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Using Lagrangian Relaxation to Compute Capacity-Dependent Bid Prices in Network Revenue Management

Huseyin Topaloglu
School of Operations Research and Information Engineering,
Cornell University, Ithaca, NY 14853, USA
topaloglu@orie.cornell.edu

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Materials for the Online Collection

This document describes the data files that we use in our computational experiments. All of our data files are labeled as `rm_AAA_B_C.C_D.D.txt`, where `AAA` corresponds to the number of time periods in the decision horizon, `B` corresponds to the number of spokes in the airline network, `C.C` corresponds to the ratio of the total expected demand to the total expected capacity and `D.D` corresponds to the fare difference between a high-fare and its corresponding low-fare itinerary. In other words, following the notation in Section 6.2, `AAA`, `B`, `C.C` and `D.D` respectively correspond to τ, N, α and κ.

In all of our data sets, we assume that we serve N spokes out of a single hub. Location 0 corresponds to the hub and locations $\{1, \dots, N\}$ correspond to the spokes. The itineraries that connect the hub to a spoke or a spoke to the hub include one flight leg. The itineraries that connect two spokes include two flight legs, one from the origin spoke to the hub and one from the hub to the destination spoke.

Figure 1 in this document shows the organization of the data file for a test problem with $\tau = 3$ and $N = 2$. The character "#" indicates a comment line and such lines are skipped. The entries in the data file have the following interpretations.

1. The first portion of the data file shows the number of time periods in the decision horizon.
2. The second portion of the data file shows the flight legs in the airline network. The first line in this portion shows the number of flight legs. After this first line, each line corresponds to one flight leg and shows the origin location, destination location and capacity of the flight leg.
3. The third portion of the data file shows the itineraries. The first line in this portion shows the number of itineraries. After this first line, each line corresponds to one itinerary and shows the origin location, destination location, fare level and revenue for the itinerary. Fare level 0 indicates a low-fare itinerary and fare level 1 indicates a high-fare itinerary. We emphasize that the itineraries that connect two spokes include two flight legs, one from the origin spoke to the hub and one from the hub to the destination spoke.
4. The fourth portion of the data file shows the arrival probabilities for the requests for different itineraries. Each line in this portion corresponds to a time period in the decision horizon. Each line first shows an itinerary indicated by the triplet [origin location, destination location, fare level], followed by the probability that we observe a request for this itinerary. For example, the probability that we observe a request for the low-fare itinerary from location 2 to 1 at the first time period is 0.2. Since we may not observe any itinerary arrivals at a particular time period, the probabilities in a particular line do not necessarily add up to one.

```
# portion 1
# number of time periods in decision horizon
3

# portion 2
# list of flights in format origin loc, destination loc, capacity
# first line is number of flights
4
1 0 16
2 0 21
0 1 12
0 2 20

# portion 3
# list of itineraries in format origin loc, destination loc, fare level, revenue
# first line is number of itineraries
7
0 1 0 24.0
0 1 1 192.0
0 2 0 34.0
1 0 0 192.0
1 2 0 53.0
2 1 0 53.0
2 1 1 212.0

# portion 4
# list of request arrival probabilities in format itinerary, probability
# first entry in each line indicates time period
0  [0 1 0] 0.1    [0 1 1] 0.1    [0 2 0] 0.1    [1 0 0] 0.1    [1 2 0] 0.1    [2 1 0] 0.2    [2 1 1] 0.1
1  [0 1 0] 0.1    [0 1 1] 0.1    [0 2 0] 0.1    [1 0 0] 0.1    [1 2 0] 0.1    [2 1 0] 0.1    [2 1 1] 0.1
2  [0 1 0] 0.1    [0 1 1] 0.1    [0 2 0] 0.1    [1 0 0] 0.1    [1 2 0] 0.1    [2 1 0] 0.1    [2 1 1] 0.1
```

Figure 1: Organization of the data file for a test problem with $\tau = 3$ and $N = 2$.