Universitat Autònoma de Barcelona

2023/2024

Introduction to Probability

Code: 104846
ECTS Credits: 6

Degree	Type	Year	Semester
2503852 Applied Statistics	FB	1	1

Contact

Name: Joaquim Bruna Floris

Email: joaquim.bruna@uab.cat

Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

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.
- Probability spaces.
- Properties of probability.
- Counting elements of a set: a little combinatorics.

2. Conditioned probability.

- Definition of conditioned probability.
- Independence of events.
- Properties of the independence of events.
- The Formula of the Total Probability.
- The Bayes' Formula.

2. Random variables.

- What is a random variable (r.v.)?
- Distribution function of a random variable.

- Discrete random variables.
- (Absolutely) continuous random variables.
- Independence of random variables.

3. Mathematical Expectation and Variance.

- Expectation of a random variable.
- Variance of a random variable.
- Covariance of two random variables.

Methodology

In this subject, face-to-face activities consist of: theoretical classes, problems and practicals with a computer. In this way, the teacher will introduce the concepts and examples, while when it is 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 topic is working in class It is about using a comprehensive system that incorporates the three classic aspects of face-to-face activities in an optimal way to facilitate the student's learning and achieve the defined objectives.

The moodle classroom will be the main communication tool between the teaching staff and the students. The teacher responsible for the subject will upload weekly descriptive summaries of the material explained.

The two assignments of exercises can be commented on individually to students who request it.

Students can also communicate with the teaching staff via email, always sent from the institutional address @e-campus.uab.cat.

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

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.

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 evaluation:
• Two deliveries of exercises LLEX1, LLEX2, with a weight of 10% each.
• Two partial exams P1, P2 of theory and combined problems, with a weight of 35% each
. • Practice exam with R (EPract), with a weight of 10%.
If both P1 and P2 are at least 3, a grade C1 = 0.1*LLEX1 + 0.1*LLEX2+0.1*EPract,+0.35*P1+ 0.35*P2 is generated
If C1 >= 5, the student passes the course. Otherwise, or if some partial test has a grade lower than 3, students have the opportunity to take the recovery exam, with an R grade, with the entire syllabus,
The C2 grade will be C2= 0.1*LLEX1 + 0.1*LLEX2+0.1*EPract,+0.70*R
The FINAL NOTE will be the maximum between C1 and C2
Single evaluation
Students who opt for the single assessment modality, on the day the second part of the subject is carried out, must:
- Deliver the two lists of problems that have been announced specifically for these students. The LLEX qualification will be obtained by individual interview.
- take the practice exam with R, with EPrac qualification
- take a final exam, with grade F,
The grade will be C1= (0.2)*LLEX+(0.1)*EPrac+(0.7)*F
If C1 < 5, the student has another opportunity to pass the subject through the recovery exam, with an R grade, which will be held on the date set by the coordination of the degree. The grade will be C2= (0.2)*LLEX+(0.1)*EPrac+(0.7)*R

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assessment Test with R	0.10	1	0.04	4, 6, 3
Intermediate tests	0.70	6	0.24	4, 1, 2, 7, 6, 5, 8
Submission of solved exercises	0.20	2	0.08	4, 1, 2, 7, 6, 5, 8

Bibliography

BASIC BIBLIOGRAPHY:

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

DeGroot, Morris H., Schervish, Mark J. Probability and statistics. Pearson, 2012, 4th ed., international ed.

Delgado, Rosario. Probabilidad y Estadística con aplicaciones.
https://www.amazon.es/Rosario-Delgado-de-la-Torre/e/B09WYTGKCL/ref=dp_byline_cont_pop_ebooks_1

Devore, Jay L. Probabilidad y Estadística para ingeniería y ciencias. Cengage Learning, 2016

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:

Ross, Sheldon M. Introduction to Probability Models, Academic Press, 12th Edition. Elsevier, 2019. https://www.sciencedirect.com/book/9780123756862/introduction-to-probability-models
Rao, C. Radhakrishna. Estadística y verdad. Aprovechando el azar. Colección Universitas-73. Serie Estadística y Análisis de datos. PPU, S.A., 1994.

Software

In this subject the R software will be used (https://cran.r-project.org/)
R is a programming environment consisting of a set of very flexible tools that can be easily expanded through packages, libraries, or by defining our own functions. It is also free and open source, an Open Source part of the GNU project, and this is one of its main advantages. Any user can download and create their code for free, without restrictions of use, the only rule is that the distribution is always free (GPL). Because it can freely access its code, R software has no limited functions, unlike other commercial statistical tools.
Preferably, we will use it using the RStudio platform (https://www.rstudio.com/)