UAB
Universitat Autònoma de Barcelona

Statistics

Code: 100105
ECTS Credits: 7

2025/2026

Degree	Type	Year
Mathematics	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

Linear algebra. Mathematical analysis. Probability.

Objectives and Contextualisation

En este curso es necesario aprender fundamentalmente el concepto de Inferencia.

Se deben introducir y asentar los conceptos de Modelización, Estimación (puntual y por intervalos) y Bondad de ajuste.

Se deben enseñar las técnicas fundamentales de regresión lineal.

Habrá que aprender:

1. La estadística descriptiva y exploratoria que permitirá extraer y resumir de forma eficiente información de los datos.

2. Inferencia estadística: cómo la Estadística cuantifica la incertidumbre de la información extraída de los datos.

3. Se trabajará la modelización de poblaciones, la estimación de parámetros, especialmente máxima verosimilitud, y el planteo y resolución de los contrastes de hipótesis (paramétricos y no-paramétricos) a partir de muestras.

4. Propiedades básicas de estimadores: Invariancia, suficiencia, eficiencia, sesgo, varianza y propiedades asintóticas.

5. Plantear y resolver problemas aplicados. Con los ejemplos, la resolución de problemas y las prácticas con software estadístico, el estudiante trabajará con modelos concretos y datos reales.

Competences

- Apply critical spirit and thoroughness to validate or reject both one's 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 one's 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

The subject is structured in four chapters:

Topic 1: Fundamentals of statistics

- Descriptive statistics and inferential statistics.
- Null and alternative hypothesis. Type of error.
- Basic estimators and properties: bias, mean squared error.
- Inference in frequencies and proportions

Topic 2: Modeling and Basic Inference

- Fisher's theorem. Student's t, Pearson's $\chi 2$ and Fisher's F laws.
- Inference in mean and variance
- Contrasts for one and two populations, of independence and goodness of fit
- Analysis of variance. Simple linear regression.

Topic 3: Advanced modeling.

- Normal, Gamma, Pareto, Poisson, Negative Binomial and more models.
- Estimation methods: moments and least squares.
- Maximum likelihood estimation method
- Exponential families.

Topic 4: Asymptotic laws of estimators and advanced contrasts.

- Asymptotic properties of estimators.
- Information from Fisher and Cota de Cramér-Rao. efficiency
- Asymptotic law of the maximum likelihood estimator.
- Neyman-Pearson, Likelihood ratio, scoring and Wald tests.

Activities and Methodology

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

We have theoretical, problem and practical classes.

The new material will primarily be introduced in the theory classes, but the teacher's explanations will need to be expanded with the student's independent study, with the support of the reference bibliography. Students' participation in the teacher's exhibitions will be assessed. There will be a partial control of theory and problems in the week of partials designated by the Faculty. Material will be uploaded to the virtual Campus to review the notes taken in class.

The class of problems will be devoted to the oriented resolution of some proposed problems. Students' participation in problem classes will be especially valued.

The practical classes will introduce the use of software such as Excel and/or R with statistical applications. Descriptive and inferential methodologies will be seen to put into practice the concepts worked on in theory and problems.

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
Computer Exam	15%	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	15%	12	0.48	1, 10, 4, 3, 9, 7, 2, 13, 11, 12

By default, the assessment is carried out continuously throughout the course.

The 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 skills and correct, if possible, the deviations that occur. Encouraging the student's continued effort against over-effort, often useless, at the last minute. Verify that the student has achieved the skills determined in the study plan. That is why it will ask for the accreditation of a minimum level in all assessment activities (a 3 out of 10).

To carry out this evaluation, the following instruments are used: A partial theory test, the documentation provided by the students of their work on problems (problem files), laboratory practice exam, which can be done in a single session or more of one The grade obtained in this assessment represents 60% of the final mark of the subject.

The continuous assessment is complemented by a final written test. The grade thus obtained will represent 40% of the final mark of the subject.

The recovery exam will be addressed to students who, having passed the minimum level, have not yet passed the exam. The part of practices and problems cannot be recovered.

Single assessment: On the date set by the Faculty for the single assessment exam, those taking this modality must hand in a problem file (15%), take a theory and problems exam (with a oral and another written) (70%) and another practical (15%).

Bibliography

BASIC:

1. D. Peña. (2002). "Fundamentos de Estadística". Alianza Editorial.
2. D. Peña. (2002). "Regresión y diseño de experimentos". Alianza Editorial.
3. Casella, G..and Berger, R. (2002) . Statistical Inference, 2º ed. Wadsworth, Belmont, CA.
4. Casella, G., Berger, R. and Santana, D. (2002). Solutions Manual for Statistical Inference,
5. Luis Ruiz Maya Pérez, Francisco Javier Martín-Pliego López. (2006). Estadística. II, Inferencia. Editoria AC.
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8. Rossi, Richard,Mathematical Statistics: An Introduction to Likelihood Based Inference, https://onlinelibrary.wiley.com/doi/book/10.1002/9781118771075

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). "Statistical computing with R". Computer Science and Data Anal Cysis Series". Chapman & Hall / CRC
8. Williams, D. (2001) "Weighihg the Odds", Cambridge University Press.
9. J.A.Rice (2007), Mathematicla Statistics and data analysis, 3rd Ed, Duxbury/Thomson

Software

R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	2	Catalan	second semester	morning-mixed

(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	2	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed