````
---
title: "Untitled"
author: "ISHIKA NISHA"
date: "11/8/2021"
output: pdf_document
---


```{r}
library(lpSolveAPI)
library(Benchmarking)
```

```{r}
DM1 <-  read.lp("dm1.lp")
DM2 <- read.lp("dm2.lp")
DM3 <- read.lp("dm3.lp")
DM4 <- read.lp("dm4.lp")
DM5 <- read.lp("dm5.lp")
DM6 <- read.lp("dM6.lp")
```

 #values of DM1,DM2,DM3,DM4,DM5,DM6,DM7

```{r}
solve(DM1)
get.objective(DM1)
get.variables(DM1)

solve(DM2)
get.objective(DM2)
get.variables(DM2)

solve(DM3)
get.objective(DM3)
get.variables(DM3)

solve(DM4)
get.objective(DM4)
get.variables(DM4)

solve(DM5)
get.objective(DM5)
get.variables(DM5)

solve(DM6)
get.objective(DM6)
get.variables(DM6)
````
````

```
[1] 0
[1] 1
[1] 7.142857e-05 0.000000e+00 5.172414e-03 1.120690e-03
[1] 0
[1] 1
[1] 0.000000e+00 4.761905e-05 1.376147e-03 6.422018e-04
[1] 0
[1] 1
[1] 2.380952e-05 0.000000e+00 1.724138e-03 3.735632e-04
[1] 0
[1] 1
[1] 0.000000e+00 2.380952e-05 6.880734e-04 3.211009e-04
[1] 0
[1] 0.9774987
[1] 0.0000115123 0.0000303506 0.0010989011 0.0005128205
[1] 0
[1] 0.8674521
[1] 1.620029e-05 4.270987e-05 1.546392e-03 7.216495e-04
```

```{r}
A <- matrix(c(150,400,320,520,350,320,200,700,1200,2000,1200,700),ncol = 2)
B <- matrix(c(14000,14000,42000,28000,19000,14000,3500,21000,10500,42000,25000,15000),ncol = 2)
colnames(A) <- c("Staff Hours perDay","Supplies perDay")
colnames(B) <- c("Reimbursed Patient-Days","Privately Paid Patient Days")

A
B
```

```
     Staff Hours perDay Supplies perDay
[1,]                150             200
[2,]                400             700
[3,]                320            1200
[4,]                520            2000
[5,]                350            1200
[6,]                320             700
     Reimbursed Patient-Days Privately Paid Patient Days
[1,]                   14000                        3500
[2,]                   14000                       21000
[3,]                   42000                       10500
[4,]                   28000                       42000
[5,]                   19000                       25000
[6,]                   14000                       15000
```

#A&B) Formulation and performance of DEA analysis under all DEA assumptions of FDH, CRS, VRS,IRS, DRS, and FRH along with the Peers and Lambdas under each of the above assumptions.

````
```{r}
Analysis.fdh <- dea(A,B,RTS = "fdh")
Analysis.fdh
peers(Analysis.fdh)
lambda(Analysis.fdh)

Analysis.crs <- dea(A,B,RTS = "crs")
Analysis.crs
peers(Analysis.crs)
lambda(Analysis.crs)

Analysis.vrs <- dea(A,B,RTS = "vrs")
Analysis.vrs
peers(Analysis.vrs)
lambda(Analysis.vrs)


Analysis.irs <- dea(A,B,RTS = "irs")
Analysis.irs
peers(Analysis.irs)
lambda(Analysis.irs)

Analysis.drs <- dea(A,B,RTS = "drs")
Analysis.drs
peers(Analysis.drs)
lambda(Analysis.drs)

