COURSE DATA

DATA SUBJECT

Code: 36504
Name: Probability, Uncertainty, and Inference
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1332 - Degree in Business Intelligence and Analytics	Facultat d'Economia	1	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1332 - Degree in Business Intelligence and Analytics	Fundamentos del Análisis de Datos	BASIC

COORDINATION

MARTINEZ VERDU ROSARIO

SUMMARY

"Randomness, Uncertainty and Inference" is a basic training subject assigned to the area of ¿¿Quantitative Methods for Economics and Business that is taught in the second semester of the first year of the Degree in INTELLIGENCE AND BUSINESS ANALYTICS with a total teaching load of 6 ECTS credits.

Within the framework of a degree clearly oriented to train business professionals with deep knowledge of the analysis and process of large volumes of information it is necessary to provide the student with adequate knowledge in the main methods of statistical inference.

In another order of things, the usual situation of uncertainty and / or incompleteness of information regarding both the environment and business development makes it necessary for future professionals to be able to deal adequately with these situations.

Without losing sight of the eminently practical orientation that the degree inspires, the course considers a rigorous journey of both the main aspects of the treatment of chance and uncertainty, through Probability and the main Distributions of random variables, as well as aspects basics of random sampling and Statistical Inference.

In the development of these questions, it will always be intended, and in keeping with the objectives of other subjects, to keep in mind the practical applicability in the exploitation of the available information, the relations with the analysis of information and the automation of the methods of analysis resulting in the continued appeal to computer simulation and the exploitation of information; trying at all times the application to practical situations in the business world.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

No prerequisites. It is assumed that to successfully complete this subject the student has a basic level of mathematics (the knowledge corresponding to first and second year of baccalaureate in the branch of science or social sciences) is familiar with the contents of the subject. Exploratory Data Analysis previously and has already acquired some of the competencies previously programmed on information management and the use of ICT.

COMPETENCES / LEARNING OUTCOMES

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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.

Be able to access and manage information in different formats for subsequent analysis in order to obtain knowledge through data.

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 produce models, calculations and reports, and to plan tasks in the specific field of business intelligence and analytics.

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.

Communicate the results of analyses effectively.

Demonstrate skills for analysis and synthesis.

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

Identify the basic probability distributions encountered in real problems.

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

Know the different types of data.

Make decisions under certainty and uncertainty.

Manage and distinguish the concepts of universe, population, sample, parameters and estimators in real problems.

Reorganise and restructure variables and databases.

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 acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

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. UNCERTAINTY AND PROBABILITY

1.1. Introduction. Chance and uncertainty.
1.2. Frequentist Probability and Subjective conception. Uncertainty Indicators
1.3. Probability of events. Axiomatics Properties
1.4. Conditioned Probability . Stochastic independence. Bayes theorem

2. RANDOM VARIABLE

2.1. Random variables. Probability distributions.
2.2. Discrete and continuous distributions.
2.3. Expected value and variance. Indicators. Transformations. Tchebychev's inequality.

3. MAIN PROBABILITY DISTRIBUTIONS

3.1. Discrete models.
3.2. Continuous models. Normal distribution
3.3. Central limit theorem
3.4. Distributions derived from Normal.
3.5. Functions in R

4. INTRODUCTION TO STATISTICAL INFERENCE AND SAMPLING DISTRIBUTIONS

4.1. Introduction to Inference. General concepts: universe, population and sample.
4.2. Sampling. Types.
4.3. Statistics and associated distributions.
4.4. Computer simulations.

5. ESTIMATION

5.1 Point estimation: estimators and estimates. Properties of estimators.
5.2 Estimation methods . Maximum-likelihood estimators.

5.3 Confidence intervals. Main confidence intervals.
5.4 Sample size determination.
5.5 Computer applications and visualization.

6. HIPOTHESIS TESTING

6.1. Statistical test of hypothesis: basic concepts. Null and alternative hypothesis. Significance, power and p-value
6.2. Main parametric contrasts. Two tails and one tail hypothesis tests.
6.3. Main non-parametric contrasts. Goodness of fit, independence and homogeneity.
6.4. Statistical significance and practical significance

7. ANALYSIS OF VARIANCE

7.1. Approach of the issue. One way Anova . Decomposition of variance. Hypothesis contrast.
7.2. Multiple comparisons Criteria
7.3. Extension to more than one way anova.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Computer classroom practice	30,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	20,00
Preparation of lessons	20,00
Preparation for assessment activities	10,00
Resolution of case studies	20,00
Total hours	**90,00**

TEACHING METHODOLOGY

The subject development is mainly structured around the theoretical and differentiated practical sessions of two hours in both cases. In the theoretical sessions the professor will explain the concepts and methods of application to the analysis of situations that imply uncertainty without neglecting the applications and the essential aspects of the use and implementation through the adequate Software (R/RStudio, Caest, SPSS / PSPP , Excel, etc.) complementing the applications with situations and practical examples. The practical sessions will mean, instead, the student's use of these tools, concepts and methods to solve practical questions under the tutelage of the teacher.

The predominant teaching method in the theoretical classes will be the participatory master class. This methodology makes it possible to manage large groups of students in an organized manner, offering the advantages of a master class without limiting the participation of students and the teacher-student interaction. Attempt to encourage participation and discussion in the class, in order to offer the student a direct involvement with the content.

In the practical sessions, of two hours, the teacher will propose to the students situations (real or fictitious) for the resolution of problems or studies of cases that these will have to solve with application of techniques and use of suitable computer programs, realizing if it is pertinent, oral presentations or debates ..., individually and / or as a team. In the practical classes projects and situations will be proposed that the students will have to solve delivering in time and form the outputs that are determined.

EVALUATION

The assessment of the subject will be carried out taking into account a final exam at the end of the four-month period and continuous assessment:

1.- The final exam will consist of theoretical-practical questions, some of them with the help of computer programmes, which will make it possible to assess whether the student has assimilated the key concepts of the subject. The final exam will account for 70% of the final mark.
2.- Continuous assessment aims to develop students' competences and stimulate daily work. Therefore, this part of the evaluation will be based on a periodic assessment of the monitoring of the subject. Continuous assessment will account for 30% of the final mark. The continuous assessment tests and/or activities **can not be retaken**.

The final mark for the course will be calculated using the following weighted average:
Final mark = final exam mark x 0,7 + continuous assessment mark x 0,3.

- No student will get a positive assessment of the course (5 points or more) without passing the final exam.

- Students who fail the final exam will get a maximum final grade of 4.5 points.

- Students who do not take the continuous assessment will have to obtain a minimum of 7 out of 10 points in the final exam in order to pass the course.

The evaluation system applies to both the first and the second call.

The Use of Artificial Intelligence for Evaluation Purposes

Intellectual honesty is a core value in academic communities and essential for the fair assessment of students' work. The use of generative artificial intelligence (ChatGPT or other similar tools) will not be allowed in the final exam of the course. Furthermore, it should be taken into account that the use of AI has limitations such as the following:

- If low-effort prompts are provided, the results obtained will be of low quality. Achieving good results requires effort.

- Artificial intelligence is not a magic solution to all problems, nor is it infallible. It may exhibit bias and is capable of producing errors. Furthermore, as it draws upon a wide range of sources—many of which may lack reliability—it may not correspond precisely to the material covered in class. You are, therefore, responsible for any inaccuracies or omissions that may arise from its use.

REFERENCES

Básica

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- Esteban, J. y otros (2006). Estadística Descriptiva y nociones de probabilidad. Paraninfo: Madrid.
- ESTEBAN GARCÍA, et al (2018): Inferencia Estadística (2ª edición revisada). Ed. Garceta. Madrid.
- Murgui, S. y otros (2002). Ejercicios de Estadística. Economía y Ciencias Sociales. Valencia: Tirant lo Blanch.
- Newbold, P. y otros (2008). Estadística para Administración y Economía. Madrid: Pearson-Prentice Hall, (6ª Edición).

Complementaria

- Chi, Y. : R Tutorial e-book http://www.r-tutor.com/elementary-statistics/probability-distributions
- Coll Serrano, V. (2024). Introducción al Análisis Exploratorio de Datos. Aplicaciones con R y datos reales. Leanpub. https://leanpub.com/analisis_exploratorio_datos_con_R
- - Crawley, M.J.: The R book https://www.cs.upc.edu/~robert/teaching/estadistica/TheRBook.pdf
- Escuder, R. y Murgui, J.S. (2011). Estadística Aplicada. Economía y Ciencias Sociales. Tirant lo Blanch. Valencia, (2ª edición).
- Kern, G.J.: Introduction to probability and statistics using R www.atmos.albany.edu/facstaff/timm/ATM315spring14/IPSUR.pdf
- Lind, D.A. y otros (2008). Estadística Aplicada a los Negocios y la Economía. México: McGraw Hill, , (13ª Edición).
- - Ortiz, M.T. : Introducción a la probabilidad ; Simulación de modelos probabilísticos R-Pubs/Tereom: https://rpubs.com/tereom/
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es/cursoR4ULPGC/10-distribProbabilidad.html