QUANT MGMT Assignment 8

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2025-10-22

```
library(Benchmarking)
```

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

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

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

```
library(lpSolveAPI)
library(ucminf)
library(quadprog)
if (!require(knitr)) {
  library(knitr)
}
```

```
## Loading required package: knitr
```

```
data <- data.frame(
  DMU = c("Facility", "Facility 2", "Facility 3",
          "Facility 4", "Facility 5", "Facility 6"),
  Staff_Hours_Per_Day = c(150, 400, 320, 520, 350, 320),
  Supplies_Per_Day = c(.2, .7, 1.2, 2, 1.2, .7),
  Reimbursed_Patient_Days = c(14000, 14000, 42000, 28000, 19000, 14000),
  Privately_Paid_Patient_Days = c(3500, 21000, 10500, 42000, 25000, 15000)
)

kable(data, format = "pandoc", caption = "Hope Valley Health Care Association")
```

Hope Valley Health Care Association

DMU	Staff_Hours_Per_Day	Supplies_Per_Day	Reimbursed_Patient_Days	Privately_Paid_Patient_Days
Facility	150	0.2	14000	3500
Facility 2	400	0.7	14000	21000
Facility 3	320	1.2	42000	10500

DMU	Staff_Hours_Per_Day	Supplies_Per_Day	Reimbursed_Patient_Days	Privately_Paid_Patient_Days
Facility 4	520	2.0	28000	42000
Facility 5	350	1.2	19000	25000
Facility 6	320	0.7	14000	15000

```
x <- matrix(c(150, 400, 320, 520, 350, 320,
              .2, .7, 1.2, 2, 1.2, .7), ncol = 2)
y <- matrix(c(14000, 14000, 42000, 28000, 19000, 14000,
              3500, 21000, 10500, 42000, 25000, 15000), ncol = 2)

colnames(y) <- c("Privately paid patient-days", "Reimbursed Patient Days")
colnames(x) <- c("Staff Hours Per Day", "Supplies Per Day")

## Question 1: Formulate and perform DEA analysis under all DEA assumptions of FDH, CRS, VRS, IR
S, DRS, and FRH.

crs <- dea(x, y, RTS = "crs")
vrs <- dea(x, y, RTS = "vrs")
fdh <- dea(x, y, RTS = "fdh")
irs <- dea(x, y, RTS = "irs")
drs <- dea(x, y, RTS = "drs")
frh <- dea(x, y, RTS = "add")

## Question 2: Determine the Peers and Lambdas under each of the above assumptions.

peers(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(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
```

```
peers(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
```

```
lambda(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
```

```
peers(fdh)
```

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

```
lambda(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
```

```
peers(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
```

```
lambda(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
```

```
peers(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
```

```
lambda(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
```

```
peers(frh)
```

