DEGREE CURRICULUM

STATISTICS AND OPTIMIZATION

Coordination: MIRET BIOSCA, JOSE MARIA

Academic year 2016-17

STATISTICS AND OPTIMIZATION 2016-17

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>Typology</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>ECTS credits</td><td>9</td></tr>
<tr><td>Groups</td><td>3GG,2GM</td></tr>
<tr><td>Theoretical credits</td><td>4.5</td></tr>
<tr><td>Practical credits</td><td>4.5</td></tr>
<tr><td>Coordination</td><td>MIRET BIOSCA, JOSE MARIA</td></tr>
<tr><td>Department</td><td>MATEMATICA</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>225 total work hours
90 lecture attendance hours
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 4.5
Josep M. Miret Biosca 9
Jordi Pujolàs Boix 4.5
Francisco Sebé Feixas 4.5</td></tr>
<tr><td>Office and hour of attention</td><td>Appointment by email.</td></tr>
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STATISTICS AND OPTIMIZATION 2016-17

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
LOPEZ LORENZO, IGNACIO	nlopez@matematica.udl.cat	4,5	Monday 13:00 - 14:00 Office 1.20 EPS email notification required.
MIRET BIOSCA, JOSE MARIA	miret@matematica.udl.cat	9	
PUJOLAS BOIX, JORDI	jpujolas@matematica.udl.cat	4,5	Wednesday 13:00 - 14:00 Office 1.20 EPS email notification required.
SEBE FEIXAS, FRANCISCO	fsebe@matematica.udl.cat	4,5	

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

- Appropiately use matrix operations and solve systems of linear equations.
- Manipulate real equations and inequalities with real numbers.
- Know the binomic, cartesian and polar forms of a complex number.
- Compute the derivative of univariate functions and partial derivatives of a multivariate function.
- Determine and characterize function extreme points.
- Use of integration methods.
- Distinguish the type of data representing a data set.
- Compute representative values of a data set.
- Apply the linear regresion model to numerical data.
- Manipulate properly operations among happenings.
- Apply the total probability and Bayes theorems.
- Distinguish discrete and continuous random variables.
- Compute the mean and variance of a random variable.
- Compute probabilities from density and distribution functions.
- Be able to determine the convergence of numerical series.

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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: the absolute value.
        2. Representations of the complex numbers.
        3. Operations with complex numbers.
        4. n-th roots.
    2. Matrix theory, determinants and systems of linear equations.
        1. Matrix operations.
        2. Invertible matrices.
        3. Equivalent matrices and rank of a matrix.
        4. Determinants: definition, properties and effective computation.
        5. Systems of linear equations: matrix formulation.
        6. Rouché-Frobenius Theorem.
        7. Gauss method.
    3. Derivatives and optimization.
        1. Derivative function at a point.
        2. Geommetric interpretation.
        3. The derivative: properties.
        4. Derivative of elemental functions.
        5. Univariate optimization.
        6. Partial derivatives and Hessian matrix.
        7. Multivariate optimitzation.
    4. Numerical sequences and series.
        1. Sequences. Limit and convergence.
        2. Sequence manipulation. Indeterminates.
        3. Numerical series. Convergence.
        4. Geometric sequences.
2. **Part II: Statistics.**
    1. Data set description.
        1. Qualitative and quantitative data.
        2. Representative values.
        3. Graphical representation.

2. Probability.
    1. Set operations.
    2. Random events.
    3. Concept of probability.
    4. Conditional probability.
    5. Total probability and Bayes Theorems.
3. Univariate random variables.
    1. Discrete random variables: mean and variance.
    2. Uniform discrete distribution.
    3. Bernoulli and Binomial distributions.
    4. Poisson distribution.
    5. Geometric distribution.
    6. Basic theory of integral calculus.
    7. Continuous random variables.
    8. Mean and variance.
    9. Uniform distribution.
    10. Exponential distribution.
    11. Normal distribution.
4. Bidimensional description.
    1. Relation between two numerical variables.
    2. Linear correlation coefficient.
    3. Linear regression model.
    4. Spearman's rank correlation 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

