Model 8 Assignment

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2022-10-26

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

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

```
##
## Loading Benchmarking version 0.30h, (Revision 244, 2022/05/05 16:31:31) ...
```

```
## Build 2022/05/05 16:31:40
```

```
library(ggplot2)
```

###CRS

```
x <- matrix(c(150,400,320,520,350,320,0.2,0.7,1.2,2,1.2,0.7),ncol = 2)
y <- matrix(c(14000,14000,42000,28000,19000,14000,3500,21000,10500,42000,25000,15000), ncol=2)
z <- dea(x,y,RTS = "crs")
z
```

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

```
peers(z)
```

```
##      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(z)
```

```
##             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
```

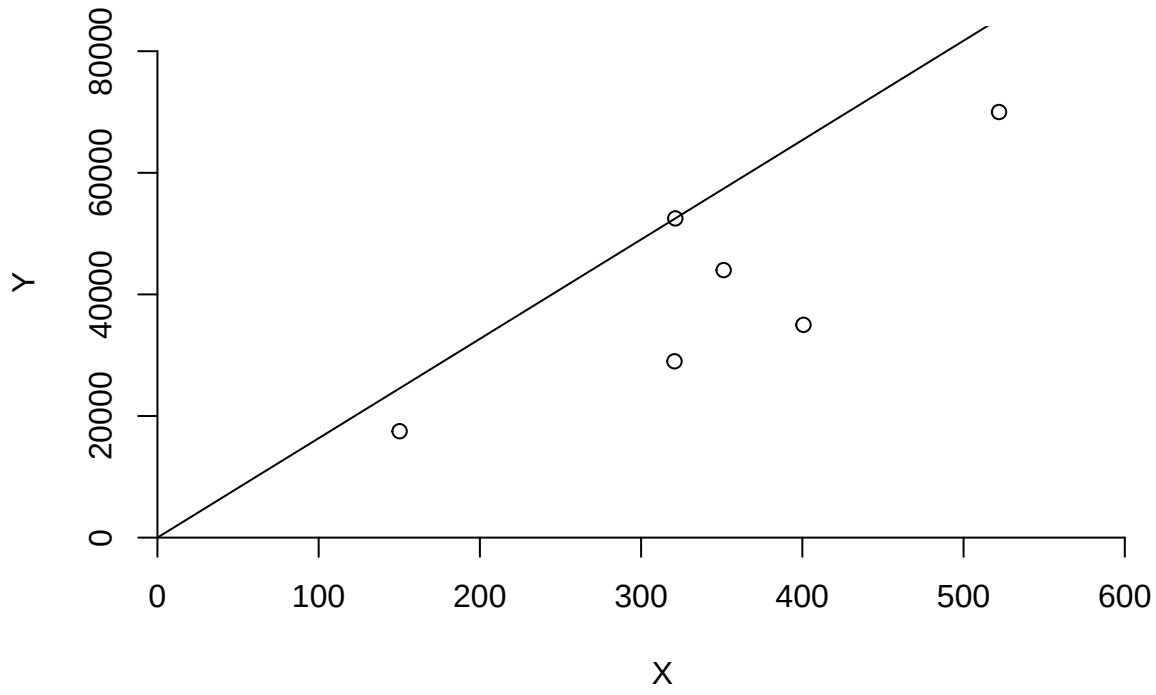
```
rowSums(x)
```

```
## [1] 150.2 400.7 321.2 522.0 351.2 320.7
```

```
rowSums(y)
```

```
## [1] 17500 35000 52500 70000 44000 29000
```

