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
$numOldBuildsDemod$	Number of old buildings 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
$meetTheBudget$:

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

C2 Can only produce new builds using the demolished buildings land

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

C3 Can only clear a certain amount of old buildings

$$maxBuildingsCleared : numOldBuildsDemod \leq maxBuildingDemod$$

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

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

C5 Non-negativity constraints

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

1.2 Code

1.2.1 AMPL Code

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Code here
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1.2.2 AMPL Solution

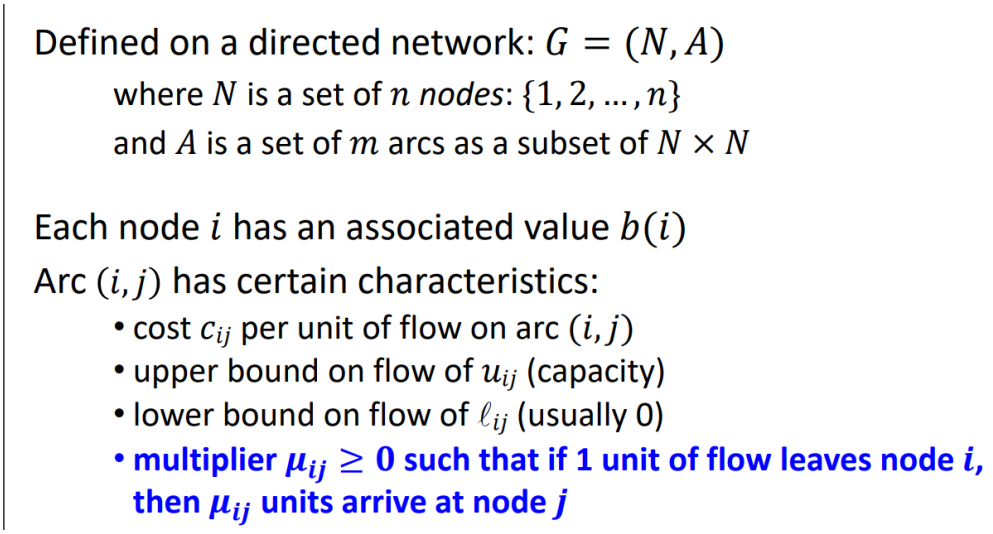

Figure 1: Problem 1 AMPL Output of Optimal Solution and Variables

2 - *Question 2* (Version 6)

3 - *Question 3* (Version 2)

4 - *Question 4* (Version 3)

5 - *Question 5* (Version 2)