UAB
Universitat Autònoma de Barcelona

Statistics

2026/2027

Code: 100105
Credits: 7

Degree programme	Type	Course
Mathematics	OB	3

Contact lecturer

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Teaching staff

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Group languages

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

Prerequisites

Linear algebra. Mathematical analysis. Probability.

Objectives

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.

Learning outcomes

1. 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.
2. 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.
3. 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.
4. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
5. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
6. Apply critical spirit and thoroughness to validate or reject both one's own arguments and those of others.
7. Work in teams
8. Formulate and solve hypothesis contrast problems in one or two populations
9. Understand the basic properties of point and interval estimators.
10. Use the maximum verisimilitude, Bayes and least square methods to construct estimators
11. Descriptively synthesise and analyse datasets.
12. Use large datasets with the help of a statistical package.
13. Identify the main inequalities and discriminations in terms of sex/gender present in society.

Contents

The course is structured into eight topics:

Topic 1: Fundamentals of Statistics

Descriptive statistics and inferential statistics.

Samples, statistics, and sampling distributions.

Distribution of the sum, sample mean, and sample proportion.

Distributions associated with normal random samples.

Topic 2: Point Estimation

Bias and MSE. MVUE estimators.

Method of moments and maximum likelihood estimation.

Sufficiency.

Information and efficiency. The Cramér-Rao lower bound.

Topic 3: Interval Estimation

Student's *t*-intervals for a single sample.

Confidence intervals for a proportion.

Confidence intervals for the variance and standard deviation.

Bootstrap confidence intervals.

Topic 4: Hypothesis Testing Based on a Single Sample

Basic concepts: significance level, power, and *p*-value.

Tests for the population mean and population proportions.

The Neyman-Pearson lemma and likelihood ratio tests.

Topic 5: Two-Sample Inference

The classical Student's *t*-test and its confidence interval.

Paired *t*-test.

Inference for two proportions.

Bootstrap inference and permutation-based methods.

Topic 6: Chi-Square Tests

Goodness-of-fit test.

Two-way contingency tables.

Topic 7: Simple Linear Regression

Parameter estimation.

Correlation.

Prediction.

Residual analysis.

Topic 8: Analysis of Variance

One-way ANOVA.

Multiple comparisons.

Multi-factor ANOVA.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes

Study and think problems	39	1.56	2, 4, 7, 8, 9, 10, 11, 12
Tutorials	5	0.2	
Practical work with computer tools	14	0.56	2, 4, 9, 10, 11
Problem classes	14	0.56	4, 8, 9, 10
Master classes: theory	28	1.12	2, 4, 7, 8, 9, 10, 11, 12
Problem solving (workshops and classes)	20	0.8	2, 4, 7, 8, 9, 10, 11, 12
Practical work with computer tools	25	1	

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

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Partial Exam-1	35%	5	0.2	2, 4, 8, 9, 10, 11, 12
Computer Exam	15%	6	0.24	1, 3, 4, 5, 6, 8, 9, 10, 11, 12
Partial Exam 2	35%	7	0.28	2, 4, 8, 9, 10, 11
Problems	15%	12	0.48	1, 4, 6, 7, 8, 9, 10, 11, 12, 13

By default, assessment is carried out through continuous assessment throughout the course.

Continuous assessment has several main objectives: to monitor the teaching and learning process, allowing both students and instructors to assess the level of competency acquisition and, where possible, correct any shortcomings that may arise; to encourage sustained student effort rather than the often ineffective last-minute intensive study; and to verify that students have acquired the competencies established in the curriculum. To this end, students must achieve a minimum mark in all assessment activities (3 out of 10).

The following assessment components will be used: two midterm theory examinations, accounting for 70% of the final grade (35% + 35%), and the assessment of practical assignments and problem sets, accounting for

the remaining 30% of the final grade. The use of artificial intelligence (AI) tools in these assignments is strictly prohibited. Any breach of this rule will be considered academic misconduct and may result in disciplinary action.

The resit examination is intended for students who, despite having achieved the minimum required mark in all assessment activities, have not yet obtained a passing final grade. The practical assignments and problem sets component cannot be retaken.

Single Assessment: On the date established by the Faculty for the single assessment examination, students who choose this assessment mode must submit a problem set portfolio (15%), complete a theory and problem-solving examination (consisting of both a written and an oral component) (70%), and take a practical examination (15%).

Bibliography

BASIC:

1. Jay L. Devore, Kenneth N. Berk and Matthew A. Carlton (2021). Modern Mathematical Statistics with Applications, 3a ed. Springer Texts in Statistics.
2. D. Peña. (2002). "Fundamentos de Estadística". Alianza Editorial.
3. D. Peña. (2002). "Regresión y diseño de experimentos". Alianza Editorial.
4. Casella, G..and Berger, R. (2002) . Statistical Inference, 2º ed. Wadsworth, Belmont, CA.
5. Casella, G., Berger, R. and Santana, D. (2002). Solutions Manual for Statistical Inference.
6. Millar, R. (2011). Maximum Likelihood Estimation and Inference. Wiley.
7. Morris H. Degroot, Mark J. Schervish, Probability and Statistics , https://es1lib.org/book/3606887/3d12fd?id=3606887&secret=3d12fd
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), Mathematical 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/.

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

Type of teaching	Group	Language	Semester	Shift

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