Week	Description	Classroom activity	Autonomous work
1	Introduction to course. Part I: Real and complex numbers. Part II: Descriptive statistics.	Introducing lecture. Part I: 1. Real and complex numbers. Part II: 1. Data set description.	**Study bibliography and course plan.**
2	Part I: Real and complex numbers. Part II: Descriptive statistics.	Part I: 1. Real and complex numbers. Part II: 1. Data set description.	Problem sheets 1.1, 2.1.
3	Part I: Linear Algebra. Part II: Basic Probability.	Part I: 1.2. Matrix theory, determinants and systems of linear equations. Part II: 2.1. Probability.	Problem solving 1.1, 1.2, 2.1, 2.2.
4	Part I: Linear Algebra. Part II: Basic Probability.	Part I: 1.2. Matrix theory, determinants and systems of linear equations. Part II: 2.2. Probability.	Problem solving 1.2, 2.2.
5	Part I: Linear Algebra. Part II: Basic Probability.	Part I: 1.2. Matrix theory, determinants and systems of linear equations. Part II: 2.2. Probability.	Problem solving 1.2, 2.2.

6	Part I: Linear Algebra. Part II: Random variables.	Part I: 1.2. Matrix theory, determinants and systems of linear equations. Part II: 2.3.Univariate random variables.	Problem solving 1.2, 2.3.
7	Part I: DerivatiDerivació. Part II: Discrete Random variables.	Part I: 1.3. Derivatives and optimization. Part II: 2.3. Univariate random variables.	Problem solving 1.3, 2.3.
8	Part I: Derivació. Part II: Discrete Random variables.	Part I: 1.3. Derivatives and optimization. Part II: 2.3. Univariate random variables.	Problem solving 1.3, 2.3.
9		**1st Partial Exam**	Exam preparation.
10	Part I: Derivació en diverses variables. Part II: Continuous Random variables.	Part I: 1.3. Derivatives and optimization. Part II: 2.3. Univariate random variables.	Problem solving 1.3, 2.3.
11	Part I: Multivariate derivatives. Part II: Continuous Random variables.	Part I: 1.3. Derivatives and optimization. Part II: 2.3. Univariate random variables.	Problem solving 1.3, 2.3.
12	Part I: Multivariate derivatives. Part II: Introduction to R.	Part I: 1.3. Derivatives and optimization. Part II: Lab tutorial R.	Problem solving 1.3, solve R tutorial questions.
13	Part I: Series. Part II: Linear regression.	Part I: 1.4. Numerical sequences and series. Part II: 2.4. Bidimensional description.	Problem solving 1.4, 2.4.
14	Part I: Series. Part II: Linear regression.	Part I: 1.4. Numerical sequences and series. Part II: 2.4. Bidimensional description.	Problem solving 1.4, 2.4.
15	Review	Review 2nd partial exams.	
16		**2nd Partial Exam**	Exam preparation.
17		**2nd Partial Exam**	Exam preparation.
18			
19		**Second chance Exam**	Exam preparation.

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
PCL	Classroom participation	0.5 points	NO	NO	NO	NO
Final Mark = 0.1*C1 + 0.4*P1 + 0.1*C2 + 0.4*P2 + 0.05*PCL						

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 plus a maximum 0.5 points due to classroom participation.

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:

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•Demidovich, B.P. 5000 Problemas de análisis matemático. Madrid, Paraninfo, 1989.

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•Granero, F. Ejercicios y problemas de Cálculo, 2 vols. Ed. Tébar Flores, Madrid, 1991.

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•Casas, J., García, C., Rivera, L. y Zamora, A. Problemas de Estadística descriptiva, probabilidad y inferencia. Pirámide, 1998.

•Colomer, M.A. y Latorre, R. Curs d'estadística. Problemes. Edicions de la Universitat de Lleida, 1999.

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

•Spiegel M. R., Schiller, J. and Srinivasan R. A. Probabilidad y estadística. McGrawHill. 3ª edición. 2009.