

Optimization for Social Good

2021-2022 Academic Year
Master of Research in Economics, Finance and Management

1. Description of the subject

- Optimization for Social Good
- Code: 32700
- Total credits: 3 ECTS
- Workload: 75 hours
- Term: 2
- Type of subject: Optative
- Department of Economics and Business
- Teaching team: Helena Ramalhinho and Jesica de Armas

2. Teaching guide

- **Introduction**

Analytics focuses on transforming data into insights by applying advanced analytical method, based on mathematics, statistics and artificial intelligent models and algorithms, to improve the performance of an organization. One of the main tools in Analytics is Optimization. In the first part of the course, the optimization tools and methodologies will be introduced. On the second part, cases studies from Humanitarian, Social, Health Care and Environmental organizations (as NGO humanitarian organization, social care organization, public services, hospital or primary health institutions) will be presented and discussed. Examples of applications of Optimization in this organizations are home health care logistics and scheduling; planning disaster response and preparedness to improved decision; location of the primary health care centers, or schools; planning the humanitarian aid distribution; planning a sustainable transportation; etc.

In this course, it will be present and discussed key topics and issues in Optimization with focus on the applications in social, health, sustainable and humanitarian organizations.

The objectives of the course are the following:

- Learn the foundational concepts and methods on Optimization.
- Learn how to develop and apply analytic tools, approaches and techniques used in decision making in Humanitarian, Social, Health Care and Environmental organizations;
- Provide strategic and operational management examples and case studies of these organizations.
- To expose students to issues in humanitarian and non-profit logistics through a series of guest speakers and case studies.

The course can be taken by MSc students. The students must have basic background on Algebra, Statistics and Probability concepts.

- **Teaching methodology**

The methodology of this course will be based on lecture classes, reading scientific articles, as well as set of highly interactive and participative activities. The students are expected to do individual activities as reading, exercises, projects and deliver reports on some activities.

- **Contents**

Topics in Optimization

In this part of the course, we will introduce the Optimization methodology and the basic concepts in Combinatorial Optimization, Metaheuristics and Multiobjective optimization.

The topic focus presenting the main concepts of Linear Programming, Integer Linear Programming, and Combinatorial Optimization models, with application to Location, Routing and Scheduling problems. Afterwards, the solution methods and algorithms,

based on Metaheuristics, are introduced to solve large-scale complex optimization problems. These concepts are important to understand the applications of optimization to social good applications.

Multiobjective optimization is an area of multiple criteria decision making that is concerned with mathematical optimization problems involving more than one objective function to be optimized simultaneously. Multiobjective optimization has been applied in many fields of science, including engineering, economics and logistics where optimal decisions need to be taken in the presence of trade-offs between two or more conflicting objectives. In real and practical problems, it is quite common to appear several objective functions.

Topics in Optimization to Social Good

In the second part of this course, mathematical models and algorithm with application in Humanitarian, Social, Health Care and Environmental organizations will be presented and discussed. Several scientific articles will be discussed.

Location Problems

Present and discuss Location and Supply Chain design problems. Introduction to Location Models and Algorithm. Examples of applications in several organizations.

Transportation and Vehicle Routing Problems

Discuss Transportation planning in Humanitarian, Social and Health Care organizations, as for example vehicle routing planning as for Home Health or Social planning, blood sample collections or vaccines distribution.

Sustainable and humanitarian logistics

Discuss real examples of applications in Return Management, Green Logistics and Humanitarian Logistics, as well as solutions developed to help the Covid-19 pandemic.

- **Assessment and Grading System**

Weekly homework sets: Exercises questions are handed out to be solved in order to master the necessary techniques. These questions include mathematical modelling, and applying and developing algorithms to obtain solutions for the different problems.

Final project: Select an original research topic related with the course and prepare a research proposal on your topic, including a literature review. Notice that it is only required a research proposal, not a full research article. Recommendations on how to write research proposals will be given during the classes. (maximum 7 pages)

The final grade is based on performance of the final project (50%) and overall performance on the homework sets (50%).