COURSE DATA

Data Subject	
Code	36418
Name	Time series
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1400 - Degree in Computer Engineering	School of Engineering	4	First term
1406 - Degree in Data Science	School of Engineering	3	First term

Subject-matter

Degree	Subject-matter	Character
1400 - Degree in Computer Engineering	16 - Optional subject	Optional
1406 - Degree in Data Science	6 - Statistical Modelling	Obligatory

Coordination

Name	Department
CORBERAN VALLET, ANA	130 - Statistics and Operational Research

SUMMARY

The subject *Series Temporales* is a compulsory subject taught in the first semester of the third year of the Degree in Data Science. This course has two main objectives: to provide students with knowledge and understanding of the different types of data that make up a time series, as well as their main properties, and to provide practical knowledge of the main models and techniques to explain the evolution of a variable of interest over time and predict its future values.

Thus, after an introduction where the concept of times series is formalized and the descriptive analysis of a time series is discussed, some of the main univariate models for time series analysis are presented: exponential smoothing, ARIMA models, GARCH and NARX models.

The theoretical classes will be taught in Spanish and the practical classes as stated in the course guidelines available on the website for this degree.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

For an adequate follow-up of this subject, it is recommended to have knowledge about the foundations of probability and inference that are acquired in the subjects Probabilidad y simulación (1st year), Inferencia estadística (2nd year) and Modelos lineales (2nd year.)

OUTCOMES

1400 - Degree in Computer Engineering

- C3 - Ability to recognise and develop computational learning techniques and to design and implement applications and systems that use them, including those for the automatic retrieval of information and knowledge from large volumes of data.
- Capacidad para participar activamente en la especificación, diseño, implementación y mantenimiento de los sistemas de información y comunicación.

1406 - Degree in Data Science

- (CG01) Knowledge of basic subjects and technologies that enable students to learn new methods and technologies, and to provide them with versatility to adapt to new situations.
- (CG05) Analysis and synthesis capability in the preparation of reports and in the defence of ideas.
- (CT01) To be able to access (bibliographical) information tools and appropriately use them in the development of their daily tasks.
- (CT03) Ability to defend your own work with rigor and arguments and to expose it in an adequate and accurate way with the use of the necessary means.
- (CE09) To methodologically know and apply the concepts and techniques of probability and statistics necessary for the extraction of useful knowledge from data analysis.
- (CE15) Ability to model and analyse the uncertainty in data-based studies, as well as to know how to interpret and contextualise the results obtained.
- (CB4) Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- (CB5) Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

LEARNING OUTCOMES

- Know the concept of time series. (Competencies CB4, CB5, CG1, CT1, CE9, CE15)
- Know the concepts of location, trend and seasonality. (Competencies CB4, CB5, CG1, CT1, CE9, CE15)
- Know the different methods and models to analyze time series. (Competencies CB4, CB5, CG1, CT1, CE9, CE15)
- Understand the fluctuations of a time series in relation to its conditioned mean and variance. (Competencies CB4, CB5, CG1, CT1, CE9, CE15)

DESCRIPTION OF CONTENTS

1. Introduction to time series

1.1. Concept of time series.
1.2. Descriptive analysis of a time series.
1.3. Components of a time series.
1.4. Stochastic processes.

2. Exponential smoothing models

2.1. Simple exponential smoothing.
2.2. Double exponential smoothing: Holts model.
2.3. Triple exponential smoothing: Holt-Winters model.
2.4. Diagnosis of the model.

3. ARIMA models

3.1. Autoregressive process (AR).
3.2. Moving average process (MA).
3.3. Autoregressive and moving average model (ARMA).
3.4. Autoregressive integrated moving average model (ARIMA).
3.5. Seasonal ARIMA process.
3.6. Estimation and selection of ARIMA models.
3.7. Diagnosis of the model.

4. Other models

4.1. ARCH model.
4.2. GARCH model.
4.3. NAR and NARX models.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	32,00	100
Laboratory practices	20,00	100
Classroom practices	8,00	100
Development of group work	10,00	0
Development of individual work	5,00	0
Study and independent work	15,00	0
Readings supplementary material	10,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	20,00	0
Preparation of practical classes and problem	10,00	0
Resolution of case studies	10,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

MD1 – Theoretical activities. Expository development of the subject with the participation of the students in the resolution of specific questions. In the theoretical sessions, the content of the subject will be developed, encouraging student participation in the class all the time. (Competency CG1)

MD2 – Practical activities. Learning through problem solving and the analysis of case studies, which enable acquisition of skills on different aspects of the subject. (Competencies CB4, CB5, CT1, CT3, CE9, CE15)

MD3 – Laboratory and/or computer classroom work. Learning through activities carried out in small groups in laboratories and/or computer classrooms. Each working group will analyze different time series with the methodology presented in the theoretical sessions using the statistical software R. They will have to present a report of results at the end of the semester. Emphasis will be placed on the advantages and limitations of the studied techniques. (Competencies CB4, CB5, CG5, CT1, CT3, CE9, CE15)

The virtual classroom of the Universitat of València (*Aula Virtual*) will be used to support communication with students. In particular, students will have access to all the educational material and it will serve as a repository for the tasks that have to be delivered.

EVALUATION

In the first call, the course will be evaluated according to three aspects:

- SE1: Objective test, which will be carried out at the end of the teaching period. It will consist of theoretical and practical questions and problems. This section of the evaluation will count 50% of the final grade of the course. The minimum grade that must be obtained in this section, to compensate with the other sections, is 5 out of 10. (Evaluation of competencies CB4, CB5, CG1, CE9, CE15).
- SE2: Evaluation of practical activities based on the final report of results. This section of the evaluation will count 35% of the final grade of the course. The minimum grade that must be obtained in this section, to compensate with the other sections, is 5 out of 10. (Evaluation of competencies CB4, CB5, CG1, CG5, CT1, CT3, CE9, CE15).
- SE3: Continuous evaluation of each student, based on the resolution of regularly proposed questions. This section of the evaluation will count 15% of the final grade of the course and it cannot be retaken. (Evaluation of competencies CB5, CG1, CE9, CE15).

In the second call, the objective test will be retaken (SE1). The practical activities (SE2) will be re-evaluated via an individual practical exam carried out in conditions equivalent to those of a practical assignment, but with time limitation. For the continuous evaluation (SE3), the grades obtained throughout the course will be used, as this component cannot be retaken. The three blocks of the evaluation will be weighted with the same percentages as in the first call, and the minimum grades for blocks SE1 and SE2 will remain the same.

In any case, the evaluation system will be governed by the Regulations of Evaluation and Qualification of the University of Valencia for bachelor's and master's degrees.
(https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639)

REFERENCES

Basic

- D. Peña (2010) Análisis de series temporales (2a edición). Alianza Editorial.
- P.S.P. Cowpertwait and A.V. Metcalfe (2009) Introductory time series with R. Springer.
- R.J. Hyndman and G. Athanasopoulos (2018) Forecasting: principles and practice (2nd Edition). OTexts: Melbourne, Australia. https://otexts.com/fpp2/

Additional

- C. Chatfield and H. Xing (2019) The analysis of time series: An introduction with R (7th edition). Chapman & Hall / CRC.