EPFL

FIN-404 **Derivatives**

Hugonnier Julien

Cursus	Sem.	Type
Financial engineering minor	E	Opt.
Financial engineering	MA2, MA4	Obl.
Statistics	MA2, MA4	Opt.

Language of teaching	English
Credits	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
Hours	**5 weekly**
Courses	3 weekly
Exercises	2 weekly
Number of positions	

Summary

The objective of this course is to provide a detailed coverage of the standard models for the valuation and hedging of derivatives products such as European options, American options, forward contracts, futures contract and exotic options.

Content

Part I: Discrete-time models

- Introduction to derivatives products and markets
- Model free results and static models
- Multiperiod discrete-time models
- American options and applications
- Convergence

Part II: Continuous-time models

- Arbitrage, valuation and hedging in continuous-time
- The Black-Scholes model
- Foreign exchange products
- American derivatives
- Implied, local, and stochastic volatility
- Exotic options

Keywords

Derivatives, options, arbitrage valuation, hedging

Learning Prerequisites

Required courses

- Introduction to finance
- Stochastic calculus

Recommended courses

• Econometrics

Important concepts to start the course

To follow this course students need to have taken an introduction to finance, and must possess solid foundations in probability theory and stochastic calculus.

Learning Outcomes

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

- Describe the principal types of derivatives contracts including forwards, futures and options and compare their basic usages for hedging or speculation
- Describe and analyse the most common types of options strategies such as spreads, straddles, collars, and covered calls or puts.
- Formulate the no-arbitrage principle and illustrate its basic application in a model-free setting: cash and carry relations for different types of underlying securities with or without dividends, put/call parity, arbitrage bounds on option prices, early exercise of American options.
- Discuss the main characteristics of a general discrete time model with finitely many states of nature, multiple securities and possibly stochastic interest rates.
- Work out / Determine whether a given discrete-time model with finitely many states of nature is arbitrage free and has complete markets; Relate these properties to the existence and uniqueness of an equivalent martingale measure.
- Discuss and apply risk-neutral valuation to price and hedge derivatives of either European or American type in the context of a given discrete time model with finitely many states and complete markets.
- Construct and implement a binomial model to price and hedge both plain vanilla derivatives of European or American type as well as any exotic derivative.
- Describe the main assumptions of the Black-Scholes model and its limitations, derive the valuation partial differential equation and the Black-Scholes-Merton formula for the price of standard European options.
- Discuss the main option Greeks and use them appropriately for risk management and financial engineering purposes in the context of the Black-Scholes model or its extensions to futures contracts and foreign exchange.
- Work out / Determine whether a general Brownian-driven model of financial markets admits an equivalent martingale measure, relate the uniqueness of this probability measure to market completeness, and derive the risk-neutral dynamics of traded securities prices and relevant state variables.
- Derive the partial differential equation satisfied by the price of a European derivative in a given Markovian model, and use it with appropriate boundary conditions to price options in specific models.
- Formulate the valuation of American options as a free boundary problem for the valuation PDE in the context of the Black-Scholes model, derive and discuss exact solutions for the infinite horizon case and the Barone-Addesi-Whaley approximation for the finite horizon case.

Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Use both general and domain specific IT resources and tools

Teaching methods

Lectures and exercise sessions

Expected student activities

- Participate in weekly lectures

- Participate in weekly exercise sessions
- Turn in assignements/projects
- Write a midterm exam (30%) and a final exam (40%)

Assessment methods

- Assignment/Project: 30%
- Midterm exam: 30%
- Final exam: 40%

Resources

Bibliography

- K. Back, A course in derivative securities, Springer Verlag, New York, 2005.
- N. Bingham and R. Kiesel, Risk neutral valuation, Springer Verlag, New York, 2004.
- J. Hull, Options, futures and other derivatives, Prentice Hall.
- D. Lamberton & B. Lapeyre, Introduction to stochastic calculus applied to finance, Second edition, Chapman and Hall, 2008.
- S. Shreve, Stochastic Calculus for Finance I and II, Springer Verlag, New York, 2004.
- T. Bjork, Arbitrage theopry in continuous-time, 2nd Edition, Oxford University Press, New York, 2004

Ressources en bibliothèque

- Arbitrage theory in continuous-time / Bjork
- Risk neutral valuation / Bingham
- Options, futures and other derivatives / Hull
- Stochastic Calculus for Finance / Shreve
- A course in derivative securities / Back
- Introduction to stochastic calculus applied to finance / Lamberton

Moodle Link

- https://go.epfl.ch/FIN-404

Prerequisite for

- Advanced derivatives
- Financial econometrics (taken concurrently)
- Interest rate and Credit risk models
- Quantiative Risk Management
- Real options and financial structuring