

Assignment- Module: 8

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- **DEA ANALYSIS**

```
tab<- matrix(c("Facility1","Facility 2", "Facility 3", "Facility 4",
               "Facility 5", "Facility 6",
               150, 400, 320, 520, 350, 320,
               0.2, 0.7, 1.2, 2.0, 1.2, 0.7,
               14000, 14000, 42000, 28000, 19000, 14000,
               3500, 21000, 10500, 42000, 25000, 15000), ncol=5, byrow = F)

colnames(tab) <- c('DMU', 'Staff Hours per day', 'Supplies per day',
                  'Reimbursed patient-days',
                  'Privately Paid patient days')

tab <- as.table(tab)
tab

##   DMU          Staff Hours per day Supplies per day Reimbursed patient-days
## A Facility1  150                   0.2             14000
## B Facility 2  400                   0.7             14000
## C Facility 3  320                   1.2             42000
## D Facility 4  520                   2               28000
## E Facility 5  350                   1.2             19000
## F Facility 6  320                   0.7             14000
##   Privately Paid patient days
## A 3500
## B 21000
## C 10500
## D 42000
## E 25000
## F 15000

DMU_names <- tab[c(1,2,3,4,5,6)]
DMU_names

## [1] "Facility1" "Facility 2" "Facility 3" "Facility 4" "Facility 5"
## [6] "Facility 6"

#Input format
x<-matrix(c( 150, 400, 320, 520, 350, 320,
            0.2, 0.7, 1.2, 2.0, 1.2, 0.7), ncol = 2) #input matrix
```

```

y<-matrix(c(14000, 14000, 42000, 28000, 19000, 14000,
            3500, 21000, 10500, 42000, 25000, 15000 ), ncol = 2) #output matrix
colnames(y)<-c('Reimbursed patient-days',
              'Privately Paid patient days')

```

- DEA assumptions of FDH, CRS, VRS, IRS, DRS, and FRH.

```

#model assumptions
#CRS

colnames(x)<-c('Staff Hours per day', 'Supplies per day')
dea(x,y, RTS = "crs")

## [1] 1.0000 1.0000 1.0000 1.0000 0.9775 0.8675

e_crs<-dea(x, y, RTS = "crs")

#efficiency
e_crs

## [1] 1.0000 1.0000 1.0000 1.0000 0.9775 0.8675

#show the peers
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

#show the lambda
lambda(e_crs)

##      L1      L2 L3      L4
## [1,] 1.0000000 0.0000000 0 0.0000000
## [2,] 0.0000000 1.0000000 0 0.0000000
## [3,] 0.0000000 0.0000000 1 0.0000000
## [4,] 0.0000000 0.0000000 0 1.0000000
## [5,] 0.2000000 0.08048142 0 0.5383307
## [6,] 0.3428571 0.39499264 0 0.1310751

#show the table
table1 <- cbind(tab,e_crs$eff, e_crs$lambda, e_crs$peers)
table1

##   DMU      Staff Hours per day Supplies per day Reimbursed patient-day
## A "Facility1" "150"                "0.2"                "14000"

