UAB
Universitat Autònoma de Barcelona

Survival Analysis

Code: 104867
ECTS Credits: 6

2025/2026

Degree	Type	Year
Applied Statistics	OB	2

Contact

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Teachers

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Teaching groups languages

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

Prerequisites

You are expected to be familiar with:

- Descriptive statistics
- Probability
- Statistical inference

In addition, it is recommended that you are currently enrolled in or have already completed the course Models Lineals 1, and that you have basic knowledge of R.

Objectives and Contextualisation

This course introduces the fundamental concepts for the analysis of survival random variables (also known as "time-to-event" variables), including: survival functions, hazard and cumulative hazard functions, concepts of censoring and truncation, likelihood and log-likelihood functions for different types of censored data (right, left, interval) as well as for truncated data. The course covers non-parametric estimators such as the Kaplan-Meier estimator (for the survival function) and the Nelson-Aalen estimator (for the cumulative hazard function). Additionally, the course provides an introduction to parametric regression models for survival analysis, focusing on proportional hazards (PH) and accelerated failure time (AFT) models, with special emphasis on exponential and Weibull regression models. An introduction to the semi-parametric Cox proportional hazards model is also included. If time permits, more advanced topics in survival analysis will be covered. Although applications will mainly focus on the field of health sciences, examples from other areas such as economics or reliability may also be discussed.

Learning Outcomes

1. CM12 (Competence) Assess the existence of inequalities on the grounds of gender in databases, to avoid bias in automatic (algorithmic) decision-making.

Content

1. Introduction to survival analysis

- Survival data: Concepts of censoring and truncation, definition of the concepts of study time and patient time, examples, etc.
- Survival function, hazard function, and cumulative hazard function. Mean residual life.
- Classical distributions of survival random variables: Exponential, Weibull, Gompertz, log-logistic, log-normal, etc.

2. Likelihood and log-likelihood functions for survival data

- The Random censoring model and the concept of non-informative censoring.
- Construction of the likelihood and log-likelihood functions under different scenarios of censoring and/or truncation in survival data.

3. Non-parametric inference for right-censored survival data

- Estimation of the survival function (Kaplan-Meier) and the cumulative hazard function (Nelson-Aalen).
- Confidence intervals for survival and hazard functions: Greenwood's formula and log and log-log transformations.
- Point estimates and confidence intervals for the median survival time and other percentiles.
- Comparison of two survival curves: Log-Rank and Wilcoxon tests.

4. Parametric models for survival time: PH and AFT models

- Proportional hazards (PH) models: The exponential regression model.
- Accelerated failure time (AFT) models: The Weibull regression model.

5. The semi-parametric Cox proportional hazards model

- General description of the model.
- Estimation of the Cox regression model: Concept of partial likelihood.
- Confidence intervals, hypothesis testing, and comparison of alternative models.
- Interpretation of parameter estimates in the model.
- Goodness-of-fit techniques in the Cox regression model.

6. Advanced Topics in Survival Analysis

- Extensions of the Cox model.
- Introduction to the Frailty models.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			

Lecture sessions	21	0.84
Resolution of certain laboratory problems and exercises during face-to-face sessions	14	0.56
Type: Supervised		
Resolution of laboratory problems in class	20	0.8
Type: Autonomous		
Complete all laboratory practice tasks independently	30	1.2
Resolution of theory-based problems	10	0.4
Self-directed learning to deepen understanding of lecture topics	30	1.2

Independent learning:

1. EXTENSION OF CONCEPTS: Some parts of the course will require independent work using the recommended bibliography, which is available as an online resource through the library.
2. REALISATION OF HANDS-ON WORK: Laboratory activities will be carried out to apply the concepts covered in the course and to gain experience with the R software for data analysis and model implementation.
3. LISTS OF THEORY-RELATED PROBLEMS: As a general rule, solutions to the problem sets will not be posted on the Moodle course page. Students are encouraged to suggest exercises during the practice sessions for correction, particularly those they have been unable to solve individually. It is expected that students approach the problem sets autonomously and consult the professor in case of questions or difficulties.

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

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Hands-on deliverables	30%	20	0.8	CM12
Primer examen (E1)	35%	2.5	0.1	
Second exam (E2)	35%	2.5	0.1	

Continuous evaluation

The continuous evaluation of the course will consist of a first exam in the middle of the course (E1, 35%), a second exam at the end of the course (E2, 35%), and the practical work during laboratory sessions (P, 30%, non-recoverable). In particular, the evaluation of the practical work will consist of a set of problems similar to those solved in lectures to be graded (PP, 15%), as well as a final project (PF, 15%). The PP problems will be solved during the second part of in-person lab sessions and submitted at the end of the session. Late submission of each the problems or the final project without a valid reason will result in a penalty. In addition, plagiarism or copying of practical work will automatically result in a mark of 0 for that assignment. Therefore, the final grade (F) will be calculated as follows:

F=E1×0.35+E2×0.35+PP×0.15+PF×0.15

If a student does not obtain a grade of 5 in the final course qualification, to pass the course, he/she will have to take the resit exam (R), where he/she will be able to retake exams E1 and E2, but not the practical work (P10 and P20). For those students who take the resit exam, the final grade of the course will be:

F=min(R×0.7+PP×0.15+PF×0.15, 5)

It is not possible to improve the final grade of the course by taking the resit exam.

Single evaluation:

Students who have chosen the single assessment mode will have to take a final examination consisting of theoretical questions and problems (E). In addition, they will also have to submit the results of a set of exercises and problems (which will not be the same as those submitted in the continuous evaluation but will cover similar content) (P10) and the final project (P20).This examination will be held on the same day, time, and place as the second exam of the continuous evaluation (E2). The weight of the exam (E) will be 70%, and the evaluation of the practical work of the course will be 30% (not recoverable), where 15% will be a set of problems (PP) and 15% will be the final project (PF). Those who do not attend this exam without justified cause will receive a grade of NOT ASSESSED. Therefore, the final grade (F) will be:

F=E×0.7+PP×0.15+PF×0.15

If a student does not obtain a grade of 5 in the final course qualification (F), to pass the course, he/she will have to take the resit exam (R), where he/she will be able to retake exams E1 and E2, but not the practical work (PP and PF). For those students who take the resit exam, the final grade of the course will be:

F=min(R×0.7+PP×0.15+PF×0.15, 5)

The resit exam will be held on the same day, time, and place as the resit exam for the rest of the students in the course. It is not possible to improve the qualification of the course by taking the resit exam.

Bibliography

- Collett, D. (2015). Modelling Survival Data in Medical Research, 3rd Edition. Chapman & Hall.
  https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010839836806709
- Hosmer, D., Lemeshow, S. and May, S. (2008). Applied Survival Analysis: Regression Modeling of Time-to-Event Data, 2nd Edition. Wiley.
  https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991001026469706709
- Klein, J. and Moeschberger, M. (2003). Survival Analysis: Techniques for Censored and Truncated Data, 2nd Editon. Springer.
  https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_proquest_miscellaneous_3673417
- Kleinbaum, D. (2012). Survival Analysis: A Self-Learning Text, 3rd Edition. Springer Science.
  https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010402570806709
- Lee, E.T. and Wang, J.W. (2003). Statistical Methods for Survival Data Analysis, John Wiley & Sons, Inc.
  https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_askewsholts_vlebooks_97804714

Software

We will carry R lab sessions

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan	second semester	afternoon
(TE) Theory	1	Spanish	second semester	afternoon