

30609 - Statistics II

Syllabus Information

Academic Year: 2021/22

Subject: 30609 - Statistics II

Faculty / School: 109 - Facultad de Economía y Empresa

Degree: 432 - Joint Law - Business Administration and Management Programme

ECTS: 6.0

Year: 2

Semester: Second semester

Subject Type: Compulsory

Module:

1. General information

1.1. Aims of the course

The expected results of the course respond to the following general aims

The subject Statistics II aims to provide the student with the basic tools for the understanding and handling of random phenomena related to the economy. Therefore, it has a practical profile so the student can analyze, solve and interpret economic realities with the aim of making decisions with scientific rigor.

The first lessons are dedicated to the study of the basic random model, the most frequently used to explain real phenomena mainly linked to economic variables. Afterwards the general scope of an economic problem is presented, in which the theoretical model is not completely known and some empirical research is required in order to have a grasp of it.

The next lesson addresses the issue of how to select a sample which allows to infer the unknown facets of the proposed method. Particular emphasis is placed in the random sampling method, which is the basis of the inferential methods that will be discussed later. A key aspect addressing this problem is to determine the size of the sample for our conclusions to be reliable and offer probabilistic guarantees.

The next lessons go into detail about the inferential methods, from the perspective of both parameter estimation and hypotheses testing. The student will learn the different approaches and conclusions, as well as the interpretation of the achieved results. The last lesson addresses the comparison of two phenomena, a very common practice when studying two different economic realities or groups (either geographic or temporary).

The contents of the module have a practical goal, namely, for the student to get the tools and the skills required to apply them to different situations, obtaining the more outstanding conclusions and providing the interpretations needed for their understanding.

1.2. Context and importance of this course in the degree

The module Statistics II is included in the unit of Quantitative Methods for Business of the curriculum, together with the modules Statistics I, Operational Research and ICTs in Business. This module combines the analytical tools with the module of Foundations of Mathematical Analysis and Tools (Mathematics I, Mathematics II, Econometrics and Econometric Applications in Business).

On the one hand, it uses the knowledge and the skills acquired in the modules Mathematics I and II and Statistics I, as a summary description of the economic phenomenon under study while, at the same time, it provides the student with the techniques and methods needed to understand that phenomenon and explain it by means of a model. In the module, inferential procedures are addressed for the first time; that is, given some observed results, a model that fits that economic phenomenon and explains it is created. The modules Econometrics and Econometric Applications in Business will tackle the same procedures with applications to more specific and sophisticated models, showing the applications of the scientific method to economic problems.

1.3. Recommendations to take this course

There are no previous requirements for studying this subject. However, it is recommended to have completed the courses Mathematics I, Mathematics II and Statistics I to facilitate the learning process and reduce the level of effort. A basic knowledge of office software, mainly a text editor and a spreadsheet, is also recommended in order to carry out the practices correctly and facilitate the acquisition of some relevant competences.

2. Learning goals

2.1. Competences

After completing the course, the student will be competent in the following skills:

Specific competences:

- Assess the situation and the development expected for companies and organizations, making decisions and extracting the relevant knowledge with reference to social responsibility.
- Understand and apply professional criteria and scientific rigor to solve economic, business and organizational problems.
- Develop and draft a project.

Transversal competences:

- Ability to solve problems
- Ability for self-organization and strategic planning
- Ability to analyze and extract information from a variety of sources
- Ability to make decisions
- Motivation for quality and excellence
- Capacity for adaptation to new situations
- Capacity to apply theoretical knowledge to real situations
- Ability to use the technological tools needed in the exercise of the profession

2.2. Learning goals

The student, in order to pass the course, will have to show her/his competence in the following skills:

Understand and use probability as a measure of uncertainty in economic phenomena.

Differentiate and apply the most important models of probability, both discrete and continuous.

Measure the uncertainty of future results and facts.

Use and schedule sampling methods to extract information from economic phenomena.

Calculate the sample size needed for making decisions with minimum guarantees.

Synthesize the sample information in the more usual statistics. Calculate and assess these statistics, examining the conclusions.

Infer properties of theoretical models from sample observations and justify the goodness of these properties.

Design tests of statistical hypotheses to corroborate or refute a theory from the sample information.

Utilize the more usual statistical tests for proportions, means and variances of random models.

Compare and analyze the properties of two random models, detecting the differences between proportions, means and variances.

