

# Analysis of Macroeconomic and Financial Markets Data

## Winter 2023/24 – Syllabus

**Important information:** Please pay attention to our communication via StudOn to receive up-to-date information about the course!

**Lecture:** Wednesday, 15:00-16:30, LG 0.224 (18.10., 18:30(!): 0.142; 8.11., 18:30(!): H6)

**Exercise Session:** Thursday, 08:00-09:30, LG H2 (first session in the third week of the semester on 2<sup>nd</sup> November)

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**Overview:** This course is an introduction to the analysis of univariate time series data at the Bachelor level. The course will give students the theoretical knowledge and practical skills to apply the covered techniques in a wide range of empirical applications, mainly in macroeconomics (e.g., business cycle forecasting) and financial econometrics (e.g., modeling and forecasting stock market volatility).

Questions that you can address using the methods that this course covers are for instance: What is the trend in a volatile sales time series? How much seasonal fluctuations do sales of a certain product have? How can we forecast next year's GDP growth? What immediate and long-run effects does a certain shock have on another variable? How can we model and forecast the time-varying volatility of financial market returns?

The course starts with an inspection of various features of different time series with a special focus on trends and seasonal fluctuations. We will see what changes in terms of the econometrics once we introduce a time dimension. Students will learn how to model time series processes using the ARMA framework. Subsequently, the course covers the basics of time series forecasting and methods for evaluating time series forecasts. We will discuss what changes if our data exhibit so-called stochastic trends and how we can test for them. Finally, we review the most important properties of financial markets data and cover the basics of the GARCH model, which is the most commonly used model to capture these properties.

Students should have solid knowledge of the basics of statistics and econometrics (as obtained, for instance, through the modules „Data Science: Statistik“ and „Data Science:

„Ökonometrie“ in the case of the German Bachelor programs or „Statistics“ and „Introduction to Econometrics“ in the case of the IBS/IES programs).

**Grading:** Grading is based on a project report that students hand in at the end of the winter term. Students can improve their grade by regularly participating in biweekly quizzes during the semester.

**Exam date:** Project reports have to be handed in at the end of the winter term. In the case of an insufficient grade, we offer the option to hand in a second report at the beginning of the summer term. There will be no option to start examination for this module in the summer term.

### Course outline

- Topic 1: Properties of time series
- Topic 2: ADL models and concept of multipliers
- Topic 3: Time trends and seasonality
- Topic 4: ARMA models
- Topic 5: Forecasting and forecast evaluation
- Topic 6: Non-stationary time series and unit root tests
- Topic 7: Properties of financial markets data
- Topic 8: (G)ARCH models

### Main textbooks:

- Wooldrige, J. M. (2016). *Introductory Econometrics. A Modern Approach*, 6<sup>th</sup> edition (or earlier or more recent editions), Cengage Learning.
- Diebold, F. X. (2007), *Elements of Forecasting*, 4<sup>th</sup> edition (or earlier editions), Thomson Higher Education.
- Verbeek, M. (2008), *A Guide to Modern Econometrics*, 3<sup>rd</sup> edition (or earlier editions), Wiley.

**Course requirements:** Course participants are strongly advised to ...

- **Attend.** You can only fully benefit from this course if you attend both lectures and exercise sessions regularly because the course content is cumulative, meaning that later topics rely heavily on stuff covered in the previous weeks.
- **Prepare.** Do the assigned readings before the lecture and come to class prepared to discuss them and to ask questions that you have. Similarly, work on the problem sets before we discuss them in class.
- **Follow the website.** We will make course material available through the course website on StudOn. We will also make announcements using this platform.
- **Code.** Your learning gains will be much, much higher if you regularly work on the R assignments, which ask to implement the material that we cover in the lectures. Do not underestimate how much actually applying an approach helps understanding it!

## R Software

We will devote approximately half of the exercise sessions to the implementation of econometric methods for the analysis of macroeconomic and financial data in R.

R and RStudio (an IDE for R) are free software. You can download R to install it on your own computer using any of the links on the following website: <https://cran.r-project.org/mirrors.html>. You can download a free copy of RStudio Desktop [here](#) (just use the download button that is most to the left). You will get more information about how to install the software at the beginning of the course.

Although we expect that you are familiar with R from your introductory course in statistics, we designed the first exercise sessions such that they also cover the basics of programming in R. You can also refresh your memory by completing our [online course "Basic Introduction to R/RStudio"](#) on StudOn.

There are also many excellent online courses for learning R available online that you might want to consult if you do have no prior experience with R at all (or have forgotten everything that you knew long ago). We recommend the following:

- The book "[R Programming for Data Science](#)" by Roger D. Peng;
- Many tutorials on various aspects of R offered via the [swirl project](#);
- The course "[Topics in R Statistical Language](#)" offered by PennState University;
- The course "[Learning R](#)" designed by NYU.

The most important thing to enhance your programming skills and to master the analysis of actual data is to write a lot of code.