Last update: 13-07-2018

820002 - ES - Statistics

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 749 - MAT - Department of Mathematics

Academic year: 2018

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: PABLO BUENESTADO CABALLERO

Others: Acho Zuppa, Leonardo
Buenestado Caballero, Pablo
Gálvez Carrillo, Imma
Mujica Delgado, Luis Eduardo
Rodellar Benede, Jose Julian
Ruiz Ordoñez, Magda Liliana

Opening hours

Timetable: Each teacher will serve students in his office according to the schedule published in ATENEA.

Requirements

To have passed Calculus.

To have studied Algebra and multivariable Calculus.
To have studied Numerical Calculus. Differential Equations

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 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and

grammatical errors.

Teaching methodology

The teaching methodology is distributed as follows:
- Lectures: 30%
- Practice classes with computer: 10%
- Self study: 45%
- Development of problems and reports: 10%
- Exams 5%

Learning objectives of the subject

Consolidate the fundamental concepts of statistics.

Identify the role of statistics in engineering problems.

Improve the students' skills in applying statistical tools to engineering modeling and problem-solving.

Use statistics to solve engineering problems or establish models.

Study load

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

1. INTRODUCTION

Learning time: 4h

Theory classes: 1h 30m
Laboratory classes: 2h
Self study : 0h 30m

Description:

Statistics in engineering.

Objectives of statistics.

Statistical method.

History of statistics.

Related activities:

Practice 1: Introduction to R. (Block 1)

Specific objectives:

Demonstrate the important role of Statistics as a methodology in the study and resolution of various problems in engineering.

Understand and appraise the possibilities of Statistics.

Review the historical evolution of Statistics.

Learn to install and start working with the statistical software R.

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2. DESCRIPTIVE STATISTICS	Learning time: 15h 30m Theory classes: 1h 30m Laboratory classes: 4h Self study : 10h

Description:
Definition of Descriptive Statistics (Exploratory Data Analysis)

Objectives of Descriptive Statistics.

General Concepts (Population, sample, variable, observation)

Types of data.

Frequency distribution.

Graphic representations.

Measures of central tendency.

Measures of variability.

Boxplot.

Sample moments.

Chebyshev inequality.

Measures of Skewness and Kurtosis.

Linear regression.

Related activities:
Practice 2: Descriptive statistics. (Block 1)
Practice 3: Linear Regression. (Block 1)
Evaluation block 1.

Specific objectives:

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Describe a methodology for organizing, representing and summarizing data sets in order to facilitate their evaluation and interpretation.

Know and appreciate the techniques for obtaining information from data.

Use the R software as a tool for the statistical descriptive analysis of a data set.

Build frequency tables.

Represent frequency tables.

Calculate and interpret the numerical descriptive measures of a data set.

Construct and interpret the boxplot.

Learn to calculate the parameters of the linear regression and to evaluate the goodness of fit.

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3. ELEMENTS OF PROBABILITY

Learning time: 16h

Theory classes: 6h
Self study : 10h

Description:

Definition of Probability.

Sample space of a random experiment.

Events. Types of events.

Operations with events.

Probability rules.

Conditional probability.

Independent events.

Total probability theorem. Bayes theorem.

Some counting rules: Permutations, variations, combinations.

Related activities:

Development of a report on probability problems.

Specific objectives:

Describe the outcomes of a random experiment in terms of the sample space.

Define the probability function.

Know the probabilistic elements for modeling random systems.

Understand and apply the concepts of conditional probability and independent events.

Know the main probability rules and apply them judiciously in practical problem-solving.

Describe, motivating through practical examples, many of the concepts needed for the study of statistical inference.

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4. RANDOM VARIABLES

Learning time: 14h 30m

Theory classes: 6h
Self study : 8h 30m

Description:
Definition of a Random Variable.

Discrete and continuous random variables.

Probability mass function and probability density function.

Probability distribution function.

Measures of central tendency.

Measures of dispersion.

Moments of a Random Variable.

Chebychev theorem.

Transformation of random variables.

Related activities:
Preparation of a report on random variable problems.

Partial Exam 1.

Specific objectives:
Present the concept of random variable.

Calculate and interpret the expectation and variance of random variables.

Understand and properly handle discrete and continuous random variables.

Relate the new concepts with those studied in descriptive statistics.

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5. PROBABILISTIC MODELS IN ENGINEERING

Learning time: 30h

Theory classes: 6h
Laboratory classes: 4h
Self study : 20h

Description:
DISCRETE MODELS:
Uniform distribution.
Bernoulli, Binomial, Negative Binomial, and Hypergeometric distribution.
Poisson distribution.

CONTINUOUS MODELS:
Uniform distribution.
Exponential distribution.
Normal distribution.

Related activities:
Preparation of problems on probabilistic models.

Practice 4: Discrets Probabilistic models. (Block 2)
Practice 5: Continus Probabilistic models. (Block 2)
Evaluation block 2.

Partial Exam 2.

Specific objectives:
Define and study the probability distributions most commonly used in engineering.

Use the R software as a computational tool for solving problems on probabilities and random variables.

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6. SAMPLING. CENTRAL LIMIT THEOREM.

Learning time: 20h

Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

Description:

Types of sampling.

Statistical distributions.

Laws of large numbers.

Central Limit Theorem.

