Universidad Zaragoza

Academic Year/course: 2023/24

27012 - Introduction to Probability and Statistics

Syllabus Information

Academic year: 2023/24
Subject: 27012 - Introduction to Probability and Statistics
Faculty / School: 100 - Facultad de Ciencias
Degree: 453 - Degree in Mathematics
ECTS: 6.0
Year: 2
Semester: Second semester
Subject type: Basic Education
Module:

1. General information

The course presents an introduction to descriptive statistics and probability, mathematically formalizing the calculation of probabilities and the concept of one-dimensional random variables, both discrete and continuous. This course serves as a basis and will have continuity in the third year compulsory subjects Probability and Mathematical Statistics.

The approaches and objectives of this module are aligned with the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda; the learning activities could contribute to some extent to the achievement of the goals 4 (quality education), 5 (gender equality), 8 (decent work and economic growth), and 10 (reducing inequality).

2. Learning results

- Be able to perform a descriptive analysis of a data set, using appropriate graphical and numerical techniques, and synthesize and interpret the results.
- Learn to calculate probabilities in different spaces.
- Understand and know how to apply the concepts of independence and conditioning. Calculate probabilities in both situations.
- Recognize and model real situations in which the most usual probability distributions appear.
- Handle random variables (one-dimensional), both discrete and absolutely continuous, and know their usefulness for modeling real phenomena.
- To know examples of mixed random variables.

3. Syllabus

1. Data analysis.
    1. Introduction: population and sample.
    2. Relative frequencies and graphic representations.
    3. Mean and standard deviation. Median and quantiles. Symmetry and kurtosis.
    4. Outliers. Transformation of variables.
    5. Two-dimensional data: joint, marginal and conditional distributions.
    6. Moments. Covariance matrix and Pearson's correlation coefficient.
    7. The simplest linear model. Linear regression. Residuals analysis.
2. Introduction to probability.
    1. Sample space, events and algebras of events.
    2. Axioms of probability. Consequences.
    3. Classical probability. Combinatorics.
    4. Finite, discrete, and geometric models. Examples.
    5. Conditional probability and independence.
    6. Total probability formula. Bayes formula.
3. Discrete random variables.
    1. Introductory examples. Probability laws and distribution functions.

2. The most usual distributions: uniform, Bernoulli and binomial, hypergeometric, geometric, negative binomial, and Poisson distributions.
3. Mathematical expectation and its relation with the sample mean. Expectation of a function of a discrete random variable.
4. Moments and central moments. Computations.
5. Moments. Chebyshev's and Markov inequalities.
6. Approximations: from the hypergeometric to the binomial, and from the binomial to the Poisson distributions.

4. Absolutely continuous random variables.
    1. Introduction. Probability densities.
    2. Distribution functions. Properties.
    3. The most usual distributions: uniform, triangular, exponential, gamma, beta and normal distributions.
    4. Transformations of absolutely continuous random variables. Change of variable.
    5. Moments and central moments. Computations.
    6. Moments. Chebyshev's and Markov inequalities.
    7. The normal distribution: specific analysis.
    8. Introduction to mixed random variables.

4. Academic activities

Master classes: 30 hours.
Problem solving: 16 hours.
Computer classes: 12 hours.
Project: 10 hours.
Study: 76 hours.
Assessment tests: 6 hours.

5. Assessment system

- Optional computer exam on topic 1 after its completion.
  The grade obtained represents 20% of the overall grade of the course.
  Students who pass the exam will be able to take the rest of the subjects in the official exams.
- Voluntary realization of problems and small works that will be proposed throughout the course.
  The grade obtained, which will be a maximum of 1 point, will be added to the final grade obtained by the student in any of the official exams. Oral presentation of problems or work done may be requested.
- Exam in May-June: computer-based exam on topic 1 and written exam on the remaining topics.
- Exam in June-July: with computer on topic 1 and in writing on the remaining topics.

Without detriment to the right that, according to the current regulations, the student has the right to attend and, if necessary, pass the subject by means of a global test.