

1. ASIGNATURA / COURSE TITLE

ESTADÍSTICA TEÓRICA PARA ECONOMÍA Y FINANZAS/[Theoretical Statistics](#)

1.1. Código / Course Code

18262

1.2. Materia / Content area

Estadística (Estadística Teórica, Instrumentos estadísticos avanzados para economía y finanzas)/[Statistics \(Theoretical Statistics for Economics and Finance\)](#)

1.3. Tipo / Course type

Obligatoria /[Compulsory](#)

1.4. Nivel / Course level

GRADO /[Bachelor](#)

1.5. Curso / Year

SEGUNDO /[Second](#)

1.6. Semestre / Semester

Segundo /[Second](#)

1.7. Número de créditos / Credit allotment

9 créditos ECTS

1.8. Requisitos Previos / Prerequisites

- Students will have previously taken the subject “Descriptive Statistics”
- Students should be familiar with the basic mathematical concepts which will be used during the course, such as derivatives, integrals, logarithms, equation solving, etc.

1.9. Requisitos mínimos de asistencia a las sesiones presenciales / **Minimum attendance requirement**

Attendance to class activities will help the students to learn the contents of the course.

1.10. Datos del equipo docente / **Faculty Data**

El equipo docente está integrado por profesores del siguiente departamento: / **The faculty is composed of professors from the following department:**

Departamento de Economía Aplicada. UDI de Estadística

Módulo E-12

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Los profesores concretos encargados de la docencia de cada asignatura aparecen en los horarios de cada curso académico, disponibles en la siguiente página web: / **The concrete professors in charge can be seen in each academic course schedule, which is available at the following web page:**

http://www.uam.es/ss/Satellite/Economicas/es/1242650730114/contenidoFinal/Horarios_y_aulas.htm?idenlace=1242661251796

Los coordinadores de cada asignatura pueden consultarse en la misma página web. / **Each subject's coordinator can be seen also at the same web page.**

1.11. Objetivos del curso / **Objective of the course**

1. GENERAL LEARNING OBJECTIVES:

To provide the students with the set of statistical techniques which will facilitate the decision-making process in an atmosphere of uncertainty

and to deepen into the role played by statistical inference in the analysis of the economic and business reality.

2. GENERAL AND TRANSVERSAL SKILLS:

Generic skills

Instrumental skills

- CI.1. Capacity for analysis and synthesis.
- CI.2. Capacity for organization and planning.
- CI.3. Oral and written communication mainly in English and eventually in Spanish.
- CI.4. Knowledge of computer programs and skills related to the chosen area of study.
- CI.5. Ability to obtain and analyse information from different sources.
- CI.6. Ability to solve problems.
- CI.7. Ability to make decisions.
- CI.8. Ability to read and to communicate in his/her chosen professional field in more than one language, especially in English.
- CI.9. Ability to use the specific terminology of this content area correctly.

Interpersonal skills:

- CIP.1. Ability to work in a team.
- CIP.3. Developing skills in personal relationships.
- CIP.5. Ability to critique and self-critique.
- CIP.6. Ethical commitment at work.
- CIP.7. Ability to work in stressful environments.
- CIP.8. Developing abilities to communicate the knowledge acquired.

Systemic skills:

- CS.1. Ability to put the knowledge into practice.
- CS.3. Auto-didactic skills.
- CS.4. Ability to adapt to new situations.
- CS.5. Creativity and ability to generate new ideas.
- CS.6. Initiative and entrepreneurial spirit.
- CS.7. Quality driven.
- CS.8. Sensitivity towards environmental and social issues.

Specific skills:

- CE.1. Ability to identify and to anticipate economic problems related to resource allocation in general, both in the public and private areas.
- CE.2. Ability to contribute to an efficient allocation of resources, both in the public and private areas.

CE.3. Ability to analyse the economic and financial reality in a rational way.

CE.4. Ability to evaluate the consequences of the different alternative courses of action and to choose the best ones, given the objectives.

CE.6. Ability to issue consulting reports on specific economic and financial situations.

CE. 8. Acquiring the abilities needed in order to integrate him/herself into the management of businesses or public administrations.

CE.9. Ability to apply theoretical or formal representations in order to understand how economic and financial institutions work.

