

BASIC PROGRAM FOR THE COURSE

## **STATISTICS APPLIED TO BUSINESS ADMINISTRATION**

Degree: BA (ADE)

Course: 2nd

Semester: second

Credits: 6

Type: Core

Code: 25837

**Department of Quantitative Methods**

## **Objectives:**

The main objective for this course is that students become familiar with all elements related to basic statistical inference and are able to use them. The following are issues to be covered: pointwise and interval estimation, properties of estimators, test of hypotheses and goodness-of-fit tests. Students have to previously become familiar with the probability distributions required to better understand these statistical concepts. In addition, students will study the most commonly used sampling methods, so that they are able to select and identify the most appropriate method for each case under study. The contents included in this course will allow the student to deal with statistical inferential problems, which are very important in any real data analysis situation, as well as in any study that includes a quantitative component.

## **Specific skills:**

- Be able to identify and discriminate the main characteristics of the different theoretical probability models (discrete and continuous). In this way, students will adequately assess their usefulness and applicability in their professional field.
- Be able to identify the different estimation methods (pointwise and by confidence interval), as well as their properties, so that students can select the most appropriate alternative of analysis to the specific situation under study.
- Be able to apply the most appropriate statistical methodology for hypothesis test design that would allow the student to take on specific decisions in his/her professional field.
- Be able to obtain and interpret the results of specific statistical analyses applied to data in Economics by making use of the most appropriate sources of information, as well as of the required statistical or text editing software tools.

## **Cross-sectional skills:**

Ability to provide motivated judgments well supported by previously obtained data.

Ability to fluently communicate orally and in writing.

Ability to work in groups, showing respect, responsibility, initiative and leadership with the working team.

Ability to develop analytical thinking and critical reflection.

Ability to communicate in a foreign language, particularly in English

## Detailed Program

In each of the chapters described below, we include the hours of class divided into lectures (L), class of exercises (CE) and seminars (S). In addition, for each specific content within each chapter, the acronym BE refers to chapters or sections for the book Bain and Engelhardt (1992), whereas the acronyms MR and RM refer to chapters and sections of the books Martín-Pliego and Ruíz-Maya (2009) and Ruíz-Maya and Martín-Pliego (2005), respectively. Finally, the acronyms LL and P refer to chapters or sections of the books Levy and Lemeshow (1991) and Pérez (2005), respectively. The contents for these books mentioned in each chapter correspond to the contents that will be described in class for the program for this course.

### 1. Using Statistics in Business Administration Decisions [2H-L, 1H-S].

Introduction. Practical cases. Databases.

### 2. Poisson and Binomial Distributions [5H-L, 2H-CE].

Bernoulli distribution (BE 2.2; MR 6.3). Binomial distribution and binomial frequency (BE 2.2; MR 6.4). Definition and properties of the Poisson distribution (BE 2.2; MR 6.5). Practical issues (BE 2.2; MR 6.5). Tables for the binomial and Poisson distributions (BE 2.2). Convergence of the binomial to the Poisson and normal distributions (BE 2.2, 7.3, 7.4, 7.5; MR 6.5, 9.3, 9.7). Convergence of the Poisson to the Normal distribution (BE 7.4, 7.5; MR 6.5, 9.3, 9.7).

### 3. Gamma, Chi-Square ( $\chi^2$ ), F and t distributions [4H-L, 1H-CE, 1H-S].

Gamma distribution (BE 2.3; MR 7.4). Exponential distribution (BE 2.3; MR 7.4). Normal square distribution (BE 2.3; MR 7.3). Pearson's  $\chi^2$  distribution (BE 2.3, 8.3; MR 7.3.1). Snedecor's F distribution (BE 8.3, 8.4; MR 7.3.3). Student's t distribution. (BE 8.3, 8.4; MR 7.3.2).

### 4. Parameter Estimation. Properties of estimators [8H-L, 2H-CE, 1H-S].

Introduction (BE 8.1, 8.2, 8.3, 9.1; RM 1.1, 1.2). Random sample and statistic (BE 8.1, 8.2, 8.3, 9.1; RM 1.3). Parameter estimation (BE 9.1; RM 3.1). Point estimation (BE 9.1, 9.2; RM 3.2). Maximum likelihood estimation (BE 9.2; RM 4.1). Method of moments estimation (BE 9.2; RM 4.3). Unbiased estimators (BE 9.3, 9.4; RM 3.3). Regular estimators (BE 9.3, 9.4; RM 3.4). Cramer-Rao lower bound (BE 9.3, 9.4; RM 3.4). Efficiency (BE 9.3, 9.4; RM 3.4). Convergence in probability and in quadratic mean (BE 7.2, 7.6, 7.7; MR 11.3). Consistency (BE 9.3, 9.4; RM 3.5).

### 5. Hypothesis Testing. Goodness of Fit Tests [16H-L, 3H-CE, 4H-S].

Fundamentals of hypothesis testing (BE 12.1; RM 6.1, 6.3). Statistical design of hypothesis tests (BE 12.1; RM 6.2). Likelihood ratio test (BE 12.6; RM 6.2). Neyman-Pearson Theorem (BE 12.6; RM 6.2).  $\chi^2$  goodness of fit test to a completely or partially specified distribution (BE 13.7, 13.8; RM 1.1, 1.2, 9.2). Tests of independence and homogeneity (BE 13.6; RM 9.6). Interval estimation and hypothesis testing. For the mean. For the difference of means. For the variance. For the ratio of variances. For the parameter  $\lambda$  in a Poisson distribution. For the proportion parameter in a binomial distribution. For the difference of proportions (BE Chapters 11 and 12; RM Chapters 5, 7 and 8).

