

Biostatistics

Code: 101965
ECTS Credits: 6

Degree	Type	Year	Semester
2500890 Genetics	FB	2	1

Contact

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Use of languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: Yes

Teachers

Rosa Maria Tarrio Fernandez

Prerequisites

It is very convenient to have some basic mathematical knowledge for a good development of this subject.

Objectives and Contextualisation

Statistical tools are very important in the field of Biology. Nowadays, the development of Genetics and Genomics require great expertise in Statistics.

The objectives of the course are (1) to master the basic concepts of statistics; (2) to develop the ability to apply these concepts correctly, especially in the problems originated in the life sciences and Genetics; (3) to learn how to communicate effectively the results of a statistical analysis; and (4) to obtain basic skills with some statistical computing programs.

Competències

Apply the scientific method to problem solving. Apply the theoretical knowledge in practice. Know, apply and interpret the basic procedures of mathematical calculation, statistical analysis and basic computer applications, which is essential in genetics and genomics. Learn the basic principles of experimental design and interpretation of results. Design and interpret association studies between genetic polymorphisms and phenotypic characters for the identification of genetic variants that affect such characters, including associations to genetic pathologies and those that confer susceptibility to diseases. Have the ability to analyse and synthesize large amounts of data.

Resultats d'aprenentatge

1. Apply the scientific method to problem solving.
2. Apply theoretical knowledge to practice.
3. Describe the problems associated with multiple statistical comparisons.

4. Design experiments and interpret the results.
5. Prepare a report on the results of genetic research.
6. List the basic statistical principles of quantitative genetics.
7. Explain the logic of statistical reasoning and the importance of the randomization of causes.
8. Pose a genetic research problem.
9. Make decisions.
10. Reason critically.
11. Capacity for analysis and synthesis.
12. Use of statistical packages.

Skills

- 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

Topic 1: Introduction. Experimental design and statistical inference. Sampling: Biological population, statistical population.

Topic 2: Hypothesis testing. Elements of a statistical test.

Topic 3: Statistical analysis of one and two samples: Student's t test. Comparison of means. Paired data.

Topic 4: Analysis of variance. I. Model of fixed effects of a factor. Analysis of variance procedure. Tests a posteriori.

Topic 5: Analysis of variance. II. Fixed effects model for two or more factors.

Topic 6: Principles of experimental design. Experimental unit and treatment. Experimental variation (error) and its control. Repetitions. Statistical power and effect size.

Topic 7: Statistical analysis in regression.

Topic 8: Multiple regression.

Topic 9: Analysis of covariance.

Topic 10: Analysis of enumerative data.

Topic 11: Introduction to the design of experiments in genetic epidemiology: Methods of detection of genes involved in diseases: linkage and association studies.

Topic 12: Non-parametric statistics.

Topic 13: Introduction to Bayesian statistics.

Methodology

General introduction to the basic concepts of statistics to understand statistical reasoning and the proper use of statistical tools in the design and analysis of experiments.

Theory classes: The student acquires the scientific knowledge of the subject by attending theory classes.

Classes of problems: The knowledge acquired in the classes of theory are applied to the resolution of practical problems.

Classes of practices: Essential to understand and put into practice the knowledge acquired in theory. The concepts and methods studied are reviewed using statistical packages.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Clases de teoria	30	1.2	4, 5, 6, 7, 9
Seminarios de problemas	11	0.44	2, 1, 5, 10, 9, 8, 11, 3
Seminarios de prácticas	12	0.48	2, 1, 5, 10, 9, 8, 11, 3, 12
Type: Supervised			
Tutorías de grupo	4	0.16	2, 1, 5, 10, 9
Type: Autonomous			
Elaboracion de trabajos	20	0.8	2, 1, 10, 11, 3
Horas de estudio	60	2.4	2, 1, 4, 5, 10, 6, 7, 9, 8, 11, 3, 12

Evaluation

Competences of this subject will be evaluated through continuous assessment, which includes written, practical exams and individual works. The evaluation system is organized into 3 modules, each with a specific weight in the final grade.

Theory

Evaluation through two partial tests. The first partial will have a weight of 30% and the second partial will have a weight of 40%. The final test is aimed at students who have not passed some of the partial tests and their weight in the final grade will be the same as that of each partial test.

Problems

This is carried out by performing short problems in class. The students have to solve and discuss the problems in front of their classmates. This section represents 15% of the final grade of the subject.

Practices

This is carried out through a practical test in the computer room in sessions of one hour for each group. In this practical session, the student must use the appropriate statistical program, enter the data of a study, propose an analysis of it, and answer specific questions. The weight of this test is 15% of the final grade for the subject.

Attendance to practical sessions is mandatory.

To be eligible for the retake process, the student should have been previously evaluated in a set of activities equaling at least two thirds of the final score of the course or module. Thus, the student will be graded as "No Avaluable" if the weight of all conducted evaluation activities is less than 67% of the final score.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Pruebas escritas. Primer parcial	30%	2	0.08	2, 4, 5, 6, 7, 9, 3
Pruebas escritas. Segundo parcial	40%	3	0.12	2, 4, 5, 6, 7, 9, 3
Pruebas prácticas	15%	1	0.04	8, 11, 12
Seminarios de problemas	15%	7	0.28	1, 10, 11, 3

Bibliography

Books

- Alan Grafen, Rosie Hails. Modern statistics for the life sciences. Oxford University Press, 2002.
- Martínez-González MA, Sánchez-Villegas, Faulín Fajardos FJ. Bioestadística amigable. 2ª Edición. Ediciones Díaz de Santos, 2006.
- Robert R. Sokal, F. James Rohlf. Biometry: The principles and practice of statistics in biological research. W.H. Freeman and Company, New York. 2013.
- David C. Howell. Statistical Methods for Psychology, 8th ed. Wadsworth, Cengage Learning ALL. 2013.
- StatSoft Electronic Statistics Textbook (<http://www.statsoft.com/Textbook>)