Assignment 4 module 8

wliu16

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```
#format the problem
tab <- matrix(c("Facility 1","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 Hour per Day','Supplies per Day','Reimbursed patient-days',
                   'Privately Paid Patient-Days')
tab <- as.table(tab)
tab
```

```
##   DMU        Staff Hour per Day Supplies per Day Reimbursed patient-days
## A Facility 1 150                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
```

1. Formulate and perform DEA of FDH, CRS, VRS, IRS, DRS, and FRH. 2. Determine the Peers and Lambdas under each of the above assumptions

```
#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)
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 Hour per Day','Supplies per Day')

#Scale: CRS, IRS, DRS, VRS
dea(x,y,RTS="crs")
```

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

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

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

```
peers(e)
```

```
##      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)
```

```
##             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
```

CRS Observation: Facility 1, 2, 3, 4 are efficient. Facility 5 is 97.75% efficient and facility 6 is 86.75 efficient. Both facility 5 and 6 use peer reference of facility 1, 2 and 4. The weights of facility 1, 2, 4 to facility 5 are 0.2, 0.08 and 0.54; The weights of the same facilities to facility 6 are 0.34, 0.39, and 0.13

```
dea(x,y,RTS="irs")
```

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

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

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

```
peers(e)
```

```
##      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)
```

```
##             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
```

IRS Observation: Facility 1, 2, 3, 4, 5 are efficient. Facility 6 is 89.63 efficient and uses facility 1, 2 and 5 as peer references. The weights of facility of 1, 2, and 5 to facility 6 are 0.4, 0.34 and 0.26

```
dea(x,y,RTS="drs")
```

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

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

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

```
peers(e)
```

```
##      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)
```

```
##             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
```

DRS Observation: Facility 1, 2, 3, 4 are efficient. Facility 5 is 97.75 efficient and Facility 6 is 86.75 efficient. Both use facility 1, 2 and 4 as peer references. The weights of facility 1, 2, 4 to facility 5 are 0.2, 0.08 and 0.54; The weights of the same facilities to facility 6 are 0.34, 0.39, and 0.13

```
dea(x,y,RTS="vrs")
```

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

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

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

```
peers(e)
```

```
##      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)
```

```
##             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
```

VRS Observation: Facility 1, 2, 3, 4, 5 are efficient. Facility 6 is 89.63 efficient and uses facility 1, 2 and 5 as peer references. The weights of facility of 1, 2, and 5 to facility 6 are 0.4, 0.34 and 0.26

```
#Free disposability FDH and free replicability FRH
dea(x,y,RTS="fdh")
```

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

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

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

```
peers(e)
```

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

```
lambda(e)
```

```
##      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
```

```
dea(x,y,RTS="fdh+")
```

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

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

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

```
peers(e)
```

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

```
lambda(e)
```

```
##      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 and FRH Observation: Both share the same results. All facilities are efficient in both methods.

