UAB
Universitat Autònoma de Barcelona

Statistical Inference 2

Code: 104856
ECTS Credits: 6

2025/2026

Degree	Type	Year
Applied Statistics	OB	2

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

It is recommended that you are familiar with the contents of Calculus 1 and 2, Probability and Inference-1.

Objectives and Contextualisation

In this course we shall stablish the theoretical foundations of the concept of *Inference* -that is, how Statistics quantifies the uncertainty of the information extracted from data.
The concepts of *Modeling*, *Estimation* (both point and interval), and *Goodness of Fit* will also be established.

The theoretical foundations of different estimation methods will be introduced, especially the *Maximum Likelihood Method* and the *Method of Moments*, as well as the fundamental properties of estimators: *invariance* , *sufficiency*, *efficiency*, *bias*, *mean squared error*, and *asymptotic properties*.

The topic of *hypothesis testing* will be explored in depth, including classical theory (Fisher's exact tests, optimal theory, asymptotic theory, and non-parametric tests).

Learning Outcomes

1. CM08 (Competence) Determine the sample size and the sampling strategies required to conduct a specific study in the field of applications.
2. KM09 (Knowledge) Discover the fundamental properties of estimators: invariance, sufficiency, efficiency, bias, mean square error and asymptotic properties, in the classical and Bayesian domains.

3. KM11 (Knowledge) Identify exact and asymptotic sampling distributions of different statistics.
4. SM09 (Skill) Analyse data through different inference techniques using statistical software.
5. SM10 (Skill) Use different estimation methods depending on the context of application.

Content

Topic 1: Consolidating Concepts

- Estimation methods: moments, maximum likelihood, and their asymptotic properties.
- Comparison of estimators: Bias and mean squared error.
- Fisher information and the Cramér-Rao bound. Sufficiency and efficiency.

Topic 2: Parametric Hypothesis Testing

- Fisher's exact theory. Types of error. Null and alternative hypotheses.
- Neyman-Pearson lemma. Likelihood ratio tests. Asymptotic distribution.
- Other asymptotic tests based on likelihood (Score and Wald).

Topic 3: Nonparametric Statistics

- Permutation tests.
- Tests based on the empirical distribution function.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical work with computer tools	30	1.2	
Practices	12	0.48	
Problems	14	0.56	
Theory	26	1.04	
Type: Supervised			
Tutorials	5	0.2	
Type: Autonomous			
Study and think problems	30	1.2	

The course includes theoretical lectures, problem-solving sessions, and practical classes.
New material will be mainly introduced during theoretical lectures, but students are expected to expand on the explanations through autonomous study, supported by the recommended bibliography. Student participation

during the professor's presentations will be valued.
A midterm assessment covering theory and problem-solving will be held during the exam week scheduled by the Faculty.
Supplementary review materials will be posted on the Virtual Campus to support the class notes.

The problem-solving classes will be dedicated to guided resolution of selected exercises. Active participation in these sessions will be particularly valued (and graded).

The practical sessions will introduce the use of R software for statistical applications. Both descriptive and inferential methodologies will be covered.

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
Final exam	40%	8	0.32	CM08, KM09, KM11, SM10
Partial exam	30%	5	0.2	KM09, KM11, SM10
Practical & problems (deliveries, controls)	30%	20	0.8	KM09, KM11, SM09, SM10

Continuous assessment

The course will be assessed through the submission of assignments (exercises, problem sets and/or practical work) and two midterm exams.
To compute the weighted grade for continuous assessment, students must obtain a minimum of 3 out of 10 in each component.

Single assessment

Students who choose the single assessment option will be evaluated based on:

- A theory exam,
- A problem-solving test,
- Submission of the reports for the first and last practical sessions.

The evaluation of submitted reports may require an individual interview with the instructor.
The final grade will be the weighted average of the three components:

- Exam: 45%
- Problem test: 45%
- Report submissions: 10%

Resit exam

If the final grade is below 5, students will have another opportunity to pass the course through a resit exam, scheduled by the degree coordinators.
This resit allows recovery of up to 70% of the grade corresponding to theory and problem-solving.
The practical report component is not recoverable.

Use of Artificial Intelligence (AI)

Use of AI technologies is permitted in this course, but only for support tasks, such as:

- Literature searches,
- Code or text proofreading,
- Translations.

Students must clearly identify the parts generated with the help of AI, specify the tools used, and include a critical reflection on how these tools influenced the process and the final result of the activity.

Lack of transparency in the use of AI in assessed activities will be considered academic dishonesty, and may lead to partial or total penalties on the grade, or more severe sanctions in serious cases.

Bibliography

Bibliografía básica

- Casella, G., & Berger, R. L. (2002). *Statistical Inference* (2ª ed.). Wadsworth, Belmont, CA.
- Casella, G., Berger, R. L., & Santana, D. (2002). *Solutions Manual for Statistical Inference* (2ª ed.).
- Ruiz Maya Pérez, L., & Martín-Pliego López, F. J. (2006). *Estadística II: Inferencia*. Editorial AC.
- Millar, R. B. (2011). *Maximum Likelihood Estimation and Inference: With Examples in R, SAS and ADMB*. Wiley.
- Peña, D. (2002). *Fundamentos de Estadística*. Alianza Editorial.
- Verzani, J. (2005). *Using R for Introductory Statistics*. Taylor & Francis.

Bibliografía complementaria

- DasGupta, A. (2008). *Asymptotic Theory of Statistics and Probability*. Springer.
- Rice, J. A. (2007). *Mathematical Statistics and Data Analysis* (3ª ed.). Duxbury/Thomson.
- Kendall, M., & Stuart, A. (1983). *The Advanced Theory of Statistics*. Griffin and Co. Limited, London.
- Lehmann, E. L., & Romano, J. P. (2005). *Testing Statistical Hypotheses* (3ª ed.). Springer.
- Rao, C. R. (1973). *Linear Statistical Inference and Its Applications*. Wiley, London.
- Rizzo, M. L. (2007). *Statistical Computing with R*. Computer Science and Data Analysis Series, Chapman & Hall / CRC.

Software

R Core Team (2025). R: A language and environment for statisticalcomputing. 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/Spanish	first semester	afternoon
(PLAB) Practical laboratories	1	Catalan	first semester	afternoon
(PLAB) Practical laboratories	2	Catalan	first semester	afternoon
(TE) Theory	1	Spanish	first semester	afternoon