Related activities:

Practice 6: Sampling. Sampling distributions of statistics. (Block 3)

Specific objectives:

Present some basic theoretical elements associated to random sampling and statistical inference.

Know the most common techniques of data collection.

Illustrate different techniques that allow applying the inductive process of statistical inference in order to obtain useful and reliable results.

Use common sampling distributions, as the Student's T distribution.

Learn some practical applications of the Central Limit Theorem.

Use the normal distribution to approximate some discrete distributions.

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7. POINT AND INTERVAL ESTIMATION	Learning time: 20h Theory classes: 8h Self study : 12h

Description:
Point estimation: method of moments and method of maximum likelihood.

Estimators: definition and properties.

Confidence interval estimation of the mean, variance and proportion.

Related activities:
Problems on point estimation.
Development of problems on interval estimation.

Partial Exam 3.

Specific objectives:
Estimate the value of a parameter from sample information.

Study the two most common methods for determining point estimates.

Study the most important properties of the estimators.

Know the sampling distributions of the estimators associated to normal, binomial and Poisson random variables.

Explain and apply interval estimation of the mean and variance of normal populations and approximately normal populations.

Know how to use the tables of the usual distributions associated to interval estimation.

Use the R software for calculating confidence intervals.

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8. HYPOTHESIS TESTING	Learning time: 30h Theory classes: 10h Laboratory classes: 2h Self study : 18h

Description:
Hypothesis testing of parametric models.

Errors associated to hypothesis testing.

P-value computation.

Statistical power.

Model testing.

Related activities:
Development of problems on statistical hypothesis testing.

Practice 7: Confidence intervals. Hypothesis testing. (Block 3)
Evaluation block 3.

Partial exam 4.

Specific objectives:
Study statistical hypothesis testing and its application to means, proportions, etc.

Be able to apply judiciously the most common statistical tests, appreciating their possibilities and limitations.

Calculate the p-value associated to a hypothesis test.

Understand the decision errors associated with hypothesis testing.

Use the R software as a computational tool to solve problems on statistical hypothesis tests.

Qualification system

The subject is declared within a framework of continuous evaluation. The global course mark (GCM) will be computed according to the weighting below. A global course mark 5.0 or higher is required to pass the course:

- Realization of 4 exams: 65% (16.25% by exam)
- Statistic practices with R: 30% (block 1: 8%, block 2: 8%, block 3: 8% and presence: 6%)
- Generic Competence (Oral and written effective communication): 5% (Competence is evaluated with an essay at the end of the course)

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Regulations for carrying out activities

The student must provide a detailed solution of the problems (in exams and reports).

- Students will not be able to attend the exam with notes, or books, or forms, or statistical tables.

- The faculty will take to the classroom the statements sheets, the exam form and the statistical tables.

- Students can take to the exam a calculator with characteristics similar to the one they use in the CNED.

- The duration of the exam will be 60 minutes in total.

- The exams consist of 2 problems that the students must answer in different sheets. The problems will be delivered separately, so students must write down their name, group and ID in each of the pages, even if they do not answer any of the problems.

- Students can not use pencil or red pen to answer problems.

- Students can only take the test in the assigned classroom and that is related to the registration group.

- The student must bring their passport to the exams.

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Bibliography

Basic:

Navidi, W.; García Hernández, A. E. Estadística para ingenieros. México [etc.]: McGraw-Hill, cop. 2006. ISBN 9701056299.

Pujol Vázquez, G.; Gibergans Bàguena, J.; García Ciaurri, F. Problemes d'estadística amb aplicació a l'enginyeria. Barcelona: UOC, 2009. ISBN 9788497887748.

Spiegel, M. R. Probabilidad y estadística. 3a ed. México [etc.]: McGraw-Hill, cop. 2010. ISBN 9786071502704.

Montgomery, D. C.; Runger, G. C. Applied statistics and probability for engineers. 4th ed. New York [etc.]: John Wiley & Sons, cop. 2006. ISBN 9780471745891.

Pozo Montero, F. [et al.]. Probabilitat i estadística matemàtica : teoria i problemes resolts [on line]. Barcelona: Iniciativa digital politècnica, 2010 [Consultation: 05/03/2012]. Available on: <http://hdl.handle.net/2099.3/36649>. ISBN 9788476535295.

Devore, Jay L. Probabilidad y estadística para ingeniería y ciencias. 6ª ed. México [etc.]: Thomson, cop. 2005. ISBN 978-970-686-457-4.

Complementary:

Delgado de la Torre, R. Probabilidad y estadística para ciencias e ingenierías. Madrid: Delta, cop. 2008. ISBN 8496477746.

Ipiña, S. L. Inferencia estadística y análisis de datos. Madrid: Pearson Educación, 2008. ISBN 9788483224045.

Sawitzki, G. Computational statistics : an introduction to R. Boca Raton: CRC Press, cop. 2009. ISBN 9781420086782.

Gonick, L.; Smith, W. La Estadística en comic. Barcelona: Zendrera Zariquiey, 1999. ISBN 8484180417.

Horra Navarro, J. de la. Estadística aplicada. 3ª ed. Madrid: Díaz de Santos, 2003. ISBN 8479785543.

Others resources:

Computer material

Probabilitat i estadística matemàtica : teoria i problemes resolts