UAB
Universitat Autònoma de Barcelona

Linear Models 2

2026/2027

Code: 104861
Credits: 6

Degree programme	Type	Course
Applied Statistics	OB	3

Contact lecturer

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Group languages

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

Prerequisites

Computer Tools for Statistics

Exploratory Data Analysis

Design of Experiments

Statistical Inference 2

Linear Models 1

Objectives

Classical parametric statistical models are based on linear and additive relationships between a response variable and explanatory variables measured on independent experimental units, assuming that the unexplained error follows a homogeneous Normal distribution; this approach constitutes the general linear model (LM), which encompasses techniques such as the t-test, ANOVA, linear regression, and analysis of covariance.

The objective of the Linear Models 2 course is to present modeling strategies that extend the approach based on the general linear model:

- When the target variable is not continuous or the errors cannot be assumed to follow a Normal distribution, through generalized linear models (GLM).
- When the errors are not independent or homogeneous -for example, due to clustering, repeated measures on the same units, or multiple response variables on the same subjects- through mixed models (MLM).

Learning outcomes

- CM09 (Assess the suitability of the models with the correct use and interpretation of indicators and

graphs.) Assess the suitability of the models with the correct use and interpretation of indicators and graphs.
- CM10 (Modify the existing software if required by the statistic model, or create new software, if necessary.) Modify the existing software if required by the statistic model, or create new software, if necessary.
- KM13 (Detect interactions, co-linearity and importance between explanatory variables.) Detect interactions, co-linearity and importance between explanatory variables.
- SM11 (Analyse the residuals of a statistical model.) Analyse the residuals of a statistical model.
- SM12 (Interpret the results obtained to formulate conclusions about the experimental hypotheses.) Interpret the results obtained to formulate conclusions about the experimental hypotheses.
- SM13 (Compare the degree of adjustment between diverse statistical models.) Compare the degree of adjustment between diverse statistical models.
- SM14 (Use graphs to visualise the fit and suitability of the model.) Use graphs to visualise the fit and suitability of the model.

Contents

0. Review of Linear Models

1. Generalized Linear Models:

- Link function, exponential family, canonical function
- Binary responses: Logistic regression
- Count responses: Poisson regression
- Regression for positive continuous responses: Gamma regression

2. Mixed Models with Random Factors

- Correlated data and random effects
- One random factor
- Multiple random factors
- Random slopes

3. Mixed Models for Covariance Structures

- Covariance structures
- General modeling

4. Generalized Linear Mixed Models

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Preparation for the exam	10	0.4	

Theory	50	2
Computer Practices	50	2
problems / exercises to solve	16	0.64

The course material (theory notes, lists of problems and statements of practice) will be available at the virtual campus, progressively throughout the course.

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
Practices (deliveries or check)	25	16	0.64	CM10, KM13, SM11, SM12, SM13, SM14
Final test	50	4	0.16	CM09, KM13, SM11, SM12, SM13, SM14
Partial exam	25	4	0.16	CM09, KM13, SM11, SM12, SM13, SM14

Continuous Assessment:

Practices 25%

Midterm Exam 25%

Final Exam 50% (Minimum grade 4)

Not Assessable

If the student has not submitted more than 60% of the weighted assessment activities, it will be considered that there is insufficient assessment evidence and the grade assigned will be Not Assessable.

Reassessment:

Reassessment Exam 100%

Single Assessment:

Students who have opted for the single assessment modality must take a final test consisting of an exam that may include theory questions, problems, and practicals. This test will take place on the same day, time, and location as the Final Exam. The review of the final grade follows the same procedure as for continuous assessment. If a grade below 5 is obtained, it can be retaken on the same day, time, and location as the Resit Exam.

The same not-assessable criterion as for continuous assessment will apply.

Use of AI tools

For this course, the use of Artificial Intelligence (AI) technologies is permitted exclusively in autonomous activities (practicals and assignments) for support tasks (bibliographic or information searches, text correction, and statistical programming correction). Students must clearly identify which parts have been generated using this technology, specify the tools used, and include a critical reflection on how these have influenced the process and final outcome of the activity. Lack of transparency in the use of AI will be considered a breach of academic integrity and may result in a partial or total penalty on the activity's grade, or more severe sanctions in serious cases.

Bibliography

Linear Mixed-Effects Models Using R A Step-by-Step Approach / by Andrzej Gałecki, Tomasz Burzykowski https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010402935906709

Lee, Y., Nelder, J. and Pawitan, Y. (2006). Generalized Linear Models with Random Effects. Chapman & Hall. London.

John E. Freund, Irwin Miller, Marylees Miller. (2000) Estadística matemática con aplicaciones. Pearson Educación. (existeix castellà)

McCullagh, P. and Nelder, J. (1992). Generalized Linear Models. Chapman & Hall. London.

Daniel Peña; *Regresión y diseño de Experimentos*, Alianza Editorial (Manuales de Ciencias Sociales), 2002.

Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani; An Introduction to Statistical Learning, Springer texts in Statistics, 2013.

Christopher Hay-Jahans; *An R Companion to Linear Statistical Models*. Chapman and Hall, 2012.

John Fox and Sandord Weisberg; *An R Companion to Applied Regression*, 2nd edition, Sage Publications, 2011.

Software

R Core Team. 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	first semester	afternoon
(PLAB) Practical laboratories	1	Catalan	first semester	afternoon