Goal Programming

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# 1st step is to solve using Simplex Method  
#calling libraries nesscary to solve problem   
  
library(lpSolveAPI)  
  
#loading .lp file   
gp = read.lp("GPSSK.lp")  
gp

## Model name:   
## x1 x2 x3 y1plus y1minus y2minus y2plus   
## Maximize 20 15 25 -6 6 3 0   
## R1 0 0 0 0 0 -3 0 = 0  
## R2 6 4 5 -1 1 0 0 = 50  
## R3 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

#where  
#we want to max Z = P- 6C- 3D  
#Product:   
#1 2 3   
#Total profit 20 15 25 Maximize Millions of dollars   
#Employment   
#level   
#6 4 5 =50 Hundreds of employees   
#Earnings next   
#year   
#8 7 5 ≥75 Millions of dollars  
  
#solve LP  
solve(gp)

## [1] 0

get.objective(gp)

## [1] 225

get.variables(gp)

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

# Max Z = 225 @ Product 1 and 2(x1,x2) = 0 and Product 3(x3)= 15 the employment goal (yp1) should be +25 in hundreds, these outputs will be part of the 2nd lp formulation.   
  
#variables that did not relate to max profit such as employment goals were removed in this first stage   
gp1 = read.lp("GPSSKS1.lp")  
gp1

## Model name:   
## x1 x2 x3 y1plus y1minus y2minus y2plus   
## Maximize 20 15 25 -6 0 0 0   
## R1 0 0 0 6 0 0 0 = 0  
## R2 6 4 5 -1 1 0 0 = 50  
## R3 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 LP  
solve(gp1)

## [1] 0

get.objective(gp1)

## [1] 250

get.variables(gp1)

## [1] 0 0 10 0 0 25 0

# After the first stage where we focussed on maximizing profit, we saw a +25 in millions increase in profit by Product 3 (x3)= 10 and y2m earnings (-) by 25 in million for the next year projected

gp2 = read.lp("GPSSKS2.lp")  
gp2

## Model name:   
## x1 x2 x3 y1plus y2minus   
## Maximize 20 15 25 6 6   
## R1 40 30 50 -6 -6 = 250  
## R2 6 4 5 1 0 = 50  
## R3 8 7 5 0 1 = 50  
## Kind Std Std Std Std Std   
## Type Real Real Real Real Real   
## Upper Inf Inf Inf Inf Inf   
## Lower 0 0 0 0 0

#solve LP  
solve(gp2)

## [1] 0

get.objective(gp2)

## [1] 329.5455

get.variables(gp2)

## [1] 0.000000 0.000000 7.727273 11.363636 11.363636

# after the second stage focusing on earnings next year +(25)in millions in addition to total profit x3 = 7.73 optimal while cutting the workforce by 11.36 each year due to only only product being ran optimally.

gpSL = read.lp("GPSSKSL.lp")  
gpSL

## Model name:   
## y1m y2p y2m y3p x3 y1p y3m   
## Minimize 1 999 4 999 0 0 0   
## R1 1 0 0 0 15 -999 0 = 0  
## R2 0 -999 1 0 15 0 0 = 50  
## R3 0 0 0 -999 15 0 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 LP  
solve(gpSL)

## [1] 0

get.objective(gpSL)

## [1] 100

get.variables(gpSL)

## [1] 0.00000000 0.00000000 0.00000000 0.00000000 3.33333333 0.05005005  
## [7] 25.00000000

#inputting the previous findings to maximize profit into 1 streamlined approach and setting p = profit to a large number to prioritize it we yeild a profit of 100 million with x3 = 3.33 in hundreds of units produced, adding (.05) in workers in hundreds and next year earnings up by 25 in millions