" and "Financial Mathematics I & II". We will aim to give the course in a way, that parallel attendance of FiMa II is possible.