Universidad Zaragoza

Academic Year/course: 2022/23

28808 - Statistics

Syllabus Information

Academic Year: 2022/23
Subject: 28808 - Statistics
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 424 - Bachelor's Degree in Mechatronic Engineering
ECTS: 6.0
Year: 1
Semester: Second semester
Subject Type: Basic Education
Module:

1. General information

1.1. Aims of the course

The subject and its expected results meet the following approaches and objectives:

In this course, the student is introduced in the processing of data analysis at a practical level. They are started in using statistical software, and through them, aspects of collection, presentation and data analysis are covered. Also, the student acquires the ability to write and report on the information obtained.

The study of uncertainty and inference approach the student to model real situations and introduces the concept of process simulation. Finally, the basic concepts of statistical inference as confidence intervals and hypothesis testing are the basis for analyzing basic statistical techniques in the engineering profession.

The ultimate goal is that the student integrates the basic knowledge of this subject in all kinds of processes, so as a basis for other materials and in turn acquire some statistical techniques that help them in their professional development.

These approaches and objectives are in line with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the course learning outcomes provides training and competence to contribute to their achievement to some degree.

1.2. Context and importance of this course in the degree

The subject is mandatory and it is part of the basic training of students. It is part of the second half of the curriculum of the Degree of Mechatronic Engineering, which means that the student has acquired training in learning outcomes in the subject of Mathematics I and is taught simultaneously with the subject of Mathematics II. In addition, the statistic provides skills that will be useful tools in different subjects in later courses with content in Economics, Quality, etc.

Various parameters in Economics, improving quality, improving existing systems and new systems simulation, are typical of engineer activities. Statistical techniques are an essential tool as it provides descriptive and analytical methods for addressing data processing.

For these reasons, statistics is a basic tool in the formation of a mechatronic engineer.

1.3. Recommendations to take this course

It is recommended that the student possesses basic knowledge of differential and integral calculus. Also, it is advisable certain familiarity with the use of symbolic and numeric computation programs.

2. Learning goals

2.1. Competences

To pass the course, students will be more competent to ...

Generic competence:

GI03. Knowledge in basic materials and technology that will enable them to learn new methods and theories, and equip them with the versatility to adapt to new situations.

GI04. Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and transmit knowledge and skills in the field of Mechatronics Engineering.

GC02. Interpret experimental data and compare them with the theoretical conclusions.

GC03. Capacity for abstraction and logical reasoning.

GC04. Ability to learn continuously, self-directed and autonomous.

GC05. Ability to evaluate alternatives.

GC07. Ability to lead a team and being a committed member of the same.

GC08. Ability to locate technical information, as well as their understanding and appreciation.

GC10. Ability to write technical documentation and to present it using appropriate tools.

GC11. Ability to communicate their thoughts and designs so clear to specialists and non-specialists.

Specific skills:

EB01. Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge of Statistics.

2.2. Learning goals

The student, for passing this subject, should demonstrate the following results ...

It has the ability to apply data analysis.
They are familiar with the concepts, applications and key results of probability.
They have the ability to modelling engineering environments under stochastic nature by random variables and performing calculations in situations of uncertainty.
They are familiar with sampling techniques and estimation.
They know how to use statistical hypothesis tests and their application in decision making.
They have the capacity for development, and critical understanding based reports in statistical analysis.

2.3. Importance of learning goals

In the course of statistics, the basic principles of decision making in the presence of uncertainty they are taught. Students develop skills to address real problems, to work with data and learn to recognize and manage models that serve to different situations in which there is randomness.

In practice, an engineer must handle information from databases and must be able to make decisions based on that information, the techniques of exploratory analysis and hypothesis testing are essential in this context.

On the other hand, constant improvement and decision making can be based on information based on simulation processes, in this regard, the simulation of real systems requires modelling process that is not alien to the concepts of uncertainty developed in this subject.

3. Assessment (1st and 2nd call)

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

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 in the computer room.

- 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 a clear and defined manner.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

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 practice sessions (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.

The approach, methodology and assessment of this guide are intended to be the same for any teaching scenarios. They will be adapted to the social-health situation at any particular time, as well as to the instructions given by the authorities concerned.

4.2. Learning tasks

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. The teacher explains the more practical aspects of the subject, which are reinforced with practical work by using statistical analysis programs.

Tutored autonomous work: 2 hours per week for 15 weeks where the student works autonomously in the computer room in performing work.
Personal work: 60 hours

4.3. Syllabus

The course will address the following topics:

- Descriptive statistics: quantitative and qualitative data. Graphical representation: pie chart, bar plot, histogram, bar chart. Summary measurements: mean, median, quartiles, 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.

4.4. Course planning and calendar

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 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.

The activities to be developed in the subject are as follows:

- lectures, in which the fundamental concepts that constitute the body of basic knowledge are exposed. The theoretical concepts are complemented by detailed examples that illustrate its operation within a specific context.
- Practical classes in which problems to be resolved using the methods and concepts considered previously proposed. In these classes, the discussion, participation, cooperation and reflection is encouraged.
- Evaluation sessions, where students undergo written tests on certain well-specified parts of the program.

4.5. Bibliography and recommended resources

Bibliography available in: http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28808&Identificador=12521