UAB
Universitat Autònoma de Barcelona

Introduction to Financial Engineering

Code: 104875
ECTS Credits: 6

2025/2026

Degree	Type	Year
Applied Statistics	OP	4

Contact

Name: Albert Ferreiro Castilla

Email: albert.ferreiro@uab.cat

Teaching groups languages

You can view this information at the end of this document.

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.

Learning Outcomes

1. CM14 (Competence) Propose the statistical model needed to analyse data sets belonging to real studies.
2. KM17 (Knowledge) Recognise the statistical models for the analysis of data with different structures and complexities that frequently appear in different fields of application.

3. KM18 (Knowledge) Recognise the language of applications of economics and finances, biomedical science and engineering, provided by research and innovation in the field of statistics.
4. SM16 (Skill) Select appropriate sources of information for the statistical work.
5. SM18 (Skill) Refine the information available for subsequent statistical processing.

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.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Case Studies	20	0.8	
Lectures	30	1.2	
Type: Supervised			
Tutorials	25	1	
Type: Autonomous			
Study + Problem & Case Sets	67.5	2.7	

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Case Problem Sets	35%	2.5	0.1	CM14, KM17, KM18
Case Sets	35%	2.5	0.1	CM14, KM17, SM16, SM18
Exam	30%	2.5	0.1	CM14, KM17, KM18

To pass the subject it is necessary that the average of the case and problem sets is greater than or equal to 4 and the exam grade is greater than or equal to 3. 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%). It is not allowed to attend recovery exam to achieve higher marks. Students will be considered as non-graded if they have not submitted any of the case and problem sets.

If a student applies for Single Assessment, consisting of an Exam (50%) and an Applied Essay (50%), the student will need to obtain a minimum of 5 in both activities to pass the subject. 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%). Students will be considered as non-graded if they have not submitted the applied essay.

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

It is allowed to use Artificial Intelligence (AI) technology exclusively for supporting activities such as bibliography or information search or correction and translate activities. Students will need to clearly identify which parts have been generated by AI, specify the technology used and include a self-assessment on how the later has influence the process and result of the submission. Failing to be transparent in the use of AI on

graded activities will be considered a lack of academic honesty and may lead to a partial or total penalty in the grade of the activity, or greater sanctions in serious cases.

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

R

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(SEM) Seminars	1	Catalan	first semester	afternoon
(TE) Theory	1	Catalan	first semester	afternoon