n: number of clusters

$x_i = \begin{cases} 1, & \text{station at cluster } i \\ 0, & \text{otherwise} \end{cases}$

y_i = # bikes in station of cluster i

z_i = # docks in station i

$x_i \leq z_i \leq M_i x_i$ ① where M_i is the maximum number of docks for station i

$x_i \leq y_i \leq z_i$ ②

m_{ij} = average # times a bike started from somewhere in cluster i and ended-up in cluster j

$m_{ii} = 0 \quad \forall i$

$\sum_j m_{ij}$ = # times a bike started from i

$\sum_i m_{ij}$ = # times a bike ended up in j

$m = \sum_i \sum_j m_{ij}$ = total number of trips

$\frac{1}{2m}\left(\sum_j m_{ij} + \sum_j m_{ji}\right)$ = proportion of demand for a station at cluster i

$p_i \in \{0, 1, 2\}$: population density weight

$\varepsilon_i = \begin{cases} 1, & \text{cluster } i \text{ point of interest} \\ 0, & \text{otherwise} \end{cases}$

- $social\_value = \sum_i \frac{(p_i+\varepsilon_i)}{2m} \sum_j (m_{ij}+m_{ji}) y_i$

!!! Constraint addition: extra docks for more bikes based on previous stats (confidence)!!

h_{ij} = average time to go from i to j with bike

C_1 = cost of making a dock
C_2 = Cost of making a bike

C_{bike} = user cost for bike / time
C_{car} = user cost for car fuel / time
p_{car} = proportion of population initially using car

- $total\_cost = -C_1 \sum_i z_i - C_2 \sum_i y_i +$
$+ C_{bike} \sum_i \sum_j m_{ij} h_{ij} x_i$

- $environmental\_value =$
$= p_{car} C_{car} \sum_i \sum_j m_{ij} h_{ij} x_i$

$\{ \text{if } p_i = \varepsilon_i = 0 \Rightarrow x_i = 0 \} \Rightarrow$
$\Rightarrow x_i \leq p_i + \varepsilon_i \quad \forall i$ (3)

if $x_i = 1$:
$y_i \geq \sum_j (m_{ij} - m_{ji})$ (4)