

Course Name	Code	Local Credits	ECTS
<i>Biomathematics</i>			

Academic Institution offering the course	Universidad San Jorge
Mode of Delivery (in class/online/blended)	Online
Prerequisites by topic	None
Language of Instruction	English
Level of Course Unit (1/2/3)	Level 3 (Advanced)
Course Coordinator	Jesús Carro
Course Lecturer(s)	Jesús Carro Ángela Jimeno Francisco José Roig
Course Objectives	The main objective of this course is to show different applications in which the mathematics help us to study and to understand the life and the functioning of living things.
Course Contents	<ol style="list-style-type: none"> 1. Bioelectromagnetism 2. Biostatistics 3. Population genetics and dynamics 4. Omics analysis
Learning Outcomes of the Course Unit	<ol style="list-style-type: none"> 1. Understand how the mathematics helps to study biological process at the cell or tissue level. 2. Apply statistical and computing methods to solve problems related to molecular biology and omic sciences. 3. Use mathematical tools to understand and quantification the characters and patters than can be inherited.

DESCRIPTION

Mathematics allows us to describe our environment and the things that happen around us. With the mathematical language we can describe from physical processes to relationships that exist between the web pages that are interconnected. Life is a complex phenomenon that addresses different levels of interconnected systems. In the study of how living systems behave, from the molecular level to relationships as species, mathematics helps us to model to study and even predict certain behaviors or situations.

This course aims to show four examples of how mathematics helps to study life sciences: modeling systems of the human body such as the cardiovascular system, applying statistics to analyze life processes and being able to draw conclusions beyond the individual behaviors, apply mathematics to study how population genetics evolve, and finally, study the genome and other omics techniques that allow us to understand how information travels in living beings.

WEEKLY SUBJECTS AND RELATED PREPARATION STUDIES

	Subjects
1	Bioelectromagnetism
2	Biostatistics
3	Population genetics
4	Omics analysis

Subject	Week	Content
1. Bioelectromagnetism	1	Introduction to the electrical and mechanical activity of the heart.
	2	Modeling the electrical activity of the heart. Evolution of the models. Modeling a pathological situation: Cardiac Ischemia
	3	Practical exercises with CellML and OpenCOR
2. Biostatistics	4	Descriptive statistics. Exploratory data analysis and data visualization.
	5	Statistical hypothesis testing. Parametric and non-parametric methods for quantitative and qualitative variables.
	6	Correlation and regression models. Grouping data with clustering methods.
3. Population genetics and Population dynamics	7	Allelic and Genotypic frequencies: Theory and Practice
	8	Evolution: Mutation rate & HWL. Theory and Practice
	9	DNA polymorphism as a tool for forensics. Theory and Practice
	10	Ecological dynamics algorithms.

4. Omics analysis	11	What is Omics?
	12	How can we arrive from DNA sequencing to Expression levels? Mathematics as biological tool

Recommended or Required Reading	<p>Jaakko Malmivuo & Robert Plonsey: <i>Bioelectromagnetism - Principles and Applications of Bioelectric and Biomagnetic Fields</i>, Oxford University Press, New York, 1995. https://www.bem.fi/book/</p> <p>SEEFELD, Kim. <i>Statistics Using R with Biological Examples</i>. Boston, 2007 (link)</p> <p>Mark A Beaumont. <i>Practical Population Genetics: Genetic Data Analysis For The Evolutionary Biologist</i>. Imperial College Press, London, 2022</p>
Other Course Resources	<p>CellML https://www.cellml.org/ OpenCOR https://opencor.ws/ Bioconductor https://www.bioconductor.org/ Cran project https://cran.r-project.org/</p>