Universitat Autònoma de Barcelona

2022/2023

Advanced Modelling

Code: 104865
ECTS Credits: 6

Degree	Type	Year	Semester
2503852 Applied Statistics	OB	3	2

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

Other comments on languages

Most supporting documentation and related articles will be in English.

Teachers

José Ríos

Prerequisites

Prior knowledge of sufficient knowledge in both theoretical statistics (linear models, statistical inference, and probability) and applied statistical software management. Internships can be followed with R, SAS or Stata.

A sufficient level of English is required to understand scientific articles to apply modeling knowledge.

Objectives and Contextualisation

Learn different modeling strategies for data analysis, both in terms of the theoretical aspect and its applications. Provide applied knowledge in terms of design, organization, implementation, supervision, analysis, interpretation and dissemination of results.

The general objectives of the subject are:

1. Know the basics for the application of different models
2. Understand criteria for selecting variables based on objectives
3. Acquire knowledge about the interpretation and implications of different models
4. Acquire and apply programming knowledge

Competences

- Analyse data using statistical methods and techniques, working with data of different types.
- Correctly use a wide range of statistical software and programming languages, choosing the best one for each analysis, and adapting it to new necessities.

- Critically and rigorously assess one's own work as well as that of others.
- Design a statistical or operational research study to solve a real problem.
- Formulate statistical hypotheses and develop strategies to confirm or refute them.
- Interpret results, draw conclusions and write up technical reports in the field of statistics.
- Make efficient use of the literature and digital resources to obtain information.
- Select and apply the most suitable procedures for statistical modelling and analysis of complex data.
- Select statistical models or techniques for application in studies and real-world problems, and know the tools for validating them.
- 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.
- Summarise and discover behaviour patterns in data exploration.
- Use quality criteria to critically assess the work done.
- Work cooperatively in a multidisciplinary context, respecting the roles of the different members of the team.

Learning Outcomes

1. Analyse data through inference techniques using statistical software.
2. Analyse data using other models for complex data (functional data, recount data etc.).
3. Critically assess the work done on the basis of quality criteria.
4. Detect and respond to missing data.
5. Draw conclusions about the applicability of models with the use and correct interpretation of indicators and graphs.
6. Establish the experimental hypotheses of modelling.
7. Identify the stages in problems of modelling.
8. Identify the statistical assumptions associated with each advanced procedure.
9. Make effective use of references and electronic resources to obtain information.
10. Make slight modifications to existing software if required by the statistical model proposed.
11. Measure the degree of fit of a statistical model.
12. Prepare technical reports within the area of statistical modelling.
13. Reappraise one's own ideas and those of others through rigorous, critical reflection.
14. 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.
15. 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.
16. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
17. Use graphics to display the fit and applicability of the model.
18. Validate the models used through suitable inference techniques.
19. Work cooperatively in a multidisciplinary context, accepting and respecting the roles of the different team members.

Content

- Basic concepts in statistics applied to modeling
- Obtaining, supervising and preparing the data
- Effect measures and related models. Selection of models depending on the design
- Models used in studies with confounding factors and effect modifiers. Role of different (co) variables
- Application of multivariate and regression logistic regression models
- Propensity score and other alternatives for control of confounding factors
- Adjusted meta-analysis for individual data
- Adjusted repeated measurements with fixed and random effects

There will be practical examples in each block and students will have to deliver the practices done in groups

Methodology

Supervised activities

- Theoretical classes (TE). Each thematic block will begin with one or more face-to-face theory classes where the teacher will explain the key concepts, encourage interaction and discussion of doubts, and give guidelines for monitoring and preparation of complementary activities..

  The support teaching material will contain the essential contents of the theoretical classes, will be available in advance on the Virtual Campus of the subject, and it is recommended that students have it available during the class (computer, tablet or paper format) to facilitate its monitoring.

- Laboratory Practices (PLAB). Practices related to the theoretical concepts will be carried out. Work will be done to expand and consolidate previous scientific and technical knowledge, and scientific articles will be used to encourage discussion.

Autonomous activities

- Self-study tests with feedback will be provided, using the questionnaire utilities of the Moodle classroom of the virtual campus of the subject, to facilitate the review of the subject synchronized with the teaching of the syllabus.
- Group work. There will be several teams works in which students will try to apply their knowledge to a real situation under the supervision of the teacher. Problems will be solved by consulting different sources and using statistical software. The student's capacity for analysis, reasoning and expertise in solving problems related to the professional field will be promoted.
- Personal study. Although the subject is eminently focused on the practical implementation of knowledge in advanced modelling, there will be a minimum individual effort in order to assimilate the theoretical classes.

Tutorials and personal attention to students

Students are expected to attend classes and consult doubts by actively participating in their discussion. However, students can consult with the professors using the foro of the virtual campus and the e-mails indicated in the teaching staff.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical lecture	50	2	2, 1, 13, 3, 12, 6, 7, 8, 10, 16, 14, 15, 9, 18
Theory lecture	50	2	2, 1, 13, 3, 12, 6, 7, 8, 10, 16, 14, 15, 9, 18

Assessment

If the criteria for averaging are met, then the final mark for the course will be calculated using the weightings described in this section. Otherwise, it will be necessary to recover the affected activities in order to make up the average. A minimum mark of 5 out of 10 points is required to pass the course.

