Course guides
310510 - 310510 - Statistics Applied to Making Decisions

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: 2020
ECTS Credits: 5.0
Languages: Spanish

LECTURER
Coordinating lecturer: Fernando Terrés de Ercilla
Others: Fernando Terrés de Ercilla

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 continuous and basic discrete distributions.

TEACHING METHODOLOGY
The objective of the course is the application of the statistical concepts, avoiding as well as possible the mathematical expositions, emphasizing the utilization of these techniques, their application and interpretation and graphical exposition of the results. Although it's true that the basis of the statistics are mathematical, the course emphasizes the applications of the statistics in the management of the organisations. Tore, during the development of the course there will be fulfilled:
- Master classes where on the basis of a specific management problem, there will be revised with rigour the concepts of the explained statistical methods, emphasizing the importance of understanding the method and its logic, its benefits and disadvantages, and its utilization and interpretation.
- Practical directed classes where there will be set out an exercise or practical case, so that the students will work in groups of three members, under the direction of the professor.
- Workshops, where the students will have more autonomy of resolution. Subsequently, after preparing the activity, the group will expound at class a presentation of the broached problem and their proposals or conclusions for the direction.

LEARNING OBJECTIVES OF THE SUBJECT
After completing the course, students will be able to transform data into useful information for decision-making (Business Analytics) information. In particular you will be able to:
- Prepare a set of data for statistical analysis, detecting and treating missing data, and identifying extreme or erroneous values.
- Describe and display characteristics and interest amounts of multidimensional data sets, levels and variability.
- To detect significant relationships between data from the same or different kinds, numerically and graphically summarize these relationships.
- Use analytical techniques for unsupervised learning to describe, visualize and summarize relationships and multidimensional data.
- Using statistical models (decision trees, regression) to aid decision making.
- Analyze the risks of business management through simulation models using the Monte Carlo method in different areas of the company (sales, finance, marketing, operations) and project management (cost and time).
STUDY LOAD

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<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tr>
<td>Self study</td>
<td>90,0</td>
<td>72.00</td>
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<tr>
<td>Hours medium group</td>
<td>5,0</td>
<td>4.00</td>
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<tr>
<td>Hours large group</td>
<td>15,0</td>
<td>12.00</td>
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<tr>
<td>Hours small group</td>
<td>5,0</td>
<td>4.00</td>
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<tr>
<td>Guided activities</td>
<td>10,0</td>
<td>8.00</td>
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Total learning time: 125 h

CONTENTS

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Description:
1. Introduction (2 hours).
1.a Decisions in companies and projects.
1.b From the Data to the Information. Business analysis.
1.c From the Information to the Prediction. Predictive analysis.
1.d From the Uncertainty to the Calculated Risk. Analysis of the Hazards.
1.e Applications.
FIRST PART: BUSINESS ANALYSIS
2. Descriptive univariate statistics (2 hours).
2.a Type of data.
2.b Empirical distribution.
2.c Measures of localization and variability.
2.d Analysis of distributions. Untypical and extreme values.
2.e Graphical representation of variables.
3. Descriptive bivariate statistics (4 hours).
3.a Intersection between two qualitative variables.
3.a.1 Contingency tables.
3.a.2 Dependence measures.
3.b Relations between a qualitative variable and a quantitative variable.
3.b.1 Medians and conditional variances.
3.b.2 Correlation.
3.b.3 Visualisation.
3.c Relations between two quantitative variables.
3.c.1 Graphical representation: the scatterplot.
3.c.2 Measurement of the relation: the lineal correlation.
3.c.3 From the relation to the prediction: the lineal adjustment.
3.c.4 Extensions: bivariate analysis.
4. Analysis in principal components (6 hours).
4.a Objectives of the analysis in principal components (ACP).
4.b Selection of variables (active and auxiliary).
4.b.1 Visualisation of the relations by pairs of variables.
4.b.2 Transformation and standardisation of variables.
4.c Geometric interpretation.
4.c.1 Representation of the cases.
4.c.2 Representation of the variables.
4.d Selection and interpretation of the components.
4.d.1 Number of components.
4.d.2 Interpretation of the components.
4.e Whole visualisation.
4.e.1 Representation of the continous variables in principal planes.
4.e.2 Representation of the cases in principal planes.
4.e.3 Representation of categorical auxiliary variables.
5. Association of individuals and segmentation (4 hours).
   5.a Analysis of conglomerates.
   5.a.1 Hierarchic methods.
   5.a.2 Non-hierarchic methods.
   5.b Application of the components of a ACP.
   5.b.1 Establishment of the number of classes in hierarchic analysis.
   5.b.2 Consolidation of partitions in non-hierarchic analysis.
   5.c Interpretation of the partitions.
   5.c.1 Relation between the classes and the components of the ACP.
   5.c.2 Relation between the classes and the continous variables.
   5.c.3 Relation between the classes and the categorical variables.

