820002 - ES - Statistics

Coordinating unit: 820 - EUETIB - Barcelona College of Industrial Engineering
Teaching unit: 727 - MA III - Department of Applied Mathematics III
Academic year: 2015
Degree: BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish, English

Teaching staff
Coordinator: PABLO BUENESTADO CABALLERO

Opening hours
Timetable: Each teacher will serve students in his office according to the schedule published in ATENEA

Requirements
Math I

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 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
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Teaching methodology

The teaching methodology is distributed as:
- Lectures: 27%
- Practice with computer classes: 10%
- Self study: 45%
- Development of problems and reports: 15%
- Exams 3%

Learning objectives of the subject

Consolidate the fundamental concepts of statistics.
Develop the ability to apply statistics in engineering problems.
To train the students to use good judgment necessary statistical tools for modeling and solving problems in the field.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 45h</th>
<th>30.00%</th>
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<tr>
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<td>Hours medium group: 0h</td>
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<td>Hours small group: 15h</td>
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<td></td>
<td>Guided activities: 0h</td>
<td>0.00%</td>
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<td>Self study: 90h</td>
<td>60.00%</td>
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### 1. Introduction and Descriptive Statistics

**Description:**
Statistics in engineering.
Data Types.
Frequency distribution.
Graphical representations.
Measures of central tendency.
Measures of variability.
Chebyshev inequality.
Boxplot.
Measures of skewness and direction.
Moments.

**Related activities:**
Practice 1: Introduction to R.
Practice 2: Descriptive statistics
Practice 3: Linear Regression

**Specific objectives:**
Exhibit statistical methods as a methodology for studying various engineering problems.
To review briefly the historical evolution of Statistics.
Describe a clear methodology organization, representation and reduction of data to facilitate the evaluation and interpretation thereof.

**Learning time:** 18h
- Theory classes: 3h
- Laboratory classes: 6h
- Self study: 9h

### 2. Elements of Probability

**Description:**
Algebra of events.
Probability: axioms and properties.
Conditional probability.
Independent events.
Law of total probability.
Bayes Theorem.
Combinatorial-count analysis.

**Related activities:**
Development of a problem report Probability

**Specific objectives:**
Transfer students probabilistic basis for modeling systems subject to chance. Describe, motivating with practical examples, many of the concepts necessary for further study of Statistical Inference.

**Learning time:** 16h
- Theory classes: 6h
- Self study: 10h
# 3. RANDOM VARIABLES

**Learning time:** 18h  
Theory classes: 6h  
Self study: 12h

**Description:**  
Discrete and continuous random variables.  
Probability mass function and probability density function.  
Probability distribution function.  
Measures of central tendency.  
Measures of dispersion.  
Chebyshev theorem.  
Moments.  
Moment generating function.  
Transformation of random variables.

**Related activities:**  
Preparation of a report aleatòries problems Variables

**Specific objectives:**  
Exposing the concept of random variable.  
Studying the random variables by calculating their hope, variance and different times.  
Independentes define the concept of random variables.  
Exposing the importance of variables aleatories transformation in its application to engineering.  
To relate these concepts to studied on the subject of exploratory data analysis.
### 4. PROBABILISTIC MODELS IN ENGINEERING

**Learning time:** 30h  
Theory classes: 9h  
Laboratory classes: 4h  
Self study: 17h

**Description:**
- **Discrete Models:** Uniform distribution.  
  Bernoulli distributions: Binomial, Negative Binomial, Hypergeometric.  
  Poisson distribution.
- **Continuous Models:** Uniform distribution.  
  Exponential distribution.  
  Normal distribution.

**Related activities:**
- Preparation of problems with probabilistic models  
- Practice 4: Discreets Probabilistic models  
- Practice 5: Continus Probabilistic models  
- Partial Exam 1

**Specific objectives:**
- Define and study the probability distributions most commonly used in engineering.

### 5. SAMPLING AND POINT ESTIMATE

**Learning time:** 30h  
Theory classes: 9h  
Laboratory classes: 2h  
Self study: 19h

**Description:**
- Estimators: definition and properties.  
- Laws of large numbers.  
- Point estimation: Method of moments and maximum likelihood method.  
- Distributions of sample statistics.  
- Theorem Central Limit.

**Related activities:**
- Practice 6: Sampling. Central Limit Theorem.

**Specific objectives:**
- Explain the point estimate and study the two most common methods for determining an estimator is the method of moments and maximum likelihood.  
- Studying the most important properties of the estimators.  
- Exhibit some basic theoretical concepts regarding sampling and statistical inference.  
- Illustrate different techniques by which the inductive statistical inference process to provide useful, reliable results can be applied.
6. INTERVAL ESTIMATION AND HYPOTHESIS TESTING

<table>
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<th>Learning time: 38h</th>
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<tbody>
<tr>
<td>Theory classes: 12h</td>
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<tr>
<td>Laboratory classes: 2h</td>
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<tr>
<td>Self study: 24h</td>
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**Description:**
Estimate confidence intervals for the mean, variance and proportion.
Distributions for sampling.
Contrast models.

**Related activities:**
Development of estimation and testing problems
Practice 7: Confidence interval. Testing hypotheses.
Partial Exam 2

**Specific objectives:**
Explain the interval estimation and applied in estimating the mean, proportions and variances.
Study hypothesis testing and apply the contrast of means, proportions, etc.
The subject is declared within a framework of continuous evaluation. In this context, the evaluation is distributed according to the following weighting:
- Realization of two exams: 70% (30% first and 40% in the second)
- Practices R statistic: 15%
- Delivery of problems: 10%
- Generic Competence (Effective oral and written communication): 5%

In this context, the evaluation is distributed according to the following weighting:
- Realization of two exams: 70% (30% first and 40% in the second)
- Practices R statistic: 15%
- Delivery of problems: 10%
- Generic Competence: Effective oral and written communication: 5%

If a student fails the course for ongoing evaluation, the school offers the opportunity to pass the subject by developing a test (reassessment).

A student suspended above 3.5 rating, which has delivered all the work of Statistics, can take the exam. Accordingly, the weighting reevaluation be:
- Reassessment exam: 70%
- Practices R statistic: 15%
- Delivery of problems: 10%
- Generic Competence: Effective oral and written communication: 5%

The note by the distribution by the revaluation can not exceed 5.0. In the end, the note will be the best record among the weighting for continuous assessment and reassessment weighting.

Regulations for carrying out activities

The student must bring their passport to the exams.
The student will write the full development of solving every problem (in exams and reports).
Bibliography

Basic:


Complementary:


Others resources:

Computer material

Probabilitat i estadística matemàtica : teoria i problemes resolts