COURSE DATA

DATA SUBJECT

Code: 36409
Name: Probability and simulation
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1406 - Degree in Data Science	Escola Tècnica Superior d'Enginyeria	1	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1406 - Degree in Data Science	Statistics	BASIC

COORDINATION

NAVARRO QUILES ANA

SUMMARY

The theory of probability is the area of mathematics which allows us measuring the uncertainty around us. It is the language which allows Statistics to develop as a science.

The main goal of this subject is to learn the language of probability providing students with the following capacities:

- To understand and use the probability calculus.

- To understand the idea of random variable and random vector.

- To recognise the main probability distributions for continuous and discrete variables as well as its interpretation as a theoretical model for a given population.

- To understand the concept of joint, conditional and marginal distribution.

- To calculate the main moments associated with a random variable or vector.

- To simulate from a probability distribution (Monte Carlo methods).

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

Knowledge of the concepts of function, limit, derivative and integral studied in the subject Mathematical Analysis (cod. 36407)

COMPETENCES / LEARNING OUTCOMES

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(CB5) Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

(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.

(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.

(CG04) Ability to work in a multidisciplinary group in a multilingual environment and to communicate, orally and in writing, knowledge, procedures, results and ideas related to data science.

(CT01) To be able to access (bibliographical) information tools and appropriately use them in the development of their daily tasks.

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.

DESCRIPTION OF CONTENTS

1. Introduction to probability

History of probability

Experiments and events
Definition and axioms of probability
Total probability theorem
Conditional probability
Bayes Theorem

2. Random variables and probability function

Definition of random variable
Types of random variables
Probability density function
Cumulative distribution function
Moments of a random variable

3. Main probability distributions

Bernoulli and binomial distributions
Hypergeometric distribution
Poisson distribution
Negative binomial distribution
Uniform distribution
Normal distribution
Exponential, gamma and beta density functions
Law of large numbers
Central limit theorem
Density functions from the normal distribution

4. Random vectors

Definition of random vector
Joint, conditional and marginal density function.
Covariance and correlation

5. Simulation and Monte Carlo methods

Monte Carlo methods
Introduction to Markov chains
Introduction to Markov Chain Monte Carlo methods

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	32,00
Laboratory	20,00
Classroom practices	8,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	2,00
Individual or group project	15,00
Independent study and work	25,00
Preparation of lessons	30,00
Preparation for assessment activities	13,00
Resolution of case studies	5,00
Total hours	**90,00**

TEACHING METHODOLOGY

MD1 – Theoretical activities: Exposition of the concepts with the enrollment of the student by solving specific questions. Completion of individual evaluation questionnaires. (GC01, CB5, CE09)

MD2 – Practical activities. Learning by solving problems, exercises and case studies through which competences are acquired on the different aspects of the subject. (CB2, CE15)

MD4 - Lab work and / or computer classroom. Learning through the performance of activities developed individually or in small groups and carried out in laboratories and / or computer rooms. (CG04, CT01, CE09, CE15)

EVALUATION

SE1 Written exam with theoretical and practical questions that will represent 40% of the mark. (GC01, CB5, CE09)

SE2 Preparation of works and/or a report in PDF, alone and/or in groups, of a report of the issues addressed in the practical sessions. This will represent a 40% of the final mark. The evaluation of this part may be recovered by means of a practical examination that will be carried out on the same date as the theoretical examination of the second call. (CB2, CE15)

SE3 ¿ Continuous evaluation based on the degree of implication of the student in the learning process. This degree of implication can be marked in two different ways:

i) Oral expositions of the theoretical concepts studied (alone and/or in groups) and problem solving in the classroom (this implies attending the class).

ii) Exercises that students should solve on their own and deliver in the virtual classroom in a given date.

Those activities will not be recoverable and will represent a 20% of the final mark. (CG04, CT01, CE09, CE15).

It will be necessary to get more than 4 in each part to be able to average and more than 5 as final grade to pass.

In any case, the evaluation system would be governed by the *Reglamento de Evaluación y Calificación de la Universitat de València para Grados y Másteres*: https://www.uv.es/graus/normatives/2017_108_Reglament_avaluacio_qualificacio.pdf

Copying or plagiarism of any activity that is part of the evaluation will result in the impossibility of passing the course, and the student will then be subject to the appropriate disciplinary procedures indicated in the ACTION PROTOCOL FOR FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA (ACGUV 123/2020).

REFERENCES

- Joseph K. Blitzstein and Jessica Hwang. Introduction to Probabilitiy. CRC Press (2015) http://proquest.safaribooksonline.com/9781466575578?uicode=valencia
- Robert P. Dobrow. Probability with applications in R. John Wiley & Sons (2014) http://syndetics.com/index.aspx?isbn=9781118241257/summary.html&client=valenciah&type=rn12
- Deborah Rumsey. Probability for Dummies. Wiley. (2006)
- Lola Ugarte, Ana Militino y Alan Arnholt. Probability and statistics with R Second ed Chapman & Hall (2016)
- Mark J. DeGroot, Morris H., Schervish Probability and Statistics 4th edition Pearson Education Limited (2014