

Project: Capacitated facility location and extensions

In class, we discussed about the facility location problem and provided one of its formulations. Opening a facility is associated with a *fixed cost* that needs to be paid before the facility can be used. On top of that, different facilities have different *capacities*; that is, they can only provide so many items to the customers.

Assume that a company is deciding where to open up their new warehouses from a set of 6 potential sites. Their goal is to satisfy all 10 of their customers in this location. The cost of shipping one item from a warehouse to a customer is shown in Table 1. Each facility in order to be “opened” comes with a fixed cost (the cost to open the facility) and a capacity (the amount of products that can be shipped from that facility): these are shown in Table 2. Last, the demands of the customers are known to be 25, 15, 20, 10, 15, 15, 25, 20, 30, and 20, respectively.

Customer	Warehouses					
	1	2	3	4	5	6
1	3	5	8	12	10	11
2	6	7	10	12	8	10
3	5	3	8	10	12	10
4	7	6	7	10	9	5
5	10	8	5	8	6	5
6	12	6	4	7	5	4
7	7	10	6	6	8	3
8	5	6	9	4	4	7
9	8	10	7	5	4	6
10	10	12	8	3	4	6

Table 1: The shipping costs from each facility (warehouses) to each customer.

Warehouse	Fixed Cost	Capacity
1	1750000	75
2	1800000	50
3	3000000	120
4	2250000	100
5	1500000	60
6	1000000	50

Table 2: The fixed cost and capacity of each potential site.

- Formulate the problem mathematically. Be careful to define your data, variables, constraints, and objective function, as shown in class.
- Use PuLP to model and solve the problem.
- Single sourcing happens when a customer only wants their demand to come from a *single* warehouse (point of origin). Reformulate the problem to accommodate for single sourcing.
- Due to an internal regulation, no warehouse is allowed to work with more than 3 customers. Is the solution to part (c) still optimal? If not, re-solve the problem adding the new constraint, and obtain the new optimal solution.

Deliverables: Your final report is due on May 5th, 2020 at 11:59pm in Compass2g. The report should be organized in a professional manner. In addition to the answers to each question,

at the beginning of the report, you are asked to include a short executive summary (1 page) that describes:

1. The key points about the problem.
2. The methods used (linear or integer programming) and your coding language.
3. A summary of your findings.

All pages must be numbered. All data and Python print outs should be clearly labeled and organized in a logical manner, and tables or figures should have detailed informative captions. It is important that your Python codes are well documented. Your grade is dependent on the graders' ability to understand what you have done in your codes, so adding 'comments' in your codes is valuable. Examples of Jupyter Notebooks are provided in Prof. Kontou's binder <https://mybinder.org/v2/gh/ekontou/CEE201/master>.

Good luck!