Universitat Autònoma de Barcelona

2021/2022

Advanced Modelling

Code: 104865
ECTS Credits: 6

Degree	Type	Year	Semester
2503852 Applied Statistics	OB	3	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

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

Directed activities:

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

  The teaching support material will contain the essential contents of the theoretical classes, will be available in advance in the Virtual Campus of the subject, and students are recommended to have it available during the class (computer, tablet or paper format) to facilitate the your follow-up.

- Laboratory Practices (PLAB). Practices related to theoretical concepts will be executed. Work will be done to expand and consolidate prior scientific and technical knowledge, and scientific articles will be used to encourage discussion. Standard teaching innovation tools that control classroom participation will be used.

Autonomous activities

- Self-learning test. Self-learning tests with feedback will be provided, using the utilities of questionnaires from the Moodle classroom of the virtual campus of the subject, to facilitate the review of the subject synchronized with the teaching of the syllabus.
- Work in group. There will be several team work where it will be tried to apply the knowledge approaching a real situation supervised by the teacher. Problems will have to be solved in which various sources and the use of statistical software will have to be consulted. It will promote the capacity of analysis, the reasoning and the expertise of the student in the resolution of problems related with the professional field.
- Personal study. Although the subject is eminently focused on the practical implementation of knowledge in advanced modeling, a minimal individual effortwill be required to establish the theoretical classes.

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

To assess the degree of achievement of the competencies, the following instruments and weights will be used:

- 2 partial exams with a weighting of 15% each
- Self-learning tests, there will be at least 3 and all 3 are mandatory to have a 10% weighting
- Practical group work* there will be at least 3 and all 3 are mandatory to have a 50% weighting
- Practice attendance#: it is not compulsory but it is very convenient for the follow-up of the subject. If a minimum of 80% is attended, individual evaluations of the same made with kahoot will be counted.

Otherwise, the grade will be calculated with the other activities excluding this one. Students may waive this partial grade if they think the final grade may worsen.

*: Collective evaluation: collective evaluations may be individualized in the case of manifest heterogeneity

#: It is considered that the natural learning of the subject requires a minimum attendance of 80% for laboratory practices (PLAB). In the event that the student anticipates that this may be a problem due to his / her personal situation, it will be necessary to contact the coordinator of the subject to establish a complementary alternative tutoring plan.

The subject will be passed if the weighted mark of all the sections is at least 5 points out of 10, and in addition

- all mandatory practical work has been submitted
- all self-learning tests have been taken
- there is no grade lower than 3 in the compulsory activities

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Attendance to practice sessions (minimum 80%) with individual evaluation	10%	4	0.16	2, 1, 13, 3, 4, 12, 6, 5, 17, 7, 8, 11, 10, 16, 14, 15, 19, 9, 18
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
Practical works	50%	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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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).