QMM Goal Programming

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2022-10-31

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.

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

Profit P is defined as: P = 20x1 +15x2 + 25x3

Employment level is defined as : 6x1 + 4x2 + 5x3 = 50

Next year Earnings goal is defined as: 8x1 + 7x2 + 5x3 >=75

1) Model_Formulation:

Let us consider y1 - Employment Level minus the target.

y2 - Next Year Earnings minus the Target.

y1+ - Penalty for employment level goal exceeding 50.

y1- - Penalty for employment level goal decreasing below 50.

y2+ - Exceed the next year earnings.

y2- - Penalty for not reaching the next year earnings.

y1 = 6x1 + 4x2 + 5x3 - 50.

y2 = 8x1 + 7x2 + 5x3 -75

For Employment level goal

y1 = y1+ - y1- where y1+, y1- >=0.

y1+ - y1-= 6x1 + 4x2 + 5x3 - 50

For Next year earnings goal

y2 = y2+ - y2- where y2+, y2- >=0.

y2+ - y2- = 8x1 + 7x2 + 5x3 -75

Final Formulation is expressed as

Max P = 20x1 +15x2 + 25x3.

6x1 + 4x2 + 5x3 - (y1+ - y1-) = 50.

8x1 + 7x2 + 5x3 - (y2+ - y2-) = 75

Where, xj >=0, where j=1,2,3.

```
   yi + >=0, where i= 1,2.

   yi - >=0, where i= 1,2.
```

2)Managements objective function Objective Function

Maximize Z = P - 6C - 3D

Objective function in terms of x1, x2, x3, y1+, y1- , y2+ and y2-.

Max Z = 20x1 +15x2 + 25x3 - 6y1+ - 6y1- - 3y2-.

```
   6x1 + 4x2 + 5x3 - (y1+ + y1-) = 50.
   8x1 + 7x2 + 5x3 - (y2+ + y2-) = 75.
                    Where,xj >=0 where j=1,2,3
                          yi + >=0 where i= 1,2
                          yi - >=0 where i= 1,2
```

3) Formulate and solve the linear programming model

```
library(lpSolveAPI)
GoalProgram<- read.lp("C:/Users/Pavan Chaitanya/Documents/Emax1.lp")
GoalProgram

## Model name:
##                          x1     x2     x3    y1p    y1m    y2m    y2p
## Maximize                 20     15     25     -6      6     -3      0
## EmploymentLevelGoal       6      4      5     -1      1      0      0  =  50
## NextYearEarningsGoal      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

solve(GoalProgram)

## [1] 0
```

```
get.objective(GoalProgram)
```

[1] 225

```
get.variables(GoalProgram)
```

[1] 0 0 15 25 0 0 0

```
get.constraints(GoalProgram)
```

[1] 50 75

Interpretation :

The penalty is 225 if you are not satisfying the goals on the objective function. The results show that x1 = 0.

```
              x2 = 0.

              x3 = 15.

              y1+ = 25.

              y1- = 0.

              y2+ = 0.

              y2- = 0.
```

which explains the Next years Earnings (y2) expectations are fully satisfied.

Emax need to produce 15 units of product 3 and none of product 1 and 2 to achieve 225 millions in profit.