CS 325 HW 4 Su17

Zhouxiang Meng

1. Shortest Paths using LP: **(5 points)**

   a) Find the distance of the shortest path from G to C in the graph below.

```
Max c
st
g= 0
a-f <=5
a-h <=4
b-a <=8
b-h <=9
b-f <=7
c-b <=4
c-f <=3
d-c <=3
d-e <=9
d-g <=2
e-b <=10
e-d <=25
e-f <=2
f-a <=10
f-d <=18
g-e <=7
h-g <=3
```

```
LP OPTIMUM FOUND AT STEP      0

       OBJECTIVE FUNCTION VALUE

       1)      16.00000

 VARIABLE        VALUE          REDUCED COST
        C        16.000000          0.000000
        G         0.000000          0.000000
        A         7.000000          0.000000
        F        17.000000          0.000000
        H         3.000000          0.000000
        B        12.000000          0.000000
        D         2.000000          0.000000
        E        19.000000          0.000000

      ROW   SLACK OR SURPLUS     DUAL PRICES
        2)         0.000000          1.000000
        3)        15.000000          0.000000
        4)         0.000000          0.000000
        5)         3.000000          0.000000
        6)         0.000000          1.000000
        7)        12.000000          0.000000
        8)         0.000000          1.000000
        9)         4.000000          0.000000
       10)        17.000000          0.000000
       11)        26.000000          0.000000
       12)         0.000000          0.000000
       13)         3.000000          0.000000
       14)         8.000000          0.000000
       15)         0.000000          0.000000
       16)         0.000000          0.000000
       17)         3.000000          0.000000
       18)        26.000000          0.000000
       19)         0.000000          1.000000

NO. ITERATIONS=       0
```

The shortest path from G to C is 16, which is G -> H -> B -> C.

b) Find the distances of the shortest paths from G to all other vertices.

```
Max a+b+c+d+e+f+g+h
st
g= 0
a-f <=5
a-h <=4
b-a <=8
b-h <=9
b-f <=7
c-b <=4
c-f <=3
d-c <=3
d-e <=9
d-g <=2
e-b <=10
e-d <=25
e-f <=2
f-a <=10
f-d <=18
g-e <=7
h-g <=3
```

```
                OBJECTIVE FUNCTION VALUE

       1)      76.00000

 VARIABLE        VALUE          REDUCED COST
        A       7.000000          0.000000
        B      12.000000          0.000000
        C      16.000000          0.000000
        D       2.000000          0.000000
        E      19.000000          0.000000
        F      17.000000          0.000000
        G       0.000000          0.000000
        H       3.000000          0.000000


      ROW    SLACK OR SURPLUS     DUAL PRICES
       2)         0.000000          8.000000
       3)        15.000000          0.000000
       4)         0.000000          3.000000
       5)         3.000000          0.000000
       6)         0.000000          2.000000
       7)        12.000000          0.000000
       8)         0.000000          1.000000
       9)         4.000000          0.000000
      10)        17.000000          0.000000
      11)        26.000000          0.000000
      12)         0.000000          1.000000
      13)         3.000000          0.000000
      14)         8.000000          0.000000
      15)         0.000000          1.000000
      16)         0.000000          2.000000
      17)         3.000000          0.000000
      18)        26.000000          0.000000
      19)         0.000000          6.000000

NO. ITERATIONS=       6
```

The shortest path from G to A is 7, G to B is 12, G to C is 16, G to D is 2, G to E is 19, G to F is 17, G to H is 3.

2. Product Mix: **(10 points)**

a) Formulate the problem as a linear program with an objective function and all constraints.

```
Max 3.45s+2.32p+2.81b+3.25c
st
s >=6000
s <=7000
p >=10000
p <=14000
b >=13000
b <=16000
c >=6000
c <=8500
0.125s <=1000
0.08p+0.05b+0.03c <=2000
0.05b+0.07c <=1250
```

. b) Determine the optimal solution for the linear program using any software you want. Include a copy of the code and output.

```
Max 3.45s+2.32p+2.81b+3.25c
st
s >=6000
s <=7000
p >=10000
p <=14000
b >=13000
b <=16000
c >=6000
c <=8500
0.125s <=1000
0.08p+0.05b+0.03c <=2000
0.05b+0.07c <=1250
```

```
LP OPTIMUM FOUND AT STEP      4

        OBJECTIVE FUNCTION VALUE

 1)      120196.0

 VARIABLE        VALUE          REDUCED COST
        S      7000.000000          0.000000
        P     13625.000000          0.000000
        B     13100.000000          0.000000
        C      8500.000000          0.000000

      ROW    SLACK OR SURPLUS     DUAL PRICES
       2)      1000.000000          0.000000
       3)         0.000000          3.450000
       4)      3625.000000          0.000000
       5)       375.000000          0.000000
       6)       100.000000          0.000000
       7)      2900.000000          0.000000
       8)      2500.000000          0.000000
       9)         0.000000          0.476000
      10)       125.000000          0.000000
      11)         0.000000         29.000000
      12)         0.000000         27.200001

NO. ITERATIONS=       4
```

. c) What are the optimal numbers of ties of each type to maximize profit?