CE.17. Understanding the fundamentals of national and international financial markets and how they work.

1.12. Contenidos del Programa / Course Contents

SUMMARY OF CONTENTS:

1. Introduction to probability.
2. Random variables.
3. Probability models: discrete and continuous random variables.
4. Introduction to statistical inference.
5. Estimation methods: Properties of point estimators.
6. Confidence interval estimation.
7. Parametric hypothesis testing.
8. Introduction to non-parametrical hypothesis testing.

DETAILED PROGRAMM

1. INTRODUCTION TO PROBABILITY. Concepts and theorems of probability theory.

Contents:

- 1.1. Introduction: random phenomena.
- 1.2. Probability: concept and axiomatic development.
- 1.3. Conditional probability, Bayes Theorem.
- 1.4. Independence of events.

Objectives:

- Understanding what a random phenomenon is and their presence in everyday life and in social sciences.

- Learning how to use probability as a measure of uncertainty and how to apply rules for assigning probabilities (Axioms and Theorems of probability theory).
- Defining and calculating joint, conditional and marginal probabilities, and interpreting their meaning.
- Understanding the enunciation of the Law of Total Probability and learning how to calculate the total probability of an event from data for disjoint events.
- Knowing the formulation of Bayes Theorem and understanding the importance of the theorem in order to modify the measure of probabilities when additional information is available.

2. RANDOM VARIABLES

Contents:

- 2.1. Definition of random variable.
- 2.2. Discrete and continuous random variables.
- 2.3. Moments of probability distributions. Mathematical expectation and variance.
- 2.4. Introduction to two-dimensional probability distributions.

Objectives:

- Understanding the usefulness of the concept of random variable in order to transform the results of a random phenomenon into figures which facilitate the handling and analysis of uncertainty.
- Learning to differentiate between discrete and continuous random variables.
- Knowing the tools and mechanisms available in order to analyse the behaviour of random variables.
- Recognising the need to consider the joint behaviour of two or more random variables in the economic area and knowing the tools available in order to analyse the relationships between random variables.
- Learning to discover when two variables are independent and understanding the economic meaning of the independence of random variables.

References:

- CAO ABAB, R. *et al.*, chapters 4 and 5
- CASAS SÁNCHEZ, J.M.; SANTOS PEÑA, J., chapters 1 and 2

3. PROBABILITY MODELS: DISCRETE AND CONTINUOUS RANDOM VARIABLES

Contents:

- 3.1. Discrete random variables.
 - 3.1.1. Binomial distribution.
 - 3.1.2. Poisson distribution.
- 3.2. Continuous random variables.
 - 3.2.1. Normal distribution.
 - 3.2.2. Distributions related to the normal distribution: Chi-square, Student's T and Snedecor's F distributions.
- 3.3. Central Limit Theorem.

Objectives:

- Deducing the usefulness of the probability distribution models in order to analyse discrete economic and social phenomena.
- Learning how to select the most appropriate model and to apply it to the resolution of problems which can appear in the analysis of the socio-economic reality.
- Understanding the usefulness of the probability distribution models in order to analyse continuous economic and social phenomena.
- Learning how and when to apply the Central Limit Theorem in order to determine the probability distribution model of the sum of several independent and identically distributed random variables.
- Learning how to select the most appropriate model and to apply it to the resolution of problems which can appear in the analysis of the socio-economic reality.

References:

- CAO ABAB, R. *et al.*, chapter 6
- CASAS SÁNCHEZ, J.M.; SANTOS PEÑA, J., chapters 3 and 4

4. INTRODUCTION TO STATISTICAL INFERENCE

Contents:

- 4.1. Fundamental concepts.
 - 4.1.1. Concept of random sample.
 - 4.1.2. Concept of estimator.
- 4.2. Sampling distributions.
 - 4.2.1. Sample mean.
 - 4.2.2. Sample variance.
 - 4.2.3. Sample proportion.
- 4.3. Sampling distributions of the difference between the sample means and the sample proportions.

Objectives:

- Understanding the need to work with samples in order to know the characteristics of a population with a high number of elements.

