# Final Exam

Adv. Analytics and Metaheuristics

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## Contents

# 1 - *Question 1* (Version 1)

## 1.1 Mathematical Formulation

### 1.1.1 Sets

$NewBuildTypes$: Set of new build types $b \in (Homes,\ Duplex,\ MiniPark)$

### 1.1.2 Parameters

| Parameter | Description | Default Value |
|---|---|---|
| $budget$ | Federal grant allocation to revitalize neighborhoods | \$15MM total budget |
| $maxBuildingDemod$ | Max amount of buildings that can be demolished | 300 total buildings |
| $demoCost$ | Cost of demolishing a building | \$4,000 per building |
| $freedUpSpace$ | Acreage generated from demolishing a building | 0.25 per building |
| $newBuildSpace_b$ | Amount of acreage that a new building ($b \in NewBuildTypes$) consumes | $Homes$: 0.2, $Duplex$: 0.4, $MiniPark$: 1.0 |
| $newBuildTax_b$ | Amount of tax dollars generated from a new building ($b \in NewBuildTypes$) | $Homes$: 1,500, $Duplex$: 2,750, $MiniPark$: 500 |
| $newBuildCost_b$ | Amount of dollars used to create a new building ($b \in NewBuildTypes$) | $Homes$: 150,000, $Duplex$: 190,000, $MiniPark$: 20,000 |
| $newBuildPercShare_b$ | Minimum required percentage share of new buildings ($b \in NewBuildTypes$) created | $Homes$: 20%, $Duplex$: 10%, $MiniPark$: 5% |

### 1.1.3 Decision Variables

| Variable | Description |
|---|---|
| $numOldBuildsDemods_b$ | Number of old buildings ($b \in NewBuildTypes$) to demolish |
| $numNewBuilds_b$ | Number of new buildings ($b \in NewBuildTypes$) to produce |

### 1.1.4 Objective

Maximize the tax revenue from the projects

$$maximize\ taxRevenue: \sum_{b \in NewBuildTypes} (numNewBuilds_b \times newBuildTax_b)$$

### 1.1.5 Constraints

**C1** Spend less than or equal to the federal budget
$meetTheBudget$ :

$$\sum_{b \in NewBuildTypes} \Big[(numNewBuilds_b \times newBuildCost_b) + (numOldBuildsDemods_b \times demoCost)\Big] \leq budget$$

**C2** Can only produce new builds using the demolished buildings land

$$useAvailLand: \sum_{b \in NewBuildTypes} numNewBuilds_b \times newBuildSpace_b$$
$$\leq \sum_{b \in NewBuildTypes} (numOldBuildsDemods_b) \times freedUpSpace$$

**C3** Can only clear a certain amount of old buildings

$$maxBuildingsCleared: \sum_{b \in NewBuildTypes} numOldBuildsDemods_b \leq maxBuildingDemod$$

**C4** For each new build type ($b \in NewBuildTypes$), the percentage share of the new build type must meet the minimum required

$$numNewBuilds_b \geq newBuildPercShare_b \times \sum_{b \in Businesses} (numNewBuilds_b),$$
$$\forall\ b \in Businesses$$

**C5** Non-negativity constraints

$$numOldBuildsDemods_b,\ numNewBuilds_b \geq 0,\ \forall\ b \in NewBuildTypes$$

## 1.2 Code

### 1.2.1 AMPL Code

```
Code here
```

### 1.2.2 AMPL Solution

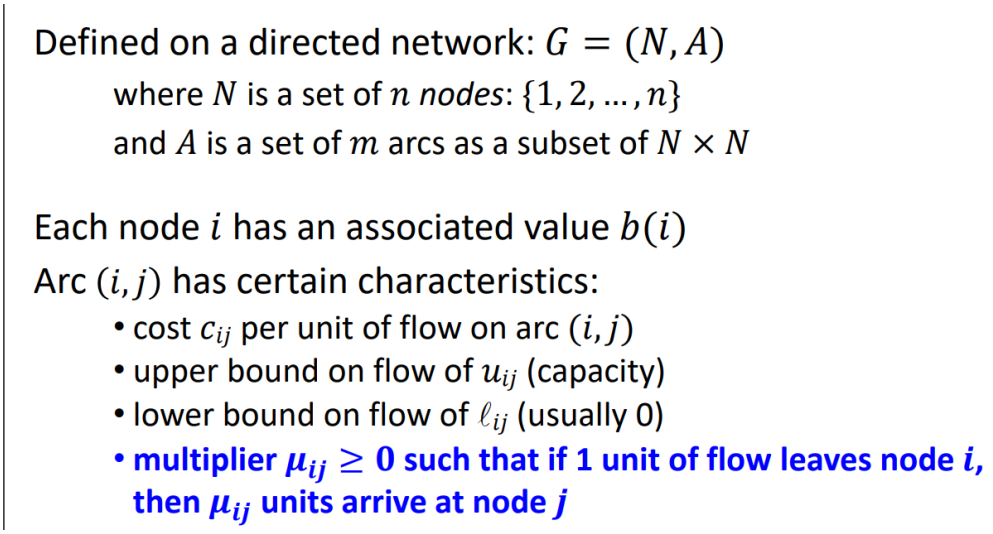


Figure 1: Problem 1 AMPL Output of Optimal Solution and Variables

## 2 - *Question 2* (Version 6)

## 3 - *Question 3* (Version 2)

# 4 - *Question 4* (Version 3)

# 5 - *Question 5* (Version 2)