Universitat Autònoma de Barcelona

2023/2024

Survival Analysis

Code: 104867
ECTS Credits: 6

Degree	Type	Year	Semester
2503852 Applied Statistics	OB	2	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Prerequisites

It is necessary to have knowledge of the following:

- Descriptive statistics
- Probability theory
- Statistical Inference

In addition, having taken or completed the course on Linear Models 1 and having a basic knowledge of R is recommended.

Objectives and Contextualisation

This course introduces the basic concepts of time-to-event data: The idea of censoring, the Kaplan-Meier and Nelson-Aalen estimators, an introduction to parametric and semi-parametric models for survival data and, finally, an introduction to some more advanced topics in survival analysis. Examples of application will be mainly from the health sciences, but examples from other fields, such as economics or reliability, may also be included.

Competences

- Critically and rigorously assess one's own work as well as that of others.
- 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.

- 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.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- 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. Critically assess the work done on the basis of quality criteria.
2. Identify the statistical assumptions associated with each advanced procedure.
3. Identify, use and interpret the criteria for evaluating compliance with the requisites for applying each advanced procedure.
4. Make effective use of references and electronic resources to obtain information.
5. Reappraise one's own ideas and those of others through rigorous, critical reflection.
6. 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.
7. 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.
8. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
9. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
10. Work cooperatively in a multidisciplinary context, accepting and respecting the roles of the different team members.

Content

1. Introduction to survival analysis

- Survival data: Censoring, concepts of study time and patient time, examples, etc.
- Survival, hazard, and cumulative hazard functions

2. Non-parametric inference with right-censored survival data

- Estimation of the survival function: Kaplan-Meier and Nelson-Aalen estimators
- Estimation of the hazard function
- Point estimates and confidence intervals for the median of survival times and other percentiles
- Survival curves comparison: The Log-Rank and Wilcoxon tests

3. Parametric models for survival times

- Distributions for non-negative random variables
- Accelerated failure time model: Definition, properties and goodness of fit

4. The proportional hazards Cox model

- General description of the model
- Estimation of the Cox regression model
- Confidence intervals, significance tests and comparison with alternative models
- Lasso techniques for the selection of variables in the Cox regression model

- Interpretation of the Cox model's parameter estimates
- Model checking in the Cox regression model

5. Advanced topics in survival analysis

- Extensions of the Cox regression model
- Interval-censored survival data
- Introduction to Frailty models

Methodology

Independent learning:

1. EXTENSION OF CONCEPTS: Some parts of the course will require personal work using notes or recommended bibliography
2. REALISATION OF HANDS-ON WORK: You will get to apply the concepts learned in the course and know how to implement them using the R software
3. LISTS OF EXERCISES: Each list of exercises will be solved in class on the basis of the student's contributions and suggestions.

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			
Problem resolution	14	0.56	5, 2, 3, 9, 6, 7, 4
Theory	21	0.84	2, 3, 7, 4
Type: Supervised			
Practices	20	0.8	5, 1, 2, 7, 10
Type: Autonomous			
Complete each practice	30	1.2	7
More concepts	30	1.2	7
Problems solutions	10	0.4	5, 1, 10, 4

Assessment

Continuous evaluation

The continuous evaluation of the course will consist of a midterm exam (30%), a final exam (40%) and hands-on activities (30%, not recoverable). In particular, the hands-on evaluation will consist of several weakly R-based exercises that will be graded and a final exam with R. It is mandatory to have over 3 in the final course qualification to write the resit exam.

One-off evaluation

If a student chooses to take a one-off evaluation, he/she will take a final-term exam with theory questions and exercises to solve. There will also be an exam with R and several deliverables with solutions to some R exercises. This one-off evaluation will take place on the same day and in the same place as for the students who are evaluated with the final-term exam from the continuous evaluation. The weight of the exam with theory questions and exercises will be 70%, and the remaining 30% will be in the R evaluation part (which is not recoverable). If a student does not write the exams or submit the R-based tutorials, the student will be graded as NO AVALUABLE. Otherwise, if the student fails the one-off evaluation but achieves a qualification above 3, the student can take a resit exam on the same day and in the same place as the resit exam of the continuous evaluation. Please note that only 70% of the course can be recovered in this resit exam.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	40%	3	0.12	2, 3, 8, 6, 7
Hands-on deliverables	30%	20	0.8	5, 1, 10, 4
Midterm exam	30%	2	0.08	2, 9, 8, 6, 7

Bibliography

- Allison, P. (2010). Survival Analysis Using the SAS System: A Practical Guide, 2nd Edition. Cary: SAS Institute Inc, cop.
- Collett, D. (2015). Modelling Survival Data in Medical Research, 3rd Edition. Chapman & Hall.
- Hosmer, D., Lemeshow, S. and May, S. (2008). Applied Survival Analysis: Regression Modeling of Time-to-Event Data, 2nd Edition. Wiley.
- Klein, J. and Moeschberger, M. (2003). Survival Analysis: Techniques for Censored and Truncated Data, 2nd Editon. Springer.
- Kleinbaum, D. (2012). Survival Analysis: A Self-Learning Text, 3rd Edition. Springer Science.

Software

We will carry R lab sessions