advantere School of Management

COMILLAS UNIVERSIDAD PONTIFICIA

GUÍA DOCENTE CURSO 2024-25

SUBJECT TECHNICAL SHEET

Subject data	
ECTS credits	5
DEGREE	Master in Finance / Master's Degree in Finance from the Pontifical University of Comillas
Manager / Teacher	Luis Manuel García Muñoz Francisco Gomez Casanova
Name	Quantitative Methods in Finance
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OBJECTIVES AND CONTENTS

GOALS

General Competencies

CG1: Learning by projects: Ability to develop and execute collective financial projects in their different phases based on real situations, proposing real solutions and making all interactions with the team, clients and any other participant efficient.

RA1: Ability to commit to the development of experimental collective projects based on the real world, managing and aligning the client's needs with the available resources, optimally distributing the work, communicating and projecting its different phases, proposing real solutions and making all the tasks efficient. interactions with the team, customers and other stakeholders..

CG2: Digital competence: Employ, take advantage of and use, efficiently and safely, the technological and digital resources that are applied in the financial management of organizations.

RA2: Being able to critically, creatively and safely use information and communication technologies in financial management in organizations, using applications and taking advantage of internet resources.

Specific Competencies

CE10: Know how to identify the main financial and non-financial risks that any company faces and apply advanced models for their control and management.

RA3: Know and apply the mathematical and financial models of risk management.

CE12: Know and apply the programming and modeling necessary to create defined functions, statistical, econometric and mathematical analysis through computer programs-

RA1: Knows how to use statistical, mathematical and econometric tools for data analysis and preparation of research and reports, mastering the main basic statistical, mathematical and econometric concepts necessary for financial operations and financial research.

RA2: He knows the R, Python and Excel environments, being able to develop programs based on predefined models, in such a way that he provides solutions to various financial problems efficiently.

CONTENTS

1. Statistical Methods

This section covers fundamental statistical techniques essential for analyzing financial data. It begins with joint probability distributions and conditional expectation, key concepts for understanding the relationships between variables. The course then explores estimators, the Central Limit Theorem (CLT) and the Law of Large Numbers (LLN), which are essential for making inferences from data. Additionally, students learn about sampling methods and Monte Carlo simulations, crucial for modeling uncertainty in financial markets. The section concludes with an introduction to MATLAB for computational tasks and fuzzy logic for decision making under uncertainty.

2. Financial Econometrics

In this section, students review matrix algebra as a basis for econometric modeling and delve into optimal asset allocation strategies. The course then focuses on Ordinary Least Squares (OLS) regression, including the assumptions and properties that ensure its validity. Time series analysis is introduced, with a particular focus on ARIMA models, which are widely used to predict financial data. This part equips students with the tools necessary to model and predict market behavior using econometric techniques.

3. Statistical Learning in Python

This section introduces students to the fundamentals of machine learning within the Python ecosystem, covering essential concepts such as error metrics and model selection. Students learn both supervised learning techniques, including linear regression, Ridge, Lasso, and Random Forest, to predict quantitative responses, and logistic regression for categorical outcomes. The section also delves into unsupervised learning methods such as Principal Component Analysis (PCA) for dimensionality reduction and k-means for clustering. The introduction to deep learning closes this section, providing an overview of the most advanced machine learning techniques.

4. Mathematics of Financial Derivatives

This part of the course explores the mathematical models that underpin the valuation and risk management of financial derivatives. Students begin by studying basic instruments such as futures contracts and options, before progressing to discrete-time models and the no-arbitrage principle, which ensures fair valuation in financial markets. The course covers the binomial model for option pricing and introduces continuous-time models with a focus on Brownian motion and the Itô calculus. Advanced topics include the Black-Scholes model for option pricing, martingale methods, and various numerical techniques used in derivatives valuation and risk management.

TEACHING METHODOLOGY

General methodological aspects of the subject

The course combines theory and practice through explanatory sessions and interactive seminars that facilitate understanding of key concepts and encourage discussion. Problem-Based Learning (PBL) is used to develop problem-solving skills in realistic scenarios. Practical sessions in laboratories allow students to apply what they have learned using technological tools. The evaluation includes continuous training activities and final exams. Autonomous work and active participation in class are encouraged, complemented by personalized tutoring to support individual learning. This approach ensures balanced and practical learning, suitable for understanding and applying course concepts.

EVALUATION AND QUALIFICATION CRITERIA

Evaluation activities	Weight (%)
Individual final evaluation	25%
Individual / Group practical cases	20%
Participation	15%
Project	40%

Ratings

The evaluation criteria of the subject are governed by the following regulations:

1.All students must have 100% attendance on the days set for this subject. Any absence must be justified. If it is not justified, there will be a penalty that will vary depending on the days of unjustified absence.
2. The final grade corresponds to the sum of the evaluation activities, evaluation criteria and weight described in the Evaluation and Qualification Criteria section. All elements of the subject evaluation must be approved
3. Work must be delivered, individually and in groups, in the time and manner planned by the subject teacher.
4. A final grade below 5 implies taking an extraordinary test. The final grade in this exam cannot be higher than the median of those approved in ordinary call.

Evaluation criteria to apply for the second registration

The student enrolled in the subject for the second year must comply with the individual and group tasks set by the subject teacher. The same evaluation criteria expressed in the Evaluation and Qualification Criteria section will be maintained.

For those circumstances not provided for in this Teaching Guide, the Regulations of Advantere School of Management and the general Regulations of Comillas will apply.

Basic Bibliography

Books:

- Björk, T. Arbitrage Theory in Continuous Time (4th Edition). Oxford University Press.
- Damiano Brigo and Fabio Mercurio : Interest Rate Models - Theory and Practice: With Smile, Inflation and Credit (Springer Finance) 2nd Edition - 2006
- Matthew F. Dixon, Igor Halperin & Paul Bilokon : Machine Learning in Finance: From Theory to Practice (2020)
- Marcos López de Prado: Advances in Financial Machine Learning (2018)
- Aurelien Geron : Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow 3e: Concepts, Tools, and Techniques to Build Intelligent Systems - 2022