UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Big Data in Business, Economics and Society

2526-2-FDS01Q039-FDS01Q040M

Aims

The course aims at showing some recent developments of model portfolio theory with a link to Big Data in finance.

Learning Objectives:
Knowledge and Understanding: students will gain a fair understanding of risk measures, Markowitz's portfolio selection model, and the application of Big Data in finance, including their theoretical foundations and practical implications.

Applying Knowledge and Understanding: students will be able to use mathematical tools, such as probability and constrained optimization, to solve portfolio selection problems and analyze financial data effectively.

Making Judgements: students will develop the ability to evaluate the suitability of portfolio models and Big Data techniques, assessing their strengths and limitations in financial applications.

Communication Skills: students will be able to clearly present their analyses and solutions to financial problems, both in oral exams and written reports, using appropriate technical language.

Learning Skills: students will acquire the skills to independently study advanced topics in portfolio theory and Big Data, enabling them to pursue further research or studies in finance.

Contents

- Recap on risk measures and on choices under uncertainty;
- Markowitz's portfolio selection model;
- properties of the minimum variance portfolios;
- the risk parity approach;
- the shrinkage approach;

- a financial application of Big Data analysis.

Detailed program

Introductive remarks: risk measures.
Mathematical derivation of Markowitz's (1952) portfolio selection model. The Capital Asset Pricing Model.
The minimum variance extension as portfolios with a limited exposure to errors in parameters estimation.
The risk parity extension as an optimization problem with no explicit solution.
An introduction to shrinkage estimator and its connections with the optimal portfolio selection theory.
Analysis of article "Thousands of Alpha Tests"; Giglio, S.; Liao, Y.; Xiu, D." - The Review of Financial Studies, Volume 34, Issue 7, July 2021

Prerequisites

Basic notions of probability and constrained optimization

Teaching form

In-class lectures covering theoretical notions as well as lab activities.
Lectures will be in English, will be fully delivered in presence and will be recorded. There will be no interactive activities.
Access to these recordings is reserved to students that, for some valid reasons, cannot attend in-class lectures. Students interested in accessing recorded lectures should email the instructor.

Textbook and teaching resource

Lecturer's teaching notes
Textbook: "Financial Data Science", G. Calafiore, L. El Ghaoui, G. Fracastoro e A. Tsai, Cambridge University Press, 2025
A book that students could refer to is: "Introduction to Risk Parity and Budgeting", T. Roncalli, Chapman & Hall/CRC Financial Mathematics Series, 2013
Additional material will be posted on the lab's e-learnong webpage

Semester

Second semester

Assessment method

The oral exam will, **alternatively**, be based:
• on the topics covered during the lab with the implementation of numerical analysis (financial data collection, portfolio management, post-optimality of optimal portfolios);
• on a report on a topic not necessarily covered in class (to be settled with the instructor at the end of the lectures). In this case, the instructor can provide some research articles that form the main idea behind the developed report.

In both cases, students' evaluation will be based on her/his capability of presenting, tackling and managing numerical and descriptive issues in a financial setting.

No partial exam will be held.

Office hours

Please refer to the following webpage:

https://en.unimib.it/enrico-moretto

Sustainable Development Goals