DEGREE CURRICULUM

STATISTICS AND OPTIMIZATION

Coordination: SEBE FEIXAS, FRANCISCO

Academic year 2020-21

STATISTICS AND OPTIMIZATION 2020-21

Subject's general information

<table>
<tr><td>Subject name</td><td>STATISTICS AND OPTIMIZATION</td></tr>
<tr><td>Code</td><td>102006</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Double bachelor's degree: Degree in Computer Engineering and Degree in Business Administration and Management</td><td>1</td><td>COMMON</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Computer Engineering</td><td>1</td><td>COMMON</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>9</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><td>PRAULA</td><td>TEORIA</td></tr>
<tr><th>Number of credits</th><td>4.5</td><td>4.5</td></tr>
<tr><th>Number of groups</th><td>4</td><td>1</td></tr>
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<tr><td>Coordination</td><td>SEBE FEIXAS, FRANCISCO</td></tr>
<tr><td>Department</td><td>MATHEMATICS</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>225 total work hours
90 lecture attendance hours (partly provided virtually)
135 autonomous work hours</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Preferably catalan or spanish depending on instructor, english if there are foreign students.</td></tr>
<tr><td>Distribution of credits</td><td>Nacho Lopez Lorenzo 11,25
Jordi Pujolàs Boix 2,25
Francisco Sebé Feixas 9</td></tr>
</table>

STATISTICS AND OPTIMIZATION 2020-21

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
LOPEZ LORENZO, IGNACIO	nacho.lopez@udl.cat	11,25	
PUJOLAS BOIX, JORDI	jordi.pujolas@udl.cat	2,25	
SEBE FEIXAS, FRANCISCO	francesc.sebe@udl.cat	9	

Subject's extra information

Previous knowledge/skills on basic mathematics (General Upper Secondary Education level) are recommended.

The course is part of the academic plan. This subject is given during the second semester in the first course. It corresponds to the basic training modulus.

Learning objectives

In this subject the student is expected to achieve the following objectives:

- Manipulation of real equations and inequalities with real numbers.
- Operational skills with the binomic, cartesian and polar forms of complex numbers.
- To recognise continuous functions and the types of dicontinuities.
- To compute limits of functions and to solve indeterminate forms.
- To compute the derivative of univariate functions.
- To determine and characterize extrema of functions.
- Knowledge of basic sequences, series and their convergence.
- To use convergence criteria for series.
- Skills on basic integration methods.
- To compute coefficients of Fourier series.
- To determine the type of characteristic represented by a data set.
- To graphically represent and compute relevant values of a data set.
- To compute probabilities applying LaPlace formula, the total probability theorem, and Bayes theorem.
- To determine the distribution model of the random variable associated to a random experiment and to make computations.
- To apply the linear regression model for relating numerical characteristics.

Competences

Specific competences

- GII-FB1 - Capacity to solve mathematical problems arisen in the engineering field. Aptitude to apply knowledge on: linear algebra; differential and integral calculus; numerical methods; algorithmic, numerical; statistics and optimisation.
- GII-FB3 - Capacity to understand and master the basic concepts of discreet mathematics, logical, algorithmic and computational complexity, and its application to solve engineering problems.

Cross-disciplinary competences

- EPS1 - Capacity to solve problems and prepare and defence arguments inside the area of studies.
- EPS5 - Capacity of abstraction and of critical, logical and mathematical thinking.

University strategic competences

- CT5 - Acquire knowledge in scientific thinking.