Analysis.frh <- dea(A,B,RTS = "add")
Analysis.frh
peers(Analysis.frh)
lambda(Analysis.frh)

```
````

```
[1] 0
[1] 1
[1] 7.142857e-05 0.000000e+00 5.172414e-03 1.120690e-03
[1] 0
[1] 1
[1] 0.000000e+00 4.761905e-05 1.376147e-03 6.422018e-04
[1] 0
[1] 1
[1] 2.380952e-05 0.000000e+00 1.724138e-03 3.735632e-04
[1] 0
[1] 1
```

```
[1] 0.000000e+00 2.380952e-05 6.880734e-04 3.211009e-04
[1] 0
[1] 0.9774987
[1] 0.0000115123 0.0000303506 0.0010989011 0.0005128205
[1] 0
[1] 0.8674521
[1] 1.620029e-05 4.270987e-05 1.546392e-03 7.216495e-04
```

```
     Staff Hours perDay Supplies perDay
[1,]                150             200
[2,]                400             700
[3,]                320            1200
[4,]                520            2000
[5,]                350            1200
[6,]                320             700
     Reimbursed Patient-Days Privately Paid Patient Days
[1,]                   14000                        3500
[2,]                   14000                       21000
[3,]                   42000                       10500
[4,]                   28000                       42000
[5,]                   19000                       25000
[6,]                   14000                       15000
```

```
[1] 1 1 1 1 1 1
     peer1
[1,]     1
[2,]     2
[3,]     3
[4,]     4
[5,]     5
[6,]     6
     L1 L2 L3 L4 L5 L6
[1,]  1  0  0  0  0  0
[2,]  0  1  0  0  0  0
[3,]  0  0  1  0  0  0
[4,]  0  0  0  1  0  0
[5,]  0  0  0  0  1  0
[6,]  0  0  0  0  0  1
[1] 1.0000 1.0000 1.0000 1.0000 0.9775 0.8675
peer1 peer2 peer3
[1,]     1    NA    NA
[2,]     2    NA    NA
[3,]     3    NA    NA
[4,]     4    NA    NA
[5,]     1     2     4
[6,]     1     2     4
```

```
          L1        L2 L3       L4
[1,] 1.0000000 0.00000000  0 0.0000000
[2,] 0.0000000 1.00000000  0 0.0000000
[3,] 0.0000000 0.00000000  1 0.0000000
[4,] 0.0000000 0.00000000  0 1.0000000
[5,] 0.2000000 0.08048142  0 0.5383307
[6,] 0.3428571 0.39499264  0 0.1310751
[1] 1.0000 1.0000 1.0000 1.0000 1.0000 0.8963
peer1 peer2 peer3
[1,]     1    NA    NA
[2,]     2    NA    NA
[3,]     3    NA    NA
[4,]     4    NA    NA
[5,]     5    NA    NA
[6,]     1     2     5
          L1       L2 L3 L4       L5
[1,] 1.0000000 0.0000000  0  0 0.0000000
[2,] 0.0000000 1.0000000  0  0 0.0000000
[3,] 0.0000000 0.0000000  1  0 0.0000000
[4,] 0.0000000 0.0000000  0  1 0.0000000
[5,] 0.0000000 0.0000000  0  0 1.0000000
[6,] 0.4014399 0.3422606  0  0 0.2562995
[1] 1.0000 1.0000 1.0000 1.0000 1.0000 0.8963
peer1 peer2 peer3
[1,]     1    NA    NA
[2,]     2    NA    NA
[3,]     3    NA    NA
[4,]     4    NA    NA
[5,]     5    NA    NA
[6,]     1     2     5
          L1       L2 L3 L4       L5
[1,] 1.0000000 0.0000000  0  0 0.0000000
[2,] 0.0000000 1.0000000  0  0 0.0000000
[3,] 0.0000000 0.0000000  1  0 0.0000000
[4,] 0.0000000 0.0000000  0  1 0.0000000
[5,] 0.0000000 0.0000000  0  0 1.0000000
[6,] 0.4014399 0.3422606  0  0 0.2562995
[1] 1.0000 1.0000 1.0000 1.0000 0.9775 0.8675
peer1 peer2 peer3
[1,]     1    NA    NA
[2,]     2    NA    NA
[3,]     3    NA    NA
[4,]     4    NA    NA
[5,]     1     2     4
[6,]     1     2     4
          L1        L2 L3       L4
[1,] 1.0000000 0.00000000  0 0.0000000
[2,] 0.0000000 1.00000000  0 0.0000000
```

```
[3,] 0.0000000 0.00000000  1 0.0000000
[4,] 0.0000000 0.00000000  0 1.0000000
[5,] 0.2000000 0.08048142  0 0.5383307
[6,] 0.3428571 0.39499264  0 0.1310751
[1] 1 1 1 1 1 1
peer1
[1,]     1
[2,]     2
[3,]     3
[4,]     4
[5,]     5
[6,]     6
    L1 L2 L3 L4 L5 L6
[1,]  1  0  0  0  0  0
[2,]  0  1  0  0  0  0
[3,]  0  0  1  0  0  0
[4,]  0  0  0  1  0  0
[5,]  0  0  0  0  1  0
[6,]  0  0  0  0  0  1
```

