QMM Goal Programming

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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.