QMM_Assignment_2

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```
library(lpSolve)
```

```
## Warning: package 'lpSolve' was built under R version 4.3.3
```

```
A12 <- matrix(c(20,900,420,15,1200,360,12,750,300), nrow = 3, ncol = 3, byrow = TRUE)
colnames(A12) <-(c('Space_Req', 'Sales Forecast(PerDay)', 'Profit'))
rownames(A12) <-(c('Large', 'Medium','Small'))
A12
```

```
##        Space_Req Sales Forecast(PerDay) Profit
## Large         20                   900    420
## Medium        15                  1200    360
## Small         12                   750    300
```

```
A12 = matrix(c(750,900,450), nrow = 3, ncol = 1, byrow = TRUE)
colnames(A12)=(c('Excess Capacity'))
rownames(A12)=(c('Plantl', 'Plant2', 'Plant3'))
A12
```

```
##        Excess Capacity
## Plantl             750
## Plant2             900
## Plant3             450
```

Let L1, M1, S1 = Number of large, medium, and small units produced at Plant 1 L2, M2, S2 = Number of large, medium, and small units produced at Plant 2 L3, M3, S3 = Number of large, medium, and small units produced at Plant 3

The objective function is

```
Max Z = 420(L1 + L2 + L3) + 360(M1 + M2 + M3) + 300(S1 + S2 + S3)
```

Rearranging this, the objective becomes

```
Max Z = 420L1 + 360M1 + 300S1 + 420L2 + 360M2 + 300S2 + 420L3 + 360M3 + 300S3
```

subject to the following constraints.,

Production Capacity Constraints:

```
L1 + M1 + S1 ≤ 750
L2 + M2 + S2 ≤ 900
L3 + M3 + S3 ≤ 450
```

Storage Space Constraints:

```
20L1 + 15M1 + 12S1 ≤ 13000
20L2 + 15M2 + 12S2 ≤ 12000
20L3 + 15M3 + 12S3 ≤ 5000
```

Sales Forecast Constraints:

```
L1 + L2 + L3 ≤ 900
M1 + M2 + M3 ≤ 1200
S1 + S2 + S3 ≤ 750
```

Capacity Usage Equality:

(L1 + M1 + S1) ∗ (100/750) = (L2 + M2 + S2) ∗ (100/900) = (L3 + M3 + S3) ∗ (100/450)
Non negativity constraints:

```
    L1, L2, L3, M1, M2, M3, S1, S2, S3 ≥ 0
```

```
#Objective Function
Object <- c(420, 360, 300, 420, 360, 300, 420, 360, 300)
```

```
#Constraints

Cnstrants  <- matrix(c(

  # Production capacity
  1, 1, 1, 0, 0, 0, 0, 0, 0,  # Plant 1
  0, 0, 0, 1, 1, 1, 0, 0, 0,  # Plant 2
  0, 0, 0, 0, 0, 0, 1, 1, 1,  # Plant 3

  # Storage
  20, 15, 12, 0, 0, 0, 0, 0, 0,  # Plant 1
  0, 0, 0, 20, 15, 12, 0, 0, 0,  # Plant 2
  0, 0, 0, 0, 0, 0, 20, 15, 12,  # Plant 3

  # Sales forecast
  1, 0, 0, 1, 0, 0, 1, 0, 0,  # Large units
  0, 1, 0, 0, 1, 0, 0, 1, 0,  # Medium units
  0, 0, 1, 0, 0, 1, 0, 0, 1,  # Small units

  6, 6, 6, -5, -5, -5, 0, 0, 0,
  0, 0, 0, 1, 1, 1, -2, -2, -2,
  3, 3, 3, 0, 0, 0, -5, -5, -5

), nrow=12, byrow=TRUE)
Cnstrants
```

```
##       [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9]
##  [1,]    1    1    1    0    0    0    0    0    0
##  [2,]    0    0    0    1    1    1    0    0    0
##  [3,]    0    0    0    0    0    0    1    1    1
##  [4,]   20   15   12    0    0    0    0    0    0
##  [5,]    0    0    0   20   15   12    0    0    0
##  [6,]    0    0    0    0    0    0   20   15   12
##  [7,]    1    0    0    1    0    0    1    0    0
##  [8,]    0    1    0    0    1    0    0    1    0
##  [9,]    0    0    1    0    0    1    0    0    1
## [10,]    6    6    6   -5   -5   -5    0    0    0
## [11,]    0    0    0    1    1    1   -2   -2   -2
## [12,]    3    3    3    0    0    0   -5   -5   -5
```

```
#Define the constraint direction
Direct<-c("<=","<=","<=","<=","<=","<=","<=","<=","<=","=","=","=")
Direct
```

```
##  [1] "<=" "<=" "<=" "<=" "<=" "<=" "<=" "<=" "<=" "="  "="  "="
```

```
# RHS of the constraints
RHS <- c(750, 900, 450, 13000, 12000, 5000, 900, 1200, 750, 0, 0, 0)
RHS
```

```
##  [1]   750   900   450 13000 12000  5000   900  1200   750     0     0     0
```

```
#Solve the linear programming problem
linear_prog_result <-lp("max", Object, Cnstrants, Direct, RHS)
linear_prog_result
```

```
## Success: the objective function is 696000
```

```
#Values of decision variables
linear_prog_result$solution
```

```
## [1] 516.6667 177.7778   0.0000   0.0000 666.6667 166.6667   0.0000   0.0000
## [9] 416.6667
```