QMM - Assignment_5

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Maximize Z = P - 6C - 3D, where P = Overall 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 coming year's earnings from the current year's level.

Loading 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_rd <- read.lp("c:/Users/rajiv/OneDrive/Desktop/emax.lp")
print(emax_rd)
```

```
## 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 effect of each of the new products (per unit rate of production) on each of these factors is shown in the table below:

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

```
##   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 gain the objective and variable values

```
solve(emax_rd)

## [1] 0

get.objective(emax_rd)

## [1] 225

get.variables(emax_rd)

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

Interpretation: 1.X1 - Product 1, X2 - Product 2, and X3 - Product 3 are the units of combination that the company must use in order to optimize the goal function. It claims that because the end result is 0, 20 units of Product 1 and 15 units of Product 2 cannot be created as anticipated. The only product that can now be manufactured, due to a modification in X3, is product 3.

15 Units of Product 3 to maximize the profit. While the initial objective was to stabilize the employment level with a maximum of 50 hundred employees, the company exceeded the employment levels by 25 hundred employees (Y1P). Due to the increase in staff, the corporation must pay a penalty.

2. Determining whether the earnings for the following year would rise or fall was the main objective of Y2P and Y2M. Given that the present level is "0," it is obvious that there will be no change in earnings for the following year.

3. The profit that the firm is maximizing is 225 Million Dollars which can be clearly interpreted from the objective function value. ```