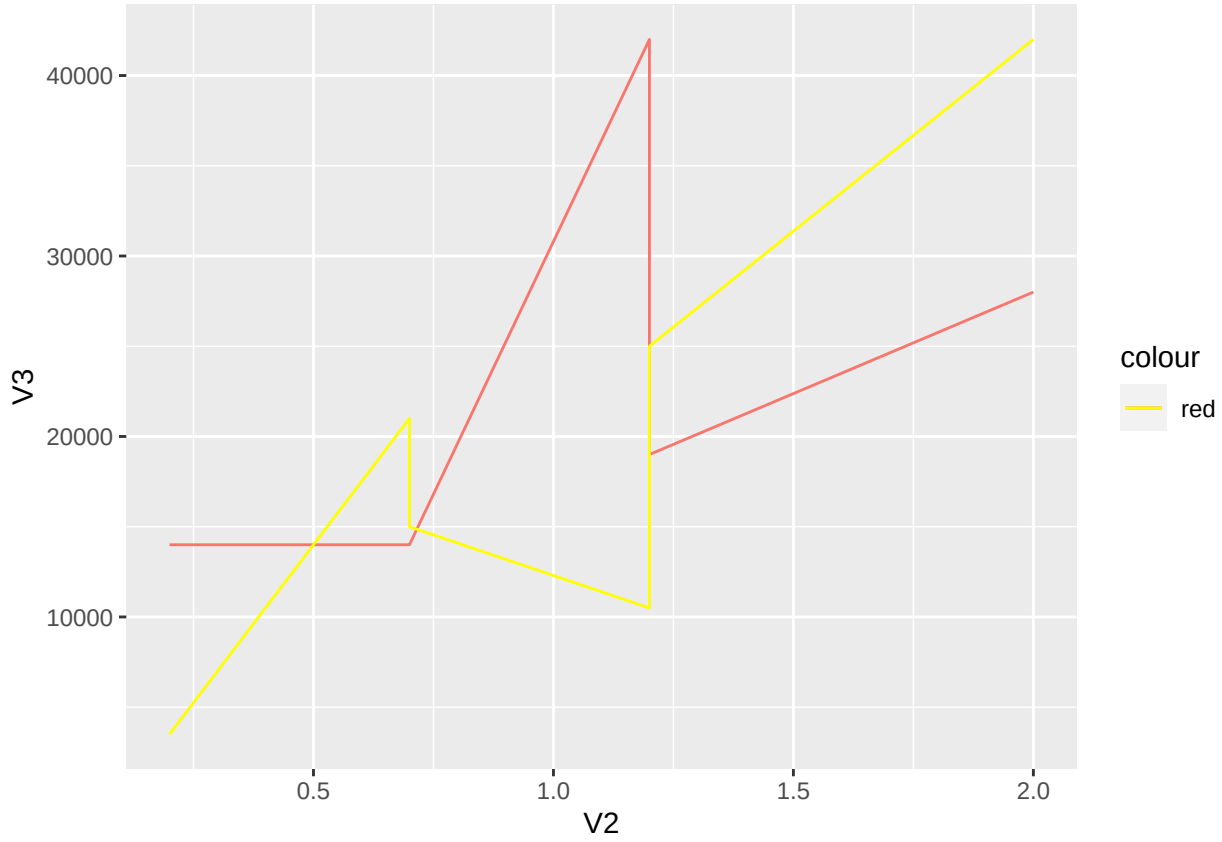
```
dea.plot( rowSums(x),rowSums(y),RTS="crs")
```




```
a <- as.data.frame(matrix(c(x,y),ncol=4))
a
```

```
##    V1  V2    V3    V4
## 1 150 0.2 14000  3500
## 2 400 0.7 14000 21000
## 3 320 1.2 42000 10500
## 4 520 2.0 28000 42000
## 5 350 1.2 19000 25000
## 6 320 0.7 14000 15000
```

```
ggplot(data=a,aes(V2,V3)) +
  geom_line(aes(color="red")) +
  geom_line(aes(V2,V4),color="yellow",show.legend = T)
```



Facility 1-4 are efficient. Facility 5-6 are not efficient.

