Course guide
2500215 - GEA0215 - Statistics

Last modified: 19/06/2024

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2020). (Compulsory subject).
BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING / BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING (Syllabus 2024). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: AGUSTÍ PÉREZ FOGUET

Others: AGUSTÍ PÉREZ FOGUET
Sarrate Ramos, Jose

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14445. Recognize the biological bases and foundations of the plant and animal field in engineering: notions of genetics, biochemistry and metabolism, physiology, organisms and environment, population dynamics, flows of matter and energy and changes in ecosystems, biodiversity, principles of the kinetics of microbial growth and reactor theory.
14447. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
14451. Apply the fundamental concepts of statistics and randomness of physical, social and economic phenomena, as well as uncertainty and decision-making techniques.
14452. Enhance the capacity of spatial vision and identify the techniques of graphic representation, topography, photogrammetry, cartography, remote sensing and Geographic Information systems.
14453. Describe and apply the techniques of analysis of physical, chemical and biological parameters; Integrate the experimental evidence found in field and / or laboratory data with the theoretical knowledge and interpret its results.
14454. Formulate the principles of fluid mechanics and the fundamentals of continuous medium mechanics.
14455. Identify the concepts and technical aspects linked to the conduit systems, both in pressure and in free sheet and apply them to the water supply transport networks; pumping systems; unit networks; separative networks; Avenues prevention systems in urban areas and analysis of tools for the recovery of altered river and coastal spaces.
14456. Describe the processes linked to the water cycle: atmospheric circulation and rain formation; rain transformation into runoff; and apply them to surface and underground hydrology associated with avenues risk, surface water pollution, aquifer management and groundwater pollution.

Generical:
14440. Identify, formulate and solve problems related to environmental engineering.
14441. Apply the functions of consulting, analysis, design, calculation, project, construction, maintenance, conservation and exploitation of any action in the territory in the field of environmental engineering.
14442. To use in any action in the territory proven methods and accredited technologies, in order to achieve the greatest efficiency respect for the environment and the protection of the safety and health of workers and users.

TEACHING METHODOLOGY

The subject consists of 2 hours a week of face-to-face classes in the classroom (large group) and 2 hour a week with half of the students (medium group). They dedicate to theoretical classes 2 hours in big group, in which the profesorado exposes the concepts and basic materials of the matter, and presents examples and exercises. 2 hour (middle group) is devoted to solving problems with greater interaction with students and to laboratory practices. Practical exercises are carried out in order to consolidate general and specific learning objectives. Support material is used in the format of a detailed teaching plan through the ATENEA virtual campus: contents, programming of assessment and guided learning activities and bibliography.

LEARNING OBJECTIVES OF THE SUBJECT

Knowledge is provided for data analysis, representation and treatment, as well as for solving uncertainty and statistical problems and their application to scientific-technological subjects, as well as applied technological ones.

1. Perform data analysis of environmental engineering problems using computer tools that use the techniques studied.
2. Perform multiple linear regression analysis using computer programs.
3. Perform data simulations and transformation of random variables, as well as the study of probability distributions.

Statistics. Knowledge will be raised for data analysis, representation and treatment, as well as for solving statistical and uncertainty problems and its application to scientific-technological subjects, as well as applied technological

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours medium group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Probability models

Description:
Probability model. Sample space. Events. Set diagrams.
Law of total probability. Uniform probability in finite spaces. Permutations. Combinations.
Conditional probability. Bayes Theorem. Independence between events. Probability interpretation. Relative frequency. Uncertainty measure.
Probability problems.

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

Probability distributions

Description:
Random variable. Distribution. Cumulative distribution function. Quantile function. Median. Discrete random variable. Continuous random variable. Probability density function. Parametric distributions, discrete and continuous distributions. Transformation of random variables. Bivariate distributions. Joint and marginal distributions. Conditional distributions. Mixture distributions. Independence between random variables.
Stochastic process. Markov model. Poisson process.
Hope. Variance. Standard deviation. Covariance. Correlation. Chebychev inequality.
Probability distribution problems.

