assignment_04

March 1, 2025

1 Assignment #4

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1. Point-to-Point Routing

Consider a 5×5 grid-like network (Table 1.)

From	To	d_{ij} (km)	t_{ij} (mins)	f_{ij} (l)
1	2	1.30	1.08	0.99
1	6	1.38	1.39	1.33
2	3	1.80	1.48	1.17
2	7	1.07	2.23	1.41
3	4	1.83	1.43	1.28
3	8	1.39	1.37	1.03
4	5	1.77	1.20	1.12
4	9	1.54	1.54	1.24
5	10	1.75	1.29	1.15
6	7	1.40	1.36	1.07
6	11	1.45	1.52	1.19
7	8	1.23	1.83	1.36
7	12	1.60	1.46	1.21
8	9	1.72	1.50	1.10
8	13	1.12	2.01	1.37
9	10	1.65	1.35	1.08
9	14	1.35	1.25	0.98
10	15	1.95	1.34	1.30
11	12	1.70	1.29	1.11
11	16	1.55	1.38	1.16
12	13	1.47	1.49	1.09
12	17	1.72	1.28	1.18
13	14	1.27	1.75	1.40
13	18	1.61	1.40	1.22
14	15	1.81	1.33	1.14
14	19	1.19	1.78	1.39
15	20	1.85	1.31	1.25
16	17	1.66	1.22	1.06
16	21	1.58	1.37	1.13

From	To	d_{ij} (km)	t_{ij} (mins)	f_{ij} (l)
17	18	1.49	1.27	1.04
17	22	1.67	1.41	1.15
18	19	1.42	1.45	1.10
18	23	1.64	1.32	1.17
19	20	1.36	1.52	1.35
19	24	1.78	1.42	1.20
20	25	1.99	1.37	1.28
21	22	1.53	1.39	1.12
22	23	1.61	1.35	1.09
23	24	1.50	1.31	1.08
24	25	1.70	1.42	1.15

Assuming node 1 as the origin node 25 as the destination, answer the questions below.

a. Formulate the objective functions for the shortest route, fastest route, and eco-route. (1)

b. Formulate all constraints. (5)

c. Formulate the above optimisation problems (each) in a spreadsheet. (9)

d. Report the optimal solution. (1)

2. Location Routing Problem

   Amazon plans to serve 10000 customers in a service region of size 307.78 km^2 from the following potential distribution facilities (Table 1.) using a fleet of diesel and electric vans (Table 2.). Cosnidering a planning horizon of 7 years, each with 330 working days, which facilities should Amazon choose to operate from?

   Table 1. Potential Distribution Facility Locations

Location	Fixed Cost (in cr)	Distance from Service Region (in km)	Capacity (in customers)
Location #1	75	1	3000
Location #2	50	5	10000
Location #3	10	20	30000

   Table 2. Fleet Characteristics

Vehicle Type	Purchase Cost ( )	Operational Cost (per km)	Maximum Fleet Size	Maximum Tours	Maximum Customers
#1 Diesel Van	6,00,000	35	20	3	200

Vehicle Type	Purchase Cost ( )	Operational Cost (per km)	Maximum Fleet Size	Maximum Tours	Maximum Customers
#2 Electric Van	9,00,000	28	-	2	150

Using the following notations, answer the questions below,

Notations:

- number of type v delivery vehicles purchased at depot node d: $f_v^d \ \forall \ v \in [1,2],\ d \in [1,3]$
- number of tours per type v delivery vehicle at depot node d: $m_v^d \ \forall \ v \in [1,2],\ d \in [1,3]$
- number of customer per delivery tour per type v delivery vehicle at depot node d: $c_v^d \ \forall \ v \in [1,2],\ d \in [1,3]$: $c_i \ \forall \ i \in [1,3]$

a. Formulate the objective function. (1)

b. Formulate the constraints. (3)

c. Formulate the above optimisation problem in a spreadsheet. (3)

d. Report the optimal solution. (2)