UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Mathematical and Statistical Methods 2

2526-3-E3303M024

Learning objectives

The aim of the course is to provide students with the fundamental theoretical and practical tools for analyzing and evaluating fixed-income securities, understanding the term structure of interest rates, constructing optimized portfolios, and managing financial derivatives.

Knowledge and Understanding
Students will gain knowledge of the theoretical principles underlying financial instruments, covering bond valuation, portfolio management, and derivatives analysis.

Ability to Apply Knowledge and Understanding
Students will be able to effectively apply mathematical and financial methods to solve real-world problems, such as pricing bonds, analyzing risk, and optimizing portfolios.

Autonomy of Judgment
Students will develop critical and analytical skills to evaluate the results of financial analysis and make informed decisions in financial contexts.

Communication Skills
Students will learn to communicate mathematical and financial concepts, methods, and results clearly and rigorously in a technical setting.

Learning Skills
Students will acquire an independent study method that will prepare them for advanced studies in quantitative finance.

Contents

This module covers the functioning and valuation of bonds. Topics include different types of bonds, price and yield calculation, risk analysis, and sensitivity measures such as duration and convexity. Next, it covers the principles of portfolio management, focusing on return, risk, the efficient frontier, and optimal portfolio construction. Finally, the module explores main derivative instruments, such as futures, forwards, and options. The course integrates theoretical lectures with applied components. Bloomberg platform materials will be used to analyze real-world data and demonstrate financial market dynamics. Additionally, Excel will be demonstrated as a tool for applying key quantitative methods to bond valuation, portfolio optimization, and derivative management.

Detailed program

**Bond Price and Yield: **

1. Basic Features of a Bond
2. Different Types of Bonds
3. Pricing of Zero Coupon Bonds, Fixed-Rate Bonds and Floating-Rate Notes
4. Yield Measures for Fixed-Rate Bonds
5. Analysis of the Risk Factors (Interest Rate Risk, Credit Risk, Market Liquidity Risk)
6. Duration and Convexity

Portfolio Management

1. Return and Risk
2. Market Characteristics
3. Efficient Risky Portfolios and Efficient Frontier
4. Optimal portfolio

Futures and Forwards:

1. Basic Characteristics
2. Profit and Loss
3. Leverage Effect
4. Pricing and Valuation
5. Hedging

Options:

1. Basic Characteristics
2. Call Option and Put Option
3. Profit and Loss
4. Intrinsic Value and Time Value
5. Binomial Option Pricing Model
6. Black-Scholes Option Pricing Model
7. Put-Call Parity
8. Leverage Effect
9. Option Price Sensitivities.

Prerequisites

Metodi Matematici is a propaedeutic exam.

Teaching methods

The course combines traditional teaching methods, through lectures and theoretical explanations, with interactive teaching aimed at stimulating active student participation through exercises, discussions, and collaborative activities. Some of the activities (up to 30% of the total hours) may be carried out remotely. Online lessons will be communicated with adequate notice by the teacher and may take place synchronously (live streaming) or asynchronously (recording).

Assessment methods

At the end of the course, there will be a written exam and an additional oral exam upon request by the instructor and/or student if the written exam grade is sufficient.

The written exam consists of:

- Exercises (open-ended questions) that allow the teacher to assess the student's ability to apply theory to problem solving
- Theoretical questions, in which the student is asked to provide complete definitions, statements, and proofs of theorems, as well as examples and
  reasons

The oral exam consists of theoretical questions and exercises.

Textbooks and Reading Materials

- E. Mondello. Applied Fundamentals in Finance - Portfolio Management and Investments (2023), Springer Texts in Business and Economics
  https://doi.org/10.1007/978-3-658-41021-6

- Lecture slides and materials provided by the instructor

Suggested reading:

- J. C. Hull. Options, Futures, and Other Derivatives, Global Edition 11th Edition (2021) Pearson

Semester

First semester

Teaching language

English

Sustainable Development Goals

QUALITY EDUCATION