UNIVERSIDAD PONTIFICIA ICAI ICADE COMILLAS MADRID

COURSE SYLLABUS
COURSE 2017-18

TRAINING COMPLEMENT DESCRIPTION

TRAINING COMPLEMENT DATA INFORMATION	
Título	Optimization Techniques
Planificación temporal	Semester 1
Créditos ECTS	3
Lengua	English

Instructor	
Name	Andrés Ramos, Sonja Wogrin

CONTENTS
Chapter 1. Linear Optimization and Mixed Integer Linear Optimization
1. Graphical simplex method. Algebraic simplex. Tabular form. **2.** Primal-dual interior point method. **3.** Branch and bound. Duality. Preprocessing. Branch and cut.
Chapter 2. Modeling of Mixed Integer Linear Programming Problems
1. Piecewise linear. Convex and concave regions. Special ordered sets. Reformulation.
Chapter 3. Equilibrium Modeling and Nonlinear Programming
1. Definition of nonlinear programs and standard optimization techniques 2. Simple equilibrium models and solution techniques. Mixed complementarity problems. 3. Mathematical Problems with Equilibrium Constraints (MPECs) and Equilibrium Problems with Equilibrium Constraints (EPECs) and solution techniques. Diagonalization.
Chapter 4. Stochastic optimization
1. Generation expansion planning case study. Manufacturing case study. 2. Decision tree and scenario tree. 3. Two-stage and multistage linear optimization. Hydrothermal coordination problem case study
Chapter 5. Decomposition techniques
1. Fixed cost transportation problem. 2. Benders decomposition. Nested Benders decomposition. 3. Dantzig-Wolfe decomposition. Lagrangian relaxation. 4. Additional improvement in decomposition techniques. 5. Stochastic dual dynamic programming.
Chapter 6. Scenario tree
1. Characterization 2. Generation

COMPETENCES

General competences

1. To learn advanced scientific knowledge and to demonstrate, in a context of scientific and technological research highly specialized, a detailed understanding of theoretical and application aspects and the methodology of work in one or more study fields.
2. To know how to apply and integrate knowledge, the understanding of it, its scientific basis, and problem-solving capabilities in new and loosely defined environments, including multidisciplinary contexts, both for research and highly-specialized professions.

Specific competences

1. To understand the usual optimization techniques and their mathematical principles, and their potential to be used in different contexts.
2. To apply the different existing optimization techniques in the expression of problems and their solution.

Learning Outcomes

At the end of the course the student must have the following competences:

RA1. Understand where to use and concepts of optimization.
RA2. Become familiar within the several topics where optimization can be applied
RA3. Know how to build an optimization model efficiently
RA4. Achieve mathematical rigorousness
RA5. Understand the mathematical techniques used
RA6. State and solve mockup problems
RA7. Analyze the solutions
RA8. Be prepared to extend their knowledge
RA9. Become familiar with an algebraic language used professionally

TEACHING METHODOLOGY

General methodological aspects

The objective is improving the learning and incentivizing the autonomous and critical thinking of the students. For that purpose, the following teaching resources are used.
The teaching resources mentioned require the active participation of the student. It is indispensable that the class activity would be complemented with the personal work of the student and, coherently, it will be considered to assess the student performance.

In-class activities

Lectures (20h): presentation of the contents of the subject.

Public presentation of the assignments (10h)

Out-of-class activities

Personal work of the student (30h): study of the contents provided in the master lectures. It requires a deep and critical analysis about modeling aspects of the optimization problems allowing different perspectives and incentivizing creativity and critical thought of the student.

Assignments (30h): improve knowledge of the techniques presented.

ASSESSMENT AND GRADING CRITERIA		
Assessment activities	**Grading Criteria**	**Weight**
Case study	▪ Practical case statement ▪ Model development ▪ Theoretical contribution ▪ Solution analysis ▪ Written communication skill ▪ Teamwork (if done in a team)	80%
Communication skill	▪ Oral presentation of the case study	15%
Classroom participation	▪ Attendance and active participation in class	5%

BIBLIOGRAPHY

- Notes prepared by the lecturer (available in Moodle).
- Williams, H.P. (2013) *Model Building in Mathematical Programming*. 5th Edition. Wiley
- Griva, I., Nash, S.G. and Sofer, A. (2008) *Linear and Nonlinear Programming*. 2nd Edition. McGraw-Hill.
- Nemhauser, G.L., Wolsey, L.A. (1999) *Integer and Combinatorial Optimization*. John Wiley and Sons.
- Birge, J.R. and Louveaux, F. (2011) *Introduction to Stochastic Programming*. Springer-Verlag.
- Ramos, A., A. Alonso-Ayuso, G. Pérez (eds.) (2008) *Optimización bajo Incertidumbre* Universidad Pontificia Comillas