Assignment - Module 4

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## Install lpSolve package to facilitate solving our problem

#install.packages("lpSolve")   
library(lpSolve)

## Warning: package 'lpSolve' was built under R version 4.2.3

# Let X1, X2, X3 be the number of large-sized units produced at Plants 1, 2, and 3, respectively, per day.  
# Let Y1, Y2, Y3 be the number of medium-sized units produced at Plants 1, 2, and 3, respectively, per day.  
# Let Z1, Z2, Z3 be the number of small-sized units produced at Plants 1, 2, and 3, respectively, per day.  
  
# Objective Function  
# Maximize Z = 420(X1+X2+X3) + 360(Y1+Y2+Y3) + 300(Z1+Z2+Z3)  
  
f.obj<-c(420,360,300,420,360,300,420,360,300)  
  
# Subject to  
# X1 + Y1 + Z1 ≤ 750  
# X2 + Y2 + Z2 ≤ 900  
# X3 + Y3 + Z3 ≤ 450  
#   
# 20X1 + 15Y1 + 12Z1 ≤ 13000  
# 20X2 + 15Y2 + 12Z2 ≤ 12000  
# 20X3 + 15Y3 + 12Z3 ≤ 5000  
#   
# X1 + X2 + X3 ≤ 900  
# Y1 + Y2 + Y3 ≤ 1200  
# Z1 + Z2 + Z3 ≤ 750  
#   
# Non Negativity  
# X1, X2, X3, Y1, Y2, Y3, Z1, Z2, Z3 ≥ 0  
  
# Write down the above constraints using all 9 variables in each equation as follow:  
# X1 + Y1 + Z1 + 0X2 + 0Y2 + 0Z2 + 0X3 + 0Y3 + 0Z3 ≤ 750  
# 0X1 + 0Y1 + 0Z1 + X2 + Y2 + Z2 + 0X3 + 0Y3 + 0Z3 ≤ 900  
# 0X1 + 0Y1 + 0Z1 + 0X2 + 0Y2 + 0Z2 + X3 + Y3 + Z3 ≤ 450  
# 20X1 + 15Y1 + 12Z1 + 0X2 + 0Y2 + 0Z2 + 0X3 + 0Y3 + 0Z3 ≤ 13000  
# 0X1 + 0Y1 + 0Z1 + 20X2 + 15Y2 + 12Z2 + 0X3 + 0Y3 + 0Z3 ≤ 12000  
# 0X1 + 0Y1 + 0Z1 + 0X2 + 0Y2 + 0Z2 + 20X3 + 15Y3 + 12Z3 ≤ 5000  
# X1 + 0Y1 + 0Z1 + X2 + 0Y2 + 0Z2 + X3 + 0Y3 + 0Z3 ≤ 900  
# 0X1 + Y1 + 0Z1 + 0X2 + Y2 + 0Z2 + 0X3 + Y3 + 0Z3 ≤ 1200  
# 0X1 + 0Y1 + Z1 + 0X2 + 0Y2 + Z2 + 0X3 + 0Y3 + Z3 ≤ 750  
  
# The coefficients of the constraints can be written in the matrix form as  
# 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  
#   
# Formulating the Constraints in the Matrix form :   
  
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=TRUE)  
  
# Setting the direction of inequalities constraints  
f.dir <- c("<=",  
 "<=",  
 "<=",  
 "<=",  
 "<=",  
 "<=",  
 "<=",  
 "<=",  
 "<=")  
  
# Setting the right hand side coefficients  
f.rhs = c(750,900,450,13000,12000,5000,900,1200,750)  
  
# Finding the value of Objective fUNCTION  
lp("max",f.obj,f.con,f.dir,f.rhs)

## Success: the objective function is 708000

# Getting the values of Variables  
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