

Degree programme	Type	Course
Bachelor in Artificial Intelligence	FB	1

Contact lecturer

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Prerequisites

There are no prerequisites besides the main contents of Mathematics from high school.

Group languages

You can consult this information at the [end](#) of the document.

Objectives

The goal of the course is to introduce the basic tools of probability and statistics used to analyse data coming from either natural, experimental, social or economic phenomena. A special focus will be given to the correct use of these tools and the interpretation of the results by providing the student with the required theoretical background. Moreover, a part of the course will be dedicated to introduce and familiarize the student with the use of the most common computer tools for statistical analysis.

Learning outcomes

- KM04 (Explain the concepts of probability and statistics that are used in methods from different fields of artificial intelligence and in the design and analysis of the experiments necessary for their validation.) Explain the concepts of probability and statistics that are used in methods from different fields of artificial intelligence and in the design and analysis of the experiments necessary for their validation.
- SM01 (Apply concepts of linear algebra, calculus, probability, and statistics to problem solving in the context of artificial intelligence applications.) Apply concepts of linear algebra, calculus, probability, and statistics to problem solving in the context of artificial intelligence applications.
- SM02 (Interpret the mathematical formulation associated with algorithms and procedures in the field of artificial intelligence.) Interpret the mathematical formulation associated with algorithms and procedures in the field of artificial intelligence.
- SM03 (Appropriately use mathematical language to formulate solutions to problems that require the use of mathematical concepts in the context of artificial intelligence.) Appropriately use mathematical language to formulate solutions to problems that require the use of mathematical concepts in the context of artificial intelligence.
- SM04 (Use computer tools and programming languages for problem solving and manipulation of mathematical objects.) Use computer tools and programming languages for problem solving and manipulation of mathematical objects.

Contents

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- Topic 1. Probability.
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- Introduction, sets, Venn diagrams, sample spaces.
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- Axioms of probability and main properties. Permutations, combinations.
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- Conditional probability. Bayes theorem. Independent events.
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- Random variables and distributions, expected value and variance.
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- Discrete random variables: Binomial and Poisson distributions.
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- Continuous random variables: Uniform, Normal and Exponential distributions.
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- Central limit theorem and applications.
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- Topic 2. Statistics
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- Descriptive statistics, visualisation techniques.
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- Joint distributions, covariance and correlation.
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- Point estimation. General concepts, unbiased estimators. Maximum likelihood estimation.
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- Interval estimation. Confidence intervals for a single mean or proportion.
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- Confidence interval for the mean and variance of a normal population, t distribution.
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- Prediction interval for a future value, chi-squared distribution
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- Hypothesis testing, general concepts. Type I and II errors. Error estimation.
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- Test for a population proportion. Test for the mean of a normal population.
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- Large sample test for a normal population with unknown variance.
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Learning activities and methodology

Title	Hours	ECTS	Learning outcomes

Independent study and preparation	60	2.4
Theoretical lectures	26	1.04
Problem sessions	12	0.48
Practices at the Computer Lab	12	0.48
Tutoring and consultations	10	0.4

Besides the mandatory student's personal work, the course will have three distinguished types of activities: The core and main theoretical lessons, problem sessions, and practice in the computer lab. With the correct combination of these activities the specific skills will be achieved.

New material will be mainly introduced in lectures where the professor will explain the main theoretical results backing the tools that will be used throughout. These theoretical results will be complemented by exercises. More examples and exercises will be discussed during the problem sessions where the teacher will provide an oriented resolution of the proposed problems. Students are encouraged to attend the sessions having previously tried the exercises by themselves.

The main theoretical part together with typical exercises will have a partial evaluation halfway along the semester. This should provide the student with a measure of their progression.

There will be practice sessions with specialized computer software for statistical analysis. These sessions will have the double effect of introducing students to the typical procedures of data analysis, as well as providing lots of examples illustrating the subject.

The practical sessions will have an independent evaluation with assignments to hand in, possibly at the end of some of the sessions.

In all the evaluations, special attention will be given to the correctness and validity of the assertions and arguments used. These include vocabulary, mathematical correctness and clarity in writing.

*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

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.

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Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Second partial exam	40%	3	0.12	KM04, SM01, SM02, SM03, SM04
First partial exam	30%	2	0.08	KM04, SM01, SM02, SM03, SM04
Practice exams	30%	20	0.8	KM04, SM01, SM02, SM03, SM04
Recovery exam	70%	5	0.2	KM04, SM01, SM03, SM04

The evaluation of theory and problems will consist of two partial exams. The first one, with a weight of 30% and

the second one with a weight of 40%. For these evaluations there will be a second-chance exam at the end of the semester. The remaining 30% of the evaluation weight will come from computer practices. This will be obtained from different exams given throughout the course, for which there will be no second-chance evaluation.

In order to attend the recovery examination, students must have been previously evaluated in a series of activities whose weight equals at least two thirds of the total.

A weighted average of a minimum of 4 out of 10 is required in the partial exams or in their recovery. A minimum grade of 4 out of 10 is also required in the average grade of the practice assignments. If the minimum of each module is reached, the final grade is the weighted mean. Otherwise, the final grade is the minimum between the weighted means and 4.5 (out of 10).

Those who have not taken tests that add up to 50% of the course will be considered Non-Assessable.

In order to pass the course with honours, the final grade must be equal to or higher than 9 (out of 10). This will be given to students that, according to the criterion of the professor, have reached in a brilliant manner all the goals of the subject.

The dates for the assessments and delivery of assignments will be published in a dedicated webpage for the course.

Bibliography

Main textbook:

Jay L. Devore; Probability and Statistics for engineering and the sciences

Further reading:

Bardina, X. Farré, M. Estadística descriptiva. Manuals UAB, 2009.

Besalú, M. Rovira C. Probabilitats i estadística. Publicacions i Edicions de la Universitat de Barcelona, 2013.

Delgado, R. Probabilidad y Estadística para ciencias e ingenierías. Delta, Publicaciones Universitarias. 2008.

Montgomery, D. C. Runger, G. C. Probabilidad y estadística aplicadas a la ingeniería. Limusa Wiley, 2002.

Walpole, R. Myers, R. H. Myers, S. L. Probabilidad y estadística para ingenieros. Prentice Hall, 1999.

Software

One of the main tools for statistical analysis and development and which has gained a growing popularity in academia is the R language. The R project is a free software environment providing a large set of libraries and tools aimed at statistical computing and graphical representation of data.

The student will learn the basics of the R language through the use of the integrated development environment RStudio

R: <https://www.r-project.org/>

Rstudio: <https://www.rstudio.com/>

No special version of the software is required for the aims of this course.

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	English	second semester	afternoon
(PLAB) Practical laboratories	1	English	second semester	morning-mixed
(PLAB) Practical laboratories	2	English	second semester	morning-mixed
(PAUL) Classroom practices	71	English	second semester	afternoon