Qmm assignment module 4

2023-09-24

Suppose,

No.of large units produced at Plant 1 : Y_{l1}

No.of medium units produced at Plant 1 : Y_{m1}

No.of small units produced at Plant 1 : Y_{S1}

No.of large units produced at Plant 2 : Y_{l2}

No.of medium units produced at Plant 2 : Y_{m2}

No.of small units produced at Plant 2 : Y_{S2}

No.of large units produced at Plant 3 : Y_{l3}

No.of medium units produced at Plant 3 : Y_{m3}

No.of small units produced at Plant 3 : Y_{S3}

objective function:

Maximize Z = $420(Y_{l1} + Y_{l2} + Y_{l3}) + 360(Y_{m1} + Y_{m2} + Y_{m3}) + 300(Y_{S1} + Y_{S2} + Y_{S3})$

Expanding the equation =
$420Y_{l1} + 360Y_{m1} + 300Y_{S1} + 420Y_{l2} + 360Y_{m2} + 300Y_{S2} + 420Y_{l3} + 360Y_{m3} + 300Y_{S3}$

Constraints:

Production Capacity Constraints:

The production output at each plant should remain within the capacity limits of the respective plants. Each plant has excess capacity of 750, 900, and 450 units per day, respectively.

$Y_{l1} + Y_{m1} + Y_{S1} \leq 750$

$Y_{l2} + Y_{m2} + Y_{S3} \leq 900$

$Y_{l3} + Y_{m3} + Y_{S3} \leq 450$

Storage Space Constraints:

The production of each size at each plant should stay within the available in-process storage capacity.

$20Y_{l1} + 15Y_{m1} + 12Y_{S1} \leq 13000$

$20Y_{l2} + 15Y_{m2} + 12Y_{S3} \leq 12000$

$20Y_{l3} + 15Y_{m3} + 12Y_{S3} \leq 5000$

Demand Constraints:

The production of each size should align the sales forecasts.

$Y_{l1} + Y_{m1} + Y_{S1} \leq 900$

$Y_{l2} + Y_{m2} + Y_{S3} \leq 1200$

$Y_{l3} + Y_{m3} + Y_{S3} \leq 750$

Employee Layoff Constraints:

$$(Y_{l1} + Y_{m1} + Y_{S1})/750 = (Y_{l2} + Y_{m2} + Y_{S3})/900 = (Y_{l3} + Y_{m3} + Y_{S3})/450$$

Non negativity constraints:

$$Y_l > 0, Y_m > 0, Y_s > 0$$

The constraints can be written as follows

$$Y_{l1} + Y_{m1} + Y_{S1} + 0Y_{l2} + 0Y_{m2} + 0Y_{S2} + 0Y_{l3} + 0Y_{m3} + 0Y_{S3} \leq 750$$

$$0Y_{l1} + 0Y_{m1} + 0Y_{S1} + Y_{l2} + Y_{m2} + Y_{S2} + 0Y_{l3} + 0Y_{m3} + 0Y_{S3} \leq 900$$

$$0Y_{l1} + 0Y_{m1} + 0Y_{S1} + 0Y_{l2} + 0Y_{m2} + 0Y_{S2} + Y_{l3} + Y_{m3} + Y_{S3} \leq 450$$

$$20Y_{l1} + 15Y_{m1} + 12Y_{S1} + 0Y_{l2} + 0Y_{m2} + 0Y_{S2} + 0Y_{l3} + 0Y_{m3} + 0Y_{S3} \leq 13000$$

$$0Y_{l1} + 0Y_{m1} + 0Y_{S1} + 20Y_{l2} + 15Y_{m2} + 12Y_{S2} + 0Y_{l3} + 0Y_{m3} + 0Y_{S3} \leq 12000$$

$$0Y_{l1} + 0Y_{m1} + 0Y_{S1} + 0Y_{l2} + 0Y_{m2} + 0Y_{S2} + 20Y_{l3} + 15Y_{m3} + 12Y_{S3} \leq 5000$$

$$Y_{l1} + 0Y_{m1} + 0Y_{S1} + Y_{l2} + 0Y_{m2} + 0Y_{S2} + Y_{l3} + 0Y_{m3} + 0Y_{S3} \leq 900$$

$$0Y_{l1} + Y_{m1} + 0Y_{S1} + 0Y_{l2} + Y_{m2} + 0Y_{S2} + 0Y_{l3} + Y_{m3} + 0Y_{S3} \leq 1200$$

$$0Y_{l1} + 0Y_{m1} + Y_{S1} + 0Y_{l2} + 0Y_{m2} + Y_{S2} + 0Y_{l3} + 0Y_{m3} + Y_{S3} \leq 750$$

```
library(lpSolve)
#Creating Objective function

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

#Develop the Constraint Matrix

CONSTRAINT_FUNCTION<-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)

#Assign inequality signs

DIRECTIVES<-c("<=",
"<=",
"<=",
"<=",
"<=",
"<=",
"<=",
"<=",
"<=")
#write down Right hand side coefficients

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

#Obtain the objective function value

lp('max',OBJECTIVE_FUNCTION,CONSTRAINT_FUNCTION,DIRECTIVES,RIGHT_HAND_SIDE_VALUES)
```

```
## Success: the objective function is 708000
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##The objective function is : 708000
#Finally obtain the value of decision variables

lp('max',OBJECTIVE_FUNCTION,CONSTRAINT_FUNCTION,DIRECTIVES,RIGHT_HAND_SIDE_VALUES)$solution
```

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