###VRS

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

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

```
peers(z)
```

```
##      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(z)
```

```
##             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
```

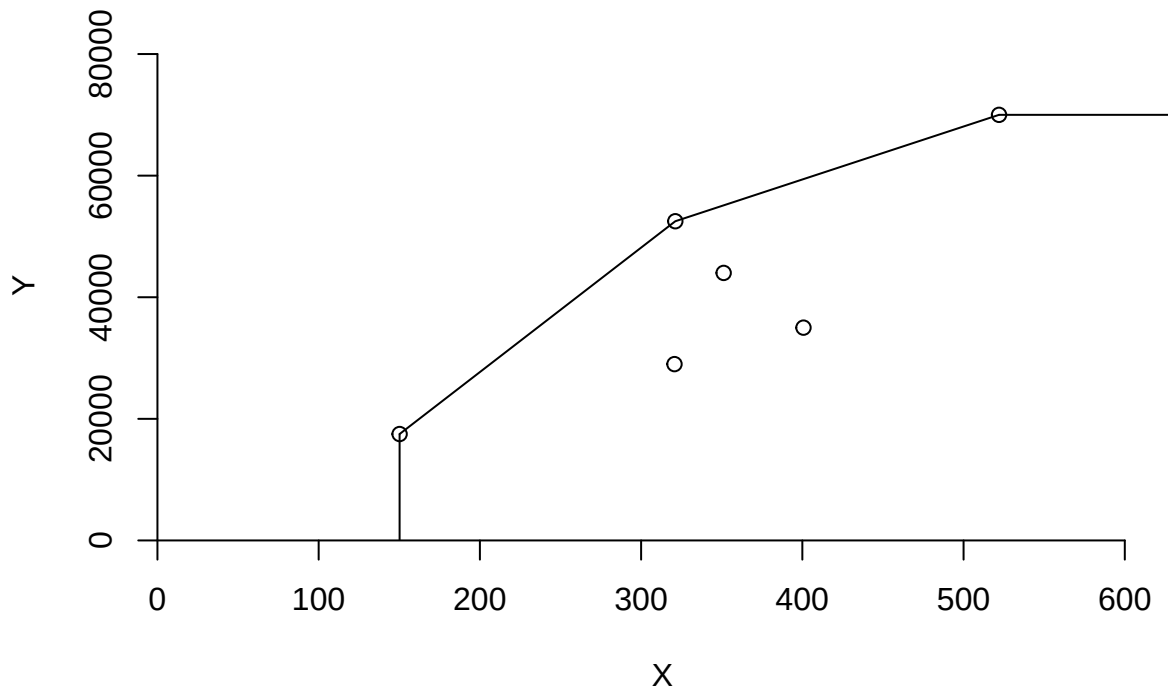
```
rowSums(x)
```

```
## [1] 150.2 400.7 321.2 522.0 351.2 320.7
```

```
rowSums(y)
```

```
## [1] 17500 35000 52500 70000 44000 29000
```

```
dea.plot( rowSums(x),rowSums(y),RTS="vrs",wx=0.01,wy=0.01)
```



Facility 6 is inefficient.

###IRS

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

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

```r
peers(z)
```

```
##      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(z)
```

```
##             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
```

