

**Statistics II**

Code: 102385  
ECTS Credits: 6

Degree	Type	Year	Semester
2501572 Business Administration and Management	FB	2	1
2501573 Economics	FB	2	1

**Contact**

Name: Dolors Márquez Cebrián  
Email: mariadolores.marquez@uab.cat

**Use of Languages**

Principal working language: catalan (cat)  
Some groups entirely in English: Yes  
Some groups entirely in Catalan: Yes  
Some groups entirely in Spanish: No

**Teachers**

Xavier Vila Carnicero  
Anabel Blasco Moreno  
Ana Vazquez Navarro  
Arnau Juanmarti Mestres  
Mikel Esnaola Acebes  
Tomeu Lopez-Nieto Veitch  
Mireia Díaz Sanchís

**Prerequisites**

It is recommended that the student has passed the following subjects: Statistics I, Mathematics I and Mathematics II. This way, the student will have acquired the competences necessary to Statistics II with the best warranty of success. It is also essential that you demonstrate basic knowledge of R.

**Objectives and Contextualisation**

This subject will enable the students to understand and apply the statistical method to solve problems characteristic of economics and business. Thus, starting from empirical evidence gathered in a given sample the students will be able to arrive to conclusions scientifically valid which will help them in decision making.

This subject must also provide students with the theoretical foundations that will enable them to follow satisfactorily other subjects (Econometrics, Econometric forecast models, Operations Research) of quantitative content as well as tools that will help them with a better understanding of subjects such as Macroeconomics, Game Theory, Marketing Research) in which some statistical concepts (theoretical or practical) can play an important role.

**Competences**

#### Business Administration and Management

- Analyse quantitative and qualitative information referring to economic phenomena and variables.
- Apply the basic statistics for improving processes of analysis and systematisation of business information and learn rigorously and scientifically about the company chain of value.
- Capacity for oral and written communication in Catalan, Spanish and English, which enables synthesis and oral and written presentation of the work carried out.
- Organise the work in terms of good time management, organisation and planning.
- Select and generate the information necessary for each problem, analyse it and take decisions based on that information.
- Take decisions in situations of uncertainty, demonstrating an entrepreneurial and innovative attitude.
- Use of the available information technology and adaptation to new technological environments.

#### Economics

- Analyse quantitative and qualitative information referring to economic phenomena and variables.
- Apply the basic statistics for improving processes of analysis and systematisation of business information and learn rigorously and scientifically about the company chain of value.
- Capacity for independent learning in the future, gaining more profound knowledge of previous areas or learning new topics.
- Demonstrate initiative and work individually when the situation requires it.
- Organise the work in terms of good time management, organisation and planning.
- Select and generate the information necessary for each problem, analyse it and take decisions based on that information.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills in order to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take decisions in situations of uncertainty, demonstrating an entrepreneurial and innovative attitude.
- Use of the available information technology and adaptation to new technological environments.
- Work well in a team, being able to argue proposals and validate or reject the arguments of others in a reasoned manner.

### Learning Outcomes

1. A capacity of oral and written communication in Catalan, Spanish and English, which allows them to summarise and present the work conducted both orally and in writing.
2. Analyse and establish both quantitative and qualitative conclusions about the performance of variables with random elements.
3. Analyse variables using the hypothesis contrast on its main characteristics.
4. Capacity to continue future learning independently, acquiring further knowledge and exploring new areas of knowledge.
5. Demonstrate initiative and work independently when required.
6. Formalise the causal relationship between economic variables and uncertainty.
7. Make decisions in situations of uncertainty and show an enterprising and innovative spirit.
8. Organise work, in terms of good time management and organisation and planning.
9. Select and generate the information needed for each problem, analyse it and make decisions based on this information.
10. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
11. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.

12. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
13. Students must develop the necessary learning skills in order to undertake further training with a high degree of autonomy.
14. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
15. Use available information technology and be able to adapt to new technological settings.
16. Work as part of a team and be able to argue own proposals and validate or refuse the arguments of others in a reasonable manner.

