811129289\_5\_Q2

Purna Sai Kiran, G

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Question 1:

Max Z = P - 6E - 3Y P = total profit over the entire new product life which is discounted, E = change in employment level in both directions, Y = reduction in next year’s earnings with respect to current year’s level.

P is formulated as: P = 20X1 +15X2 + 25X3

Level of employment is formulated as : 6X1 + 4X2 + 5X3 = 50

Next year Earnings goal is formulated as: 8X1 + 7X2 + 5X3 >=75

1. LP Formulation:

Let us consider A1 - Level of employment - Target A2 - Earnings in the next year - Target B1 - Penalty if level of employment goal exceeds 50 B2 - Penalty if level of employment goal decreases below 50 C1 - Exceed the next year earnings C2 - Penalty if the next year’s goals are not reached

A1 = 6X1 + 4X2 + 5X3 - 50 A2 = 8X1 + 7X2 + 5X3 - 75

For Employment level goal A1 = B1 - B2 where B1, B2 >= 0 B1 - B2 = 6X1 + 4X2 + 5X3 - 50

For Next year earnings goal A2 = C1 - C2 where C1, C2 >= 0 C1 - C2 = 8X1 + 7X2 + 5X3 - 75

Final Formulation is expressed as Max P = 20X1 +15X2 + 25X3 6X1 + 4X2 + 5X3 - (B1 - B2) = 50 8X1 + 7X2 + 5X3 - (C1 - C2) = 75

Xi >=0, where i=1,2,3 Yi >=0, where Y = B, C and i= 1,2 Yi >=0, where Y = B, C and i= 1,2

Question 2:

Maximize Z = P - 6E - 3Y

Objective function in terms of x1, x2, x3, y1+, y1- , y2+ and y2- Max Z = 20X1 +15X2 + 25X3 - 6B1 - 6B2 - 3C2

Subject to:

6X1 + 4X2 + 5X3 - B1 + B2 = 50 8X1 + 7X2 + 5X3 - C1 + C2 = 75

Xi >=0, where i=1,2,3 Yi >=0, where Y = B, C and i= 1,2 Yi >=0, where Y = B, C and i= 1,2

Question 3:

library(lpSolveAPI)  
LP\_1 <- read.lp("Emax.lp")  
solve(LP\_1)

## [1] 0

get.objective(LP\_1)

## [1] 225

get.constraints(LP\_1)

## [1] 50 75

get.variables(LP\_1)

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

We can see that the penalty is 225 if the goal is not achieved X3 is 15 and B1 is 25, rest of the variables are all zeroes. Employment level is exceeded by 25. Profits reduced by 15 as a result