Course guide
310713 - 310713 - Applied Statistics

Last modified: 28/01/2025

Unit in charge: Barcelona School of Building Construction
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN ARCHITECTURAL TECHNOLOGY AND BUILDING CONSTRUCTION (Syllabus 2019). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, English

LECTURER

Coordinating lecturer: Bruguera Padro, Maria Montserrat

Others: Bruguera Padro, Maria Montserrat

Guillamon Grabolosa, Antoni

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
2. FB-1 Aptitude to use the applied knowledges related with the numerical and infinitesimal calculus, linear algebra, analytic and differential geometry, and the probabilistic and statistical analysis thecniques and methods.

Transversal:
1. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
3. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

TEACHING METHODOLOGY

The supervised learning hours are organized in sessions of two types:

a) Theoretical Classes (T) in which the teacher introduces the general learning objectives and the basic concepts of the subject. These concepts are also illustrated with the resolution of practical examples-exercises to motivate and involve the student so that they can actively participate in their learning. The support material used is published in advance in Atenea: practice notes, detailed teaching plan, content learning objectives, concept support slides, examples, programming of assessment activities and directed learning, and bibliography.

b) Classes of Practices (P) in which they work through the resolution of exercises and data analysis, related to the specific learning objectives of each one of the contents of the subject. These sessions are carried out in the same ordinary classroom with the student's laptop, and with the Minitab data analysis software. The documentation for these sessions (lists of problems or data analysis) is in Atenea from the beginning of the course. Usually, these practice sessions incorporate the generic competence of teamwork, since the development of resolutions is conducted from group work. The generic competence of a third language is also incorporated into the practical part of data analysis.

It is necessary to consider other hours of autonomous learning by the student, such as those dedicated to the study of the different topics of the course, bibliographic expansion, resolution of the proposed problems or data analysis, as well as the resolution of self-learning and self-assessment questionnaires. the different topics through the Atenea virtual campus. In addition, the student must work on the self-assessments corresponding to each topic in the allotted time to contribute to the competence of autonomous learning-level 1.

The content, the learning method and the evaluation of this subject have been designed taking into account sustainability, social commitment and gender perspective criteria.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, students should be able to:
- Know how to describe one-dimensional and two-dimensional data groups, and their variability, either in a numerical or graphical form.
- Identify the interrelation between two statistic variables from their correlation.
- Use the regression tools (linear and non-linear) in order to do a prediction.
- Understand the concepts and experiences of randomness.
- Understand the probability concepts and conditional probability.
- Calculate the probability of random events in simple experiences.
- Use the concept of random variable as a description element of the variability of a random experience and its modelling.
- Identify the probability distribution and the expectation and variance parameters of random discrete and continuous variables: Bernoulli, Binomial, Poisson, Uniform, Normal, t-Student, Khi2 Pearson, as well as to calculate the probabilities associated in the aforementioned random variables.
- Understand the need and the concept of estimator of a population parameter, as a random variable, from the obtained information of a sample.
- Distinguish the concepts of bias and estimator consistency.
- Estimate the expected value and the variance of a population from the correspondent sample statistics and for a given confidence level. In particular, to estimate proportions.
- Use hypothesis testing (two-sided and one-sided) for the decision making.
- Analyse and interpret data using an analytical statistics software (Minitab).

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	21,0	14.00
Hours large group	30,0	20.00
Hours medium group	9,0	6.00

Total learning time: 150 h

CONTENTS

C1 Descriptive Statistics Review and Random Variables

Description:
This content work with the first three themes: Descriptive Statistics Review, Discrete Random Variables (VAD) and Continuous Random Variables (VAC). Specifically,

The Descriptive Statistic Review works:
- Population and associated statistic variables.
- Uni-dimensional distributions and its representations.
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- The Theorem or Inequality of Txebyshev (for data).
- The axiomatic theory of probability and derived properties.
- The tool of the tree diagrams for the representation of the sample space.
- The concept of conditional probability and the Bayes formula.

The VAD theme works:
- The concept of discrete random variable (r.v.), probability function and associated distribution function.
- The definition and calculation of the hope and variance of a discrete r.v.
- The Theorem or Inequality of Txebyshev (for r. v. discrete).
- The Bernoulli, Binomial and Poisson distributions.

The VAC theme works:
- The concept of continuous random variable (r. v.), density function and associated distribution function.
-The definition of Hope and variance of a continuous r. v.
- The Theorem or Inequality of Txebyshev (for r. v. continuous).
- The Normal distribution, t-Student and Chi^2.
- The approximation of the Binomial distribution by the Normal or Poisson.

Each theme works in the resolution of problems associated to the previous concepts, manually and using the software Minitab.

Related activities:
The linked assessment activities are the following: The Atenea Qi quiz, and the Ti and Pi written tests for i=1, 2 and 3.