SECOND PART: PREDICTIVE ANALYSIS
   6.a Samples and populations.
   6.b Estimation of points.
   6.b.1 Estimation of a proportion.
   6.b.2 Estimation of the median.
   6.c Confidence intervals.
   6.c.1 Confidence interval for a proportion.
   6.c.2 Confidence interval for the median.
   6.d Formulation and statistical hypothesis testing.
   6.d.1 Statistical hypothesis testing in the business practice.
   6.d.2 Tests for medians and proportions.
   6.d.3 Tests to compare independent groups.
   6.d.4 Tests to compare paired groups.
7. Linear regression (8 hours).
   7.a Simple linear regression.
   7.a.1 Data generating process (assumption).
   7.a.2 Calculation of the coefficients.
   7.a.3 Validation of a regression model.
   7.a.4 Quality of the adjustment.
   7.a.5 Utilization of the results.
   7.b Multiple linear regression.
   7.b.1 Data generating process (assumption).
   7.b.2 Calculation of the coefficients.
   7.b.3 Validation of the regression model.
   7.b.4 Quality of the adjustment.
   7.b.5 Utilization of the results.
   7.c Extensions.
   7.c.1 Introduction of categorical independent variables.
   7.c.2 Interaction between variables.
   7.c.3 Temporary series.

THIRD PART: HAZARD ANALYSIS
8. Risk and uncertainty (4 hours).
   8.a Risks in companies and in projects.
   8.a.1 Statistical analysis of the risk.
   8.a.2 Management of the risks.
   8.b What-if analysis (what happens if).
   8.b.1 Construction of scenarios.
   8.b.2 Basic, worst and best scenario.
   8.b.3 Limits of the What-If analysis.
   8.c Stages of a hazard study.
   8.c.1 Identification of dangers.
   8.c.2 Quantifying of hazards.
   8.c.3 Alternatives to the risk.
9. The probabilistic analysis of the hazards (4 hours).
   9.a Continuous distributions.
   9.a.1 Triangulate. Use and applications. Examples.
   9.a.3 Uniform. Use and applications. Examples.
9.b Discrete distributions.
9.b.1 Binomial and Bernoulli. Use and applications. Examples.
9.c Other distributions of less common use.
10. Simulation: the Monte Carlo method (6 hours).
10.a Application of the method in standard spreadsheets.
10.a.1 Use of the data analysis complement.
10.a.2 Types of distribution.
10.a.3 Analysis of the results.
10.b Utilization of specific complements.
10.b.1 Basic cells: variables of entrance and exit.
10.b.2 Selection of the distribution of the entrance variables.
10.b.3 Execution of the simulation.
10.b.4 Analysis of the results.
10.b.5 Graphics of help to the interpretation.
10.c Utilization of statistical loads.
10.d Extensions.
10.d.1 Adjustment of distributions.
10.d.2 What-If analysis.
10.

Related activities:
Practical exercises supervised.
Workshops.
Oral presentation of studies, conclusions and proposals.

Full-or-part-time: 125h
- Theory classes: 46h
- Laboratory classes: 20h
- Guided activities: 19h
- Self study: 40h

GRADING SYSTEM
The main evaluation systems are:
- Mark of proposed works during the practical classes.
- Mark of the workshops prepared and expounded by the students.
- Mark of the written test of control of knowledges.

EXAMINATION RULES.
For the works proposed during the practical classes (30%), there will be facilitated the most possible the delivery by telematic means, by Atenea.
In the case of the workshops (30%), the delivery of the works, previously to their exposition, will be done by telematic means, through Atenea; the exposition of the works will be done in-person.
Regarding the written test of control of knowledge (40%), it will be done in-person.
BIBLIOGRAPHY

Basic:

- Lafuente, E., Vaillant, Y., Serarols Ch.. "Location decisions of knowledge-based entrepreneurs: Why some Catalan KISAs choose to be rural?". Technovation. 2010, 30, 590-600.