Assignment 8

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```
library(Benchmarking)
```

```
## Loading required package: lpSolveAPI
```

```
## Loading required package: ucminf
```

```
## Loading required package: quadprog
```

```
inputs <- matrix(c(150, 400, 320, 520, 350, 320,
                   0.2, 0.7, 1.2, 2.0, 1.2, 0.7), ncol = 2)
outputs <- matrix(c(14000, 14000, 42000, 28000, 19000, 14000,
                    3500, 21000, 10500, 42000, 25000, 15000), ncol=2)
colnames(inputs)  <- c("Daily Staff Hours", "Daily Supplies Cost")
colnames(outputs) <- c("Reimbursed Patient-Days", "Privately-Paid Patient Days")
inputs
```

```
##      Daily Staff Hours Daily Supplies Cost
## [1,]               150                 0.2
## [2,]               400                 0.7
## [3,]               320                 1.2
## [4,]               520                 2.0
## [5,]               350                 1.2
## [6,]               320                 0.7
```

```
outputs
```

```
##      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
```

I have combined questions 1 and 2, and divided the code based on assumption:

```
# FDH
e.fdh <- dea(inputs,outputs,RTS = "fdh")
e.fdh
```

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

```
peers(e.fdh)
```

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

```
lambda(e.fdh)
```

```
##       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
```

```
# FDH shows all 6 facilities as efficient

# CRS
e.crs <- dea(inputs, outputs,RTS = "crs")
e.crs
```

```
## [1] 1.0000 1.0000 1.0000 1.0000 0.9775 0.8675
```

```
peers(e.crs)
```

```
##       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.crs)
```

```
##              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
```

```r
# CRS shows only facilities 1 through 4 as efficient

# VRS
e.vrs <- dea(inputs, outputs,RTS = "vrs")
e.vrs
```

```
## [1] 1.0000 1.0000 1.0000 1.0000 1.0000 0.8963
```

```r
peers(e.vrs)
```

```
##      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
```

```r
lambda(e.vrs)
```

```
##              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
```

```r
# VRS shows only facilities 1 through 5 as efficient

# IRS
e.irs <- dea(inputs, outputs,RTS = "irs")
e.irs
```

```
## [1] 1.0000 1.0000 1.0000 1.0000 1.0000 0.8963
```

```r
peers(e.irs)
```

```
##      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
```

```r
lambda(e.irs)
```

```
##              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
```

```r
# IRS shows only facilities 1 through 5 as efficient

# DRS
e.drs <- dea(inputs, outputs,RTS = "drs")
e.drs
```

```
## [1] 1.0000 1.0000 1.0000 1.0000 0.9775 0.8675
```

```r
peers(e.drs)
```

```
##       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
```

```r
lambda(e.drs)
```

```
##              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
```

```r
# DRS shows only facilities 1 through 4 as efficient

# FRH
e.frh <- dea(inputs, outputs,RTS = "add")
e.frh
```

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

```r
peers(e.frh)
```

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

```
lambda(e.frh)
```

```
##      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
```

```
#FRH shows all facilities as efficent
```

Question 3: I could not figure out how to directly transfer the results to a tabular format. Instead, I created a matrix where 1 is efficent and 0 is not efficent.

```
results <- matrix(c(1, 1, 1, 1, 1, 1,
                    1, 1, 1, 1, 0, 0,
                    1, 1, 1, 1, 1, 0,
                    1, 1, 1, 1, 1, 0,
                    1, 1, 1, 1, 0, 0,
                    1, 1, 1, 1, 1, 1), ncol = 6)
colnames(results)  <- c("FDH", "CRS", "VRS", "IRS", "DRS", "FRH")
rownames(results) <- c("Facility 1", "Facility 2", "Facility 3", "Facility 4", "Facility 5", "Facility 6
results
```

```
##            FDH CRS VRS IRS DRS FRH
## Facility 1   1   1   1   1   1   1
## Facility 2   1   1   1   1   1   1
## Facility 3   1   1   1   1   1   1
## Facility 4   1   1   1   1   1   1
## Facility 5   1   0   1   1   0   1
## Facility 6   1   0   0   0   0   1
```

Question 4: Facilities 1-4 are efficent according to the models, while 5-6 are not efficent in all models