3. Summary of results in tabular format

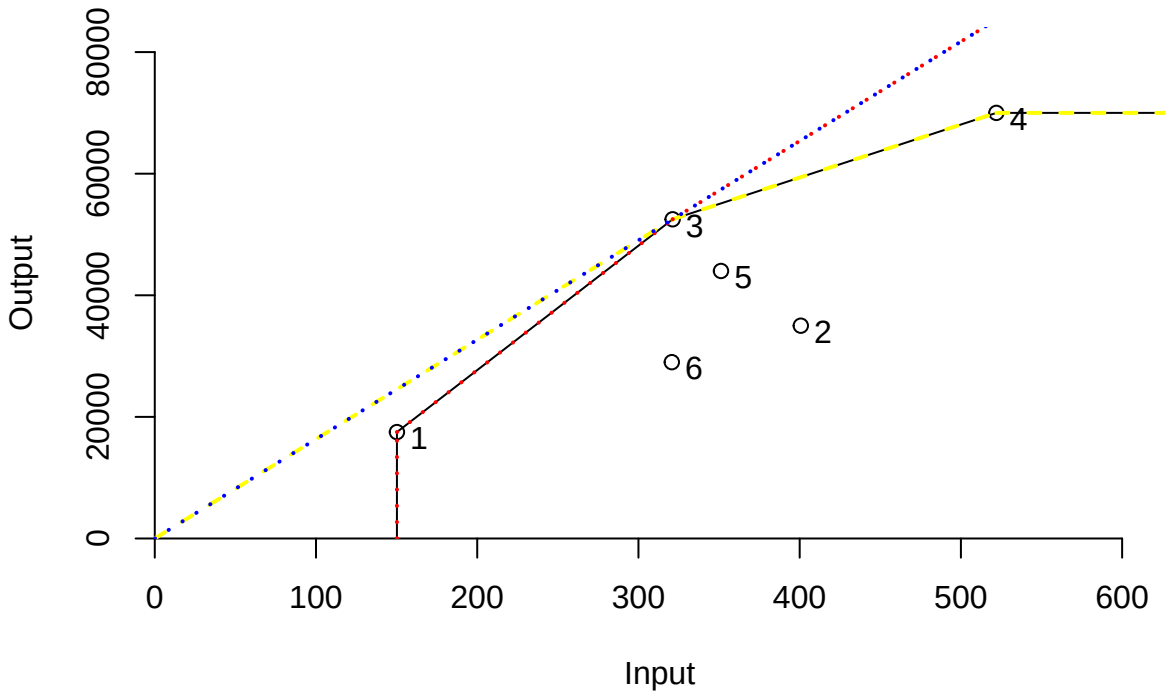
```
summary_tab <- matrix(c("Facility 1","Facility 2","Facility 3","Facility 4","Facility 5",
                "Facility 6", "Peer set",
              1,1,1,1,0.9775, 0.8675, "1,2,4",
              1,1,1,1,0.9775, 0.8675, "1,2,4",
              1,1,1,1,1,0.8963, "1,2,5",
              1,1,1,1,1,0.8963,"1,2,5",
              1,1,1,1,1,1,"NA",
              1,1,1,1,1,1, "NA"), ncol=7, byrow=F)
colnames(summary_tab) <- c('DMU', 'CRS','DRS','IRS','VRS', 'FDH','FRH')
summary_tab <- as.table(summary_tab)
summary_tab
```

```
##   DMU        CRS    DRS    IRS    VRS    FDH FRH
## A Facility 1 1      1      1      1      1   1
## B Facility 2 1      1      1      1      1   1
## C Facility 3 1      1      1      1      1   1
## D Facility 4 1      1      1      1      1   1
## E Facility 5 0.9775 0.9775 1      1      1   1
## F Facility 6 0.8675 0.8675 0.8963 0.8963 1   1
## G Peer set   1,2,4  1,2,4  1,2,5  1,2,5  NA  NA
```

Comments: 1 means efficient. Since Facility 5 and 6 always have the same peer set, we use one peer set to refer to each method.

4. Compare and contrast the above results

```
dea.plot(x,y,RTS="vrs",ORIENTATION="in-out",txt=TRUE,
         xlab = "Input", ylab ="Output")
dea.plot(x,y,RTS="drs",ORIENTATION="in-out",add=TRUE,lty="dashed",lwd=2,col="yellow")
dea.plot(x,y,RTS="irs",ORIENTATION="in-out",add=TRUE,lty="dotted",lwd=2, col="red")
dea.plot(x,y,RTS="crs",ORIENTATION="in-out",add=TRUE,lty="dotted",lwd=2, col="blue")
```




```
dea.plot(x,y,RTS="fdh",ORIENTATION="in-out",txt=TRUE,main="fdh",
         xlab = "Input", ylab ="Output")
dea.plot(x,y,RTS="fdh+",ORIENTATION="in-out",add=TRUE,lty="dotted",param=.5)
```