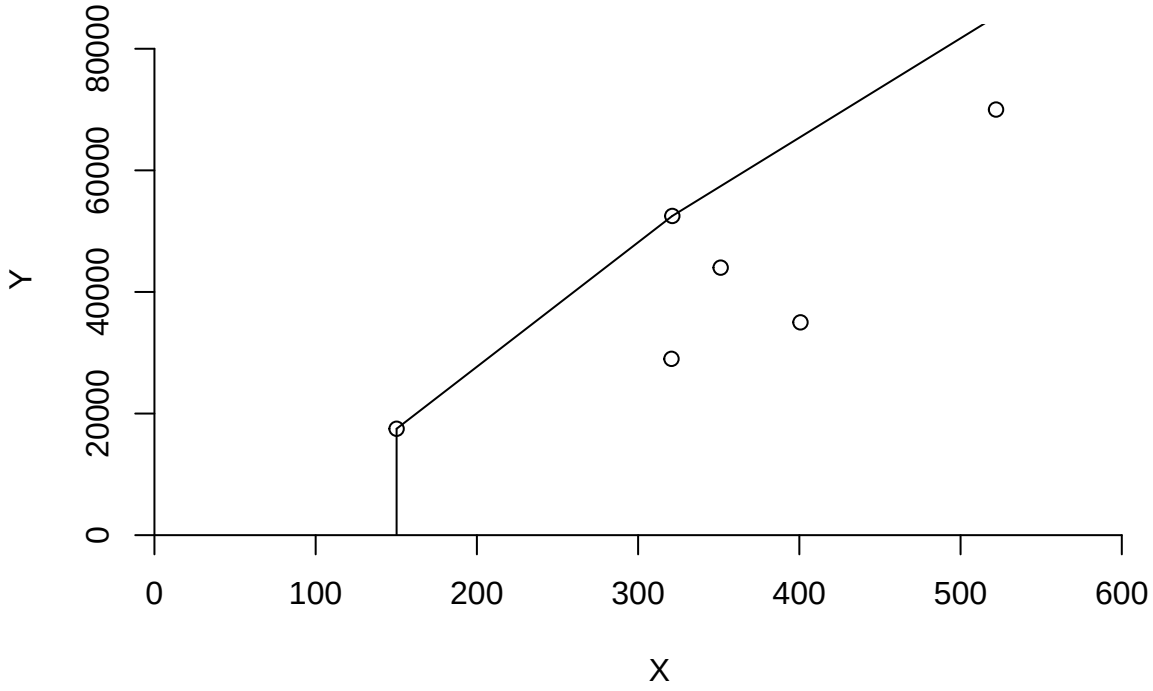
```r
rowSums(x)
```

```
## [1] 150.2 400.7 321.2 522.0 351.2 320.7
```

```r
rowSums(y)
```

```
## [1] 17500 35000 52500 70000 44000 29000
```

```r
dea.plot( rowSums(x),rowSums(y),RTS="irs",wx=0.01,wy=0.01)
```



Facility 6 is inefficient.

###DRS

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

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

```
peers(z)
```

```
##      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(z)
```

```
##             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
```

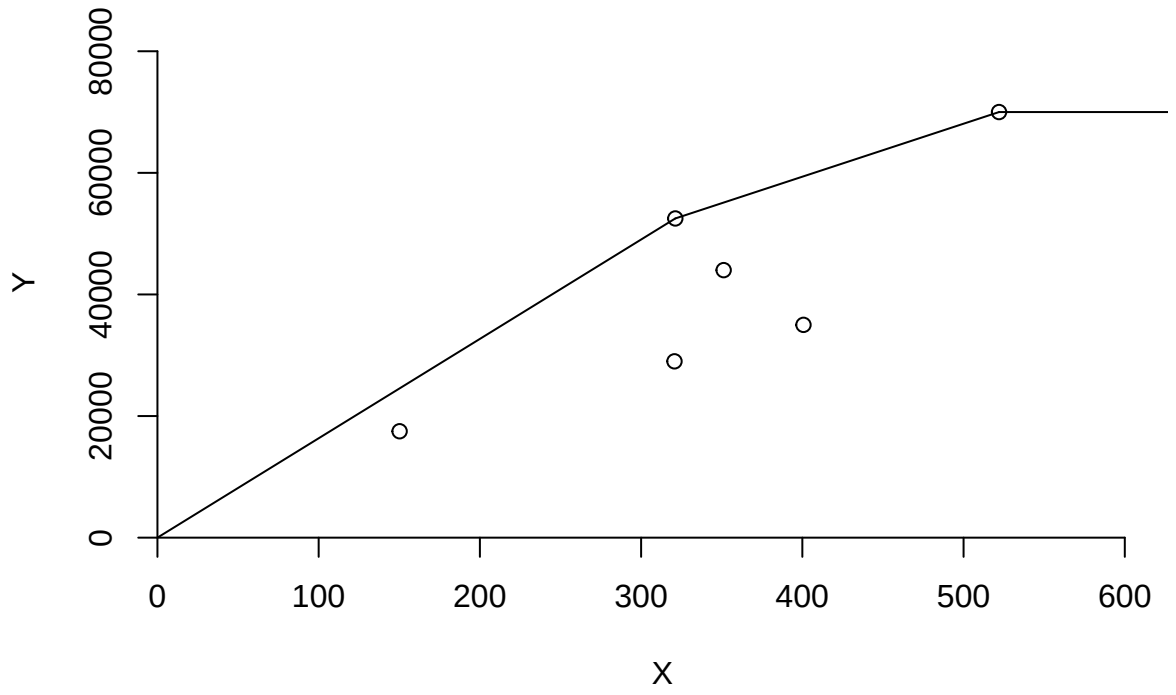
```
rowSums(x)
```

```
## [1] 150.2 400.7 321.2 522.0 351.2 320.7
```

```
rowSums(y)
```

```
## [1] 17500 35000 52500 70000 44000 29000
```

```
dea.plot( rowSums(x),rowSums(y),RTS="drs",wx=0.01,wy=0.01)
```