Subject contents

1. **Part I: Optimization.**
    1. Real and complex numbers.
        1. Real numbers: absolute value.
        2. Representations of complex numbers.
        3. Operations with complex numbers. Roots.
    2. Numerical sequences and series.
        1. Sequences. Limit and convergence.
        2. Sequence manipulation. Indeterminates.
        3. Numerical series. Convergence.
    3. Functions and continuity.
        1. Elementary functions: definition and properties.
        2. Limits.
        3. Algebra of limits. Indeterminations.
        4. Continuity: definition and properties
        5. On Theorems of continuous functions.
    4. Derivatives and optimization.
        1. Derivative of a function at a point.
        2. Geommetric interpretation.
        3. Properties of derivatives.
        4. Derivatives of elemental functions.
        5. Univariate optimization.
    5. Integration.
        1. Calculation of primitives
        2. Variable change formulas.
        3. Integration by parts.
        4. Definite integral. Geometric interpretation.
    6. Fourier Series.
        1. Definition and coefficients of Fourier series.
        2. Dirichlet theorem.
2. **Part II: Statistics.**
    1. Univariate data analysis.
        1. Qualitative data. Tabulation. Pareto diagram.
        2. Quantitative data. Tabulation. Boxplot, steam-leaf diagram, histogram.
        3. Representative values.
    2. Probability calculation.
        1. Experiments and random events. Independence.
        2. Concept of probability. Properties.
        3. LaPlace rule. Conditional probability. Total probability and Bayes Theorems.
    3. Random variables.

1. Discrete random variables. Probability function. Mean and variance.
2. Bernoulli distribution
3. Binomial distribution.
4. Poisson distribution.
5. Geometric distribution.
6. Continuous random variables. Density function.
7. Uniform distribution.
8. Normal distribution.

4. Bivariate data analysis.
    1. Covariance and linear correlation.
    2. Linear regression. Determination coefficient.

Methodology

Theoretical and practical contents are mixed to combine basic aspects with illustrative examples. Practical lectures include joint student-lecturer sessions and individual-group sessions, and also sessions with the open symbolic package R.

Development plan

OPTIMITZATION

Description	Presential Activity	Autonomous Work	Duration
Chapter 1. Real numbers and Complex numbers.	Theory and problems of Chapter 1	Solve exercises and study theory.	3 weeks
Chapter 2. Functions.	Theory and problems of Chapter 2	Solve exercises and study theory.	2 weeks
Chapter 3. Derivatives and optimitzation.	Theory and problems of Chapter 3	Solve exercises and study theory.	3 weeks
Chapter 4. Numerical sequences and series	Theory and problems of Chapter 4	Solve exercises and study theory.	2 weeks
Chapter 5. Intregration.	Theory and problems of Chapter 5	Solve exercises and study theory.	2 weeks
Chapter 6. Fourier series.	Theory and problems of Chapter 6	Solve exercises and study theory.	2 weeks

STATISTICS

Description	Presential Activity	Autonomous Work	Duration
Chapter 1. Univariate data analysis	Theory and problems of Chapter 1	Solve exercises and study theory.	3 weeks
Chapter 2. Probability calculation	Theory and problems of Chapter 2	Solve exercises and study theory.	4 weeks
Chapter 3. Random variables	Theory and problems of Chapter 3	Solve exercises and study theory.	5 weeks
Chapter 4. Bivariate data analysis	Theory and problems of Chapter 4	Solve exercises and study theory.	2 weeks

Evaluation

Abbr.	Marking Activity	Ponderation	Minimum Mark	Group	Compulsory	Mendable
C1	1st Test	10%	NO	NO	YES	NO
P1	1st Partial Exam	40%	1	NO	YES	YES
C2	R tutorial Test	10%	NO	YES (<=2)	YES	NO
P2	2nd Partial Exam	40%	1	NO	YES	YES
Final Mark = 0.1*C1 + 0.4*P1 + 0.1*C2 + 0.4*P2						

The course is passed if the final mark is 5 or higher. The final mark is a weighted sum of both partial exams, the 1st test and the R tutorial test.

Each partial exam has a weight of 40% in the final mark, with a minimum mark of 1 required. Both partial exams and the tests are compulsory.

Bibliography

Optimization:

•Isaac A. García y Susanna Maza. Curso de introducción al cálculo para grados en ingeniería. Edicions de la Universitat de Lleida, 2013

•Francesc Aguiló y ....[et al]. Temes Clau de Càlcul. Edicions de la UPC,Barcelona, 1991.

Statistics:

• Peña, Daniel. Fundamentos de estadística. Alianza editorial, 2001.

• Spiegel, Murray. R., et al. Probabilidad y estadística. McGrawHill. 3ª edición. 2010.