Assignment_5

Manasa Chelukala

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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 auxilary 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:

Y1p represents Y1+

Y1M represents Y1-

Y2p represents Y2+

Y2M represents Y2-

X1, X2, X3 >= 0

Y1P, Y1M, Y2P, Y2M >= 0

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

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

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

```r
# Import the .lp file for this problem
lp <- read.lp("emax.lp")
# Return the linear programming model
lp
```

```
## 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
```

```r
# Solve the linear programming model
solve(lp)
```

```
## [1] 0
```

```r
get.objective(lp)
```

```
## [1] 225
```

```r
get.variables(lp)
```

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

Here,Based on the output of the linear programming model, we can conclude that.

X1 = 0

X2 = 0

X3 = 15

Y1P = 25

Y1M = 0

Y2M = 0

Y2P = 0

As a result, the product mix should only contain product 3.

This mix would result in an object value of 225 units.

Earnings goal for next year has been met fully,however, employment level goal will be exceeded by 25 units, causing 2,500 employees to be penalized and 150 units to be deducted.