Full-or-part-time: 75h
Theory classes: 15h
Practical classes: 15h
Self study : 45h

Statistical Inference and Linear Models

Description:
In this content the last two subjects are worked, Statistical Inference (IE) and Linear Models (ML). Specifically,

In the Theme of Statistical Inference, IE, we work:
- The necessity of estimating a population parameter from sample statistics, and its character as a random variable.
- The concepts of bias, consistency and efficiency of an estimator.
- The difference and interpretation of the point estimate and the interval estimation.
- The calculation of confidence intervals for the estimation of means.
- The calculation of confidence intervals for estimation of variance (or standard deviation).
- The calculation of confidence intervals for the estimation of proportions.
- The contrast of hypotheses (bilateral and unilateral) for decision making.

In the Linear Models Theme, ML, we work:
- Two-dimensional distributions and their representation.
- The marginal distributions.
- The concepts of covariance, correlation and coefficient of determination.
- The calculation and use for prediction of the regression lines of Y on X and of X on Y.

In both themes, work is done to solve problems associated with the above concepts, manually and using Minitab software.

Related activities:
The linked assessment activities are the following: The Atenea Qi quiz, and the Ti and Pi written tests for i=4 and 5.

Full-or-part-time: 75h
Theory classes: 15h
Practical classes: 15h
Self study : 45h

GRADING SYSTEM

The evaluation of the subject is designed to be continuous, so that each Theme or Module is evaluated separately based on the weighted average of a theoretical-practical questionnaire (Q), of some development questions (T) and a practical part of problem solving and data analysis (P). The final mark of the course is the average of the marks of the 5 subjects or modules.

Specifically,

For each module Mi (i = 1,..., 5) there are three tests:
- Qi: Atenea random quiz, 8 questions, single-answer and with penalty, on the theoretical and elementary calculation aspects of the Mi module, 30 minutes long and done in class at the end of the subject.
-Ti: Written test of an answer to a development question on the Mi module, 15 minutes long and given during the midterm or final exam.
- Pi: Written test consisting of problem solving and data analysis on the Mi module, 40 minutes long and given during the partial or final exam.

As a result, subject Mi has the following grade: Ni=(30*Qi + 20*Ti + 50*Pi) / 100 and the final course grade is Nf = (N1 + N2 + N3 + N4 + N5) / 5, where

Nf: Final grade of the course
Ni: Note of the subject or module Mi (i=1,..., 5)

The subject has a Re-evaluation test for those students who have a minimum course grade of 3.5 points but less than 5. The Re-evaluation test will take place within the period established by the EPSEB. The Reassessment exam is a comprehensive exam, consisting of 3 separate tests: a QR quiz (60 min), a written test answering developmental questions TR (40 min) and a problem solving and data analysis test PR (120 min), and with a final mark equal to the minimum between 5 and (30*QR + 20*TR + 50*PR) / 3.

All the notes indicated in this section are calculated on 10 points.

EXAMINATION RULES.

- The student can take part in the partial tests of all Modules without any requirement.

- Those assessment activities not carried out will be scored with a zero (0).

- In order to take the reassessment test, the student must have a final course grade of at least 3.5 and less than 5 (always in accordance with EPSEB regulations in this regard).

- For each test, it will be announced in advance what additional material is available.

BIBLIOGRAPHY

Basic:
- Ferrer, A; Guillamon, A;Mitjana, M;Rodríguez, J J; Serrat C.. Fonaments d'estadística aplicada : quadern de pràctiques amb Minitab. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1997.
- Ferrer, A; Mitjana, M; Rodríguez, J J; Serrat, C; Torrent, J A. Fonaments d'estadística aplicada. Barcelona: Escola Politècnica Superior d'Edificació de Barcelona, 1995. ISBN 8460545857.
- Ferrer, A. ; Pantazi, C. ; Serrat C. Pràctiques de minitab, problemes guia i preguntes. Barcelona, 2015. ISBN 978-84-608-2368-1.
- Grima, P.; Marco, LL.; Tort-Martorell, X. Estadística práctica con Minitab. Madrid: Pearson Educación, 2004. ISBN 8420543551.
- Montgomery, D. C.; Runger, G. C. Probabilidad y estadística aplicadas a la enginiería. 2a ed. México: Limusa Wiley, 2002. ISBN 9789681859152.
- Ras, A. Estadística Aplicada per a enginyeria [on line]. Barcelona: Edicions UPC, 1993 [Consultation: 02/10/2014]. Available on: http://ebooks.upc.edu/product/estadstica-aplicada-per-lenginyeria. ISBN 9788498801170.
- Spiegel, Murray R.; Stephens, Larry J. Estadística. 4ª ed. Madrid: McGraw-Hill Interamericana, 2009. ISBN 9789701068878.

RESOURCES

Other resources:
Minitab software version 22 or higher.