yli130_Assignment6

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Question 1

```
lp file:

// Objective function
max: 5 x12 + 3 x13 + 3 x35 + 2 x25 + 4 x24 + 6 x57 + 2 x58 + 1 x46 + 4 x47 + 5 x69 + 4 x79 + 7 x89;

// Constraints
x12 + x13 <= 1;
x35 + x25 + x24 <= 1;
x58 + x57 + x46 + x47 <= 1;
x69 + x79 + x89 <= 1;
x12 + x35 <= 1;
x13 + x24 + x25 <= 1;
x35 + x46 + x47 <= 1;
x25 + x46 + x47 <= 1;
x24 + x57 + x58 <= 1;
x58 + x69 + x79 <= 1;
x57 + x69 + x89 <= 1;
x47 + x69 + x89 <= 1;
x46 + x79 + x89 <= 1;

bin x12, x13, x35, x25, x24, x57, x58, x46, x47, x69, x79, x89;
```

```r
library(lpSolveAPI)                       # import library
Question_1 <- read.lp('Question_1.lp')    # import lp file

solve(Question_1)                         # solve lp file
```

```
## [1] 0
```

```r
get.objective(Question_1)                 # get the objective function value
```

```
## [1] 17
```

```r
get.variables(Question_1)                 # get the decision variables value
```

```
##  [1] 1 0 0 1 0 1 0 0 0 0 1 0
```

From the objective value, the longest path is 17.

The path is 1-2-5-7-9.

Question 2

Integer

```
integer lp file:

// Objective function
max: 4000 x1 + 6500 x2 + 5900 x3 + 5400 x4 + 5150 x5 + 10000 x6 + 8400 x7 + 6250 x8;

// Constraints
T: 40 x1 + 50 x2 + 80 x3 + 60 x4 + 45 x5 + 60 x6 + 30 x7 + 25 x8 <= 2500;
S: 40 x1 + 50 x2 + 80 x3 <= 1000;
H: 60 x4 + 45 x5 + 60 x6 <= 1000;
C: 30 x7 + 25 x8 <= 1000;
S1: 40 x1 >= 100;
S2: 50 x2 >= 100;
S3: 80 x3 >= 100;
H1: 60 x4 >= 100;
H2: 45 x5 >= 100;
H3: 60 x6 >= 100;
C1: 30 x7 >= 100;
C2: 25 x8 >= 100;

// Integer definitions
int x1, x2, x3, x4 ,x5, x6, x7, x8;
```

```
Question_2_int <- read.lp("Question_2.lp")    # import lp file
Question_2_int                                # show lp file
```

```
## Model name: 
##                x1     x2     x3     x4     x5     x6     x7     x8          
## Maximize     4000   6500   5900   5400   5150  10000   8400   6250          
## T              40     50     80     60     45     60     30     25  <=  2500
## S              40     50     80      0      0      0      0      0  <=  1000
## H               0      0      0     60     45     60      0      0  <=  1000
## C               0      0      0      0      0      0     30     25  <=  1000
## S1             40      0      0      0      0      0      0      0  >=   100
## S2              0     50      0      0      0      0      0      0  >=   100
## S3              0      0     80      0      0      0      0      0  >=   100
## H1              0      0      0     60      0      0      0      0  >=   100
## H2              0      0      0      0     45      0      0      0  >=   100
## H3              0      0      0      0      0     60      0      0  >=   100
## C1              0      0      0      0      0      0     30      0  >=   100
## C2              0      0      0      0      0      0      0     25  >=   100
## Kind          Std    Std    Std    Std    Std    Std    Std    Std          
## Type          Int    Int    Int    Int    Int    Int    Int    Int          
## Upper         Inf    Inf    Inf    Inf    Inf    Inf    Inf    Inf          
## Lower           0      0      0      0      0      0      0      0          
```

```
solve(Question_2_int)                         # solve lp file
```

```
## [1] 0
```

```r
get.variables(Question_2_int)                        # get decision variables value
```

```
## [1]  3  5  2  2  3 12 29  5
```

```r
get.objective(Question_2_int)                        # get objective function value
```

```
## [1] 477400
```

result data frame

```r
# Create Columns
Types <- c('S1', 'S2', 'S3', 'H1', 'H2', 'H3', 'C1', 'C2')
Number_of_Shares <- c(3000, 5000, 2000, 2000, 3000, 12000, 29000, 5000)
Dollar_Amount <- c(120000, 250000, 160000, 120000, 135000, 720000, 870000, 125000)

# Create data frame
Shares_dataframe <- data.frame(Types, Number_of_Shares, Dollar_Amount)

# show data frame
Shares_dataframe
```

```
##   Types Number_of_Shares Dollar_Amount
## 1    S1             3000        120000
## 2    S2             5000        250000
## 3    S3             2000        160000
## 4    H1             2000        120000
## 5    H2             3000        135000
## 6    H3            12000        720000
## 7    C1            29000        870000
## 8    C2             5000        125000
```

Total dollar return from both growth and dividends over the course of coming year is 477400.

