Course Guide

36519 Time Series Analysis and Forecasting

# COURSE DATA

## DATA SUBJECT

**Code:** 36519
**Name:** Time Series Analysis and Forecasting
**Cycle:** Undergraduate Studies
**ECTS Credits:** 6
**Academic year:** 2026-27

## STUDY (S)

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1332 - Degree in Business Intelligence and Analytics | Facultat d'Economia | 2 | Second quarter |

## SUBJECT-MATTER

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

## COORDINATION

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# 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.

# COMPETENCES / LEARNING OUTCOMES

## 1332 - Degree in Business Intelligence and Analytics

Acquire basic training that can be used to learn new methods and technologies and to adapt to new situations in academic and professional areas.

Apply methods and techniques of analysis, synthesis and graphical representation by means of software tools.

Apply supervised machine learning techniques using software.

Be able to apply analytical and mathematical methods for the analysis of economic and business problems.

Be able to define, solve and present complex problems systemically.

Be able to learn autonomously.

Be able to make autonomous decisions in digital environments characterised by the abundance and dynamism of data.

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.

Demonstrate skills for analysis and synthesis.

Distinguish between the explanatory and predictive approaches in data analysis and in business.

Know and know how to properly use the appropriate quantitative and qualitative methods to reason analytically, evaluate results and predict economic and financial magnitudes.

Make predictions using appropriate software tools to manage time series.

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.

Use software tools to solve problems under uncertainty.

## DESCRIPTION OF CONTENTS

### 1. Introduction

Introductory topic where we will motivate the subject, focus its objectives and delimit the scope of the contents of the course.

### 2. Definitions and components

Core topic where we will define the concept of time series and its components: trend, cycle, seasonality, intervention and residual. In addition, we will propose simple tools to be able to identify the components of a given series and to be able to describe them adequately. Depending on the components present in a series, we will apply the techniques that we will see in topics 4, 6, 7 and 8.

### 3. Prediction methods

In this topic we will describe the main forecasting techniques that we will use in the course: simple methods, smoothing models and ARIMA models. In addition, we will indicate the main advantages and disadvantages of each method. We will have time during the course to go deeper into these methods.

### 4. Series without trend and seasonality

We will apply the forecasting techniques described in topic 3 to the simplest series, those without trend or seasonality. In addition, we will define the goodness-of-fit and forecasting criteria that we will use during the course.

### 5. Evaluation of predictions

There are two different approaches to assess forecasts: Training Set/Test Set and Rolling forecast origin. In this topic we will describe them and apply them to different examples.

### 6. Series with trend and without seasonality

We are going to apply the forecasting techniques described in topic 3 to series that have a trend but no seasonality, adding a degree of complexity to the methods seen in topic 4.

## 7. Series with seasonality (first part)

The series with seasonality are the most complex to analyse and predict, so we are going to divide their study into two parts. In this first one we will see how to predict them using the simple and smoothing methods.

## 8. Series with seasonality (second part)

We finish the course by applying the ARIMA models to the prediction of series with seasonality.

# WORKLOAD

## PRESENCIAL ACTIVITIES

| Activity | Hours |
|---|---|
| Theory | 15,00 |
| Computer classroom practice | 45,00 |
| **Total hours** | **60,00** |

## NON PRESENCIAL ACTIVITIES

| Activity | Hours |
|---|---|
| Attendance at other activities | 0,00 |
| Individual or group project | 15,00 |
| Independent study and work | 30,00 |
| Preparation of lessons | 15,00 |
| Preparation for assessment activities | 30,00 |
| Resolution of case studies | 0,00 |
| **Total hours** | **90,00** |

# 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

Two interesting books:

- 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

Other books of interest:

- 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

R Books and Time Series:

- 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

Two classics:

- Makridakis, S. y Hibon, M. (2000). The M3-Competition: results, conclusions and implications. International Journal of Forecasting, 16(4), pp. 451¿476. 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