Assignment 2_QMM_lpSolve

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Answer to the Question

Suppose,

Plant 1 be

$$= X$$

Plant 2 be

$$= Y$$

Plant 3 be

$$= Z$$

Production of Plant 1 in Large be

$$= X_l$$

Production of Plant 1 in Medium be

$$= X_m$$

Production of Plant 1 in Small be

$$= X_s$$

Production of Plant 2 in Large be

$$= Y_l$$

Production of Plant 2 in Medium be

$$= Y_m$$

Production of Plant 2 in Small be

$$= Y_s$$

Production of Plant 3 in Large be

$$= Z_l$$

Production of Plant 3 in Medium be

$$= Z_m$$

Production of Plant 3 in Small be

$$= Z_s$$

The objective function is:

$$ Max \hspace{.3cm} A= 420(X_l+X_m+X_s)+360(Y_l+Y_m+Y_s)+300(Z_l+Z_m+Z_s)$$

Improvising the objective function further to:

$$ Max \hspace{.3cm} A= 420X_l+420X_m+420X_s+360Y_l+360Y_m+360Y_s+300Z_l+300Z_m+300Z_s $$

Subject to the following:

$$X_l + X_m + X_s \leq 750$$

$$Y_l + Y_m + Y_s \leq 900$$

$$Z_l + Z_m + Z_s \leq 450$$

$$20X_l + 15X_m + 12X_s \leq 13000$$

$$20Y_l + 15Y_m + 12Y_s \leq 12000$$

$$20Z_l + 15Z_m + 12Z_s \leq 5000$$

$$X_l + Y_l + Z_l \leq 900$$

$$X_m + Y_m + Z_m \leq 1200$$

$$X_s + Y_s + Z_s \leq 750$$

Non-negativity constraints:

$$X_l + Y_l + Z_l + X_m + Y_m + Z_m + X_s + Y_s + Z_s \geq 0$$

These LP problem constraints can be writing in another format

$$X_l + X_m + X_s + 0Y_l + 0Y_m + 0Y_s + 0Z_l + 0Z_m + 0Z_s \leq 750$$

$$0X_l + 0X_m + 0X_s + Y_l + Y_m + Y_s + 0Z_l + 0Z_m + 0Z_s \leq 900$$

$$0X_l + 0X_m + 0X_s + 0Y_l + 0Y_m + 0Y_s + Z_l + Z_m + Z_s \leq 450$$

$$20X_l + 15X_m + 12X_s + 0Y_l + 0Y_m + 0Y_s + 0Z_l + 0Z_m + 0Z_s \leq 13000$$

$$0X_l + 0X_m + 0X_s + 20Y_l + 15Y_m + 12Y_s + 0Z_l + 0Z_m + 0Z_s \leq 12000$$

$$0X_l + 0X_m + 0X_s + 0Y_l + 0Y_m + 0Y_s + 20Z_l + 15Z_m + 12Z_s \leq 5000$$

$$X_l + 0X_m + 0X_s + Y_l + 0Y_m + 0Y_s + Z_l + 0Z_m + 0Z_s \leq 900$$

$$0X_l + X_m + 0X_s + 0Y_l + Y_m + 0Y_s + 0Z_l + Z_m + 0Z_s \leq 1200$$

$$0X_l + 0X_m + X_s + 0Y_l + 0Y_m + Y_s + 0Z_l + 0Z_m + Z_s \leq 750$$

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#Solution

#installing the required packages
#install.packages("lpsolve")

#library
library(lpSolve)

#The objective function is to maximize A = 420X_l + 360X_m + 300X_s + 420Y_l
+ 360Y_m + 300Y_s + 420Z_l + 360Z_m + 300Z_s

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

#Below constraints written in the matrix form:

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)

#set the direction of the inequalities using subject to equation

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

#set the right hand side of the coefficients

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

#finding the objective function value


lp("max", obj_fun, con_fun, dir_fun, rhs_fun)

## Success: the objective function is 708000
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