Universitat Autònoma de Barcelona

2023/2024

Introduction to Financial Engineering

Code: 104875
ECTS Credits: 6

Degree	Type	Year	Semester
2503852 Applied Statistics	OT	4	1

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Prerequisites

The subject focuses on the applications of mathematical and statistics tools that have been acquired in previous courses, in particular it requires that the student has acquired the basic theoretical knowledge of calculus, calculus of probabilities, time series and numerical methods.

Objectives and Contextualisation

The objective of this course is to introduce the student to a very active area, both scientifically and professionally, such as financial mathematics. The main educational goal is to show the student the different applications of mathematical and statistical concepts in financial engineering, focusing on their proper use and interpretation of results.

Thus, the subject is set as a high-level journey by the most relevant quantitative units present in the financial industry to introduce the most fundamental economic and financial concepts and show the most commonly used techniques. From the application of time series used in macroeconomic studies, to the numerical calculation by means of Monte Carlo methods present in front offices to price financial derivatives, throughout optimization techniques in risk-return models used by fund managers and loss calculation techniques found in risk departments.

For this reason the course focuses on applications and requires the student to have acquired the basic theoretical knowledge of calculus, calculus of probabilities, time series and numerical methods.

It is also a goal that the student does a job that requires the use of the computer, and this will lead to completing the theory classes with classes of problems and case sets where the computer is present.

Competences

- Correctly use a wide range of statistical software and programming languages, choosing the best one for each analysis, and adapting it to new necessities.
- Critically and rigorously assess one's own work as well as that of others.
- Formulate statistical hypotheses and develop strategies to confirm or refute them.
- Identify the usefulness of statistics in different areas of knowledge and apply it correctly in order to obtain relevant conclusions.
- Interpret results, draw conclusions and write up technical reports in the field of statistics.
- Make efficient use of the literature and digital resources to obtain information.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Use quality criteria to critically assess the work done.
- Work cooperatively in a multidisciplinary context, respecting the roles of the different members of the team.

Learning Outcomes

1. Critically assess the work done on the basis of quality criteria.
2. Design and conduct hypothesis tests in the different fields of application studied.
3. Draw conclusions that are consistent with the experimental context specific to the discipline, based on the results obtained.
4. Interpret statistical results in applied contexts.
5. Justify the choice of method for each particular application context.
6. Make effective use of references and electronic resources to obtain information.
7. Reappraise one's own ideas and those of others through rigorous, critical reflection.
8. Recognize the importance of the statistical methods studied within each particular application.
9. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
10. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
11. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
12. Use different programmes, both open-source and commercial, associated with the different applied branches.
13. Work cooperatively in a multidisciplinary context, accepting and respecting the roles of the different team members.

Content

- Introduction
  - What is finance?
  - Fair value and finances
  - Time value of money
  - Academia vs Industry: Disclaimer
- Time Series: Macroeconomic series
  - ARMA, ARCH and GARCH applications
- Stochastic calculus: Valuation of financial derivatives
  - Introduction to financial derivatives and their fair value
  - Discrete models for the evolution of financial assets
  - The continuous model as a step to the limit: the Brownian motion
  - Simulation of continuous models and Monte Carlo methods

- Mathematical Optimization: Portfolio management on a risk-return framework
  - Modern portfolio theory (Markowitz): risk-return framework
  - Lagrange multipliers and portfolio optimization
  - CAPM: Financial assets valuation model
- Probability calculus: Risk estimation
  - Typology of Risks
  - VaR calculations
- Financial disasters: Lessons

Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Methodology

The student acquires the scientific-technical knowledge of the subject by attending to lectures and completing it with a personal study of the topics covered. The theory classes are activities in which less interactive activity is required from the student: they are conceived as a fundamentally unidirectional method of transmitting knowledge from teacher to student.

Problems and case sets are sessions with a small number of students with a double goal. On the one hand they work the scientific-technical knowledge showed in lectures to complete their understanding and to deepen in them through a variety of activities, from the typical resolution of problems to the discussion of practitioner cases. On the other hand, the problem set activities are the natural forum in which to discuss in common the development of practitioner cases work, providing the necessary knowledge to carry it out, or indicating where and how they can be acquired. The case problem sets of this subject is proposed as a way to guide the student in a statistical fieldwork in each of its stages.

This approach is aimed at promoting active learning and developing critical reasoning and the ability to analyze and synthesize.

The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Case Studies	20	0.8	7, 3, 5, 11, 9, 10, 8, 13, 12, 6
Lectures	30	1.2	2, 3, 4, 5, 9, 8, 12
Type: Supervised			
Tutorials	25	1	1, 2, 3, 4, 5, 9, 10, 8, 12, 6
Type: Autonomous			
Study + Problem & Case Sets	67.5	2.7	7, 1, 2, 3, 4, 5, 11, 9, 10, 13, 6

Assessment

To pass the subject it is necessary that the average of the case and problem sets is greater than or equal to 4. If the student attends the recovery exam, the final grade will be the maximum between the course grade and the weighted average of it (30 %) and the grade of the recovery exam (70%).

In the event that a student applies for Single Assessment, consisting of an Exam (50%) and an Applied Essay (50%), the student would need to obtain a mínimum of 5 in both activities to pass the subject.

Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Case Problem Sets	35%	2.5	0.1	7, 1, 2, 3, 4, 5, 8, 12, 6
Case Sets	35%	2.5	0.1	7, 1, 3, 5, 11, 9, 10, 8, 13, 12
Exam	30%	2.5	0.1	3, 4, 5, 8

Bibliography

Arratia, A. (2014) Computational Finance, an introductory course with R, Atlantis Press.

Hull, J. (2008) Options, Futures, and Other Derivatives, Prentice Hall.

Ruppert, D. (2010) Statistics and Data Analysis for Financial Engineering, Springer.

Software

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