```

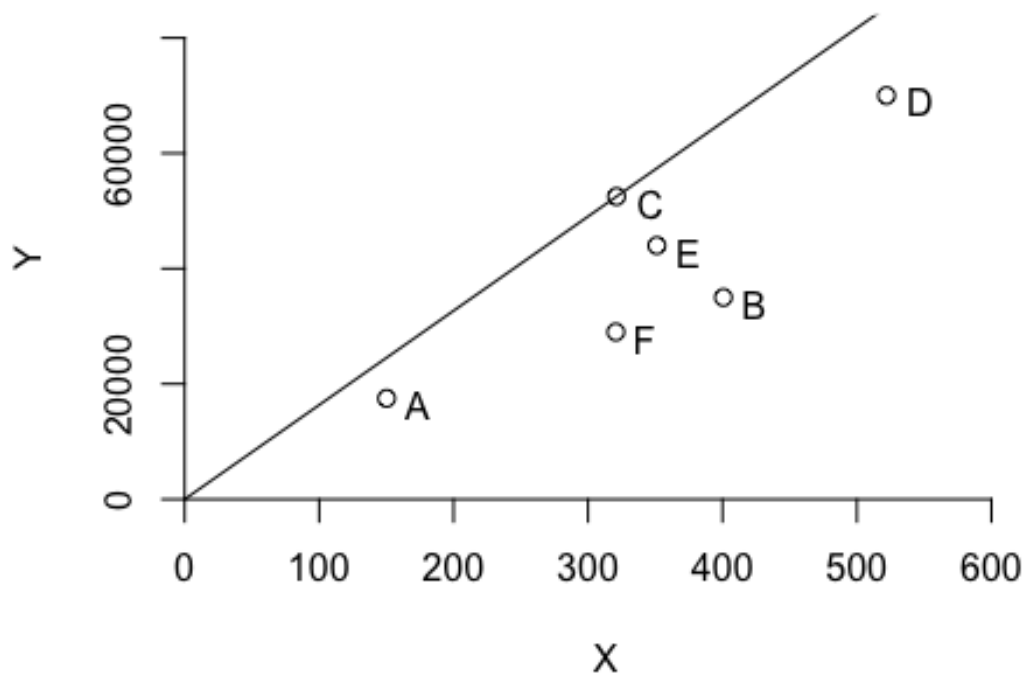
```

## B "Facility 2" "400"          "0.7"          "14000"
## C "Facility 3" "320"          "1.2"          "42000"
## D "Facility 4" "520"          "2"            "28000"
## E "Facility 5" "350"          "1.2"          "19000"
## F "Facility 6" "320"          "0.7"          "14000"
##   Privately Paid patient days
## A "3500"                      "1"            "1"
## B "21000"                     "1"            "0"
## C "10500"                      "1"            "0"
## D "42000"                      "1"            "0"
## E "25000"                      "0.977498691784406" "0.2"
## F "15000"                      "0.867452135493373" "0.342857142857143"
##   L2      L3  L4      L5  L6
## A "0"      "0" "0"      "0" "0"
## B "1"      "0" "0"      "0" "0"
## C "0"      "1" "0"      "0" "0"
## D "0"      "0" "1"      "0" "0"
## E "0.0804814233385661" "0" "0.538330716902146" "0" "0"
## F "0.39499263622975"  "0" "0.131075110456554" "0" "0"

```

#plot the graph

```
dea.plot(x, y, RTS = "crs", txt = rownames(table1) )
```



#FDH

```
colnames(x)<-c('Staff Hours per day', 'Supplies per day')
dea(x,y, RTS = "fdh")
```

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

```
e_fdh<-dea(x, y, RTS = "fdh")
```

```
#efficiency
```

```
e_fdh
```

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

```
#show the peers
```

```
peers(e_fdh)
```

```
##      peer1
```

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

```
## [2,]      2
```

```
## [3,]      3
```

```
## [4,]      4
```

```
## [5,]      5
```

```
## [6,]      6
```

```
#show the lambda
```

```
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
```

```
#show the table
```

```
table2 <- cbind(tab,e_fdh$eff, e_fdh$lambda, e_fdh$peers)
```

```
table2
```

```
##   DMU           Staff Hours per day Supplies per day Reimbursed patient-day
S
```

```
## A "Facility1"  "150"           "0.2"           "14000"
```

```
## B "Facility 2"  "400"           "0.7"           "14000"
```

```
## C "Facility 3"  "320"           "1.2"           "42000"
```

```
## D "Facility 4"  "520"           "2"             "28000"
```

```
## E "Facility 5"  "350"           "1.2"           "19000"
```

