nkollibo_2

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The below decision variables are:

For the quantities produced at Plant 1(P1):

L1: L1 is the no.of units of the Large size product

M1: M1 is the no.of units of the Medium size product

S1: S1 is the no.of units of the Small size product

For the quantities produced at Plant 2(P2):

L2: L2 is the no.of units of the Large size product

M2: M2 is the no.of units of the Medium size product

S2: S2 is the no.of units of the Small size product

For the quantities produced at Plant 3(P3):

L3: L3 is the no.of units of the Large size product

M3: M3 is the no.of units of the Medium size product

S3: S3 is the no.of units of the Small size product

Formulation of LP problem

Objective function is Zmax $= 420(L_1 + L_2 + L_3) + 360(M_1 + M_2 + M_3) + 300(S_1 + S_2 + S_3)$

Expanding the objective function Zmax $= 420L_1+360M_1+300S_1+420L_2+360M_2+300S_2+420L_3+360M_3+300S_3$

subject to

$$L_1 + M_1 + S_1 \leq 750$$

$$L_2 + M_2 + S_2 \leq 900$$

$$L_3 + M_3 + S_3 \leq 450$$

$$20L_1 + 15M_1 + 12S_1 \leq 13000$$

$$20L_2 + 15M_2 + 12S_2 \leq 12000$$

$$20L_3 + 15M_3 + 12S_3 \leq 5000$$

$$L_1 + L_2 + L_3 \leq 900$$

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

$$S_1 + S_2 + S_3 \leq 750$$

The non-negativity constraints

$$L_1, L_2, L_3, M_1, M_2, M_3, S_1, S_2, S_3 \geq 0$$

The above LP problem constraints can now be written as

$$L_1 + M_1 + S_1 + 0L_2 + 0M_2 + 0S_2 + 0L_3 + 0M_3 + 0S_3 \leq 750$$

$$0L_1 + 0M_1 + 0S_1 + L_2 + M_2 + S_2 + 0L_3 + 0M_3 + 0S_3 \leq 900$$

$$0L_1 + 0M_1 + 0S_1 + 0L_2 + 0M_2 + 0S_2 + L_3 + M_3 + S_3 \leq 450$$

$$20L_1 + 15M_1 + 12S_1 + 0L_2 + 0M_2 + 0S_2 + 0L_3 + 0M_3 + 0S_3 \leq 13000$$

$$0L_1 + 0M_1 + 0S_1 + 20L_2 + 15M_2 + 12S_2 + 0L_3 + 0M_3 + 0S_3 \leq 12000$$

$$0L_1 + 0M_1 + 0S_1 + 0L_2 + 0M_2 + 0S_2 + 20L_3 + 15M_3 + 12S_3 \leq 5000$$

$$L_1 + 0M_1 + 0S_1 + L_2 + 0M_2 + 0S_2 + L_3 + 0M_3 + 0S_3 \leq 900$$

$$0L_1 + M_1 + 0S_1 + 0L_2 + M_2 + 0S_2 + 0L_3 + M_3 + 0S_3 \leq 1200$$

$$0L_1 + 0M_1 + S_1 + 0L_2 + 0M_2 + S_2 + 0L_3 + 0M_3 + S_3 \leq 750$$

```
library(lpSolve)

obj_fun<-c(420,360,300,420,360,300,420,360,300)
#Objective function

#Constraints
con_fun<-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)

#Direction of inequality constraints
dir_fun<-c("<=","<=","<=","<=","<=","<=","<=","<=","<=")

#Right hand side coefficients
rhs_fun<-c(750,900,450,13000,12000,5000,900,1200,750)


#objective value(Zmax)
lp('max',obj_fun, con_fun, dir_fun, rhs_fun)
```

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

```
#Values of the variables
lp_solution <- lp('max',obj_fun, con_fun, dir_fun, rhs_fun)$solution
# Extract solution values
production_plant <- lp_solution
# Format,print the production plan for each plant
for (plant in 1:3) {
  start_idx <- (plant - 1) * 3 + 1
  end_idx <- start_idx + 2
  plant_production <- production_plant[start_idx:end_idx]
```

```r
  cat(sprintf("Plant %d:\n", plant))
  cat(sprintf("  Large: %f units\n", plant_production[1]))
  cat(sprintf("  Medium: %f units\n", plant_production[2]))
  cat(sprintf("  Small: %f units\n\n", plant_production[3]))
}
```

```
## Plant 1:
##   Large: 350.000000 units
##   Medium: 400.000000 units
##   Small: 0.000000 units
##
## Plant 2:
##   Large: 0.000000 units
##   Medium: 400.000000 units
##   Small: 500.000000 units
##
## Plant 3:
##   Large: 0.000000 units
##   Medium: 133.333333 units
##   Small: 250.000000 units
```