2.3. Importance of learning goals

The module has a double objective concerning the training of the future professional. The first challenge comes from the instrumental and quantitative character of the module, with the aim of providing the student with the basic tools needed to extract information and to use and interpret it in order to understand an economic reality. The methods and techniques acquired in the module enable the student to develop contents and skills in other modules of the degree. A second goal is to promote a critical spirit in the student when tackling projects in the economic and business field. Statistical methods, which allow to quantify and measure the uncertainty of the information collected, help to guarantee precise and reliable conclusions for taking scientific decisions, providing the students with the criteria needed to understand and examine both their own results and the results provided by external sources.

3. Assessment (1st and 2nd call)

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

The student will prove that he/she has achieved the expected learning results by means of the following assessment tasks:

The assessment of the subject is global, based on two different tests: a theoretical-practical test and a computer-based test.

The theoretical-practical test involves solving problems and theoretical questions similar to those taught in the practical

sessions and in the classroom lectures. The test consists of four questions with three items each. Tests from previous years are available for the students in the learning platform, which can help them to know the nature of the test.

The computer-based test consists of solving problems based on real data with the Excel spreadsheet. The proposed problems are similar to those solved in the practical sessions. Alternatively, this test may be passed by doing two intermediate tests, PT1 and PT2, during the semester.

The theoretical-practical test (WT) is worth 70% of the overall mark and the computer-based test (PT) is worth 30%. There are two alternatives for the first sitting:

- Students who take only the theoretical-practical test (WT): those students who have obtained a minimum of three points in each of the intermediate test PT1 and PT2. Their grade in the PT test will be $0,5 \text{ PT1} + 0,5 \text{ PT2}$.
- Students who take both tests (WT and PT): those students who either have not taken the intermediate tests, PT1 and PT2, have failed one of them or both with not less than three points, or who want to improve their mark.

The final assessment mark for the course will be computed as follows:

Final grade = $0,7 \text{ WT} + 0,3 \text{ PT}$.

The written test (WT), as well as the intermediate tests (PT1 and PT2) and the computer-based test (PT), will be marked on a scale from 0 to 10. The student should obtain at least 3 points in each (WT, PT1 and PT2; or WT and PT) to apply the formula and, consequently, obtain the final mark.

In order to pass the course the student should obtain at least 5 points as the final mark. If the final mark is under 5 or the student has less than 3 points in any of the two parts WT and PT the student is required to re-sit. Reassessment will be similar to the global test in the first sitting. Students who have an average mark is equal to or greater than 5 in the intermediate tests ($0,5 \text{ PT1} + 0,5 \text{ PT2} \geq 5$) are not required to re-sit the computer-based test. The student will keep this average mark in order to obtain the final mark.

Assessment criteria

In the theoretical-practical test, the student will demonstrate his/her ability to model and develop the suggested problems, obtain their solutions and explain them in the context of the proposed situation.

In the computer-based tests, the student will demonstrate his/her ability to obtain accurate numerical results and analyze their adequacy and correspondence with the real situation under study.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process that has been designed for this course is based on the following activities:

Several teaching methods will be used in the learning process, based on the objectives set and the competences to develop. Explanatory techniques will be used in the lectures, aiming to analyze and develop the basic concepts of the subject, and collaborative training techniques will be used to get the student involved in order to develop her/his ability to organize, plan and make decisions.

Furthermore, computer tools and solving case studies will be used to tackle the competences related to the use of technological tools, problem solving and ability to analyze and extract information from external sources. Moreover, the classroom practicals will enable the student to develop the capacity to adapt to new situations and apply the knowledge acquired in professional practice.

The learning platform Blackboard 9.1 will provide the educational support. All the documentation and material needed for the lectures and the classroom practicals and the associated information, including this teaching guide will be published in this platform. In particular, documents such as conceptual maps and video tutorials will be of great interest for the student when preparing and revising the subject.

4.2. Learning tasks

Lectures (30 classroom hours and 45 autonomous working hours): They will be mainly invested in the introduction of the basic concepts and the theoretical developments of each lesson. Expository lectures will be used, always encouraging the participation and discussion in the classroom. The lectures will be supported by slides. Class attendance, participation and note-taking are highly recommended.

Applied sessions (26 classroom hours and 33 autonomous working hours): These activities aim to show the student how to address and solve problems. The sessions will take place either in the classroom or in the computer lab.

Small group tutorials (4 classroom hours and 4 autonomous working hours): They will take place in the classroom and/or in the computer lab in the established hours. The goal of these sessions is to help the student to acquire skills and facility in the resolution of statistical problems.

This methodology is planned for in person teaching. Nevertheless, if health issues arise during the semester, that impose restrictions, the sessions may be taught in a blended manner or even completely online.

