ORIE 5380, CS 5727: Optimization Methods
Homework Assignment 6
Due October 30, 12:00 pm

(Make sure to submit one pdf file ready to print. If you handwrite your work, then please try to use a scanner instead of a photo. But if you don't have a scanner then a photo(s) will suffice.)

Question 1 (Just this one question)

A transportation company provides ambulance rides to patients transferring between 4 medical facilities, 1, 2, 3 and 4. The time in minutes needed to travel to another facility is given in the following table.

From/To	**1**	**2**	**3**	**4**
1	-	15	30	60
2	15	-	15	45
3	30	15	-	30
4	60	45	30	-

In addition to the travel time, each patient transport requires an additional 15 minutes to load/unload the patient and complete paperwork. So, for example, a patient transport from Facility 1 to Facility 3 takes 45 minutes. An ambulance that is not currently transporting a patient can relocate to another facility or remain where it is. If no ambulance is available at the time and location when a patient wants to be transferred, then the patient uses an alternative form of transport. Each ambulance can only transport one patient at a time.

A list of patient reservations for tomorrow's operations giving all pickups between 7am and 7pm is given in an attached Excel file (see the class webpage under Files/HW Attachments/hospital xfers.xlsx). Each line consists of a pickup time, pickup location, and destination location. The company wants to know how many of those patient transports can be completed as a function of how many ambulances it provides.

(a) Formulate a minimum cost network flow problem that can be used, for a fixed number of ambulances, to determine the maximum number of patient transports that can be completed. Be sure to explain how you would use your formulation to determine the number of patient transports that can be completed.
(b) Implement your formulation and use it to generate a table that lists, for each (reasonable) number of ambulances, the number of patient transports that can be completed. Hand in your code and your table.

Some help: The Excel file lists pickup times in one column. These are actually stored as numbers in Excel, representing fractions of a day. For example, 7:00am is actually stored as 7/24 or approximately 0.292. Similarly, 12pm (noon) is stored as 0.5. If it makes the work easier for you, you are welcome to "preprocess" the Excel file to generate a different input file for your optimization, though our solution works directly with the Excel file. Also, our solution uses linear programming, but you are welcome to use the OR-Tools min-cost network flow tool.

© 2020 Shane Henderson