## **Content**

### Unit 1 Introduction to Inferential Statistics and Estimation

#### 1.1 Inferential Statistics: Definition and Inference Methods

#### 1.2 Definition, characteristics and Distribution of the main sample statistics: mean, variance and proportion

#### 1.3 Methods of point estimation and interval estimation

#### 1.4 Properties of estimators: bias, efficiency and consistency

#### 1.5 Methods of estimation: maximum likelihood and method of moments

### Unit 2 Parametric hypothesis tests

#### 2.1 Concept of parametric test: null hypothesis and alternative hypothesis

#### 2.2 Test statistic and error type

#### 2.3 Tests on the population mean, population variance and population proportion

#### 2.4 Sample comparison test

#### 2.5 Analysis of Variance

#### 2.6 The p-value

### Unit 3 Goodness-of-fit and analysis of the relationship between variables

#### 3.1 Chi-Square goodness-of-fit test for discrete variables

#### 3.2 K-S goodness-of-fit test for continuous variables

#### 3.3 Test of independence between qualitative variables

#### 3.4 Analysis of the correlation between quantitative variables: correlation coefficient

### Unit 4 Introduction to the regression model

#### 4.1 Presentation and objectives of the model

#### 4.2 Hypothesis of the model specification

#### 4.3 Estimation by Ordinary Least Squares (OLS) and their properties

#### 4.4 Model testing

#### 4.5 Coefficient of the goodness-of-fit and relationship between the correlation and the regression analysis

## 4.6 Forecasting

### Methodology

The activities that will allow the students to learn the basic concepts included in this course are:

1. Theory lectures where the instructor will explain the main concepts.

The goal of this activity is to introduce the basic notions and guide the student learning.

2. Problem Sets

A problem set which students will have to solve individually will be included in every unit. The goal of this activity is twofold. On one hand students will work with the theoretical concepts explained in the classroom, and on the other hand through this practice they will develop the necessary skills for problem solving.

3. Lab sessions

The aim of this activity is to learn to use computational tools for the treatment and analysis of data.

This activity will be developed, on the programmed days, in the computer rooms of the faculty. Faculty or in the teaching room depending on the circumstances and availability of spaces. If the activity is developed in the regular classroom, students will need to bring their own laptop in order to participate in the activity.

4. Tutoring hours

Students will have some tutor hours in which the subject instructors will help them solve any doubts they may have.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

### Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lab sessions	17	0.68	3, 6, 5, 8, 16, 15
Lectures	32.5	1.3	2, 3, 6, 7, 9, 15
Type: Supervised			
Tutoring and monitoring work in progress	7.5	0.3	2, 3, 1, 4, 6, 5, 8, 7, 9, 16, 15
Type: Autonomous			
Individual study	89.5	3.58	2, 3, 1, 4, 6, 5, 8, 7, 9, 16, 15

### Assessment

The evaluation of the students will be carried out according to the following activities:

1. A midterm exam

Written evidence in which the student will not be allowed to consult any kind of teaching material. The maximum resolution time will be 60 minutes. This test does not release matter.

## 2. A final exam

Written evidence in which the student will not be allowed to consult any kind of teaching material. The maximum resolution time will be 2 hours, and will include all the subject matter of the course.

The exam is designed so that the student performs a last learning effort that is considered necessary to consolidate the previously acquired knowledge, thus guaranteeing the success in the continuous learning process of the greatest possible number of students.

## 3. Submission of problem sets and essays, and/or lab practices

Students will submit, at the request of the teaching staff and following their instructions, exercises, essays and/or lab practices to be solved individually and/or in groups of between 2 and 4 students.

### Evaluation criteria

The grade of the midterm exam will weight a 20% of the average grade of the subject.

The grade of the final exam will weight a 50% of the average grade of the subject.

The grade of the submission of exercises, essays and/or lab practices will weight a 30% of the average grade of the subject.

