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

$\sum_j m_{ij}$ = # 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

a_{ik} = number of k buildings in cluster i
where k = [residential, commercial, school, university, hospital, library]

p_k = weight for k building

- $social\_value = \sum_i \sum_k \frac{p_k a_{ik}}{2m} \sum_j (m_{ij} + m_{ji}) y_i$

objective function: = social_value

c_1 = cost of making a dock
c_2 = cost of making a bike

C_{car} = user cost for car fuel/time
C_{max} = maximum amount of money we can expend

p_{car} = proportion of population initially using car

- $total\_cost = c_1 \sum_i z_i + c_2 \sum_i y_i$

- environmental_value =
$= p_{car} C_{car} \sum_i \sum_j m_{ij} h_{ij} x_i$
where h_{ij} = average time to go from i to j

$total\_cost \leq C_{max}$ (3)

environmental_value ≥ (proportion) *
* (total cost for car fuel for all residents in a e.g. month) (4)

$$y_i \geq \sum_j (m_{ij} - m_{ji}) \quad \forall i \quad 5$$

$$\text{total\_cost} \leq \ell_1 \cdot \text{social\_value} + \ell_2 \cdot \text{environmental\_value}$$

6 maybe?

!!! Constraint 7: extra docks for more bikes based on previous stats (confidense interval)!!!