Advanced Optimization and Decision Analytics

Academic Year: (2023 / 2024) **Review date: 25-04-2023**

Department assigned to the subject: Statistics Department

Coordinating teacher: RUIZ MORA, CARLOS

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

OBJECTIVES

The goal of this course is to become familiar with the main optimization modeling techniques and the solution algorithms that are being applied in Data Science. In this way, we provide the necessary tools and modern techniques of optimization for the efficient solution of many Data Science problems arising in diverse areas like Business, Health, Marketing, Finance and Engineering.

In particular, the objectives are:

1. Modeling and application of optimization methods for a series of general problems (linear models, discrete models, nonlinear models and also optimization under uncertainty)

2. Learn about the basic (mathematical) foundations that support the development of solution algorithms for the optimization problems mentioned above.

3. Study the main solution algorithms that are being applied to address problems in Data Science.

4. Use Python to apply tools of modern optimization techniques in an efficient way.

DESCRIPTION OF CONTENTS: PROGRAMME

Contents:

1. Advanced Optimization Modeling
1.1. Algebraic modeling languages
1.2. Introduction to Pyomo
1.3. Examples
1.4. Automatic differentiation

2. Nonlinear Optimization
2.1. Introduction
2.2. Examples
2.3. Unconstrained Optimization
2.4. Constrained Optimization
2.5. Solution Algorithms

3. Optimization and Machine Learning
3.1. Introduction
3.2. Examples
3.3. Solution Algorithms

4. Optimization under uncertainty
4.1. Introduction
4.2. Simulation
4.3. Stochastic Programming
4.4. Examples

LEARNING ACTIVITIES AND METHODOLOGY

½ lectures with supporting materials available on the Web
½ practical sessions (computer labs with Python)

ASSESSMENT SYSTEM

90% continuous evaluation along the course + 10% attendance/participation in class

The Extraordinary call is based on an individual assignment that covers the topics treated in the course.

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

BASIC BIBLIOGRAPHY

- Bertsimas, Dimitris, and John Tsitsiklis Introduction to Linear Optimization, Belmont, MA: Athena Scientific, 1997
- D Bertsimas, R Weismantel Optimization over integers, Belmont: Dynamic Ideas, 2005
- Jorge Nocedal Stephen J. Wright Numerical Optimization, Springer, 2006
- Sra, S., Nowozin, S., and Wright, S. J Optimization for machine learning, Mit Press, 2012
- Stephen Boyd and Lieven Vandenberghe Convex Optimization, Cambridge University Press, 2004