



Course guide

240042 - 240042 - Statistics

Last modified: 16/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 715 - EIO - Department of Statistics and Operations Research.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: PEDRO GRIMA CINTAS

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

2. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Transversal:

1. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

TEACHING METHODOLOGY

There are two types of sessions: lectures and hands-on sessions. In the lectures (2 hours per week) the teacher explains the basics of the subject using examples and with the minimal mathematical apparatus necessary to understand the concepts.

In the hands-on sessions (2 hours per week), case studies will be solved using statistical packages (with the computer) or using calculator and statistical tables (in classrooms "with blackboard").

Students must prepare the sessions in a self-study manner, following the detailed plan available in the subject's intranet. Material is also offered in this intranet.

LEARNING OBJECTIVES OF THE SUBJECT

After the course the student will be able to:

1. Design how to collect data and how to convert these data into useful information for decision making in environments where there is variability.
2. Understand the concept of variability, how it is measured, the problems it brings and how its influence can be reduced in any process.
3. Know and apply some of the most common techniques of data collection and analysis.
4. Learn the use of statistical software to solve problems as close as possible to those in their future professional work.



STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	30,0	20.00
Hours small group	30,0	20.00

Total learning time: 150 h

CONTENTS

INTRODUCTION TO STATISTICS. DESCRIPTIVE STATISTICS

Description:

Introduction: Definition and usefulness of statistics? Measures of central tendency, position and dispersion. Graphics: Histogram, boxplot, scatterplots.

Specific objectives:

Knowing and appreciating the possibilities of statistical techniques to obtain information from data.

Related competencies :

CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Full-or-part-time: 10h

Theory classes: 2h

Practical classes: 1h

Laboratory classes: 1h

Self study : 6h

VARIABILITY. PROBABILITY DISTRIBUTIONS

Description:

Concepts of population and sample. Probability distributions for continuous and discrete case. Mathematical expectation and variance of a random variable. Distribution function. The Normal distribution. Binomial model. Poisson model. Expected value and variance of lineal combinations of random variables.

Specific objectives:

Understanding the concept of variability, how it is measured and the problems it generates. Knowing and being able to use some probability distributions.

Related competencies :

CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Full-or-part-time: 28h

Theory classes: 4h

Practical classes: 4h

Laboratory classes: 4h

Self study : 16h



ESTIMATION OF POPULATION PARAMETERS

Description:

Distribution of the sample mean. Student's t Distribution. Confidence interval for the mean. Distribution of mean's difference. Distribution of s^2 . The Chi-square distribution. F-Snedecor distribution. Distribution of the ratio of two variances.

Specific objectives:

Learning the theoretical foundation for later establishing criteria for making decisions in the presence of variability.

Related competencies :

CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Full-or-part-time: 24h

Theory classes: 4h

Practical classes: 2h

Laboratory classes: 2h

Self study : 16h

SIGNIFICANCE TESTS. COMPARISON OF TREATMENTS

Description:

Significance tests. Formalization of the contrast of hypotheses. p-value. Type I and type II error. Comparison of means and variances in totally randomized designs. Comparison of means in blocked designs. Comparison of proportions. Crosstabs. Analysis of variance with one factor.

Specific objectives:

Being able to apply the most common statistical tests, and knowing its possibilities and limitations. Also, knowing and being able to apply the most common techniques for collecting and analyzing data for the comparison of treatments.

Related competencies :

CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Full-or-part-time: 44h

Theory classes: 10h

Practical classes: 4h

Laboratory classes: 4h

Self study : 26h



MEASURING THE RELATIONSHIP BETWEEN TWO VARIABLES. SIMPLE AND MULTIPLE LINEAR REGRESSION

Description:

Concepts of covariance and correlation coefficient. Calculation of the coefficients of the model. Least squares criterion. Simple linear regression: measures of goodness of fit, distribution of the estimators, significance tests, verification of the model, matrix formulation. Multiple linear regression: general approach, hypothesis, significance tests, measures of goodness of fit. Selecting the best regression equation.

Specific objectives:

Being able to identify relationships between variables and to explain the relationship with the most appropriate models.

Related competencies :

CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Full-or-part-time: 44h

Theory classes: 10h

Practical classes: 4h

Laboratory classes: 4h

Self study : 26h

ACTIVITIES

EXERCISES RESOLUTION

Description:

The students will have exercises to solve. These assignments will be done individually or in groups, as indicated by the teacher. Some of these activities will be assessed by the teacher.

Specific objectives:

Practicing the acquired concepts and having feedback on the level of assimilation and understanding of the concepts.

Material:

Each lessons will have a collection of exercises available on the intranet.

Delivery:

Three problem sessions will be dedicated to the completion of exercises that will be delivered and evaluated by the teacher (Continuous evaluation mark)

Full-or-part-time: 15h

Practical classes: 2h

Self study: 13h



RESOLUTION OF ONLINE QUESTIONNAIRES

Description:

Students must answer multiple choice questions through the subject's intranet.

Specific objectives:

Encouraging independent learning, facilitating self-study from the immediate feedback that the student obtains.

Material:

Questionnaires will be available on the subject's intranet. Eventually, other exercises will be available through a specific web platform.

Delivery:

Either the completion of the questionnaires or their numerical evaluation will be used as evidence for this activity.

Full-or-part-time: 15h

Self study: 15h

PARTIAL EXAM

Description:

Assessment of knowledge.

Delivery:

Solved exam.

FINAL EXAM

Description:

Assessment of knowledge.

Delivery:

Solved exam.

GRADING SYSTEM

The final mark (NF) will consist of four inputs:

- 1) Continuous assessment mark: AC
- 2) Grade obtained in activities carried out during the course: NA
- 3) Midterm Exam: EP
- 4) Final Exam: EF

The final mark will be calculated according to:

$$NF = 0,25*AC+0,15NA + \max\{0,15*EP+0,45EF; 0,6*EF\}$$

If the reevaluación exam is performed, the grade obtained (NR) will replace the EP and EF. Therefore, the final mark in this case will be:

$$NF = 0.25*AC + 0.15*NA + 0,6*NR$$



BIBLIOGRAPHY

Basic:

- Prat Bartés, A. [et al.]. Métodos estadísticos : control y mejora de la calidad [on line]. 2a ed. Barcelona: Edicions UPC, 2004 [Consultation: 09/09/2022]. Available on: <https://upcommons.upc.edu/handle/2099.3/36342>. ISBN 8483017865.
- Grima Cintas, Pere. Estadística con Minitab : aplicaciones para el control y la mejora de la calidad. Madrid: Garceta, 2010. ISBN 9788492812394.

Complementary:

- Box, George E. P. Statistics for experimenters : design, innovation, and discovery. 2nd ed. Hoboken: John Wiley & Sons, 2005. ISBN 0471718130.

RESOURCES

Other resources:

Students will have, as written material:

- Copies of the slides used in class.
- Collections of exercises (some with their solution.)
- Statistical Tables.

All written material will be available, at least, in the subject's intranet.

Students will have, as multimedia material:

- Links to web pages and videos of interest

Students will have, as software:

- The statistical software package MINITAB. This software is in the computer rooms and also available to students through a campus license.