Course guide
310510 - 310510 - Statistics for Decision Making

Last modified: 05/12/2023

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

Degree: MASTER'S DEGREE IN BUILDING CONSTRUCTION MANAGEMENT (Syllabus 2015). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: Serrat Pie, Carles

Others: Lafuente Gonzalez, Esteban Miguel
Serrat Pie, Carles

PRIOR SKILLS

The abilities acquired in a Degree of Building Construction, Engineering or Architecture.

REQUIREMENTS

To have taken the subject Estadística Aplicada or be able to describe sets of one-dimensional and two-dimensional data, use regression tools, identify and estimate parameters of confidence and variance of random variables with continous and basic discrete distributions.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE10MUGE. Design indicator systems for building processes.
CE16MUGE. Integrate acquired competences in the building management field, for carrying out the final master project

Generical:
CG1MUGE. Apply the acquired knowledge in solving complex problems in any sector of the building management.
CG3MUGE. Develop a research Project in the field of Building management.
CG4MUGE. Analyse, evaluate and synthesise critically, the information to propose solutions or alternatives to situations arising from building management processes.

Transversal:
02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

Basic:
CB6. Possess and understand knowledge which provide a basis or opportunity to be original in the development and/or application of ideas, usually in a context of research.
CB7. The students must be able to apply the acquired knowledges and their ability of resolution of problems in new or little known environments inside more wide environments (or multidisciplinary) related with their study field.
CB9. The students must be able to communicate their conclusions and the knowledges and ultimate reasons which support to specialised and non-specialised audiences in a clear mode and without ambiguities.
CB10. The students must possess the learning abilities which allow them to continue studying in a way which should be to a large extent self-directed and autonomous.

TEACHING METHODOLOGY

The objective of the course is the application of statistical concepts and methods aimed at decision-making in the field of building management. As far as possible, mathematical expositions will be avoided in order to highlight the use of these techniques, their application and interpretation, and the exposition of the results.

The directed learning hours are organized in sessions of two types:
a) Theoretical classes 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 exercises-practical examples to motivate and involve the student to actively participate in their learning. The support material used is published in advance to Athena: practice notes, detailed teaching plan, content-based learning objectives, concepts support slides, examples, programming of evaluation and directed learning activities, and bibliography.
b) Classes of Problems that are worked on by solving exercises or numerical problems, related to the specific learning objectives of each of the contents of the subject. The documentation for these sessions (problem lists) are to Athena from the beginning of the course. Additionally, in these problem sessions it is intended to incorporate some generic skills, such as teamwork skills, for which cooperative learning techniques are developed sporadically in the classroom.

Other hours of autonomous learning by the student must also be considered, such as those devoted to the study of the different topics of the course, bibliographic expansion, resolution of the proposed problems, follow-up of the laboratory practices.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, the student will be able to transform data into useful information for decision making (Business Analytics). In particular you will be able to:

- Prepare a data set for statistical analysis, detecting and treating missing data, and identifying extreme and anomalous values.
- Identify the interrelation between two statistical variables from the correlation between them.
- Use regression tools (linear and nonlinear) for prediction.
- Understand the concept of randomness, random experience, probability and conditional probability.
- Describe and visualize characteristics and quantities of interest in multidimensional data, their levels and variability.
- Use analytical techniques to describe, visualize and summarize multidimensional data and relationships.
- Understand the need and the concept of estimator of a population parameter, as a random variable, from the information obtained from a sample.
- Estimate the expectation and variance of a population from the corresponding sample statistics and for a given confidence level. In particular, estimate proportions.
- Use hypothesis testing (bilateral and unilateral) for decision making.
- Properly interpret the results obtained from the linear regression analysis (OLS).
- Understand and estimate linear regression models (OLS) that involve interaction effects (moderation).
- Understand and estimate non-linear regression coefficients (binary) by the maximum likelihood method (logit).
- Interpret in an appropriate way the results obtained from the non-linear regression analysis (logit)
- Estimate and interpret appropriately the marginal effects derived from a non-linear regression model (logit)
- Analyze and interpret data using the statistical analysis program Minitab and, at a generic level, MS-Excel.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	72.00
Hours large group	15,0	12.00
Guided activities	10,0	8.00
Hours small group	5,0	4.00
Hours medium group	5,0	4.00

Total learning time: 125 h

CONTENTS

Topic 1. Descriptive statistics and random variables

Description:
In this topic the main contents of Descriptive Statistics and Random Variables are reviewed.

In Descriptive Statistics, we work on:
- The concepts of population and associated statistical variables.
- One-dimensional character distributions and their representation.
- One-dimensional statistics and their representation are introduced.
- Txebyshev's Theorem or Inequality (for data).
- The axiomatics of probability theory and derived properties.
- The tree diagrams tool for the representation of the sample space.
- The concept of conditional probability.

