

Mathematical Methods in Finance

Master's in mathematical finance

1^o Semester of 2026/2027

Lecturer Team:

- Carlos Oliveira (Course Coordinator) - carlosoliveira@iseg.ulisboa.pt

Office hours: Students should contact in advance the lecturer by email to book an appointment

Course Syllabus

1. Overview of linear algebra and differential calculus
 - a. Quadratic forms
 - b. Implicit function theorem
 - c. Inverse function theorem
2. Optimization in $\mathbb{R}^n$
 - a. Optimization without constraints
 - b. Optimization with constraints
 - c. Portfolio Optimization and Risk Measures
3. Ordinary and Partial differential equations
 - a. First and second order ODEs
 - b. PDEs
4. Basic concepts of option theory
 - a. European and American options.
5. Option Pricing
 - a. Introduction
 - b. The binomial model (one-period and multiperiod)
 - c. Portfolios and arbitrage
 - d. Risk-neutral pricing
 - e. The Black-Scholes model.
 - f. The Black-Scholes equation.
 - g. Explicit Solution for European Call and Put Options
 - h. Greeks
6. Free boundary problems and variational inequalities
 - a. American Options
 - b. Real Options

Bibliography

- Giorgi, Giorgio, Bienvenido Jiménez, and Vicente Novo. Lectures on Mathematics for Economic and Financial Analysis. Springer, 2025.

- Wilmott, Paul. Jeff Dewynne, Sam Howison. Option Pricing: Mathematical Models and Computation. Oxford Financial Press, 1993
- Bjork, T. (2009) Arbitrage Theory in Continuous Time. Third edition. Oxford. ISBN: 9780199574742.

Assessment

- The assessment consists of a final written exam.
- No consultation materials are permitted during the exam.
- Students may bring a calculator, provided it does not have graphical capabilities.
- Mobile phones, laptops, and any devices with communication functions or digital storage are strictly prohibited. Their use or presence near the student will result in the cancellation of the exam and further sanctions as defined by ISEG and the University of Lisbon.

Schedule

- Lectures take place in room 109, Building F1.
 - o Mondays: 15:30 – 17:30
 - o Tuesday: 15:00 – 17:30