Both facility 5 and 6 are inefficient, Facility 5 could be updated by closing to the facility 1,2 and 4. Facility 6 should be updated by using the facility 1,2 and 4. Both coeficients should be the lambda values.

###FDH

```
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)
z <- dea(x,y,RTS = "fdh", ORIENTATION = 2)
z
```

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

```
peers(z)
```

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

```
lambda(z)
```

```
##      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
```

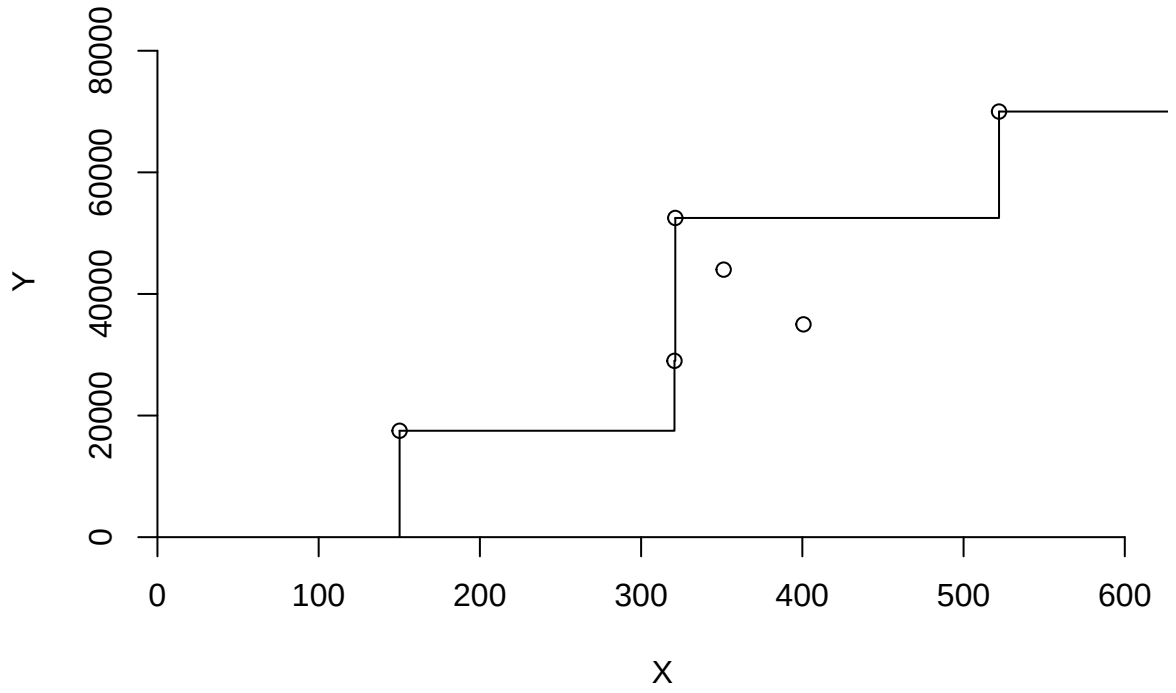
```
rowSums(x)
```

```
## [1] 150.2 400.7 321.2 522.0 351.2 320.7
```

```
rowSums(y)
```

```
## [1] 17500 35000 52500 70000 44000 29000
```

```
dea.plot( rowSums(x),rowSums(y),RTS="fdh",wx=0.01,wy=0.01)
```



