Operations Research Applications

Assignment 3

Due Date: Apr. 20, 2021, 5pm

Please zip your files, including MS Word, Excel, Python code files or others, with the file name: **ORA_Assignment3_ID_NAME.zip**, and submit your homework to **NTU COOL** by due.

Questions (100%)

Please answer following questions and justify your answer. Show all your works in details.

1. (25%) In multi-facility location problem, assume n = 2 new facilities and m = 4 existing facilities having locations of (0,2), (4,0), (6,8) and (10,4), respectively. The data is shown as follows.

$$W = \begin{pmatrix} 5 & 3 & 0 & 0 \\ 0 & 1 & 8 & 4 \end{pmatrix} \qquad V = \begin{pmatrix} 0 & 6 \\ 6 & 0 \end{pmatrix}$$

$$a = (0 \quad 4 \quad 6 \quad 10)$$

$$b = (2 \quad 0 \quad 8 \quad 4)$$

   (a) (10%) Define the decision variables and formulate a LP model by goal programming technique (you may formulate a nonlinear programming (NLP) model via rectilinear distance and then transfer the NLP model with absolute value to LP equivalent model).

   (b) (10%) Solve the model by Python + Pulp/Gurobi.

   (c) (5%) Show the graphic result of the solutions by X- and Y- Coordinate.

2. (30%) Proof problem- Facility Location

   (a) (15%) SFMS with rectilinear distances. A “short-cut” is introduced to observe that the slope at point x is equal to the sum of the weights to the left of x, minus the sum of the weights to the right of x. Prove and show why this is generally true?

   (b) (15%) SFMS with rectilinear distances. Given what you have shown in (i) above, prove that the median property gives an optimal solution to the problem.

3. (45%) In cutting-stock problem, the objective is to minimize the area with the data shown as follows.

Number of Rectangles	Side p_i	Side q_i
4	8	16
5	9	9
3	18	3

   (a) (10%) Formulate the problem as LP model by piecewise linearization technique.

   (b) (10%) Solve the model by Python + Pulp/Gurobi.

(c) (5%) Show the graphic result of the solutions by X- and Y- Coordinate.

(d) (20%) Please give an **experiment** associated with different number of break point (for testing the resolution of piecewise linearization) or different number of rectangles (for testing the problem scale). The result should illustrate the **quality of solution** and **time spent**.

Note

1. Show all your work in detail. **Innovative** idea is encouraged.
2. If your answer refers to any external source, please "must" give an academic citation. Any "plagiarism" is not allowed.