## IE400 2018 Fall

## Group Project

## Meghdut Telecom

Below are the necessary decision variables for building the constraints and writing objective function:

Our parameters are *Cij, R1ij* and *R2ij* for costs of links, first year revenues and second year revenues. (The question does not state explicitly, but I assume that revenues from pairs of connected cities in year 1 will also be collected in year 2, since they will continue to be linked).

Here, i takes values between 1 and 7. After designing these decision variables, our three Integer Programming problems are:

1. Revenue maximization

Max

Subject to:

1. Only four cities linked in year1
2. Only two cities in position 2 and 4
3. Cities in position 2 and 4 must be in year 1 linked cities
4. every connected city in year 1 has two links in year 1
5. total of four links in year 1
6. A link in year 2 can be across cities that are not linked in year 1 and cities in position 2 and 4. A city has one link in second year if it is in position 2 and 4. If it is not connected in year 1, then in year 2 it must have two links.
7. total of four links in year 2
8. A link can be built in first year or second year or not built at all
9. First Year revenues for any pair will be collected only when cities i and j are in year 1 connected cities
10. 6 pairs in year 1 for revenue collection
11. Cities in position 2 and 4 are not connected in first year

All decision variables are binary.

1. Cost minimization

Min

Subject to:

1. Only four cities linked in year1
2. Only two cities in position 2 and 4
3. Cities in position 2 and 4 must be in year 1 linked cities
4. every connected city in year 1 has two links in year 1
5. total of four links in year 1
6. A link in year 2 can be across cities that are not linked in year 1 and cities in position 2 and 4. A city has one link in second year if it is in position 2 and 4. If it is not connected in year 1, then in year 2 it must have two links.
7. total of four links in year 2
8. A link can be built in first year or second year or not built at all
9. Cities in position 2 and 4 are not connected in first year

All decision variables are binary.

1. Profit maximization

Max -

Subject to:

1. Only four cities linked in year1
2. Only two cities in position 2 and 4
3. Cities in position 2 and 4 must be in year 1 linked cities
4. every connected city in year 1 has two links in year 1
5. total of four links in year 1
6. A link in year 2 can be across cities that are not linked in year 1 and cities in position 2 and 4. A city has one link in second year if it is in position 2 and 4. If it is not connected in year 1, then in year 2 it must have two links.
7. total of four links in year 2
8. A link can be built in first year or second year or not built at all
9. First Year revenues for any pair will be collected only when cities i and j are in year 1 connected cities
10. 6 pairs in year 1 for revenue collection
11. Cities in position 2 and 4 are not connected in first year

All decision variables are binary.

Solution of these problems with Excel solver yields the following results:

(First Year links in blue, second year links in orange)

**Revenue Maximization:**

Maximum Revenue: 954

4

5

3

7

2

6

1

**Cost Minimization:**

Minimum Cost: 915

1

3

2

4

5

7

6

**Profit Maximization:**

Maximum Profit: -33

7

3

2

4

5

1

6

Since this is a long-term plan, considering only two years of revenues for revenue and profit calculations would be misleading. Minimizing costs would be more reasonable.