Goal programming

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Three new items have been created by the Emax Corporation's Research & Development division. Which combination of these items to be manufactured must now be decided. The management requests that three considerations be given priority attention: 1. Total Profit, 2. Stability in the workforce and 3. Achieving an increase in the company's earnings next year from the $75 million achieved this year. Objective Function Maximize Z = P - 6C - 3D, where P = Total discounted profit over the life of the new products, C = Change in either direction towards the current level of employment, D = decrease if any in next year's earnings from the current year's level.

```
library(lpSolve)
library(lpSolveAPI)
```

printing the model after loading the LP file from the current path Y1p and Y1m are defined as the amounts above and below, respectively, the employment level target. defining y2p and y2m similarly for the purpose of the target for earnings the following year. Define x1, x2, and x3 as the corresponding production rates for Products 1, 2, and 3. Additionally, P may be expressed in terms of x1, x2, and x3, as well as the objective function, y1p, y1m, y2p, and y2m

```
emax_rd <- read.lp("C:/Users/prath/Downloads/Emaxproducts.lp")
print(emax_rd)
```

```
## 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
```

```
emax_table <- matrix(c("Total Profit", "Employment Level", "Earnings Next Year",
20,6,8,
15,4,7,
25,5,5,
"Maximize","=50",">=75", "Millions of Dollars", "Hundreds of Employees", "Millions of Dollars"), ncol=6)
colnames(emax_table) <- c("Factor","Product 1", "Product 2", "Product 3", "Goal", "Units")
as.table(emax_table)
```

```
##   Factor             Product 1 Product 2 Product 3 Goal
## A Total Profit       20        15        25        Maximize
```

```
## B Employment Level   6         4         5         =50
## C Earnings Next Year 8         7         5         >=75
##   Units
## A Millions of Dollars
## B Hundreds of Employees
## C Millions of Dollars
```

```
solve(emax_rd)
```

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

```
get.objective(emax_rd)
```

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

```
get.variables(emax_rd)
```

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

Analysis: 1.The units of combination that the company must use in order to optimize the goal function are X1, X2, and X3. 20 units of Product 1 and 15 units of Product 2 cannot be created, according to X1 for Product 1 and X2 and X3 for Product 2 and Product 3, respectively since "0" was the outcome of the solution. However, X3 has changed, meaning that the company can only make 15 units of Product 3—the only product—in order to increase profits.

2.The intention was to stabilize employment levels with a cap of 50 hundred workers as the maximum, however in this situation the company had 25 hundred extra employees (y1p), for which they would have to pay a penalty for the excess/rise in the employee count.

3.The objective of y2p and y2m was to measure the rise or fall in the earnings for the following year relative to the present level, which in this case is "0," indicating that there will be no change in the profits for the following year compared to those for the current year. As a result, the earnings for the next year are unchanged.

4. The objective function value, in this case 225 million dollars, calls out the profit that the company is maximizing.