Course guides
2500014 - GECPROBEST - Probability and Statistics

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.
Degree: BACHELOR’S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Compulsory subject).
Academic year: 2021 ECTS Credits: 6.0 Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer: MARÍA ISABEL ORTEGO MARTÍNEZ
Others: AGUSTIN MEDINA SIERRA, MARÍA ISABEL ORTEGO MARTÍNEZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14392. 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 algorithmic; Statistics and optimization. (Basic training module)

TEACHING METHODOLOGY

The course consists of 2 hours per week of classroom activity (large size group) and 2 hours weekly with half the students (medium size group).

The 2 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 2 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.
LEARNING OBJECTIVES OF THE SUBJECT

Development of the fundamental concepts and methodology of probability and statistics. Application of non-deterministic methods of analysis to civil and environmental engineering problems: probability, descriptive statistics, random variables, statistical inference. Basic use of specific computer software for the application of these methodologies.

1. Ability to perform data analysis of a problem in Civil Engineering using a computer tool that uses the techniques studied.
2. Ability to perform multiple linear regression analysis using computer programs.
3. Ability to perform data simulations and transformation of random variables, as well as the study of distributions.

Knowledge and skills for data representation and processing, including basic knowledge of databases as well as computer programs with engineering applications, as well as statistical concepts. Knowledge of data analysis. Knowledge of regression models, estimation of parameters. Knowledge of probability and uncertainty.
Basic knowledge of point and interval estimation; hypothesis testing.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
<tr>
<td>Self study</td>
<td>84,0</td>
<td>56.00</td>
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Total learning time: 150 h

CONTENTS

Data exploration

Description:
Scale, support and data transformation. Location and dispersion measures
Graphic representations. Sample distribution.
Multivariate data. Covariance and linear correlation.
Minimum square line fit. Trends

Full-or-part-time: 14h 23m
Theory classes: 4h
Laboratory classes: 2h
Self study: 8h 23m
Elemental Probability

**Description:**
Definition and properties of probability
Total probability theorem and Bayes theorem. Experimental model.
Probability calculation

**Full-or-part-time:** 14h 23m
Theory classes: 4h
Practical classes: 2h
Self study : 8h 23m

Univariate probabilistic models

**Description:**
Random variable
General discrete models. Commonly used discrete models.
Continuous models. Frequently used continuous models.
Normal distribution. LogNormal and logitNormal distributions
Simple transformations of random variables.
Model applications

**Full-or-part-time:** 24h
Theory classes: 8h
Practical classes: 2h
Self study : 14h

Simulation of random variables

**Description:**
Elementary simulation methods. Simulation and representation of samples. Basic Monte Carlo method.

**Full-or-part-time:** 4h 48m
Laboratory classes: 2h
Self study : 2h 48m

Multivariate probabilistic models

**Description:**
Multivariate probabilistic models
Multivariate normal distribution
Central limit theorem
Applications of multivariate models

**Full-or-part-time:** 14h 23m
Theory classes: 4h
Practical classes: 2h
Self study : 8h 23m
## Evaluation

**Full-or-part-time:** 19h 12m  
Laboratory classes: 8h  
Self study : 11h 12m

## Parameter estimation

**Description:**  
Statistics. Estimators. Method of moments  
Likelihood of a sample. Maximum likelihood method.  
Properties of estimators  
Applications of point parameter estimation.  
Central limit theorem. Distributions of usual statistics.

**Full-or-part-time:** 16h 48m  
Theory classes: 3h  
Practical classes: 2h  
Laboratory classes: 2h  
Self study : 9h 48m

## Contrast of statistical hypotheses

**Description:**  
Hypothesis tests  
Contrasts in normal context  
Contrasts in Normal context  
Simulated contrasts. Other contrast statistics.

**Full-or-part-time:** 14h 23m  
Theory classes: 2h  
Practical classes: 2h  
Laboratory classes: 2h  
Self study : 8h 23m

## Multiple linear regression

**Description:**  
Linear regression model and adjustment for least squares  
Complete linear model. Hypothesis and evaluation of the model.

**Full-or-part-time:** 21h 36m  
Laboratory classes: 9h  
Self study : 12h 36m
GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

EXAMINATION RULES.

The materials and resources to carry out the tests (calculator, forms ...) will be determined for each exam session. Information will be posted on Atenea.

BIBLIOGRAPHY

Basic:

Complementary: