Assignment 5

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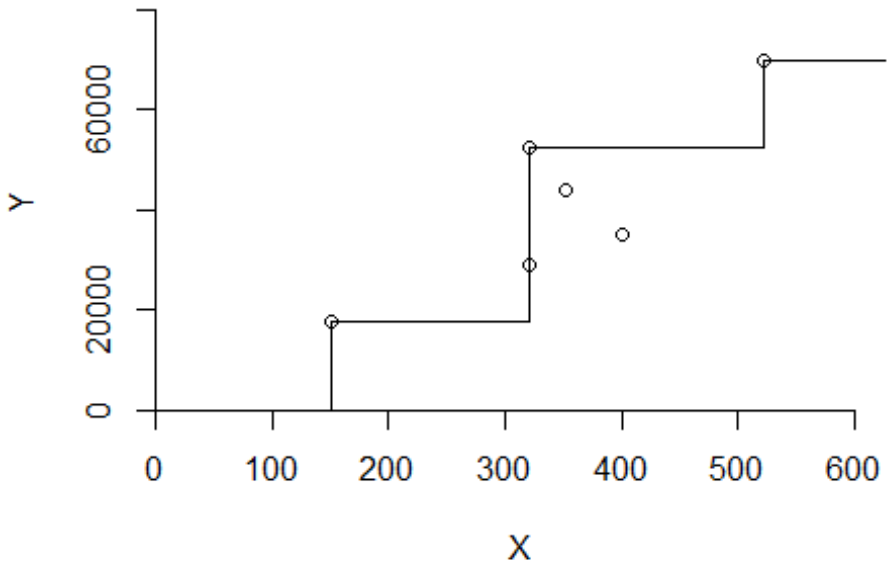
11/7/2021

DEA Analysis

```
#install.packages("Benchmarking")
library(lpSolveAPI)
library(Benchmarking)

## Loading required package: ucminf

## Loading required package: quadprog

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("REMPD","PRIPD")
colnames(x)<-c("SHPD","SUPD")

# FDH
d1<-dea(x,y,RTS = 0)
d1

## [1] 1 1 1 1 1 1

peers(d1)

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

lambda(d1)

##      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.plot.frontier(x,y,RTS = 0)
```

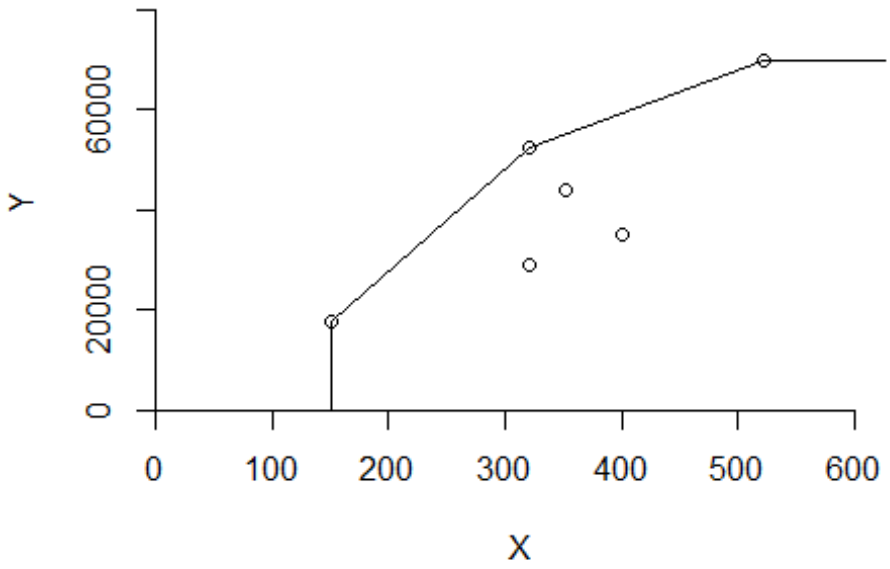
```
## Number '0' is 'fdh'
```



The results indicate all DMUS are efficient in FDH assumption.

```
#VRS
d2<-dea(x,y,RTS = 1)
d2

## [1] 1.0000 1.0000 1.0000 1.0000 1.0000 0.8963

peers(d2)

##      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(d2)

##             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

dea.plot.frontier(x,y,RTS = 1)

## Number '1' is 'vrs'
```



