Assignment6

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```
getwd()

## [1] "C:/Users/shari/OneDrive/Desktop/Business Analytics/QMM/Assignment6"

setwd("C:/Users/shari/OneDrive/Desktop/Business Analytics/QMM/Assignment6")
```

Question 2 - Research and Development Division of Emax Corporation

Based on the problem statement, the goal is to:

Maximize Z = P - 6*C* - *3*D

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.

Subject to:

Total Profit: Maximize P = 20*X1 + 15*X2 + 25*X3

Employment Level: 6*X1 + 4*X2 + 5*X3 = 50

Earnings Next Year: 8*X1 + 7*X2 + 5*X3 >= 75

As a result, the auxillery variables become:

Y1 = 6*X1 + 4*X2 + 5*X3 - 50 Y2 = 8*X1 + 7*X2 + 5*X3 - 75

Which becomes:

(Y1P - Y1M) = 6*X1 + 4*X2 + 5*X3 - 50 (Y2P - Y2M) = 8*X1 + 7*X2 + 5*X3 - 75

Therefore, the final setup of the problem statement is:

Maximize Z = 20*X1 + 15*X2 + 25*X3 - 6*Y1P - 6*Y1M - 3*Y2M

Subject to:

6*X1 + 4*X2 + 5*X3 - (Y1P - Y1M) = 50 8*X1 + 7*X2 + 5*X3 - (Y2P - Y2M) = 75

And:

X1, X2, X3 >= 0 Y1P, Y1M, Y2P, Y2M >= 0

Lastly, we will run this problem in R as a linear programming model and discuss the results.

```
# This problem will require the "lpSolveAPI" library
require(lpSolveAPI)

## Loading required package: lpSolveAPI

## Warning: package 'lpSolveAPI' was built under R version 4.1.3

# Import the .lp file for this problem
lpm <- read.lp(filename="emax.lp",type = "lp")
# Return the linear programming model
lpm

## 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

# Solve the linear programming model
solve(lpm)

## [1] 0

get.objective(lpm)

## [1] 225

get.variables(lpm)

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

Based on the output of the linear programming model, we can conclude several things.

X1 = 0 X2 = 0 X3 = 15 Y1P = 25 Y1M = 0 Y2M = 0 Y2P = 0

Therefore, we can infer that only product 3 should be included in the product mix. This combination would result in an object value of 225 units. The employment level goal will be exceeded by 25 units, or 2,500 employees, which will result in a 150 unit penalty for the objective function and a full achievement of the earnings goal for the upcoming year.