Full-or-part-time: 30h
Theory classes: 6h
Practical classes: 6h
Self study : 18h

Descriptive statistics

Description:
Sample. Statisticians. Location. Dispersion. Symmetry. Order.
Histograms. Box plots. Cumulative sampling distribution. Q-Q plot.
Exploratory data analysis.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

Parameter estimation

Description:
Law of large numbers. Central limit theorem. Fisher–Tippett theorem.
Properties of the estimators. Bias. Consistency. Minimum variance.
Estimation by the method of moments. Properties. Improvements.
Likelihood function. Maximum plausible estimate. Invariance principle. Asymptotic behavior.
Estimation of confidence intervals (using normal distribution, t, chi2). Estimation of prediction intervals.
Bayes estimation. Uniform a priori distribution. Credibility intervals. Conjugate distributions.
Problems on parameter estimation.

Full-or-part-time: 40h
Theory classes: 8h
Practical classes: 8h
Self study : 24h

Hypothesis testing

Description:
Definition. Type I and II errors. Power. p-value.
Parametric tests.
Tests on mean and variance of normal populations.
Likelihood ratio test.
Non-parametric and goodness-of-fit tests.
Sample size selection.
Problems on hypothesis tests

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

Linear regression

Description:
Simple linear regression.
Multiple linear regression. Categorical variables.
Normal regression model.
Coefficient of determination. ANOVA.
Influence measures. Outliers
Linear regression problems.

Full-or-part-time: 30h
Theory classes: 6h
Practical classes: 6h
Self study : 18h

GRADING SYSTEM

The grade for the subject is obtained from the continuous assessment grades . Continuous assessment consists of carrying out different activities, both individual and group, of an additive and formative nature, carried out during the course (inside and outside the classroom). The assessment tests consist of a part with questions on concepts associated with the learning objectives of the subject in terms of knowledge or understanding, and a set of application exercises. The course grade corresponds to 20% partial exam, 30% final exam and 50% course follow-up.

Re-evaluation (RE)
Criteria for grading and admission to re-evaluation (RE):

Students failed in the ordinary assessment who have regularly sat the assessment tests of the failed subject will have the option to take a re-evaluation test in the period set in the academic calendar. Students who have already passed the re-evaluation test of a subject and students who have not handed in all the exercises/problems (Pr) and the assignments and reports (Tr) will not be able to sit the re-evaluation test of a subject.

The re-evaluation (RE) will consist of a single exam covering the whole course content. The maximum mark for the re-evaluation will be five (5.0) and the final mark for the course will be the maximum mark between the continuous assessment and the re-evaluation exam, i.e. MAX(EO,RE).

The non-attendance of a student summoned to the re-evaluation test, held in the fixed period, may not give rise to the taking of another test at a later date. Extraordinary assessments will be carried out for those students who, due to accredited force majeure, have not been able to take any of the continuous assessment tests. These tests must be authorised by the corresponding Head of Studies, at the request of the teacher responsible for the subject, and will be held within the corresponding teaching period.

EXAMINATION RULES.

If any of the continuous assessment activities are not carried out in the scheduled period, it will be considered a zero score. The tests will be carried out individually, with questions that can be theoretical or problem type questions. The exams can include short questions to be developed by the students and exercises to be solved.

BIBLIOGRAPHY

Basic:
- Devore, J. L.. Probability and Statistics for Engineering and the Sciences. 8a ed. Belmont, CA: Brooks/Cole, 2012. ISBN 9780840068279.
- Ang, A. H-S; Tang, W.H. Probability concepts in engineering. Emphasis on Applications to Civil and Enviromental Engineering. 2nd ed. New York: Wiley, 2007. ISBN 9780471720645.
- Devore, J.L.; Berk, K.N. Carlton, Matthew A. Modern mathematical statistics with applications. 3rd ed. Cham, Switzerland: Springer, 2021. ISBN 9783030551582.
- Ang, A.H-S.; Tang, W.H. Probability concepts in engineering: emphasis on applications in civil & environmental engineering. 2nd ed. New York: Wiley, 2007. ISBN 9780471720645.
- Kottegoda, N.T.; Rosso, R. Applied statistics for civil and environmental engineers [on line]. 2nd ed. Oxford: Blackwell, 2008 [Consultation: 28/10/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=428240. ISBN 9781405179171.

Complementary:
- DeGroot, M.H.; Schervish, M.J. Probability and statistics. 4th ed. Boston: Pearson, 2012. ISBN 9780321709707.