

Connection Between Scooters

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1 Problem Statement

We are looking to find a optimum way(time, distance) to connect scooters to each other. For example in a case that charge level for a single scooter is not enough for completing the commute, linking between scooters makes the whole trip from start point to end point possible for commuter.

2 Index

i : origins
 j : destinations
 s : scooter

3 Parameters

C_{ij} : travel time control parameter
 h_{ij} : commute demand from i to j

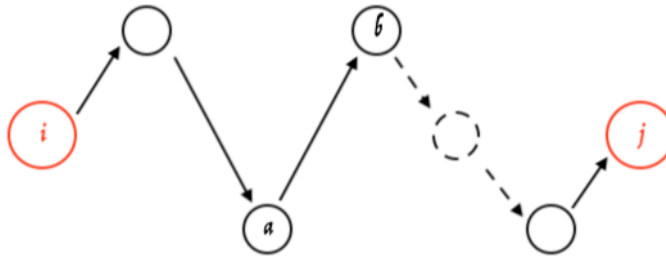


Figure 1: Connection Model

4 Variables

$$X_{i,s} = \begin{cases} 1 & \text{if scooter } s \text{ is in location } i \\ 0, & \text{otherwise} \end{cases}$$

$$H_{ab} = \begin{cases} 1 & \text{if arc } (a,b) \text{ is used to an trip} \\ 0, & \text{otherwise} \end{cases}$$

$$Y_{ij} = \begin{cases} 1 & \text{if there is a trip from } i \text{ to } j \\ 0, & \text{otherwise} \end{cases}$$

$$P_{ab}^{ij} = \begin{cases} 1 & \text{if a paved trip between } i \text{ and } j \text{ uses arc } (a,b) \text{ in the direction of } a \text{ to } b \\ 0, & \text{otherwise} \end{cases}$$

5 Model

5.1 Objective Function

$$\max \sum_i \sum_j h_{ij} \cdot Y_{ij} \quad (1)$$

5.2 Constraints

$$\sum_{a,b} (P_{ab}^{ij} + P_{ba}^{ij}) \cdot c_{ab} \leq C_{ij} \cdot Y_{ij} \quad \forall i \in I, \forall j \in J \quad (2)$$

$$\sum_{a,i} P_{ai}^{ij} = Y_{ij} \quad \forall i \in I, \forall j \in J \quad (3)$$

Starting point of each interior path is equal to 1 if the a trip between i,j exists.

$$P_{ab}^{ij} + P_{ba}^{ij} \leq H_{ab} \quad \forall i \in I, \forall j \in J \quad (4)$$

$$P_{ab}^{ij} \leq H_{ab} \quad \forall i \in I, \forall j \in J \quad (5)$$

$$\sum_{a,k} P_{ak}^{ij} - \sum_{k,b} P_{kb}^{ij} = 0 \quad \forall i \in I, \forall j \in J \quad (6)$$

$$H_{ab} \leq \sum_s x_{a,s} \quad \forall a \in I \quad (7)$$