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

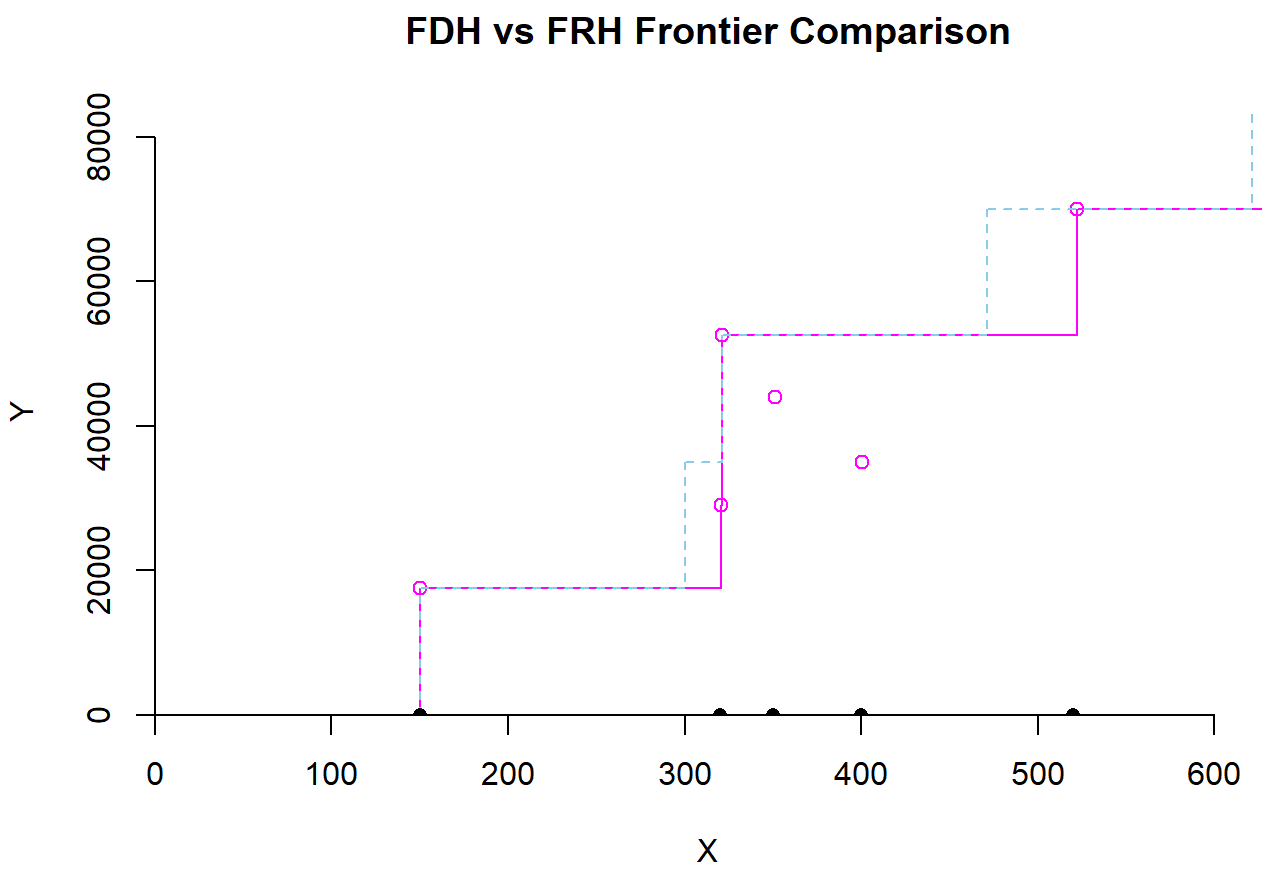
```
lambda(frh)
```

```
##      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
```

```
## Question 3: Summarize your results in a tabular format

summary_results <- data.frame(
  Facility = character(),
  CRS_Efficiency = numeric(),
  VRS_Efficiency = numeric(),
  FDH_Efficiency = numeric(),
  IRS_Efficiency = numeric(),
  DRS_Efficiency = numeric(),
  FRH_Efficiency = numeric(),
  CRS_Peers = character(),
  VRS_Peers = character(),
  FDH_Peers = character(),
  IRS_Peers = character(),
  DRS_Peers = character(),
  FRH_Peers = character(),
  stringsAsFactors = FALSE
)

for (i in 1:nrow(x)) {
  summary_results <- rbind(summary_results, data.frame(
    Facility = paste("Facility", i),
    CRS_Efficiency = crs$eff[i],
    VRS_Efficiency = vrs$eff[i],
    FDH_Efficiency = fdh$eff[i],
    IRS_Efficiency = irs$eff[i],
    DRS_Efficiency = drs$eff[i],
    FRH_Efficiency = frh$eff[i],
    CRS_Peers = paste(which(crs$lambda[i,] > 0), collapse = ", "),
    VRS_Peers = paste(which(vrs$lambda[i,] > 0), collapse = ", "),
    FDH_Peers = paste(which(fdh$lambda[i,] > 0), collapse = ", "),
    IRS_Peers = paste(which(irs$lambda[i,] > 0), collapse = ", "),
    DRS_Peers = paste(which(drs$lambda[i,] > 0), collapse = ", "),
    FRH_Peers = paste(which(frh$lambda[i,] > 0), collapse = ", "),
    stringsAsFactors = FALSE
  ))
}

print(summary_results)
```

```
##     Facility CRS_Efficiency VRS_Efficiency FDH_Efficiency IRS_Efficiency
## 1 Facility 1      1.0000000      1.0000000              1      1.0000000
## 2 Facility 2      1.0000000      1.0000000              1      1.0000000
## 3 Facility 3      1.0000000      1.0000000              1      1.0000000
## 4 Facility 4      1.0000000      1.0000000              1      1.0000000
## 5 Facility 5      0.9774987      1.0000000              1      1.0000000
## 6 Facility 6      0.8674521      0.8963283              1      0.8963283
##   DRS_Efficiency FRH_Efficiency CRS_Peers VRS_Peers FDH_Peers IRS_Peers
## 1      1.0000000              1         1         1         1         1
## 2      1.0000000              1         2         2         2         2
## 3      1.0000000              1         3         3         3         3
## 4      1.0000000              1         4         4         4         4
## 5      0.9774987              1   1, 2, 4         5         5         5
## 6      0.8674521              1   1, 2, 4   1, 2, 5         6   1, 2, 5
##   DRS_Peers FRH_Peers
## 1         1         1
## 2         2         2
## 3         3         3
## 4         4         4
## 5   1, 2, 4         5
## 6   1, 2, 4         6
```

```
# Question 4: COmpare and contrast the above results

dea.plot(x, y, RTS = "fdh", main = "FDH vs FRH Frontier Comparison",
         col= "magenta", lty = 1)
dea.plot(x, y, RTS = "add", add = TRUE,
         col = "skyblue", lty = 2)

points(x, type = "p", col = "black", pch = 16)
```


FDH vs FRH Frontier Comparison
Y
0
20000
40000
60000
80000
X
0
100
200
300
400
500
600