

## Course guide

# 820076 - AEAE - Advanced Statistics and Applications in Engineering

Last modified: 09/07/2024

<b>Unit in charge:</b>	Barcelona East School of Engineering	
<b>Teaching unit:</b>	749 - MAT - Department of Mathematics.	
<b>Degree:</b>	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).	
<b>Academic year:</b> 2024	<b>ECTS Credits:</b> 6.0	<b>Languages:</b> Catalan, Spanish

### LECTURER

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**Coordinating lecturer:** PABLO BUENESTADO CABALLERO

**Others:**

### REQUIREMENTS

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Prerequisite  
820002 - ES - Statistics

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**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

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The sessions are done with a computer.

Learning is based on problems applied to different areas.

Each session begins with the presentation of the learning subject and then the students work on the concepts of interest.

The activities are carried out individually or as a couple.

The course can be done without attending the classroom (DISTANCE COURSE IS POSSIBLE).

## LEARNING OBJECTIVES OF THE SUBJECT

Students gain confidence to tackle problems related to the statistics and their applications in engineering.  
The statistic that students learn in this course is very advanced and useful for the future of an engineer.

In recent years a large increase in jobs for engineers in the field of applied statistics is appreciated.  
With this course we want to help the student to train in this area.

## 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 of a single factor.  
ANOVA formulation.  
ANOVA with two or three factors.

### Specific objectives:

Using the ANOVA technique for making decisions with a factor.  
Using ANOVA applied to engineering problems with 2 or 3 factors.

### 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

## 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

## 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

## GRADING SYSTEM

The evaluation focuses on the delivery of individual or couple work (6 reports).

Each report has the same weight in the final grade. It is not obligatory to hand in all the reports in order to obtain a pass in the subject.

This subject not has re-evaluation.

## EXAMINATION RULES.

The reports must be submitted via ATENEA within the deadline and with good presentation.

The UPC academic regulations define as a serious offence to commit academic fraud, defined as any premeditated behavior tending to falsify the results of an exam or work that has been done as a requirement to pass a subject. This action must involve the descriptive qualification of suspense and numeric of 0 of the overall evaluation of the subject, without prejudice to the disciplinary process that may arise as a result of the acts carried out.

## 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. México [etc.]: McGraw-Hill, 2006. ISBN 9701056299.
- Aldas Manzano, Joaquín; 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

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### Hyperlink:

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