#C Summarize your results in a tabular format

`![](TABLE.jpg)`

FACILITY	FRH	CRS EFF%	CRS PEERS	CRS LAMBDA	VRS EFF%	VRS PEERS	VRS LAMBDA	IRS EFF%	IRS PEERS	IRS LAMBDA	DRS EFF%	DRS PEERS	DRS LAMBDA	FDH%
FACILITY1	100%	100%	1		100%	1		100%	1		100%	1		100%
FACILITY2	100%	100%	2		100%	2		100%	2		100%	2		100%
FACILITY3	100%	100%	3		100%	3		100%	3		100%	3		100%
FACILITY4	100%	100%	4		100%	4		100%	4		100%	4		100%
FACILITY5	100%	97%	1,2,4	0.2,0.08,0.538	100%	5		100%	5		97%	1,2,4	0.2,0.08,0.538	100%
FACILITY6	100%	86%	1,2,4	0.34,0.39,0.13	89%	1,2,5	0.4,0.34,0.26	89%	1,2,5	0.4,0.34,0.26	86%	1,2,4	0.34,0.39,0.13	100%

#D Compare and contrast the above results

```
 #Graphically
dea.plot(A,B,RTS="fdh", main= ("FDH Graph"))
dea.plot(A,B,RTS="crs", main= ("CRS Graph"))
dea.plot(A,B,RTS="vrs", main= ("VRS Graph"))
dea.plot(A,B,RTS="irs",  main= ("IRS Graph"))
dea.plot(A,B,RTS="drs", main= ("DRS Graph"))
dea.plot(A,B,RTS="add", main=("FRH Graph"))`
```

FDH- All DMs(1,2,3,4,5,6) are effective.

CRS- DM 1,2,3,and 4 are 100% effective.While, DM5 is 97% effective, and DM6 is   only 86% effective.
PEERS- The peer value for DM5 are 1,2,and 4,and DM6 are 1,2,and 4.
LAMBDA- The lambda value for DM6 IS 0.20, 0.08,and o.53 and for DM6 is 0.34,   0.39,and 0.13

VRS- DMs (1,2,3,4,5)are 100% effective. DM 6 is 89% effective.
PEERS- The peer value for DM6 are 1,2,and 5.
LAMBDA- The lambda value for DM6 is 0.40, 0.34,and 0.25

IRS- DMs (1,2,3,4,5)are 100% effective. DM 6 is 89% effective.
PEERS- The peer value for DM6 are 1,2,and 5.
LAMBDA- The lambda value for DM6 is 0.40, 0.34,and 0.25

DRS- DM 1,2,3,and 4 are 100% effective.While, DM5 is 97% effective, and DM6 is only 86% effective.
PEERS- The peer value for DM5 are 1,2,and 4,and DM6 are 1,2,and 4.
LAMBDA- The lambda value for DM6 IS 0.20, 0.08,and o.53 and for DM6 is 0.34, 0.39,and 0.13

FRH- All DMs(1,2,3,4,5,6) are effective.

2. (1) P = 20x1 + 15x2 + 25x3
S.T. 6x1 + 4x2 + 5x3 = 50
8x1 + 7x2 + 5x3 >=75

The auxiliary variables are
6x1 + 4x2 + 5x3 – 50 = y1
8x1 + 7x2 + 5x3 – 75 = y2

Given y1= y1P – y1N
Y2= y2P- y2N

Therefore,
6x1 + 4x2 + 5x3 – (y1P – y1N) = 50
8x1 + 7x2 + 5x3 – (y2P – y2N) = 75
P = 20x1 + 15x2 + 25x3
X1,x2,x3,y1P,y1N,y2P,y2N >=0

(2) The objective function in terms of x1, x2, x3, y1P,y1N, y2P, y2N will be
Maximize P = 20x1 + 15x2 + 25x3 – 6y1P – 6y1N – 3y2N

(3) #setting up the working directory

~~~~
```{r}
getwd()
```
~~~~

#Reading the lp file Assign

~~~~
```{r}
Assign <- read.lp("assn.lp")
Assign
~~~~

```
solve(Assign)
get.objective(Assign)
get.variables(Assign)
```

```
Model name:
          x1    x2    x3   y1P   y1N   y2N   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
[1] 0
[1] 225
[1]  0  0 15 25  0  0  0
```

#Findings

A = 225

x1=0, x2=0, x3=15

y1P=25, y1N=0, y2N=0, y2P=0

So, there are 25 employees more than the desired employement goal and therefore the penalty is 225

The total profit would be 25*15 = 375 million. #discounted