## VNIVERSITAT Ġ ID VALÈNCIA

# COURSE DATA

| Data Subject | |
|---|---|
| **Code** | 33040 |
| **Name** | Mathematics II |
| **Cycle** | Grade |
| **ECTS Credits** | 6.0 |
| **Academic year** | 2021 - 2022 |

| Study (s) | | | |
|---|---|---|---|
| **Degree** | **Center** | **Acad. year** | **Period** |
| 1100 - Degree in Biology | Faculty of Biological Sciences | 1 | Second term |

| Subject-matter | | |
|---|---|---|
| **Degree** | **Subject-matter** | **Character** |
| 1100 - Degree in Biology | 1 - Mathematics | Basic Training |

| Coordination | |
|---|---|
| **Name** | **Department** |
| NAVARRO QUILES, ANA | 130 - Statistics and Operational Research |

# SUMMARY

Mathematics II is a basic subject in scientific education. It aims to provide students with the basic concepts and analytical tools required to recognize simple probabilistic models, formulate hypothesis tests, analyze observational or experimental data and make decisions based on the conclusions drawn from these analysis. The concepts of differentiation and integration, introduced in the previous course Mathematics I, help the student to understand those of probability density and distribution function, which are the basis for any statistical method. On the other side, Mathematics II introduces the concepts of Binomial Distribution and Chi-Square Test, which are basic for posterior subjects, such as "Genetics" or "Evolutionary Processes and Mechanisms". Moreover, understanding and management of all the statistical techniques introduced in Mathematics II will be necessary for the compulsory subject "Integrated Experimentation in Biology".

## PREVIOUS KNOWLEDGE

### Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

### Other requirements

It is assumed that students will have achieved an appropriate level of mathematics and probability at high school or equivalent. It is recommended that students be able to formulate mathematical problems that arise from everyday situations and use problem solving to investigate and understand mathematical content.

## COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

### 1100 - Degree in Biology

- Capacidad de pensamiento lógico-matemático.

- Utilización del lenguaje matemático y estadístico.

- Saber representar gráficamente funciones matemáticas básicas.

- Comprender el concepto de integral de una función y su relación con el área comprendida bajo la misma.

- Saber seleccionar tamaños de muestra óptimos para los objetivos de un estudio.

- Conocer software estadístico adecuado para análisis de diferentes tipos de datos.

- Comprender los conceptos de estimaciones puntuales y por intervalos y saber calcularlas.

- Comprender los conceptos de contraste de hipótesis, estadístico de contraste y p-valor y saber calcularlos.

- Saber utilizar herramientas informáticas para analizar los problemas estadísticos.

- Saber obtener muestras aleatorias.

- Entender y plantear los problemas de estadística que se presentan en la Biología.

## LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

• To plan simple experiments to achieve the objectives of the study.

• To describe and synthesize the data set observed in the experiment.

• To analyze the observed data using appropriate statistical software.

• To interpret the results provided by the statistical software.

• To write and present a report of the study

## DESCRIPTION OF CONTENTS

### 1. Exploratory Data Analysis

1.1. - Populations and samples.
1.2. - Types of variables and relationships between them.
1.3. - Graphical description of variables and analysis of their relationship.
1.4. - Description of samples.
1.5. - Description of populations through probabilistic models.

### 2. Inferences about a population

2.1.-. Parameters of a population.
2.2.-. Estimating the population mean.
2.3.-. Hypothesis testing of a single population mean.

### 3. Two Sample Analysis

3.1.-. Paired samples.
3.1.1.-. Paired Experimental Design.
3.1.2.-. T-Test and Confidence Interval.
3.1.3.-. Paired Sample Sign Test.
3.2.-. Independent Samples.
3.2.1.-. Independent Samples Design.
3.2.2.-. T-Test and Confidence Interval.
3.2.3.-. Mann-Whitney Test.

### 4. K Independent Samples Analysis

4.1.- K Independent Samples Design.
4.2.-. Analysis of Variance and Post hoc Comparisons.
4.3.-. Kruskal-Wallis Test.

### 5. Categorical Data Analysis

5.1.-. Proportion Analysis.
5.2.-. Goodness of fit Analysis.
5.3.-. Contingency Tables Analysis.

**6. Linear Regression**

6.1.-. Parametric Regression Analysis: The Linear Model.

6.2.-.Statistical Inference about the slope.

6.3. - Correlation Coefficients.

## WORKLOAD

| ACTIVITY | Hours | % To be attended |
|---|---|---|
| Theory classes | 31,00 | 100 |
| Computer classroom practice | 26,00 | 100 |
| Tutorials | 3,00 | 100 |
| Development of group work | 10,00 | 0 |
| Development of individual work | 5,00 | 0 |
| Study and independent work | 14,00 | 0 |
| Preparing lectures | 35,00 | 0 |
| Preparation of practical classes and problem | 26,00 | 0 |
| **TOTAL** | **150,00** | |

## TEACHING METHODOLOGY

Statistical concepts and methods will be introduced during lecture sessions, always through biological studies and by using real data in at least some of these. The appropriate statistical technique to solve the real problem will be applied by using statistical software. Independent study will include to work through the problems, from problem formulation, through solution of the formulated problem, to interpretation and presentation of the solution.

