QMM GP

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Objective Function

Maximize Z = P - 6C - 3D, where

P = Total discounted profit over the life of the new products,

C = Change in either direction towards the current level of employment,

D = decrease if any in next year's earnings from the current year's level.

Loading the required packages

```
library(lpSolveAPI)
```

##Getting the model after loading the LP file from the current path.

##Defining y1+(y1p) and y1-(y1n) as the amount over (if any) and the amount under (if any) the employment level goal.

##Defining y2+(y2p) and y2-(y2n) in the same way for the goal regarding earnings next year.

##Define x1, x2 and x3 as the production rates of Products 1, 2, and 3, respectively.

##Also expressing P in terms of x1, x2 and x3 and the objective function in terms of x1, x2, x3, y1p, y1n , y2p and y2n.

```
PushpEmax.C <- read.lp("C:\\Users\\pushp\\OneDrive\\Desktop\\qmmgp.lp")
PushpEmax.C
```

```
## Model name:
##             x1    x2    x3   y1n   y1p   y2n   y2p
## Maximize    20    15    25    -6    -6    -3     0
## R1           6     4     5     1    -1     0     0  =  50
## R2           8     7     5     0     0     1    -1  =  75
## Kind       Std   Std   Std   Std   Std   Std   Std
## Type      Real  Real  Real  Real  Real  Real  Real
## Upper      Inf   Inf   Inf   Inf   Inf   Inf   Inf
## Lower        0     0     0     0     0     0     0
```

The following table displays the effects of each of the new goods (per unit rate of production) on each of these variables.

```
PushpEmax.C_table <- matrix(c("Total Profit", "Employment Level", "Earnings Next Year",
                        20,6,8,
                        15,4,7,
                        25,5,5,
                        "Maximize","=50",">=75",
                        "Millions of Dollars", "Hundreds of Employees", "Millions of Dollars"),
                        ncol=6, byrow = F)

colnames(PushpEmax.C_table) <- c("Factor","Product 1", "Product 2", "Product 3", "Goal", "Units")

as.table(PushpEmax.C_table)
```

```
##   Factor             Product 1 Product 2 Product 3 Goal
## A Total Profit       20        15        25        Maximize
## B Employment Level   6         4         5         =50
## C Earnings Next Year 8         7         5         >=75
##   Units
## A Millions of Dollars
## B Hundreds of Employees
## C Millions of Dollars
```

Solving the goal programming model to obtain the objective and variable values

```
solve(PushpEmax.C)
```

```
## [1] 0
```

```
get.objective(PushpEmax.C)
```

```
## [1] 225
```

```
get.variables(PushpEmax.C)
```

```
## [1]  0  0 15  0 25  0  0
```

```
get.constraints(PushpEmax.C)
```

```
## [1] 50 75
```

Summary

1. The units of combination that the company must use in order to optimize the objective function are X1, X2, and X3. Product 1 and Product 2 cannot be created as intended, i.e., 20 Units of Product 1 and 15 Units of Product 2 cannot be produced because the final solution was "0," according to X1 - Product 1, X2- Product 2, and X3 - Product 3. However, X3, or Product 3, has changed. Now, the company can only make 15 Units of Product 3 in order to maximize profit.
2. The goal was to stabilize the employment level with the maximum number of employees confined to 50 Hundred Employees but here in this case the firm exceeded the employment levels by 25 Hundred Employees (y1p) for which they would be needing to pay penalty for the excess/rise in the employees count.

3. The goal of y2p and y2n was to capture the increase or decrease in the next years earnings from the current level which states as "0" in this case which indicates that there is no increase or decrease in the earnings of next year when compared to that with the current year. Therefore, the earnings for next year remain constant.

4. The profit that the firm maximizing is called out by the objective function value which here in our case is 225 Million Dollars.