# Time Series Analysis

**Academic Year: ( 2022 / 2023 )** **Review date: 17-05-2022**

**Department assigned to the subject: Statistics Department**

**Coordinating teacher: MARIN DIAZARAQUE, JUAN MIGUEL**

**Type: Electives ECTS Credits : 3.0**

**Year : 1 Semester : 2**

## REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Probability
Statistical Inference
Programming in R

## OBJECTIVES

COMPETENCES THAT THE STUDENT ACQUIRES WITH THIS SUBJECT

CB6 Possess and understand the knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
CB7 That students know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of ¿¿study
CB8 That students are able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments
CB9 That students know how to communicate their conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous way
CB10 That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.
CG1 Ability to apply information analysis and representation techniques, in order to be able to adapt it to real problems.
CG2 Ability to identify the most appropriate statistical model for each real problem and know how to apply it to its analysis, design and solution.
CG3 Ability to obtain scientifically viable solutions for complex real statistical problems, both individually and in teams.
CG4 Ability to synthesize the conclusions obtained from these analyzes and present them clearly and convincingly in a bilingual environment (Spanish and English) both in writing and orally.
CG5 Be able to generate new ideas (creativity) and anticipate new situations, in the context of data analysis and decision making.
CG6 Apply social skills for teamwork and to relate to others autonomously.
CG7 Apply advanced techniques of analysis and representation of information, in order to be able to adapt it to real problems.
CE1 Apply in the development of analysis methods for real problems, advanced knowledge of statistical inference.
CE2 Use free software such as R and Python to implement statistical analysis.
CE5 Apply advanced statistical foundations for the development and analysis of real problems, which involve the prediction of a response variable.
CE7 Apply optimization techniques in the estimation of faces in complex sample models
CE9 Correctly identify the type of statistical analysis corresponding to certain objectives and data.
CE10 Apply statistical modeling in the treatment of relevant problems in the scientific field.
CE12 Apply models for supervised and unsupervised learning.
CE13 Model complex data with stochastic dependency.

LEARNING RESULTS THAT THE STUDENT ACQUIRES

Knowledge acquisition of:
1) univariate time series models;
2) multivariate time series models.

## DESCRIPTION OF CONTENTS: PROGRAMME

1. Basic concepts in Time Series Analysis.
1.1. Random samples and properties of time series.
1.2. Decomposition of a time series: trend, seasonality, cycle and noise.
1.3. Stationary transformations for trend and seasonal.
1.4. Deterministic and stochastic components.

2. Machine learning methods in time series
2.1 Introduction to neural network models
2.2 Applications of neural networks in time series
2.3 Modeling and prediction of time series with machine learning methods

3. Linear Univariate ARIMA models.
3.1. Sationarity and differencing.
3.2. Autocorrelation function and its estimation.
3.3. Autoregressive models AR(p).
3.4. Moving Average models MA (q).
3.5. Non seasonal ARIMA models.
3.6. Estimation and order of selection.
3.7. Forecasting.
3.8. Seasonal ARIMA models.

4. Multivariate time series
4.1. Time series regression.
4.2. VAR models.
4.3. Cointegration.
4.4. Forecasting properties.

## LEARNING ACTIVITIES AND METHODOLOGY

MD1 Lectures in the teacher's class supported by computer and audiovisual media, in which the main concepts of the subject are developed and the bibliography is provided to complement student learning.
MD3 Resolution of practical cases, problems, etc. raised by the teacher individually or in a group
MD5 Preparation of work and reports individually or in groups

## ASSESSMENT SYSTEM

SE2 Individual or group works done during the course (100%)

| | |
|---|---|
| **% end-of-term-examination:** | 40 |
| **% of continuous assessment (assigments, laboratory, practicals…):** | 60 |

## BASIC BIBLIOGRAPHY


- Brockwell P.J. and Davis R.A. Introduction to Time Series and Forecasting., Springer., 2002
- Enders W. Applied Econometric Time Series., Wiley, 2015
- Hamilton J. Time Series Analysis., Princeton University Press, 1994
- Lazzeri, F Machine Learning for Time Series Forecasting with Python, Wiley, 2020
- Mills T.C.  The Econometric Modelling of financial Time Series., Cambridge University Press, 1999


## BASIC ELECTRONIC RESOURCES

- . Introduction to Time Series Analysis and Forecasting in R: https://bookdown.org/singh_pratap_tejendra/intro_time_series_r
- . Using R for Time Series Analysis: https://a-little-book-of-r-for-time-series.readthedocs.io/en/latest/src/timeseries.html
- . Time Series Analysis in Python: https://www.machinelearningplus.com/time-series/time-series-analysis-python