

## FALL 2017 IE 310 QUIZ 4

### 1-) GAMS Code:

SETS

i sectors / 1\*10 /

j d\_sites / 1\*5 /;

TABLE d(i,j) distances (in kilometers) for ten sectors in the city

	1	2	3	4	5
1	3.4	1.4	4.9	7.4	9.3
2	2.4	2.1	8.3	9.1	8.8
3	1.4	2.9	3.7	9.4	8.6
4	2.6	3.6	4.5	8.2	8.9
5	1.5	3.1	2.1	7.9	8.8
6	4.2	4.9	6.5	7.7	6.1
7	4.8	6.2	9.9	6.2	5.7
8	5.4	6	5.2	7.6	4.9
9	3.1	4.1	6.6	7.5	7.2
10	3.2	6.5	7.1	6	8.3;

PARAMETER c(j) capacity of j th d\_site / 1 350, 2 250, 3 500, 4 400, 5 200 /;

PARAMETER req(i) estimated the snow removal requirements (in 1000s of cubic meters) for each sector in the coming year / 1 153, 2 152, 3 154, 4 138, 5 127, 6 129, 7 111, 8 110, 9 130, 10 135 /;

VARIABLES

Z total cost for snow removal and disposal

BINARY VARIABLE X(i,j) 0 or 1 indicating assignment of d\_site j to sector i ;

## EQUATIONS

COST cost for snow removal and disposal

ASSIGN(i) sector-disposal sites assignment constraints

CAPACITY(j) disposal site capacity constraints;

COST ..  $Z = \sum_{(i,j)} 0.1 * 1000 * d(i,j) * X(i,j) * req(i)$ ;

ASSIGN(i) ..  $\sum_j X(i,j) = 1$ ;

CAPACITY(j) ..  $\sum_i X(i,j) * req(i) \leq c(j)$ ;

MODEL GAP /ALL/ ;

Option MIP = Cplex;

option optca=0;

option optcr=0;

SOLVE GAP USING MIP MINIMIZING Z;

DISPLAY X.L;

**2&3 -)Optimal Cost: 547000.0000**

**Optimal Solution:**

	1	2	3	4	5
1		1.000			
2	1.000				
3			1.000		
4			1.000		
5			1.000		
6				1.000	
7				1.000	
8					1.000
9	1.000				
10				1.000	

**4-)** If we remove the capacity constraint, we can assume that each disposal site is eligible to disposal of snow for each assigned sector. So,5 possible assignments for each sector is available, this means  $5^{10}$ .

**5-) Increasing the capacity of a single disposal site by 100,00 cubic meters:**

**5.1-) For the single assignment case :**

The optimal costs obtained by changing the capacity of different disposal sites:

**1 : 494240.000000**

**2 : 489680.0000**

**3 : 529660.0000**

**4 : 547000.0000**

**5 : 526360.0000**

The minimum is obtained by changing the capacity of disposal site 2.

The improvement in the objective value is 57320.

**5.2-) For the multiple assignment case :**

The optimal costs obtained by changing the capacity of different disposal sites:

**1** : 455100.0000

**2** : 456650.0000

**3** : 478100.0000

**4** : 478490.0000

**5** : 474700.0000

The minimum is obtained by changing the capacity of disposal site 1.

The improvement in the objective value is 23390.