All facilities are efficient.

##FDH

```
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)
z <- dea(x,y,RTS = "fdh", ORIENTATION = 2)
z
```

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

```
peers(z)
```

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

```
lambda(z)
```

```
##      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
```

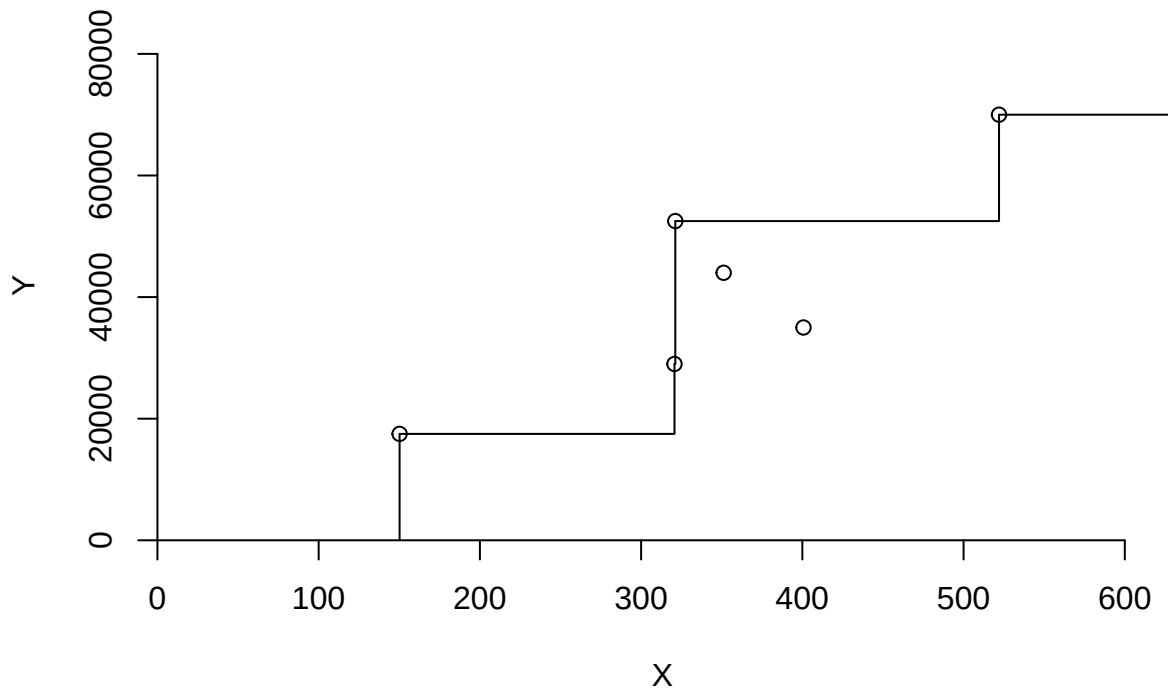
```
rowSums(x)
```

```
## [1] 150.2 400.7 321.2 522.0 351.2 320.7
```

```
rowSums(y)
```

```
## [1] 17500 35000 52500 70000 44000 29000
```

```
dea.plot( rowSums(x),rowSums(y),RTS="fdh",wx=0.01,wy=0.01)
```



All facilities are efficient.

