Quantitative Manangement Modeling- Assignment-5

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#The Research and Development Division of the Emax Corporation has developed three new products. A decision now needs to be made on which mix of these products should be produced. Management wants primary consideration given to three factors: #1. Total Profit, #2. Stability in the workforce and #3. Achieving an increase in the company's earnings next year from the $75 million achieved this year.

#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.

#To obtain a clean result, using default values.

```
knitr::opts_chunk$set(message = FALSE)
knitr::opts_chunk$set(warning = FALSE)
```

#Loading the required packages

```
library(lpSolve)
library(lpSolveAPI)
```

#Loading the LP file from the current directory and printing the model

#Defining y1P and y1M as the amount over (if any) and the amount under (if any) the employment level goal.

#Defining y2P and y2M 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, y1M , y2P and y2M

```
emax_1<-read.lp('/Users/ELMYLUKA/Desktop/MS BA/Quantitative  Management Modeling/Assignment-5/emax.lp',
                type = c('lp'))
print(emax_1)
```

```
## Model name:
##             X1    X2    X3   Y1P   Y1M   Y2M   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 products (per unit rate of production) on each of these factors.

```
emax_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(emax_table) <- c("Factor","Product 1", "Product 2", "Product 3", "Goal", "Units")
as.table(emax_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
```

#Obtaining the objective and variable values by solving the goal programming model

```
solve(emax_1)
```

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

```
get.objective(emax_1)
```

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

```
get.variables(emax_1)
```

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

#Interpretation

#1. The units of combination that the company must use in order to optimize the objective function are x1, x2, and x3. X1 for Product 1, X2 for Product 2, and X3 for Product 3 indicate that 20 Units of Product 1 and 15 Units of Product 2 cannot be manufactured because the resultant solution was "0".However, X3 has changed, meaning that the company can only make 15 units of Product 3 i.e the only product in order to maximize profit is Product 3.

#The aim was just to stabilize employment levels with a limit of 50 hundred employees as the maximum, however in this situation, the firm's employment levels were surpassed by 25 hundred employees (y1), necessitating the payment of a penalty for the rise in the number of employees.

#2. The objective of y2P and y2M was to measure the increase or decrease in the following year's profits from the current level, which in this case is "0," meaning that there will be no change in the earnings of the following year compared to those of the current year. As a result, the earnings for the following year are unchanged.

#3. The goal function value, which in our case is 225 million dollars, calls out the profit that the company is maximizing.