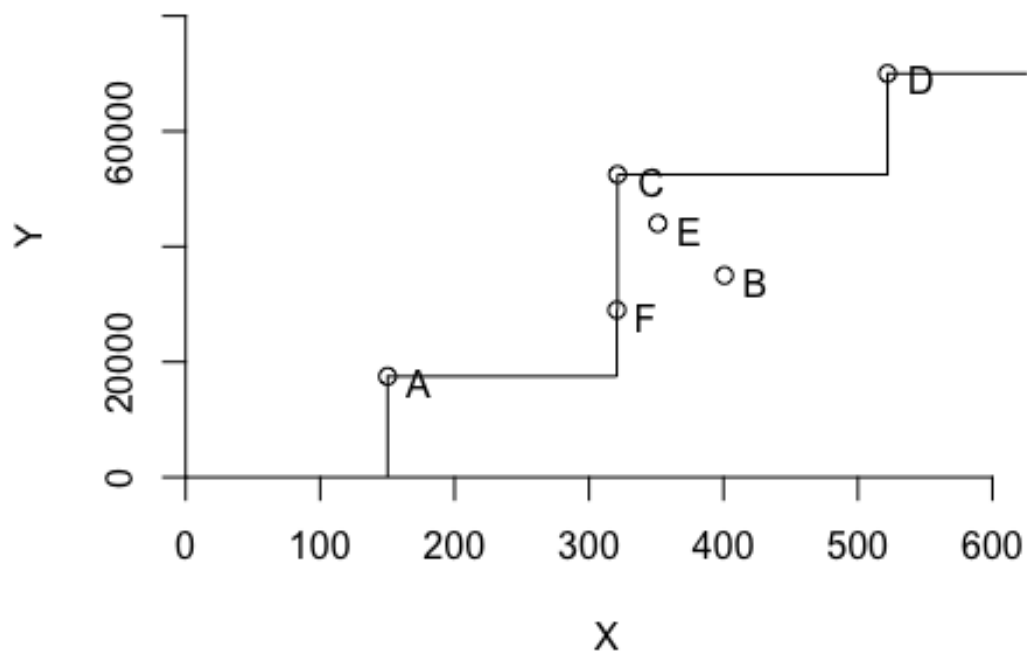
```
## F "Facility 6"  "320"           "0.7"           "14000"
```

```
##   Privately Paid patient days    L1  L2  L3  L4  L5  L6
```

```
## A "3500"      "1" "1" "0" "0" "0" "0" "0" "1"
## B "21000"     "1" "0" "1" "0" "0" "0" "0" "2"
## C "10500"     "1" "0" "0" "1" "0" "0" "0" "3"
## D "42000"     "1" "0" "0" "0" "1" "0" "0" "4"
## E "25000"     "1" "0" "0" "0" "0" "1" "0" "5"
## F "15000"     "1" "0" "0" "0" "0" "0" "1" "6"
```

#plot

```
dea.plot(x, y, RTS = "fdh", txt = rownames(table2) )
```



#VRS

```
colnames(x)<-c('Staff Hours per day', 'Supplies per day')
dea(x,y, RTS = "vrs")
```

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

```
e_vrs<-dea(x, y, RTS = "vrs")
```

#efficiency

```
e_vrs
```

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

```
#show the peers
```

```
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
```

```
#show the lambda
```

```
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
```

```
#show the table
```

