Course guide
820076 - AEAE - Further Statistics and Applications in Engineering

Last modified: 02/10/2025

Unit in charge: Barcelona East School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: PABLO BUENESTADO CABALLERO

Others:

PRIOR SKILLS

Basic knowledge of probability and statistics

REQUIREMENTS

Prerequisite
820002 - ES - Statistics

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Solve mathematical problems that may arise in engineering. Apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial differential equations; numerical methods; numerical algorithms; statistics and optimisation.

Transversal:
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

TEACHING METHODOLOGY

The course focuses on problem-based learning, applying statistics to various areas. Each session begins with the presentation of a statistical technique, including practical examples, so that students can then work on key concepts during the rest of the session.

Generally, every Monday, in class, a new activity is introduced, performing the necessary tasks for its resolution and comprehension. In each session, relevant documentation is covered, useful calculation notions and tools are explained, and practical exercises are performed. Emphasis is placed on spreadsheet implementation, problem-solving, and subject learning.

All activities are carried out on the computer, with the support of the professor and, if necessary, the rest of the class, fostering collaborative work. Tasks are primarily developed in pairs, although they can also be done individually or in groups of three, when relevant.

TOOLS:
The ATENEA platform is the central hub for the course's teaching documentation and assignment submission. The documentation for all activities has a very clear and comprehensive design and content.

The Microsoft Office suite is used for developing course activities. However, students are free to use other tools to complete their assignments if they wish.

LEARNING OBJECTIVES OF THE SUBJECT

The course aims for students to gain confidence in solving statistical problems applied to engineering, learning advanced statistics crucial for their professional future.

They'll be taught how to work with spreadsheets without needing prior knowledge or programming. The activities and content will be highly useful for preparing and presenting their Final Degree Projects, creating appropriate calculations and representations.

Given the increasing number of job opportunities for engineers in applied statistics, this course prepares them to enter this field with strong foundational knowledge and critical thinking. Furthermore, the subject and its documentation are highly valued by students across different degrees.

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	30.00
Self study	90,0	60.00
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

INFERENCE BASED ON ONE SAMPLE

Description:
Initially working the usual statistical models for engineering.
Analysis of different types of sampling and sampling the main elements.
We review the basics of inference:
Confidence intervals
Hypothesis contrast

Specific objectives:
Reviewing the most useful engineering statistical models.
Deepen the main concepts related to the inference based on a single sample.
Learn to make decisions by estimating and contrast.

Related activities:
Practical statistical modeling. Recognizes the model from a sample.
Practice simulation to estimate. Experience the mean estimate.
Practice simulation for contrast. Decision making on average.

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

INFERENCE BASED ON TWO SAMPLES

Description:
Inference two population means.
Analysis of data pairs.
Inference proportions.
Inference two variances.

Specific objectives:
Enable the student to make decisions for cases with 2 samples.

Related activities:
Practice of Inference for two averages
Practice of inference data pairs
Practice of Inference for two proportions
Practice of Inference for two variances

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

ANALYSIS OF VARIANCE

Description:
Learn to perform analysis of variance pruebas of hypotheses.
ANOVA formulation.

Specific objectives:
Using the ANOVA technique for making decisions with a factor.
Using ANOVA applied to engineering problems.

Related activities:
Practice of analysis of variance of a factor
Practice of analysis of variance of two factors
Practice of ANOVA of three factors

Full-or-part-time: 20h
Theory classes: 4h
Laboratory classes: 4h
Self study : 12h

ADJUST MODELS. MULTIPLE LINEAR REGRESSION.

Description:
Using linear regression of two variables for modeling engineering data based on hypothesis testing. Linear model to predict values.
Learn the possibilities of the linear model for nonlinear relationships.
Extend the linear regression model to several variables.

Specific objectives:
Modeling linear relationship between two variables.
Learn the technique of linear modeling of several variables.

Related activities:
Practice of Linear modeling for two variables
Practice of multiple linear modeling

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

STATISTICAL QUALITY CONTROL

Description:
Apply statistical quality control to make decisions.
Knowing the useful graphical control.
Learning to use acceptance sampling.

Specific objectives:
Train students in the use of different techniques that help make decisions for statistical quality control.

Related activities:
Practice control charts
Practice of Acceptance sampling

Full-or-part-time: 20h
Theory classes: 4h
Laboratory classes: 4h
Self study : 12h

TIME SERIES ANALYSIS

Description:
content englishIntroduction to time series and the components that characterise them.
Modelling and validation of time series.
Smoothing of time series.
Forecasting.

Specific objectives:
Learn the elements that characterise time series.
To model and validate time series.
Learn how to smooth time series.
Predict values of time series.

Related activities:
Time series modelling, validation and forecasting practice.
Time series smoothing practice.

Full-or-part-time: 20h
Theory classes: 4h
Laboratory classes: 4h
Self study : 12h

GRADING SYSTEM

The course is structured around twelve activities throughout the semester, divided into three assessment blocks with four activities each.

Within each block, student pairs (or groups of three, or individuals) will write a report summarizing the completion of specific tasks. This document, along with the spreadsheets developed for the purpose, will be submitted for grading. Given the dynamic nature of the sessions, attendance at activities is a weighted factor in the score. Consequently, each block's grade will be an equitable blend of activity attendance and the evaluation of deliverables.

All blocks contribute equally to the final grade. The course does not require passing all blocks to pass the subject overall.

This course does NOT have a re-evaluation exam.

EXAMINATION RULES.

At the final session of each block, the professor will explain and publish the guidelines for the report to be compiled, along with its submission deadline, which will be at least one week.

Reports and spreadsheets must be submitted via ATENEA within the deadline specified for each block and should be well-presented.

The UPC's academic regulations define academic fraud as a serious offense. This is understood as any premeditated behavior aimed at falsifying the results of an exam or assignment required to pass a subject. Such action will result in a "Fail" descriptive grade and a numerical grade of 0 for the overall evaluation of the subject, without prejudice to any disciplinary process that may arise from the actions committed.

BIBLIOGRAPHY

Basic:
- Navidi, William; Murrieta Murrieta, Jesús Elmer; Martínez Velasco, Antonieta. Estadística para ingenieros y científicos. Quinta edición. Ciudad de México: McGraw Hill, 2022. ISBN 9781456293147.
- Devore, Jay L. Probabilidad y estadística para ingeniería y ciencias. 8a ed. México [etc.]: Cengage Learning, 2012. ISBN 9786074816198.
- Montgomery, Douglas C; Runger, George C. Applied statistics and probability for engineers. 4th ed. New York [etc.]: John Wiley & Sons, cop. 2006. ISBN 9780471745891.

Complementary:
- Peña, Daniel. Análisis de datos multivariantes. Madrid: McGraw-Hill, 2002. ISBN 8448136101.
- Navidi, W. Estadística para ingenieros y científicos. Mèxico [etc.]: McGraw-Hill, 2006. ISBN 9701056299.
- Aldas Manzano, Joaquin; Uriel Jimenez, Ezequiel. Análisis multivariante aplicado con R. 2a ed. Madrid: Paraninfo, 2017. ISBN 9788428329699.
- Dodge, Yadolah. The concise encyclopedia of statistics. New York [etc.]: Springer, [2010]. ISBN 9781441913906.

RESOURCES

Hyperlink:
- The concise encyclopedia of statistics. https://doi-org.recursos.biblioteca.upc.edu/10.1007/978-0-387-32833-1