

Academic Year/course: 2022/23

## 29908 - Statistics

### Syllabus Information

**Academic Year:** 2022/23

**Subject:** 29908 - Statistics

**Faculty / School:** 110 - Escuela de Ingeniería y Arquitectura

**Degree:** 435 - Bachelor's Degree in Chemical Engineering

**ECTS:** 6.0

**Year:** 2

**Semester:** 435-First semester o Second semester

107-First semester

**Subject Type:** Basic Education

**Module:**

## 1. General information

## 2. Learning goals

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

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

### 4.1. Methodological overview

The proposed methodology aims at encouraging students for daily work. Concepts are presented sequentially in time from probability models and random variables to parameter estimation and hypothesis testing. Thus, the concepts related to random sampling and inference constitute the last topic to be covered in this course. In so doing a better understanding of the contents is achieved and at the same time, the student's interest is promoted by means of a practical approach based on the use of actual problems and data.

The general principles of the course are presented in large-group-sessions where a formal description is carried out with applications inappropriate examples. Classes in computer room deal with both data analysis and modeling of real events. Students completing them are enabled to use specific statistical software.

### 4.2. Learning tasks

This course comprises four learning blocks:

- Block 1: Descriptive statistics for one and two variables. Regression analysis
- Block 2: One random variable, Probability models
- Block 3: Point estimation and confidence intervals
- Block 4: Statistical inference. Test of hypothesis for one and two samples
- Block 5: Introduction to optimization.

### 4.3. Syllabus

The course will address the following topics:

\*.- INTRODUCTION

The role of statistics in engineering

\*.- DESCRIPTIVE STATISTICS FOR ONE AND TWO VARIABLES

Univariate graphs.

Percentiles. Box-plot

Location and dispersion measures.

Skewness and kurtosis

Association measures. Scatterplots. Correlation coefficient. Smoothing.

Fitting simple regression lines to data. Model-checking.

\*.- SAMPLE SPACES, CONDITIONAL PROBABILITY. INDEPENDENCE

Random experiments.

Sample space and events.

The axioms of probability. Consequences

Conditional probability.

Partition of the sample space. Total probability rule and Bayes formula.

Independence of two events. Mutually independent events.

\*.- RANDOM VARIABLES. PROBABILITY DISTRIBUTIONS

Definition of the random variable.

Distribution function.

Probability mass function.

Discrete random variable.

Continuous random variable: density function.

Conditional distribution.

\*.- CHARACTERISTICS OF RANDOM VARIABLES

Expected value of a random variable.

Expected value of a function of a random variable.

Properties of the expected value.

Variance and its properties. Standard deviation

Chebyshev's inequality.

Skewness and kurtosis.

\*.- PROBABILITY MODELS

Discrete uniform distribution.

Bernoulli random variable.

Binomial distribution.

Geometric distribution, memoryless property

Negative binomial distribution.

Poisson distribution. Approximation to the binomial distribution.

Poisson process.

Exponential distribution. Memoryless property.

Gamma distribution.

Interarrival times in the Poisson process: exponential and gamma distributions.

Continuous uniform distribution.

Normal distribution. Approximations to the binomial and Poisson distributions.

Weibull, Rayleigh and lognormal distributions.

\*.- STATISTICS.

Random sampling.

Point estimation and confidence intervals.

Tests of hypotheses.

Statistical inference for a single sample. Test on the mean, variance and population proportion.

Statistical inference for two samples. Tests on the difference in means, on the ratio of the variances and on two population proportions. Paired t-test.

Independence tests. Chi-Squared test

Distribution fitting. Probability plots. Anderson-Darling test

\*.- OPTIMIZATION

Introduction to design of experiments. Factor and variation.

One-Way design. ANOVA table

Two-Way design. Interaction.

#### **4.4. Course planning and calendar**

The course corresponds to 6 ECTS equivalent to 150 hours of activities for students with the following distribution:

30 hours (2 hours/week) in large-group sessions.

30 hours (2 hours/week) of practical classes. These classes take place in a computer room for small groups, the target being the development of skills in both problem-solving and data analysis.

84 hours for out-of-class work.

6 hours for student appraisal.

#### **4.5. Bibliography and recommended resources**

[http://biblos.unizar.es/br/br\\_citas.php?codigo=29908&year=2019](http://biblos.unizar.es/br/br_citas.php?codigo=29908&year=2019)