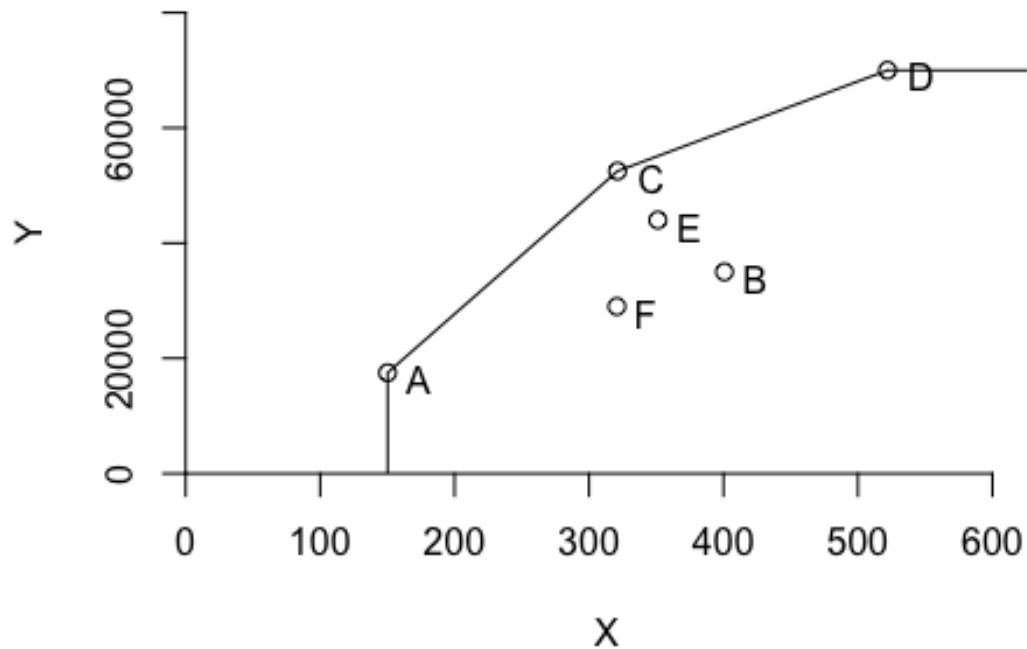
```
table3 <- cbind(tab,e_vrs$eff, e_vrs$lambda, e_vrs$peers)
```

```
table3
```

```
##      DMU      Staff Hours per day Supplies per day Reimbursed patient-day
s
## A "Facility1" "150"      "0.2"      "14000"
## B "Facility 2" "400"      "0.7"      "14000"
## C "Facility 3" "320"      "1.2"      "42000"
## D "Facility 4" "520"      "2"        "28000"
## E "Facility 5" "350"      "1.2"      "19000"
## F "Facility 6" "320"      "0.7"      "14000"
##      Privately Paid patient days      L1
## A "3500"      "1"      "1"
## B "21000"      "1"      "0"
## C "10500"      "1"      "0"
## D "42000"      "1"      "0"
## E "25000"      "1"      "0"
## F "15000"      "0.896328293736501" "0.401439884809215"
##      L2      L3 L4 L5      L6
## A "0"      "0" "0" "0"      "0"
## B "1"      "0" "0" "0"      "0"
## C "0"      "1" "0" "0"      "0"
## D "0"      "0" "1" "0"      "0"
## E "0"      "0" "0" "1"      "0"
## F "0.342260619150468" "0" "0" "0.256299496040317" "0"
```

```
#plot
```

```
dea.plot(x, y,RTS ="vrs", txt = rownames(table3) )
```



#IRS

```
colnames(x)<-c('Staff Hours per day', 'Supplies per day')
dea(x,y, RTS = "irs")
```

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

```
e_irs<-dea(x, y, RTS = "irs")
```

```
#efficiency
```

```
e_irs
```

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

```
#show the peers
```

```
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
```

```
#show the lambda
```

```
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
```

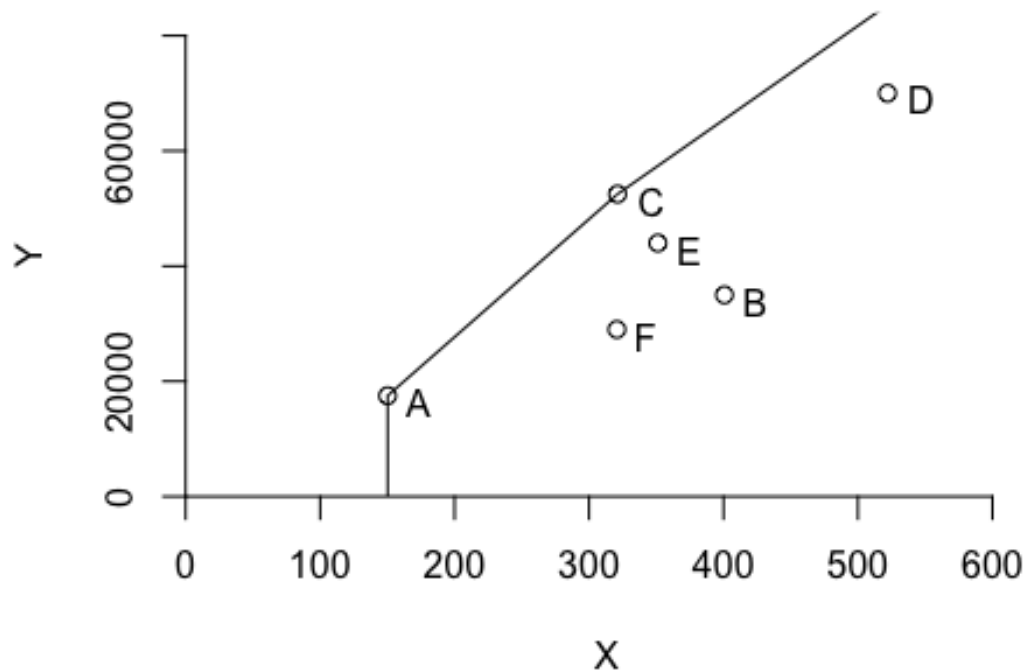
```
#show the table
```

```
table4 <- cbind(tab,e_irs$eff, e_irs$lambda, e_irs$peers)
```

```
table4
```

```
##   DMU           Staff Hours per day Supplies per day Reimbursed patient-day
s
## A "Facility1"  "150"                "0.2"                "14000"
## B "Facility 2" "400"                "0.7"                "14000"
## C "Facility 3" "320"                "1.2"                "42000"
## D "Facility 4" "520"                "2"                  "28000"
## E "Facility 5" "350"                "1.2"                "19000"
## F "Facility 6" "320"                "0.7"                "14000"
##   Privately Paid patient days          L1
## A "3500"                      "1"        "1"
## B "21000"                      "1"        "0"
## C "10500"                      "1"        "0"
## D "42000"                      "1"        "0"
## E "25000"                      "1"        "0"
## F "15000"                      "0.896328293736501" "0.401439884809215"
##   L2           L3   L4   L5          L6
## A "0"          "0"  "0"  "0"        "0"
## B "1"          "0"  "0"  "0"        "0"
## C "0"          "1"  "0"  "0"        "0"
## D "0"          "0"  "1"  "0"        "0"
## E "0"          "0"  "0"  "1"        "0"
## F "0.342260619150468" "0" "0" "0.256299496040317" "0"
```

```
dea.plot(x, y,RTS ="irs", txt = rownames(table4) )
```

