

29507 - Probability and Statistics

Syllabus Information

Academic year: 2023/24

Subject: 29507 - Probability and Statistics

Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia

Degree: 625 - Bachelor's Degree in Industrial Processes' Data Engineering

ECTS: 6.0

Year: 2

Semester: First semester

Subject type: Basic Education

Module:

1. General information

This subject introduces the student to the second great block of statistics, statistical inference based on the calculation of probabilities.

Starting from the possibility of occurrence of an event, the concept of probability associated with experiments in which there is some uncertainty about what will happen will be defined. From here we start in the study of probability, which in itself provides solutions to different problems. Probability Theory is the basis for the study of Statistical Inference, in which mathematical models will be provided to help us to know the different random variables from the data of a sample.

The final objective is that the student integrates the basic knowledge that together with the skills in the tools used in the course, students will be able to make decisions as well as the elaboration of the necessary reports for professional development as a data engineer.

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations Agenda 2030 (<https://www.un.org/sustainabledevelopment/es/>) so that the acquisition of the learning results of the subject provides training and competence to contribute to some extent to their achievement: Goal 4: Quality Education

2. Learning results

- To know the reflexive use of symbolic and numerical calculation tools
- Master the modeling of engineering environments under stochastic nature by means of random variables, as well as the performance of calculations in uncertainty situations.
- Possess scientific-mathematical thinking skills that allow them to ask and answer certain mathematical questions.
- Have the ability to handle mathematical language; in particular, symbolic and formal language.

3. Syllabus

The syllabus is as follows:

- Probability: Elements of probability: Event. Probability. Probabilistic space. Conditional probability. The total probability theorem. Bayes theorem. Random variables: VAD: mass function, distribution function. VAC: density function, distribution function. Expected value: mean, variance.

Discrete distributions: Bernoulli tests, binomial distribution, Poisson distribution. Continuous distributions: uniform, normal, exponential, beta, gamma. Multidimensional random variables: probability function, expected value, covariance, a.v. independence, chi-square distribution, Student's t, Snedecor's F.

- Introduction to reliability theory: Quality and reliability, reliability function and risk function.

Exponential distribution, Weibull distribution.

- Inference: Parameter estimation: Population and sample. Random, stratified, cluster and systematic sampling. Statistics and Estimator. Simulation. Method of moments, maximum likelihood method.

Desirable properties of estimators: bias, efficiency, consistency. Point and interval estimation.

Fisher's theorem. Central limit theorem. Confidence intervals.

- Hypothesis testing: Null and alternative hypothesis. Type I and II error, significance level, power of contrast. Unilateral and bilateral contrasts. P-value.
- Goodness-of-fit test: Kolmogorov-Smirnov contrast.
- Multiple linear regression: Model estimation. Step-by-step model. Akaike index. Residue analysis. Analysis of variance: One-factor analysis of variance. Table ANOVA. Two-factor analysis of variance.
- Time series: Components. Combination of components. Trend analysis. Seasonal variations.

4. Academic activities

Different teaching methods will be used in the learning process of the subject of Probability and Statistics, depending on the objectives set and the competences developed:

- Expository techniques will be used for the theoretical classes, with the objective of analyzing and developing the fundamental concepts of the subject.
- Didactic forms of participation will be used, involving the student, to develop the capacity to organize, plan and make decisions.
- Computer tools and case studies will be used to address the competencies of using technological tools and instruments, problem solving, and the ability to analyze and search for information from other sources.
- The students will be taught blackboard problems that will allow them to develop the ability to adapt to new situations and to apply knowledge in professional practice.
- The Moodle platform will be used as a support, where the theoretical and practical materials of the course will be published, as well as all the information necessary for its development, starting with the teaching guide itself.

The approach, methodology and evaluation of this guide is prepared to be the same in any teaching scenario. They will be adjusted to the socio-sanitary conditions of each moment, as well as to the indications given by the competent authorities.

5. Assessment system

The student must demonstrate that they have achieved the expected learning results by means of the following assessment activities.

At the beginning of the subject the student will choose one of the following two assessment methodologies:

- A **continuous assessment system**, which will be carried out throughout the entire teaching period.
- A global **assessment test**, reflecting the achievement of the learning results, at the end of the teaching period.

Continuous assessment system

- **Written tests:** There will be two written tests along the term. They will deal with theoretical and/or practical aspects of the subject, their weight will be 60%. A **minimum grade of 3** on each written test is required for to continue with the continuous assessment:

Written test 1: It will take place on week 8 and will deal with the topics taught in the first 8 weeks of the subject. It is related to learning results 2, 3 and 4. Its weight in the final grade will be 30%.

Written test 2: It will be held on week 15 and will deal with the topics taught in the second half of the subject.

It is related to learning results 5 and 6. Its weight in the final grade will be 30%.

- Participatory controls: Throughout the term the student will carry out participatory type controls valued as a whole in 20% of the final grade, which will consist of the realization of practical exercises in the computer classroom.
- Applied work: Throughout the term, the student will carry out an applied work on the subjects of the subject, it weights 20% of the final grade.

Global assessment test. Students who have not passed the course with the continuous grading system, must take a compulsory written test equivalent to the written tests described in point 1, whose weight in the final grade will be 80%. Likewise, they must submit the 2 applied papers required during the term.