To assess the degree of achievement of the competences, the following instruments and weightings will be used:

Exams

There will be two partial exams with a weighting of 15% each, in which students will have to answer questions on theoretical and applied concepts. The minimum mark for weighting is 3 out of 10.

These activities are compulsory. In order to have access to the recovery it is necessary to have done 80% of the evaluable activities and to have taken the 2 mid-term exams.

Practical work

These activities are compulsory and it is necessary to have at least a mark of 4 out of 10 in each of them, otherwise it will be necessary to recover the affected activities. Practical work is worth 45% of the overall mark for the course.

Deliveries after the deadline:

- The late delivery of the practices will imply a penalty of 20% of the obtained mark.

These activities are compulsory and recoverable.

Self-study activities

They will have a weight of 10% provided that at least 80% of the activities have been carried out, otherwise the mark for this part will be a zero. There is no minimum grade for these activities.

Deliveries after the deadline:

- The delivery of these activities late and up to 48 hours after the deadline, will imply a penalty of 20% on the grade obtained.
- The late delivery of activities after this 48-hour marginwillmean that they will be counted as not having beencompleted for the evaluation.

These activities are not mandatory, but they are not recoverable either.

Continuous training and evaluation

It is reminded that the evaluation will be made according to the contents commented by the teacher in class, and that, therefore, attendance in person is highly recommended since not all the information will be accessible on the virtual campus.

In addition, during the course there will be a continuous assessment and it will be necessary to have participated in 80% of the assessment activities for them to be weighted at 15%, otherwise the mark for this part will be a zero. Standard teaching innovation tools will be used to control class participation. There is no minimum mark for these activities.

These activities are not mandatory, but they are not recoverable either.

Summary of criteria and weights for the evaluation of the subject

	Participation[1]	minimum Participation[2]	minimum Mark[3]	Exercise recoverable[4]	Weights[5]
Test 1st partial	Compulsory	100%	3	Compulsory	15%

Test 2nd partial	Compulsory	100%	3	Compulsory	15%
Practical work	Compulsory	100%	4	Compulsory	45%
Self- study	Volunteer	≥80%	NA	Unrecoverable	10%
Continued appraisal	Volunteer	≥80%	NA	Unrecoverable	15%

NA: Not applicable

1: Compulsory participation implies that non-participation will have to be recovered in order to be weighted, and if it is not done, it will not be possible to average, and therefore the subject will not be approved either. Voluntary participation implies that it is not compulsory but that it cannotberecovered later

2: Value of minimum participation to weight, otherwise the activities will count as 0

3: Minimum mark of 10 points to be weighted with the rest, if the minimum is not reached, the specific activity will have to be recovered, regardless of the rest of the marks of the same type

4: When the activity is recoverable, it must be recovered if the minimum mark is not obtained. In case of non-recoverable activity, the mark cannot be recovered, and therefore it will be weighted to the final mark, even if it is 0 or less than any threshold

5: Weight value if the previous criteria are met

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam 1	15%	6	0.24	2, 1, 13, 3, 12, 6, 7, 8, 10, 16, 14, 15, 9, 18
Exam 2	15%	6	0.24	2, 1, 13, 3, 12, 6, 7, 8, 10, 16, 14, 15, 9, 18
On-site continuous assessment during classes	15%	4	0.16	2, 1, 13, 3, 4, 12, 6, 5, 17, 7, 8, 11, 10, 16, 14, 15, 19, 9, 18
Practical works	45%	30	1.2	2, 1, 13, 3, 4, 12, 6, 5, 17, 7, 8, 11, 10, 16, 14, 15, 19, 9, 18
Self-learning tests	10%	4	0.16	2, 1, 13, 3, 4, 12, 6, 5, 17, 7, 8, 11, 10, 16, 14, 15, 19, 9, 18

Bibliography

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Pinheiro JC & Bates D (2000) Mixed-Effects Models in S and S-PLUS. Springer.

T Hastie, R Tibshirani, J Friedman. (2009) The Elements of Statistical Learning. Data Mining, Inference and Prediction, Springer, New York.

Therneau T, Grambsch P. Modeling Survival Data: Extending the Cox Model (Statistics for Biology and Health). Springer-Verlag New York Inc.; Edición: 1st ed. 2000.

Venables, W. & Ripley, B. (2002). Modern Applied Statistics with S-PLUS. Springer

Verbeke G, Molenberghs G. Linear Mixed Models for longitudinal Data. New York: Springer-Verlag, 2000.

Software

SAS version 9.4 software (© SAS Institute Inc., Cary, NC, USA)

STATA (© Stata Corporation, College Station, TX, USA) and

R (© 2010 R free software foundation: http://www.r-project.org).