#DRS

```
colnames(x)<-c('Staff Hours per day', 'Supplies per day')
dea(x,y, RTS = "drs")
```

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

```
e_drs<-dea(x, y, RTS = "drs")
```

```
#efficiency
```

```
e_drs
```

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

```
#show the peers
```

```
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
```

```
#show Lambda
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
```

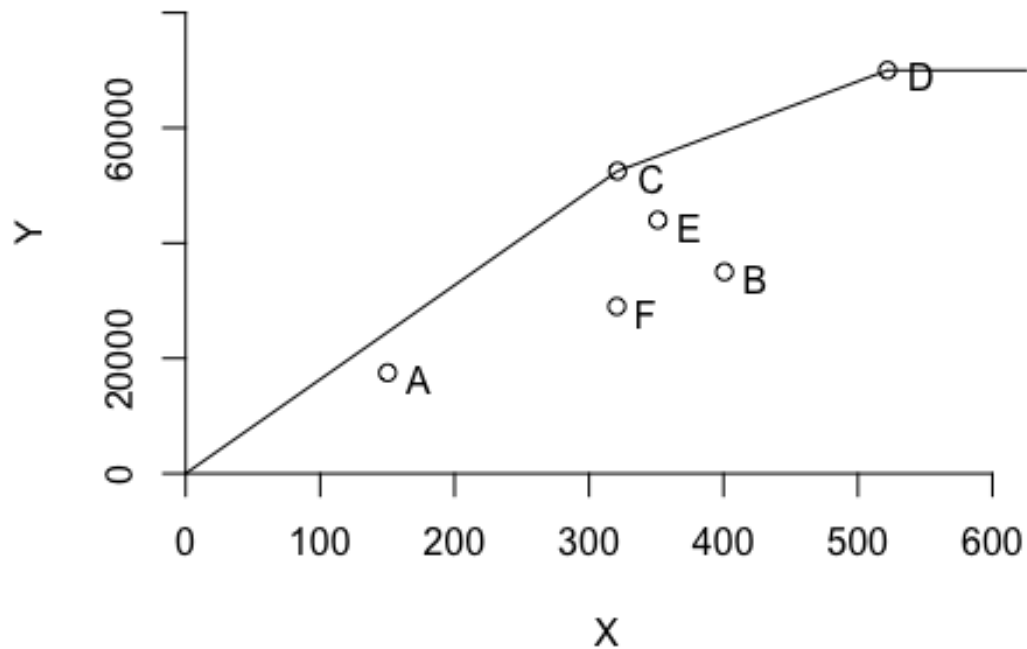
```
#show the table
```

```
table5 <- cbind(tab,e_drs$eff, e_drs$lambda, e_drs$peers)
table5
```

```
##   DMU           Staff Hours per day Supplies per day Reimbursed patient-day
s
## A "Facility1"  "150"                "0.2"                "14000"
## B "Facility 2" "400"                "0.7"                "14000"
## C "Facility 3" "320"                "1.2"                "42000"
## D "Facility 4" "520"                "2"                  "28000"
## E "Facility 5" "350"                "1.2"                "19000"
## F "Facility 6" "320"                "0.7"                "14000"
##   Privately Paid patient days                L1
## A "3500"                "1"                "1"
## B "21000"                "1"                "0"
## C "10500"                "1"                "0"
## D "42000"                "1"                "0"
## E "25000"                "0.977498691784406" "0.2"
## F "15000"                "0.867452135493373" "0.342857142857143"
##   L2           L3 L4           L5 L6
## A "0"           "0" "0"           "0" "0"
## B "1"           "0" "0"           "0" "0"
## C "0"           "1" "0"           "0" "0"
## D "0"           "0" "1"           "0" "0"
## E "0.0804814233385655" "0" "0.538330716902146" "0" "0"
## F "0.394992636229749" "0" "0.131075110456554" "0" "0"
```

```
#show the plot
```

```
dea.plot(x, y, RTS ="drs", txt = rownames(table5) )
```



