

Indices:

Trucks = $\{1, \dots, 5\}$

Cities = $\{1, \dots, 4\}$

Customers = $\{1, \dots, 20\}$

Decision Variables

$x_{tc} = \{1 \text{ if truck } t \text{ is used in city } c, 0 \text{ otherwise}\}$

$y_{tk} = \{1 \text{ if truck } t \text{ is assigned to customer } k, 0 \text{ otherwise}\}$

Parameters

$renting_cost_t$: fixed cost of using truck t

$cost_{tk}$: the cost of assigning truck t to customer k

z_{cm} : $\{1 \text{ if distance between two cities } c \text{ and } m \text{ is less than } \gamma, 0 \text{ otherwise}\}$

$hometown_{kc}$: $\{1 \text{ if customer } k \text{ is in city } c, 0 \text{ otherwise}\}$

Model

$$\text{Min } \sum_{t=1}^T \sum_{c=1}^C renting_cost_t * x_{tc} + \sum_{t=1}^T \sum_{k=1}^K cost_{tk} * y_{tk}$$

Subject to

- 1) $\sum_{t=1}^T y_{tk} \geq 1$ for all k in $\{1, \dots, K\}$ (each customer must be served by a truck type – at least 1-)
- 2) $\sum_{t=1}^T x_{tc} \leq 3$ for all c in $\{1, \dots, C\}$ (at most 3 types of truck can be assigned for each city)
- 3) $x_{32} + x_{33} \leq 1$ (truck Type 3 can be used in either Bodrum or Çeşme but not both)
- 4) $z_{cm}(x_{tc} - x_{tm}) \leq 0$ for all t in $\{1, \dots, T\}$, c in $\{1, \dots, C\}$, m in $\{1, \dots, C\}$ when $k \neq m$ (if the distance between two cities is less than a predetermined threshold, same kind of trucks must be used in those cities)
- 5) $hometown_{kc} * y_{tk} \leq x_{tc}$ for all t in $\{1, \dots, T\}$, k in $\{1, \dots, K\}$, c in $\{1, \dots, C\}$ (customer- city allocation)

6) $x_{tc} \in \{0,1\}$ for all t in $\{1,...,T\}$, c in $\{1,...,C\}$

7) $y_{tk} \in \{0,1\}$ for all t in $\{1,...,I\}$, k in $\{1,...,K\}$

Data Set

The first 3 customers are in Antalya, 7 are in Bodrum, 5 are in Çeşme and 5 are in İzmir. Distance threshold between cities is 270.

City Distance	Antalya	Bodrum	Çeşme	İzmir
Antalya	0	430	540	469
Bodrum	430	0	317	239
Çeşme	540	317	0	86
İzmir	469	239	86	0

Truck Price	
1	1110
2	590
3	870
4	1190
5	510

Truck-Cust Assignment Price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	231	416	290	636	695	1431	1595	479	1894	1655	1766	1445	445	2442	2015	1742	1033	1240	993	2159
2	298	715	600	638	370	2011	1748	803	2487	1957	575	1390	545	2103	3246	578	733	603	1260	699
3	615	1937	600	786	729	2024	921	2003	389	175	2654	534	2040	744	5341	262	2526	308	58	380
4	725	2302	240	3672	423	313	842	1672	965	478	305	2320	244	1041	248	1767	2332	591	698	1934
5	1085	1693	2047	2791	1026	924	1104	1950	62	1380	2693	814	235	1326	86	1678	1948	2248	1313	139