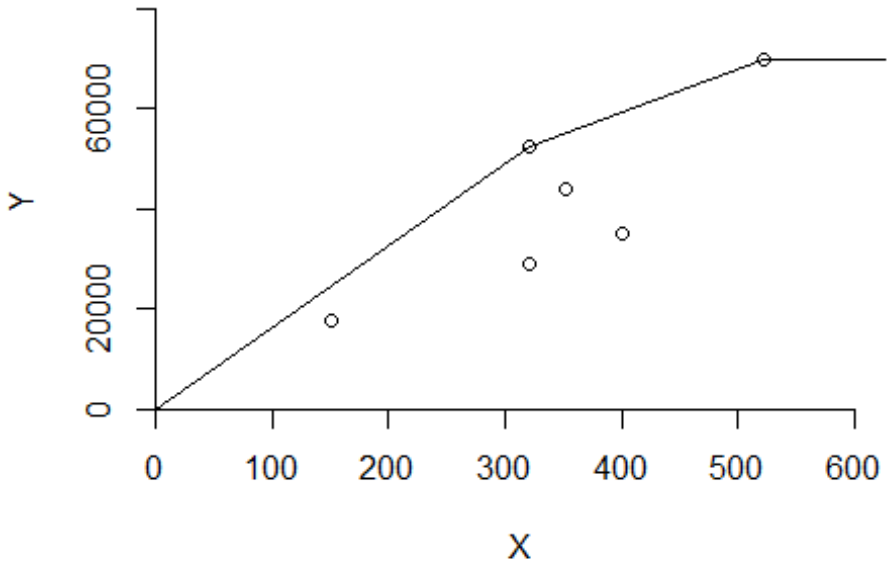
The results indicate that the DMU(6) is not efficent. The peers unit for DMU(6) are 1,2 and 5, with the relatives weight 0.40, 0.34 and 0.26.

```
#DRS
d3<-dea(x,y,RTS = 2)
d3

## [1] 1.0000 1.0000 1.0000 1.0000 0.9775 0.8675

peers(d3)

##      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(d3)
```

```
##             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
```

```
dea.plot.frontier(x,y,RTS = 2)
```

```
## Number '2' is 'drs'
```



The results indicate that the DMU(5) and DMU(6) are not efficent. The peers unit for DMU(5) are 1,2 and 4, with the relatives weight 0.20, 0.08 and 0.54. The peers unit for DMU(6) are 1,2 and 4, with the relatives weight 0.34, 0.39 and 0.13.

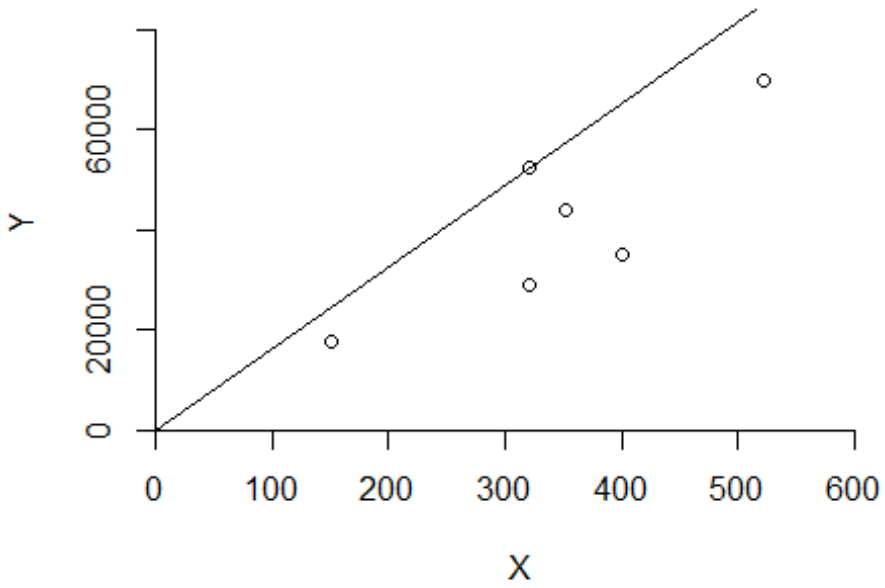
```
#CRS
d4<-dea(x,y,RTS = 3)
d4
```

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

```
peers(d4)
```

```
##      peer1 peer2 peer3
## [1,]     1    NA    NA
## [2,]     2    NA    NA
## [3,]     3    NA    NA
```

