COURSE DATA

DATA SUBJECT

Code: 36520
Name: Advanced Forecasting Techniques in Business
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	3	First quarter

SUBJECT-MATTER

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

COORDINATION

MONTORO PONS JUAN DE DIOS

SUMMARY

Advanced Prediction Techniques in Business is a compulsory subject assigned to the area of Quantitative Methods for Economics and Business which is part of the Data Analysis Tools and Techniques subject taught in the first term of the third year of the Degree in BUSINESS INTELLIGENCE AND ANALYTICS, with a total workload of 6 ECTS credits.

In a degree that aims to develop professionals with comprehensive business knowledge and who are capable of exploring and exploiting, with a business vision, the growing data flows (both internal and external) that the new digital reality is providing, a subject such as Advanced Prediction Techniques in Business is fundamental. With billions of data produced daily and with our ability to collect and store them increasing faster than our ability to analyse them, being able to extract value by building (semi-) automatic predictive models for a correct decision-making and definition of business actions is a competency that new graduates clearly need.

Being able to combine the creative potential of the human being and flexibility of thought in a process guided by knowledge, coupled with the storage and computer processing capacity available, allows us to find new opportunities and solutions to the most complex problems through a well-informed decision-making process. Having instruments with which to support the production, creation and analysis of

predictions, thereby allowing the generation of new business models or getting more out of current businesses, enables opportunities to be exploited and adequately monetised, extracting value from new tools and algorithms.

This subject addresses the most advanced prediction methods and their application in the company and business environment. Understanding the prediction philosophy based on machine learning methods and being able to apply the available algorithms to different problems associated with the business environment is part of the basic skills acquired through this subject. Compression at a higher level to be able to adapt current algorithms to new realities, data sets or specific problems will be part of the deeper understanding acquired through this subject.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

There are no specified enrolment restrictions in relation to other subjects of the curriculum.

Although no restrictions have been established, it is assumed that in order to successfully study this subject the student has previously studied the contents of the subjects Exploratory Data Analysis and Databases, Chance, Uncertainty and Inference, Data Mining in Business, Forecasting with Temporal Data and Forecasting with Cross-Sectional Data.

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 analyse and search for information from diverse sources.

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 plan, organise, monitor and evaluate the implementation of business strategies.

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 use ICT, both in academia and in professional practice.

Be able to work in a team demonstrating commitment to quality, ethics, equality and social responsibility.

Demonstrate skills for analysis and synthesis.

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

Express situations of uncertainty and randomness using mathematical, synthetic and graphic languages.

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

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.

Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.

Use software tools to solve problems under uncertainty.

DESCRIPTION OF CONTENTS

1. Machine Learning
• Supervised, unsupervised, and semi-supervised learning
• Reinforcement learning
• The bias-variance tradeoff
• Parametric and non-parametric models
• Complexity and overfitting
• Gradient descent and stochastic gradient descent

2. Model Selection and Evaluation
• The predictive approach: training/test error
• Resampling methods: validation, LOOCV, and k-fold CV
• Regularization: parameters and hyperparameters
• Model selection in classification
• Classification with imbalanced data

3. Generalized Linear Model (GLM)
• Components of a GLM
• Types of GLMs
• Regularization in generalized linear models
• Generalized additive models (GAMs)
• Practical application: nonlinearities in predictors

4. Ensemble Methods
• Bootstrap (resampling)
• Bagging
• Random forests
• (Extreme) Gradient boosting
• Other ensemble methods: voting and stacking

5. Introduction to Deep Learning
• Neural networks
• The multilayer perceptron (feed-forward neural network)
• Backpropagation
• Recurrent neural networks (RNNs)
• Convolutional neural networks (CNNs)

6. Other Prediction Techniques
• Generative models for classification: Naive Bayes, LDA, and QDA
• Support vector machines (SVMs) for regression and classification
• KNN

7. Prediction and Causal Effects
• Prediction problems vs. causal problems
• Causal models: directed acyclic graphs
• Types of data
• Individual effects and average effects
• Predicting individual effects with machine learning techniques: meta-learners and causal forests (or generalized random forests)

8. Recommender Systems
• Objectives of a recommender system
• Types of recommender systems
• Validation
• Applications

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	35,00
Independent study and work	35,00
Preparation of lessons	0,00
Preparation for assessment activities	5,00
Resolution of case studies	15,00
Total hours	**90,00**

TEACHING METHODOLOGY

The subject is fundamentally structured around practical sessions where, via the resolution of practical examples, the theoretical content of the theory classes will be introduced, established and reinforced.

In the theory sessions, with a weekly duration of 1 hour, the main content of the topics that make up the subject will be presented, introducing the relevant elements and concepts and contextualizing them with respect to the different prediction problems within a business environment and applied to the world of business. The predominant teaching method in the theory classes will be the participatory master class.

In the practical sessions, which have a duration of 3 hours, the teacher will propose situations (real or fictitious) of problems or case studies that the students must solve with the application of techniques and use of appropriate computer programs, carrying out, if appropriate, oral presentations or debates, individually and/or in teams. In the practical classes, projects and situations will be proposed that the students will have to solve by delivering the determined outputs within a given time.

EVALUATION

The subject will be evaluated through the following tripartite procedure:

1. Assessment based on a final exam that will cover both theoretical and practical aspects.

2. Evaluation of the practical activities carried out by the student during the course. Activities may be individual or group-based. Students will prepare academic papers or reports and may be required to give oral presentations in which they defend the arguments developed in their written work.

3. Continuous assessment of each student, based on their participation and level of engagement in the teaching-learning process. This includes regular attendance at scheduled in-person activities and the completion of periodically assigned questions and problems.

Continuous assessment and the evaluation of practical activities (items 2 and 3) are not eligible for retake.

The percentages assigned to each item will be specified in the syllabus at the beginning of the term.

REFERENCES

Aggarwal, C.C. (2016) Recommender Systems: The Textbook. Springer

Aggarwal, C.C. (2020) Linear Algebra and Optimization for Machine Learning. Springer

Aggarwal, C.C. (2018) Neural networks and deep learning: A textbook. Springer

James, G., Witten, D., Hastie, T. and Tibshirani, R. (2023) *An Introduction to Statistical Learning: With Applications in Python*. Springer International Publishing.

Kuhn, M., and Johnson, K. (2013). *Applied Predictive Modeling* (1st ed. 2013.). Springer New York.

Hastie, T., Tibshirani, R. and Friedman, J. (2016) *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Springer.

Theobald, O. (2024). *MACHINE LEARNING: make your own recommender system*. Packt Publishing Ltd.

Wickham, H., Çetinkaya-Rundel, M., and Grolemund, G. (2023). *R for data science: import, tidy, transform, visualize, and model data* (2nd edition). O'Reilly.