MANOJ QMM MODULE 4

2023-09-24

Suppose,

Large units produced at Plant 1 : X_{l1}

Medium units produced at Plant 1 : X_{m1}

Small units produced at Plant 1 : X_{s1}

Large units produced at Plant 2 : X_{l2}

Medium units produced at Plant 2 : X_{m2}

Small units produced at Plant 2 : X_{s2}

Large units produced at Plant 3 : X_{l3}

Medium units produced at Plant 3 : X_{m3}

Small units produced at Plant 3 : X_{s3}

objective function can be given as follows:

Maximize Z = $420(X_{l1} + X_{l2} + X_{l3}) + 360(X_{m1} + X_{m2} + X_{m3}) + 300(X_{s1} + X_{s2} + X_{s3})$

Expanding the equation =
$420X_{l1} + 360X_{m1} + 300X_{s1} + 420X_{l2} + 360X_{m2} + 300X_{s2} + 420X_{l3} + 360X_{m3} + 300X_{s3}$

Constraints can be given as :

Production Capacity Constraints:

The production levels at each plant must not exceed their individual daily capacity limits. These limits are 750, 900, and 450 units per day for the respective plants, indicating an available excess capacity..

$X_{l1} + X_{m1} + X_{s1} \leq 750$

$X_{l2} + X_{m2} + X_{s2} \leq 900$

$X_{l3} + X_{m3} + X_{s3} \leq 450$

Storage Space Constraints:

Each plant should ensure that the production of each size remains within the capacity of the available in-process storage.

$20X_{l1} + 15X_{m1} + 12X_{s1} \leq 13000$

$20X_{l2} + 15X_{m2} + 12X_{s2} \leq 12000$

$20X_{l3} + 15X_{m3} + 12X_{s3} \leq 5000$

Demand Constraints:

The production of each size should align the sales forecasts.

$X_{l1} + X_{m1} + X_{s1} \leq 900$

$X_{l2} + X_{m2} + X_{s2} \leq 1200$

$X_{l3} + X_{m3} + X_{s3} \leq 750$

Employee Layoff Constraints:

$$(X_{l1} + X_{m1} + X_{s1})/750 = (X_{l2} + X_{m2} + X_{s2})/900 = (X_{l3} + X_{m3} + X_{s3})/450$$

Non negativity constraints:

$$X_l > 0, X_m > 0, X_s > 0$$

The constraints can be given as :

$$X_{l1} + X_{m1} + X_{s1} + 0X_{l2} + 0X_{m2} + 0X_{s2} + 0X_{l3} + 0X_{m3} + 0X_{s3} \leq 750$$

$$0X_{l1} + 0X_{m1} + 0X_{s1} + X_{l2} + X_{m2} + X_{s2} + 0X_{l3} + 0X_{m3} + 0X_{s3} \leq 900$$

$$0X_{l1} + 0X_{m1} + 0X_{s1} + 0X_{l2} + 0X_{m2} + 0X_{s2} + X_{l3} + X_{m3} + X_{s3} \leq 450$$

$$20X_{l1} + 15X_{m1} + 12X_{s1} + 0X_{l2} + 0X_{m2} + 0X_{s2} + 0X_{l3} + 0X_{m3} + 0X_{s3} \leq 13000$$

$$0X_{l1} + 0X_{m1} + 0X_{s1} + 20X_{l2} + 15X_{m2} + 12X_{s2} + 0X_{l3} + 0X_{m3} + 0X_{s3} \leq 12000$$

$$0X_{l1} + 0X_{m1} + 0X_{s1} + 0X_{l2} + 0X_{m2} + 0X_{s2} + 20X_{l3} + 15X_{m3} + 12X_{s3} \leq 5000$$

$$X_{l1} + 0X_{m1} + 0X_{s1} + X_{l2} + 0X_{m2} + 0X_{s2} + X_{l3} + 0X_{m3} + 0X_{s3} \leq 900$$

$$0X_{l1} + X_{m1} + 0X_{s1} + 0X_{l2} + X_{m2} + 0X_{s2} + 0X_{l3} + X_{m3} + 0X_{s3} \leq 1200$$

$$0X_{l1} + 0X_{m1} + X_{s1} + 0X_{l2} + 0X_{m2} + X_{s2} + 0X_{l3} + 0X_{m3} + X_{s3} \leq 750$$

```
library(lpSolve)
# Objective function creation

objective__function<-c(420,360,300,420,360,300,420,360,300)

#Constraint Matrix

constraints__matrix<-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 = TRUE)

# inequality signs

Directions<-c("<=",
"<=",
"<=",
"<=",
"<=",
"<=",
"<=",
"<=",
"<=")

# Right hand side coefficients

RHS<-c(750,900,450,13000,12000,5000,900,1200,750)

#Get the value of objective function

lp('max',objective__function,constraints__matrix,Directions,RHS)
```

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

```
#Get the value of decision variables

lp('max',objective__function,constraints__matrix,Directions,RHS)$solution
```

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