In the Random Variables section we work on:
- The concept of the random variable (r.v.), discrete and continuous, of the probability / density function and of the associated distribution function.
- The definition and calculation of the expectation and the variance of a r.v.
- Txebyshev's Theorem or Inequality (for r.v.).
- Bernoulli, Binomial, Poisson, Uniform, Normal, t-Student and Chi^2 distributions.

Related activities:
Case 1: Descriptive analysis of CO2 Emission data, Technical Inspection of Buildings.
Case 2: Handling of random variables with Materials and Units data.
Case 3: Practical case of analysis with data on human capital and business growth.

Full-or-part-time: 31h 15m
Theory classes: 3h 45m
Practical classes: 3h 45m
Guided activities: 4h 30m
Self study : 19h 15m

Topic 2. Statistical inference

Description:
This topic will deal with the content of statistical inference, in particular the estimation of parameters and the test of hypotheses:

- The need to estimate a population parameter from sample statistics, and its nature as a random variable.
- The concepts of bias, consistency and efficiency of an estimator.
- The difference and interpretation of the point estimate and the estimate by interval.
- The calculation of confidence intervals for the estimation of means.
- The calculation of confidence intervals for the estimation of the variance (or the standard deviation).
- The calculation of confidence intervals for estimating proportions.
- The test of hypotheses (bilateral and unilateral) for decision making.

Related activities:
Case 1: Sampling simulation of estimators and their properties.
Case 2: Inference and decision making with human capital and business growth data.

Full-or-part-time: 31h 15m
Theory classes: 3h 45m
Practical classes: 3h 45m
Guided activities: 4h 30m
Self study : 19h 15m

Topic 3. Linear regression

Description:
Within this module, topics related to linear regression models will be discussed. Specifically, this part of the course will address the following topics:

- Basic assumptions of the linear regression model estimated via “ordinary least squares” (OLS): linearity, homoscedasticity vs. heteroscedasticity, exogeneity, normality of the estimation error.
- Estimation of coefficients (parameters) of linear regression by the OLS method.
- Analysis of results: Estimation and interpretation of coefficients in linear regression models.
- The interaction effects (moderation) in linear regression: Model estimation and analysis of results.

Related activities:
Case 1: Manual computation of linear regression coefficients (OLS).
Case 2: Practical case - Exports and business growth.
Case 3: Practical case - Moderation effects in linear models (OLS) (Human capital and business growth).

Full-or-part-time: 31h 15m
Theory classes: 3h 45m
Practical classes: 3h 45m
Guided activities: 4h 30m
Self study : 19h 15m

Topic 4. Discrete (binary) decision models. Logistic regression (logit)

Description:
This module focuses on non-linear regression models, specifically on the discrete choice model, estimated using the maximum likelihood method (logistic regression). Specifically, this part of the course will address the following topics:

- Discrete choice model: Basic assumptions of the non-linear regression model estimated via maximum likelihood (logistic regression), that is, properties of the endogenous variable (dependent variable), and estimation of the probability of occurrence of events.
- Estimation of coefficients (parameters) in binary choice models (logit)
- Analysis of results: Estimation and interpretation of coefficients and marginal effects in non-linear regression models (logistic regression)

Related activities:
Case 1: Manual computation of coefficients in binary choice models (logistic regression).
Case 2: Practical case - Entrepreneurial decision (business creation) and fear of failure.
Case 3: Practical case - Export propensity (to export or not to export).

Full-or-part-time: 31h 15m
Theory classes: 3h 45m
Practical classes: 3h 45m
Guided activities: 4h 30m
Self study : 19h 15m

GRADING SYSTEM

The evaluation of the subject is planned continuously and based on the analysis of data or practical cases. To this end, it is foreseen:

a) A scoring activity of a data analysis case study for each of the topics (namely, T1, T2, T3, T4). These practices will be carried out in groups of 2 or 3 students and will be published in a timely manner on the Atenea platform, and the .pdf file resulting from the analysis report must be sent by email to the professor of the subject within the foreseen term.
b) A scoring activity of an integrated project of global analysis of the topics covered (namely, PI) and carried out individually in the computer room of the EPSEB. The data of the integrated project will be to the style of those worked in the scoring practices of each topic.

The weighted calculation formula for the final grade is NF = (15 · T1 + 20 · T2 + 15 · T3 + 20 · T4 + 30 · PI) / 100

Those students who do not pass the course based on the continuous assessment will be able to take the final exam, in the style of the individual practice of the integrated project, called on the date (fixed) by the Director of the Master and announced in the schedule of the course and published on the EPSEB website.

EXAMINATION RULES.

- For all the activities the student will be able to have all the course material.
- Failure to deliver any of the practices (in groups or individual) will be evaluated with a 0 in the corresponding item.

BIBLIOGRAPHY

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RESOURCES

Other resources:
Minitab 19 software or higher and MS-Excel