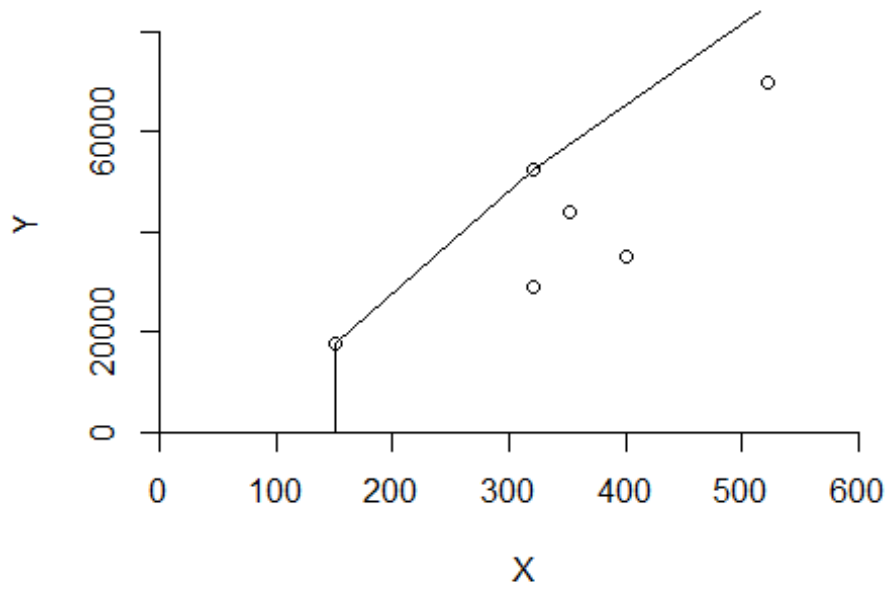
```
## [4,]     4    NA    NA
## [5,]     1     2     4
## [6,]     1     2     4

lambda(d4)

##              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

dea.plot.frontier(x,y,RTS = 3)

## Number '3' is 'crs'
```



The results indicate that the DMU(5) and DMU(6) are not efficent. The peers unit for DMU(5) are 1,2 and 4, with the relatives weight 0.20, 0.08 and 0.54. The peers unit for DMU(6) are 1,2 and 4, with the relatives weight 0.34, 0.39 and 0.13.

```
#IRS
d5<-dea(x,y,RTS = 4)
d5

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

```
peers(d5)

##      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(d5)

##             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

dea.plot.frontier(x,y,RTS = 4)

## Number '4' is 'irs'
```



The results indicate that the DMU(6) is not efficent. The peers unit for DMU(6) are 1,2 and 5, with the relatives weight 0.40, 0.34 and 0.26.

```r
#FRH
d6<-dea(x,y,RTS = 6)
d6
```

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

```r
peers(d6)
```

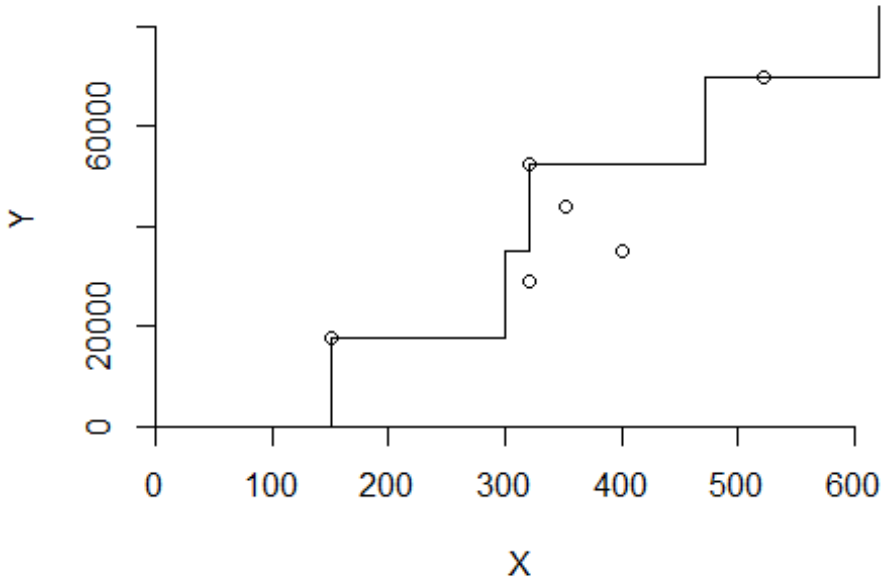
```
##      peer1
## [1,]     1
## [2,]     2
## [3,]     3
## [4,]     4
## [5,]     5
## [6,]     6
```

```r
lambda(d6)
```

```
##      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
```

```r
dea.plot.frontier(x,y,RTS = 6)
```

```
## Number '6' is 'add'
```



The results indicate all DMUS are efficient in FRH assumption.