. The number of each ties is 7000 for Silk,13625 for Poly, 13100 for Blend1, 8500 for Blend2. The optimal profit is 120196.

3. Transshipment Model **(10 points)**

. a) Formulate the problem as a linear program with an objective function and all constraints.

```
Min 10cp11+15cp12+11cp21+8cp22+13cp31+8cp32+9cp33
+14cp42+8cp43+5cw11+6cw12+7cw13+10cw14+12cw23+8cw24
+10cw25+14cw26+14cw34+12cw35+12cw36+6cw37
st
cp11+cp12 =150
cp21+cp22 =450
cp31+cp32+cp33 =250
cp42+cp43 =150
cw11 >=100
cw12 >=150
cw13+cw23 >=100
cw14+cw24+cw34 >=200
cw25+cw35 >=200
cw26+cw36 >=150
cw37 >=100
cp11+cp21+cp31-cw11-cw12-cw13-cw14 >=0
cp12+cp22+cp32+cp42-cw23-cw24-cw25-cw26 >=0
cp33+cp43-cw34-cw35-cw36-cw37 >=0
```

.

. b) Determine the optimal solution for the linear program using any software you want. Include a copy of the code and output.

```
Min 10cp11+15cp12+11cp21+8cp22+13cp31+8cp32+9cp33
+14cp42+8cp43+5cw11+6cw12+7cw13+10cw14+12cw23+8cw24
+10cw25+14cw26+14cw34+12cw35+12cw36+6cw37
st
cp11+cp12 =150
cp21+cp22 =450
cp31+cp32+cp33 =250
cp42+cp43 =150
cw11 >=100
cw12 >=150
cw13+cw23 >=100
cw14+cw24+cw34 >=200
cw25+cw35 >=200
cw26+cw36 >=150
cw37 >=100
cp11+cp21+cp31-cw11-cw12-cw13-cw14 >=0
cp12+cp22+cp32+cp42-cw23-cw24-cw25-cw26 >=0
cp33+cp43-cw34-cw35-cw36-cw37 >=0
```

.

```
LP OPTIMUM FOUND AT STEP     15

        OBJECTIVE FUNCTION VALUE

        1)      17100.00

 VARIABLE        VALUE          REDUCED COST
     CP11       150.000000          0.000000
     CP12         0.000000          8.000000
     CP21       200.000000          0.000000
     CP22       250.000000          0.000000
     CP31         0.000000          2.000000
     CP32       150.000000          0.000000
     CP33       100.000000          0.000000
     CP42         0.000000          7.000000
     CP43       150.000000          0.000000
     CW11       100.000000          0.000000
     CW12       150.000000          0.000000
     CW13       100.000000          0.000000
     CW14         0.000000          5.000000
     CW23         0.000000          2.000000
     CW24       200.000000          0.000000
     CW25       200.000000          0.000000
     CW26         0.000000          1.000000
     CW34         0.000000          7.000000
     CW35         0.000000          3.000000
     CW36       150.000000          0.000000
     CW37       100.000000          0.000000


       ROW    SLACK OR SURPLUS      DUAL PRICES
        2)          0.000000         -7.000000
        3)          0.000000         -8.000000
        4)          0.000000         -8.000000
        5)          0.000000         -7.000000
        6)          0.000000         -8.000000
        7)          0.000000         -9.000000
        8)          0.000000        -10.000000
        9)          0.000000         -8.000000
       10)          0.000000        -10.000000
       11)          0.000000        -13.000000
       12)          0.000000         -7.000000
       13)          0.000000         -3.000000
       14)          0.000000          0.000000
       15)          0.000000         -1.000000

 NO. ITERATIONS=       15
```

c) What are the optimal shipping routes and minimum cost.

P1 to W1 is 150, P2 to W1 is 200, P2 to W2 is 250, P3 to W2 is 150, P3 to W3 is 100, P4 to W3 is 150.
W1 to R1 is 100, W1 to R2 is 150, W1 to R3 is 100, W2 to R4 is 200, W2 to R5 is 200, W3 to R6 is 150, W3 to R7 is 100.