DO Problem Statement

September 2021

1 Problem description

The problem is to optimize tourist routes inside the museum's territory to maximize joy of tourists within given time limits. Problem's traits:

1. Time limit : for each tourist n there is maximum time value $T^n_{\max}$ which he can spend inside the museum.
2. Subject matters : there are $S = 10$ subject matters which exhibits of museums are split into. For each exhibit E_i there is according topic S_i.
3. Preferences and profits : each tourist rates subject matters by his preferences from $l = 1$ to $h = 4$. Joy of the tourist from visiting the exhibit is random, but highly depends on the rate of exhibit's subject matter by the tourist.
4. Visit time of exhibit is much higher than time of travelling between exhibits.
5. Duration time for exhibit : time of exhibit visit is random. Depends on subject matter and number of other tourists at this time at the exhibit.
6. Preference stagnation (debatable) : if several exhibits of the same subject matter are visited in row, the joy of each next exhibit will be reduced.

Let N be the number of tourists, E be the set of exhibits.

2 Simple model

Suggestions :

1. Impact of the other tourists is neglected, route for a tourist is built independently.
2. Preference stagnation is neglected.

3. Joy distribution of the exhibit is its preference with $p_{max} = 0.85$ and with $p_{rest} = 0.15$ is uniformly random equal one of the rest.

   Let object i have the preference 3. Then profit P_i is 3 with probability p_{max} and is $1, 2$ or 4 with probabilities $p_{rest}/3$ accordingly.

4. Visit time distribution is gaussian with constant μ_i, σ_i^2

Let x_{ij} be the indicator value, which is 1 if there is edge between i and j, and 0 else, t_{ij} time travelling between i and j exhibits, P_i collected profit on i-th object, T_i time spent on i-th object, α is confidence level.

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\begin{aligned}
\max \quad & \mathbb{E} \sum_{i=2}^{|E|-1} \sum_{j=2}^{|E|} P_i x_{ij} \\
\text{s.t.} \quad & \sum_{j=2}^{|E|} x_{1j} = \sum_{i=1}^{|E|-1} x_{i|E|} = 1 \\
& \sum_{i=1}^{|E|-1} x_{ik} = \sum_{j=2}^{|E|} x_{kj} \leq 1 \\
& P(\sum_{j=2}^{|E|} t_{ij} x_{ij} + \mathbb{E} \sum_{j=2}^{|E|} T_i x_{ij} \geq T_{\max}) \leq \alpha
\end{aligned}
\tag{1}
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