

Time Series Analysis

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About this course

Time Series (Wikipedia):

“In mathematics, a time series is a series of data points indexed (or listed or graphed) in time order. Most commonly, a time series is a sequence taken at successive equally spaced points in time. Thus it is a sequence of discrete-time data.”

Time Series Analysis: Methods for analyzing time series data, taking into consideration their key characteristic – *serial dependence*.

Example

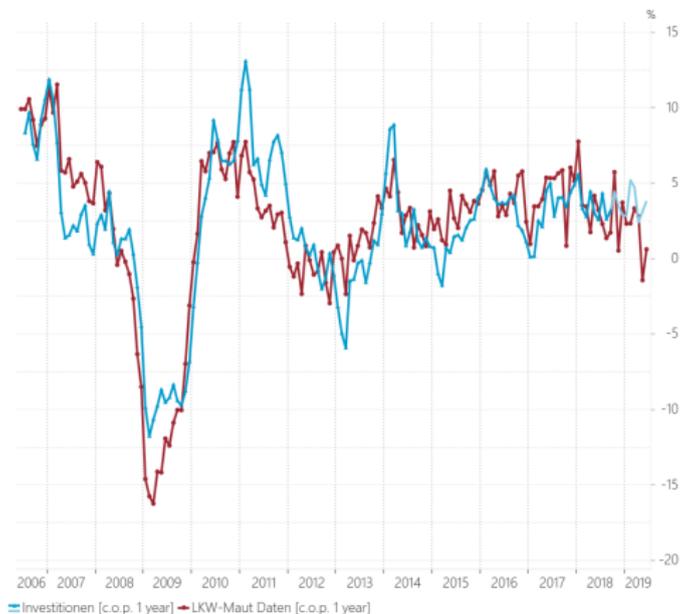


Figure: Number of kilometers travelled by trucks and German investment. Year-on-year percentage change. Source: Statistisches Bundesamt, own calculations.

About this course

Aims of time series analysis

- Description of a time series and its components
- Modelling – fitting stochastic models describing the dependence of a time series on e.g. its own past values
- Forecasting future values
- Dynamic regressions – uncovering the dependencies of a time series on explanatory variables
- Multivariate models – uncovering the dynamic relationships between multiple time series
- Monitoring and (optimal) control

Topics (tentative outline)

- Descriptive time series analysis
 - Decomposition in and extraction of trend and cyclical components
 - Naive forecasting methods (e.g. exponential smoothing)
- Theory of linear filters
- Models for stationary time series (AR, MA, ARMA)
- Models for non-stationary time series (ARIMA)
- Volatility modelling (ARCH, GARCH)
- State-space models and the Kalman Filter

Organization

Lecture

Tuesdays 10:15 – 11:45 am, HGII / HS 4

Thursdays 12:15 – 1:45 pm (12:00–1:30), Geschossbau II / HS 103

Exercise

Tuesdays 12:15 – 1:45 pm, Math Tower E21

Wednesdays 2:15 – 3:45 pm, CDI 120

Exam

Written 2-hour exam (tba), otherwise oral exam

Organization exercise sessions

- Weekly exercise sheet will be uploaded on Moodle, solutions to be handed in
- Only selected problems will be graded and corrections returned
- A minimum of 40% of the points **for the selected problems** required to be eligible for the final exam
- Group work (2-3 people) is not only possible and encouraged, but also mandatory. Single submission per group is required.

Literature

The slides, in conjunction with the lectures, are aimed to be self-contained. This is a non-exhaustive list of relevant textbooks:

- Shumway, R.H. & Stoffer, D.S. (2016). *Time Series Analysis and its Applications*. Springer.
- Cryer, J.D. & Chan, K. (2008). *Time Series Analysis With Applications in R*. Springer.
- Brockwell, J.P. & Davis, R.A. (2016). *Introduction to Time Series and Forecasting*. Springer, New York.
- Brockwell, J.P. & Davis, R.A. (1991). *Time Series: Theory and Methods*. 2nd Edition. Springer.
- Schlittgen, R. & Streitberg, B. H. J. (2001) *Zeitreihenanalyse*. Oldenbourg, München.