240042 - Statistics

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 715 - EIO - Department of Statistics and Operations Research
Academic year: 2017
Degree: BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Coordinator
PEDRO GRIMA CINTAS

Degree competences to which the subject contributes

Specific:
2. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Transversal:
1. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Teaching methodology

There are two types of sessions: lectures and hands-on sessions. In the lectures (2 hours per week) the teacher explains the basics of the subject using examples and with the minimal mathematical apparatus necessary to understand the concepts.

In the hands-on sessions (2 hours per week), case studies will be solved using statistical packages (with the computer) or using calculator and statistical tables (in classrooms "with blackboard").

Students must prepare the sessions in a self-study manner, following the detailed plan available in the subject's intranet. Material is also offered in this intranet. Throughout the course students must work on a project where they have to analyze data and make decisions based on the information obtained.

Learning objectives of the subject

After the course the student will be able to:
1. Design how to collect data and how to convert these data into useful information for decision making in environments where there is variability.
2. Understand the concept of variability, how it is measured, the problems it brings and how its influence can be reduced in any process.
3. Know and apply some of the most common techniques of data collection and analysis.
4. Learn the use of statistical software to solve problems as close as possible to those in their future professional work.
### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>20.00%</th>
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<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>30h</td>
<td>20.00%</td>
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<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time</th>
<th>Description</th>
<th>Specific objectives</th>
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<tbody>
<tr>
<td><strong>INTRODUCTION TO STATISTICS. DESCRIPTIVE STATISTICS</strong></td>
<td>10h</td>
<td><strong>Description:</strong> Definition and usefulness of statistics? Measures of central tendency, position and dispersion. Graphics: Histogram, boxplot, scatterplots.</td>
<td>Knowing and appreciating the possibilities of statistical techniques to obtain information from data.</td>
</tr>
<tr>
<td><strong>VARIABILITY. PROBABILITY DISTRIBUTIONS</strong></td>
<td>28h</td>
<td><strong>Description:</strong> Concepts of population and sample. Probability distributions for continuous and discrete case. Mathematical expectation and variance of a random variable. Distribution function. The Normal distribution. Binomial model. Poisson model. Expected value and variance of lineal combinations of random variables.</td>
<td>Understanding the concept of variability, how it is measured and the problems it generates. Knowing and being able to use some probability distributions.</td>
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<tr>
<td><strong>ESTIMATION OF POPULATION PARAMETERS</strong></td>
<td>24h</td>
<td><strong>Description:</strong> Distribution of the sample mean. Student's t Distribution. Confidence interval for the mean. Distribution of mean's difference. Distribution of s^2. The Chi-square distribution. F-Snedecor distribution. Distribution of the ratio of two variances.</td>
<td>Learning the theoretical foundation for later establishing criteria for making decisions in the presence of variability.</td>
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### SIGNIFICANCE TESTS. COMPARISON OF TREATMENTS

**Description:**

**Specific objectives:**
Being able to apply the most common statistical tests, and knowing its possibilities and limitations. Also, knowing and being able to apply the most common techniques for collecting and analyzing data for the comparison of treatments.

### MEASURING THE RELATIONSHIP BETWEEN TWO VARIABLES. SIMPLE AND MULTIPLE LINEAR REGRESSION

**Description:**

**Specific objectives:**
Being able to identify relationships between variables and to explain the relationship with the most appropriate models.
## Planning of activities

| WORKGROUP TRAINING IN DATA ANALYSIS TECHNIQUES | Hours: 20h  
Practical classes: 2h  
Self study: 18h |
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>The work will be to establish what is the strategy for achieving an objective, using information obtained through the analysis of a database.</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>The project will be performed through a web platform specifically created for the subject. The web platform will extract the data in different phases. Written documentation is available on the intranet.</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>The web platform will keep a record of each group's actions, to be taken into account in the assessment. Each group will also make presentations and reports.</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>Applying the studied concepts in the lectures in a practical example, realistic, close to the student and with real objectives.</td>
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</table>

| EXERCISES RESOLUTION | Hours: 15h  
Practical classes: 2h  
Self study: 13h |
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<tr>
<td><strong>Description:</strong></td>
<td>The students will have exercises to solve. These assignments will be done individually or in groups, as indicated by the teacher. They will be delivered and discussed in the hands-on sessions. Some of these activities will be assessed by the teacher, self-assessed or co-assessed.</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Each lesson will have a collection of exercises available at least on the intranet (probably also as printed material).</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>The exercises done by each student will be used to assess this activity.</td>
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<tr>
<td><strong>Specific objectives:</strong></td>
<td>Practicing the acquired concepts and having feedback on the level of assimilation and understanding of the concepts.</td>
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| CASE STUDIES | Hours: 15h  
Self study: 15h |
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<tr>
<td><strong>Description:</strong></td>
<td>Students must understand a case study describing a realistic industrial problem. Using a database to be provided, they must determine the appropriate statistical tools to answer questions, using statistical software.</td>
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<tr>
<td><strong>Support materials:</strong></td>
<td>Students will have self-learning videos about the statistical software used, together with the set of cases and databases on the intranet.</td>
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### 240042 - Statistics

**Descriptions of the assignments due and their relation to the assessment:**
- The evaluation will be based on questionnaires about the case studies, class discussion and, eventually, in delivering reports.

**Specific objectives:**
- Acquiring skills in working with data and the use of statistical software packages. Identifying the appropriate statistical tools to each situation.

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<tr>
<th>RESOLUTION OF ONLINE QUESTIONNAIRES</th>
<th>Hours: 15h</th>
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<tr>
<td><strong>Description:</strong></td>
<td>Self study: 15h</td>
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<tr>
<td>Students must answer multiple choice questions through the subject's intranet.</td>
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</table>

**Support materials:**
- Questionnaires will be available on the subject's intranet. Eventually, other exercises will be available through a specific web platform.

**Descriptions of the assignments due and their relation to the assessment:**
- Either the completion of the questionnaires or their numerical evaluation will be used as evidence for this activity.

**Specific objectives:**
- Encouraging independent learning, facilitating self-study from the immediate feedback that the student obtains.

### PARTIAL EXAM

**Description:**
- Assessment of knowledge.

**Descriptions of the assignments due and their relation to the assessment:**
- Solved exam.

### FINAL EXAM

**Description:**
- Assessment of knowledge.

**Descriptions of the assignments due and their relation to the assessment:**
- Solved exam.
Qualification system

The final mark (NF) will consist of four inputs:
1) Continuous assessment mark: AC
2) Mark of the project work: NT
3) Midterm Exam: EP
4) Final Exam: EF

The final mark will be calculated according to:
NF = 0.25*AC + 0.15*NT + 0.15*EP + 0.45*EF

If the reavaluación exam is performed, the grade obtained (NR) will replace the EP and EF. Therefore, the final mark in this case will be:
NF = 0.25*AC + 0.15*NT + 0.6*NR

Bibliography

Basic:

Complementary:

Others resources:
Students will have, as written material:
- Copies of the slides used in class.
- Collections of exercises (some with their solution.)
- Collections of case studies.
- Statistical Tables.
All written material will be available, at least, in the subject's intranet.
Students will have, as multimedia material:
- Educational videos created by teachers of the subject, and available on Videoteca UPC (UPCommons ).
- Links to web pages and videos of interest
Students will have, as software:
- The statistical software package MINITAB. This software is in the computer rooms and also available to students through a campus license.
- The program for HP calculators Stat+, freely available, prepared by teachers of the subject.