# Ficha de la asignatura

**Curso académico 2006-2007**

*Datos válidos a fecha:* 2/11/2006

**Asignatura: Applied optimization: modeling and case study**

**Departamento:** Departamento de Organización Industrial

**Titulación/es:** Libre elección

**Tipo:** Libre Configuración **Curso:** Sin Curso **Periodo Académico:** Primer Semestre

**Nivel:** GRADO **Idioma:** Inglés **Créditos BOE:** 3

**Responsable:** Andrés Ramos

**Objetivos:** The main objective is to learn some existing techniques in optimization problem formulation. In particular, as a result the students:

- Will become familiar with the diverse fields where optimization models can appear
- Will learn how to model small problems
- Will achieve a rigorous mathematical formulation
- Will formulate and solve problems
- Will become familiar with the GAMS modeling language
- Will analyze and understand the obtained solutions

**Descriptores BOE:** Optimization, modeling, decissions; management, planning, GAMS.

**Descripción Breve:** Many companies use optimization technology into their day to day operations. Building models, using optimization software and applying general operations research methodology in various contexts is becoming an important skill. This course covers the part of operations research called optimization. It is designed to teach students about “optimization in practice”. Its purpose is to learn the use of optimization techniques that deal with typical decision problems encountered in any company by developing models and analyzing their solution. It is focused on modeling and use of state of the art software. Students will learn how to design good models for realistic applications in engineering and sciences. For that purpose students are required to develop a project. It implies using optimization in solving a real problem, ideally one involving your work or your interest. It is expected that through a complete understanding of the topics the student can broaden his/her scope as needed in the future.
In this course slides will be used for the presentation of concepts. All the material has been compiled in lecture notes (http://www.doi.icai.upcomillas.es/simio/transpa/s_gams_ar.pdf) and will be given to students. The aim of the course is also to familiarize students with some specific optimization language such as GAMS, which will be installed in the university computer network and can be used by students at any time.
At the beginning of the course, the theoretical content will be covered in several classes. This will include optimization problems and modeling languages. Then, the GAMS language will be presented in detail with practical exercises. Finally, the third part consists of modeling cases of applied optimization. The detailed daily structure of the course sessions can be found at http://www.iit.upcomillas.es/~aramos/AO.htm.

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**Tipo Evaluación:** In February the evaluation will be based on the following:

- Attendance and active participation in class will be worth 10 %.
- Casework and oral presentations will be worth another 25 %. Students will grade the presentations made by their colleagues.
- A practical and original project will be chosen, developed, written and orally presented by each team and will be worth 40 %. Students will grade the presentations made by their colleagues.
- A final modeling exam will account for 25 % of the final mark.

In case of a mark below 5 over 10 in the February evaluation, the student will have another opportunity to sit the exam in September. This exam can be with or without a computer. The September exam will count for 100 % of the course grade.

**Método Docente :** Course methodology combines some lecture classes with a great amount of practical class work. Students will be grouped in teams (usually pairs) to formulate and solve the different case studies covered in the course. This organization is intended to promote group work, collaboration and the active participation of all the students. The students have to develop an optimization problem as the team project. Each project will require:

- Write a one page outline of the project and get it approved. You can ask for my advice.
- Write a report that defines the case study, the mathematical formulation, the GAMS code, the solution and its detailed analysis. Describe, modify, and implement improvements to the original format if necessary. The report should make clear what you have done, and detail your contribution. If you ran into significant problems with certain aspects of the project, you should detail what changes were made, and why they were necessary/time consuming.
- Oral presentation of the project.
- Last year examples of projects:
  - Spring break: optimize the actions taken to raise money for the trip.
  - Critical path method: minimize the time scope of a project.
  - Optimize free time: minimize the effort needed to pass the subject exams.
  - Mechanical assistance vehicle: optimize traction distribution alternatives in Dakar rally.
  - Job-shop scheduling: task scheduling to minimize makespan.
  - Wind mill and pumping hydro scheduling: combined wind power and water pumping operation to maximize production.

## Bibliografía Básica


McCarl, B.A. and Spreen, Th.H.. Applied Mathematical Programming using Algebraic Systems. http://agecon2.tamu.edu/people/faculty/mccarl-bruce/books.htm,

Fourer, R., Gay, D. M. and Kernighan, B.W.. AMPL A Modeling Language for Mathematical Programming. 2nd edition. Thomson Books/Cole, 2003

Brooke, A., Kendrick, D., Meeraus, A. and Raman, R.. GAMS A User´s Guide. GAMS Development Co., 2005

McCarl, B.A.. McCarl GAMS User Guide Version 22.2. , 2006


## Bibliografía Complementaria


. OR/MS Today. http://www.lionhrtpub.com/ORMS.shtml,

. Interfaces. http://interfaces.pubs.informs.org/index.htm,

Schrage, L.. Optimization Modeling with LINDO. Thomson Books/Cole, 1997

Williams, H.P.. Model Building in Mathematical Programming. 4th Edition. John Wiley and Sons, 1999

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# Programa de la Asignatura

| **Asignatura: Applied optimization: modeling and case study** | Titulación: IIND 4º-5º, IOI-IAEI 2º, IINF 3º-5º, ITIG/S 3º |
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1. Introduction to optimization (4 h)
   Presentation of the course. Optimization definition. Algebraic modeling languages. Transportation problem.
   Mathematical formulation and coding in GAMS. Execution and analysis of the results.

2. GAMS Language (4 h)
   Integrated development environment (IDE). General structure of a GAMS model. Variables. Equations. Model and solve. Sets and parameters. Alias. $ operator. Relational operator. Dynamic sets. Index shifting. Lag and lead. Data input/output. Big tables.

3. Practical modeling cases (16 h)
   Practical cases will be studied regarding decisions made in different industries. The case studies are aimed at consolidating the modeling of optimization problems that can appear in the day to day operations of any company. They have to be completed and emailed by the end of the week.
   Students will give a very short oral presentation of the case worked in the previous session (5 slides for a 5 minute presentation).
   You may discuss the cases with your classmates. However, you may not share any code, copy solution from another person, or carry out an assignment together. Discussion should only involve verbal communication.

4. Team project oral presentation (4 h)

5. Final exam (2 h)
   The exam will be just like another practical case.