Universitat Autònoma de Barcelona

2019/2020

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

Teachers

Anna López Ratera

Prerequisites

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

Objectives and Contextualisation

This course is devoted to introduce the student to the study of basic time series models and its applications.

A time series is a collection of observations of a random phenomenon evolving over time (or any other ordered magnitude).

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.

The ultimate goal is the modelling of the mechanism that generates the data, perform model diagnostics and predict future values.

Competences

- 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.
- Formulate hypotheses and devise strategies to confirm or reject them.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- 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. Identify relationships or associations.
8. Identify the stages of problems that require advanced technologies.
9. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
10. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
11. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
12. Use graphs to summarise multivariate data and show dynamical pictures.
13. Use multivariate data summary indexes, time series and all other advanced techniques.
14. Use quantitative thinking and reasoning.
15. Use statistical programs to calculate sample sizes.
16. Use statistical programs to manage databases.
17. Use statistical programs to obtain summarised indexes of study variables.
18. 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. Stationary Processes. On the concept of stationarity Examples. Simulation of time series.
3. ARIMA Models I. MA(q) and AR(p). Correlograms.Yule-Walker equations. The difference operator. Relationship between MA snd AR models ACF and PACF.
4. 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.
5. Diagnostic checking and Forecasting. AIC and BIC criteira. Analysis of residuals. Confidence intervals for predictions.
6. Models for non-stationary series: ARCH/GARCH, ARMA with covariates.

Methodology

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

During the lab hours (with laptop) 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	

Assessment

During the course, studenst must handle computer labs. There will 2 partial exams, with both theoretical and practical questions.

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

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Homework (problems & computer excercises)	0,4	8	0.32	2, 6, 4, 12, 15, 13, 8, 7, 14, 5, 16, 17, 18
Partial	0,2	2	0.08	2, 1, 3, 13, 14, 11, 10
exam	0,4	10	0.4	2, 1, 3, 13, 14, 11, 10, 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