Data Analysis for Time Series

Instructor: László Márkus

Term: Spring

Weeks: 1-7

Contact hours: 3

Credits: 6

Aim and scope:

The course provides an insight into advanced time series modeling and simulation. The notions and assertions are presented in the context of practical applications and illustrated by applying them to diverse data series. The presented analyses and practical exercises rely on the R and Python programming languages and include machine learning techniques.

Syllabus:

Time series basics, refreshing: Stationary series, autocovariance, autocorrelation, partial autocorrelation, properties, long and short memory

Trend, seasonality, and smoothing. Linear models: AR(1), AR(2) AR(p), autocovariance, Yule-Walker equations. MA(q), ARMA(p,q), ARIMA(p,d,q). Estimation of linear model parameters, model selection by information criteria. Non-normally generated AR models.
Stationary distributions, tails, and extremes of linear models. Nonlinear models: ARCH(1), ARCH(p), GARCH(p,q), Stochastic volatility; their fitting. Interdependence within and between series: autocopula, cointegration. Multivariate time series and forecasting. Short and Long Memory (Hurst exponent, Fractionally integrated time series)

Grading: term mark (incorporating the solution of homeworks)

Literature:

Paul S.P. Cowpertwait, Andrew V. Metcalfe: Introductory Time Series with R, Springer 2009.
Ruey S. Tsay: Multivariate Time Series Analysis, with R and Financial Applications, Wiley 2014.
Rob J Hyndman and George Athanasopoulos: Forecasting: Principles and Practice, Monash University, Australia, 2018. available online at https://otexts.org/fpp2/
Gianluca Bontempi, Souhaib Ben Taieb, Yann-Aël Le Borgne: Machine Learning Strategies for Time Series Forecasting.
https://link.springer.com/book/10.1007/978-3-642-36318-4