

# GoalProgramming

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## 1. Express $y_1^+$ and $y_1^-$ ; $y_2^+$ and $y_2^-$ ; $P$ using $x_1$ , $x_2$ , $x_3$

$$y_1^+ - y_1^- = 50 - 6x_1 - 4x_2 - 5x_3;$$

$$y_2^+ - y_2^- = 75 - 8x_1 - 7x_2 - 5x_3;$$

$$P = 20x_1 + 15x_2 + 25x_3;$$

## 2. Express management objective function

$$\text{Max } Z = 20x_1 + 15x_2 + 25x_3 - 6y_1^+ - 6y_1^- - 3y_2^-$$

#v3. Formulate and solve LP

```
library(lpSolveAPI)
goalprog <- read.lp("GoalProg.lp")
goalprog
```

```
## Model name:
##           x1    x2    x3    y1p    y1m    y2m    y2p
## Maximize  20    15    25     -6     -6     -3     0
## R1        6    15     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(goalprog)
```

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

```
get.objective(goalprog)
```

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

```
get.variables(goalprog)
```

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

## Conclusion

1. The units of combination which the firm needs to implement in order to maximize the objective function are X1 - Product 1, X2 - Product 2 and X3 - Product 3. It states that 20 units of Product 1 and 15 units of product 2 cannot be produced as expected as the resultant solution is 0. However, there is a change to X3 which means that only product that can be produced is product 3.

2. The firm exceeded the employment levels by 25 hundred employees (Y1P) whereas the original goal was to stabilize the employment level with the maximum number of employees confined to 50 hundred employees. The company has to pay penalty for the rise in the employees count.
3. The primary goal of Y2P and Y2M was to determine the increase or decrease in the next year earnings. It can be clearly interpreted that there is no increase or decrease in the next year earnings as the current level states "0".
4. The profit that the firm is maximizing is 225 Million Dollars which can be clearly interpreted from the objective function value.

In Short,

$Z = 225$  million dollars,  $x_1 = x_2 = 0$ ,  $x_3 = 15$ ,  $y_{1p} = 25$ ,  $y_{1m} = y_{2m} = y_{2p} = 0$ . Profit is  $25 * 15 = 375$  million dollar. Employment is 7500 which has 2500 employees more than the goal so  $y_{1p} = 25$ ,  $y_{1m} = 0$ . Earnings next year is 75 millions of dollars which is the same with the goal so  $y_{2m} = y_{2p} = 0$ .