



## MODULE 2: Advanced research tools and methodologies. Research funding and innovation.

**Code:** 43642      **Type:** Compulsory

**Credits:** 6 ECTS      **Language:** English

**Module’s Coordinator:** Mireia Ferrer Almirall, PhD

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**Schedule for mentoring:** Wednesdays from 15:00 to 17:00h

*Although having this timetable proposal, the **students have to arrange an appointment with the teacher by e-mail.***

## OBJECTIVES

This module will provide the student with a variety of transversal tools, which can be considered essential for research.

The Research Funding and Innovation section will provide the student with knowledge and tools to develop a look-for-funding strategy. Basic concepts and strategies about write a grant, kind of grants, etc. will be explained on the course. Moreover, students will learn about patents, IP and basis of technology transfer process.

On the other hand, the Biostatistics and Bioinformatics part will present the main Statistical methods for carrying out data management and data analysis tasks as well as some bioinformatics tools for dealing with high-throughput data produced by modern technologies such as microarrays or Next Generation Sequencing.

At the end of the module the student should:

- Be able to identify the different type of problems that require statistical methods for their analysis
- Be familiar with the main groups of statistical methods, their applicability conditions and their interpretation.
- Know how to use some (of the most common) methods using the free statistical language R with the R-commander graphical interface.
- Be acquainted of high throughput analysis methodologies and know how to use some user-friendly tools such as Galaxy for doing basic processes such as gene selection or exome variant analysis.
- Be able to identify different grant calls and funding scheme.
- Have a sound knowledge about funding schemes, rules and grant writing basis.
- Have basic knowledge about Innovation in Health (R&D and Hospitals).
- Be familiar with the Technology Transfer process (evaluation of technologies, intellectual property rights contracts, licenses and business development).
- Have basic knowledge about spin off creation, business plan, financing and Business Model Canvas.

## SKILLS

- E01. Identify and use the concepts, tools, techniques and methodologies for translational biomedical research.
- E01.1. Identify the tools for management and analysis of biomedical data. Databases and R.
  - E01.2. Use the programs and statistical tests and interpret the results from both the medical and biostatistical point of view.
  - E01.3. Build and test statistical models, especially those most used in biomedical research.
  - E01.4. Identify and know how to search in the main bioinformatics resources.
  - E01.5. Know the main high performance data types and the techniques and peculiarities for their analysis.
  - E01.6. Identify the role of research centers in terms of innovation and business development.
  - E01.7. Know the terminology and identify the elements of the innovation process, as well as, the main steps of the technology transfer process.
  - E01.8. Develop skills for planning and research project management, both in public and private sector.
  - E01.9. Identify national and international financial systems, as well as the tools to develop winner proposals.

## CONTENTS

### SECTION I: RESEARCH FUNDING AND INNOVATION

1. Writing a competitive proposal: Types of grants. Tips for Grants application
2. Research policy change in Europe: RRI and its dimensions.
3. Bibliographic Search
4. Innovation in Health and Technology Transfer Process
5. Spin off: Business Model Canvas
6. IP protection strategy and Development Plan
7. Contracts, Licenses and creation of companies
8. Workshop Innovation's processes

### SECTION II: BIOSTATISTICS

1. Statistical Methods in biomedicine.
  - 1.1. Descriptive Studies. Biological variability.
  - 1.2. Principles of Statistical Inference. Estimation.
  - 1.3. Hypothesis testing.
2. Experimental design and Analysis of Variance.
  - 2.1. Principles of experimental design.
  - 2.2. Analysis of Variance and its relation with design.
3. Regression Models in Biomedicine.
  - 3.1. Regression for quantitative outcome variable: Multiple linear regression model.
  - 3.2. Regression for categorical outcome variable: Logistic regression model.
  - 3.3. Regression for time to event outcome: Survival analysis and Cox regression model.
4. Statistical methods for Biomarker building and validation.
  - 4.1. Biomarkers: Definition, use, types.
  - 4.2. The biomarker development process.
  - 4.3. Building and validating biomarkers: statistical and bioinformatical approaches.
5. Introduction to high throughput data analysis:
  - 5.1. Microarrays and RNA-seq
  - 5.2. Biological significance analysis
6. Other bioinformatic analyses
  - 6.1. Exome Variant analysis

## METHODOLOGY

Biostatistics and bioinformatics sessions will combine theory and practice. Starting from real scientific problems requiring the use of these methodologies a theoretical exposure of the main principles will be explained, followed by a practical part where the way to apply the methods will be described. The sessions will finish by solving practical problems and going back to the initial problem and providing its solution.