- Being able to differentiate between random and non-random sampling, and knowing the different types of sampling.
- Defining with accuracy the properties of a simple random sample and learning how to select random samples.
- Calculating the appropriate estimators in order to estimate the population parameters, and understanding their character of random variables.
- Being able to analyse the sampling distribution and the main characteristics of the most relevant estimators in Economics.

References:

- CASAS SÁNCHEZ, J.M.; SANTOS PEÑA, J., chapter 5

5. ESTIMATION METHODS. PROPERTIES OF POINT ESTIMATORS

Contents:

- 5.1. Basic concepts.
- 5.2. Mean squared error.
- 5.3. Calculation of estimators using the Maximum Likelihood method.

Objectives:

- Understanding the difference between population parameters and estimators.
- Knowing the properties which are desirable in the estimation process and which help select the most appropriate estimators.
- Defining the mean squared error and learning how to calculate it.
- Applying the Maximum Likelihood method in order to obtain estimators. Knowing its properties in the case of big samples.

References:

- CASAS SÁNCHEZ, J.M.; SANTOS PEÑA, J., chapters 6 and 7

6. CONFIDENCE INTERVAL ESTIMATION

Contents:

- 6.1. Confidence intervals in normally distributed populations.
 - 6.1.1. Confidence interval for the mean of a normally distributed population.
 - 6.1.2. Confidence interval for the variance of a normally distributed population.
 - 6.1.3. Confidence interval for the difference between the means of two normally distributed populations.
- 6.2. Confidence intervals for proportions.

Objectives:

- Understanding the need for every estimation to be accompanied by an average of the sampling error.
- Knowing, learning how to apply and interpreting the process leading to the calculation of confidence intervals for any population parameter.

References:

- CASAS SÁNCHEZ, J.M.; SANTOS PEÑA, J., chapter 8
- CAO ABAB, R. *et al.*, chapter 9

7. PARAMETRIC HYPOTHESIS TESTING

Contents:

- 7.1. Basic concepts for statistical hypothesis testing.
- 7.2. Critical region and region of acceptance.
- 7.3. Type-I errors, type-II errors and power of a test.
- 7.4. Tests of significance.
 - 7.4.1. Tests for the mean of a normally distributed population.
 - 7.4.2. Tests for the proportions.
 - 7.4.3. Tests for the difference between the means in normally distributed populations.
 - 7.4.4. Tests for the variance in normally distributed populations.

Objectives:

- Knowing what a statistical hypothesis is and the different types of hypotheses.
- Knowing the different types of errors which may be made in every decision-making process. Knowing how to define them formally.
- Calculating and understanding the usefulness of the power or the power function (where appropriate) in a test.
- Knowing the different steps which must be followed in order to perform a test of significance and their purpose.
- Calculating the critical value(s) of a test and the p-value and learning how to use them in order to make decisions in hypothesis testing.

References:

- CASAS SÁNCHEZ, J.M.; SANTOS PEÑA, J., chapter 9
- CAO ABAB, R. *et al.*, chapter 10

8. INTRODUCTION TO NON-PARAMETRICAL HYPOTHESIS TESTING

Contents:

- 8.1. Chi-squared goodness-of-fit test.
- 8.2. Chi-squared homogeneity and independence tests.

Objectives:

- Understanding the difference between parametric and non-parametric tests.
- Knowing other kinds of non-parametric tests in order to evaluate the goodness of fit to a given distribution model.
- Determining whether or not there is a relationship between variables of a qualitative nature.

References:

- CAO ABAB, R. *et al.*, chapter 11

1.13. Referencias de Consulta / Course bibliography

1. THEORY

- ☞ HORRA NAVARRO, J.: “Estadística Aplicada”, 3ª edición. Ed. Díaz de Santos. Madrid 2009 E/519.2/HOR/est
- ☞ CAO ABAB, R.; FRANCISCO FERNÁNDEZ, M.; NAYA FERNÁNDEZ, S.; PRESEDO QUINDIMIL, M.A.; VAZQUEZ BRAGE, M.; VILAR FERNÁNDEZ, J. A.; VILAR FERNANDEZ, J.M. “Introducción a la estadística y sus aplicaciones” Ed. Pirámide. Madrid 2001. E/519.2/CAO/int
- ☞ CASAS SÁNCHEZ, J.M.; SANTOS PEÑA, J. “Estadística empresarial” Ed. Ramón Areces. Madrid 2005.
- ☞ DOWNING, DOUGLAS AND JEFFREY CLARK “Business Statistics”, Barron’s Educational Series. Business Review Books, USA, 2010 (5th edition).
- ☞ DWORSKY, LAWRENCE N.: “Probability not”, WILEY, New Jersey, 2008
- ☞ LYMAN OTT, R.; LONGGNECKER M.: “An Introduction to Statistical Methods and Data Analysis”, 6ª edición CENGAGE Learning. Canadá 2010
- ☞ NEWBOLD, P.: “Estadística para los negocios y la economía”, 4º edición. Prentice hall. Madrid, 1997. E/519.2/NEW/est
- ☞ NOVALES, A. : “Estadística y Econometría”. Ed. McGraw-Hill, 1997. E/330.4/NOV/est
- ☞ PEÑA, D. y ROMO, J.: “Introducción a la estadística para las Ciencias Sociales”. Ed. McGraw-Hill, 1998. E/519.2/PEÑ/int

- ☞ ROSS, M. S.: “Introducción a la estadística”. Ed. Reverté, 2007, Ed. en español. “Introductory Statistics”, Third Edition, Ed. Elsevier, 2010.

2. PRACTICE

- ☞ GIL, M., GONZÁLEZ, A.I., JANO, M.D., ORTIZ, S.: “Problemas de Estadística: Probabilidad e Inferencia”. UAM Ediciones. 2006. E/519.2/GIL/pro
- ☞ KAZMIER, L. J.: “Estadística aplicada a administración y economía”. 4ª edición . Ed.McGraw-Hill, 2004
- ☞ LÓPEZ ORTEGA, J. (2003) “Problemas y Ejercicios de Probabilidad”. Ed. ADI E/519.2/LOP/pro
- ☞ LÓPEZ ORTEGA, J. (1994) Problemas de inferencia estadística para ciencias económicas y empresariales (muestreo y control de calidad. Ed. Tebar Flores. E/519.2/LOP/pro
- ☞ MURGÜI, J.S., AYBAR, C., CASINO, A., COLOM, C., CRUZ, M., YAGÜE, R.: “Estadística para Economía y Administración de empresas: Aplicaciones y Ejercicios”. Puchardes. Valencia, 1992. E/1-105/26124.
- ☞ PARRA FRUTOS, I.: “Problemas de Inferencia Estadística con Microsoft Excel”. Ed. Thomson. 2ª Edición. 2003. E/1-91/22723/1.
- ☞ CASAS, J.M.: “Ejercicios de Inferencia Estadística y Muestreo”. Ed. Pirámide. 2006. E/519.2/CAS/eje

3. USEFUL ONLINE RESOURCES

- ❖ Instituto Nacional de Estadística (INE) [Spanish National Institute of Statistics]: <http://www.ine.es> (there is also an English version of the website available).
- ❖ EUROSTAT: <http://epp.eurostat.ec.europa.eu>
- ❖ [SPSS. Guía para el análisis de datos.](#)

2. Métodos Docentes / Teaching methodology

1. IN-CLASS ACTIVITIES

a. Lectures in the classroom

There will be three lectures in the classroom, which will last one hour and a half each, and which will promote the active participation of the students and will encourage their learning. At least one hour per week will be devoted to solving practical exercises and problems.

b. Scheduled time with the lecturer and special activities

In addition, there will also be special sessions with the lecturer and special activities in order to encourage a better understanding of the contents of the course and which will help the students to understand and to put into practice the theoretical knowledge acquired. Sometimes, these activities will be carried out with the help of electronic support. They will be carried out within the scheduled time for “Complementary activities”, and the lecturer will inform the students about the dates established for the activities, depending on the teaching needs of the lecturer. Each student is expected to participate in these activities at least four hours during the course.

c. Attendance to seminars, conferences and other activities of academic interest which may have a transversal nature.

d. Some tests and a final exam will be carried out.

2. LECTURER-DIRECTED ACTIVITIES

- ❖ Working with the course material and the recommended course bibliography for the appropriate development of the course.

