UAB
Universitat Autònoma de Barcelona

Biostatistics

Code: 101965
ECTS Credits: 6

2025/2026

Degree	Type	Year
Genetics	FB	2

Contact

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Teaching groups languages

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

Prerequisites

Those required for admission to the degree program.

A basic understanding of mathematics is highly recommended for successful progress in this course.

Objectives and Contextualisation

Statistical tools are fundamental for research and analysis in Genetics and Genomics. In this Biostatistics course, we will not only understand and analyze experimental data but also learn how to communicate statistical results rigorously and effectively. This course introduces the basic concepts of statistics, data handling with R, and basic visualization techniques to clearly and effectively represent data.

The course objectives are:

- Develop mastery of basic statistical concepts.
- Develop the ability to correctly apply these concepts, especially to problems arising in life sciences and Genetics.
- Learn to effectively communicate the results of statistical analyses, both numerically and graphically.
- Acquire basic competencies in R for statistical analysis and data visualization.

Competencies

- Application of the scientific method to problem solving.
- Application of theoretical knowledge to practice.
- Knowledge and application of basic statistical analysis procedures and software tools.
- Ability to design experimental studies and interpret results.
- Development of critical thinking, analysis, and synthesis skills.
- Use of the R language for statistical analysis.
- Design and creation of effective visualizations for communicating scientific results.

Learning Outcomes

- Apply the scientific method to problem solving.
- Apply theoretical knowledge to practice.
- Describe and recognize issues associated with multiple comparisons.

- Design experiments and interpret their results.
- Prepare reports of results in genetic studies.
- Identify and explain principles of quantitative genetics.
- Understand the importance of variability and randomization.
- Formulate relevant research questions in genetics.
- Make data-driven decisions.
- Use statistical packages in R.
- Visualize data to communicate scientific results.
- Reason and discuss critically and scientifically.

Competences

- Apply knowledge of theory to practice.
- Apply scientific method to problem solving.
- Be able to analyse and synthesise.
- Design and interpret studies associating genetic polymorphisms and phenotypical characters to identify genetic variants that affect the phenotype, including those associated to pathologies and those that confer susceptibility to human illnesses or those of other species of interest.
- Design experiments and interpret the results.
- Know, apply and interpret the basic procedures of mathematical calculation, statistical analysis and IT, the use of which is indispensable in genetics and genomics.
- Make decisions.
- Reason critically.

Learning Outcomes

1. Apply knowledge of theory to practice.
2. Apply scientific method to problem solving.
3. Be able to analyse and synthesise.
4. Describe the problems associated to multiple statistical comparisons.
5. Design experiments and interpret the results.
6. Enumerate the basic statistical principles of quantitative genetics.
7. Explain the logic of statistical reasoning and the importance of the randomisation of causes.
8. Make decisions.
9. Pose a genetic research problem.
10. Produce a report on the results of genetic research.
11. Reason critically.
12. Use statistical packages.

Content

The topics covered will include:

- Introduction to biostatistics. Experimental design and statistical inference. Sampling: biological population, statistical population.
- Hypothesis testing: elements of a statistical test.
- Statistical analysis of one or two samples: Student's t-test. Comparison of means. Paired data.
- Analysis of variance I: fixed effects model with one factor. ANOVA procedure. Post hoc tests.
- Analysis of variance II: fixed effects model for two or more factors.
- Principles of experimental design: experimental unit and treatment. Experimental variation (error) and its control. Replications. Statistical power and effect size.
- Statistical analysis in regression.
- Multiple regression.

- Analysis of covariance.
- Analysis of categorical data.
- Introduction to designs in genetic epidemiology: methods for detecting genes involved in diseases: linkage and association.
- Non-parametric statistics.

Additionally, parallel work will be done with R:

- Introduction to the R language. Data import, manipulation, and cleaning.
- Data visualization with R (ggplot2).
- Reproducible reports with R Markdown.
- Statistical analyses using R packages.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Computer practicals	12	0.48	2, 1, 5, 10, 9, 8, 11, 3, 12
Lecture classes	30	1.2	4, 5, 6, 7, 9
Problems seminars	11	0.44	2, 1, 5, 10, 9, 8, 11, 3
Type: Supervised			
Group mentoring sessions	4	0.16	2, 1, 5, 10, 9
Type: Autonomous			
Practical work	20	0.8	2, 1, 10, 11, 3, 12
Studying hours	60	2.4	2, 1, 4, 5, 10, 6, 7, 9, 8, 11, 3, 12

The contents of the Biostatistics course are designed to provide students with a general introduction to basic statistical concepts, aiming to develop an understanding of statistical reasoning and the appropriate use of these tools in the design and analysis of experiments.

