MIS 64018 - Assignment 5

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Load libraries

```
library(lpSolveAPI)
library(Benchmarking)
```

Create Matrix

```
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)
colnames(y) <- c("reimbursed_patient-days","privately_paid_patient-days")
colnames(x) <- c("staff_hours_per_day","supplies_per_day")
x
```

```
##      staff_hours_per_day supplies_per_day
## [1,]                 150              0.2
## [2,]                 400              0.7
## [3,]                 320              1.2
## [4,]                 520              2.0
## [5,]                 350              1.2
## [6,]                 320              0.7
```

```
y
```

```
##      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
```

DEA Assumptions

FDH

```
e <- dea(x,y,RTS = "fdh")            # provide the input and output
eff(e)                               # display efficiencies
```

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

```
peers(e)                             # identify the peers
```

```
##      peer1
## [1,]     1
## [2,]     2
## [3,]     3
```

```
## [4,]     4
## [5,]     5
## [6,]     6
```

```
lambda(e)                              # identify the relative weights given to the peers
```

```
##      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
```

Free Disposability Hull shows all facilities as efficient.

CRS

```
e <- dea(x,y,RTS = "crs")              # provide the input and output
eff(e)                                 # display efficiencies
```

```
## [1] 1.0000000 1.0000000 1.0000000 1.0000000 0.9774987 0.8674521
```

```
peers(e)                               # identify the peers
```

```
##      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
```

```
lambda(e)                              # identify the relative weights given to the peers
```

```
##             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
```

Constant Return to Scale (CRS) shows Facilities 1-4 as efficient. Facility 5 has a 97.8% efficiency and Facility 6 has an 86.8% efficiency. Both had Facilities 2 and 4 as peers.

VRS

```
e <- dea(x,y,RTS = "vrs")              # provide the input and output
eff(e)                                 # display efficiencies
```

```
## [1] 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 0.8963283
```

```
peers(e)                               # identify the peers
```

```
##      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
```

```
lambda(e)                              # identify the relative weights given to the peers
```

```
##             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
```

Varying Return to Scale (VRS) shows Facilities 1-5 as efficient. Facility 6 has a 89.6% efficiency with Facilities 2 and 5 as peers.

IRS

```
e <- dea(x,y,RTS = "irs")              # provide the input and output
eff(e)                                 # display efficiencies
```

```
## [1] 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 0.8963283
```

```
peers(e)                               # identify the peers
```

```
##      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
```

```
lambda(e)                              # identify the relative weights given to the peers
```

```
##             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
```

Increasing Return to Scale (IRS) shows Facilities 1-5 as efficient. Facility 6 has a 89.6% efficiency with Facilities 2 and 5 as peers. This is the same result as VRS.

DRS

```
e <- dea(x,y,RTS = "drs")              # provide the input and output
eff(e)                                 # display efficiencies
```

```
## [1] 1.0000000 1.0000000 1.0000000 1.0000000 0.9774987 0.8674521
```

```
peers(e)                               # identify the peers
```

```
##      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
```

```
lambda(e)                              # identify the relative weights given to the peers
```

```
##             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
```

Decreasing Return to Scale (DRS) shows Facilities 1-4 as efficient. Facility 5 has a 97.8% efficiency and Facility 6 has an 86.8% efficiency. Both had Facilities 2 and 4 as peers. This is the same result as CRS.

FRH

```
e <- dea(x,y,RTS = "add")              # provide the input and output
eff(e)                                 # display efficiencies
```

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

```
peers(e)                               # identify the peers
```

```
##      peer1
## [1,]     1
## [2,]     2
## [3,]     3
## [4,]     4
## [5,]     5
## [6,]     6
```

```
lambda(e)                              # identify the relative weights given to the peers
```

```
##      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
```

Free Replacibility Hull shows all facilities as efficient.

Compare and Contrast

The results were showed three different results, in the following pairs:

FDH and FRH

All six facilities are efficient

VRS and IRS

Facilities 1-5 are efficient

Facility 6 has an 89.6% efficiency

Facility 6 has Facilities 2 and 5 as peers

DRS and CRS

Facilities 1-4 are efficient

Facility 5 has an 97.8% efficiency and Facility 6 has an 86.8% efficiency

Facilities 5 and 6 have Facilities 2 and 4 as peers