Course guides
340029 - ESTA-N3O43 - Statistics

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR’S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2020  ECTS Credits: 6.0  Languages: Catalan

LECTURER

Coordinating lecturer: Simo Mezquita, Ester
Others: Neus Ybern
Zaragoza Monroig, Maria Luisa
Igual Lopez, Susana

PRIOR SKILLS

Ability to apply the basic tools of differential and integral calculus in one real variable.

REQUIREMENTS

FOMA

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.

Transversal:
2. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
3. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

TEACHING METHODOLOGY

In the lectures the instructor presents some motivating ideas, the fundamental concepts and some relevant developments, intermingled with key examples and the resolution of representative problems.

In the lab classes the students learn how to solve some statistical questions, using MINITAB. In the last sessions, several short exercises, to be solved in the lab, will be assigned and graded afterwards.
LEARNING OBJECTIVES OF THE SUBJECT

- Ability to apply the basic techniques to extract statistical information from a database.
- Ability to apply the basic theory of probability
- Ability to apply the distribution models that rules random behavior.
- Ability to apply the techniques of statistical inference to find, from an observation of the population, certain characteristics of the population as a whole.
- Ability to apply the techniques of process quality control to analyze and measure the variability of an industrial process.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>45,0</td>
<td>30.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

1. Descriptive Statistics

Description:
1.1 Variables. Types.
1.2 Graphical and statistical tools for analyzing one-dimensional variables.
1.3 Graphical and statistical tools for analyzing two-dimensional variables.

Specific objectives:
Ability to use the basic techniques to extract statistical information from a database.

Related activities:
Activity 1

Related competencies:
- CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.
- 06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
- 07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Full-or-part-time: 2h
Theory classes: 2h
2. Probability

Description:
2.1 Definition of probability
2.2 Conditional probability
2.3 Independence of events

Specific objectives:
Understand the basic theory of probability

Related activities:
Activity 3
Activity 5

Related competencies:
CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.

06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
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Full-or-part-time: 2h
Theory classes: 2h

3. Random variables

Description:
3.1 Definition and types of random variables.
3.2 Density function and distribution function of random variables.
3.3 Expectation and variance of a random variable.
3.4 Distribution models: Binomial, Poisson, Exponential and Normal.
3.5 Central limit theorem.

Specific objectives:
Understand distribution models that govern random behavior.

Related activities:
Activity 3
Activity 5

Related competencies:
CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.

06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Full-or-part-time: 4h
Theory classes: 4h
4. Quality control

**Description:**

4.1 Study of the variability of a process  
4.2 Control of variability by variables  
4.3 Control of the variability by attributes  
4.4 Study of the capacity of a process

**Specific objectives:**  
Ability to apply the techniques of quality control of processes to analyze and measure the variability of an industrial process

**Related activities:**  
Activity 2  
Activity 3  
Activity 5

**Related competencies :**  
. CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.  
06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.  
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

**Full-or-part-time:** 2h  
Theory classes: 2h

5. Inference

**Description:**

5.1 Sampling.  
5.2 Estimation of parameters.  
5.3 Confidence intervals.  
5.4 Hypothesis tests.

**Specific objectives:**  
Ability to apply the statistical inference to find, from an observation of the population, certain characteristics of the population as a whole.

**Related activities:**  
Activity 2  
Activity 4  
Activity 5

**Related competencies :**  
. CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.  
06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.  
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

**Full-or-part-time:** 1h  
Theory classes: 1h
## ACTIVITIES

### 1: FIRST LAB TEST

**Description:**
The student will have to solve problems, with the help of MINITAB, using Descriptive Statistics techniques and Probability tools of contents 1 and 2.

**Specific objectives:**
Confirm the domain of the descriptive statistical techniques and Probability using MINITAB.

**Material:**
Statement of the test and class material.

**Delivery:**
The written solution of the problems proposed.

**Related competencies:**
- CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.
- 07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
- 06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

**Full-or-part-time:** 1h
Laboratory classes: 1h

### 2. SECOND LAB TEST

**Description:**
The student will have to make an assignment, with the help of MINITAB, using the techniques of contents 4 and 5.

**Specific objectives:**
- Be able to use quality control tools and statistical inference using MINITAB.

**Material:**
Assignment statement and class material.

**Delivery:**
The work will have to hand a week after the last session of laboratory.

**Related competencies:**
- CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.
- 07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
- 06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

**Full-or-part-time:** 5h
Self study: 5h
3. FIRST THEORETICAL EXAM

Description:
The student will have to solve, in person and in writing, problems on the contents 2 and 3 of probability and random variables.

Specific objectives:
- Be able to use basic probability theory.
- Be able to use distribution models of aleatory variables.
- Be able to use central limit theorem.
- Be able to use the quality control tools

Material:
Statement of test and summary table of theory

Delivery:
The written solution of the proposed exercises

Related competencies:
. CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

Full-or-part-time: 1h
Theory classes: 1h

4. SECOND THEORETICAL EXAM

Description:
The student will have to solve, in person and in writing, problems on contents 4 and 5. Content 4 will be evaluated in activity 3 or 4 depending on the calendar of partial exams.

Specific objectives:
- Be able to use statistical inference tools.
- Be able to use quality control tools.

Material:
Statement of the test and summary table of theory

Delivery:
The written solution of the proposed problems.

Related competencies:
. CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

Full-or-part-time: 1h
Theory classes: 1h
5: FINAL EXAM

Description:
The student will have to solve, in person and in writing, problems about contents 2, 3, 4 and 5.

Specific objectives:
Be able to use the basic techniques of the subject.

Material:
Statement of test and summary table of theory

Delivery:
The written solution of the proposed problems.

Related competencies:
. CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

Full-or-part-time: 1h
Theory classes: 1h

6. RE-EVALUATION TEST

Description:
The student will have to solve, in person and in writing, problems about contents 2, 3, 4 and 5.

Specific objectives:
Be able to use the basic techniques of the subject

Material:
Statement of test and summary table of theory

Delivery:
The written solution of the proposed problems.

Full-or-part-time: 2h
Theory classes: 2h

GRADING SYSTEM

A1= laboratory exam with MINITAB
A2= assignment with MINITAB
A3= first partial exam
A4= second partial exam
A5= final exam
A6= re-evaluation test

FINAL GRADE = MAX (0.1*A1+0.1*A2+0.4*A3+0.4*A4, 0.1*A1+0.1*A2+0.8*A5)

(all partial scores on a 0-10 scale)
EXAMINATION RULES.

- The conditions for conducting the individual written tests will be announced with sufficient time.
- Attendance at laboratory sessions and activities A1 and A2 are compulsory.
- Activities 4 and 5 will be done on the same day and, therefore, only one can be done.
- Only activity 5 can be re-evaluated

BIBLIOGRAPHY

Basic:

Complementary: