



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Computational Finance and Financial Econometrics

2223-2-F8204B036-F8204B037M

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#### Learning objectives

A statistician specializing in finance must master not only the theoretical aspects of the discipline, but also develop the 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 him/her to become operational in real-world situations.

#### 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 fundamental theorem of asset pricing for approximating the value of derivative contracts
- Possible extensions (GARCH asset pricing, jump diffusion, yield curve)

## Prerequisites

A working knowledge of R, descriptive, inferential and multivariate statistics and time series analysis.

## Teaching methods

All lessons take place in computer labs. Theory is immediately illustrated through practical exercises using R.

## Assessment methods

Writing an R script to solve a real financial problem provided by the lecturer. The exam session takes place in a computer lab and lasts one hour.

## 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 (or unimib vpn) 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

DECENT WORK AND ECONOMIC GROWTH | INDUSTRY, INNOVATION AND INFRASTRUCTURE

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