Assignment 5

**Formulation and solutions for an Integer Programming problem.**

1. **Decision variable:**

Xij, = 1 if the arc from node i to node j is chosen in the optimal (longest) path otherwise Xij = 0

= X12 +X13 + X35 + X25 + X24 + X46 + X47 + X57 + X58 + X89 + X79 + X69

**Objective function:**

Maximize Z: the total time required from node 1 to node 9.

Max Z = ∑(Tij)(Xij)

Where Tij = time taken by arc (activity) from ith node and jth node;

Xij = arc from node i to node j; j=1,2,3,4,5,6,7,8,9,10,11,12 and i= 1,2,3,4,5,6,7,8,9

**Max Z** = 5X12 +3X13 + 3X35 + 2X25 + 4X24 + 1X46 + 4X47 + 6X57 + 2X58 + 7X89 + 4X79 + 5X69

**Subject to:**

Starting node

Node 1: X12 + X13 = 1

**Intermediate nodes**

Node 2: X12 = X25 + X24  or X12 - X25 - X24 = 0

Node 3: X13 = X35 or X13  -X35 = 0

Node 4: X24 =X47 + X46 or X24 -X46 -X47 = 0

Node 5: X35  + X25 = X58 + X57 or X35  + X25 - X58 - X57 = 0

Node 6: X46 = X69 or X46 - X69 = 0

Node 7: X47 + X57 = X79  or X47 + X57  - X79  =0

Node 8: X58  = X89  or X58  - X89  = 0

**Finished node**

Node 9: X69 + X79 + X89 = 1

Xij ≥ 0

See file named Celijah5.lp for the Formulation and solutions. The optimal solution is Z = 17

2a) **Selecting an Investment Portfolio**

**To create objective function, we first calculate Expected return of stock then use that as our maximization function.**

**Therefore:**

S1 = x1 = 2\*(1+0.05)/40+0.05 = 10.25

S2 = x2 = 1.50\*(1+0.10)/50+0.10 = 13.3

S3 = x4 = 3.50\*(1+0.03)/80+0.03 = 7.51

H1 = x5 = 3\*(1+0.04)/60+0.04 = 9.2

H2 = x6 = 2\*(1+0.07)/45+0.07 = 11.76

H3 = x7 = 1\*(1+0.15)/60+0.15 = 16.92

C1 = x8 = 1.80\*(1+0.22)/30+0.22 = 29.32

C2 = x9 = 0\*(1+0.25)/25+0.25 = 0

Objective functions:

Max z = 1.1025x1 + 1.133x2 + 1.075x3 + 1.092x4 + 1.1176x5 + 1.1692x6 + 1.2932x7 + 0x8

Constraints:

x1 + x2 + x3 + x4 + x5 + x6 + x7 + x8 = 2500000

x1 + x2 + x3 <= 1000000

x4 + x5 + x6 <= 1000000

x7 + x8 <= 1000000

x1 >= 100000

x2 >= 100000

x3 >= 100000

x4 >= 100000

x5 >= 100000

x6 >= 100000

x7 >= 100000

x8 >= 100000

x1 = 1000y1

x2 = 1000y2

x3 = 1000y3

x4 = 1000y4

x5 = 1000y5

x6 = 1000y6

x7 = 1000y7

x8 = 1000y8

**Maximum amount invested in1 sector: 2.5 million\*40%** = 1million

Minimum investment in each stock = .1million

Return on the portfolio if invested equally => (10.25 +13.3 + 7.51 + 9.2 + 11.76 + 16.92 + 29.32 + 0)/8 = 12.28

$40% investment in sector 3(c1, c2) => C1 = 900,000

C2 = 100,000

40% investment in sector 3(H1, H2, H3) => H1 = 100,000

H2 = 100,000

H3 = 800,000

Balance in sector 1(S1, S2, S3) => S1 = 100000

S2 = 300000

S3 = 100000

Please see Celijah\_5.lp and R file for formulation and solutions.