### 6. Sampling in Finite populations [7H-L, 1H-CE, 2H-S].

Introduction (LL Chapters 1 and 2; P Chapter 2). Simple random sampling (LL Chapter 3; P Chapter 3). Stratified random sampling (LL Chapters 5 and 6; P Chapter 4). Cluster sampling (LL Chapters 8 and 9; P Chapter 7). Two-stage cluster sampling (LL Chapter 10; P Chapter 8). Items selection process (LL Chapters 3, 5-6 and 8-10; P Chapters 1-4 and 7-8). Sampling in practice.

## Teaching Methodology

The teaching methodology to be used in this course will be based on lecture type classes (L), class of exercises (CE) and seminars (S). In the lecture type classes the theoretical contents of the course will be introduced and, in addition, students' participation will be actively motivated by using take-home questions and/or exercises that should be analyzed by students prior to the next class and outside of the regular class time period. In the exercise type classes (CE), both the students and the professor will solve exercises and examples that will help illustrate the theoretical contents described in the lectures. In the seminars, students will develop specifically designed group activities, in which they will solve a series of exercises that will be jointly solved and corrected. In general, in the activities designed for the course, students will be able to better understand and adequately assess the applicability the concepts covered in class will have, and, thus, select the most appropriate methods for each specific application.

## Grading Process:

The final grade for this course will be based on exercises students will have to do during the whole class period, as well as on passing a written final exam that will include a multiple choice questionnaire, as well as some theoretical and/or practical exercises related to the material included in the program for the course. All of these activities will be preferably carried out in a face-to-face format. However, if this is not possible, they will be done using the services available in Egela.

Exercises and problems included both in the classroom exercise type, seminar type classes, and lectures, as well as the regular exercises assigned to students, are all part of the students' ongoing evaluation process.

Practical exercises:	30%
Final exam:	70%

In order to pass the course the student should obtain a grade of at least 4.5 (out of 10) in the final exam. Students that, after participating in the ongoing evaluation process, decide not to come to the exam will have a final grade of "Absent" or "No presentado".

In any case, any student will have the right to the on-going evaluation exemption regardless of having participated or not in the on-going evaluation process. In order to do so, the student should fill in a formal written request and hand it in to his/her professor making it clear the s/he wishes to request the on-going evaluation exemption. This request should be formally presented within the first nine weeks of the official school class period for this specific course (i.e., before the end of the 24th week of the class period that goes from week 16 to week 30).

Following the Plagiarism Protocol from the University of the Basque Country UPV/EHU, students will be able to use, in the different exams they will have during the course, their calculators, as well as the statistical tables and formulas provided as part of the course material. The use of cellular telephones or any other electronic device, personal computers or class notes will not be allowed.

The grading process for the course's second call for each academic year will be, in any case, a final written exam based on the total 100% of the grade for this course. This exam will assess all

skills that have been developed and contents that have been covered in the different activities during the class period of the course.

## References

### ***Basic References:***

- Bain, L. and Engelhardt, M. (1992). Introduction to Probability and Mathematical Statistics, Second edition. Duxbury Press, Boston.
- Levy, P.S. and Lemeshow, S. (1991). Sampling of Populations. Methods and Applications. Wiley, New York.
- Lohr, S.L. (2000). Muestreo: Diseño y Análisis, Internacional Thomson Editores, Mexico.
- Martín Pliego, F.J. and Ruíz Maya, L. (2009). Fundamentos de Probabilidad, 3ª Edición. AC, Madrid.
- Peña, D. (2001). Fundamentos de Estadística, Alianza Editorial, Madrid.
- Pérez, C. (2005). Muestreo Estadístico. Conceptos y problemas resueltos, Pearson Educación, Madrid.
- Ross, S. (2001). Probability and Statistics for Engineers and Scientists. Academic Press, London.
- Ruíz Maya, L. and Martín Pliego, F.J. (2005). Fundamentos de Inferencia Estadística, 3ª Edición, AC, Madrid.

### ***Complementary References for Exercises:***

Arteche et al. (2000). Ejercicios de Estadística II: Estadística Empresarial y para Economistas, Servicio Editorial de la Universidad del País Vasco-Euskal Herriko Unibertsitatea, Bilbao.

Fernández, K.; Orbe, J. eta Zubia, M. (1996). Estatistika I eta Estatistika II ariketak. Probabilitate Teoria eta Inferentzia Estatistikoa, UEU, Bilbo.

Garín, A. and Tusell, F. (1990). Ejercicios de Probabilidad e Inferencia Estadística, Tébar-Flores, Madrid.

Martín Pliego, F.J., Montero, J.M<sup>a</sup> and Ruíz Maya, L. (2005). Problemas de Inferencia Estadística, 3ª Edición, AC, Madrid.

Martín Pliego, F.J., Montero, J.M<sup>a</sup> and Ruíz Maya, L. (2006). Problemas de Probabilidad, 2ª Edición, AC, Madrid.