

STATISTICAL METHODS WITH APPLICATION TO FINANCE

a.y. 2023-2024

Introduction

R. PAPPADÀ

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Mathematics and Statistics "B. de Finetti"
University of Trieste

February 26, 2024

Summary

- 1 Course Overview
 - General information
- 2 Course aim and content
 - Aim of the Course
 - Summary of the course
 - Course Material
- 3 Expected learning outcomes and Final Exam

General Info

The core of this course is the use of basic statistical techniques and tools to deal with data analysis in the framework of economics and finance, with emphasis on financial risk.

The course duration is 45 hours:

- frontal lectures ($\approx 35\text{h}$)
- Practical sessions with \mathbb{R} ($\approx 10\text{h}$)

Access the **syllabus** of the course:

<https://units.coursecatalogue.cineca.it/cerca-insegnamenti>



Lecture recordings will be available in the course team in MS Teams (available till the end of the semester). Practical sessions are interactive and hence recordings may not be available.

Lecturer

Roberta Pappadà

Contact rpappada@units.it

Office: room 2.18, 2nd floor, Via Valerio 4/1

Office hours at the personal page

deams.units.it/it/dipartimento/persona/personale-docente

→ R. Pappadà → *scheda persona*

Office hours can also be scheduled through teams upon motivated request.

Lessons timetable

Anno accademico: 2023/2024
Docente: PAPPADA' ROBERTA

	lunedì	martedì	mercoledì	giovedì	venerdì
09:00					
09:30					
10:00					STATISTICAL METHODS WITH APPL. TO FINANCE Aula 1_B [Edificio D] 10:00 - 11:00
10:30					
11:00	STATISTICAL METHODS WITH APPLICATION TO FINANCE Aula 1_B [Edificio D - Economia] 11:00 - 13:00				
11:30					
12:00					
12:30					
13:00			STATISTICAL METHODS WITH APPLICATION TO FINANCE Aula 4_B [Edificio D - Economia] 13:00 - 15:00		
13:30					
14:00					
14:30					
15:00					
15:30					

→ Any change that occur in the timetable will be communicated via Moodle or posted on the main page www.deams.units.it

Course calendar

2nd Semester's lessons: from February 26th to May 24, 2024.



→ Lesson suspended on **March 29th**, **April 1st** and **April 3rd**, 2024, for Easter Holidays



→ Friday classes are optional: NO LESSON on **Friday 8th and 22nd March**



→ Lesson suspended on **April 15th** for the DEAMS celebration day of UniTS 100th Anniversary

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Course Objectives

The course aims to provide students with an introduction to well-established *statistical methods and models* in the financial and economic context, with a focus on time series data.

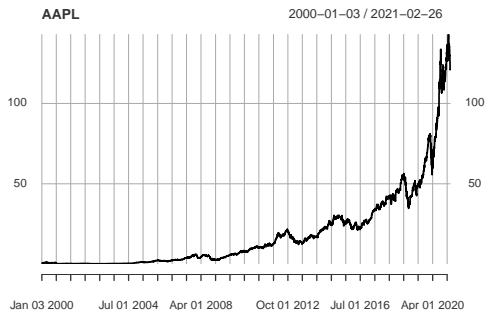


Figure 1: Closing prices of Apple stock (2000–2021)

Course Objectives

Starting from stock prices and asset returns, the R statistical software will be used in hands-on sessions for exploratory data analysis and time series modelling.

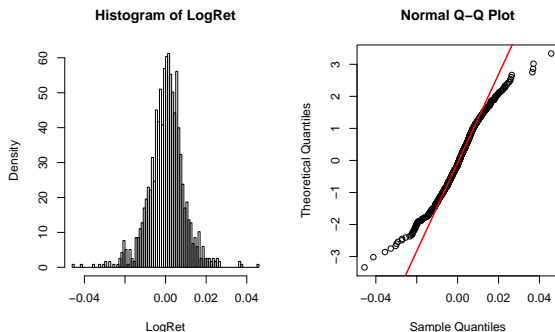


Figure 1: Histogram and QQ plot of daily log returns of the McDonald's asset (Jan 2010 - Sept 2014).

Course Objectives

We will also explore more advanced statistical topics such as forecasting techniques and models for non-constant variance used in the financial framework

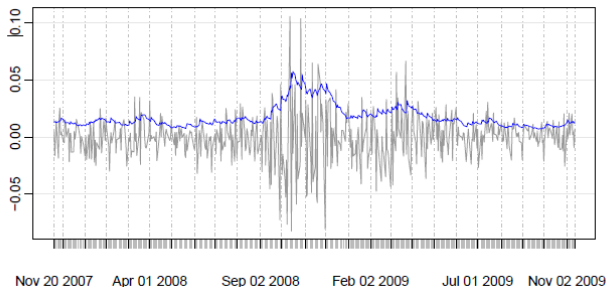


Figure 1: GARCH one-step-ahead predictions of the DJIA volatility (solid line) superimposed on part of the DJIA series including the financial crisis of 2008.

Prerequisites

The *Statistics* course is a prerequisite for Financial Econometrics and Statistical Methods with Applications to Finance: it is assumed that the student is at least somewhat familiar with the basics of probability and statistics: exploratory data analysis, random variables and distribution functions, and the fundamentals of statistical inference.

