QMM\_Assignment\_Module-4

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#Install and load the lpsolve library  
  
library(lpSolve)

## Warning: package 'lpSolve' was built under R version 4.3.3

A12 <- matrix(c(20,900,420,15,1200,360,12,750,300), nrow = 3, ncol = 3, byrow = TRUE)  
colnames(A12) <-(c('Space Required', 'Sales Forecast(PerDay)', 'Profit'))   
rownames(A12) <-(c('Large', 'Medium','Small'))  
A12

## Space Required Sales Forecast(PerDay) Profit  
## Large 20 900 420  
## Medium 15 1200 360  
## Small 12 750 300

A12 = matrix(c(750,900,450), nrow = 3, ncol = 1, byrow = TRUE)  
colnames(A12)=(c('Excess Capacity'))   
rownames(A12)=(c('Plant l', 'Plant 2', 'Plant 3'))   
A12

## Excess Capacity  
## Plant l 750  
## Plant 2 900  
## Plant 3 450

Let L1, M1, S1 = Number of large, medium, and small units produced at Plant 1 L2, M2, S2 = Number of large, medium, and small units produced at Plant 2 L3, M3, S3 = Number of large, medium, and small units produced at Plant 3

The objective function is

Max Z = 420(L1 + L2 + L3) + 360(M1 + M2 + M3) + 300(S1 + S2 + S3)

Rearranging this, the objective becomes

Max Z = 420L1 + 360M1 + 300S1 + 420L2 + 360M2 + 300S2 + 420L3 + 360M3 + 300S3

subject to the following constraints.,

Production Capacity Constraints:

L1 + M1 + S1 ≤ 750  
 L2 + M2 + S2 ≤ 900  
 L3 + M3 + S3 ≤ 450

Storage Space Constraints:

20L1 + 15M1 + 12S1 ≤ 13000  
 20L2 + 15M2 + 12S2 ≤ 12000  
 20L3 + 15M3 + 12S3 ≤ 5000

Sales Forecast Constraints:

L1 + L2 + L3 ≤ 900  
 M1 + M2 + M3 ≤ 1200  
 S1 + S2 + S3 ≤ 750

Capacity Usage Equality:

(L1 + M1 + S1) ∗ (100/750) = (L2 + M2 + S2) ∗ (100/900) = (L3 + M3 + S3) ∗ (100/450)  
Non negativity constraints:

L1, L2, L3, M1, M2, M3, S1, S2, S3 ≥ 0

#Objective Function  
Obj <- c(420, 360, 300, 420, 360, 300, 420, 360, 300)  
Obj

## [1] 420 360 300 420 360 300 420 360 300

#Constraints  
  
Constraints <- matrix(c(  
   
 # Production capacity  
 1, 1, 1, 0, 0, 0, 0, 0, 0, # Plant 1  
 0, 0, 0, 1, 1, 1, 0, 0, 0, # Plant 2  
 0, 0, 0, 0, 0, 0, 1, 1, 1, # Plant 3  
   
 # Storage  
 20, 15, 12, 0, 0, 0, 0, 0, 0, # Plant 1  
 0, 0, 0, 20, 15, 12, 0, 0, 0, # Plant 2  
 0, 0, 0, 0, 0, 0, 20, 15, 12, # Plant 3  
   
 # Sales forecast  
 1, 0, 0, 1, 0, 0, 1, 0, 0, # Large units  
 0, 1, 0, 0, 1, 0, 0, 1, 0, # Medium units  
 0, 0, 1, 0, 0, 1, 0, 0, 1, # Small units  
   
 6, 6, 6, -5, -5, -5, 0, 0, 0,  
 0, 0, 0, 1, 1, 1, -2, -2, -2,  
 3, 3, 3, 0, 0, 0, -5, -5, -5  
   
), nrow=12, byrow=TRUE)  
Constraints

## [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9]  
## [1,] 1 1 1 0 0 0 0 0 0  
## [2,] 0 0 0 1 1 1 0 0 0  
## [3,] 0 0 0 0 0 0 1 1 1  
## [4,] 20 15 12 0 0 0 0 0 0  
## [5,] 0 0 0 20 15 12 0 0 0  
## [6,] 0 0 0 0 0 0 20 15 12  
## [7,] 1 0 0 1 0 0 1 0 0  
## [8,] 0 1 0 0 1 0 0 1 0  
## [9,] 0 0 1 0 0 1 0 0 1  
## [10,] 6 6 6 -5 -5 -5 0 0 0  
## [11,] 0 0 0 1 1 1 -2 -2 -2  
## [12,] 3 3 3 0 0 0 -5 -5 -5

#Define the constraint direction  
Dir<-c("<=","<=","<=","<=","<=","<=","<=","<=","<=","=","=","=")  
Dir

## [1] "<=" "<=" "<=" "<=" "<=" "<=" "<=" "<=" "<=" "=" "=" "="

# RHS of the constraints  
RHS <- c(750, 900, 450, 13000, 12000, 5000, 900, 1200, 750, 0, 0, 0)  
RHS

## [1] 750 900 450 13000 12000 5000 900 1200 750 0 0 0

#Solve the linear programming problem  
lp\_result <-lp("max", Obj, Constraints, Dir, RHS)  
lp\_result

## Success: the objective function is 696000

#Values of decision variables  
lp\_result$solution

## [1] 516.6667 177.7778 0.0000 0.0000 666.6667 166.6667 0.0000 0.0000  
## [9] 416.6667