Practical exercises will teach how to use some open statistical tools -such as R, Rcommander or Galaxy- to apply the methods explained in the module.

Research Funding and Innovation sessions will combine theory and practice. Starting from an overview of the national and international financial opportunities, we will focus on those fellowships and calls that may be an opportunity as predoctoral and postdoctoral researchers. Students will achieve some experience on writing national and international proposals through practical exercises and we will give them some tips and advises. We will continue explaining the Innovation in Health environment, a theoretical exposure of the main principles of Tech Transfer, Intellectual Property Rights, Contract and Licenses and Spin off creation will be explained, followed by a practical part where students will apply these concepts on a Business Model Canvas. Some sessions will finish by solving a practical case related with the theory. Additional bibliographic info will complement the contents explained in the module.

## EVALUATION

- Research funding section: Writing a research project (15%). The application of the concepts explained in this section will be evaluated considering the written research project prepared for Module 1.
- Innovation section: Multiple choice test (10%) + oral presentation (15%)
- Biostatistics section: Two final take-home exercises -one in biostatistics and another in bioinformatics- to check the work done by the students will be performed at the end of the biostatistics and bioinformatics sessions. These will mainly consist of practical data analysis exercises and eventually some short-multi answer questions. (60%)

### **Attending a minimum of 80% of the classes is required for taking the exam and passing the course.**

- Students who fail the course (grade lower than 5), will be entitled to a second evaluation, provided that they have participated in all the evacuation activities and have a final average grade equal to or higher than 3.5. in each part of the course
- Second-chance evaluation will consist on
  - A second writing of the protocol and a second multiple choice test will have to be passed.
  - A second take home exercise will be provided for the biostatistics and bioinformatics exercise and will be evaluated.
- The maximum grade of the second-chance evaluation will be a pass mark (5).

## TEACHING STAFF

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## ACADEMIC SCHEDULE

**Dates:**

[See the Master's Degree Schedule for academic year 2024-2025](#)

## BIBLIOGRAPHY

- Rosner, Bernard (2013). Fundamentals of Biostatistics 7th edition
- Irizarry. Data Analysis for life sciences (<https://leanpub.com/dataanalysisforthelifesciences>)
- Statistics at Square Two: Understanding Modern Statistical Applications in Medicine
- Estadística básica con R y R Commander  
<http://cran.r-project.org/doc/contrib/Saez-Castillo-RRCmdrv21.pdf>
- Apuntes y videos de Bioestadística  
<http://www.bioestadistica.uma.es/baron/apuntes/>
- Material docente de la Unidad de Bioestadística Clínica del Hospital Ramón y Cajal  
[http://www.hrc.es/bioest/M\\_docente.html](http://www.hrc.es/bioest/M_docente.html)
- [http://grants.nih.gov/grants/grant\\_tips.htm](http://grants.nih.gov/grants/grant_tips.htm)
- <http://www.timeshighereducation.co.uk/news/tips-on-writing-a-winning-research-proposal-for-horizon-2020/2015750.article>
- <http://ec.europa.eu/research/participants/portal/desktop/en/home.html>
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- <http://www.grants.gov/web/grants/home.html>
- <https://proposalcentral.altum.com/>
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- [https://ec.europa.eu/info/sites/info/files/mazzucato\\_report\\_2018.pdf](https://ec.europa.eu/info/sites/info/files/mazzucato_report_2018.pdf)
- <http://informecotec.es/>
- <https://www.epo.org/applying/basics.html>
- <https://www.youtube.com/watch?v=6gEj4qw8ud4>