QUANTITATIVE MANAGEMENT MODELING

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```
#installation("lpSolve")

library("lpSolve") #Activation of lpSolve Package
```

To solve the problem we need to define the objective, constraints, direction and constants

Objective Function

$$\text{Objective function is to } Max \;\; Z = 420(Q_1 + Q_2 + Q_3) + 360(M_1 + M_2 + M_3) + 300(P_1 + P_2 + P_3)$$

$$

$$

$$\text{that can be written as } Z = 420Q_1 + 360M_1 + 300P_1 + 420Q_2 + 360M_2 + 300P_2 + 420Q_3 + 360M_3 + 300P_3$$

Subject to the following constraints

$$Q_1 + M_1 + P_1 \leq 750$$

$$Q_2 + M_2 + P_2 \leq 900$$

$$Q_3 + M_3 + P_3 \leq 450$$

$$20Q_1 + 15M_1 + 12P_1 \leq 13000$$

$$20Q_2 + 15M_2 + 12P_2 \leq 12000$$

$$20Q_3 + 15M_3 + 12P_3 \leq 5000$$

$$Q_1 + Q_2 + Q_3 \leq 900$$

$$M_1 + M_2 + M_3 \leq 1200$$

$$P_1 + P_2 + P_3 \leq 750$$

Non Negativity Constraints

$$Q_1, Q_2, Q_3, M_1, M_2, M_3, P_1, P_2, P_3 \geq 0$$

The above constraints can be written as below

$$Q_1 + M_1 + P_1 + 0Q_2 + 0M_2 + 0P_2 + 0Q_3 + 0M_3 + 0P_3 \leq 750$$

$$0Q_1 + 0M_1 + 0P_1 + Q_2 + M_2 + P_2 + 0Q_3 + 0M_3 + 0P_3 \leq 900$$

$$0Q_1 + 0M_1 + 0P_1 + 0Q_2 + 0M_2 + 0P_2 + Q_3 + M_3 + P_3 \leq 450$$

$$20Q_1 + 15M_1 + 12P_1 + 0Q_2 + 0M_2 + 0P_2 + 0Q_3 + 0M_3 + 0P_3 \leq 13000$$

$$0Q_1 + 0M_1 + 0P_1 + 20Q_2 + 15M_2 + 12P_2 + 0Q_3 + 0M_3 + 0P_3 \leq 12000$$

$$0Q_1 + 0M_1 + 0P_1 + 0Q_2 + 0M_2 + 0P_2 + 20Q_3 + 15M_3 + 12P_3 \leq 5000$$

$$Q_1 + 0M_1 + 0P_1 + Q_2 + 0M_2 + 0P_2 + Q_3 + 0M_3 + 0P_3 \leq 900$$

$$0Q_1 + M_1 + 0P_1 + 0Q_2 + M_2 + 0P_2 + 0Q_3 + M_3 + 0P_3 \leq 1200$$

$$0Q_1 + 0M_1 + P_1 + 0Q_2 + 0M_2 + P_2 + 0Q_3 + 0M_3 + P_3 \leq 750$$

Describing the Objective Function - f.obj

```
f.obj <- c(420,360,300,420,360,300,420,360,300)
```

Describing the Constraints - f.con

```
f.con <- matrix(c(1,1,1,0,0,0,0,0,0,
                  0,0,0,1,1,1,0,0,0,
                  0,0,0,0,0,0,1,1,1,
                  20,15,12,0,0,0,0,0,0,
                  0,0,0,20,15,12,0,0,0,
                  0,0,0,0,0,0,20,15,12,
                  1,0,0,1,0,0,1,0,0,
                  0,1,0,0,1,0,0,1,0,
                  0,0,1,0,0,1,0,0,1), nrow = 9, byrow=T)
```

Describing the Direction of the constraints - f.dir

```
f.dir <- c('<=',

           '<=',

           '<=',

           '<=',

           '<=',

           '<=',

           '<=',

           '<=',

           '<=')
```

Describing the constants i.e. the right hand side values - f.rhs

```
f.rhs <- c(750,900,450,13000,12000,5000,900,1200,750)
```

Calling the lp function to solve the problem basing the objective function i.e. to maximize the profits

```
lp('max',f.obj,f.con,f.dir,f.rhs)
```

```
## Success: the objective function is 708000
```

Calling the lp function again to get the values for the variables defined above

```
lp('max',f.obj,f.con,f.dir,f.rhs)$solution
```

```
## [1] 350.0000 400.0000   0.0000   0.0000 400.0000 500.0000   0.0000 133.3333
## [9] 250.0000
```