

## **Time Series (61201)**

**Instructors: E.IOANNIDIS**

Core Course, 2nd semester, 4 ECTS units

Course level: Graduate (MSc)

Language: Greek/English

### **Course Description**

The notion of stationarity, definition and properties of the autocovariance function of a stationary time series, test for white noise, Parametric and non-parametric estimation and elimination of the components of a time series, method of differences, statistical properties of the sample mean, estimates of the auto-correlation function and properties of their distribution, linear time series, prediction of a stationary time series and the partial auto-correlation function, Autoregressive moving average (ARMA) models for stationary time series, linear time series representation of an ARMA model and conditions for causality and invertibility, theorem of Wold, calculation of the ACF and the PACF of an ARMA model, estimating the parameters of an AR(p), asymptotic properties, efficiency, estimating the order of an ARMA model: AIC. Time series with a Unit root kai the Dickey-Fuller test. The spectral density of a stationary time series: definition, properties and interpretation. The spectral density of ARMA processes. Estimating the spectrum: the smoothed periodogram, statistical properties.

### **Prerequisites**

Basic knowledge of mathematical calculus, Linear algebra and Probability theory. Knowledge of Estimating and Testing and Linear Models and ability to apply them in data analysis. Basic knowledge of the R programming language.

### **Target Learning Outcomes**

Understand in depth the concepts, models and methods described in the syllabus: capability to respond to relevant theoretical questions and exercises. The ability to apply the methods taught in real data analysis.

### **Recommended Bibliography**

- Brockwell, P.J. and R.A. Davis (1996): *Introduction to Time Series and Forecasting*, Springer Verlag
- Brockwell, P.J. and R.A. Davis (1991): *Time Series: Theory and Methods, 2<sup>nd</sup> Edition*, Springer Verlag.
- Hamilton, J.D. (1994) : *Time Series Analysis*, Princeton University Press.
- Koopmans, L.H. (1974): *The Spectral Analysis of Time Series*, Academic Press.
- Brillinger, R. D. (1981): *Time Series: Data Analysis and Theory*, Holden Day.

**Teaching and Learning Activities**

One three-hour lecture per week and a one-hour per-week lecture in data analysis of time series with R. Study exercises and data analysis exercises with R as homework.

**Assessment and Grading Methods**

The final grade is the grade of the written (or/and oral) final examination increased by a percentage of 1.5 proportional to the performance in exercises to be submitted, provided that the final examination grade is at least 4/10. Otherwise, the final grade equals the final examination grade.