Optimization Model for Hydrogen Fueling Station Placement V5

Group 2

Mathematical Model

Sets and Indices

- S: Set of potential stations, indexed by i.
- C: Set of sensors, indexed by k.

Parameters

- d_{ik}: Distance (as a straight line) between station i and sensor k.
- D: Maximum allowable distance for a station to cover a sensor (sensitive variable).
- I_k: Average demand per hour at sensor k.
- c_i: Installation cost for station i.
- B: Total available budget for installing stations (sensitive variable).

Decision Variables

- $x_i \in \{0, 1\}$: Binary variable indicating whether to place a station at location i.
- $z_{ik} \in \{0, 1\}$: Binary variable indicating whether station i covers sensor k.

Objective Function

Maximize the total coverage of sensors weighted by their hourly demand:

$$\text{Maximize} \quad \sum_{i \in S} \sum_{k \in C} z_{ik} \cdot I_k$$

Constraints

1. **Distance Constraint**: A sensor can only be covered by a station within the maximum distance.

$$z_{ik} \leq y_{ik} \cdot x_i \quad \forall i \in S, \forall k \in C$$

   where $y_{ik} = 1$ if $d_{ik} \leq D$, otherwise $y_{ik} = 0$.

2. **Sensor Coverage Constraint**: Each sensor can be covered by at most one station.

$$\sum_{i \in S} z_{ik} \leq 1 \quad \forall k \in C$$

3. **Budget Constraint**: The total installation cost cannot exceed the available budget.

$$\sum_{i \in S} c_i \cdot x_i \leq B$$

4. **Binary Variables**:

$$x_i \in \{0, 1\} \quad \forall i \in S$$

$$z_{ik} \in \{0, 1\} \quad \forall i \in S, \forall k \in C$$