Optimization and Simulation

Optimization project

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Goals

Full application of a **simulation-based optimization** example:

- Simulation
    - develop a discrete-event simulation
    - identify the appropriate statistical indexes
    - correctly use simulation for generating results
    - correctly analyze the result of simulation
    - use variance reduction techniques
    - use bootstrapping technique

- **Optimization**
    - **identify the decision variables**
    - **identify the objectives**
    - **develop the optimization algorithm to explore the space**
    - **identify the "optimal" solutions (multi-objectives)**

Overview

Aim: identify the "optimal" system configuration

Example

simulation-based project: traffic simulation

Simulation project example

Traffic simulation of Kid City

Discrete event simulation to represent the traffic in Kid City

What is the best street to close?

Decision variables:

- Close roads

Objectives:

- traffic conditions (queue-length)
- cost

Keep in mind

The Optimization Problem

Objective: identify the best location for the road closure.

Objective function example:

minimize average-queue-length in the city

minimize cost of closing the road

$$\min_{x \epsilon X} Z(x)$$

$$Z = \theta\{f(x)\}$$

where
- *x* is the network with road *i* closed
- *f(x)* is the desired indicator at solution *x*, e.g. average-queue-length with road *i* closed, and cost of closing road *i*
- θ is the statistic considered, e.g. maximum, 95-percentile, average

Keep in mind

Recommendations

"Optimization Project":

- expand the discrete-event simulation

- embed the discrete-event simulation in the optimization algorithm

Attention: computational time

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Group project

Assigned projects

Group	Project	Title
Group 1	Project 1	Train service
Group 2	Project 2	Restaurant design
Group 3	Project 3	Drone delivery service
Group 4	Project 4	Jeans store management
Group 5	Project 5	Online movie streaming
Group 6	Project 6	Airline yield management

All information already present in the project description

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Assigned projects

Group 1:

Group 2:

Group 3:

Assigned projects

Group 4:

Group 5:

Group 6:

Project and exercise deliverables

Project presentation

Deliverables

- Please submit by email to melvin.wong@epfl.ch:
  - Jupyter Notebook from the TSP (lab 6) exercise
  - Project presentation in the PDF format
  - Jupyter Notebook developed for the project

- Please group all deliverables into a single archive (e.g. OptSim2019_GroupX.zip)

- **Deadline: 25.05.2020 at noon**

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Project presentation

Presentation

35 minutes per group. 25 min presentation + 10 min questions (both simulation and optimization parts)

Required contents for the optimization part

- Problem description

- Decision variables, objective function

- Optimization algorithm

- Results

- Suggested "optimal" configuration

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Project presentation

Schedule, 26.05.2020, Room GC B1 10

- May 26, 2020, at GC B1 10.

- Make sure that the 1st presentation will start 13:15 on time.

- 25 minutes presentation and 10 minutes Q&A.

- You should include both simulation and optimization parts.

Group	Time	Review
Group 1	13:15–13:50	Group 6
Group 2	13:50–14:25	Group 1
Group 3	14:25–15:00	Group 2
15 minutes break		
Group 4	15:15–15:50	Group 3
Group 5	15:50–16:25	Group 4
Group 6	16:25–17:00	Group 5

- Review example: Group 6 asks questions to Group 1

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