```
sum<-matrix(c("FDH",0,0,0,"VRS","DMU6","1,2,5","0.4,0.34 and 0.26","DRS
","DMU5 DMU6","1,2,4","0.20, 0.08 and 0.54, 0.34, 0.39 and 0.13","CRS",
"DMU5 DMU6","1,2,4","0.20, 0.08 and 0.54, 0.34, 0.39 and 0.13","IRS","D
MU6","1,2,5","0.4,0.34 and 0.26","FRH",0,0,0),nrow  = 4)
colnames(sum)<-c("t1","t2","t3","t4","t5","t6")
rownames(sum)<-c("DEA TYPE","Non-efficient","relative peers","relative
weights")
sum<-as.data.frame(sum)
sum

##                    t1                t2
         t3
## DEA TYPE          FDH               VRS
        DRS
## Non-efficient       0              DMU6
  DMU5 DMU6
## relative peers      0             1,2,5
      1,2,4
## relative weights    0 0.4,0.34 and 0.26 0.20, 0.08 and 0.54, 0.34, 0.
39 and 0.13
##                                                                  t4
     t5  t6
## DEA TYPE                                                        CRS
    IRS FRH
## Non-efficient                                          DMU5 DMU6
```

```
   DMU6   0
## relative peers                                          1,2,4
  1,2,5   0
## relative weights 0.20, 0.08 and 0.54, 0.34, 0.39 and 0.13 0.4,0.34 a
nd 0.26   0
```

Compared to these six methods, The all DMU in FDH and FRH are efficent. The DMU in IRS and VRS have the same peers and relative weights for unefficient DMUS. The DMU in DRS and CRS have the same condition too. Im my opinion, I will choose FDH and FRH methods. They could be efficient and fexible.

Goal Programming

1)

$y_1^+ - y_1^- = 6x_1 + 4x_2 + 5x_3 - 50$

$y_2^+ - y_2^- = 8x_1 + 7x_2 + 5x_3 - 75$

$P = 20x_1 + 15x_2 + 25x_3$

2)Obj Function

$Z = 20x_1 + 15x_2 + 25x_3 - 6y_1^+ - 6y_1^- - 3y_2^-$

```
lpec1<-make.lp(0,7)
set.objfn(lpec1,c(20,15,25,-6,-6,0,-3))
lp.control(lpec1,sense='max')
```

```
## $anti.degen
## [1] "fixedvars" "stalling"
##
## $basis.crash
## [1] "none"
##
## $bb.depthlimit
## [1] -50
##
## $bb.floorfirst
## [1] "automatic"
##
## $bb.rule
## [1] "pseudononint" "greedy"       "dynamic"      "rcostfixing"
##
## $break.at.first
```

```
## [1] FALSE
##
## $break.at.value
## [1] 1e+30
##
## $epsilon
##       epsb       epsd      epsel     epsint epsperturb   epspivot
##      1e-10      1e-09      1e-12      1e-07      1e-05      2e-07
##
## $improve
## [1] "dualfeas" "thetagap"
##
## $infinite
## [1] 1e+30
##
## $maxpivot
## [1] 250
##
## $mip.gap
## absolute relative
##    1e-11    1e-11
##
## $negrange
## [1] -1e+06
##
## $obj.in.basis
## [1] TRUE
##
## $pivoting
## [1] "devex"    "adaptive"
##
## $presolve
## [1] "none"
##
## $scalelimit
## [1] 5
##
## $scaling
## [1] "geometric"   "equilibrate" "integers"
##
## $sense
## [1] "maximize"
##
## $simplextype
## [1] "dual"   "primal"
##
## $timeout
## [1] 0
##
```

```
## $verbose
## [1] "neutral"

add.constraint(lpec1,c(6,4,5,-1,1,0,0),"=",50)
add.constraint(lpec1,c(8,7,5,0,0,-1,1),"=",75)

write.lp(lpec1,filename = "Assignment5.lp",type = "lp")

solve(lpec1)

## [1] 0

get.objective(lpec1)

## [1] 225

get.variables(lpec1)

## [1]  0  0 15 25  0  0  0
```

The best way to reach the goal is that increase the number of employees. It might have the bad influence in the future.