200616 - OC - Continuous Optimisation

Coordinating unit:	200 - FME - School of Mathematics and Statistics
Teaching unit:	715 - EIO - Department of Statistics and Operations Research
Academic year:	2015
Degree:	MASTER'S DEGREE IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2013). (Teaching unit Optional)
ECTS credits:	5 Teaching languages: Spanish

Teaching staff

Coordinator: JORDI CASTRO PÉREZ

Others:

JORDI CASTRO PÉREZ - A
FRANCISCO JAVIER HEREDIA CERVERA - A

Prior skills

A background equivalent to one/two degree-level semesters of algebra, analysis and optimization/operations research is advisable, though not mandatory, as the course intends to be self-contained.

Degree competences to which the subject contributes

Specific:
3. CE-2. Ability to master the proper terminology in a field that is necessary to apply statistical or operations research models and methods to solve real problems.
4. CE-3. Ability to formulate, analyze and validate models applicable to practical problems. Ability to select the method and / or statistical or operations research technique more appropriate to apply this model to the situation or problem.
5. CE-5. Ability to formulate and solve real problems of decision-making in different application areas being able to choose the statistical method and the optimization algorithm more suitable in every occasion.
Translate to english
6. CE-6. Ability to use appropriate software to perform the necessary calculations in solving a problem.

Transversal:
1. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
2. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

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Teaching methodology

The course is composed by both theory and laboratory sessions.
During the theoretical sessions the fundamental properties of the continuous optimization problems and its solution algorithms will be introduced, with special interest to all the issues related the numerical solution of practical optimization problems arising both in statistics as well as in operations research.
During the laboratory sessions the students will have the opportunity to learn how to find the numerical solution to the different kinds of continuous optimization problems studied in the theoretical sessions with the help of languages for mathematical optimization modeling (as AMPL or SAS/OR) as well as numerical/statistic software (as MATLAB or R).
Language: Prof. Castro will impart half of the course (topics 1 and 2) in either English, Catalan or Spanish. Prof. Heredia will give the other half of the course (topics 1 and 3) in Spanish.

Learning objectives of the subject

* To know the different types of continuous optimization problems and to understand its properties.
* To know the most relevant algorithms for continuous optimization and to understand its local and global convergence properties.
* To known some of the most relevant continuous optimization problems arising both in statistics and operations research and to be able to solve with the most efficient optimization algorithms.
* To be able to formulate and numerically solve real cases instances of continuous optimization problems from statistics and operations research with professional optimization software.

Study load

Total learning time: 125h			
	Hours large group:	30h	24.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	12.00%
	Guided activities:	0h	0.00%
	Self study:	80h	64.00%

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Content

Computational modelization solution of mathematical optimization problems.

Degree competences to which the content contributes:

Description:
Continuous optimization problems in statistics and operations research. Modeling languages for mathematical optimization problems. Solvers for continuous optimization problems.

Unconstrained optimization

Degree competences to which the content contributes:

Description:
Fundamentals of unconstrained optimization. Nelder-Mead procedure. Gradient method. Conjugate gradient method. Newton's and modified Newton's method. Quasi-Newton methods. Trust-region methods. Least-squares problems.

Constrained optimization

Degree competences to which the content contributes:

Description:
Fundamentals of constrained optimization. Linear programming. Quadratic programming. Nonlinearly constrained programming through sequential quadratic programming.

Qualification system

Two laboratory assignments (40% of the total grade) and a final exam covering the totality of the course contents (60% of the total grade). Additionally, there will be two partial exams by the middle/end of the semester. Each partial exam can add up to 0.5 points (over 10) to the final grade of those students having obtained a mark greater or equal to 4 (over 10) in their total grade (lab. assignments and final exam).

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Bibliography

Basic:

Nocedal, Jorge; Wright, Stephen J. Numerical optimization [on line]. 2nd ed. New York: Springer, 2006Available on: <http://dx.doi.org/10.1007/978-0-387-40065-5>. ISBN 0387987932.

Luenberger, David G. Linear and nonlinear programming [on line]. 3rd ed. Kluwer Academic Publishers, 2004Available on: <http://dx.doi.org/10.1007/978-0-387-74503-9>. ISBN 1402075936.

Fourer, Robert ; Gay, David M. ; Kernighan, Brian W. AMPL: a modeling language for mathematical programming. 2nd ed. Duxbury Press / Brooks/Cole Publishing Company, 2003. ISBN ISBN 0-534-38809-4.

Complementary:

Athanary, T.S. ; Dodge, Y. Mathematical programming in statistics. NY: John Wiley & Sons, 1993. ISBN 0-471-59212-9.

Bertsekas, Dimitri P. Nonlinear programming. 2nd ed. Belmont: Athena Scientific, 1999. ISBN 1886529000.

Gill, Philip E.; Murray, Walter; Wright, Margaret H. Practical optimization. London: Academic Press, 1991. ISBN 0122839501.

Boyd, Stephen ; Vandenberghe, Lieven. Convex optimization. Cambridge: Cambridge University Press, 2004. ISBN 978-0-521-83378-3.

SAS/OR® 9.3 User's guide : mathematical programming [on line]. Cary, NC: SAS Institute Inc, 2011 [Consultation: 17/07/2013]. Available on: <http://support.sas.com/documentation/cdl/en/ormpug/63975/PDF/default/ormpug.pdf>.