#FRH

```
colnames(x)<-c('Staff Hours per day', 'Supplies per day')
dea(x,y, RTS = "ADD")

## [1] 1 1 1 1 1 1

e_frh<-dea(x, y, RTS = "ADD")
#efficiency
e_frh

## [1] 1 1 1 1 1 1

#show the peers
peers(e_frh)

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

```
#show the lambda
```

```
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
```

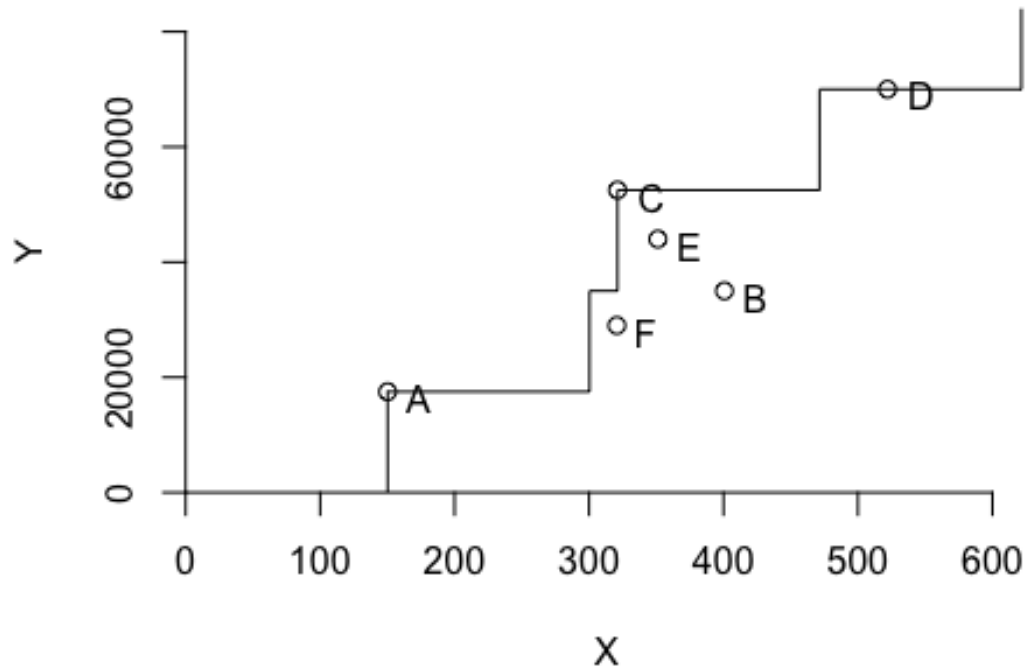
```
#show the table
```

