

**COURSE DATA****DATA SUBJECT****Code:** 34166**Name:** Probability**Cycle:** Undergraduate Studies**ECTS Credits:** 6**Academic year:** 2025-26**STUDY (S)**

Degree	Center	Acad. year	Period
1107 - Degree in Mathematics	Facultat de Ciències Matemàtiques	3	First quarter
1928 - Double Degree Program Physics-Mathematics	Facultat de Ciències Matemàtiques	4	Second quarter
1935 - Double Degree Program in Mathematics-Telematics Engineering	Facultat de Ciències Matemàtiques	3	First quarter
1936 - Double Degree Program in Mathematics-Telematics Engineering	Facultat de Ciències Matemàtiques	3	First quarter

**SUBJECT-MATTER**

Degree	Subject-matter	Character
1107 - Degree in Mathematics	Probability and statistics	COMPULSORY
1928 - Double Degree Program Physics-Mathematics	Cuarto Curso (Obligatorio)	COMPULSORY
1935 - Double Degree Program in Mathematics-Telematics Engineering	Tercer curso	COMPULSORY
1936 - Double Degree Program in Mathematics-Telematics Engineering	Tercer curso	COMPULSORY

**COORDINATION**

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**SUMMARY**

The Probability is the part of Mathematics that deals with the formal study of uncertainty. Our world is full of elements with uncertainty: accidents, epidemics, storms, climate change, financial market movement, migration, disease, and so on. And it's also full of data. Probabilistic models are key for analysing data and making scientifically sound predictions and estimates. Probability is the basis of stochastic simulation and provides reference tools for the treatment of uncertainty and randomness in territories such as artificial



intelligence or data science.

This subject is dedicated exclusively to the learning of Probability. The subject uses in the theoretical classes the traditional format "definition-theorem-proof" that guarantees the rigorous and mathematically precise introduction of the material, but will always be accompanied by an intuitive and critical explanation that enhances the map of probabilistic concepts and the relationship between them. The practical classes and seminars give full prominence to the students with the aim that they can consolidate the learning of the subject.

The course covers all the basic concepts of probability, including the axiomatic definition of probability and its frequency interpretation, random variables and vectors and associated basic characteristics, the main probabilistic models and their usefulness as models for others. disciplines that are essential in their scientific studies.

## PREVIOUS KNOWLEDGE

### RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

### OTHER REQUIREMENTS

Necessary: Análisis Matemático I , convenient: Análisis Matemático II

## COMPETENCES / LEARNING OUTCOMES

### 1107 - Degree in Mathematics

Apply the knowledge in the professional world.

Argue logically in decision-making.

Capacity of abstraction and modeling.

Participate in the implementation of software and learn mathematical software.

Possess and understand the mathematical knowledge.

Reason logically and identify errors in the procedures.

## DESCRIPTION OF CONTENTS



## 1. Experiment and probability

- 1.1. Random experiment.
- 1.2. Measure of probability. Probability space.
- 1.3. Basic properties of Probability.
- 1.4. Conditional probability. Independence.
- 1.5. Total probability and Bayes' theorems.

## 2. Random variables

- 2.1. Random variable: definition and properties.
- 2.2. Discrete and continuous distributions of random variables.
- 2.3. Cumulative distribution function.
- 2.4. Expectation, variance and standard deviation. Other moments.
- 2.5. Function of a random variable.

## 3. Special distributions.

- 3.1. Discrete distributions: Bernoulli, binomial, negative binomial, hypergeometric and Poisson.
- 3.2. Continuous distributions: Uniform, exponential and gamma.
- 3.3. Normal and derived distributions.
- 3.4. Random variables simulation.

## 4. Random vectors.

- 4.1. Random vector. Definition and properties.
- 4.2. Continuous and marginal distributions. Independence of random variables.
- 4.3. Conditional distribution.
- 4.4. Expectation, variance, covariance and correlation. Moments
- 4.5. Functions of random vectors.

## 5. Convergence of sequences of random variables.

- 5.1. Weak convergence in probability and almost sure.
- 5.2. Weak and strong law of large numbers.
- 5.3. Central limit theorem.

### WORKLOAD

### PRESENCIAL ACTIVITIES

Activity	Hours
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Theory	30,00
Other activities	7,50
Computer classroom practice	22,50
<b>Total hours</b>	<b>60,00</b>

## NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	10,00
Independent study and work	20,00
Preparation of lessons	40,00
Preparation for assessment activities	20,00
Resolution of case studies	0,00
<b>Total hours</b>	<b>90,00</b>

## TEACHING METHODOLOGY

**Lectures.** Exposition of the concepts with the enrollment of the student by solving punctual questions.

**Practical activities.** Learning by solving problems, exercises and lab work in which competences will be acquired on the different aspects of the subject. These activities will be developed individually or in small groups.

## EVALUATION

The evaluation of the knowledge and competences achieved by the students will be carried out continuously throughout the course, and will consist of the following evaluation blocks:

1. 30% for continuous assessment tests: activities carried out in seminars, in practice sessions or at home.
2. 70% for the final exam, with theoretical and practical content, in which it will be necessary to obtain at least a grade of 5 out of 10 to pass the subject.

The total grade must be greater than or equal to 5 to pass the course.

The criteria to obtain the final qualification will be the same in the first and second call. Seminar/tutoring activities and continuous assessment tests will not be recoverable for the second call.

## REFERENCES

- G. Ayala y F. Montes. Probabilidad básica (2023).



- D. Stirzaker. Elementary Probability. Cambridge. Second Edition (2010)
- Jim Pitman. Probability. Springer-Verlag (1993)
- Sheldon Ross. A First Course in Probability (8th Edition). Pear-son Prentice Hall, 2009.
- G.R. Grimmett and D.R. Stirzaker. One Thousand Exercises in Probability. Oxford University Press. Third edition (2020).
- S. M. Ross. Introduction to Probability Models. Twelfth Edition. Academic Press. (2019)
- Gazi, Orhan Introduction to Probability and Random Variables 2023 Springer Nature Switzerland.