Universidad Zaragoza

Academic Year/course: 2021/22

30108 - Statistics

Syllabus Information

Academic Year: 2021/22
Subject: 30108 - Statistics
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
179 - Centro Universitario de la Defensa - Zaragoza
Degree: 425 - Bachelor's Degree in Industrial Organisational Engineering
563 - Bachelor's Degree in Industrial Organisational Engineering
ECTS: 6.0
Year: 563 - Bachelor's Degree in Industrial Organisational Engineering: 2
425 - Bachelor's Degree in Industrial Organisational Engineering: 1

Semester: 563 - First semester
425 - Second semester
Subject Type: Basic Education
Module:

1. General information

1.1. Aims of the course

The subject and its expected results respond to the following approaches and objectives:

In this subject the student is introduced to practical data processing. He is initiated in the use of computer-like tools, and through them, aspects of data collection, presentation and analysis are covered. Likewise, the student acquires the ability to write and / or present reports on the information obtained. The study of uncertainty approaches the student to the modeling of real situations and introduces him to the concept of process simulation. Finally, the basic concepts of statistical inference such as confidence intervals and hypothesis testing are the basis for analyzing basic statistical techniques in the engineering profession. The final goal for the student is to integrate the basic knowledge of this subject in all types of processes within the industrial organization, so that they serve as a basis for other subjects and in turn acquire statistical techniques that allow their professional development.

1.2. Context and importance of this course in the degree

This subject belongs to the basic training module which addresses the ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculation; differential equations and partial derivatives; numerical methods; numerical algorithm; statistics and optimization. This skill is covered by the subjects Mathematics I, Mathematics II, Mathematics III and Statistics.

Defence: This subject gives the students the necessary skills to understand the basic statistical language, estimate probabilities, analyze data, and make informed decisions based on that data.

1.3. Recommendations to take this course

It is recommended that the student has basic knowledge of integral and differential calculus. Familiarity with the use of symbolic and numerical software is also highly valuable.

2. Learning goals

2.1. Competences

Upon passing the subject, the student will be more competent to:

Ability to plan, budget, organise, manage and monitor tasks, people and resources.

Ability to solve problems and take decisions with initiative, creativity and critical reasoning.

Ability to communicate knowledge and skills in Spanish.

Ability to use techniques, skills and tools necessary to practise engineering.

Ability to solve mathematical problems in engineering. Ability to apply knowledge about statistics and optimisation.

Knowledge and capacities for applying qualitative methods of decision-making in organisations.

2.2. Learning goals

In order to pass this subject the student must demonstrate the following results:

He uses data processing and analysis techniques and uses some statistical software to summarize, classify and present the data.

He is able to apply the concepts, applications and fundamental results of probability.

He differentiates the basic concepts of a one-dimensional and multidimensional random variable and distinguishes the different formulation existing between discrete and continuous random variables.

He is able to choose the appropriate technique for the modeling of engineering environments under stochastic nature through random variables as well as performing calculations in situations of uncertainty.

He argues the choice of estimators for a parameter and distinguishes between point and interval estimates. He knows the importance of analyzing the uncertainty around the parameter estimate.

He raises statistical hypotheses and selects the appropriate mathematical tool to make an acceptance or rejection decision.

He is able to elaborate, understand and criticize reports based on statistical analysis.

He solves statistical problems of calculation of probabilities and hypothesis contrasts using statistical software.

He distinguishes between different probability models and is able to simulate them using appropriate statistical software.

He uses data processing and analysis techniques and uses some statistical software to summarize, classify and present the data.

2.3. Importance of learning goals

In the subject of statistics, the basic principles of decision-making are taught in the presence of uncertainty. Students develop competences to address real problems, to work with data and learn to recognize and manage models that serve to describe situations in which there is randomness. In the professional practice, an engineer must handle information from databases and must be able to make decisions based on that information, the techniques of exploratory analysis, probability models and hypothesis testing are basic in that context. On the other hand, the constant improvement and decision making can be based on information based on simulation processes, in this aspect, the simulation of real systems requires a modeling process to which the concepts of uncertainty developed in this subject are not unrelated.

3. Assessment (1st and 2nd call)

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

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Continuous assessment system:

- Exams: During the course two main exams will be conducted. They will focus on theoretical and / or practical aspects of the subject:

  Written test 1: Week 8 will be held and will focus on the subject in the first 8 weeks of the course. Its weight in the final grade will be 30%.

  Written test 2: Week 15 will be made and will focus on the subject in the second half of the course. Its weight in the final grade will be 30%.

- Participatory controls: Throughout the course, students will perform six participatory controls together valued at 20% of the final grade, which consist of conducting practical exercises.

- Applied work: Throughout the course, students will perform two works applied to matters of the subject, its valuation is 20% of the final grade.

Overall Assessment: Students who have not passed the subject with the system of continuous assessment, have to pass a global exam whose weight in the final grade will be 80%. Also, they must submit the two applied work required during the course.

Evaluation criteria

In the written tests, controls and work participation will be evaluated:

Practical exercises must be properly raised. If a computer program is used in solving exercises, the code used and in any case the results are clearly explained be detailed. The probability distribution assigned to each random variable must be duly justified, identifying the value or values ??of the model parameters. Hypothesis testing will arise clear and defined manner.

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January call:

There will be applied tests and assignments during the the semester. The amount and type will be adapted to the circumstances of the course. The weight in the course grade will be 20%.

There will be a midterm exam whose value on the course grade will be 35%.

The rest of the grade, 45% of the course grade, corresponds to a final exam.

To pass the subject it is required to obtain 50% or more in the aggregated course grade.

