Assignment 5 - Goal Programming

Sai Sree Pulimamidi

2022-11-06

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: total profit, stability in the workforce, and 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.

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/girne/Downloads/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 following table displays the effects of each of the new goods (per unit rate of production) on each of these factors.:

```
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, 

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
```

Using the goal programming model to obtain 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.To maximize the goal function, the company must use the units of combination X1 - Product 1, X2 - Product 2, and X3 - Product 3. It states that the final answer is zero, it is impossible to manufacture 20 units of Product 1 and 15 units of Product 2 as anticipated. However, X3 has been changed, and as a result, only Product 3 can be manufactured.

15 Units of Product 3 to maximize the profit.

2. The initial objective is to sustain the employment level with a maximum of 50 hundred workers, the company exceeded the employment levels by 25 hundred employees (Y1P). Due to rise in staff, the corporation must pay a penalty.
3. Predicting the profits for the following year will rise or fall was the main objective of Y2P and Y2M. We can say that the present level is "0," it is obvious that there will be no change in earnings for the following year.

4.The objective function value makes it evident that the company has a maximizing profit of 225 million dollars.