Linnæus University

Dr: 2020/2441-3.1.2.2

Course syllabus

Faculty of Technology

Department of Mathematics

4MA503 Stokastisk analys, 7.5 credits
Stochastic Analysis

Main field of study
Mathematics

Subject Group
Mathematics

Level of classification
Second Level

Progression
A1F

Date of Ratification
Approved 2014-10-03
Revised 2020-06-24 by Faculty of Technology. Assessment methods is revised.
The course syllabus is valid from spring semester 2021

Prerequisites
4MA501 Foundations of probability 7.5 credits or equivalent.

Objectives

After completing the course the student should be able to

1. independently and with adequate techniques solve problems, perform calculations and conduct lines of reasoning within the part of stochastic analysis covered by the course and to in writing communicate these solutions, calculations and reasoning; in particular

- master the basic tools in terms of structure and methods in the theory of stochastic differential equations (SDEs) of Ito-type and their applications to share pricing
- apply the above tools in a given situation
- defend the choice of these tools in a coherent and precise manner
- perform the relevant calculations for the Brownian motion and solutions for SDEs and interpret the results
- relate a given SDE a Kolmogoro equation and interpret the solution of the parabolic equation

2. orally conduct lines of reasoning within the part of the stochastic analysis covered in the course; in particular

- defend the choice of the basic tools in the form of structure and methods in the theory of stochastic differential equations (SDEs) of Ito-type and their applications to share pricing in a coherent and precise manner
- account for properties of the Brownian motion and solutions to SDEs and show results links to more complex processes
- compare the different concepts of existence and uniqueness of solutions for SDEes
- relate a given SDE a Kolmogorov equation and interpret the solution of the parabolic equation
- motivate SDEs for share prices
- communicate and argue the basic content of stochastic differential equations and stochastic share pricing:
- examine the possibilities and limitations of the Black-Scholes option pricing formula and option synthezation
- critically evaluate put options' impact on the financial system and relate these to responses given by the Basel Accords.

3. implement a graded assignment report , in particular

- present the graded report in a concise manner
- master the basic tools in the form of structures and methods needed to solve the graded assigment report
- apply the above tools for the graded assignment
- defend the choice of these tools in a coherent and precise manner
- evaluate the chosen tools of the graded assignment and to select the most appropriate
- independently obtain knowledge of the graded assignment through consultation of relevant literature .

Content

The course contains:

- alternative definitions of the Brownian motion
- properties of the Brownian motion, e.g. scaling, martingale, and Markov property as well as properties of its sample paths
- Ito-integrals and its properties
- SDEs: existence and uniqueness of solutions
- explicit solutions of linear SDEs
- properties of Ito processes, i.e. solutions of SDEs
- change of probability measure by the Cameron-Girsanov transformation
- random time change
- the Dynkin Formula
- Kolmogorov's forward and backward equations and Feynman-Kac' formula: the link between SDE's and parabolic equations
- option pricing and hedging in the Black Scholes model.

Type of Instruction

Lectures and exercises

Examination

The course is assessed with the grades A, B, C, D, E, Fx or F.

The grade A constitutes the highest grade on the scale and the remaining grades follow in descending order where the grade E is the lowest grade on the scale that will result in a pass. The grade F means that the student's performance is assessed as fail (i.e. received the grade F).

Assessment of how well the student fulfills the objectives is achieved by

- graded exercises
- oral examination

Repeat examination is offered in accordance with Local regulations for courses and examination at the first and second-cycle level at Linnaeus University.

If the university has decided that a student is entitled to special pedagogical support due to a disability, the examiner has the right to give a customised exam or to have the student conduct the exam in an alternative way.

Course Evaluation

During the implementation of the course or in close conjunction with the course, a course evaluation is to be carried out. Results and analysis of the course evaluation are to be promptly presented as feedback to the students who have completed the course. Students who participate during the next course instance receive feedback at the start of the course. The course evaluation is to be carried out anonymously.

Credit Overlap

The course cannot be included in a degree along with the following course/courses of which the content fully, or partly, corresponds to the content of this course: 4MA203 Stochastic Analysis, 7.5 credits

Other

Grade criteria for the A–F scale are communicated to the student through a special document. The student is to be informed about the grade criteria for the course by the start of the course at the latest.

Required Reading and Additional Study Material

Required reading

Shreve S E *Stochastic calculus for finance II, Continuous-time models*, Springer Verlag 2004.
60 (550) pages.

Oksendal B *Stochastic differential equations*, Springer Verlag 2000.
160 (320) pages.