No prior knowledge of computer programming is required for attending the **R Lab** sessions.

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Course Content

Review of basic statistics, prices and returns.

- Returns; log returns; multi-period returns; portfolios.
- Distributional properties of returns; review of statistical distributions and their moments; visualization of financial data
- Index numbers and Stock Market Indices.

R Lab Exploratory data analysis and Stylized Facts of returns

Linear models for financial time series

- Characteristics of time series data; Simple models for time series of returns; model selection techniques
- Unit-root nonstationarity; Integrated ARMA (or ARIMA) models

R Lab Fitting ARMA models to time series data

Course Content / 2

Forecasting

- Point forecasts and prediction intervals; forecasting using ARMA models
- exponential smoothing
- R Lab** Prediction of time series using linear models

GARCH and conditional volatility

- Testing for ARCH effects; the ARCH model; GARCH models and their extensions.
- R Lab** Fitting ARMA-GARCH models to financial returns

Course Activities

The activities include

- Lessons with slides illustrating the theoretical background of the statistical methods presented in the course, as well as examples on simulated and real-world datasets
- Sessions of exercises with full solutions
- *R* Labs to focus on statistical models for financial returns, primarily for the purpose of forecasting risk
- Wocclap or Moodle Quizzes for self-evaluation (homework or live quizzes)

More on quizzes and live tests

- During the course, moodle quizzes will be scheduled, which include true/false questions, multiple choice, or problems with numeric solution
- Students wishing to participate in the Moodle quizzes will have a deadline to submit the answers (few days)
- There will some interactive quizzes during the lessons, which may serve for self-evaluation
- Students that obtain at least the 60% of correct answers in all tests can receive up to 2 additional points in the final grade (only for the summer session)

Summary

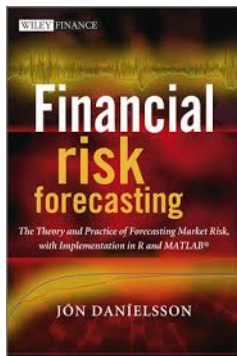
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Textbooks

Main textbooks:

J. Danielsson (2011)

Financial Risk Forecasting: The Theory and Practice of Forecasting Market Risk with Implementation in R and Matlab,
Wiley

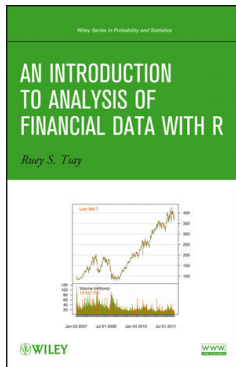


Textbooks

Main textbooks:

Tsay, Ruey S. (2013)

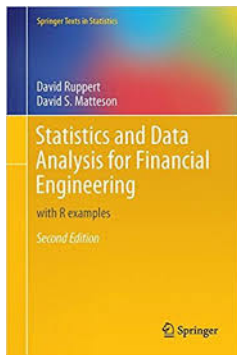
An Introduction to the Analysis of Financial Data with R, Wiley



Textbooks

Further textbooks
(demanding)

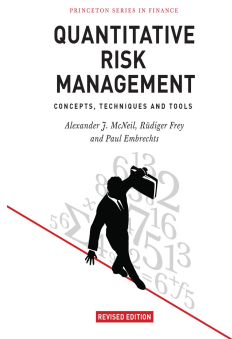
D. Ruppert, D.S. Matteson (2015)
*Statistics and Data Analysis for Financial
Engineering with R examples*
Second edition, Springer Texts in Statistics



Textbooks

Further textbooks
(demanding)

J. McNeil, R. Frey, and P. Embrechts
(2015) *Quantitative Risk Management: Concepts, Techniques and Tools*, Revised Edition, Princeton Series in Finance



Course Material and further resources

Slides, exercises, R source files and datasets will be available on the Moodle page of the course.

Online resources for review of statistical concepts and R language

- D. M. Diez, C. D. Barr, M. Çetinkaya-Rundel, *OpenIntro Statistics*
<https://leanpub.com/openintro-statistics> (get the full book PDF for free by setting to zero the amount to be paid)
- An introduction to R available at
<https://cran.r-project.org/>

Learning outcomes

At the end of the course, you will be able to

- to understand the basic statistical tools needed in our *empirical* study of financial markets data
- to consider the relevance of probability and statistics to finance and how they are applied to real problems
- to focus on the fundamentals of linear time series models employed in business, finance and economics
- to address the important issue of the modeling and forecasting of volatility, the most common measure of market uncertainty

Structure of the Final exam

The final exam consists of a **written test** of 2 hours with

- exercises and open questions to assess your comprehension level of all the topics covered during the course
- questions concerning the output of various statistical analysis to assess your ability to interpret results, plots, and evaluate different models in applied contexts

Examples of past exams will be made available via Moodle.



A bonus of maximum **2 points** is added to the final exam grade according to the performance in the Moodle Quizzes (only for the summer session).



There will be three exams dates in May–July and one in September (you must register in Esse3 within the given deadline, i.e. four days prior to the exam).

Questions?