Practical sessions, in computer lab, will be synchronized with the lectures; in these classes the students will solve problems by applying the statistical methods introduced in the lectures through a statistical package. A dossier describing the contents of the practical sessions, including the problems to be solved during the class, will be accessible in the web platform; some of these problems will be delivered to the teacher for evaluation.

Tutorials in reduced groups will serve to remember, discuss and focus the concepts that the student must know and understand at the time. They will be based on additional material, provided to students in advance.

All documents will be available on the Virtual Classroom environment PDF (portable document format).

# EVALUATION

Learning, knowledge and skills achieved by students will be continuously evaluated throughout the course, according to the following guidelines:

**1**. Theory and Practice. Since the objectives of the course Mathematics II focus on applying statistical techniques to biological problems, theoretical knowledge and practical skills will be jointly evaluated. Evaluation will be made in two stages:

> **i.** Continuous evaluation corresponding to different tasks (up 2 points, 20% of final grade)

> **ii.** Final exam, involving theoretical concepts and practical skills, consisting of solving problems similar to those from the practical sessions and the proposed list for independent work. Solving these problems will require interpreting the results provided by the statistical software used during the course (up to 7 points, 70% of final grade

**2.** Interdisciplinary seminar (up 1 point, 10% of final grade) will serve to evaluate the social skills: teamwork, use of English and disseminating scientific knowledge. Alternatively, students can make another activity, supported by the CAT as part of an Education Innovation Project.

NOTES:

• In the continuous evaluation, a zero mark will be assigned to any required and undelivered tasks.

• Grade earned in continuous evaluation (**paragraph 1.i**) will be the same in the two examination periods of the present academic year.

• To pass the subject it will be necessary: (1) To get at least 3 of the 7 points corresponding to the final exam; and (2) to get a final grade (Continuous evaluation + Final Exam + Interdisciplinary Seminar) equal or greater than 5.

In case a student doesn't pass the subject, **the mark obtained in the interdisciplinary seminar will be the only one saved for the next academic year.**

# REFERENCES

## Basic

- Milton, J.S. (2001). Estadística para Biología y Ciencias de la Salud. Madrid: Ed. Interamericana-McGraw-Hill. 3ª Edición.

- Quinn, Gerry P. y Keough, Michael J. (2002) Experimental Design and Data Analysis for Biologists. Cambridge University Press.

- Samuels, M.L. & Witmer, J.A. (2003). Statistics for the Life Sciencies.(Third Ed.) San Francisco, CA: Dellen Publishing Company. CD-Rom incluido.

**Additional**

- Hawkins, D. (2005) Biomeasurement, Understanding, analysing, and communicating data in the biosciences. Oxford University Press.

- Sokal, R.R. & Rohlf, F.J. (1995). Biometry: the principles and practice of statistics in biological research. 3rd edition. W. H. Freeman and Co.: New York.

# ADDENDUM COVID-19

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

## 1. Contents

All the contents initially programmed are kept.

## 2. Workload and teaching planning

Maintenance of workload and distribution among the different activities. Maintenance of temporary teaching planning both days and hours.

## 3. Teaching methodology

Substitution of the face-to-face class (theory, regulated tutorials and practices) by synchronous videoconferences, by creating tasks "Videoconference" in the Virtual Classroom and execution of these by Blackboard Collaborate the day and time of the face-to-face class. Upload to the Virtual Classroom of the materials for these sessions (transparencies, practical documents). Use of the Virtual Classroom forum to answer questions at the end of the videoconference. Supply of problems solved through documents uploaded to the Virtual Classroom. Resolution of questionnaires in the Virtual Classroom with multiple choice questions with immediate self-correction option.

The virtual tutoring program (by email) is maintained.

## 4. Evaluation

Maintenance of the proportions of the 2 evaluation blocks: Theory and Practices up to 90% and the interdisciplinary seminar up to 10%.

Increase in the weight of continuous assessment, which is from 20% in the current teaching guide to 50%. The continuous evaluation (up to 50%) is divided in turn into 2 blocks: the delivery of 3 tasks in the theory, practical and / or tutoring sessions (up to 30%) and resolution of a practical case (up to 20%).

Final exam weight reduction goes from 70% to 40%. During the resolution of the exam, students must be connected via BBC videoconference with the camera activated and the microphone muted.

The final test grade can be recovered in the second call of the subject but the continuous assessment grade cannot be recovered, that is, it is kept for the second call.

If a person does not have the means to establish this connection and access the Virtual Classroom, they should contact the teaching staff by email at the time of publication of this annex to the teaching guide.

If, for duly justified technical reasons, a student cannot take an exam, the possibility of taking an alternative test will be studied, which, in any case, will be oral.

## 5. Bibliography

## 6. Additional information

Due to the fluctuations in the evolution of the pandemic, the specific details of the adjustments of teaching activities to the different health scenarios that may occur will be informed through the "Aula Virtual".