Universitat Autònoma de Barcelona

2019/2020

Introduction to Probability

Code: 104846
ECTS Credits: 6

Degree	Type	Year	Semester
2503852 Applied Statistics	FB	1	1

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

As a subject of the first semester of the first year, it has no prerequisites except to take the subject Calculus 1 simultaneously.

To a lesser degree, it may also be convenient to take the Computer Tools for Statistics course at the same time.

Objectives and Contextualisation

What does a lottery draw have in common, a clinical trial to experimentally evaluate the efficacy and / or safety of a new medical treatment, the weather forecast of rain in a certain place, the management of a company's inventory, the transmission of genes from parents to children, the estimation of the size of the population of whales, an epidemiological study on the incidence of a certain disease, the inspection of the batches of products manufactured by a company to verify its quality, an experiment to study the effect of pressure and temperature in the result of a certain chemical reaction, or the effect of the use of different fertilizers in the agricultural production of a farm, ...?

They are real situations in which randomness intervenes.

To study them and be able to draw reliable conclusions, we have to use an appropriate mathematical model. This model is provided by Probability, which is the mathematical theory that allows the modeling of random phenomena, that is, situations where chance intervenes.

The objective of this subject is to introduce Probability, which studies the models that allow dealing with chance, and is fundamental in Statistics. The topics that will be introduced and developed in this subject include basic contents of Probability, which will be expanded and on which will be deepened in the subject "Probability" of the second semester, putting the emphasis on applications, among which the Statistics stand out. In the applications one should try to find the best possible probabilistic model in a given real situation and, using it in an appropriate way, with the tools that we will learn throughout the course, extract valuable information, knowledge, and reach useful conclusions.

Competences

- Calculate and reproduce certain mathematical routines and processes with agility.

- Critically and rigorously assess one's own work as well as that of others.
- Make efficient use of the literature and digital resources to obtain information.
- Select and apply the most suitable procedures for statistical modelling and analysis of complex data.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Use quality criteria to critically assess the work done.

Learning Outcomes

1. Critically assess the work done on the basis of quality criteria.
2. Distinguish deterministic models from probabilistic-statistical models.
3. Make effective use of references and electronic resources to obtain information.
4. Reappraise one's own ideas and those of others through rigorous, critical reflection.
5. Recognise the usefulness of mathematical methods (calculus, algebra, numerical methods) for probabilistic modelling.
6. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
7. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
8. Use probabilistic models to describe data in contexts of uncertainty and deduce behaviour patterns.

Content

1. Probabilistic models.

Introduction.
Random phenomena and probability.
Properties of probability.
Probability spaces.
Combinatorics.

2. Conditioned probability.

Definition of conditioned probability.
Conditioning and independence of events.
The Formula of the Total Probability.
The Bayes' Formula.

2. Random variables.

Definition of random variable.
Discrete random variables. Examples
Absolutely continuous random variables. Examples
Mixed random variables. Examples
Distribution function of a random variable.
Functions of a random variable.
Independence of random variables.

3. Mathematical Expectation.

Expectation of discrete random variables.
Expectation of absolutely continuous random variables.
Moments of a random variable. Variance
Covariance and Correlation. Relationship with the independence of random variables.
The inequality of Chebyshev.

4. Classic models of probability.

Discrete models: Bernoulli, Binomial, Hypergeometric, Negative Binomial and Poisson. Approximation of the Binomial by the Poisson.
Continuous models: Uniform, Exponential, Erlang, Weibull, Normal, Gamma.
Continuous models related to the Normal of special interest in Statistics: Chi-square, Student's t and Fisher-Snedecor's F.

5. The Central Limit Theorem.

Convergence in distribution of random variables.
The central limit theorem.
The DeMoivre-Laplace Theorem of Binomial approximation by Normal. Correction of continuity.

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 the contents of the subject, as far as possible, knowledge produced by women scientists,often forgotten, seeking the recognition of his contributions, as well as that of his works in the bibliographical references.

Methodology

In this subject, the classical distinction is not made in the classroom activities of: theoretical classes, problems and practices with a computer, but will be combined according to the educational needs at each moment, thanks to the ease faced by the fact that students bring their computer to class.

In this way, the teacher will introduce the concepts and examples, while when appropriate the problems will be worked on in class or the statistical software and programming language R will be used to carry out some practice related to the subject that is " be working in class. It involves using an integral system that incorporates the three classical aspects of the classroom activities in an optimal way to facilitate the student's learning and achieve the goals set, while making the class as participatory as possible, following the The beginning of which you only learn what you try to do.

This subject has a teaching space in the Aula Moodle in the Virtual Campus of the UAB: http://cv.uab.cat.

The students will be able to communicate with the teacher through the email, always sent from the institutional address @e-campus.uab.cat.

IMPORTANT: To work more comfortably with R, it is recommended to use the RStudio interface: it's free, "open source" and works with Windows, Mac and Linux.
https://www.rstudio.com/

OBSERVATION: Although we have already talked about the gender perspective in teaching in the section of the contents of the subject, we go further by doing a review of the teaching methodology and the interactions between students and teachers. In this sense, a participatory teaching methodology will be implemented, generating an egalitarian environment, less hierarchical in the classroom, avoiding stereotypical examples in gender and sexist vocabulary, with the objective of developing critical reasoning and respect for diversity and A plurality of ideas, people and situations, which will be more favorable to the integration and full participation of the students.

Activities

Title	Hours	ECTS	Learning Outcomes

Type: Directed			
Problems in the classroom	18	0.72	4, 7, 6, 8
Theory in the classroom	26	1.04	4, 1, 2, 7, 6, 5, 3, 8
Type: Supervised			
Practical sessions	8	0.32	1, 7, 6, 3
Type: Autonomous			
Personal work	89	3.56	4, 1, 2, 7, 6, 5, 3, 8

Assessment

The evaluation of this subject will consist of:

Continuous assessment:

control of practices with a computer (20% of the final grade). UNRECOVERABLE.
Two non-eliminatory partial exams of matter, with 30 and 50% respecius weights.

Final exam of recovery: it is worth 80% of the final grade and will allow to increase the joint grade of the two partial ones.

If a student presents at least one of the two partial exams, or in the final exam of recovery, it will be considered as

presented; otherwise, your qualification will be "Not evaluable".

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
First partial exam	0.30	3	0.12	4, 1, 2, 7, 6, 5, 8
Practice exam	0.20	3	0.12	4, 6, 3
Second partial exam	0.50	3	0.12	4, 1, 2, 7, 6, 5, 8

Bibliography

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Devore, Jay L. Probabilidad y Estadística para ingeniería y ciencias. México [etc.] : Cengage Learning, cop., 2012

Julià, Olga; Márquez, David; Rovira, Carles i Sarrà, Mónica. Probabilitats: Problemes i més problemes. Publicacions i edicions de la Universitat de Barcelona, 2005.

Kai Lai, Chung. Teoría elemental de la probabilidad y los procesos estocásticos. Reverté, cop., 1983.

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

COMPLEMENTARY BIBLIOGRAPHY:

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Rao, C. Radhakrishna. Estadística y verdad. Aprovechando el azar. Colección Universitas-73. Serie Estadística y Análisis de datos. PPU, S.A., 1994.