Course guides
200611 - AB - Bayesian Analysis

Unit in charge: School of Mathematics and Statistics
Teaching unit: 715 - EIO - Department of Statistics and Operations Research.

Degree: MASTER'S DEGREE IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2013). (Optional subject).

Academic year: 2020 ECTS Credits: 5.0 Languages: Spanish

LECTURER
Coordinating lecturer: XAVIER PUIG ORIOL
Others: Segon quadrimestre:
JESUS CORRAL LOPEZ - A
XAVIER PUIG ORIOL - A

PRIOR SKILLS
We start from scratch and hence there are no pre-requisites for this course. But having some basic knowledge of statistics will help get the best out of the course.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
3. CE-1. Ability to design and manage the collection of information and coding, handling, storing and processing it.
4. CE-3. Ability to formulate, analyze and validate models applicable to practical problems. Ability to select the method and / or statistical or operations research technique more appropriate to apply this model to the situation or problem.
5. CE-4. Ability to use different inference procedures to answer questions, identifying the properties of different estimation methods and their advantages and disadvantages, tailored to a specific situation and a specific context.
6. CE-6. Ability to use appropriate software to perform the necessary calculations in solving a problem.
7. CE-7. Ability to understand statistical and operations research papers of an advanced level. Know the research procedures for both the production of new knowledge and its transmission.
8. CE-8. Ability to discuss the validity, scope and relevance of these solutions and be able to present and defend their conclusions.

Transversal:
1. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

TEACHING METHODOLOGY
One half of the sessions will be theoretical and one half of them will be based on computer use.
LEARNING OBJECTIVES OF THE SUBJECT

Abilities to be acquired:
* Knowledge of the difference between Bayesian and non Bayesian statistical modelling, and of the role of the likelihood function.
* Understand the role of the prior distribution, the role of reference priors and how to go from prior to posterior distributions.
* Understand the difference between hierarchical and non-hierarchical Bayesian models.
* Understand how to check a Bayesian model, how to compare Bayesian models and how to use them for prediction.
* Understand the Montecarlo methods that allow one to simulate from the posterior and how to make inferences from those simulations.
* Posing and solving Bayesian inference problems analytically with exponential family statistical models and conjugate prior distributions.
* Posing and solving Bayesian inference problems numerically under complex situations using WinBugs, JAGS or STAN.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>24.00</td>
</tr>
<tr>
<td>Self study</td>
<td>80,0</td>
<td>64.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>12.00</td>
</tr>
</tbody>
</table>

Total learning time: 125 h

CONTENTS

1- Bayesian Model

Description:

Full-or-part-time: 45h
Theory classes: 14h
Laboratory classes: 6h
Self study : 25h

2- Bayesian Inference

Description:

Full-or-part-time: 39h
Theory classes: 10h
Laboratory classes: 4h
Self study : 25h
### 3- Bayesian computation

**Description:**
1. The need for integration and for simulation. 2. Markov chain montecarlo simulation. 3. Monitoring Convergence

**Full-or-part-time:** 13h
- Theory classes: 2h
- Laboratory classes: 1h
- Self study: 10h

### 4- Hierarchical Models

**Description:**
1. Hierarchical Models

**Full-or-part-time:** 14h
- Theory classes: 2h
- Laboratory classes: 2h
- Self study: 10h

### 5. Checking and defining the model

**Description:**
Checking and defining the model

**Full-or-part-time:** 14h
- Theory classes: 2h
- Laboratory classes: 2h
- Self study: 10h

### GRADING SYSTEM

Final grade = 0.4*Assignments + 0.2*MidtermExam + 0.4*Project

### BIBLIOGRAPHY

**Basic:**

**Complementary:**
- Ntzoufras, I. Bayesian modeling using WinBUGS. Wiley. 2009.