

Applied Analysis of Time Series and Financial Markets Data (RUW-3190)

Winter 2019/20 – Syllabus

Lecture: Thursday, 08:00-09:30, LG 0.141

Exercise: Wednesday, 11:30-13:00, LG 4.109/LG 0.422

Exam date: tba

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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 (eg, business cycle forecasting) and financial econometrics (eg, modeling and forecasting stock market volatility).

Questions that can be addressed using the methods that this course covers are: 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 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 GARCH models which is the most commonly used type of model to capture these properties.

Students should have solid knowledge of the basics of statistics and econometrics (as obtained, for instance, in „Statistik“ and „Praxis der empirischen Wirtschaftsforschung“).

Grading: Grading is based on a written exam (60 minutes).

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:

- Wooldridge, J. M. (2015). *Introductory Econometrics. A Modern Approach*, 6th edition (or most earlier editions), Cengage Learning.
- Diebold, F. X. (2007), *Elements of Forecasting*, 4th edition (or earlier editions), Thomson Higher Education.
- Verbeek, M. (2008), *A Guide to Modern Econometrics*, 3rd 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 exercises regularly because the course content is highly cumulative, meaning that later topics rely heavily on stuff covered in the previous weeks.
- **Prepare.** Ideally, 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 they are discussed in class.
- **Follow the website.** I'll make course material available through the course website on StudOn. I 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. Don't 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 time series analysis in R.

R is a free software environment. We will make the software (and problem sets) available through RStudio Cloud. You will get more information about how this works and how to register at the beginning of the course.

Although we expect that you are familiar with R from your introductory course in statistics, the first exercise sessions are designed such that they also cover the basics of programming in R. But there are also many excellent online courses for learning R available online which you might want to consult if you do have no prior experience with R at all. We recommend the following:

- A free course on [Coursera](#) offered by Johns Hopkins University;

- The book “R Programming for Data Science” by one of the authors of the Coursera course;
- 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 implementation of econometric methods is to write a lot of code.

You can also 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).