- ❖ Problem-based learning. The lecturer will propose problems that the students may find in real-life situations.

- ❖ Exercises using computer programs.

3. E-LEARNING

- ❖ The students will have different course materials available for them on Moodle.

4. TUTORIALS

- ❖ The lecturer will establish her office hours, so that the students, after having requested it, will be able to ask any question or doubt about the

subject. The lecturer's office hours will be communicated by the lecturer at the beginning of the course.

3. Tiempo estimado de Trabajo del Estudiante / Estimated workload for the student

This course has 9 ECTS credits allocated.

Activity	Number of hours	%
Lecturing hours 4,5 hs. / week x 14 weeks	63	28%
Attendance to conferences, seminars and other Activities of Academic Interest 2 hs. x 3 activities	6	3%
Attendance to programmed tutorials/Scheduled time with the lecturer 4 h. / course	4	2%
Two tests 2 h. x test x 2	4	2%
Final exam 2 h. / course	2	1%
In-class number of hours	79	35%
Self-study at home: preparing for the lectures 5 hs. / week x 14 weeks	70	31%
Self-study at home: preparing for the assessment tests 2 tests + final exam	54	24%
Doing the exercises in the practice book 7 h. Probability + 15 h. inference	22	10%
Outside-class number of hours	146	65%
Total working hours: 25 hours x 9 ECTS credits	225	100%

4. Métodos de Evaluación y Porcentaje en la Calificación Final / **Assessment Methods and Percentage in the Final marks**

Assessment at the end of the course will be based on:

- ❖ Continuous evaluation, which will be promoted. The lecturer will propose different complementary activities (including tests during the course and Excel activities), as he/she may deem appropriate in order to promote continuous learning. These activities will be detailed during the course and will account for 40% of the final grade.
- ❖ There will be a final exam, which will assess the theoretical and practical assimilation by the student of the contents of the course, and which will account for 60% of the final grade.
- ❖ In order to obtain a final numerical grade, the student must take at least one of the tests during the course. Otherwise, his/her final grade will be “*no evaluado*” (“Not assessed”).
- ❖ If the student does not take the final exam, his/her final grade will be the grade obtained in the continuous assessment (on a 10-point grading system) and with a weight of 40% of the final grade.

For those students who are not able to take one of the tests for duly justified reasons (in due time and in the appropriate manner), the weight of the final exam in the final grade will be increased by the corresponding quantity.

The final grade of the course will be the best of the following two options:

- a) The average grade obtained by weighing the grades obtained in the continuous assessment and in the final exam, with the weights specified above.
- b) The grade obtained in the final exam.

In order for the final grade to be the one indicated in b) above, the student must obtain a grade of at least 4 out of 10 in the continuous assessment, and he/she will do a test on the day of the exam review.

The final grade at the Re-sit Exam will be the best of the following two options:

- The grade obtained in the Re-sit Exam.
- The weighted grade resulting from the continuous assessment (40% according to the chart above) and the Re-sit Exam (60%).

Students enrolled in the course for the second time

The same assessment criteria will be applied to those students who are enrolled in the course for the second time and for those who are enrolled for the first time, except if a different criterion is established by the Faculty.

5. Cronograma de Actividades / Activities Cronogram

TOTAL NUMBER OF HOURS OF IN-CLASS AND OUTSIDE-CLASS ACTIVITIES FOR THE STUDENT*

Week	Contents	In-class hours	Outside-class hours/self- study at home
1	Unit 1	4.5	7.5
2	Unit 2	4.5	7.5
3	Unit 2	4.5	7.5
4	Unit 3	4.5	7.5
5	Unit 3 + Tutorials	7.5	10
6	Unit 4 Test 1	6.5	10
7	Unit 4-Unit 5 Seminar	6.5	9
8	Unit 5	4.5	7.5
9	Unit 6	4.5	7.5
10	Unit 6 Tutorials	7.5	10
11	Unit 7	4.5	7.5
12	Unit 7 Seminar 2	6.5	10
13	Unit 7 Unit 8 Test 2	6.5	10
14	Unit 8	4.5	7.5
Final exam		2	27

Total number of hours **79** **146**

* This timetable is for guidance only.