No Integer

```
lp file:

// Objective function
max: 4000 x1 + 6500 x2 + 5900 x3 + 5400 x4 + 5150 x5 + 10000 x6 + 8400 x7 + 6250 x8;

// Constraints
T: 40 x1 + 50 x2 + 80 x3 + 60 x4 + 45 x5 + 60 x6 + 30 x7 + 25 x8 <= 2500;
S: 40 x1 + 50 x2 + 80 x3 <= 1000;
H: 60 x4 + 45 x5 + 60 x6 <= 1000;
C: 30 x7 + 25 x8 <= 1000;
S1: 40 x1 >= 100;
S2: 50 x2 >= 100;
S3: 80 x3 >= 100;
H1: 60 x4 >= 100;
H2: 45 x5 >= 100;
H3: 60 x6 >= 100;
C1: 30 x7 >= 100;
C2: 25 x8 >= 100;
```

```
Question_2_not_integer <- read.lp('Question_2_not_integer.lp') # import data
Question_2_not_integer                                        # show lp file
```

```
## Model name: 
##                x1     x2     x3     x4     x5     x6     x7     x8            
## Maximize     4000   6500   5900   5400   5150  10000   8400   6250            
## T              40     50     80     60     45     60     30     25  <=  2500
## S              40     50     80      0      0      0      0      0  <=  1000
## H               0      0      0     60     45     60      0      0  <=  1000
## C               0      0      0      0      0      0     30     25  <=  1000
## S1             40      0      0      0      0      0      0      0  >=   100
## S2              0     50      0      0      0      0      0      0  >=   100
## S3              0      0     80      0      0      0      0      0  >=   100
## H1              0      0      0     60      0      0      0      0  >=   100
## H2              0      0      0      0     45      0      0      0  >=   100
## H3              0      0      0      0      0     60      0      0  >=   100
## C1              0      0      0      0      0      0     30      0  >=   100
## C2              0      0      0      0      0      0      0     25  >=   100
## Kind          Std    Std    Std    Std    Std    Std    Std    Std            
## Type         Real   Real   Real   Real   Real   Real   Real   Real            
## Upper         Inf    Inf    Inf    Inf    Inf    Inf    Inf    Inf            
## Lower           0      0      0      0      0      0      0      0
```

```
solve(Question_2_not_integer)                                 # solve lp file
```

```
## [1] 0
```

```
get.variables(Question_2_not_integer)                         # get decision variables value
```

```
## [1]  2.500000  6.000000  1.250000  1.666667  2.222222 13.333333 30.000000
## [8]  4.000000
```

```
get.objective(Question_2_not_integer)                         # get objective function values
```

```
## [1] 487152.8
```

Total dollar return for no integer restriction is is 487152.8.

Compare Solution

```
# create columns
Types <- c('S1', 'S2', 'S3', 'H1', 'H2', 'H3', 'C1', 'C2')
Quantity_Integer <- c(3000, 5000, 2000, 2000, 3000, 12000, 29000, 5000)
Quantity_No_Integer <- c(2500, 6000, 1250, 1667, 2222, 13333, 30000, 4000)
# calculate alter percentage
Integer_change <- (Quantity_Integer - Quantity_No_Integer) / (Quantity_No_Integer)
Percentage_change <- c('20%', '-16.7%', '60%', '19.98%', '35%', '-10%', '-3.33%', '25%')
```

```
# create data frame
Compare_dataframe <- data.frame(Types, Quantity_Integer, Quantity_No_Integer,
                                                             Percentage_change)

# show data frame
Compare_dataframe
```

```
##   Types Quantity_Integer Quantity_No_Integer Percentage_change
## 1    S1             3000                2500               20%
## 2    S2             5000                6000            -16.7%
## 3    S3             2000                1250               60%
## 4    H1             2000                1667            19.98%
## 5    H2             3000                2222               35%
## 6    H3            12000               13333              -10%
## 7    C1            29000               30000            -3.33%
## 8    C2             5000                4000               25%
```

Total dollar return for integer is 477400.

Total dollar return for no integer restriction is is 487152.8.

Percentage for integer restriction change is (477400 - 487152.8)/487152.8 = -0.02 = -2%.

Integer restriction makes the amount of objective function decrease 2%.