QMM LP Model In R

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The Weigelt Corporation has three branch plants with excess production capacity. Fortunately, the corporation has a new product ready to begin production, and all three plants have this capability, so some of the excess capacity can be used in this way. This product can be made in three sizes--large, medium, and small--that yield a net unit profit of $420, $360, and $300, respectively. Plants 1, 2, and 3 have the excess capacity to produce 750, 900, and 450 units per day of this product, respectively, regardless of the size or combination of sizes involved.  
  
The amount of available in-process storage space also imposes a limitation on the production rates of the new product. Plants 1, 2, and 3 have 13,000, 12,000, and 5,000 square feet, respectively, of in-process storage space available for a day's production of this product. Each unit of the large, medium, and small sizes produced per day requires 20, 15, and 12 square feet, respectively. Sales forecasts indicate that if available, 900, 1,200, and 750 units of the large, medium, and small sizes, respectively, would be sold per day.  
  
At each plant, some employees will need to be laid off unless most of the plant’s excess production capacity can be used to produce the new product. To avoid layoffs if possible, management has decided that the plants should use the same percentage of their excess capacity to produce the new product. Management wishes to know how much of each of the sizes should be produced by each of the plants to maximize profit.  
  
Solve the problem using lpSolve, or any other equivalent library in R

Weigelt\_Plant <- matrix(c(750,900,450,13000,12000,5000), ncol = 3, byrow = TRUE )  
  
colnames(Weigelt\_Plant) <- c("Plant1","Plant2","Plant3")  
rownames(Weigelt\_Plant) <- c("Capacity","Space Available(Sq.Ft)")  
  
final=as.table(Weigelt\_Plant)  
  
final

## Plant1 Plant2 Plant3  
## Capacity 750 900 450  
## Space Available(Sq.Ft) 13000 12000 5000

Weigelt\_Decleration <- matrix(c(900,1200,750,20,15,12,"$420","$360","$300"), ncol = 3, byrow = TRUE )  
  
colnames(Weigelt\_Decleration) <- c("Large","Medium","Small")  
rownames(Weigelt\_Decleration) <- c("Sales","Space Req(Sq.Ft)","Profit$")  
  
final=as.table(Weigelt\_Decleration)  
  
final

## Large Medium Small  
## Sales 900 1200 750   
## Space Req(Sq.Ft) 20 15 12   
## Profit$ $420 $360 $300

# Explanation

# Declaring decision Variable

**Assume**

Let’s will be number of Units and size (where can be “Large”, “Medium”, “Small”) produced in three different plant which is mentioned as (“Plant1”, “Plant2”, “Plant3”)

For better Understanding we consider Sizes and Plants as mentioned below.

***(Sizes)***

Large =

Medium =

Small =

**(Plants)**

Plant1 =

Plant1 =

Plant3 =

***Small size product***

Number of small sized units produced at Plant 1 =

Number of small sized units produced at Plant 2 =

Number of small sized units produced at Plant 3 =

***Medium size product***

Number of Medium sized units produced at Plant 1 =

Number of Medium sized units produced at Plant 2 =

Number of Medium sized units produced at Plant 3 =

***Large size product***

Number of Large sized units produced at Plant 1 =

Number of Large sized units produced at Plant 2 =

Number of Large sized units produced at Plant 3 =

# Declaring Objective function

Management wishes to know how much of each of the sizes should be produced by each of the plants to maximize profit.

$$ Max \hspace{.2cm} Z = 420(A\_l,p1+A\_l,p2+A\_l,p3)+360(A\_m,p1+A\_m,p2+A\_m,p3)+300(A\_s,p1+A\_s,p2+A\_s,p3)$$

# Production Capacity constraint

Each plant have there own capacity to produce three different size of productes as mentioned below.

***Plant1 capacity***

***Plant2 capacity***

***Plant3 capacity***

# Storage Constraints

***Plant1***

***Plant2***

***plant3***

# Sales Constraints

***Small Size product Capacity***

***Medium Size product Capacity***

***Large Size product Capacity***

*Same capacity constraints*

Management has decided that the plants should use the same percentage of their excess capacity to produce the new product

# Non-Negativity Contraints

Note: As Mentioned above G is the size of products and K refers all three plants

# Solution in R Markdown

library(lpSolve)

*Objective function Weigelt Corporation Management wishes to know how much of each of the sizes should be produced by each of the plants to maximize profit*

### MaxZ= 420L,P1+420L,P2+420L,P3+360M,P1+360M,P2+360,P3+300S,P1+300S,P2+300S,P3

function\_obj<-c(300,360,420,300,360,420,300,360,420)

# Constraints

### Below are the three different constraints which are mentioned in matrix form

### *Production capacity Constraints*

### *Storage constraints*

### *Sales Constraints*

function\_contrnt <-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,  
 12,15,20,0,0,0,0,0,0,  
 0,0,0,12,15,20,0,0,0,  
 0,0,0,0,0,0,12,15,20,  
 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 for this

function\_direction <-c("<=","<=","<=","<=","<=","<=","<=","<=","<=")

# Set the right hand side of the coefficients for all Constraints

function\_RHS <-c(750,900,450,13000,12000,5000,750,1200,900)

# Objective function total profit

lp("max", function\_obj, function\_contrnt, function\_direction, function\_RHS)

## Success: the objective function is 708000

# Final Values of each varible

lp("max", function\_obj, function\_contrnt, function\_direction, function\_RHS)$solution

## [1] 0.0000 400.0000 350.0000 500.0000 400.0000 0.0000 250.0000 133.3333  
## [9] 0.0000