Assignment 5

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Problem Descripiton

Three new goods from the Emax Corporation need to be chosen as the combination to be released. The company's total profit, worker stability, and seeking an increase in overall earnings from the \$75 million realized this year are given top priority. We are required to resolve the following linear programming model in particular: Maximize $Z = P - 6C - 3D$, where
P = total (discounted) profit over the life of the new products,
C = change (in either direction) in the current level of employment, and
D = decrease in next year's earnings from the current year's.

Loading required package

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

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

```
# The file "x.lp" contains a representation of the model mentioned above.
Emax <- read.lp("x.lp")
# Solving the model
solve(Emax)
```

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

```
Emax
```

```
## Model name:
##             x1    x2    x3   y1p   y1m   y2p   y2m
## Maximize    20    15    25    -6    -6     0    -3
## 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 illustrates the effects of each of the new goods (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,
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
```

To get the objective function's maximum value and the values of the decision variables, we utilize the 'get.objective' and 'get.variables' functions. The decision variables xj are represented by the first three variables in the "x.lp" model.

```
# Finding the objective function and values of the variables
solve(Emax)
```

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

```
get.objective(Emax)
```

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

```
get.variables(Emax)
```

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

INTERPRETATION:

1. The business must employ X1, X2, and X3 as the units of combination in order to optimize the objective function. The best solution was "0," as indicated by the codes X1 for Product 1, X2 for Product 2, and X3 for Product 3, hence 20 units of Product 1 and 15 units of Product 2 cannot be produced. However, X3 has altered, limiting the business to only producing 15 units of Product 3—the sole product—in an effort to boost profits.

2. A cap of 50 hundred employees was intended to stabilize employment levels, however in this case, the company had 250 extra workers (y1p), for which they would be required to pay a penalty for the excess/rise in the employee count.

3. The goal of y2p and y2m was to measure how much earnings will increase or drop from the current level. In this situation, it says "0," meaning that there will be no change in profits between the current year and the one after that. The earnings for the following year remain unchanged as a result..

4. In this case, the objective function value of 225 million dollars highlights the profit that the company is aiming to maximize.