Universitat Autònoma de Barcelona

2018/2019

Time series

Code: 100124
ECTS Credits: 6

Degree	Type	Year	Semester
2500149 Mathematics	OT	4	0

Contact

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Use of languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Other comments on languages

Class metrial (slides and practical excercises) will be in english and/or spanish

Prerequisites

It is advisble to have knowledge on Probability, Statistical Inference and Linear models

Objectives and Contextualisation

A time series is a collection of observations of a random phenomenon evolving over time. Time series appear in almost all fields of application. Hence, its analysis and modelling of the underlying random phenomenon is of crucial theoretical and applied importance. This course is devoted to introduce the student to the study of basic time series models and its applications. The ultimate goal is the modelling of the mechanism that generates the data, perform model diagnostics and predict future values.

Skills

- Actively demonstrate high concern for quality when defending or presenting the conclusions of ones work.
- Develop critical thinking and reasoning and know how to communicate it effectively, both in ones own languages and in a third language.
- Effectively use bibliographies and electronic resources to obtain information.
- For the students to have developed the necessary learning skills to undertake further studies in a highly autonomous manner.
- For the students to have shown that they possess and understand knowledge in a study area on the basis of general secondary education and tend to have reached a level that, though supported by advanced textbooks, also includes some aspects that imply knowledge acquired from latest developments in their field of study.
- For the students to have the capacity to gather and interpret relevant data (normally within their field of study) in order to issue judgements that include considerations of relevant matters of a social, scientific or ethical nature.

- Formulate hypotheses and devise strategies to confirm or reject them.
- Use computer applications for statistical analysis, numeric and symbolic calculus, graphic display, optimisation or other purposes to experiment with Mathematics and solve problems.
- When faced with real situations of a medium level of complexity, request and analyse relevant data and information, propose and validate models using the adequate mathematical tools in order to draw final conclusions

Learning outcomes

1. Actively demonstrate high concern for quality when defending or presenting the conclusions of ones work.
2. Data analysis.
3. Develop critical thinking and reasoning and know how to communicate it effectively, both in ones own languages and in a third language.
4. Devise predictions and scenarios.
5. Effectively use bibliographies and electronic resources to obtain information.
6. Filter and store information on digital supports.
7. For the students to have developed the necessary learning skills to undertake further studies in a highly autonomous manner.
8. For the students to have shown that they possess and understand knowledge in a study area on the basis of general secondary education and tend to have reached a level that, though supported by advanced textbooks, also includes some aspects that imply knowledge acquired from latest developments in their field of study.
9. For the students to have the capacity to gather and interpret relevant data (normally within their field of study) in order to issue judgements that include considerations of relevant matters of a social, scientific or ethical nature.
10. Identify the stages of problems that require advanced technologies.
11. Use graphs to summarise multivariate data and show dynamical pictures.
12. Use multivariate data summary indexes, time series and all other advanced techniques.
13. Use quantitative thinking and reasoning.
14. Use statistical programs to manage databases.
15. Use statistical programs to obtain summarised indexes of study variables.
16. Validate and manage information for statistical treatment.

Content

1. **Introduction.** Classical anaysis of time series models. Trend an seasonality. Regression Models, Regression with AR(1) errors. Durbin Watson test.
2. **Filtering and smoothing.** Linear filterong. Local polynomials. Exponential smoothing. Differential filtering.
3. **Stationary Processes.** On the concept of stationarity Examples. Simulation of time series.
4. **ARIMA Models I.** MA(q) and AR(p). Correlograms.Yule-Walker equations. The difference operator. Relationship between MA snd AR models ACF and PACF.
5. **ARIMA** Models II. ARMA(p,q). Parameter estimation: method of moments, MLE, unconditional least squares, conditional least squares. ARIMA(p,d,q) and SARIMA. Box-Jenkins methodology. Predicction.
6. **Diagnostic checking and Forecasting.** AIC and BIC criteira. Analysis of residuals. Confidene intervals for predictions.
7. **Models for non-stationary series:** ARCH/GARCH**,** ARMA with covariants**.**

Methodology

During the theoretical lessons (2 H/week) the fundamental results will be presented, and computer excercises will be developed.

During the lab hours, students will solve by themselves real data problems. The programing language used is R.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Theoretical sessions	30	1.2	
Type: Supervised			
Lab sessions	30	1.2	
Type: Autonomous			
Personal Work	60	2.4	
Real data analysis	10	0.4	

Evaluation

During the course, studenst must handle computer labs. There will be a final examination in the lab and a theoretical exams as well.

In order to pass the course, a minimum of 3/10 in both prectice and theory is required, and an average over 5/10

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Homework (problems & computer excercises)	0,4	8	0.32	6, 4, 11, 10, 5, 14, 15, 16
Problems during classtime	0,2	2	0.08	2, 1, 3, 12, 13, 8, 7
exam	0,4	10	0.4	2, 1, 3, 12, 13, 8, 7, 9

Bibliography

P.J. Brockwell and R.A. Davis: *Introduction to Time Series and Forecasting*. 2nd edit. Springer, 2002.

J.D. Cryer and K.S. Chan: *Time Series Analysis with Applications to R*. 2nd. edit. Springer, 2008

R.D. Peña. *Anàlisis de series temporales*. Alianza Editorial. 2005.

R.H. Shumway, and D.S. Stoffer: *Time Series Analysis and its Applications.* 3rd. edit. Springer,2011.

R. Tsay Analysis of Financial Time Series, 3rd Edition, Wiley 2010