DEA Assignment

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Question:

Creating matrix for the problem

```
x <- matrix(c(150,400,320,520,350, 320, 0.2, 0.7, 1.2, 2.0, 1.2, 0.7),ncol = 2)
y <- matrix(c(14000,14000,42000,28000,19000,14000,3500,21000,10500,42000,
25000, 15000),ncol = 2)

# Assign column names
colnames(x) <- c("Staff_Hours_per_day","Supplies_per_day")
colnames(y) <- c("Reimbursed_patient_days", "Privately_paid_patient-days")
```

Solution:

Formulating and performing DEA analysis

DEA Analysis using FDH

```
library(Benchmarking)
```

```
## Loading required package: lpSolveAPI

## Loading required package: ucminf

## Loading required package: quadprog

##
## Loading Benchmarking version 0.30h, (Revision 244, 2022/05/05 16:31:31) ...

## Build 2022/05/05 16:31:40
```

```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --

## v ggplot2 3.3.6      v purrr   0.3.4
## v tibble  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      v stringr 1.4.1
## v readr   2.1.2      v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
# Analysing DEA using FDH with x and y values
fdh_ana = dea(x,y,RTS = "fdh")

#Coverting efficiency value to Data frame
fdh_eff = as.data.frame(fdh_ana$eff)
```

DEA Analysis using CRS

```
# Analysing DEA using CRS with x and y values
crs_ana = dea(x,y,RTS = "crs")

#Coverting efficiency value to Data frame
crs_eff = as.data.frame(crs_ana$eff)
```

DEA Analysis using VRS

```
# Analysing DEA using VRS with x and y values
vrs_ana = dea(x,y,RTS = "vrs")

#Coverting efficiency value to Data frame
vrs_eff = as.data.frame(vrs_ana$eff)
```

DEA Analysis using IRS

```
# Analysing DEA using IRS with x and y values
irs_ana <- dea(x,y,RTS = "irs")

#Coverting efficiency value to Data frame
irs_eff = as.data.frame(irs_ana$eff)
```

DEA Analysis using DRS

```
# Analysing DEA using DRS with x and y values
drs_ana = dea(x,y,RTS = "drs")

#Coverting efficiency value to Data frame
drs_eff = as.data.frame(drs_ana$eff)
```

DEA Analysis using FRH

```
# Analysing DEA using FRH with x and y values
frh_ana = dea(x,y,RTS = "add")

#Coverting efficiency value to Data frame
frh_eff = as.data.frame(frh_ana$eff)
```

Determining the Peers and Lambdas under each of the above assumptions

Determining Peers and Lambdas for FDH

```r
# Determining peers
fdh_peers <- peers(fdh_ana)

# Determining the weights using lambda function for the  peer values
fdh_lamda <- lambda(fdh_ana)
```

Determining Peers and Lambdas for CRS

```r
# Determining peers
crs_peers <- peers(crs_ana)

# Determining the weights using lambda function for the  peer values
crs_lamda <- lambda(crs_ana)
```

Determining Peers and Lambdas for VRS

```r
# Determining peers
vrs_peers <- peers(vrs_ana)

# Determining the weights using lambda function for the peer values
vrs_lamda <- lambda(vrs_ana)
```

Determining Peers and Lambdas for IRS

```r
# Determining peers

irs_peers <- peers(irs_ana)

# Determining the weights using lambda function for the peer values

irs_lamda <- lambda(irs_ana)
```

Determining Peers and Lambdas for DRS

```r
# Determining peers
drs_peers <- peers(drs_ana)

# Determining the weights using lambda function for the peer values
drs_lamda <- lambda(drs_ana)
```

Determining Peers and Lambdas for FDH

```r
# Identify the peers
frh_peers <- peers(frh_ana)

# Identify the relative weights given to the peers using lambda function
frh_lamda <- lambda(frh_ana)
```

