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.

#lptable 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", "Millions 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: 20x1 + 15x2 + 25x3 - 6y1m - 6y1p - 3y2m;

# Constraints #6x1 + 4x2 + 5x3 + y1m - y1p = 50; #8x1 + 7x2 + 5x3 + y2m - y2p = 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.