

CIVIL-557

Decision-aid methodologies in transportation

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Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.
Digital Humanities	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
Hours	4 weekly
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Remark

The course is given by various lecturers

Summary

The course proposes an introduction to operations research, and mathematical modelling for decision support in transportation systems.

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, behavioural modelling, transportation.

Learning Prerequisites**Required courses**

Introduction to optimization and operations research (CIVIL-265), Recherche opérationnelle,

Recommended courses

Introduction to python.

Important concepts to start the course

The Simplex Algorithm, Integer programming. Knowledge of python. Statistics and regression modelling. Some knowledge of commercial solvers like CPLEX and Gurobi.

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 solve optimization problems using state-of-the-art solvers.
- Know and understand various optimization approaches.
- Model decision processes in transportation systems as optimization problems and solve optimization problems using state-of-the-art solvers, i.e., CPLEX.
- Choose an appropriate optimization approach.
- Analyze data using state-of-the-art mathematical methods.
- Choose an appropriate data analysis and modelling approach.

Teaching methods

The optimization, data analysis and modelling approaches will be presented and applied to real world case studies during lectures. The students will apply the methods learnt in class during the laboratory sessions and work in groups on a project with real data.

Assessment methods

- At the end of each module, each group will submit a project report.
- At the end of the course, each group will present the project during an oral exam. The assessment will be based on the quality of the report, the quality of the presentation and the answers to the questions. The oral exam will account for 80% of the final grade.
- At the end of the course, each student will complete a written exam. The written exam will include multiple choice and short answer questions, and it will account for 20% of the final grade.

Resources

Ressources en bibliothèque

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Moodle Link

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