Syllabus

SECTION I: PROBABILITY CONCEPTS

Lesson 1: Discrete probability distributions.

Random variables. Discrete and continuous random variable. Probability distribution or mass function. Binomial, Hypergeometric and Poisson distributions.

Lesson 2: Continuous probability distributions.

Continuous random variable. Probability density function. Uniform and Exponential distributions. Normal distribution and related to normal distributions. Independence of random variables.

SECTION II: SAMPLING THEORY

Lesson 3: Basic notions of sampling theory.

Sampling from a population. Sampling methods. Sampling distribution of statistics: Monte Carlo method. Asymptotic behavior of sampling moments. Sample-size determination.

SECTION III: ESTIMATION OF UNKNOWN DISTRIBUTION PARAMETERS

Lesson 4: Point estimators.

Estimation. Building estimators: method of moments, maximum likelihood estimates, least squares method. Properties of estimators: unbiasedness, consistency and efficiency.

Lesson 5: Interval estimation.

Confidence interval. Methods of finding interval estimators. Confidence intervals for parameters of normal distribution. Some applications.

SECTION IV: HYPOTHESIS TESTS OF A SINGLE POPULATION

Lesson 6: Parametric hypotheses.

Basic concepts: Simple, compound, null and alternative hypotheses, significance level, power of a test. Tests of the mean and variance of a normal distribution, tests of the population proportion.

SECTION V: TWO POPULATION HYPOTHESIS TESTS

Lesson 7: Two-sample hypothesis tests.

Independent and dependent samples. Comparing proportions, means and variances: confidence intervals and tests of statistical hypotheses.

4.3. Syllabus

PART 1. DISCRETE AND CONTINUOUS RANDOM VARIABLES
 Unit 1: Discrete random variable. Random variables. Probability distribution. Discrete and continuous random variables. Discrete random variable: Probability distribution or mass function. Expected value and its properties. Binomial, Hypergeometric and Poisson distributions.
 Unit 2: Continuous random variable. Continuous random variable: density and probability density functions. Characteristics of a continuous variable. Uniform, Exponential and Normal distributions. Continuous approximations of discrete distributions.
 PART 2. INTRODUCTION TO SAMPLE THEORY
 Unit 3: Introduction to sampling theory. Basic concepts: population, sample, parameters and statistics. Sampling methods. Simple Random Sampling. Sampling with and without replacement. Sampling distribution of statistics. The importance of the sample-size. Central Limit Theorem..
 PART 3. INFERENCE METHODS: ESTIMATION AND HYPOTHESIS TESTS
 Unit 4: Point and interval estimation. Concept of estimator. Point estimators. Confidence interval estimation. Construction of a confidence interval: the pivot method. Confidence intervals to estimate the population mean, the population variance and the population proportion. Sample size determination.
 Unit 5: Hypotheses testing. Basic concepts: Simple, composite, null and alternative hypotheses, significance level, power of a test and types of errors. Parametric hypothesis testing. Hypothesis Tests about the mean and the variance of a normal distribution, tests about the Bernoulli parameter. P-value. Non parametric hypothesis tests.
 Unit 6: Two sample inference. Inference for comparing means and variances and proportions. Independent and paired samples. Analysis of categorical variables: Contingency tables.

4.4. Course planning and calendar

The workload of the course is 6 ECTS credits (150 hours of study), distributed between classroom hours and individual homework in the following way:

Activities	Classroom hours	Individual homework hours	Total study load
Lectures (full group)	30	45	75
Practical classes and Computer labs (two subgroups)	26	33	59
Small group tutorials (two subgroups)	4	4	8

Intermediate computers test (two subgroups)	4	0	4
Final exams	4	0	4
TOTAL	68	82	150

A c a d e m i c i m p o r t a n t d a t e s

Presentation of the course: The first day of class, the objectives and contents of the course, the teaching methodology and the assessment criteria will be explained in detail.

Intermediate test: The students can take one intermediate problems test (CTI) about solutions obtained with computer programs.

Final exam: According to the official calendar established by Faculty of Economics, the students will take a final exam during the examination period that will consist of a methods and theory exam (ME) and a problems test about solutions obtained with computer programs (CT). With these two tests, the competencies and skills achieved will be evaluated. The weight of the ME test will be 70% and the weight of CT will be 30% of the final mark, respectively. The student who got a mark of at least 4 on the intermediate test, CTI, will be exempt from taking the CT test on the first sit of the global exam. Further details have been described in section 3 Evaluation, in this teaching guide.

The teaching materials developed during the course, as well as the examination calls and their results will be published in the learning platform: <http://moodle2.unizar.es>.