

Multiple Time Series Analysis

This course is intended to give an introduction to multiple time series analysis. We focus on the mechanics of the different procedures and their application. Asymptotic properties of estimators and test statistics will only be mentioned but not derived. At the beginning we will repeat and introduce some important univariate time series concepts.

During the course we will discuss a selected set of related empirical research papers I expect you to read them in advance. Moreover, the lecture will be accompanied by exercise sessions, mostly empirical computer tutorials. Note that we will have 8 exercise sessions in total: 5 tutorials and 3 whiteboard sessions. A preliminary schedule for the lectures, exercise sessions and computer tutorials will be provided soon. Moreover, there will be 2 assignments to be handed in which together count 25% for the final grade.

1. Introduction and Overview (**L**: Ch. 1)
2. Univariate Time Series Concepts and Models (**E**: Chs. 2, 4)
 - Time Series Concepts: Data vs. Stochastic Process, Stationarity, Ergodicity
 - ARMA Models: Box-Jenkins Methodology
 - Integrated Processes and Unit Root Tests
3. Stable Vector Autoregressive (VAR) Processes (**L**: Sect. 2.1)
 - Model Representations
 - Properties
4. Estimation of VAR Processes (**L**: Sect. 3.1-3.4)
5. VAR Model Selection and Model Checking (**L**: Ch. 4)
 - Information Criteria
 - Checking Model Adequacy (Autocorrelation, Non-normality, Stability)
6. Forecasting (**L**: Sect. 2.2, 3.5)
7. Structural Analysis with VAR Models (**L**: Sect. 2.3, 3.6-3.7, Appendix D)
 - Granger Causality and Instantaneous Causality
 - Impulse-Response Analysis
 - Forecast Error Variance Decomposition
8. Multivariate Integrated Processes: Cointegration (**L**: Chs. 6-8)
9. Structural VAR Models (**E**: Sect. 5.5, 5.10-5.13, **L**: Ch. 9)

Literature

The main reference for the course is Lütkepohl (2005, Chs. 1-4, 6-9, and Appendix D). *New Introduction to Multiple Time Series Analysis*, Springer, Berlin. (L).

Moreover, we use some material from Enders (2004) (E) for the univariate part. As an additional reading you may have a look at Chapter 2 in Lütkepohl and Krätzig (2004) which provides a good overview on univariate time series methods. Note, however, that this is not a textbook but it rather assumes some background knowledge in time series analysis. Finally, you could also take a look at Chapter 3 of Hamilton (1994) on some basic time series concepts like stationarity and ergodicity and a rather extensive discussion of ARMA models.

There is a new textbook by Kilian and Lütkepohl (2018) which extensively deals with structural VAR analysis. It contains relatively concise descriptions of VAR and VEC models and related time series tools in Chapters 2 to 4. You may have a look to get a quick overview. You could also consult Chapters 3 and 4 of Lütkepohl and Krätzig (2004) for an overview on multivariate time series methods.

Due to legal constraints I am not allowed to upload pdf-scans of (substantial parts of) the textbooks. However, all books are available at the University library. Moreover, Lütkepohl (2005) is even available as an online-resource, i.e., you can download pdfs of the book chapters.

References

Enders, W. (2004), *Applied Econometric Time Series*, 2nd ed., Wiley. (E).

Hamilton, J.D. (1994), *Time Series Analysis*, Princeton.

Kilian, L. and Lütkepohl, H. (2018), *Structural Vector Autoregressive Analysis*, Cambridge University Press [available at Lutz Kilians webpage].

Lütkepohl, H. (2005), *New Introduction to Multiple Time Series Analysis*, Springer, Berlin. (L).

Lütkepohl, H. & Krätzig, M. (2004), *Applied Time Series Econometrics*, Cambridge University Press.

Software

For the illustrations and the computer tutorials we will use the software JMulTi, which can be downloaded free of charge at www.jmulti.com. At this webpage you also find JMulTi helpsets as pdf-files. The relevant ones for our course are: Initial Analysis, Vector Autoregression and Vector Error Correction Models. In addition, the datasets used in Lütkepohl (2005) and Lütkepohl & Krätzig (2004) are provided there.

Note, however, that this software program will no longer be maintained. Nevertheless, I have decided to keep on using it since JMulTi contains some features, e.g. in terms of SVAR analysis, that are not available in other canned software packages. Moreover, JMulTi is free of charge.