Universitat de Lleida

DEGREE CURRICULUM

STATISTICS AND OPTIMIZATION

Coordination: SEBE FEIXAS, FRANCISCO

Academic year 2019-20

STATISTICS AND OPTIMIZATION 2019-20

Subject's general information

Subject name	STATISTICS AND OPTIMIZATION
Code	102006
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	

Degree	Course	Character	Modality
Double bachelor's degree: Degree in Computer Engineering and Degree in Business Administration and Management	1	COMMON	Attendance-based
Bachelor's Degree in Computer Engineering	1	COMMON	Attendance-based

Course number of credits (ECTS)	9
Type of activity, credits, and groups	

Activity type	PRAULA	TEORIA
Number of credits	4.5	4.5
Number of groups	3	2

Coordination	SEBE FEIXAS, FRANCISCO
Department	MATHEMATICS
Teaching load distribution between lectures and independent student work	225 total work hours 90 lecture attendance hours 135 autonomous work hours
Important information on data processing	Consult this link for more information.
Language	Preferably catalan or spanish depending on instructor, english if there are foreign students.
Distribution of credits	Nacho Lopez Lorenzo 4.5 Jordi Pujolàs Boix 9 Francisco Sebé Feixas 9
Office and hour of attention	Appointment by email.

STATISTICS AND OPTIMIZATION 2019-20

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
LOPEZ LORENZO, IGNACIO	nacho.lopez@udl.cat	4,5	
PUJOLAS BOIX, JORDI	jordi.pujolas@udl.cat	9	
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. Functions
        1. Elementary functions: definition and properties.
        2. Limits.
        3. Continuity.
    3. 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.
    4. Numerical sequences and series.
        1. Sequences. Limit and convergence.
        2. Sequence manipulation. Indeterminates.
        3. Numerical series. Convergence.
    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
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:

•Aguiló, F., Boadas, J. y otros. Temes Clau de Càlcul. Edicions de la UPC,Barcelona, 1991.

•Cardona, M.,Grau, M., Hernández, X., Miret, J., Moreno, R. i Pujolàs, J. Quadern de Càlcul (resums i problemes). Quaderns EPS-80.

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

•Garcia, F. y Gutiérrez, A. Cálculo infinitesimal-II. Tomos 1 y 2. Pirámide, 1985.

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

•Gimbert, J., Hernández, X., López, N., Miret, J., Moreno, R, i Valls, M. Curs Pràctic d'Àlgebra per a Informàtics, Col.lecció Eines. Edicions de la Universitat de Lleida, 2004.

•Tébar, E. Problemas de cálculo infinitesimal, 2 vols. Ed. Tébar Flores, Madrid, 1987.

Statistics:

•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.

Adaptations to the methodology due to COVID-19

We will use a flipped classroom methodology in which lecturers will progressively publish, in the virtual campus, documents with theoretical concepts and solved exercises. Students have to study the published materials and use the virtual campus forum tool to pose any question. Lecturers will check the forum and will answer the post questions. A set of exercises has also been made available to the students, who have to try to solve them. In case of difficulties with some exercise, students will be able to ask the lecturers for the publication of its solution.

Teleconference sessions will be scheduled weekly. They will be devoted to provide an overview on the published materials and respond directly to questions by students.

So as to carry out the practical sessions using the R software, the students will have to install that software in their computers. At the scheduled days, a guide for each session will be published through the activities tool in the virtual campus. The solutions will be uploaded by the students using that tool, before the established deadline.

Adaptations to the evaluation due to COVID-19

Written exams will be carried out remotely. Exam exercises will be published through the activities tool in the virtual campus. The solutions will be uploaded by the students using that tool, before the established deadline. After publishing the exercises, the lecturers will be available during some time through the teleconference tool so as to solve any question about the exam. After that, students will be able to ask any question via e-mail.

Since evaluating the participation is a hard issue in distance learning, the additional 0.5 points of this part will be obtained, optionally, by responding some questions about relevant mathematicians after accessing the information sources provided by the lecturers.