August call:

A single exam for all the grade will be taken. To pass the subject the student must obtain 50% or more in this exam.

Evaluation criteria

Both the tests carried out during the academic period and the written exam will assess the following aspects:

- The understanding of the statistical concepts used to solve the problems.
- The use of appropriate strategies and procedures in their resolution.
- Clear and detailed explanations with justification of the answers.
- The correct interpretation of the results obtained.
- Correct use of the terminology and the own notation of the subject.
- Orderly, clear and organized exposition of the procedures used.
- The proper use of computer tools and / or statistical software (if applicable).
- The result and final quality of the work (if applicable).

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

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The proposed methodology seeks to promote student work and continued focus on the more practical aspects of statistics: working with real data.

In order to achieve this goal all practical classes (2 hours per week) will be held in the computer room, using R programming language. The theoretical explanations of the concepts of the subject (2 hours weekly) will be reinforced by examples or case studies analyzed with the computer.

If classroom teaching were not possible due to health reasons, it would be carried out on-line.

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The proposed methodology tries to promote the continuous work of the student focusing on the theoretical and practical aspects of Statistics: learning of basic concepts such as random variable, probability distribution, differences between sample and population and the application to studies based on real data.

In order to achieve this objective, classes will combine theory with problem-solving sessions and also computer lab sessions with specific software.

In addition, an individual tutorial will be offered to students for solving doubts and helping for the evaluation tests.

If this teaching could not be done in person for health reasons, it would be done telematically.

4.2. Learning tasks

The course includes the following learning tasks:

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The course is organized with 4 hours of class a week for the 15 weeks of the semester. Some of these hours are taught in the computer room, and in them, the teacher explains the more practical aspects of the subject, which are reinforced with practical work by using statistical analysis programs.

Tutored self-employment: 2 hours per week for 15 weeks where the student works autonomously in the computer room in performing work.

Personal work: 60 hours

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The subject consists of different types of activities:

Presential activities, that are:

1. Magistral classes.
2. Problem-solving classes.

3. Use of statistical software.
4. Personal tutorials.
5. Realization of evaluations tests.

Non presential activities:

1. Realization of group activities.
2. Autonomous study.

4.3. Syllabus

The course will address the following topics:

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- Descriptive statistics: quantitative and qualitative data. Graphical representation: pie chart, bar plot, histogram, bar chart. Summary measurements: mean, median, quantiles, range, interquartile range, standard deviation, variance, coefficient of variation of Pearson. Measures of skewness and Kurtosis. Box plots, stem-and-leaf plot. Multidimensional distributions: marginal distribution, conditional distribution, scatterplot, linear regression.
- Probability: Elements of probability: Event. Probability. Probabilistic space. Conditional probability. Total probability theorem. Bayes theorem. Random variables: Discrete: mass function, distribution function. continuous: density function, distribution function. Expected value: mean, variance. Discrete distributions: Bernoulli trials, binomial, Poisson distribution. Continuous distributions: normal, exponential, uniform distribution, beta, gamma distribution. Multivariate random Variables: probability function, expected value, covariance, independence V.A., distribution chi-square, Student's t, F Snedecor.
- Introduction to reliability theory: Quality and reliability function, reliability 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 estimation and interval. Fisher theorem. Central limit theorem. Confidence intervals.
- Hypothesis testing: null and alternative hypotheses. Error type I and II, significance level, power of contrast. unilateral and bilateral tests. P-value.
- The goodness of fit: Kolmogorov-Smirnov test.
- Multivariate linear regression model: Parameter Estimation. stepwise procedures: backward and forward. Akaike index. Residue analysis.

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Contents of the subject are the following:

PART 1: PROBABILITY AND RANDOM VARIABLES

1. Probability: Combinatorics. Concept of probability and its computation. Conditional probability. Total Probability and Bayes Theorems.
2. Random Variables: Concept of random variable, probability, and density function. Characteristics of random variables. Discrete and continuous random variables and principal types (Bernouilli, Binomial, Uniform, Poisson, Normal and associated distributions). Central Limit Theorem. Chebyshev's inequality. Random vectors.

PART 2: DESCRIPTIVE STATISTICS AND STATISTICAL INFERENCE

1. Descriptive statistics: Univariate analysis: frequency tables and graphics, characteristic measures (position, dispersion, and shape). Bivariate analysis: contingency tables, marginal distributions, correlation, and regression analysis.
2. Statistical inference: Estimators and their distributions. Estimation theory. Confidence intervals (mean, variance and proportion). Statistical hypothesis testing (mean, variance, the proportion for one and two independent samples). Related samples. p-value.

4.4. Course planning and calendar

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Since the subject consists of 6 ECTS credits, and each consists of 25 hours divided into 10 hours of supervised work and 15 hours of autonomous work, activities of classroom learning (lectures, practical classes and seminars) and activities continuous assessment (participatory controls and written tests) will occupy 60 hours during the semester. Other classroom activities as personal and tutorials non-contact as the study for the assimilation of concepts and techniques, practice for familiarization with computer tools, problem-solving and test preparation, will require 90 hours of independent student work. All these activities should add the 150 hours required to achieve learning outcomes pursued the subject.

The concrete and comprehensive planning of the course it will be informed to students at the beginning of the course. Also from the beginning of the course, it will be set the dates of the official announcements from the school management.

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Presential activities will take place according to the established distribution, which depends on the Direction of the CUD. Specific information can be found on the web site http://cud.unizar.es.

The subject is thought for 4 hours per week for 15 weeks.

4.5. Bibliography and recommended resources

References available at: http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30108