

Module 9 - Goal Programming

2022-11-06

#The objective of the Emax corporation is to maximize the profit of the new products with respect to objective function and constraints i.e., employment levels and earnings of the company.

#Libraries required for the current environment

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

#objective function #Maximize $Z = P - 6C - 3D$, where

#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.

#lp table of each new product shown in the table

```
lp_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", "Milli
ons of Dollars"), ncol=6, byrow = F)
colnames(lp_table) <- c("Factor", "Product 1", "Product 2", "Product 3", "Goal
", "Units")
as.table(lp_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				

#Lp file was used under goal programming to import the objective functions. Following are the formulations used under objective function and constraints to lp formulation:

Objective function #max: $20x_1 + 15x_2 + 25x_3 - 6y_{1m} - 6y_{1p} - 3y_{2m}$;

Constraints # $6x_1 + 4x_2 + 5x_3 + y_{1m} - y_{1p} = 50$; # $8x_1 + 7x_2 + 5x_3 + y_{2m} - y_{2p} = 75$;

```
setwd("/Users/thupiliabhinav/Downloads")
lp<-read.lp("formulation_file.lp")
lp
```

```
## Model name:
##           x1    x2    x3    y1m    y1p    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
```

#Goal programming model

```
solve(lp)
```

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

#The formulation of lp was successful as the returned value is 0.

The objective function is to achieve maximize profit.

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

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

#Variable value of goal programming model

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

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

#interpretation

#1. From above we can see there is a change to X3. Product 3 is the only product that the firm can produce i.e., 15 Units of Product 3 to thereby maximize the profit.

#2. With respect to the employment level, the maximum number of employees is confined to 50 Hundred Employees as per the constraints defined above, but here in this case the firm exceeded the employment levels by 25 Hundred Employees.

#3. The goal of y2p and y2m in earnings for next year was to see any deviations. As per the above formulation, it didnt show any deviations.

#4.The profit that the firm maximizes is 225 Million Dollars.