**Sets and Indices**

: Set of zip codes.

: Set of existing facilities in zip code z.

: All potential locations for new facilities in zip code z

: Set of facility types available for new construction (Small, Medium, Large).

: Expansion tiers (1, 2, 3)

**Parameters**

**(1) Demand Data per Zip Code z:**

**​**: Demand classification in zip code z (High or Normal-Demand).

: Population of children aged 0-5 in zip code z.

**​**: Population of children aged 5-12 in zip code z.

**​**: Population of children aged 0-12 in zip code z.

**(2) Existing Facility Data per Facility f in Zip Code z:**

: Current capacity (slots) for children aged 0-5 at facility f in zip code z

: Current capacity (slots) for children aged 5-12 at facility f in zip code z

: Total current capacity at facility f in zip code z

**(3) Facility Sizes for New Construction s∈S:**

: Total capacity (slots) of facility size s.

: Number of slots for children aged 0-5 in facility size s

: Construction cost of facility size s

**Decision Variables**

**(1) Expansion Variables for Existing Facilities:**

: Expansion amount at facility f in zip code z in tier t

: Binary variable indicating whether tier t is fully utilized at facility f.

: Number of additional slots to be added through expansion at facility f in zip code z

: Number of new under-5 slots added at facility f in zip code z

**(2) Construction Variables for New Facilities:**

: Binary variable indicating if a facility of size s is built at location l in zip code z

**Objective Function**

Minimize **the Total Cost :**

**Constraints**

**1. Capacity Requirements per Zip Code z**

**(1) Total Slots Requirement**

**(2) Under-5 Slots Requirement**

**2. Expansion Constraints for Existing Facilities**

**3. Distance Constraints**

**a. Between Existing and Potential New Facilities**

For all existing facilities f and potential locations l:

**b. Between Potential New Facilities**

For all pairs of potential locations :

**c. Facility Size Selection Constraints**

**4. Non-negativity and Integrality**