Course: Mathematical Methods

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Description

- This course is devoted to understanding, defining and solving decision support problems. These problems and methods are divided into four parts:
  - ✓ Optimization or mathematical programming problems
  - ✓ Simulation models
  - ✓ Decision models
  - ✓ Other specific techniques
- The purpose of the course is twofold:
  - ✓ To understand how to model a certain decision problem and to know the appropriate technique to obtain the optimal solution
  - ✓ To be able to develop optimization and simulation models using professional languages

Objectives

- After the course the student should be able to:
  - ✓ Recognize situations where to apply these mathematical methods
  - ✓ State a decision support model
  - ✓ Understand the mathematical technique used to solve it
  - ✓ Write and solve several mockup problems
  - ✓ Analyze and interpret the solution
  - ✓ Write a report and present orally the whole decision support model

Assessment system

- Grading consists of three parts:
  - ✓ Continuous assessment (5 %)
  - ✓ Practical cases (25 %)
  - ✓ Exams (70 %)
  - ✓ Exam grade must be above 3.5 to consider grades corresponding to practical cases and continuous assessment.
- Continuous assessment takes into account the active participation in class, several assignments of modeling problems, class attendance, problem solution in class
- Two practical cases
  - ✓ One of optimization coded in GAMS (15 %) presented in class and
  - ✓ The other of simulation coded in GPSS World (10 %)
- If grade in June is below 5 a resit exam can be taken in September that will determine the final grade

Exam assessment

- Exam grading
  - ✓ **First term grade**: 2/7 mid term (November) exam + 5/7 term (February) exam
  - ✓ If first term grade >= 3.5, **second term grade**: 2/7 mid term (April) exam + 5/7 term (June) exam
  - ✓ **Exam grade** is the minimum of both first and second term grades if any of them is < 3.5 or is the average if both are >= 3.5
  - ✓ If first term grade < 3.5, then final exam is mandatory. **Exam grade** is 1/7 mid term (April) exam + 6/7 final (June) exam.
- Any material can be consulted during the exam
- Exams from previous years have been included into the draft books

Teaching methodology

- Lectures are a mix of theory and problems that will be presented by using slides and blackboard
- The forecasted daily activities can be found at http://www.iit.upcomillas.es/~aramos/MME.htm
- Almost all the material has been compiled and it is continuously updated in several draft books that can be found at http://www.doi.icai.upcomillas.es/intro_simio.htm

  and the slides to be used in the class can also be found in the same web page
- The optimization practical case will be coded in the algebraic modeling language called GAMS that has been installed in any university PC and can be downloaded from www.gams.com
- The simulation practical case will be coded in the language called GPSS World that has also been installed in any university PC and can be downloaded from http://www.minutemansoftware.com/

Bibliography

- Hillier, F.S., Lieberman, G.J. *Introduction to Operations Research and Revised CD-ROM 8*. 8th Edition. McGraw-Hill, 2005
- Sarabia, A. *La investigación operativa. Una herramienta para la adopción de decisiones*. Universidad Pontificia Comillas, 1996

Contents (107 h)

	Duration [h]
Introduction	1
Optimization Modeling	16
Linear Programming (LP)	9
Review of Midterm Exam	1
Duality and Sensitivity	7
Mixed Integer Linear Programming (MIP)	3
Dynamic Programming (DP)	5
GAMS Cases Presentation	5
Non Linear Programming (NLP)	8
Review of Term exam	2
Decision Theory	5
Game Theory	5
Queuing Theory	6
Simulation	8
Review of Midterm exam	1
Continuous and Discrete Random Variables	6
Inventory Management	7
Network Optimization	6
Project Evaluation and Review Technique (PERT)	6
Final exam	