UAB
Universitat Autònoma de Barcelona

Bayesian Methods

Code: 104858
ECTS Credits: 6

2024/2025

Degree	Type	Year
2503852 Applied Statistics	OB	3

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

It is convenient a good knowledge of the subjects of Probability and Inference 1 and 2. A good formation in Calculus 1 and 2 is also important.

Objectives and Contextualisation

This is the only course of Bayesian Statistic of the degree (GEA). The principal aim is to introduce the Bayesian thought to the students, providing the necessary elements to solve simple problems of inference using Bayesian methodology.

Learning Outcomes

1. KM10 (Knowledge) Describe the characteristics of the distribution and density functions of random variables.
2. KM11 (Knowledge) Identify exact and asymptotic sampling distributions of different statistics.
3. SM09 (Skill) Analyse data through different inference techniques using statistical software.
4. SM10 (Skill) Use different estimation methods depending on the context of application.

Content

The contens of the course are divided into three chapters:

1- Introduction to Bayesian Inference

1.1 Bayes' theorem and its consequences.
1.2 The basics of Bayesian Statistics: prior distributions.
1.3 Bayesian inference: the posterior distribution.

2-Bayesian Inference for some one and two-parameter models

2.1 Poisson distribution
2.2 Conjugate distributions
2.3 Prior and Posterior predictive distributions
2.4 Normal distribution (σ^2 known)
2.5 Normal distribution (μ and σ^2 unknown)
2.6 Jeffreys priors.
2.7 Bayesian hypothesis testing

3- Bayesian approximated inference for complex models

3.1 Simulation of the posterior distribution 1: AR method.
3.2 Simulation of the posterior distribution 2: MCMC.
3.3 Laplace approximation and INLA models

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical sessions	15	0.6	SM09, SM10, SM09
Theoretical lectures	30	1.2	KM10, KM11, KM10
Type: Supervised			
Mentoring	10	0.4	KM10, KM11, SM09, SM10, KM10
Workshop of exercises	15	0.6	KM10, KM11, SM09, SM10, KM10
Type: Autonomous			
Personal working	66	2.64	KM10, KM11, SM09, SM10, KM10

Accordingly with the aims of the subject, the development of the course will be based on the following activities:

Theoretical lectures: The student acquires the scientific and technic skills of the subject assisting to the theoretical lectures and complementing them with the personal work on the topics explained. The theoretical lectures are the activities demanding less interactiveness: they are conceived like a fundamentally unidirectional method of transmission of knowledge of the teacher to the student. The lectures will be given using a support of slides (PowerPoint) in English that will be uploaded also at the Virtual Campus.

Problems and practices: The problem and practical sessions have a double mission. On the one hand the students will work with the scientific and technical issues exposed in the theoretical lectures to complete its understanding developing a variety of activities, since the typical resolution of problems until the discussion of practical cases. On the other hand, the lectures solving problems are the natural forum at which argue in common the development of the practical work.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exercises	30	10	0.4	SM09, SM10
Partial exam 1	35	2	0.08	KM10
Partial exam 2	35	2	0.08	KM11

The evaluation runs continuously along the course. The continued evaluation has several fundamental aims: To check the process of education and learning and to verify that the student has attained the corresponding skills of the course.

This is the method of evaluation: The practical exercises delivered by the students (30%), a partial examination of Theory in the middle of the course (35%), and another partial examination of Theory at the end of the course (35%). The second-chance examination only will be allowed to the students having a minimum score of 3 at the final mark, recovering only the part correpong¡ding to Theory.

The students who chose the single assessment modality must take a final test that will consist of an exam in which there may be questions of theory and problem-solving and a practice exam in front of the computer. This test will be carried out on the same day, time, and place in which the test of the second partial is carried out. Anyone who misses the test without a valid excuse will be classified as NOT EVALUABLE. If a grade of less than a 5 is received, it may be recovered on the same day, at the same time, and in the same location as the other students in the course with the same format.

Bibliography

- Albert, Jim (2007). *Bayesian Computation with R*. Springer, New York.

- McElreath, Richard (2015). *Statistical Rethinking: A Bayesian Course with Examples in R and Stan*. Chapman and Hall/CRC.

- Andrew Gelman, John B. Carlin, Hal S. Stern, David B. Dunson, Aki Vehtari, Donald B. Rubin, (2013). *Bayesian data analysis*, third edition, Chapman and Hall/CRC.

Software

We will mostly use the R programming language.

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	first semester	afternoon
(PLAB) Practical laboratories	1	Catalan	first semester	afternoon
(TE) Theory	1	Catalan	first semester	afternoon