Universidad Zaragoza

Year : 2020/21

28711 - Statistics

Syllabus Information

Academic Year: 2020/21
Subject: 28711 - Statistics
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 423 - Bachelor's Degree in Civil Engineering
ECTS: 6.0
Year: 2
Semester: Second semester
Subject Type: Basic Education
Module: ---

1.General information

1.1.Aims of the course

This course is an introduction to practical data treatment. It covers compiling, presentation and data analysis through the use of software tools. Moreover, the student acquires the ability of prepare and present reports on the gathered information. The study of uncertainty introduces the student to real-life modelling and proccess simulation. Finally, basic statistical inference concepts such as confidence intervals and hypothesis test serve as a basis for more advanced, engineering-inspired statistical techniques. The ultimate goal is that students integrate basic knowledge of the course in all kinds of topics related with their future professional life.

1.2.Context and importance of this course in the degree

This course is compulsory and belongs to the basic education module. It is taken during the second semester of the second year of the Bachelor's Degree in Civil Engineering It is assumed that the student has acquired the learning goals in Mathematics I and Mathematics II courses.

Moreover, Statistics provides skills in tools relevant to different subsequent courses with contents such as economy, quality, etc. Different economic parameters, quality improvement, system refinement and new system simulation are activities specific to engineers.

Because of these reasons, Statistics is a basic tool in a Civil Engineer's education.

1.3.Recommendations to take this course

The recommended profile to take the Statistics course is to possess working knowledge of differential and integral calculus. In addition, it is highly advisable that the student be familiar with symbolic and numeric software tools.

2.Learning goals

2.1.Competences

In passing this subject, the student will be competent in:

- G01 - Ability to scheduling and organization
- G02 - Ability to problem solving
- G03 - Ability to decision making
- G04 - Ability for oral and written communication in the native language
- G05 - Ability for analysis and synthesis
- G06 - Ability to manage information
- G07 - Ability for teamwork
- G08 - Ability for critical reasoning
- G09 - Ability to work in an interdisciplinary team
- G10 - Ability to work in an international context

- G11 - Improvisation and adaptation capacity to face new situations
- G12 - Leadership aptitude
- G13 - Positive social attitude towards social and technological innovations
- G14 - Ability to reason, discuss and present your own ideas
- G15 - Ability to communicate through words and images
- G16 - Ability to search, analyze and select information
- G17 - Ability for independent learning
- G18 - Possess and understand knowledge in an area of study that starts at the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that involve cutting-edge knowledge from your field of study
- G19 - Apply their knowledge to their work or vocation in a professional way and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and problem solving within their area of study
- G20 - Ability to collect and interpret relevant data (usually within their area of study) to make judgments that include reflection on relevant issues of a social, scientific or ethical nature
- G21 - Transmit information, ideas, problems and solutions to a specialized and non-specialized audience
- G22 - Develop those learning skills necessary to undertake further studies with a high degree of autonomy
- G23 - Know and understand respect for fundamental rights, equal opportunities for women and men, universal accessibility for people with disabilities, and respect for the values of the culture of peace and democratic values
- G24 - Promote entrepreneurship
- G25 - Knowledge in information and communication technologies
- B01 - Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; ordinary and partial differential equations; numerical methods; statistics and optimization

2.2.Learning goals

The student, in order to pass this subject, will have to achieve the following goals...

- He/She employs data analysis and processing techniques and uses some statistical software to summarize, classify and present the data.
- He/She is able to apply the concepts and fundamental results of probability theory.
- He/She recognizes basic concepts of one-dimensional and multidimensional random variables and distinguishes the different formulation between discrete and continuous random variables.
- He/She is able to choose the appropriate technique for modeling engineering environments of stochastic nature using random variables as well as carrying out calculations in situations of uncertainty.
- He/She argues the choice of estimators for a parameter and distinguish between point and interval estimation.
- He/She knows the importance of analyzing the uncertainty around a parameter estimate.
- He/She makes statistical hypotheses and selects the adequate mathematical tools to accept or reject a hypotesis test.
- He/She is able to prepare, understand and criticize reports based in statistical analysis.
- He/She solves probability and hypothesis testing problems using statistical software.
- He/She distinguishes between different probability models and he/she can simulate them using appropriate statistical software.

