Universidad Zaragoza

Year : 2019/20

29708 - Statistics

Syllabus Information

Academic Year: 2019/20
Subject: 29708 - Statistics
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 434 - Bachelor's Degree in Mechanical Engineering
ECTS: 6.0
Year: 1
Semester: 434-First semester o Second semester
107-Second semester
Subject Type: Basic Education
Module: ---

1.General information

1.1.Aims of the course

1.2.Context and importance of this course in the degree

1.3.Recommendations to take this course

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. It is based on participation and the active role of the student favours the development of communication and decision-making skills. A wide range of teaching and learning tasks are implemented, such as lectures, guided assignments, laboratory sessions, autonomous work and tutorials.

Students are expected to participate actively in the class throughout the semester.

Classroom materials will be available via Moodle. These include a repository of the lecture notes used in class, the course syllabus, as well as other course-specific learning materials.

Further information regarding the course will be provided on the first day of class. The proposed methodology seeks to encourage the student's continued work and focuses on the most Practices of Statistics: the work with real data.

In the sessions with the complete group, theoretical aspects are treated in the form of a Lecture, that complements each other with its application to solve problems of real nature in the classes of problems in small groups.

The processing of real data is done in sessions in the computer lab using computer programs, and, in addition, basic problems of Optimization are solved by the computer.

The evaluation focuses on both theoretical and applied aspects according to the evaluation criteria established.

4.2.Learning tasks

The course includes 6 ECTS organized according to:

- Lectures (3 ECTS): 30 hours.
- Laboratory sessions (1.5 ECTS): 15 hours.
- Guided assignments (1.5 ECTS): 15 hours.
- Autonomous work: 90 hours.
- Tutorials: 6 hours/week

Lectures: the professor will explain the theoretical contents of the course and solve illustrative applied problems. These problems and exercises can be found in the problem set provided at the beginning of the semester. Lectures run for 2 weekly hours. Although it is not a mandatory activity, regular attendance is highly recommended.

Laboratory sessions: sessions will take place every 2 weeks (6 sessions in total) and last 2.5 hours each. Students will work together in groups actively doing tasks such as practical demonstrations, measurements, calculations, and the use of graphical and analytical methods.

Guided assignments: students will complete assignments, problems and exercises related to concepts seen in laboratory sessions and lectures. Guided assignments run for 1 weekly hour. They will be submitted at the beginning of every laboratory sessions to be discussed and analyzed. If assignments are submitted later, students will not be able to take the assessment test.

Autonomous work: students are expected to spend about 90 hours to study theory, solve problems, prepare lab sessions, and take exams.

Tutorials: the professor's office hours will be posted on Moodle and the degree website to assist students with questions and doubts. It is beneficial for the student to come with clear and specific questions.

4.3.Syllabus

The course will address the following topics:

Sections

Section 1: Exploratory data analysis in the computer laboratory.

Section 2: Models of the probability distribution.

Section 3: Sampling, estimation and hypothesis tests.

Section 4: Introduction to Optimization.

Section 1: Exploratory Data Analysis

Descriptive statistics

Basic concepts. Types of variables.

Data organization. Frequency table.

Graphic descriptions of a variable.

Numerical descriptions of a variable. Box-plot.

Bidimensional distributions. Bidimensional table.

Marginal and conditional distributions.

Measures of association. Regression and correlation.

Section 2: Models of the probability distribution

Basic concepts. Sample space and events, algebra of events. Random and deterministic experiments.

Interpretations of probability.

Kolmogorov axiomatic definition.

Conditional probability. Independence of events.

Partition of a sample space, law of total probability and Bayes theorem.

Reliability of systems.

Random variables

Definition of random variable. Classification.

Discrete random variable, probability function, distribution function.

Continuous random variable, density function, distribution function.

Expectation of a random variable and of a function of a random variable.

Basic properties of expectation and variance

Moments of a random variable.

Other measures of central tendency and dispersion.

Chebyshev inequality.

Main discrete distributions: Bernoulli, binomial, Poisson, geometric, hypergeometric.

Main continuous distributions: uniform, exponential, normal.

Reproductivity of random variables.

Poisson process: relationship to exponential distribution.

Approximations between random variables.

Two-dimensional distributions. Calculation of expectations and variances of a linear combination of independent random variables.

Section 3: Sampling, estimation and hypothesis tests

Sampling and Estimation

Introduction. Basic concepts associated with sampling distributions in normal populations: chi-square, Student's t, F.

Distributions important statistical sampling: Central Limit Theorem and Fisher theorem.

Confidence interval estimation. Intervals for means, variances and proportions. Calculation of the minimum sample size.

Hypothesis tests: null and alternative hypothesis, level of significance.

Relationship between confidence intervals and hypothesis tests.

Calculating the p-value.

Hypothesis testing for means, variances and proportions.

Chi-square and tests of contingency tables.

Section 4: Introduction to Optimization

Optimization problems

Decision variables, objective function and constraints.

Linear programming problems: graphic resolution.

Contents of Practical classes in the computer laboratory

? Uni-dimensional descriptive statistics.

? Instructions for implementation of the Statistical Report.

? Two-dimensional Descriptive Statistics. Regression and correlation.

? Probability distributions of discrete and continuous random variables.

? Test goodness of fit.

? Hypothesis testing for means, variances and proportions.

? Introduction to Optimization.

4.4.Course planning and calendar

For further details concerning the timetable, classroom and further information regarding this course please refer to the "Escuela de Ingeniería y Arquitectura " website (https://eina.unizar.es/)

4.5.Bibliography and recommended resources