



UNIVERSITÀ
CATTOLICA
del Sacro Cuore

Derivative securities pricing

PROF. GIOVANNI PETRELLA

Course aims and intended learning outcomes

The course provides students with an in-depth knowledge of derivative securities. We will cover the pricing of several types of options (on stocks, stock indices, currencies, futures), interest rate derivatives (bond options, interest rate caps and floors, swaptions) as well as credit derivatives. The course includes tutorials to apply the concepts outlined during the lectures.

As for the expected learning outcomes, at the end of this course students will be able to understand and apply the main models used in the industry to price derivative securities.

Course content

1. **Options on stocks.**

At the end of this section of the course, the student will be able to:

- Understand the stochastic behavior of stock prices.
* Estimate the expected stock price at a future point in time.
- Apply the Black-Scholes-Merton model to price European options on non-dividend and dividend paying stocks.
- Use the Black's method to approximate the value of an American-style call option on stocks.

2. **Options on stock indices, currencies and futures.**

At the end of this section of the course, the student will be able to:

- Use index options to limit portfolio downside risk.
- Price European stock index options.
- Price European currency options.
- Price futures options using binomial trees.
- Price European futures options using the Black's model.

3. **Greek letters.**

At the end of this section of the course, the student will be able to:

- Understand the mechanics of delta hedging.
- Understand and estimate delta, gamma, theta, rho, vega.

4. **Volatility smile.**

At the end of this section of the course, the student will:

- Know how traders use the Black-Scholes model.
- Know how traders use the volatility surfaces as pricing tools.

5. **Numerical procedures.**

At the end of this section of the course, the student will:

- Know the underlying logic of the Monte Carlo simulation.
- Know how to run basic Monte Carlo simulations.

6. **Volatility estimation.**

At the end of this section of the course, the student will:

- Know how to estimate volatility based on rolling standard deviation of historical data.
- Know autoregressive models to estimate volatility.



UNIVERSITÀ
CATTOLICA
del Sacro Cuore

7. Exotic options.

At the end of this section of the course, the student will:

- Know several types of exotic options.
- Be able to apply numerical procedures to price exotic options.

8. Interest rate derivatives.

At the end of this section of the course, the student will:

- Know the mechanics of bond options, interest rate caps and floors, swaptions.
- Be able to price interest rate derivatives based on several pricing models.

* The Standard Market Model.

* Models of the Short Rate.

Reading list

J. HULL, *Options, Futures and Other Derivatives*, Pearson, 2018 (tenth edition), ISBN 9780134472089.

Supplementary material (e.g., slides and Excel files) will be posted on the class Blackboard website, available at <http://blackboard.unicatt.it>

Teaching method

This course will use lecturing for 70% and tutorials for 30%.

Assessment method and criteria

As for the assessment of the learning outcomes, students are expected to take a written test. The test usually consists of 3 questions, with three to four sub-questions for each question.

As for the grading criteria, course grades are set based on the evaluation of the individual questions. The final grade of the exam aggregates the grades assigned to the individual questions. The exam is written only. The test lasts between 60 and 120 minutes. The questions refer to concepts, examples, models dealt in the course and may also require to solve numerical problems.

Notes and prerequisites

Before entering the course, the student should:

- possess a basic knowledge of futures, options and swaps;
- be able to use continuously compounding interest rates.

Office Hours

Office hours are held once a week every Tuesday at 6 pm in Necchi 5 building (room 202-bis).

Further information, updates notices of change are published on the instructor's webpage at http://docenti.unicatt.it/eng/giovanni_petrella.