###FRH

```
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)
z <- dea(x,y,RTS = "add")
z
```

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

```
peers(z)
```

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

```
lambda(z)
```

```
##      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
```

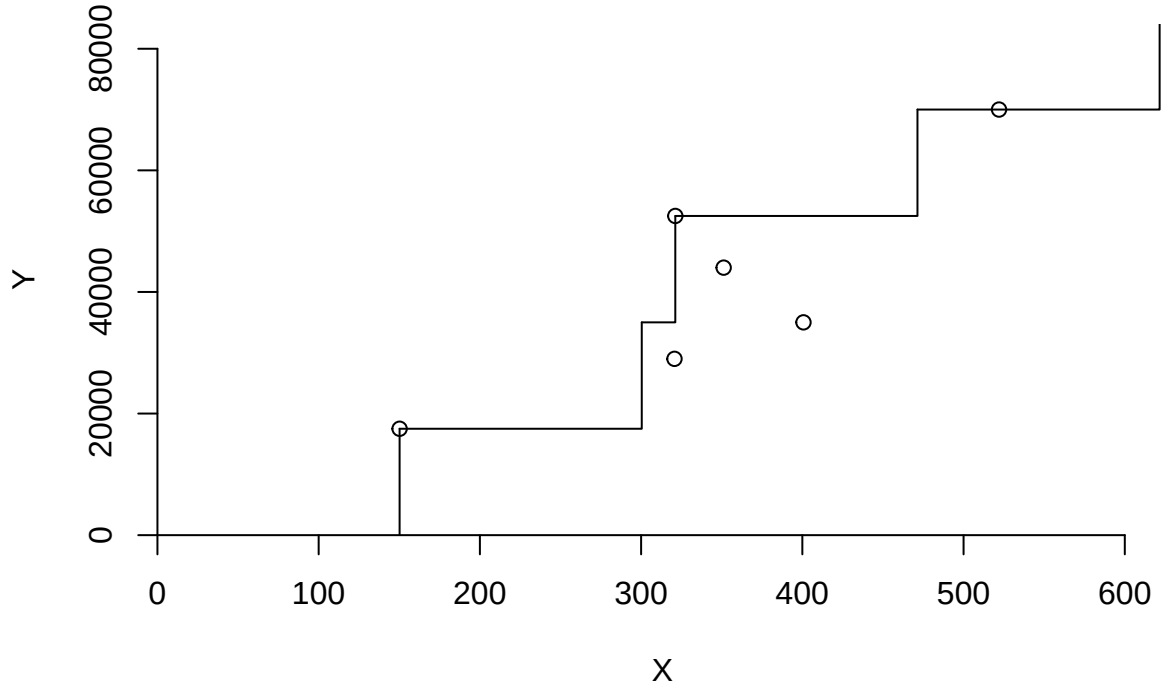
```
rowSums(x)
```

```
## [1] 150.2 400.7 321.2 522.0 351.2 320.7
```

```
rowSums(y)
```

```
## [1] 17500 35000 52500 70000 44000 29000
```

```
dea.plot( rowSums(x),rowSums(y),RTS="add",wx=0.01,wy=0.01)
```



All facilities are all efficient

CRS - Facility 1-4 are efficient. Facility 5-6 are not efficient.

VRS - Facility 6 is inefficient.

IRS - Facility 6 is inefficient.

DRS - Both facility 5 and 6 are inefficient. Both coeficients should be the lambda values

FDH - All facilities are efficient.

FRH - All facilities are efficient

Under VRS and IRS, the peers unit for inefficient facilities were 1,2 and 5.

Under CRS and DRS, the peers unites were 1,2,and 4.