UAB
Universitat Autònoma de Barcelona

Sampling

Code: 100123
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500149 Mathematics	OT	4

Contact

Name: Aureli Alabert Romero

Email: aureli.alabert@uab.cat

Teachers

Roger Borràs Amoraga

Teaching groups languages

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

Prerequisites

It is assumed that the student has acquired the competences of the previous courses in Statistics Inference, Probability, and Stochastic Processes, and that they has a good level with the R programming language.

Objectives and Contextualisation

To learn how to produce random samples with a computer and how to apply it to the analysis of complex systems, the process optimisation.

To learn the resampling techniques in statistical inference and machine learning.

Competences

- Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
- Effectively use bibliographies and electronic resources to obtain information.
- Formulate hypotheses and devise strategies to confirm or reject them.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Use computer applications for statistical analysis, numeric and symbolic calculus, graphic display, optimisation or other purposes to experiment with Mathematics and solve problems.

- When faced with real situations of a medium level of complexity, request and analyse relevant data and information, propose and validate models using the adequate mathematical tools in order to draw final conclusions

Learning Outcomes

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

Content

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

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classroom lectures (theoretical and practical)	50	2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
Type: Autonomous			
Assignments	48	1.92	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
Personal study of the subject	48	1.92	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17,

The metodology 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

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam of Resampling	37.5%	2	0.08	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
Exam of Simulation	37.5%	2	0.08	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
Resampling assignments hand in	12.5%	0	0	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
Simulation Assignments hand in	12.5%	0	0	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18

The evaluation is based on:

- Homework deliveries (25% of the final grade).
- Exams (75% of the final grade).

To pass the course you must:

- Get a mean of at least 5.0/10 in the exams, with a minimum grade of 4.0/10 in each of them.
- Get a global mean of 5.0/10, which will be the final grade.

Grades not satisfying these conditions can be studied case by case.

Each exam will have a second call ("recuperació" in the official terminology of UAB). The attendamce to the second call shall automatically invalidate the grade of the first one. There is no second call for the homework deliveries.

The student that have attended exams or hand-in homework for a total of 50% or more of the course, according to the weight that appears in the Avaluation Activities table, will be evaluated. Otherwise will be considered "not evauable".

For the eventual award of Special Honours ("Matricula de Honor" in the official terminology) the grades of second exam calls will not be taken into account.

The plagiarism in the homework deliveries will be considered an offense as serious as any kind of cheating in and exam, and shall be penalised with an automatic course failure.

UNIQUE EVALUATION: Students opting for the so-called "Unique Evaluation" will be evaluated in one only exam covering the whole course, including the matter relative to homework. There will not be homework deliveries. One piece of the exam can be oral.In case of passing the first call there will not be an option to a second one to improve the grade.

Bibliography

- Ross, Sheldon (2013) Simulation. Elsevier (Recurs electrònic UAB).
- 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.

Language list

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan	second semester	afternoon
(TE) Theory	1	Catalan	second semester	afternoon