Summarizing results in a tabular format

```r
fdh_result <- data.frame(fdh_eff,fdh_peers, fdh_lamda)
crs_result <- data.frame(crs_eff,crs_peers, crs_lamda)
vrs_result <- data.frame(vrs_eff,vrs_peers, vrs_lamda)
irs_result <- data.frame(irs_eff,irs_peers, irs_lamda)
drs_result <- data.frame(drs_eff,drs_peers, drs_lamda)
frh_result <- cbind(frh_eff,frh_peers, frh_lamda)
```

```r
fdh_result
```

```
##   fdh_ana.eff peer1 L1 L2 L3 L4 L5 L6
## 1           1     1  1  0  0  0  0  0
## 2           1     2  0  1  0  0  0  0
## 3           1     3  0  0  1  0  0  0
## 4           1     4  0  0  0  1  0  0
## 5           1     5  0  0  0  0  1  0
## 6           1     6  0  0  0  0  0  1
```

```r
crs_result
```

```
##   crs_ana.eff peer1 peer2 peer3        L1         L2 L3        L4
## 1   1.0000000     1    NA    NA 1.0000000 0.00000000  0 0.0000000
## 2   1.0000000     2    NA    NA 0.0000000 1.00000000  0 0.0000000
## 3   1.0000000     3    NA    NA 0.0000000 0.00000000  1 0.0000000
## 4   1.0000000     4    NA    NA 0.0000000 0.00000000  0 1.0000000
## 5   0.9774987     1     2     4 0.2000000 0.08048142  0 0.5383307
## 6   0.8674521     1     2     4 0.3428571 0.39499264  0 0.1310751
```

```r
vrs_result
```

```
##   vrs_ana.eff peer1 peer2 peer3        L1        L2 L3 L4        L5
## 1   1.0000000     1    NA    NA 1.0000000 0.0000000  0  0 0.0000000
## 2   1.0000000     2    NA    NA 0.0000000 1.0000000  0  0 0.0000000
## 3   1.0000000     3    NA    NA 0.0000000 0.0000000  1  0 0.0000000
## 4   1.0000000     4    NA    NA 0.0000000 0.0000000  0  1 0.0000000
## 5   1.0000000     5    NA    NA 0.0000000 0.0000000  0  0 1.0000000
## 6   0.8963283     1     2     5 0.4014399 0.3422606  0  0 0.2562995
```

```r
irs_result
```

```
##   irs_ana.eff peer1 peer2 peer3        L1        L2 L3 L4        L5
## 1   1.0000000     1    NA    NA 1.0000000 0.0000000  0  0 0.0000000
## 2   1.0000000     2    NA    NA 0.0000000 1.0000000  0  0 0.0000000
## 3   1.0000000     3    NA    NA 0.0000000 0.0000000  1  0 0.0000000
## 4   1.0000000     4    NA    NA 0.0000000 0.0000000  0  1 0.0000000
## 5   1.0000000     5    NA    NA 0.0000000 0.0000000  0  0 1.0000000
## 6   0.8963283     1     2     5 0.4014399 0.3422606  0  0 0.2562995
```

```r
drs_result
```

```
##   drs_ana.eff peer1 peer2 peer3        L1         L2 L3        L4
## 1   1.0000000     1    NA    NA 1.0000000 0.00000000  0 0.0000000
## 2   1.0000000     2    NA    NA 0.0000000 1.00000000  0 0.0000000
## 3   1.0000000     3    NA    NA 0.0000000 0.00000000  1 0.0000000
## 4   1.0000000     4    NA    NA 0.0000000 0.00000000  0 1.0000000
## 5   0.9774987     1     2     4 0.2000000 0.08048142  0 0.5383307
## 6   0.8674521     1     2     4 0.3428571 0.39499264  0 0.1310751
```

```
frh_result
```

```
##   frh_ana$eff peer1 L1 L2 L3 L4 L5 L6
## 1           1     1  1  0  0  0  0  0
## 2           1     2  0  1  0  0  0  0
## 3           1     3  0  0  1  0  0  0
## 4           1     4  0  0  0  1  0  0
## 5           1     5  0  0  0  0  1  0
## 6           1     6  0  0  0  0  0  1
```

Compare and contrast the above results

For FDH

From the information peer value was given one unit, both lamda and efficiency values are 1 and from the result table it states that every DMU and facility is having maximum capacity and effectiveness.

For CRS

From the lamdas and peers it is observed that the efficiency of facilities 1, 2, 3, and 4 are 100% which means they use CRS fully. The efficiency for 5 and 6 is 97.74% and 86.74% respectively which can be improved.

For VRS

From the lamdas and peers we can tell facilities—numbers 1, 2, 3, 4, and 5 has maximum efficieny/productivity. With facility 6, which has an efficiency of 89.63%.

For IRS

Facilities 1, 2, 3, 4, and 5 operate at full productivity, IRS and VRS are both achieved. For facility 6, has 89.63% efficiency requires improvement from units 1, 2, and 5.

For DRS

For facilities 1, 2, 3, and 4, Decreasing Returns to Scale (DRS) performs well in terms of efficiency and for facilities 5 and 6 needs improvement and require a portion of facilities 1, 2, and 4 in order to get maximum efficiency of 1.

For FRH

All facilities are efficient which are observed in peer and lambda.