LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Prissättning av derivattillgångar
Valuation of Derivative Assets

FMSN25, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED I
Date of Decision: 2023-04-14

General Information

Elective for: F5, F5-fm, I5-fir, Pi5-fm, R5
Language of instruction: The course will be given in English

Aim

The student should get a thorough understanding and insight in the economical and mathematical considerations which underlie the valuation of derivatives on financial markets. The student should get knowledge about and ability to handle the models and mathematical tools that are used in financial mathematics. The student should also get a thorough overview concerning the most important types of financial contracts used on the stock- and the interest rate markets and moreover get a solid base for understanding contracts that have not been explicitely treated in the course.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- understand the fundamental economical concepts : Financial contract/Contingent claim, Self financing portfolio, Arbitrage, Replicating portfolio/Hedge and Complete market,
- understand the tools and concepts from stochastic calculus: martingales, Itô's formula, Itô isometry, Feynman-Kac representation, change of measure (Girsanov transformation) and change of numeraire,
- understand how the basic financial contracts work and how they relate to each other, e.g., European and Asian options, Forward contracts, zero coupon bonds, coupon bond, LIBOR and interest rate swap.

Competences and skills
For a passing grade the student must

- use the fundamental financial concepts to express relations between various financial contracts,
- use the tools and concepts from stochastic calculus to price financial contracts assuming specific models for the underlying assets. This especially includes the ability to use, derive and understand the Black-Scholes formula as well as the ability of extending it to similar contracts,
- use Monte Carlo methods to price financial derivatives. Here the student should be able to use various variance reduction techniques such as antithetic variables, control variates and importance sampling. This part of the course is assessed in the home assignments and compulsory computer exercises.

Judgement and approach
For a passing grade the student must

- apply a mathematical point of view on financial contracts,
- from a financial and a mathematical perspective, judge what a reasonable valuation of a financial contract should fulfil.

Contents

The course consists of two related parts. In the first part we will look at option theory in discrete time. The purpose is to quickly introduce fundamental concepts of financial markets such as free of arbitrage and completeness as well as martingales and martingale measures. We will use tree structures to model time dynamics of stock prices and information flows.

In the second part we will study models formulated in continuous time. The models we focus on are formulated as stochastic differential equations (SDE:s). The theories behind Brownian motion, stochastic integrals, Ito-'s formula, measures changes and numeraires are presented and applied to option theory both for the stock and the interest rate markets. We derive e.g. the Black-Scholes formula and how to create a replicating portfolio for a derivative contract.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written exam, compulsory computer exercises, and written home assignments.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0115. **Name:** Written Examination.
Credits: 6. **Grading scale:** TH. **Assessment:** Written examination.
Code: 0215. **Name:** Laboratory Part 1.
Credits: 0,5. **Grading scale:** UG. **Assessment:** The first computer exercise
Code: 0315. **Name:** Laboratory Part 2.
Credits: 1. **Grading scale:** UG. **Assessment:** The rest of the computer exercises, including a written assignment

Admission

Admission requirements:

- FMSF10 Stationary Stochastic Processes or FMSF15 Markov Processes

Assumed prior knowledge: Probability theory corresponding to FMSF05 or equivalent helps.
The number of participants is limited to: No
The course overlaps following course/s: MASM24, FMS170, MASM19

Reading list

- Björk, T.: Arbitrage Theory in Continuous Time, 4th ed. Oxford University Press, 2020, ISBN: 978-0-19-885161-5.
- Åberg, S.: Derivative Pricing. KF Sigma, 2019.

Contact and other information

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Course homepage:
https://www.maths.lu.se/utbildning/civilingenjoersutbildning/matematisk-statistik-paa-civilingenjoersprogram/
Further information: The course is also given at the faculty of science with code MASM24.