

## 30108 - Statistics

### Información del Plan Docente

<b>Academic Year</b>	2016/17
<b>Academic center</b>	175 - Escuela Universitaria Politécnica de La Almunia 179 - Centro Universitario de la Defensa - Zaragoza
<b>Degree</b>	425 - Bachelor's Degree in Industrial Organisational Engineering 563 - Bachelor's Degree in Industrial Organisational Engineering 457 - Bachelor's Degree in Industrial Organisational Engineering
<b>ECTS</b>	6.0
<b>Course</b>	
<b>Period</b>	Half-yearly
<b>Subject Type</b>	Basic Education
<b>Module</b>	---

### 1. Basic info

#### 1.1. Recommendations to take this course

#### 1.2. Activities and key dates for the course

### 2. Initiation

#### 2.1. Learning outcomes that define the subject

#### 2.2. Introduction

### 3. Context and competences

#### 3.1. Goals

#### 3.2. Context and meaning of the subject in the degree

#### 3.3. Competences

#### 3.4. Importance of learning outcomes

### 4. Evaluation

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Continuous assessment system:

- Exams: During the course two main exams will be conducted. They will focus on theoretical and / or practical aspects of the subject:

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[Written test 1] Week 8 will be held and will focus on the subject in the first 8 weeks of the course. Its weight in the final grade will be 30%.

[Written test 2] Week 15 will be made and will focus on the subject in the second half of the course. Its weight in the final grade will be 30%.

- Participatory controls: Throughout the course, students will perform six participatory controls together valued at 20% of the final grade, which consist of conducting practical exercises in the computer room.
- Applied work: Throughout the course, students will perform two works applied to matters of the subject, its valuation is 20% of the final grade.

Overall Assessment: Students who have not passed the subject with the system of continuous assessment, have to pass a global exam whose weight in the final grade will be 80%. Also, they must submit the two applied work required during the course.

### Evaluation criteria

In the written tests, controls and work participation will be evaluated:

Practical exercises must be properly raised. If a computer program is used in solving exercises, the code used and in any case the results are clearly explained be detailed. The probability distribution assigned to each random variable must be duly justified, identifying the value or values of the model parameters. Hypothesis testing will arise clear and defined manner.

## 5. Activities and resources

### 5.1. General methodological presentation

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The proposed methodology seeks to promote student work and continued focus on the more practical aspects of statistics: working with real data.

In order to achieve this goal all practical classes (2 hours per week) will be held in the computer room, using R programming language. The theoretical explanations of the concepts of the subject (2 hours weekly) will be reinforced by examples or case studies analyzed with the computer.

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The proposed methodology tries to promote the continuous work of the student focusing on the theoretical and practical aspects of Statistics: learning of basic concepts such as random variable, probability distribution, differences between sample and population and the application to studies based on real data.

In order to achieve this objective, classes will combine theory with problem solving sessions and also computer lab sessions with specific software.

In addition, individual tutorial will be offered to students for solving doubts and helping for the evaluation tests.

### 5.2.Learning activities

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The course is organized with 4 hours of class a week for the 15 weeks of the semester. Some of these hours are taught in the computer room, and in them the teacher explains the more practical aspects of the subject, which are reinforced with practical work by using statistical analysis programs.

Tutored self-employment: 2 hours per week for 15 weeks where the student works autonomously in the computer room in performing work.

Personal work: 60 hours

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The subject consists on different types of activities:

Presential activities, that are:

1. Magistral classes.
2. Problem solving classes.
3. Computer-lab classes.
4. Personal tutorials.
5. Realization of evaluations tests.

Non presential activities:

1. Realization of grupal activities.
2. Autonomous study.

### 5.3.Program

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- Descriptive statistics: quantitative and qualitative data. Graphical representation: pie chart, bar plot, histogram, bar chart. Summary measurements: mean, median, quantiles, range, interquartile range, standard deviation, variance, coefficient of variation of Pearson. Measures of skewness and Kurtosis. Box plots, stem-and-leaf plot. Multidimensional distributions: marginal distribution, conditional distribution, scatterplot, linear regression.
- Probability: Elements of probability: Event. Probability. Probabilistic space. Conditional probability. Total probability theorem. Bayes theorem. Random variables: Discrete: mass function, distribution function. continuous: density function, distribution function. Expected value: mean, variance. Discrete distributions: Bernoulli trials, binomial, Poisson distribution. Continuous distributions: normal, exponential, uniform distribution, beta, gamma distribution. Multivariate random Variables: probability function, expected value, covariance, independence V.A., distribution chi-square, Student's t, F Snedecor.
- Introduction to reliability theory: Quality and reliability function, reliability and risk function. Exponential distribution, Weibull distribution.
- Inference: Parameter estimation: Population and sample. Random, stratified, cluster and systematic sampling. Statistics and Estimator. Simulation. Method of moments, maximum likelihood method. Desirable properties of estimators: bias, efficiency, consistency. Point estimation and interval. Fisher theorem. Central limit theorem. Confidence intervals.
- Hypothesis testing: null and alternative hypotheses. Error type I and II, significance level, power of contrast. unilateral and bilateral tests. P-value.
- Goodness of fit: Kolmogorov-Smirnov test.
- Multivariate linear regression model: Parameter Estimation. stepwise procedures: backward and forward. Akaike index. Residue analysis.

