Universitat Autònoma de Barcelona

2021/2022

Statistics

Code: 100105
ECTS Credits: 7

Degree	Type	Year	Semester
2500149 Mathematics	OB	3	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Other comments on languages

Class materials will be mostly written in English/Spanish. Exams in catalan unless demanded otherwise.

Teachers

Yamila Garcia Martinez

Prerequisites

Linear algebra. Mathematical analysis. Probability.

Objectives and Contextualisation

In this course, the concept of Inference, in its inductive version, must be fundamentally learned.

The concepts of Modeling, Estimation (by point and intervals) and Goodness of fit must be introduced. And the linear regression techniques.

The students will have to learn:

1. The descriptive and exploratory statistics that will allow to extract and summarize efficiently information of the data.

2. Statistical Inference: how the Statistics quantifies the uncertainty of the information extracted from the data.

3. The modeling of populations, the estimation of parameters, especially maximum likelihood, and the planning and resolution of contrasts of hypotheses (parametric and non-parametric).

3. Basic properties of optimal estimators: invariance, sufficiency, efficiency, bias, variance and asymptotic properties.

4. Establish and solve applied problems. With the examples, the resolution of problems and the practices with statistical software (R), the student will work with concrete models and with real data: inferential for the most important parameters of one and two normal populations. Adjustment tests, inferential methods for the linear model.

Competences

- Apply critical spirit and thoroughness to validate or reject both ones own arguments and those of others.
- Distinguish, when faced with a problem or situation, what is substantial from what is purely chance or circumstantial.
- Recognise the presence of Mathematics in other disciplines.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- 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
- Work in teams.

Learning Outcomes

1. Apply critical spirit and thoroughness to validate or reject both ones own arguments and those of others.
2. Descriptively synthesise and analyse datasets.
3. Formulate and solve hypothesis contrast problems in one or two populations
4. Identify the main inequalities and discriminations in terms of sex/gender present in society.
5. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
6. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
7. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
8. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
9. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
10. Understand the basic properties of point and interval estimators.
11. Use large datasets with the help of a statistical package.
12. Use the maximum verisimilitude, Bayes and least square methods to construct estimators
13. Work in teams

Content

Modelling and estimationa: Random experiments. Some important distributions.

Point estimation and Intervals:

Estimators. Bias, mean quadratic error, consistency, sufficiency, asymptotic normality.
Estimation methods: moments, maximum likelyhood, Bayesian estimators.

Fisher Information and the Cramér-Rao lower bound. Efficiency.

Asymptotic normality of the MLE .

Hypothesis Testing:

Null and alternative hypotheses. Types of errors.

Neyman & Pearson lemma and UMP tests.

Likelyhood ratio test, Score and Wald tests.

Permutations and bootstrap.

Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Methodology

We have theoretical classes, problems and computer practices.

New subjects will be introduced primarily in the theretical sessions, but it will be necessary to deepen the teacher's explanations through student's autonomous study, with the support of the bibliography. Student participation will be encouraged. There will be a partial control of theory and problems in the period dessignated by the school. Material to complement the classes will be available through Virtual Campus.

Problems' classes will be devoted to the resolution of proposed problems. Students' participation in these classes will be especially encouraged.

Practical classes will introduce the use of R software through statistical applications. You will see descriptive and inferential methodologies.

The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Master classes: theory	28	1.12	10, 3, 7, 5, 2, 13, 11, 12
Practical work with computer tools	14	0.56	10, 7, 5, 2, 12

Problem classes	14	0.56	10, 3, 7, 12
Type: Supervised			
Tutorials	5	0.2	
Type: Autonomous			
Practical work with computer tools	25	1	
Problem solving (workshops and classes)	20	0.8	10, 3, 7, 5, 2, 13, 11, 12
Study and think problems	39	1.56	10, 3, 7, 5, 2, 13, 11, 12

Assessment

The assessment is carried out continuously throughout the course.

Continuous assessment has several fundamental objectives: Monitor the teaching and learning process, allowing both the student and the teacher to know the degree of achievement of the competencies and correct, if possible, the deviations that occur. Encourage the students' continued effort in the face of over-effort, often useless, last-minute. Verify that the student has achieved the competences determined in the syllabus. For this, the accreditation of a minimum level in all assessment activities will be requested (3 out of 10).

To carry out this evaluation, the following instruments are available: problem sessions, practical exams (in one or more than one session), and the first partial examination.

The continuous assessment is complemented by a written test at the end of the semester. The qualification thus obtained will represent 40% of the final mark of the subject (it allows to recover a part of a first fundamental proof).

The recovery exam will be directed to students who have not passed attained a final mark of 5. The practical and problems 30% cannot be recovered.
Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Computer Exam (R)	20 %	6	0.24	1, 10, 3, 9, 8, 7, 6, 2, 11, 12
Partial Exam 2	40%	7	0.28	10, 3, 7, 5, 2, 12
Partial Exam-1	30%	5	0.2	10, 3, 7, 5, 2, 11, 12
Problems	10%	12	0.48	1, 10, 4, 3, 9, 7, 2, 13, 11, 12

Bibliography

Fundamental

1. Casella, G..and Berger, R. (2002) . *Statistical Inference, 2º ed*. Wadsworth, Belmont, CA.
2. Casella, G., Berger, R. and Santana, D. (2002). Solutions Manual for Statistical Inference, Second Edition.

3. Morris H. Degroot, Mark J. Schervish, *Probability and Statistics* , https://es1lib.org/book/3606887/3d12fd?id=3606887&secret=3d12fd
4. Luis Ruiz Maya Pérez, Francisco Javier Martín-Pliego López. (2006). Estadística. II, Inferencia. Editoria AC.
5. Millar, R. (2011). *Maximum Likelihood Estimation and Inference*. Wiley.
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Complement

1. Das Gupta ("2008) "Asymptotic Theory of Statistics and Porbability", Springer.
2. J.A.Rice (2007), Mathematicla Statistics and data analysis, 3rd Ed, Duxbury/Thomson
3. Versani, J. "Using R for introductory Statistics", Taylor and Francis.
4. M. Kendall and A. Stuart (1983). "The Advanced Theory of Statistics".Griffin and Co. Limited, London.
5. Lehman, E.L. and Romano (2005, 3rd Ed.), J.P, "Testing Statistical Hypotheses", Springer
6. C.R. Rao (1973). "Linear Statistical Inference and its Applications". Wiley, London.
7. M.L. Rizzo (2007). "Statisticalcomputing with R". Computer Science and Data Anal Cysis Series". Chapman & Hall / CRC
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Software

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