Optimization and Simulation

Optimization project

Nikola Obrenović

Transport and Mobility Laboratory TRANSP-OR

École Polytechnique Fédérale de Lausanne EPFL

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*
- $\theta\{.\}$ 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

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

Assigned projects

Group	Name
Group 1	Segrelles Munárriz Lara Gimena
	Ecker András
	Gehrke Alexander
Group 2	Genc Murat
	Park Jangwon
	Beojone Caio Vitor
	Montesinos Ferrer Martí
Group 3	De La Rochefoucauld Louis Marie Franois Bernard
	Ataç Selin
	Mallya Nithin

Assigned projects

Group	Name
Group 4	Lüthi Adrien Bernard André
	Cattry Alexandre Dominique M.
	Mariani Olivia
Group 5	Amorim Leandro De Castro Amoedo Rafael
	Granacher Julia
	Li Xiang
Group 6	Bolón Brun Natalie
	de Guyon-Crozier Guillaume
	Wasilewski Stephen William

Project and exercise deliverables

Deliverables

- Please submit by email to *nikola.obrenovic@epfl.ch* :
  - Source code from the TSP exercise
  - Project presentation in the PDF format
  - Source code developed for the project

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

- **Deadline: 28.05.2018 at noon**

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

Project presentation

Schedule, 28.05.2018, Room GR C0 01

- May 28, 2019, at GR C0 01.
- 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