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 betheoretical 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>
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</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.