270601 - SMDE - Statistical Modelling and Design of Experiments

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 715 - EIO - Department of Statistics and Operations Research
Academic year: 2018
Degree: MASTER'S DEGREE IN INNOVATION AND RESEARCH IN INFORMATICS (Syllabus 2012). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan

Prior skills

Students must have sufficient knowledge of algebra and mathematical analysis to assimilate the concepts related to algebra of sets, numerical series, functions of real variables of one or more dimensions, derivation and integration.

Degree competences to which the subject contributes

Specific:
CEE2.3. Capability to understand models, problems and mathematical tools to analyze, design and evaluate computer networks and distributed systems.
CEE4.1. Capability to analyze, evaluate and design computers and to propose new techniques for improvement in its architecture.

General:
CG1. Capability to apply the scientific method to study and analyse of phenomena and systems in any area of Computer Science, and in the conception, design and implementation of innovative and original solutions.
CG3. Capacity for mathematical modeling, calculation and experimental designing in technology and companies engineering centers, particularly in research and innovation in all areas of Computer Science.

Transversal:
CTR4. INFORMATION LITERACY: Capability to manage the acquisition, structuring, analysis and visualization of data and information in the area of informatics engineering, and critically assess the results of this effort.
CTR6. REASONING: Capacity for critical, logical and mathematical reasoning. Capability to solve problems in their area of study. Capacity for abstraction: the capability to create and use models that reflect real situations. Capability to design and implement simple experiments, and analyze and interpret their results. Capacity for analysis, synthesis and evaluation.

Teaching methodology

The course is practical and aims that students will be able, once the course is completed and from the work done in the sessions, to solve real problems similar to those developed in class.

Learning objectives of the subject

1. Applying the mathematical formalism to solve problems involving uncertainty.
2. Applying the queuing models for computer systems performance evaluation and/or configurations analysis.
3. Ability to design, conduct experiments and analyze results.
### Study load

<table>
<thead>
<tr>
<th><strong>Total learning time:</strong> 150h</th>
<th>Theory classes: 16h 10.67%</th>
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<tbody>
<tr>
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<td>Practical classes: 16h 10.67%</td>
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<td>Laboratory classes: 16h 10.67%</td>
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<td>Guided activities: 6h 4.00%</td>
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<td>Self study: 96h 64.00%</td>
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### Content

#### Introduction to probability

**Degree competences to which the content contributes:**

**Description:**
Students should feel comfortable with the use of set notation and basic statistical terminology. Likewise, the student should be able to write the sample space of simple experiments, including sampling with replacement (like throwing coins or throwing dice), sampling without replacement, from Bernoulli trials and with rules of detention. Likewise, the student should be able to calculate the probabilities in simple cases of the above type of experiment.

#### Introduction to statistical estimation

**Degree competences to which the content contributes:**

**Description:**
Estimation, in the framework of statistical inference, is the set of techniques with the aim of give an approximate value for a parameter of a population from data provided by a sample. From the different methods that exist (point estimate, estimate intervals, or Bayesian estimation) we focus on the point estimate.

#### Analysis of data

**Degree competences to which the content contributes:**

**Description:**
The main objective of the section is to know the procedures associated with the analysis of variance (ANOVA terminology in English) and when is useful to be applied. This activity also introduces MANOVA, as a technique useful when there are two or more dependent variables. We also work with the techniques of linear regression and PCA, completing the repertoire of tools for data analysis.

#### Introduction to experimental design

**Degree competences to which the content contributes:**

**Description:**
Statistical experimental design, a.k.a. design of experiments (DoE) is the methodology of how to conduct and plan experiments in order to extract the maximum amount of information in the fewest number of runs (saving resources). In this section we describe different techniques to achieve that.

#### Introduction to queuing theory

**Degree competences to which the content contributes:**

**Description:**
This section will introduce the student to use the techniques of operations research for systems analysis for making quantitative decision in the presence of uncertainty through their representation in terms of queuing models.
Qualification system

The course will have different exercises that the students must solve during the course (80% of the final grade). At the end there will be an exam that will weigh 20% of the final grade.

Bibliography

Basic:


Complementary:


Others resources:

Hyperlink


http://cran.r-project.org/