```
table6 <- cbind(tab,e_frh$eff, e_frh$lambda, e_frh$peers)
```

```
table6
```

```
##   DMU           Staff Hours per day Supplies per day Reimbursed patient-day
s
## A "Facility1"  "150"                "0.2"                "14000"
## B "Facility 2" "400"                "0.7"                "14000"
## C "Facility 3" "320"                "1.2"                "42000"
## D "Facility 4" "520"                "2"                  "28000"
## E "Facility 5" "350"                "1.2"                "19000"
## F "Facility 6" "320"                "0.7"                "14000"
##   Privately Paid patient days      L1  L2  L3  L4  L5  L6
## A "3500"                    "1"  "1"  "0"  "0"  "0"  "0"
## B "21000"                   "1"  "0"  "1"  "0"  "0"  "0"
## C "10500"                   "1"  "0"  "0"  "1"  "0"  "0"
## D "42000"                   "1"  "0"  "0"  "0"  "1"  "0"
## E "25000"                   "1"  "0"  "0"  "0"  "0"  "1"
## F "15000"                   "1"  "0"  "0"  "0"  "0"  "1"
```

```
dea.plot(x, y,RTS ="ADD", txt = rownames(table6) )
```



- **COMPARE AND CONTRAST THE ABOVE RESULTS**

Efficiency Result – Summarize in a table

DMU	<u>CRS</u>	<u>FDH</u>	<u>VRS</u>	<u>IRS</u>	<u>DRS</u>	<u>FRH</u>
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	0.9975	1	1	1	0.9775	1
Facility 6	0.8675	1	0.8963	0.8963	0.8675	1

Peer Units- Summarize Table

<u>DMU</u>	<u>CRS</u>			<u>FDH</u>		<u>VRS</u>		<u>IRS</u>			<u>DRS</u>			<u>FRH</u>
	<u>p1</u>	<u>p2</u>	<u>p3</u>	<u>p1</u>	<u>p1</u>	<u>p2</u>	<u>p3</u>	<u>p1</u>	<u>p2</u>	<u>p3</u>	<u>p1</u>	<u>p2</u>	<u>p3</u>	<u>p1</u>
<u>Facility 1</u>	1	NA	NA	1	1	NA	NA	1	NA	NA	1	NA	NA	1
<u>Facility 2</u>	2	NA	NA	2	2	NA	NA	2	NA	NA	2	NA	NA	2
<u>Facility 3</u>	3	NA	NA	3	3	NA	NA	3	NA	NA	3	NA	NA	3
<u>Facility 4</u>	4	NA	NA	4	4	NA	NA	4	NA	NA	4	NA	NA	4
<u>Facility 5</u>	1	2	4	5	5	NA	NA	5	NA	NA	1	2	4	5
<u>Facility 6</u>	1	2	4	6	1	2	5	1	2	5	1	2	4	6

- Here p1 denotes peer = 1, p2 denotes = peer 2, p3 denotes = peer 3.
- For understanding peers, we can see that in CRS assumption Facility 1 is compared to facility 1 i.e., to itself. This is not surprising because unit 1 is efficient. It can also be seen that Facility 5 has peers 2 and 4.
- We can see that in FDH and FRH assumptions, the facilities 1- 5 have been compared to itself , this is because their efficiency is 1.

Similarly, we can see the peers of all the other assumptions.

- **OBSERVATIONS:**

- a) In CRS model Facility 1- 4 are efficient. In VRS and IRS model facility 1-5 appears to be efficient. We can see that in FDH and FRH all the facilities are efficient and thus equal to 1.
- b) We see how efficiency falls or stays constant as we move down through the DMUs.
- c) We can see that Facilities 1, 2, 3 and 4 are fully efficient under all assumptions.
- d) Facility 5 is fully efficient for FDH, VRS, IRS and FRH assumptions. For assumptions DRS and CRS, it is 97.7 % efficient.
- e) Facility 6 is fully efficient for FDH and FRS assumptions. For CRS and DRS assumptions it is 86.7% efficient. On the other hand, for IRS and VRS assumptions, it is 89.6% efficient.
- f) Lastly, Lambda value (DEA core), the Lambda Values are the raw weights assigned to the peer UNITS when solving the DEA model.

- **Note:** In all the graphs:

A stand for Facility 1

B stand for: Facility 2

C stand for: Facility 3

D stand for: Facility 5

E stand for: Facility 6

- **Conclusion:**

- a) Successfully able to use the “Benchmarking” library for DEA analysis for Hope Valley heath Care Association.
- b) After the DEA analysis, we are successfully able to determine the peers and lambdas for each assumption.
- c) Able to summarise the results in a tabular form and compare the result.