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Contents of the subject are the following:

Part 0: Presentation.

**PART 1: PROBABILITY AND RANDOM VARIABLES**

1. Probability. (2.5 weeks): Concept of probability and its computation. Conditional probability. Total Probability and Bayes Theorems.
2. Random Variables. (4 weeks): Concept of random variable, probability and density function. Characteristics of random variables. Discrete and continuous random variables and principal types (Bernoulli, Binomial, Poisson, Normal and associated distributions). Central Limit Theorem.

**PART 2: DESCRIPTIVE STATISTICS AND STATISTICAL INFERENCE**

1. Descriptive statistics (2.5 weeks): Univariate analysis: frequency tables and graphics, characteristic measures (position, dispersion and shape). Bivariate analysis: contingency tables, marginal distributions, correlation and regression analysis.
2. Statistical inference (5 weeks): Estimators and their distributions. Estimation theory. Confidence intervals (mean, variance and proportion). Statistical hypothesis testing (mean, variance, proportion for one and two independent samples). Related samples. p-value.

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### 5.4.Planning and scheduling

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Since the subject consists of 6 ECTS credits, and each consists of 25 hours divided into 10 hours of supervised work and 15 hours of autonomous work, activities of classroom learning (lectures, practical classes and seminars) and activities continuous assessment (participatory controls and written tests) will occupy 60 hours during the semester. Other classroom activities as personal and tutorials non-contact as the study for the assimilation of concepts and techniques, practice for familiarization with computer tools, problem solving and test preparation, will require 90 hours of independent student work . All these activities should add the 150 hours required to achieve learning outcomes pursued the subject.

The concrete and comprehensive planning of the course it will be informed to students at the beginning of the course. Also from the beginning of the course it will be set the dates of the official announcements from the school management.

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Presential activities will take place according to the established distribution, which depends on the Direction of the CUD. Specific information can be found in the web site <http://cud.unizar.es> .

The subject is thought for 4 hour per week during 15 weeks.

### 5.5.Bibliography and recommended resources

#### SPECIALIZATION IN BUSINESS

- Introducción a la estadística y sus aplicaciones / Ricardo Cao Abad ... [et al.] Madrid : Pirámide, D.L. 2001
- Canavos, George C.. Probabilidad y estadística : aplicaciones y métodos / George C. Canavos Mexico[etc.] : McGraw-Hill, cop. 1988 (imp. 1998)
- García Pérez, Alfonso. Estadística aplicada :conceptos básicos / Alfonso García Pérez. - 1a. ed., 9a reimp.] Madrid : Universidad Nacional de Educación a Distancia, 2006
- Peña Sánchez de Rivera, Daniel. Fundamentos de estadística / Daniel Peña . - [1ª ed.] Madrid : Alianza Editorial, [2001]
- Spiegel, Murray R.. Estadística / Murray R. Spiegel ; traducción, Rafael Hernández Heredero ; revisión técnica, Lorenzo Abellanas Rapún . - 2a. ed Madrid [etc.] : McGraw-Hill : Interamericana de España, D.L. 2000

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**BB**

Introducción a la estadística : ejercicios y prácticas / Javier Martínez, José Olmo, Marcos Rodríguez, Silvia Vilariño . - 1ª ed. Zaragoza : Centro Universitario de la

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- Defensa, 2012
- BB** Introducción a la estadística / Javier Martínez, José Olmo, Marcos Rodríguez, Silvia Vilariño . 1ª ed. Zaragoza : Centro Universitario de la Defensa, 2012
- BC** Canavos, George C.. Probabilidad y estadística : aplicaciones y métodos / George C. Canavos Mexico[etc.] : McGraw-Hill, cop. 1988 (imp. 1989)
- BC** Ejercicios de cálculo de probabilidades : resueltos y comentados / H. Fernández-Abascal... [et al.] . - 1a. ed. Barcelona : Ariel, 1995
- BC** Introducción a la estadística y sus aplicaciones / Ricardo Cao Abad ... [et al.] . Madrid : Pirámide, D.L. 2005
- BC** Nortes Checa, Andrés. Estadística teórica y aplicada / Andrés Nortes Checa . - Barcelona : PPU, 1993
- BC** Peña Sánchez de Rivera, Daniel. Fundamentos de estadística / Daniel Peña Madrid : Alianza, D.L. 2008
- BC** Pérez López, César. Estadística aplicada a través de Excel / César Pérez López . - Reimp. Madrid [etc.] : Prentice Hall, 2011