

Computational Finance

Course Outline

Academic Semester: 2025/26

1. General

School	School of Finance and Statistics		
Academic Unit	Department of Banking and Financial Management		
Level of Studies	Undergraduate		
Course Code	XPYXM01		
Semester	6th or 8th		
Course Title	Computational Finance		
Independent Teaching Activities	Weekly Teaching Hours	Credits	
Lectures	4	7,5	
Course Type	Compulsory / Scientific Expertise / Skills Development		
Prerequisite Courses			
Language of Instruction and Examinations	Greek		
Is the course offered to Erasmus Students?	Yes (in Greek)		
Url (Eclass)	https://eclass.unipi.gr/modules/auth/courses.php?fc=64		

2. Learning Outcomes

Learning Outcomes

This course is an introduction to the numerical techniques used widely by applied economists in finance. Its main goal is to bridge the gap between financial theory and computational practice. This is accomplished with the use of the programming language Matlab which is a powerful numerical computing environment for financial applications.

Upon successful completion of the course, the students will be able to

- know and understand the capabilities and functions of the programming language of Matlab.
- develop numerical algorithms in Matlab for pricing financial derivatives with the simulation method of Monte Carlo.
- employ variance reduction techniques for the numerical improvement of simulation methods of random numbers.
- develop numerical lattice algorithms in Matlab for pricing financial derivatives with the method of Binomial Tree.
- solve numerically partial differential equations in Matlab for pricing financial derivatives with the method of Finite Differences.
- construct numerical paths of Geometric Brownian Motion and simulate dynamic risk hedging.
- perform directly In Matlab portfolio optimization with or without constraints.

General Competences

- Search for, analysis and synthesis of data and information by the use of appropriate technologies.
- Adapting to new situations.
- Decision-making.
- Individual/Independent work.

- Group/Team work.
- Working in an interdisciplinary environment.
- Introduction of innovative research.
- Critical thinking.
- Development of free, creative and inductive thinking.

3. Syllabus

The following sections will be presented:

- Introduction to Matlab: Matrices, Basic Functions, Programming (M-files), Diagrams.
- Binomial Model Simulation: Construction of Binomial Tree, Pricing of European and American Options.
- Monte Carlo Simulation: Generating Random Numbers, Expected Value Estimation, Pricing of European Options, Number of Replications.
- Variance Reduction Techniques: Antithetic Sampling, Control Variates, Common Random Numbers – Estimation of the Greeks.
- Hedging Strategies: Simulation of Geometric Brownian Motion, Stop-Loss Hedging, Delta Hedging.
- Finite Difference Method: Difference Quotients, Construction of Grid, Boundary Conditions, Explicit and Implicit Methods in Pricing European Options, Connection with Trinomial Tree.
- Portfolio Theory: Construction of Efficient Portfolios, Efficient Frontier under Budget Constraints.

4. Teaching and Learning Methods - Evaluation

Delivery	Lecturing and practicing in the P/C lab of the Department	
Use of Information and Communications Technology	<ul style="list-style-type: none"> • Use of lecture slides via PowerPoint. • Distribution of lecture slides to the students via an educational electronic platform. • Use of P/C lab of the Department for practical exercises. • Communication with students via e-mail. 	
Teaching Methods	Activity	Semester Workload
	Lectures	26
	Studying	40
	Laboratory Practice	26
	Project and/or Coursework	95,5
	Course Total	187,5

Student Performance Evaluation

- Written exam (90%) that includes:
 - Questions on theory.
 - Explicit description of algorithmic methods.
 - Development of computational algorithms for the numerical solution of problems.
- Coursework (10%) that includes the development and execution of computational algorithms for the numerical solution of problems, subject to the material taught in class.
- This is a 2-hour written exam. The individual evaluation grades are explicitly written next to each question.

Or alternatively.

- Project (40%) that includes the development and execution of computational algorithms for pricing and/or hedging financial derivatives.
 - Presentation (30%) of the above project.
 - III. Coursework (30%) that includes the development and execution of computational algorithms for the numerical solution of problems, subject to the material taught in class.
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5. Attached Bibliography

Suggested Bibliography

- Paolo Brandimarte, Numerical Methods in Finance and Economics: A Matlab- Based Introduction, 2nd Edition, John Wiley & Sons, New York, 2006.
- Cleve B. Moler, Αριθμητικές Μέθοδοι με το MATLAB, Εκδόσεις Κλειδάριθμος ΕΠΕ, Αθήνα, 2010.
- Ιωάννης Θ. Φαμέλης, Υπολογιστικά Μαθηματικά: Αριθμητικές μέθοδοι και μέθοδοι βελτιστοποίησης με υλοποίηση σε Matlab (Octave) και Python, Εκδόσεις Κριτική, Αθήνα, 2021.

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