MATH-470

Martingales in financial mathematics

Schmutz Michael

Cursus	Sem.	Type
Financial engineering	MA2, MA4	Opt.
Ing.-math	MA2, MA4	Opt.
Mathématicien	MA2	Opt.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	Oral
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The aim of the course is to apply the theory of martingales in the context of mathematical finance. The course provides a detailed study of the mathematical ideas that are used in modern financial mathematics. Moreover, the concepts of complete and incomplete markets are discussed.

Content

- Discrete time models and the Fundamental Theorem of Asset Pricing
  - Fundamental results
  - Binomial- and trinomial model
  - The Snell envelope, optimal stopping, and American options
- Geometric Brownian motion and the Black-Scholes model
  - Option pricing and hedging
  - Exotic options
- On the theory of (no-)arbitrage in continuous time
- Selected topics on
  - Local- and stochastic volatility models
  - Stochastic interest rates
  - Lévy driven models
  - New trends in financial mathematics

Keywords

martingales, financial mathematics, theory of (no-)arbitrage

Learning Prerequisites

Recommended courses

Stochastic calculation

Important concepts to start the course

Stochastic calculation

Learning Outcomes

By the end of the course, the student must be able to:

- Explore in detail the use of martingales in financial mathematics.
- Prove a criteria for absence of arbitrage in a model based on a finite probability space and state an analogous general result.
- Prove a criteria for completeness of a market model based on a finite probability space and state an analogous general result.
- Explain the difference and the resulting consequences between claims and American options.
- Derive prices for some financial derivatives based on several different models.
- Derive different hedging strategies for some financial derivatives based on several different models.
- Analyze the choice of asset price models according to different criteria.
- Optimize the calibration of chosen asset price models.
- Prove a criteria for completeness of a viable market modeled based on a finite probability space and state an analogous general result.

Assessment methods

Exam oral
Dans le cas de l'art. 3 al. 5 du Règlement de section, l'enseignant décide de la forme de l'examen qu'il communique aux étudiants concernés.

Supervision

Office hours	Yes
Assistants	No
Forum	No
Others	Office hours: Friday, 13:00-14:00

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

- Lamberton, D. and Lapeyre, B. (2008), Introduction to Stochastic Calculus Applied to Finance, Second Edition, Chapman and Hall, London.
- Shiryaev, A.N. (1999), Essentials of Stochastic Finance: Facts, Models, Theory, World Scientific Publishing, Singapore.
- Barndorff-Nielsen, O.E. and Shiryaev, A.N. (2010), Change of Time and Change of Measure, World Scientific Publishing, Singapore.
- Eberlein, E. and Kallsen, J. (2019), Mathematical Finance, Springer Finance, Cham.

Ressources en bibliothèque

- Mathematical Finance / Eberlein & Kallsen
- Change of Time and Change of Measure / Barndorff-Nielsen
- Introduction to Stochastic Calculus Applied to Finance / Lamberton
- Essentials of Stochastic Finance / Shiryaev