Universitat Autònoma de Barcelona

2018/2019

Linear Models

Code: 100117
ECTS Credits: 6

Degree	Type	Year	Semester
2500149 Mathematics	OT	4	0

Contact

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Use of languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

The student is supposed to have basic knowledge of Linear Algebra, Probability and Statistics, and some experience with the software package R is recommended, but there are not regulated prerequisites.

Objectives and Contextualisation

The objective of the course is to describe, analyze and validate mathematical models that attempt to assess the relationships between different variables under uncertainty conditions. Linear models are probabilistic models that use confidence intervals and statistical hypotheses testing to interpret the results and make decisions. The goal of a regression model is to explain the mean behaviour of a response variable in terms of other variables related to it. Given a model, predictions and residuals can be obtained and analyzed, analysis that will be translated into decisions at an experimental level. The students must be conscious of the constraints in each mathematical model and select which model behaves better. Thus, they must know how to adjust, validate and compare various linear models first, and the subsequent extensions, as generalized-linear or nonlinear models, among others. To this end, theoretical and problems sessions are devoted to explore the theoretical properties of the mathematical models, dealing with data management and modelling using free statistical software, in the practical sessions.

Content

I. Preliminaries.

• Simple linear model: square minimums, maximum likelihood and other estimation methods (inverse, orthogonal, etc.).

• Multidimensional laws: Random vectors. Expectation vector and covariance matrix. Multidimensional normal distribution. Laws related to the Gaussian.

II. The multiple regression model.

• The linear model. Estimable functions. Normal equations. Properties of the coefficients' estimators. BLUE. Estimation of the variance. Goodness of fit measures. The centred model. The model with linear constraints.

• Sum of squares decompositions and distributions. Hypothesis tests and confidence regions. The Cochran theorem. Estimation of the mean response and prediction of new observations.

• Diagnosis of the model: centred, Gaussian, equal variance and uncorrelated errors. Transformations.

• Outliers and influential observations. The multicolinearity problem. The bias problem. Model selection criteria.

III. The analysis of variance and design of experiments.

• One-way analysis of Variance. Multiple comparisons. Diagnostics.

• Analysis of the variance with several factors. Interactions.

• Latin and Greco-Latin squares. Analysis of covariance.

• The 2^2 and 2^k designs. Fractions of factorial designs.

• Response surfaces models.

IV. The extensions of the linear model.

• Random effects models. Repeated measures models.

• Generalized linear models: logit, probit, Poisson.

• Nonlinear regression.