**Sets and Indices**

: Set of zip codes.

: Set of existing facilities in zip code z.

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

**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

**(4) Cost Parameters**

Under5SlotsCost = 100

ExpansionBaseCost = 20000

ExpansionPerSlotCost = 200

**Decision Variables**

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

: 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:**

: Number of new facilities of size sss to be built in zip code z

**Objective Function**

Minimize **the Total Cost :**

Where the **Expansion Cost per Facility f** is calculated as:

**Constraints**

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

(1) Total Slots Requirement

if = High-Demand,

if = Normal-Demand,

(2) Under-5 Slots Requirement

**2. Expansion Constraints for Existing Facilities**

**3. Non-negativity and Integrality**