ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA

Operations Research

SEMESTER: Fall

CREDITS: 6 ECTS (4 hrs. per week)

LANGUAGE: English

DEGREES: GITI-GITT

Course overview

This course is an introduction to modeling by optimization and simulation. In this course we focus on how to formulate complex realities in mathematical format, and present the methodology to solve arising optimization problems numerically. The main focus is on linear optimization problems, but nonlinear programming is also briefly introduced and simulation techniques are taught in a practical way. Game theory, queueing theory and decision theory are introduced. Finally, project planning is explained in a numerical interpretation. The theoretical contents of this course are also applied in a practical manner due to programming and modeling exercises.

Prerequisites

Basic knowledge of Linear Algebra, Statistics and Calculus.

Course contents

1. Optimization and modeling. Linear and Mixed Integer Modeling. Classical modeling problems. Multicriteria Decision.
2. Linear, Mixed Integer and Nonlinear Programming. Simplex Method. Branch and Bound Method. Newton's Method.
3. Decision Theory and Game Theory. Decision Making Criteria. Decision Tree. Rectangular and Bi-personal Games. Nash Equilibrium.
4. Simulation. Discrete Event Simulation Modeling. Simulation Software. Random Number Generation. Output Analysis.
5. Queueing Theory. Poisson process. Classical Queueing Models. Close System Models.
6. Resource Planning and Optimization. PERT. Project Planning. Project Planning Software.

Main References

- F.S. Hillier, G.J. Lieberman Introduction to Operations Research, 9/e. McGraw-Hill Higher Education. 2014

- A. Ramos, P. Sánchez, J.M. Ferrer, S. Wogrin. Modelos Matemáticos de Optimización. 2013. (http://www.iit.comillas.edu/aramos/simio/apuntes/a_mmo1a.pdf) (http://www.iit.comillas.edu/aramos/simio/apuntes/a_mmo1b.pdf)
- A. Ramos, P. Sánchez, J.M. Ferrer, S. Wogrin. Modelos Matemáticos de Técnicas Específicas de Optimización. 2013. (http://www.iit.comillas.edu/aramos/simio/apuntes/a_mmo2.pdf)
- A. Ramos, P. Sánchez, J.M. Ferrer, J. Barquín, A. Campos, B. Vitoriano. Modelos Matemáticos de Simulación. 2009. (http://www.iit.comillas.edu/aramos/simio/apuntes/a_mms.pdf)
- A. Sarabia, La investigación operativa. Una herramienta para la adopción de decisiones. Universidad Pontificia Comillas. 1996
- Slides of theory (http://www.iit.comillas.edu/aramos/intro_simio.htm)
- Practical problems (http://www.iit.comillas.edu/swogrin/OM.htm)
- Past exam problems (http://www.iit.comillas.edu/swogrin/OM.htm)
- Coding examples (http://www.iit.comillas.edu/swogrin/OM.htm)

Grading

The following conditions must be accomplished to pass the course:

A minimum overall grade of at least 5 over 10. The overall grade is obtained as follows:

- Continuous evaluation (5%):
  - Attendance
  - Periodical assignments
  - Active participation in class
- Practical exercises/Case study (25%):
  - Optimization case study in a team, using GAMS, with written report (20%)
  - Individual simulation case study in class, using language ARENA (5%)
- Exams (70%): A minimum average exam grade of 4 is required to pass the course. This average is calculated as: 1/7 first intermediate + 1/7 second intermediate + 5/7 final (in ordinary case); and, as 7/7 of the grade of the final in the extraordinary case.
  - Intermediate evaluation tests (October + November)
  - Final exam (December)
  - Ordinary exam: 5% cont. eval.; 25% Practical exercise; 70% exams (50% final, 20% intermediate tests)
  - Extraordinary exam: 5% cont. eval.; 25% Practical exercise; 70% exams (70% final exam)