

Academic Year/course: 2022/23

## 27019 - Mathematical Statistics

### Syllabus Information

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**Academic Year:** 2022/23

**Subject:** 27019 - Mathematical Statistics

**Faculty / School:** 100 - Facultad de Ciencias

**Degree:** 453 - Degree in Mathematics

**ECTS:** 7.5

**Year:** 3

**Semester:** Second semester

**Subject Type:** Compulsory

**Module:**

## 1. General information

### 1.1. Aims of the course

This module is compulsory in the BSc in Mathematics. Its goal is to teach the main results and technics in statistical inference.

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (<https://www.un.org/sustainabledevelopment/es/>), in such a way that the acquisition of the learning outcomes of the module provides training and competence to contribute to some extent to their achievement: (4) Quality education, (5) Gender equality, (8) Decent work and economic growth, (9) Industry, innovation and infrastructure, (10) Reducing inequality, (17) Partnerships for the goals.

### 1.2. Context and importance of this course in the degree

This compulsory module is an introductory course on statistical inference. Previous knowledge on descriptive statistics, probability theory and calculus is required.

### 1.3. Recommendations to take this course

Students are assumed to have taken a first course in probability theory, including probability spaces, random variables, random vectors, laws of large numbers and the central limit theorem.

The continuous work of the student from the beginning of the course is essential to follow the classes and finally, pass the exam.

## 2. Learning goals

### 2.1. Competences

After this course, the student will be more competent in:

- Understanding the basic concepts and principles in statistical inference.
- Proposing a model to be analyzed with statistical tools.
- Using the concepts of convergence of random variables and their limit laws for studying the asymptotic behaviour of statistics.
- Using statistics associated to inference in normal populations.
- Identifying sufficient statistics and determining the basic properties of most commonly used statistics.
- Understanding the methods of maximum likelihood and substitution for finding statistics.
- Understanding the concept of confidence interval and being able to construct them.
- Understanding the concept and first properties of hypothesis testing. Knowing methods for their construction and applying them to models involving one or two populations.

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## 2.3. Importance of learning goals

This module provides the student with the basic knowledge in statistical inference from a mathematical point of view and in the basic techniques for statistical data analysis. It is the basis for the module Regression Methods in the fourth year and also for statistical modules in a MSc in Statistics.

## 3. Assessment (1st and 2nd call)

### 3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

Assessment is split into two parts, corresponding to theory/problems and computer classes. Once the marks for theory/problems (CT) and computer classes (CP) are obtained, the final mark will be

$$CF = 0.7 \times CT + 0.3 \times CP$$

The student will pass the module if CF is greater than or equal to 5.0.

CT and CP marks are computed as follows:

#### First call (June)

Both for CT and for CP, students may take two mid-term exams. The first exams correspond to Topic 1 and the second exams correspond to Topics 2 and 3. The first exams will be held at the end of that topic. The second exams will be held at the official date of the June exam. The CT and/or CP marks will be obtained as

$$CT = 0.2 \times CT1 + 0.8 \times CT2$$

$$CP = 0.2 \times CP1 + 0.8 \times CP2$$

Alternatively, students may take a unique final exam for getting either CT, CP or both at the official date of the June exam.

#### Second call (July)

In the second call, students will take a unique final exam for getting CT and CP at the official date of the July exam.

In the group taught in English, T6 activities will consist on three 2 hour practical classes where students will present solutions of problems, summaries of theoretical results... These activities are optional and will be assessed and marked between 0 and 1 points; this score will be added to the final score obtained in the exams.

## 4. Methodology, learning tasks, syllabus and resources

### 4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving sessions, computer laboratory sessions, tutorials and autonomous work and study.

### 4.2. Learning tasks

This course is organized as follows:

- **Lectures.**
- **Problem-solving sessions.**
- **Computer laboratory sessions.**
- **Tutorials.**
- **Autonomous work and study.**

The teaching activities and assessment tasks will take place in a face-to-face mode, except in the case that, due to the

health situation, the dispositions emitted by the competent authorities and by the University of Zaragoza compel to take them to a greater or lesser extent in a telematic form.

### 4.3. Syllabus

- **Topic 1.** Introduction to statistical inference. Population and random samples. Statistics. Sampling from the Normal distribution. Order statistics. Convergence concepts and limit theorems.
- **Topic 2.** Point estimation. Desirable properties of an estimator. Methods of finding and evaluating estimators. Large sample properties for maximum likelihood estimators. Interval estimation.
- **Topic 3.** Hypothesis testing. The Neyman-Pearson approach. The duality of confidence intervals and hypothesis tests. Likelihood ratio tests. Tests for normality, goodness of fit and independence. Comparing two samples.

### 4.4. Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of Science website and Moodle.

### 4.5. Bibliography and recommended resources

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=27019>