

Part2 modification2_{by}servicetype

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1 Part 1

Data:

- \mathcal{O} : 14HS headquarters
- N : $N \in \{2, \dots, n+1\}$ the set of clients
- N' : $N' \in \{1, \dots, n+1\}$ the set of depot and clients where depot $\in \{1\}$
- M : $M \in \{1, \dots, m\}$ the set of service providers
- K : $K \in \{1, \dots, k\}$ the set of service types
- A^k : the set of clients who need service type k and the set of depot for all type k .
 - N^k : the number of clients for type k.
- A^k : the set of clients who need service type k.
- H^k : the set of service providers who provide service type k.
- l : time of the end of the work day (when all service providers should be back at 14HS headquarters).
- $i, j \in N'$: set of clients
 - t_{ij} : travel times between any pair of locations $i, j \in N \cup \{\mathcal{O}\}$
- s_i : service start time of i client
- d_i^k : k type service duration of i client
- g_k : The cost of using one kth type service provider per hour.

Variables:

- X_{ijv}^k : a matrix containing the planning route. $X_{ijv}^k = 1$ if v provider of k service travels from provider i to customer j and $X_{ijv}^k = 0$ otherwise.

Model:

$$Z = \min \sum_{k \in K} \sum_{v \in M} \sum_{j \in N} x_{1jv}^k g_k \left[\sum_{i \in N'} \sum_{j \in N'} x_{ijv}^k (t_{ij} + d_i^k + \max(0, s_j - s_i - t_{ij} - d_i^k)) \right]$$

subject to the following constraints:

1. $\sum_{i \in A'^k} \sum_{v \in M} X_{ijk} = 1, \forall j \in A^k, k \in K$
2. $\sum_{i \in A'^k} x_{ipv}^k = \sum_{j \in A'^k} x_{pjk}^k, \forall v \in H^k, p \in A^k, k \in K$
3. $\sum_{j \in A^k} x_{1jv}^k \leq 1, \forall v \in H^k, k \in K$
4. $\sum_{j \in A^k} \sum_{v \in M} x_{1jv}^k \geq 1, \forall k \in K$
5. $u_{iv} - u_{jv} + (N^k - 1)x_{ijv}^k \geq (N^k - 1) - 1, \forall j \in A^k, i \in A^k, v \in H^k, k \in K$
6. $x_{1jv}^k (s_{v1} + t_{1j} + d_1^k) \leq s_{vj}, \forall v \in H^k, j \in A^k, k \in K$
7. $x_{ijv}^k (s_{vi} + t_{ij} + d_i^k) \leq s_{vj}, \forall i \in A^k, j \in A^k, v \in H^k, k \in K$
8. $x_{i1v}^k (s_{vi} + t_{i1} + d_i^k) \leq l, \forall i \in A^k, v \in H^k, k \in K$
9. $X_{ijv}^k \in \{0, 1\}, \forall i, j \in A'^k, v \in H^k, k \in K$