240EO011 - Applied Statistics

**Coordinating unit:** 240 - ETSEIB - Barcelona School of Industrial Engineering

**Teaching unit:** 715 - EIO - Department of Statistics and Operations Research

**Academic year:** 2017

**Degree:** MASTER'S DEGREE IN MANAGEMENT ENGINEERING (Syllabus 2012). (Teaching unit Compulsory)

**ECTS credits:** 6  

**Teaching languages:** English

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### Degree competences to which the subject contributes

**Specific:**

2. Acquire concepts and techniques related to descriptive and inferential statistics.

3. Apply concepts and techniques of descriptive and inferential statistics.

**General:**

1. Learn and master the analytical tools necessary for decision making in the organizational context more efficient.

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### Teaching methodology

There are two types of sessions: main lectures and sessions in the computer lab. In the lectures (2 hours per week) the teacher explains the basics of the subject using examples.

In the hands-on sessions (2 hours per week), practical problems will be solved using statistical packages.

Students will need to do a team project in which they will have to build a model to a set of data selected by them, and several smaller individual project that will be collected.

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### 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 and how it is measured.

3. Know and apply some of the most common techniques of data collection and analysis.

4. Learn how to build statistical models to summarize information, make predictions and dimensionality reduction.

5. Learn the use of statistical software to solve problems as close as possible to those in their future professional work.
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**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours medium group: 27h</th>
<th>18.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours small group: 27h</td>
<td>18.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 96h</td>
<td>64.00%</td>
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# 240EO011 - Applied Statistics

## Content

### Chapter 1: Probability and Statistics

**Learning time:** 18h  
Theory classes: 4h  
Laboratory classes: 4h  
Self study: 10h

**Description:**  
2. Difference between statistics and probability.  
3. Discrete probability models; Binomial and Poisson.  
4. Continuous probability models; Normal model.  
5. Point estimation of the population mean.  
6. Confidence intervals and hypotheses tests for the population mean.

**Specific objectives:**  
Understand the concept of variability and how it can be modeled. Know how to use some probability models.  
Difference between probability and statistics. The concepts of confidence intervals and hypotheses tests.

### Chapter 2: Linear model

**Learning time:** 45h  
Theory classes: 10h  
Laboratory classes: 10h  
Self study: 25h

**Description:**  
1. Theoretical versus fitted model.  
2. Model fit by least squares and other model fit criteria.  
3. ANOVA table and goodness of fit measures.  
4. Statistical inference on the parameters of the model.  
5. Prediction.  
6. Model checking through residual analysis.  
7. Model selection.  
8. Interpretation of the fitted model; Bias, colinearity and causality.  
9. Use of categorical explanatory variables.  
10. Comparison of means.  
11. Analysis of two-level factorial experimental experiments.  
12. Press and cross validation.

**Specific objectives:**  
To learn how to build a linear model that relates one continuous response variable to a list of explanatory variables, to learn how to interpret that model and make predictions with it, and to learn how to design experiments statistically efficient.

### Chapter 3: Non-linear models

**Learning time:** 9h  
Theory classes: 2h  
Laboratory classes: 2h  
Self study: 5h

**Description:**  
1. Normal non-linear model.  
2. Model fit.  
4. Model checking.

**Specific objectives:**  
To learn how to build a non-linear model that relates one continuous response variable to a list of explanatory variables, to learn how to interpret that model and make predictions with it, and to check that the model is a good enough approximation of reality.
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### Chapter 4: Binary response models

**Description:**

**Specific objectives:**
To learn how to build a linear model that relates one binary response variable to a list of explanatory variables and to learn how to interpret that model and make predictions with it.

**Learning time:** 18h
- Theory classes: 4h
- Laboratory classes: 4h
- Self study: 10h

### Chapter 5: Time series models

**Description:**
1. Description of a time series. 2. AR models. 3. MA models. 4. ARMA models. 5. ARIMA models. 6. Seasonal ARIMA models.

**Specific objectives:**
To learn how to build a time series model.

**Learning time:** 18h
- Theory classes: 4h
- Laboratory classes: 4h
- Self study: 10h

### Chapter 6: Visualization of multivariate data

**Description:**
1. Principal components analysis. 2. Correspondence Analysis

**Specific objectives:**
Learn about dimensionality reduction techniques both for continuous as well as discrete data.

**Learning time:** 9h
- Theory classes: 2h
- Laboratory classes: 2h
- Self study: 5h
Chapter 7: Classification (learning)

<table>
<thead>
<tr>
<th>Learning time: 9h</th>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Self study: 5h</td>
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**Description:**
2. Partition methods for cluster analysis.
3. Discriminant analysis.

**Specific objectives:**
To learn about unsupervised and supervised classification (learning).

**Qualification system**

The final course grade (NF) will be computed starting from four 'inputs':

1) Grade in small projects: NP
2) Grade in the team project: NT
3) Midterm exam: EP
4) Final exam: EF

The final course grade will be obtained through: \( NF = 0.10 \times NP + 0.20 \times NT + 0.20 \times EP + 0.50 \times EF \)

**Bibliography**

**Basic:**