Therefore, the average grade of the subject is computed as:

$$\begin{aligned} \text{average grade of the subject} &= 20\% (\text{grade of the midterm exam}) + \\ &+ 50\% (\text{grade of the final exam}) + \\ &+ 30\% (\text{grade exercises/essays/lab practices}) \end{aligned}$$

The subject will be considered "passed" if the following two requirements are met:

1. the average grade of the subject is equal to or greater than 5 and
  2. the grade of the final exam is equal to or greater than 3.
- A student that meets the first requirement above but does not meet the second will receive an average grade of the subject equal to 4.5, and will qualify for the re-evaluation test according to what is established in the section "Retake Process" below.
  - A student that meets the second requirement above but does not meet the first, or any of them, will qualify for the re-evaluation test according to what is established in the section "Retake Process" below.

A student who has not participated in any of the assessment activities will be considered "Not evaluable".

### Calendar of evaluation activities

The dates of the evaluation activities (exercises in the classroom, assignments, ...) will be announced well in advance during the semester on the Campus Virtual. The dates of the final exam and midterm exam are scheduled in the assessment calendar of the Faculty.

"The dates of evaluation activities cannot be modified, unless there is an exceptional and duly justified reason why an evaluation activity cannot be carried out. In this case, the degree coordinator will contact both the teaching staff and the affected student, and a new date will be scheduled within the same academic period to make up for the missed evaluation activity." Section 1 of Article 115. Calendar of evaluation activities (Academic Regulations UAB).

Students of the Faculty of Economics and Business, who in accordance with the previous paragraph need to change an evaluation activity date must process the request by filling out an Application for exams' reschedule (on the website of the Faculty)

### Grade revision process

After all grading activities have ended, students will be informed of the date and way in which the course grades will be published.

Students will be also be informed of the procedure, place, date and time of grade revision following University regulations.

### Retake Process

"To be eligible to participate in the retake process, it is required for students to have been previously been evaluated for at least two thirds of the total evaluation activities of the subject." Section 3 of Article 112 ter. The recovery (UAB Academic Regulations). Additionally, it is required that the student to have achieved an average grade of the subject between 3.5 and 4.9.

The date of the retake exam will be posted in the calendar of evaluation activities of the Faculty. Students who take this exam and pass, will get a grade of 5 for the subject. If the student does not pass the retake, the grade will remain unchanged, and hence, student will fail the course.

### Irregularities in evaluation activities

In spite of other disciplinary measures deemed appropriate, and in accordance with current academic regulations, "in the case that the student makes any irregularity that could lead to a significant variation in the grade of an evaluation activity, it will be graded with a 0, regardless of the disciplinary process that can be instructed. In case of various irregularities occur in the evaluation of the same subject, the final grade of this subject will be 0". Section 10 of Article 116. Results of the evaluation. (UAB Academic Regulations).

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exercises, essays and/or lab practices	30%	0.5	0.02	2, 3, 1, 4, 6, 5, 8, 7, 13, 12, 11, 9, 16, 15
Final exam	50%	2	0.08	2, 3, 6, 14, 10, 9
Midterm exam	20%	1	0.04	2, 3, 6, 14, 10, 9

## Bibliography

- Canavos, GC Applied probability and statistical methods. McGraw-Hill. McGraw-Hill. 1998
- Heumann C, Schomaker M. and Shalabh Introduction to Statistics and Data Analysis Springer 2016  
<https://link.springer.com/content/pdf/10.1007%2F978-3-319-46162-5.pdf>
- Illowsky, B., and Dean, S. Introductory Statistics OpenStax Rice University 2018  
<https://openstax.org/details/books/introductory-statistics>
- Lind, D. A. et al. Statistical Techniques in Business and Economics. McGraw-Hill. 2018
- **Newbold P.** Statistics for business and economics. Pearson-Prentice Hall. 2013

## Software

R and RStudio

R is a mighty programming language for doing statistics. It covers from the most basic concepts, like computing the mean of a list of numbers, to the most advanced techniques as linear and nonlinear modeling, statistical tests, time series analysis, classification, clustering, etc. As a matter of fact, R is considered to be one of the most widely used statistical software tools in the industry and the academia. R is a highly versatile and easy to expand open source project, which means that is freely distributable and that there is a community of thousands of users and developers continuously contributing to this software. You can learn everything about R by visiting the Comprehensive R Archive Network at CRAN. R Studio is a powerful IDE (Integrated Development Environment) for working with R, and is the tool that will be used throughout this course.