OR4030

Projects

2021 December

Each group is required to write a report which should include the following parts.

1. State the problem;
2. Formulate the problem as an optimization model with necessary specification and explanation;
3. Explain the methodology and algorithm for solving your model;
4. Write a Matlab (or C or Python) code and run the program. Attach a copy of your code and running record;
5. Give your solution;
6. Make a short discussion or extension if necessary.

Upload your report and source code (one zip file including report and code)via ispace by the Due Date – 23:59 Jan 2nd, 2022 (one for each group).

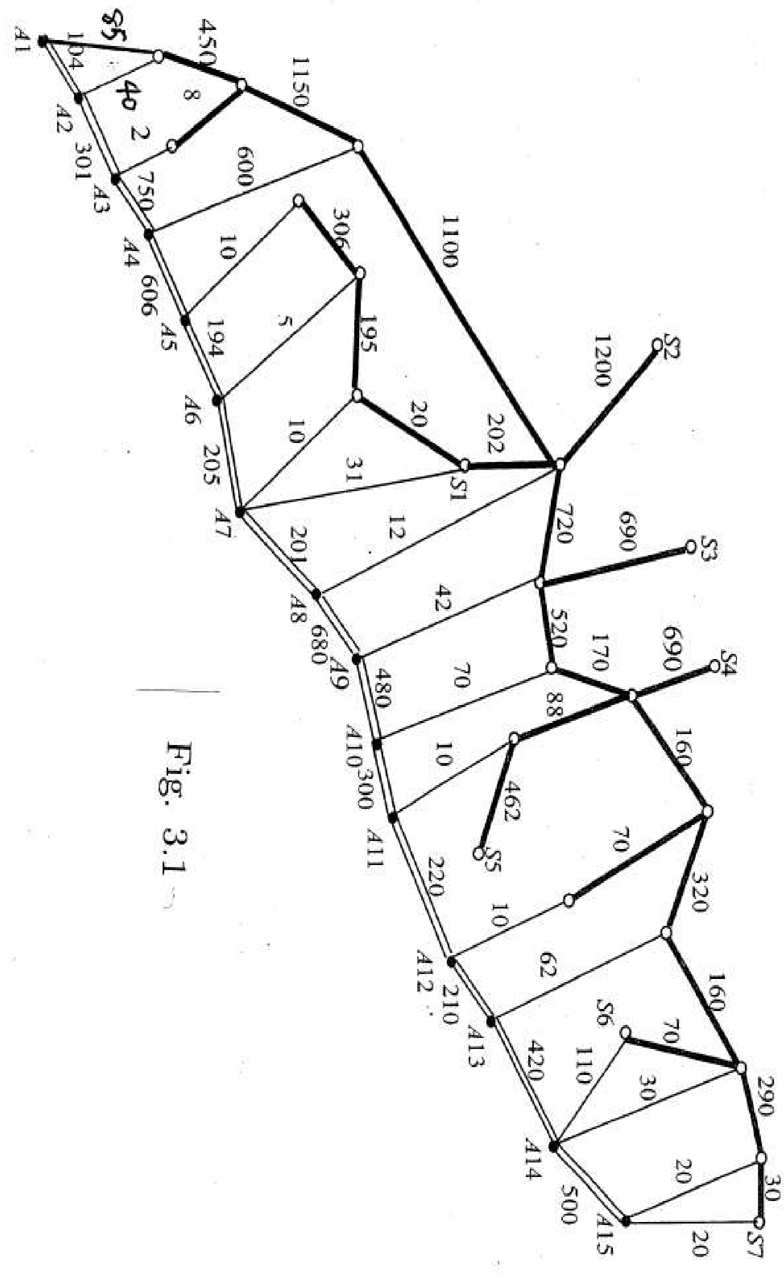
OR4030

Project 1

A pipeline is about to be built in order to deliver natural gas. The pipeline should link location points $A_1 \to A_2 \to \ldots \to A_{15}$ as shown by the double lines in Fig. 3.1. Seven steel factories $S_1, S_2, \ldots,$ and S_7 are able to provide the required pipes. The production capacity and selling price of each steel factory S_i are listed in Table 3.1, where K_i is the maximum production capacity (in km of length), and P_i is the price for 1 km (i.e. 1 unit) of pipes (the money unit used is 10,000 Yuan) for the product of factory S_i. It is requested that if pipes are bought from factory i, then at least a total of 500 km of pipes should be purchased from it (regardless of which location the pipes are purchased for).

Table 3.1: Production Capacity and Sell Price

Factory S_i	S1	S2	S3	S4	S5	S6	S7
Capacity K_i	800	800	1000	2000	2000	2000	3000
Price P_i	160	155	155	160	155	150	160



A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
S1
S2
S3
S4
S5
S6
S7
104
301
750
606
194
205
201
680
480
300
220
210
420
500
450
1150
1100
1200
202
720
690
520
170
690
160
320
160
290
30
20
20
30
70
110
62
10
70
462
88
10
70
42
12
31
10
20
195
306
5
10
600
8
2
40

Fig. 3.1

The pipes are shipped from factories S_i $(i = 1, 2, \ldots, 7)$ via railway or highway to the location points A_j $(j = 1, 2, \ldots, 15)$, where pipes are unloaded and paved towards either A_{j-1} direction or A_{j+1} direction. In Fig. 3.1, the dark solid lines represent railways and the thin lines represent highways. Their lengths (in km) are shown beside these lines. The highway transportation cost is 0.1 (money unit) per km for per unit of pipes, and the railway transportation cost is 0.065 (money unit) per km for per unit of pipes.

It is assumed that the pipes shipped to location point A_j can only be used to pave the interval between A_{j-1} and A_{j+1}, and the interval must contain A_j, that is, such pipes can be paved towards A_{j-1}, but cannot exceed A_{j-1}, or similarly, towards A_{j+1}, but cannot exceed A_{j+1}, or towards both directions. For such movement of pipes, the transportation cost is 0.1 per km for per unit of pipes, and for a moving distance shorter than 1km, the cost is counted as 1km, i.e., 0.1 per unit. For simplicity, we further assume that during the construction process, no pipes shall be wasted and hence the total amount of pipes required is equal to the length of the entire pipeline $A_1 \to A_2 \to \ldots \to A_{15}$. Also, all required pipes are of the same size.

Consider a pipe purchasing and shipping plan so that the total cost for buying and moving pipes (from factories to location points, and between location points) can be minimized.