Quantitative Management Modelling

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Assignment 4 – LP Model (R Program)

Question 2:

Let X = Large, Y = Medium and Z= small

2A. Decision Variables:

Let X1, Y1, Z1 be the quantities produced in L, M & S for plant 1
Let X2, Y2, Z2 be the quantities produced in L, M & S for plant 2 Let
X3, Y3, Z3 be the quantities produced in L, M & S for plant 3

2B. Formulating LP model:

Let the objective function be Z which represents the maximum profit =

Z= 420 (X1+X2+X3) + 360(Y1 +Y2+Y3) + 300 (Z1+Z2+Z3)

Capacity Constraints:

X1+Y1+Z1<=750 (Excess production of 750 units of plant 1 every day)

X2+Y2+Z2<=900 (excess production of 900 units of plant 2 every day)

X3+Y3 +Z3<=450 (excess production of 450 units of plant 3every day) Storage

constraint:

20X1+15Y1+12Z1<=13000 (storage capacity of plant 1 13000 sq.ft)

20X2+ 15Y2+ 12Z2<= 12000 (storage capacity of plant 2 12000 sq.ft)

20X3+15Y3+12Z3<= 5000 (storage capacity of plant 3 5000 units sq.ft) Sales

constraints:

L = X1+X21+X3 <=900 (900 Units needs to be sold plant 1 every day)

M= Y1+Y2+Y3<= 1200 (1200 Units needs to be sold plant 2 every day)

S= Z1+Z2+Z3<= 750 (750 Units needs to be sold plant 3 every day)

Xx,Yx,Zx>=0

Percentage Constraints:

As said that plant always consumes same % of their excess capacity to produce the new product, below are the equations:

$(X1+Y1+Z1)/750=(X2+Y2+Z2)/900=(X3+Y3+Z3)/S450$

It can be written as:

$900(X1+Y1+Z1) = 750 (X2+Y2+Z2)$

$450 (X2+Y2+Z2) = 900 (X3+Y3+Z3)$

$450 (X1+Y1+Z1) = 750(X3+Y3+Z3)$ <u>Non-</u>

<u>Negative zero:</u>

$X1,Y1,Z1, X2,Y2,Z2,X3,Y3, Z3>=0$

QMM_Assignment 4

"Pallavi"

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#calling the "lpsolve" library and declaring the objective function as "f.obj"#library #objective function

```
library(lpSolve)
f.obj<-c(420,420,420,360,360,360,300,300,300)
f.con<-matrix(c(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,
                20,0,0,15,0,0,12,0,0,
                0,20,0,0,15,0,0,12,0,
                0,0,20,0,0,15,0,0,12,
                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,
                900,-750,0,900,-750,0,900,-750,0,
                0,450,-900,0,450,-900,0,450,-900,
                450,0,-750,450,0,-750,450,0,-750),ncol=9, byrow=TRUE)
f.con

##       [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9]
##  [1,]    1    0    0    1    0    0    1    0    0
##  [2,]    0    1    0    0    1    0    0    1    0
##  [3,]    0    0    1    0    0    1    0    0    1
##  [4,]   20    0    0   15    0    0   12    0    0
##  [5,]    0   20    0    0   15    0    0   12    0
##  [6,]    0    0   20    0    0   15    0    0   12
##  [7,]    1    1    1    0    0    0    0    0    0
##  [8,]    0    0    0    1    1    1    0    0    0
##  [9,]    0    0    0    0    0    0    1    1    1
## [10,]  900 -750    0  900 -750    0  900 -750    0
## [11,]    0  450 -900    0  450 -900    0  450 -900
## [12,]  450    0 -750  450    0 -750  450    0 -750

#Declaring the direction as "f.dir"
f.dir<-c("<=","<=","<=","<=","<=","<=","<=","<=","<=","=","=","=")

#Declaring the right hand side constants as "f.rhs"
f.rhs<-c(750,900,450,13000,12000,5000,900,1200,750,0,0,0)
#Calling the LP function to solve the problem based on objective function to maximize the profit using "int. vec" to get exact values
f.sol<- lp("max",f.obj,f.con,f.dir,f.rhs,int.vec = 1:9)
f.sol$solution
```

```
## [1] 530   0   1 160 688   8   0 140 405
```

```
f.sol
```

```
## Success: the objective function is 694680
```