UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Computational Finance and Financial Econometrics

2425-2-F8204B036-F8204B037M

Learning objectives

A statistician specializing in finance must master not only the theoretical aspects of the discipline but also develop computational and data-analytic skills to apply the theory to data.

The objective of this class is to illustrate the stylized facts about financial data, explain the statistical/econometric models that well capture those features and to make students familiar with the fundamental aspects of computational finance, such as Monte Carlo pricing and dynamic portfolio management, which allow them to become operational in real-world situations.

The module in Computation Finance and Financial Econometrics completes the statistical-financial preparation of students in the Insurance and Financial Markets (MAF) program, making the theoretical knowledge acquired or being acquired practical.

Contents

Advanced R.

Working with financial data and assessing their empirical properties.

Uni- and multivariate GARCH models for portfolio management and derivative pricing.

Estimating large covariance matrices with applications to portfolio management.

Monte Carlo simulation for derivative pricing.

Detailed program

- Advanced R
- Definition of the main financial assets and contracts
- Stylized facts of financial prices and returns
- Univariate GARCH models
- Multivariate GARCH models
- Large covariance matrix estimation
- Monte Carlo and Bootstrap
- Simulation of univariate (geometric) Brownian motions
- Simulation of multivariate (geometric) Brownian motions
- Using the fundamental theorem of asset pricing for approximating the value of derivative contracts
- Possible extensions (GARCH asset pricing, jump-diffusion, yield curve)

Prerequisites

Working knowledge of R, matrix algebra, descriptive, inferential, multivariate statistics, and time series analysis.

Teaching methods

All lessons take place in computer labs. The theory is immediately illustrated through practical exercises using R aimed at solving real financial problems by coding.
Lab lessons are two or three hours long for a total of 42 hours. Students are asked to reason with the lecturer to implement coding solutions to operationalise the theoretical concepts learned in this class and the Financial Mathematics and Risk Management classes for solving real financial problems.

Assessment methods

The exam takes place in a computer laboratory, and students must solve a real problem by writing R code. The exam, usually taken immediately after the Risk Management exam, lasts one hour and is preferably, but not necessarily, taken in the same session as the Risk Management exam (preparing both modules together enhances your understanding of the subject). If one of the two modules is not passed, the passing grade from the other module will be retained until the other module is successfully passed.
On the e-learning page, you will find many past exams sometimes with the solution. There is no oral examination unless requested by the student to discuss the errors made in the R script.

The final grade for *Risk Management M* is computed as the rounded arithmetic mean of the grades for *Risk Management* and *Computational Finance and Financial Econometrics*.

Textbooks and Reading Materials

- Lecturer's notes available in the e-learning platform.
- Wickham (2015) *Advanced R*. CRC Press. First 7 chapters. Available also on-line: http://adv-r.had.co.nz/

- Remillard (2013) *Statistical Methods for Financial Engineering*, Chapman and Hall/CRC. https://doi.org/10.1201/b14285
- Iacus (2008) *Simulation and Inference for Stochastic Differential Equations: With R Examples*. Springer. Only the first chapter. The volume can be downloaded under unimib network at https://link.springer.com/

Semester

2nd term (November - January). Notice that we adopt a four terms organization of the academic year.

Teaching language

English

Sustainable Development Goals

QUALITY EDUCATION | DECENT WORK AND ECONOMIC GROWTH | INDUSTRY, INNOVATION AND INFRASTRUCTURE