2.3.Importance of learning goals

In Statistics, basic principles of decision making in the presence of uncertainty are taught. Students develop skills to

tackle real problems and work with data. They learn to recognize and handle models used to describe different situations in presence of randomness.

In 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 and hypothesis testing are basic in that context. On the other hand, constant improvement and decision making may be based on information obtained through simulation. Real system simulation requires a modeling process based on 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)

Students must show that they have achieved the expected learning outcomes through the following assessment activities:

- **Continuous assessment system:**
    - **Written tests:** Throughout the semester there will be two written tests on theoretical and practical aspects on the subject:

      Written test 1:
      It will be done on week 8. It will cover Probability topics. It is related with learning goals 2, 3 y 4. Its weight in the final grade will be 35 %.

      Written test 2:
      It will be done on week 14. It will cover Estimation and Hypothesis Test topics. It is related with learning goal 5. Its weight in the final grade will be 35 %.

      These tests will assess:
        - The understanding of mathematical and statistical topics used in problem solving.
        - The correct use of strategies and appropriate procedures towards its resolution.
        - Clear and detailed explanations.
        - The correct use of terminology and notation.
        - Orderly, clear and organized exhibition.

      In order to opt for the continuous assessment modality, it is necessary to attend at least 80% of the classroom activities of the subject.

    - **Participatory test:** Throughout the course, the student will carry out 6 participatory tests valued at 5% of the final grade. They will consist of carrying out practical exercises. The learning goals they are related to are 2, 3, 4, 5 and 6.
      These tests will assess:

        - The understanding of mathematical and statistical topics used in problem solving.
        - The correct use of strategies and appropriate procedures towards its resolution.
        - Clear and detailed explanations.
        - The correct use of terminology and notation.
        - Orderly, clear and organized exhibition.

- **Global assessment:** Students who have not passed the subject with the continuous assessment system must take a compulsory written test in official calls equivalent to the written tests described in point 1, whose weight in the final grade will be 100%. The evaluation criteria will be those described in the previous sections.

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. A wide range of teaching and learning tasks are implemented, such as lectures, practice sessions, tutorials, and autonomous work and study.

A strong interaction between the teacher/student is promoted. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

The current course, Statistics, is conceived as a stand-alone combination of contents, yet organized into three fundamental

and complementary forms, which are: the theoretical concepts of each topic, problem-solving or resolution of questions, and at the same time supported by other activities.

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

4.2.Learning tasks

This course is organized as follows:

- **Lectures**: The theoretical concepts of the course are explained and illustrative examples are developed as a support to the theory when necessary.
- **Practice sessions**: Problems and practice sessions are carried out, complementary to the theoretical concepts studied.
- **Autonomous work and study**
    - Study and understanding of the theory taught in the lectures.
    - Understanding and assimilation of the problems and practical cases solved in the practical classes.
    - Preparation of seminars, solutions to proposed problems, etc.
    - Preparation of the written tests for continuous assessment and final exams.
- **Tutorials**.

4.3.Syllabus

This course will address the following topics:

1. Introduction to the Statistics Programming Language R
2. Descriptive Statistics
3. Probability Theory
4. Random Variables
5. Useful Distributions
6. Multidimensional Random Variables
7. Reliability Theory
8. Linear Programming
9. Point Estimates and Confidence Intervals
10. Hypothesis test
11. Multivariate Linear Regression

4.4.Course planning and calendar

Week	No. Topic	Topic	Tests	Weight	Content
1	1	R Introduction			
2	2	Descriptive Statistics	1st test	5	Descriptive St.
3	3	Probability	2nd test	5	Probability
4	4	Random Variables			
5	5	Distributions			
6			3rd control	5	Distributions
7	6	Multidimensional RV			
8	7	Reliability Theory	1st exam	35	Probability
9	8	Linear Programming	4th test	5	Linear Programming
10	9	Statistical Inference			
11		Confidence Intervals	5th test	5	Estimation
12	10	Hypothesis Tests			

13					
14			6th test	5	Hyp. Tests
15	11	Linear Regression	2nd exam	35	Inference

Further information concerning the timetable, classroom, office hours, assessment dates (https://eupla.unizar.es/asuntos-academicos/examenes) and other details regarding this course will be provided on the first day of class or please refer to the Faculty of EUPLA website and Moodle.

4.5.Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=28711&year=2020