Universitat Autònoma de Barcelona

2021/2022

Financial Data Analysis

Code: 104412
ECTS Credits: 6

Degree	Type	Year	Semester
2503740 Computational Mathematics and Data Analytics	OT	4	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: Albert Ferreiro Castilla
Email: Albert.Ferreiro@uab.cat

Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

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

- Design, develop, maintain and evaluate software systems that allow large volumes of heterogeneous data to be represented, stored and handled in accordance with the established requirements.
- Formulate hypotheses and think up strategies to confirm or refute them.
- Make effective use of bibliographical resources and electronic 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.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Using criteria of quality, critically evaluate the work carried out.
- Work cooperatively in a multidisciplinary context assuming and respecting the role of the different members of the team.

Learning Outcomes

1. Draft the technical report based on a statistical analysis.
2. Extract relevant conclusions from applied problems through the application of statistical methods.
3. Extract relevant conclusions from applied problems, through the application of advanced statistical methods.
4. Identify the special methodological characteristics of statistical analysis according to the distinct areas of application.
5. Identify, use and interpret the criteria for evaluating degree of fulfillment of the requirements needed to apply each advanced statistical procedure.
6. Interpret results with advanced methodologies, and extract conclusions.
7. Interpret statistical results in applied contexts.
8. Make effective use of bibliographical resources and electronic resources to obtain information.
9. Prepare technical reports that clearly express the results and conclusions of the study using terminology pertaining to the field of application.
10. Recognize the advantages and disadvantages of distinct statistical methodologies when applied to the various disciplines.
11. 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.
12. 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.
13. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
14. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
15. Understand statistical software for programming functions and advanced procedures.
16. Using criteria of quality, critically evaluate the work carried out.
17. Work cooperatively in a multidisciplinary context, taking on and respecting the role of the distinct members in the team.

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	16, 15, 2, 4, 13, 11, 12, 10, 17, 8
Lectures	30	1.2	15, 3, 4, 5, 7, 6, 11, 10
Type: Supervised			
Tutorials	25	1	15, 3, 4, 5, 7, 6, 14, 13, 11, 12, 10, 8
Type: Autonomous			
Study + Problem & Case Sets	67.5	2.7	16, 15, 9, 3, 2, 4, 5, 7, 6, 14, 13, 12, 1, 17, 8

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%).

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	16, 15, 9, 3, 2, 4, 5, 7, 6, 14, 13, 12, 1, 8
Case Sets	35%	2.5	0.1	16, 9, 3, 2, 4, 5, 7, 6, 14, 13, 11, 12, 10, 1, 17, 8
Exam	30%	2.5	0.1	15, 3, 2, 4, 5, 7, 6

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