

Degree programme	Type	Course
Mathematics	OP	4

Contact lecturer

Name : Amanda Fernandez Fontelo

Email : amanda.fernandez@uab.cat

Group languages

You can consult this information at the [end](#) of the document.

Prerequisites

Students are expected to have acquired the knowledge, skills, and competences covered in the courses Statistical Inference, Probability Theory, and Stochastic Processes. In addition, a solid working knowledge of the statistical software R is highly recommended.

Objectives

- Learn different methods for generating random variables from continuous and discrete probability distributions, including both univariate and multivariate distributions.
- Learn Monte Carlo simulation techniques.
- Learn resampling techniques.

Learning outcomes

1. Effectively use bibliographies and electronic resources to obtain information.
2. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
3. Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
4. Recognise the different types of sampling.
5. Determine the size of the sample and establish a sampling strategy for parameter estimation studies.
6. Determine the size of the sample and establish a sampling strategy for proportion comparison studies.
7. Determine the size of the sample and establish a sampling strategy for comparison of means studies.
8. Determine the size of the sample and establish a sampling strategy for special comparisons.
9. Manage databases.
10. Have the capacity to randomly detect and model in real problems.
11. Draw conclusions and draft reports.
12. Use quantitative thinking and reasoning.
13. Identify the different sources of information available.
14. Know the different data collection techniques.
15. Understand, identify and select statistical sources.
16. Design, program and implant statistical packages.
17. Use programs correctly and rationally.
18. Use statistical programs to calculate sample sizes.

Contents

1. Simulation: Simulation of random variables and vectors. Generation of random numbers.
2. Permutation tests: Two-sample tests. Test with paired data. Correlation tests. Advanced examples.
3. Bootstrap and other resampling methods: Basic concepts. Estimations of standard error and bias. Parametric bootstrap. Non-parametric bootstrap. Methods to compute confidence intervals. Applications (linear and generalised-linear models, hypothesis testing, time series, ...).
4. Resampling for machine learning: Bagging. Boosting.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Personal study of the subject	47	1.88	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
Assignments	47	1.88	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
Classroom lectures (theoretical and practical)	50	2	1, 2, 4, 5, 6, 7, 8, 10, 12

The methodology will combine classroom lectures delivered by the teachers and practical work of the student with computers.

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

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Final exam	40%	3	0.12	2, 4, 9, 10, 12, 13, 16, 17
Resampling assignments hand in	30%	0	0	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
Mid-term exam	30%	3	0.12	2, 4, 9, 10, 12, 13, 16, 17

See catalan version.

Use of AI

The use of Artificial Intelligence (AI) technologies is not permitted at any stage of this course. Any work that includes AI-generated content will be considered a breach of academic integrity and may result in a partial or total penalty to the activity's grade, or more severe disciplinary sanctions in cases of greater seriousness.

Irregularities in Assessment Activities

Any irregularity committed during an assessment activity (including academic fraud, plagiarism, or the improper use of AI) that may lead to a significant alteration of the student's grade will result in that assessment being graded as 0. If the course syllabus establishes that obtaining a minimum grade in that assessment is a mandatory requirement for passing the course, or if multiple irregularities are committed in the assessment activities of the same course, the final grade for the course will be 0. In addition, disciplinary proceedings may be initiated against any student who commits any of these irregularities.

Bibliography

- Law (2014) Simulation. Modelling and Analysis.
- James - Witten - Hastie - Tibshirani (2013) An introduction to Statistical Learning: with applications in R. Springer (Recurs electrònic UAB).
- Efron - Hastie (2016) Computer Age Statistical Inference. Cambridge University Press.

Software

During the course the relevant installation instructions for the software to be used will be given, at the appropriate time.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this [link](#). To access the information, you will need to enter the course CODE