Time Series - course description

General information

Course name	Time Series
Course ID	11.1-WK-MATD-SC-L-S14_pNadGenMH8KN
Faculty	Faculty of Mathematics, Computer Science and Econometrics
Field of study	Mathematics
Education profile	academic
Level of studies	Second-cycle studies leading to MS degree
Beginning semester	winter term 2019/2020

Course information

Semester	4
ECTS credits to win	8
Course type	optional
Teaching language	polish
Author of syllabus	

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Laboratory	30	2	-	-	Credit with grade
Lecture	30	2	-	-	Credit with grade
Class	30	2	-	-	Credit with grade

Aim of the course

Learning models of time series and their forecasting methods.

Prerequisites

Probability Theory, Mathematical Statistics.

Scope

Lecture

1. Linear difference equations, polynomial characteristic; solution form; G-Transform (4 hours)
2. Time series as a stochastic proces and statistical data;Classical decomposition of time series; .Modelling of trend and seasonality; Smoothing methods (moving-avagrege, exponential smoothing, Holt method). *ex ante* and *ex post*. forecastings (4 hours.)
3. Linear time series: Autocovariance and autocorrelation function, weakly and strictly stationary time series, estimation of autocovariance and autocorrelation function, spectra properties of stationary models, periodogram and its relationship with estimation of autocovariance function; sampling spectrum; power spectrum and spectral density function; generating function of autocovariance; conditions of stationarity and invertibility. (8 hours.)
4. Autoreggresive models AR(p): stationarity and invertibility conditions, Autocorrelation; spectrum, Yule-Walker equations; Partial autocorrelation function; identification of models AR; estimation of parameters and forecasting. (4 hours.)
5. Moving average models MA(q): stationary and invertibility conditions, Autocorrelation function, spectrum, identyfication of models MA, estymation of parameters, forecasting. (4 hours.)
6. Mixed models of autoregression and moving average ARMA(p,q): stationarity and invertibility conditions; autocorrelation function; spectrum; identification of ARMA; forecasting (2 hours)
7. Linear stationary models ARIMA(p,d,q): representation in difference form, random impulses and inverse form, identification of models ARIMA, forecastings. (4 godz.)

Class

1. Solving difference equations. (4 hours.)
2. Smothing of time series (analytic and mechanics metods). (3 hours.)
3. Computing of seasonal indicators. (2 hours.)
4. Computing of ex post and ex ante forecasts. (3 hours.)
5. Verification of stability of linear filters. (4 hours.)
6. Verification of weak and strict stationarity of time series. (4 hours)
7. Computing of autocorrelation and partial autocorrelation function in models AR, MA, ARMA, ARIMA. (4 hours.)
8. Calculation of parameters of models using Yule-Walker equations. (2 hours)
9. Calculation of forecastings of models AR, MA, ARMA, ARIMA. (4 hours)

Laboratory

1. Polynomial models of trend. (3 hours)
2. Seasonal variation models. (2 hours)
3. Prediction based on trend and seasonall models. (3 hours)
4. AR(p) models. (4 hours)

5. MA(q) models. (4 hours)
6. ARMA(p,q) models. (4 hours)
7. Verification of stationarity of model: unit root test. (2 hours)
8. ARIMA(p,d,q) models. (4 godz.)
9. Procedurs of elimination of seasonality. (4 godz.)

Teaching methods

Lecture. Class. On laboratory – solving tasks using computer package GRETL, R.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Student can explain and verify the stability of unstability of linear filter	• K_U05	• a test • Current control in class	• Class
Student can determine a forecast based on the time series model.	• K_U13	• a test • Performance of laboratory reports	• Laboratory • Class
Student can determine a proper model of time series adapter to data and determine its parameters	• K_U13	• Performance of laboratory reports	• Laboratory
Student knows matematical models of time series and understand their applicability.	• K_W06	• a test	• Lecture
Student can calculate the function of autocorrelation and partial autocorrelation in ARMA models.	• K_U10	• a test • Current control in class	• Class

Assignment conditions

A student performs a report (laboratory) in which selects and solves a forecasting problem using time series models. The positive mark from laboratory is possible if the mark from report is positive. A student not attending to laboratory is not classified. Two tests (class) with mathematical tasks. The person not attending to class is not classified. One test (lecture) multiple choice.

Final mark O is a weighted average of marks from laboratory OL, from class OC and lecture OW, and is determined by the formula: O=0.4*OL+0.4*OC+0.2*OW.

Recommended reading

1. P. J. Brockwell, R. A. Davis, Introduction to time series and forecasting, Springer, New York, 2002.
2. G. Kirchgaessner, J. Wolters, *Introduction to modern time series analysis,* Springer, Berlin, 2007.
3. R. S. Tsay, *Analysis of Financial Time Series*, Wiley&Sons, New Jersey, 2005.

Further reading

1. G. E. P. Box, G. M. Jenkins, *Analiza szeregów czasowych. Prognozowanie i sterowanie*, PWN, Warszawa, 1983.
2. T. Kufel, *Ekonometria. Rozwiązywanie problemów z wykorzystaniem programu Gretl*, PWN, Warszawa, 2007.

Notes

Modified by dr Robert Dylewski, prof. UZ (last modification: 20-09-2019 11:51)