- Theoretical classes: Students will acquire the scientific knowledge relevant to the subject by attending lectures, which will be complemented by personal study of the topics covered. The sessions will be dynamic and interactive, incorporating active participation tools to enhance understanding and encourage reflection on key concepts.
- Problem-solving classes: The knowledge acquired in lectures will be applied to the resolution of practical cases. These sessions will be used to demonstrate the statistical analyses introduced in the theoretical classes.
- Computer-based practical sessions: This part of the course is essential for consolidating the acquired knowledge. Students will learn to use the R language and various statistical packages to implement the analyses covered in theory. In addition, basic data visualization techniques will be practiced to clearly and effectively communicate the results.

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
Practical exams	15%	1	0.04	8, 11, 12
Problem-based seminars	15%	7	0.28	1, 10, 11, 3
Written exams. First midterm	30%	2	0.08	2, 4, 5, 6, 7, 9, 3
Written exams. Second midterm	40%	3	0.12	2, 4, 5, 6, 7, 9, 3

Assessment

The competencies of this course will be assessed through continuous assessment, which includes written exams, practical exercises, and individual assignments.
The assessment system is divided into three modules, each with a specific weight in the final grade:

Theory
Assessment will consist of two midterm exams. The first midterm will account for 30% and the second for 40% of the final grade. A final resit exam will be available for students who did not pass one of the midterms, and it will carry the same weight as the respective missed midterm.

Problem-solving
This part will be assessed through the completion of short problem exercises in class.
Students are expected to solve and discuss these problems in front of their classmates. This component represents 15% of the final grade.

Practical sessions
This component will be assessed through a practical exam conducted in the computer lab in one-hour sessions for each group. In this session, students must use the appropriate statistical software, enter data from a study, propose an analysis, and respond to specific questions. This exam will account for 15% of the final grade.

The problem-solving and practical components will only be considered if the student has passed the theory exams.

The final grade is calculated by weighting each component (theory, problem-solving, and practical work). However, a minimum grade of 4.5 in the second midterm or in the resit exam is required in order to calculate the final average. Students who have passed the course via midterms and wish to improve their grade may take the resit exam for the theory section. In doing so, they forfeit the previous grade obtained in that section.

Students who have not participated in the continuous assessment or submitted the problem-solving exercises may be assessed through a final exam. In such cases, the final grade cannot exceed 70% of the maximum possible score.

To pass the course, students must achieve a final grade of 5 or higher, whether through the midterms or the resit exam, always considering the weighted contribution of the problem-solving and practical components.

Repeat students must complete all evaluation activities, including the submission of exercises and the practical exam.

Attendance at the practical sessions is mandatory.

To be eligible for the resit exam, students must have been previously assessed in activities that amount to at least two-thirds (67%) of the total course grade. Otherwise, the student will be marked as "Not Assessable."

Single assessment
Single assessment will consist of one comprehensive exam covering theory (70%), computer-based practice (15%), and classroom-based practice (15%). This exam will count for 100% of the final grade.
The single assessment exam will take place on the same date as the second midterm of the continuous assessment, and its resit exam will coincide with the resit exam of the continuous assessment.

Bibliography

Books

- Grafen, A., & Hails, R. (2002). Modern statistics for the life sciences. Oxford University Press.
- Martínez-González, M. A., Sánchez-Villegas, A., & Faulín Fajardo, F. J. (2006). Bioestadística amigable (2ª ed.). Ediciones Díaz de Santos.
- Sokal, R. R., & Rohlf, F. J. (2013). Biometry: The principles and practice of statistics in biological research (4th ed.). W.H. Freeman and Company.
- Howell, D. C. (2013). Statistical methods for psychology (8th ed.). Wadsworth, Cengage Learning.
- Rodenburg, F. J. (2020). Introduction to biostatistics. https://github.com/FransRodenburg/Biostatistics-Book-Series
- Rodenburg, F. J. (2021). Elements of biostatistics. https://github.com/FransRodenburg/Biostatistics-Book-Series
- Shahbaba, B. (2012). Biostatistics with R: An introduction to statistics through biological data. Springer. https://link.springer.com/book/10.1007/978-1-4614-1302-8
- Marcello Pagano, Kimberlee Gauvreau, Heather Mattie (2022). Principles of biostatistics (3rd ed) Boca Raton, FL: CRC Press
- Vu, J., & Harrington, D. (2023). Introductory statistics for the life and biomedical sciences (Full Color ed.). OpenIntro, Inc.

Software

The course will use the R software and the RStudio development environment, employing specific packages for statistical analysis and data visualization (such as *ggplot2*, *dplyr*, *tidyr*, among others). All the necessary software will be installed and available on the faculty's computers.

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
(PAUL) Classroom practices	621	Spanish	first semester	morning-mixed
(PAUL) Classroom practices	622	Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	621	Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	622	Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	623	Spanish	first semester	morning-mixed

(TE) Theory	62	Spanish	first semester	morning-mixed