UAB
Universitat Autònoma de Barcelona

Probability

2026/2027

Code: 104386
Credits: 6

Degree programme	Type	Course
Computational Mathematics and Data Analytics	FB	1

Contact lecturer

Name : Aureli Alabert Romero

Email : aureli.alabert@uab.cat

Teaching staff (external to UAB)

Aureli Alabert

Group languages

You can consult this information at the end of the document.

Prerequisites

Knowledge previously taught in the courses *Calculus in One Variable* and *Introduction to Programming* will be used.

It is also important to take the course *Calculus in Several Variables* simultaneously.

Objectives

What do a lottery draw, a clinical trial to experimentally evaluate the effectiveness and/or safety of a new medical treatment, a weather forecast predicting rain in a specific location, inventory management in a company, the transmission of genes from parents to children, estimating the size of a whale population, an epidemiological study on the incidence of a certain disease, the inspection of batches of products manufactured by a company to verify their quality, an experiment to study the effect of pressure and temperature on the outcome of a certain chemical reaction, or the effect of using different fertilizers on agricultural production, ... have in common?

They are real-world situations in which chance plays a role.

To study them and draw reliable conclusions, we must use an appropriate mathematical model. Probability is the mathematical theory that allows us to model random phenomena, that is, situations in which chance is involved, and it is the mathematical foundation of Statistics. In practical applications, the goal is to find the best possible probabilistic model for a given real situation and, by using it appropriately, extract valuable information, knowledge, and useful conclusions.

The aim of the course is to introduce Probability theory at a basic level for this degree.

Learning outcomes

- CM05 (Design numerical, probabilistic algorithm and combinatorial algorithm solutions to solve real problems.) Design numerical, probabilistic algorithm and combinatorial algorithm solutions to solve real problems.
- KM02 (Distinguish the objects of calculus with functions and their properties and uses.) Distinguish the objects of calculus with functions and their properties and uses.
- KM04 (Describe the mathematical concepts and objects specific to probability.) Describe the mathematical concepts and objects specific to probability.
- SM05 (Develop independent strategies to solve problems specific to numerical calculus, probability and graph theory.) Develop independent strategies to solve problems specific to numerical calculus, probability and graph theory.

Contents

1. Modeling randomness: the probabilistic model.

- Random phenomena and probability spaces.
- Properties of the Probability. Probability and Odds.
- Counting elements of a set: some combinatorics.
- Conditioned probability and independence of events.
- The Formula of Total Probability and the Bayes' Formula.
- Evidence Evaluation and Bayes Formula: The Odds Ratio.

2. Random variables.

- Introduction. Distribution function of a random variable.
- Discrete random variables. Probability function. Examples
- (Absolutely) continuous random variables. Density function. Examples.
- Functions of a random variable.
- Independence of random variables.

3. Mathematical Expectation, Variance and Moments.

- Expectation of discrete random variables.
- Expectation of (absolutely) continuous random variables.
- Expectation and independence of random variables.
- Variance of a random variable.
- Covariance of two random variables. The (Pearson) correlation coefficient.
- Moments of a random variable. Txevixev inequality.
- Moment generating function.

4. Sequences of random variables.

- Types of convergence.
- Laws of large numbers (LLN).
- The central limit theorem (TCL).

IMPORTANT: To include the gender perspective in the teaching of this subject, we have reviewed the possible androcentric biases and questioned hidden gender assumptions and stereotypes.
This revision involves including in the contents of the subject, as far as possible, knowledge produced by women scientists, often forgotten, seeking the recognition of their contributions, as well as that of their works in the bibliographical references.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Theory in the classroom	27	1.08	
Practical sessions	12	0.48	
Personal work	92	3.68	
Problems in the classroom	10	0.4	

Face-to-face activities consist of lectures, problem-solving sessions, and computer-based practicals. Efforts will be made to coordinate the content so that all three types of activities effectively contribute to the acquisition of knowledge and skills. Lectures and problem classes will be mainly expository, while encouraging participation through moments of reflection and the joint resolution of small tasks. Practical sessions will primarily involve independent work.

Every effort will be made to avoid sexist language and any kind of discriminatory attitude toward any group in

class. Both teaching staff and students must strive to be involved, remain vigilant, and report it if necessary.

The Moodle classroom on the Virtual Campus will be the communication tool between teaching staff and students. All questions, whether about the operation of the course or its content, that may be of interest to other classmates should be raised in class or through the General Forum available in the Moodle classroom. Issues that are not of interest to others will be handled individually or by email, always sent from the institutional *@autonoma.cat* address.

The use of artificial intelligence tools is allowed. It should be noted that there is no guarantee that the assistance they provide is correct or useful, and the responsibility always lies with the person who uses them, both in learning concepts and in submitting assignments.

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Continuous Assessment Test	0.30	3	0.12	KM02, KM04, SM05
Problems exam	0.50	4	0.16	KM02, KM04, SM05
Practice delivery	0.20	2	0.08	CM05, KM02, SM05

The assessment of the course will be based on:

- Two midterm exams covering theory and problems (80% of the final grade).
- A practical exam (20% of the final grade).

To pass the course, students must:

- Obtain an average of 5.0 out of 10 in the theory and problem exams, with a minimum of 4.0 in each.
- Obtain an overall average of 5.0 out of 10, which will be the final course grade.
- Grades that do not meet these requirements may be reviewed on a case-by-case basis.

Each exam will have a second sitting ("resit" in official UAB terminology). Attending this second sitting will automatically override the grade from the first. Practical components are NOT resittable.

A student will be considered assessable if they have submitted coursework or taken exams corresponding to at least 50% of the course. Otherwise, they will be recorded as Not Assessed.

For the possible awarding of Honors, grades from the second sitting will not be taken into account.

Single assessment: *Students who have opted for the single assessment system must take a single exam and submit the required coursework on the day of the second midterm exam. The details will be agreed upon with the interested students.*

Bibliography

Bardina, Xavier. Càlcul de Probabilitats. Servei de Publicacions UAB, 2004.

Julià, Olga; Márquez, David; Rovira, Carles i Sarrà, Mónica. Probabilitats: Problemes i més problemes.

Publicacions i edicions de la Universitat de Barcelona, 2005.

Delgado, R.: Probabilidad y Estadística con aplicaciones. 2018.

Sanz-Solé, Marta. Probabilitats. Edicions de la Universitat de Barcelona, 1999.

Software

In the practical sessions, the R programming language and the RStudio environment will be used.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	1	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(SEM) Seminars	1	Catalan	second semester	morning-mixed