10th AIMMS-MOPTA Optimization Modeling Competition
A Vehicle Routing Problem with Stochastic and Correlated Travel Times

In this competition, we are interested in a model of delivering some perishable goods (such as icecream) from a warehouse to retailers. We will assume that the travel times are stochastic and governed by some "hidden" process. We will provide some information regarding those features which influence the travel times, however, the "exact" formula is not provided: therefore you should try to model and estimate it.

Your task is to design a routing assignment for the actual input set of external conditions called here "features". For example, in the morning, you observe the "features" (outside temperature, precipitation, . . .) and then you design the routes and assignments deemed appropriate. In the evening, you observe and record the cost of your assignments for this specific day.

Problem Description

We consider a warehouse, designated as Node 0, and the set $J = \{1, 2, \ldots, n\}$ represents retailers. Each retailer $j \in J$ has a demand d_j for a given day.

We assume that we have up to V vehicles that can be used to distribute the goods. The fixed transportation cost is M_F if a vehicle is used, the cost per mile is m_v, and the cost per hour when the vehicle is used is m_t.

We assume that all the vehicles which should be used on any given day will leave the warehouse at 5am. For each item which arrives to a retailer j after 8am there is a penalty c_m.

We denote by $L_{i,j}$ the route length between node i and j, the stochastic travel-time between nodes i and j is denoted by $T_{i,j}$.

We further assume that the maximal capacity of each vehicle is C.

Objective

We want to minimize the total cost based on the distribution costs plus the possible penalty for late delivery.

Data

All data are stored in files that your team has to download.

One of these files is called **test.txt**. This file only contains "features" as discussed above. Your task is to provide for each input a route assignment. See **sample_submission.txt** file to see a sample submission file (with a very bad solution).

Note, that we do not provide the times $T_{i,j}$, instead, we provide a set of recorded ("historical") values of the delivery times.

Stochastic Demands (optional)

In this extended problem, we will assume that the demand is stochastic, and that it depends on the same "features" as the travel-times. The file **historical_demands.txt** contains information about past demands. In the model, we assume that at the morning, you observe the features, decide how much to deliver to each retailer and build the routes. At the evening, the cost will have two parts: transportation cost (defined as before) and the opportunity cost for incorrectly estimated demand. For each unit in excess of the actual demand at each retailer, you incur a cost of c_h, and for each unit by which you underestimated the actual demand, you incur a cost of c_p.

As in the simpler model version stated above, the objective is to minimize the total cost.

For details, see the files **test_stochastic_demand.txt** and **sample_submission_stochastic_demand.txt**.

Deliverables

Your team has to deliver a complete solution to the problem described above. More specifically, we expect the submission of the following deliverables:

- An implementation of the model in AIMMS

- A user interface that provides graphical and textual output

- A solution of the model for the given test data sets

- A max. 15-page report that describes the mathematical background of the model, the solution techniques used, the results obtained and your team's final recommendations.

You are allowed to use topical literature selected by your team. Please cite properly all information sources used, and carefully distinguish your ideas from ideas found in the literature.

The deadline for submission is June 30, 2018 23:59 EDT. If you have questions about the problem or the competition in general, then please contact Professor Martin Takac "takac(at)lehigh.edu". The subject line of your email should start with "MOPTA Competition 2018". All questions related to the AIMMS software should be directed to "support(at)aimms.com".

Software

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