Universidad Zaragoza

Academic Year/course: 2023/24

69701 - Biostatistics and numerical simulation in biomedical engineering

Syllabus Information

Academic year: 2023/24
Subject: 69701 - Biostatistics and numerical simulation in biomedical engineering
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 633 - Master's Degree in Biomedical Engineering
ECTS: 6.0
Year:
Semester: First semester
Subject type: Compulsory
Module:

1. General information

Biostatistics provides the tools for data analysis: application of parametric and non-parametric techniques and survival analysis for risk comparison along with the construction of regression models to explain relationships between variables of interest in observational studies in the biomedical field.
Numerical simulation provides the necessary knowledge to implement and use different numerical tools in specific biomedical engineering problems.
This approach is aligned with some Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda providing training and competence to contribute to the achievement of the following specific goal and target:
Goal 3: Health and Well-Being. Ensure healthy lives and promote well-being for all at all ages (Objective 3.B i+D).

2. Learning results

In order to pass this subject the student must prove that they is able to:

Interpret observational or experimental data of biomedical origin, extract the information they contain and the relationships between them, and evaluate hypotheses in the presence of uncertainty and variability.
Understand the methods of hypothesis testing on means, variances and proportions, on data of biomedical origin, quantitative or categorical, and know how to apply the most appropriate according to the characteristics of the data, adequately interpreting the results.
Determine relationships between variables from observational studies. Know the procedures for the construction and validation of empirical models that explain these relationships, as well as the most relevant techniques of multivariate analysis.
Understand and know how to interpret the terminology and statistics most widely used in epidemiology and clinical studies, including those referring to frequencies of occurrence, risk and survival analysis and diagnostic or predictive capacity.
Know the methods of numerical interpolation, differentiation and integration.
Know the least squares adjustment technique and optimization techniques.
Know the methods of numerical solution of equations and systems of differential equations of biological systems.
Know the applications to initial value and boundary problems.
Know the methods of numerical solution of partial differential equations describing biological systems.
Choose the most appropriate numerical technique (finite elements, finite differences, finite volumes) for the solving of each type of problem within the framework of biomedical engineering.
Know how to manage, at user level, numerical calculation programs (Matlab), as well as how to develop simple algorithms in these codes.
Know how to manage at user level general finite element codes (Abaqus) and solve simple problems in the field of Biomedical Engineering.

3. Syllabus

Biostatistics:
1.1. Exploratory data analysis and basic concepts.
2.1 ANOVA test, multiple comparisons.
2.2 Non-parametric contrasts: rachas, Mann-Whitney, Kruskal-Wallis.
3.1 Simple linear regression, critique and validation, Box-Cox transformation, prediction.
3.2 General linear model, analysis of covariance. Automatic model building procedures.
3.3 Linear model with multivariate response, MANOVA.
4.1 Contingency table
4.2 Logistic regression models, log-linear models.
5.1 Risk and survival measures. Censorship. Kaplan-Meier estimator
5.2 Weibull and proportional hazard models.

Numerical simulation:
1. Introduction
2. Equations continuous media
3. Numerical methods
4. Finite differences
5. Finite elements
6. Finite volumes

4. Academic activities

Biostatistics:
A01 Master class (10 hours).
A03 Laboratory practices (20 hours).
A01 and A03 are developed in a computer classroom using statistical software.
A05 Application/research work on biomedical problems, including a report.
A06 Tutoring for personalized attention
A08 Assessment. Individual written test and assignments of section A05.

Numerical Simulation:
A01 Master Class (24 hours).
A03 Laboratory practices (6 hours). This is a mainly practical subject that focuses on numerical techniques to problems in the field of biomedical engineering.
A05 Practical work applying the knowledge acquired.
A06 Tutorials.
A08 Assessment. Individual written test, practices A03 and assignments A05.

5. Assessment system

In order to pass the subject, the student must obtain a grade equal to or higher than 5 in each of the parts: biostatistics and numerical simulation.
If in the 1st call the student obtains a grade equal to or higher than 5 in only one of the parts, biostatistics or numerical simulation, they will only need to take the exam of the pending part in the 2nd call for exams.
There will be a global test in each call for each of the parts on the dates and times determined by the School.

Assessment of the biostatistics part:
written test on data analysis (30% of the final grade). A minimum grade of 5 out of 10 points must be obtained.
Academic papers (15% of the final grade).
Assessment of laboratory practices (5% of the final grade).

Assessment of the numerical simulation part:
Subject exam: Minimum exam, multiple choice (multiple choice, possible penalties for failures). The grade for this part will account for 35% of the final grade.
Assessment of computer practices (5% of the final grade).
Work assessment (10% of the final grade).