CIVIL-557

Decision-aid methodologies in transportation

Paschalidis Evangelos, Torres Fabian

Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.
Civil engineering minor	E	Opt.
Territories in transformation and climate minor	E	Opt.
Urban Planning and Territorial Development minor	E	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Remark

The course is given by various lecturers

Summary

The course has two modules, the first Operations Research (OR), and the second is statistical modeling of transportation systems. Students will be modeling applied problems and developing solution methods and modelling of driver behavior for decision support in transportation.

Content

The course is divided into two modules: (1) operations research and (2) data analysis and behavioural modelling. Each module will present one or more case studies for decision support in transportation systems based on real data. Each module will be structured as follows:
1. Presentation of the problem, outline of the process, and analysis of the major challenges.
2. Formulation of the optimization/data analysis and modelling problem.
3. Introduction to optimization/data analysis and modelling methods.
4. Implementation of the methods using software tools.
5. Solution of a concrete problem by the lecturer, using real data.
6. Solution of similar problems by the students, using also real data.

During the course, emphasis will be put on enhancing students' abilities to model and implement decision support methods in transportation systems. During the course, the students will use the optimization software tool,(e.g., CPLEX or Gurobi) to solve complex optimization problems and the computer language Python for data analysis and modelling. Basic programming skills are required for the successful participation in the course.

Keywords

Operations research, transportation, vehicle routing, statistical modeling, supply chain management.

Learning Prerequisites

Required courses

Indtoduction to optimization and operations research (MATH-265), Recherche opérationnelle

Recommended courses

Introduction to python.

Important concepts to start the course

Basic understanding of the simplex algorithm. Basic statistics, python programming.

Learning Outcomes

By the end of the course, the student must be able to:

- Model decision processes in transportation systems as optimization problems
- Implement and sold optimization problems using state-of-the-art solvers.
- Detect know and understand various optimization approaches.
- Implement and sold optimization/data mining/machine learning problems using state-of-the-art tools and algorithms.
- Detect , know and understand various optimization/data mining/machine learning approaches.
- Model decision processes in transportation systems as optimization problems.
- Implement and solve optimization problems using state-of-the-art solvers, i.e., CPLEX.
- Choose an appropriate optimization approach.
- Analyze and model big data using state-of-the-art mathematical methods.
- Choose an appropriate data analysis and modelling approach.
- Detect , know and understand various optimization approaches.
- Implement and solve optimization problems using state-of-the-art solvers, i.e., CPLEX.
- Analyze data using state-of-the-art mathematical methods.

Transversal skills

- Manage priorities.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.

Teaching methods

- In-class coding exercises in python.
- Ex cathedra
- Projects
- Problem sets

Expected student activities

- Attend lectures.
- Participate in class exercises.
- Home study
- Work on project

Assessment methods

Final written exam after each module (50% of total grade) with open and multiple choice questions - Final project for each module (50% of total grade).

Supervision

Office hours	Yes
Assistants	No
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

Bierlaire, M. (2015). Optimization: principles and algorithms. EPFL Press.
Toth, Paolo, and Daniele Vigo, eds. The vehicle routing problem. Society for Industrial and Applied Mathematics, 2002,
Gendreau, Michel, and Jean-Yves Potvin, eds. Handbook of metaheuristics. Vol. 2. New York: Springer, 2010.

Ressources en bibliothèque

- The vehicle routing problem / Toth, Vigo
- Handbook of metaheuristics / Gendreau, Potvin
- Optimization: principles and algorithms / Bierlaire

Moodle Link

- https://go.epfl.ch/CIVIL-557