

**Non Linear Programming.** Eight students need to be assigned to four dorm rooms (two students to a room) at State University. Based on incompatibility measures, the “cost” incurred if two students room together is shown below. How should these students be assigned to rooms to minimize the total incompatibility?

Assigning students to rooms							
Incompatibilities							
Student	2	3	4	5	6	7	8
1	9	3	4	2	1	5	7
2		4	5	6	7	8	3
3			4	2	8	3	5
4				3	2	4	6
5					8	7	6
6						2	3
7							4

### Discussion.

In this problem we need to assign 8 students to 4 dorms such that there is minimum incompatibility between 2 students who are put in the same dorm. The objective is to minimize incompatibility and we must ensure all 8 students are housed, i.e. all 4 dorms are filled keeping in mind no students gets allocated to more than 1 roommate. The decision is to check which 2 students must be grouped together.

### Model.

#### Parameters:

$C_{ij}$  :Cost incurred if student  $i$  shares the dorm with student  $j$  , where  $i, j \in (1,2,3,4,5,6,7,8)$

#### Decisions:

$x_{ij}$  : whether student  $i$  should shares the dorm with student  $j$  , where  $i, j \in (1,2,3,4,5,6,7,8)$

**Objective:** Minimize incompatibility

$$\min \sum_{i,j} C_{ij} * x_{ij}$$

#### Constraints:

$$\sum_{ij} x_{ij} \geq 4$$

(1) Four total dorms must be filled

$$\sum_i x_{ij} \leq 1$$

(2) A student cannot be assigned to more than one roommate

$$x_{ij} \in \{0,1\}$$

(3) Binary assignment decision

**Commented [YW1]:** Maybe put a note, saying that constraint 2 is needed because otherwise there would be multiple assignments to one students

Maybe also mention that we don't need summation over j because we are minimizing cost ...

**Optimal Solution.** The following is the solution obtained from Excel Solver.



60(AP).xlsx

A minimum incompatibility metric of 8 can be attained by grouping the students as shown below.

Which students should be grouped together									
Student	2	3	4	5	6	7	8		
1	0	0	0	0	1	0	0	1	≤
2	0	0	0	0	0	0	1	1	≤
3	0	0	0	1	0	0	0	1	≤
4	0	0	0	0	0	0	0	0	≤
5	0	0	0	0	0	0	0	0	≤
6	0	0	0	0	0	1	0	1	≤
7	0	0	0	0	0	0	0	0	≤
	0	0	0	1	1	1	1		
	1	1	1	1	1	1	1		
objective	8								
constraints									
total rooms	4	≥	4						