Optimization and Simulation

Simulation project

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Goals

Full application of a simulation example:

- 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

Keep in mind, during the “Optimization project”:

- use of simulation for complex optimization problems

Overview

Aim: chose between two alternatives evaluating the performance of the system

Example

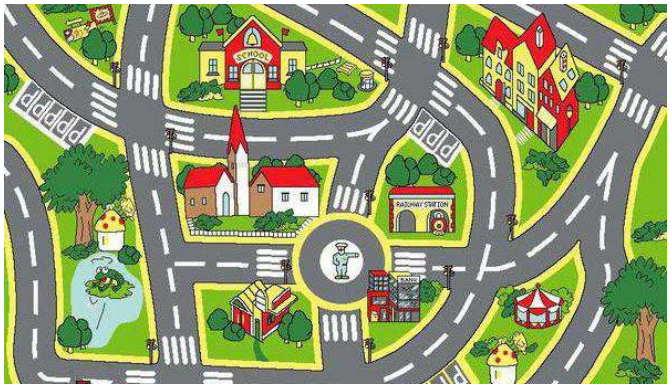
Simulation project: traffic simulation

Simulation project example

Traffic simulation of Kid City

Develop a discrete event simulation to represent the traffic in Kid City

Infrastructure



Vehicle generation

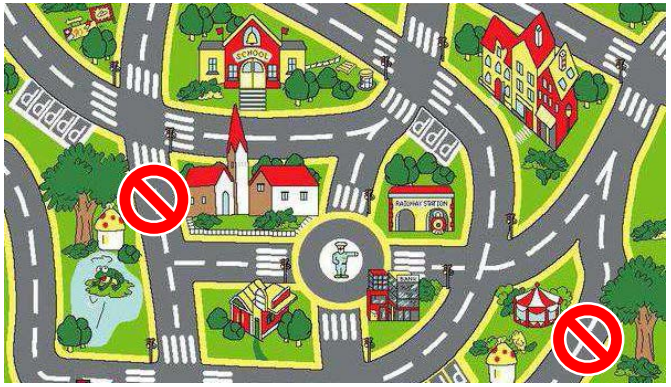
Intersection policy (traffic light)

Vehicle destination

Simulation project example

Road closure

- Mayor M. needs to choose between two alternatives
- Mayor M. concern: traffic conditions (queue-length)
  - Average, extreme cases, variability
- Mayor M. choice: close the road in the location with the smaller impact on traffic conditions (queue-length)



Project focus

The focus of this project is to use simulation correctly to evaluate two alternatives and to present proper statistical indexes to evaluate the scenarios.

BE CREATIVE

(extreme cases, worst case, probability of events, …)

Not only average.

Give MSE of your estimates

Keep in mind

Optimization project

Keep in mind

The Optimization Problem

Objective: identify the best location for the road closure.

Objective function example:

maximum average-queue-length in the city

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

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

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
- $\theta\{.\}$ is the statistic considered, e.g. maximum, 95-percentile, average

Keep in mind

Recommendations

During the “Optimization Project”:

- the discrete-event simulation is expanded
- the optimal solution is identified by an optimization algorithm

Develop the discrete event simulation with a modular structure

The components should be easy to modify (vehicle generation, road closed, traffic light policy)

Short computational time

Individual group project

Individual group project

Group	Project	Question
Group 1	Jeans store management	Riccardo, Marija
Group 2	Ambulance service	Riccardo, Marija
Group 3	Ambulance service	Riccardo, Marija
Group 4	Airline yield management	Yousef, Iliya
Group 5	Call center staffing	Yousef, Iliya
Group 6	Airline yield management	Yousef, Iliya
Group 7	Restaurant design	Riccardo, Marija

Project presentation

Presentation

25 minutes per group. 20 min presentation + 5 min questions

Contents

- Problem description
- Simulation approach used
- Suggested indexes (from qualitative to quantitative)
- Results
- Suggested best alternative

Code

Send me the code of this and previous laboratories, and the presentation by email (same day of the presentation)

Schedule, April 05

Group	Time	Reviewed by
1	9:15-9:40	Group 5
2	9:40-10:05	Group 3
	10 minutes break	
3	10:15-10:40	Group 2
4	10:40-11:05	Group 6
	10 minutes break	
5	11:15:12:40	Group 7
6	12:40-12:05	Group 4
	10 minutes break	
7	12:15-12:40	Group 1

Example: Group 5 asks questions to Group 1