VNIVERSITAT DE VALÈNCIA

Course Guide
36519 Time Series Analysis and Forecasting

COURSE DATA

Data Subject	
Code	36519
Name	Time Series Analysis and Forecasting
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1332 - Degree in Business Intelligence and Analytics	Faculty of Economics	2	Second term

Subject-matter

Degree	Subject-matter	Character
1332 - Degree in Business Intelligence and Analytics	24 - Herramientas y Técnicas de Análisis de Datos	Obligatory

Coordination

Name	Department
ARRIBAS FERNANDEZ, IVAN	10 - Economic Analysis

SUMMARY

Forecasting with Time Data is a basic training subject assigned to the areas of Quantitative Methods for Economics and Business and Foundations of Economic Analysis. It is taught in the second term of the second year of the Degree in INTELLIGENCE AND BUSINESS ANALYSIS with a total of 6 ECTS credits.

The general objective is the training of professionals capable of applying the methods to analyze, describe, evaluate and especially make forecasts on data series that evolve over time, that is, Time Series models.

In particular, the student will have to respond to complex real problems, developing hypotheses, building models, applying statistical analysis techniques and all with the ultimate goal of developing predictions and knowing their quality as an aid to decision making.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

The course has no actual prerequisites. However, it is assumed that in order to successfully take this course the student has a basic level of mathematics (the knowledge that corresponds to first and second year of high school in the branch of science or social sciences) and is familiar with the contents of the subjects "Exploratory Data Analysis" and "Chance, Uncertainty and Inference" taken in first year, and "Prediction with Transverse Data" taken in the first term of second year.

OUTCOMES

1332 - Degree in Business Intelligence and Analytics

- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- Acquire basic training that can be used to learn new methods and technologies and to adapt to new situations in academic and professional areas.
- Be able to solve problems and to communicate and spread knowledge, skills and abilities, taking account of the ethical, egalitarian and professional responsibility of the activity of business intelligence and analytics.
- Be able to make autonomous decisions in digital environments characterised by the abundance and dynamism of data.
- Know and know how to properly use the appropriate quantitative and qualitative methods to reason analytically, evaluate results and predict economic and financial magnitudes.
- Be able to apply analytical and mathematical methods for the analysis of economic and business problems.
- Demonstrate skills for analysis and synthesis.
- Be able to learn autonomously.
- Be able to define, solve and present complex problems systemically.

- Apply methods and techniques of analysis, synthesis and graphical representation by means of software tools.
- Use software tools to solve problems under uncertainty.
- Distinguish between the explanatory and predictive approaches in data analysis and in business.
- Make predictions using appropriate software tools to manage time series.
- Apply supervised machine learning techniques using software.

LEARNING OUTCOMES

- Knowing how to apply different methods and techniques of temporal data analysis through computer programs.
- Knowing and differentiating the components of a time series.
- Learn how to extract unobserved components from time series, how to interpret them and how to make projections of them.
- Know the theoretical basis of ARIMA modelling and its application through computer software.
- Know how to make predictions of economic time variables.
- Know how to incorporate calendar variations in predictive models.
- Learn to value the predictive capacity of methods according to the prediction horizon.
- Know how to use the software for the implementation of automatic learning models.
- Know the potentialities and weaknesses of the different predictive techniques in machine learning, as well as their application to different business problems.
- Know the problems of over-parameterization and the role of training and testing sets.
- Know how to solve business problems using automatic learning methodologies and to know how a recommendation system works.

DESCRIPTION OF CONTENTS

1. Introduction

Forecasting
Forecasting methods
What will we do and what will we not do in this course?

2. Definitions and components

Time Series
Components of a time series and their combination
Manipulation of a time series
Decomposition of a series

3. Naive prediction methods

Introduction
Quality criteria
Simple prediction methods
Evaluation of predictions

4. Moving averages methods

Introduction
Simple moving average for series without trend (or seasonality)

5. Exponential smoothing methods

Introduction
Components of a series in the context of exponential smoothing
Possible cases
Simple exponential smoothing (N, N)
Holt exponential smoothing (A, N)
Exponential smoothing with damped slope (Ad, N)
Additive (A, A) and multiplicative Holt-Winters smoothing (A, M)
Example with logarithmic transformation
General cases of exponential smoothing

6. ARIMA process

Introduction
Stochastic process
Transformations of a series
Autocorrelation function
ARIMA processes
Box-Jenkins approximation

7. Seasonal Arima models

Introduction
ARIMA processes with seasonality

WORKLOAD

ACTIVITY	Hours	% To be attended
Computer classroom practice	45,00	100
Theory classes	15,00	100
Development of group work	15,00	0
Study and independent work	30,00	0
Preparation of evaluation activities	30,00	0
Preparation of practical classes and problem	15,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The development of the course is structured fundamentally around the differentiated theoretical and practical sessions, being the theoretical ones of 1 hour per week (25%) and the practical ones of 3 hours per week (75%). The methodology, therefore, emphasizes the more practical and computational aspects of the subject.

- Theory lessons: core concepts of each subject will be presented in a precise and rigorous way, in natural, graphic and formal language.
- Practice lessons: from the R code and the data files, the theoretical concepts seen will be practiced and the handling of R for the analysis of time series will be learned.

For the proper course of the classes it is essential that students bring their own laptop to work both in theory and practice classes.

EVALUATION

Continuous assessment will account for 80% of the subject's grade and the **final assessment exam for 20%**

- After each of the thematic units, a **test** will be carried. The test will contain multiple choice questions, numerical, etc. This part will account for 40% of the course grade.
- Students will carry out **works of practical application** of the concepts seen during the course. The total of works will suppose a 40% of the note of the subject.
- At the end of the course and on the official dates, there will be a **final exam** that will account for 20% of the course grade.

REFERENCES

Basic

- Dos libros interesantes:
  * Forecasting: Principles and Practice de Rob J. Hyndman y George Athanasopoulos: https://otexts.com/fpp2/ (existe una version fpp3 que aplica el entorno 'tidy')
  * An Introduction to Statistical Learning with Applications in R de Gareth, Witten, Hastie y Tibshirani. Springer New York 2013

  Otros libros de interés:
  * Hyndman, R. J., Koehler, A., B., Ord, J. K. y Snyder, R. D. (2008) Forecasting with Exponential Smoothing: the State Space Approach. Ed. Springer.
  * Machine Learning Using R With Time Series and Industry-Based. Use Cases in R. Ramasubramanian y Singh. Apress, 2019

  Libros de R y Series Temporales:
  * Cowpertwait, P. S. P. y Metcalfe, A. V. (2009) Introductory Time Series with R. Springer (Collection Use R!)
  * Pfaff, B. (2008) Analysis of Integrated and Cointegrated Time Series with R. Springer (Collection Use R!)
  * Cryer, J. D., Chan, Kung-Sik. (2008) Time Series Analysis. With Applications in R. Springer

  Dos clásicos:
  * Makridakis, S. y Hibon, M. (2000). The M3-Competition: results, conclusions and implications. International Journal of Forecasting, 16(4), pp. 451476. doi:10.1016/S0169-2070(00)00057-1
  * Box, G. E.P. y Jenkins, G. (1976). Time Series Analysis: Forecasting and Control Editado por Holden-Day, San Francisco, CA