820076 - AEAE - Advanced Statistics and Applications in Engineering

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)

ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: PABLO BUENESTADO CABALLERO
email: Pablo.Buenestado@upc.edu

Opening hours
Timetable: Session 2019-2020:
Thursday 10-14 h
(or another day before contact by email)

Requirements
Statistics

Degree competences to which the subject contributes

Specific:
1. Solve mathematical problems that may arise in engineering. Apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial differential equations; numerical methods; numerical algorithms; statistics and optimisation.

Transversal:
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
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**Teaching methodology**

The course can be done remotely.

The sessions are done with a computer.

Learning is based on applied engineering problems.

Each session begins with the presentation of the learning subject and then the students work on the concepts of interest in the classroom.

The activities are carried out individually or as a couple.

**Learning objectives of the subject**

Students gain confidence to tackle problems related to the statistics and their applications in engineering. The statistic that students learn in this course is very advanced and useful for the future of an engineer.

In recent years a large increase in jobs for engineers in the field of applied statistics is appreciated. With this course we want to help the student to train in this area.

**Study load**

<table>
<thead>
<tr>
<th><strong>Total learning time:</strong> 150h</th>
<th>Hours large group:</th>
<th>45h</th>
<th>30.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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## Content

### INFERENCE BASED ON ONE SAMPLE

**Description:**
Initially working the usual statistical models for engineering.
Analysis of different types of sampling and sampling the main elements.
We review the basics of inference:
Confidence intervals
Hypothesis contrast

**Related activities:**
Practical statistical modeling. Recognizes the model from a sample.
Practice simulation to estimate. Experience the mean estimate.
Practice simulation for contrast. Decision making on average.

**Specific objectives:**
Reviewing the most useful engineering statistical models.
Deepen the main concepts related to the inference based on a single sample.
Learn to make decisions by estimating and contrast.

**Learning time:** 40h
- Theory classes: 8h
- Laboratory classes: 8h
- Self study: 24h

### INFERENCE BASED ON TWO SAMPLES

**Description:**
Inference two population means.
Analysis of data pairs.
Inference proportions.
Inference two variances.

**Related activities:**
Practice of Inference for two averages
Practice of inference data pairs
Practice of Inference for two proportions
Practice of Inference for two variances

**Specific objectives:**
Enable the student to make decisions for cases with 2 samples.

**Learning time:** 30h
- Theory classes: 6h
- Laboratory classes: 6h
- Self study: 18h
### ADJUST MODELS. MULTIPLE LINEAR REGRESSION.

**Learning time:** 30h  
Theory classes: 6h  
Laboratory classes: 6h  
Self study: 18h  

**Description:**  
Using linear regression of two variables for modeling engineering data based on hypothesis testing. Linear model to predict values.  
Learn the possibilities of the linear model for nonlinear relationships.  
Extend the linear regression model to several variables.  

**Related activities:**  
Practice of Linear modeling for two variables  
Practice of multiple linear modeling  

**Specific objectives:**  
Modeling linear relationship between two variables.  
Learn the technique of linear modeling of several variables.

### ANALYSIS OF VARIANCE

**Learning time:** 30h  
Theory classes: 6h  
Laboratory classes: 6h  
Self study: 18h  

**Description:**  
Learn to perform analysis of variance pruebas of hypotheses.  
ANOVA of a single factor.  
ANOVA formulation.  
ANOVA with two or three factors.  

**Related activities:**  
Practice of analysis of variance of a factor  
Practice of analysis of variance of two factors  
Practice of ANOVA of three factors  

**Specific objectives:**  
Using the ANOVA technique for making decisions with a factor.  
Using ANOVA applied to engineering problems with 2 or 3 factors.
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<table>
<thead>
<tr>
<th>STATISTICAL QUALITY CONTROL</th>
<th>Learning time: 20h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
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<tr>
<td></td>
<td>Laboratory classes: 4h</td>
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<tr>
<td></td>
<td>Self study: 12h</td>
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</table>

**Description:**
Apply statistical quality control to make decisions.
Knowing the useful graphical control.
Learning to use acceptance sampling.

**Related activities:**
Practice control charts
Practice of Acceptance sampling

**Specific objectives:**
Train students in the use of different techniques that help make decisions for statistical quality control.

**Qualification system**

The evaluation focuses on the delivery of individual or couple work (6 reports). The weight of each report in the final grade is proportional to the time it occupies in the course.

The course can be done without attending the classroom (DISTANCE COURSE IS POSSIBLE).

This subject not has re-evaluation.

**Regulations for carrying out activities**

The reports must be submitted via ATENEA within the deadline and with good presentation.

**Bibliography**

**Basic:**

**Complementary:**