QMM -#4

Formulating the problem as lp to get the weight for Facility 1

```
library(Benchmarking)
```

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

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

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

```
library(lpSolveAPI)

Facility1 <- read.lp("Health.lp")
solve(Facility1)
```

```
## [1] 0
```

```
get.objective(Facility1)     #the lp was able to achieve the max efficiency for Facility 1
```

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

```
get.variables(Facility1)    #The proposed inputs and outputs weights for maximum efficiency
```

```
## [1] 7.142857e-05 0.000000e+00 5.172414e-03 1.120690e+00
```

First we type our inputs and outputs as vectors . we have 2 inputs (Staff hours, Supplies) and 2 outputs ("Reimbursed Patient_Days","Privately Paid Patient_Day) .

```
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_Hours", "Supplies")

print(x)
```

```
##      Staff_Hours Supplies
## [1,]         150      0.2
## [2,]         400      0.7
## [3,]         320      1.2
## [4,]         520      2.0
## [5,]         350      1.2
## [6,]         320      0.7
```

```r
print(y)
```

```
##      Reimbursed Patient_Days Privately Paid Patient_Days
## [1,]                  14000                        3500
## [2,]                  14000                       21000
## [3,]                  42000                       10500
## [4,]                  28000                       42000
## [5,]                  19000                       25000
## [6,]                  14000                       15000
```

```r
Table<- cbind(x,y)
row.names(Table) =  c("Fac1", "Fac2", "Fac3", "Fac4", "Fac5", "Fac6")
Table
```

```
##      Staff_Hours Supplies Reimbursed Patient_Days Privately Paid Patient_Days
## Fac1         150      0.2                  14000                        3500
## Fac2         400      0.7                  14000                       21000
## Fac3         320      1.2                  42000                       10500
## Fac4         520      2.0                  28000                       42000
## Fac5         350      1.2                  19000                       25000
## Fac6         320      0.7                  14000                       15000
```

Next we run DEA Analysis under all DEA assumptions (FDH, CRS, VRS, IRS, DRS, and FRH)

```r
#Constant returns to scale, convexity and free disposability
CRS <- dea(x,y, RTS = "crs") # provide the input and output . The results show that Facilities 1,2,3,4
print(CRS)
```

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

```r
peers(CRS)    # identify the peers. The peers units for for facilities 5,6 are 1,2,4
```

```
##      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
```

```r
CRS_Weights <- lambda(CRS)    # identify the relative weights given to the peers. The weights for facil

#Free disposability hull
FDH <- dea(x,y, RTS= "fdh")
FDH  #all facilities are efficient
```

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

```
peers(FDH)  #the peer for each facility is itself
```

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

```
FDH_Weights <- lambda(FDH)

#Variable returns to scale, convexity and free disposability
VRS <- dea(x,y, RTS = "vrs")
VRS    #All facilities are efficient except for facility 6
```

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

```
peers(VRS)   #peers for facility 6 are 1,2,5
```

```
##      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
```

```
VRS_Weights <- lambda(VRS)

#Increasing returns to scale, (up-scaling, but not down-scaling), convexity and free disposability
IRS <- dea(x,y, RTS= "irs")
IRS    #All facilities are efficient except for facilit
```

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

```
peers(IRS)    #peers for facility 6 are 1,2,5
```

```
##      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
```

```
IRS_Weights <- lambda(IRS)

#Decreasing returns to scale, convexity, down-scaling and free disposability
DRS <- dea(x,y, RTS= "drs")  #DRS gave same results as CRS
DRS     #All facilities are efficient except for facility 5,6
```

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

```
peers(DRS)  # The peers units for for facilities 5,6 are 1,2,4
```

```
##      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
```

```
DRS_Weights <- lambda(DRS)
```

```
FRH <- dea(x,y, RTS= "add")
FRH  #all facilities are efficient
```

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

```
peers(FRH)    #the peer unit for each facility is itself
```

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

```
FRH_Weights <- lambda(FRH)
```

```
as.data.frame(Table)
```

```
##      Staff_Hours Supplies Reimbursed Patient_Days Privately Paid Patient_Days
## Fac1         150      0.2                  14000                         3500
## Fac2         400      0.7                  14000                        21000
## Fac3         320      1.2                  42000                        10500
## Fac4         520      2.0                  28000                        42000
## Fac5         350      1.2                  19000                        25000
## Fac6         320      0.7                  14000                        15000
```

```
Df <-data.frame (CRS = c(1.0000, 1.0000, 1.0000, 1.0000, 0.9775, 0.8675),
FDH= c(1,1,1,1,1,1), VRS= c(1.0000, 1.0000, 1.0000, 1.0000, 1.0000, 0.8963),IRS =c( 1.0000, 1.0000, 1.0
Df
```

```
##      CRS FDH    VRS    IRS    DRS FRH
## 1 1.0000   1 1.0000 1.0000 1.0000   1
## 2 1.0000   1 1.0000 1.0000 1.0000   1
```

```
## 3 1.0000   1 1.0000 1.0000 1.0000   1
## 4 1.0000   1 1.0000 1.0000 1.0000   1
## 5 0.9775   1 1.0000 1.0000 0.9775   1
## 6 0.8675   1 0.8963 0.8963 0.8675   1
```

```
#Now we look at the efficiency results at each facility in every DEA assumption. CRS and DRS give same
Results <- cbind(Table,Df)
Results[,-c(1:4)]
```

```
##         CRS FDH    VRS    IRS    DRS FRH
## Fac1 1.0000   1 1.0000 1.0000 1.0000   1
## Fac2 1.0000   1 1.0000 1.0000 1.0000   1
## Fac3 1.0000   1 1.0000 1.0000 1.0000   1
## Fac4 1.0000   1 1.0000 1.0000 1.0000   1
## Fac5 0.9775   1 1.0000 1.0000 0.9775   1
## Fac6 0.8675   1 0.8963 0.8963 0.8675   1
```

```
#Summary of the weights assigned to each Facility in every DEA assumption
Weights_tbl <- cbind(FDH_Weights, CRS_Weights, VRS_Weights, IRS_Weights, DRS_Weights, FRH_Weights)
row.names(Weights_tbl) =   c("Fac1", "Fac2", "Fac3", "Fac4", "Fac5", "Fac6")

colnames(Weights_tbl) <- c("FDH","FDH", "FDH", "FDH","FDH","FDH", "CRS", "CRS", "CRS", "CRS", "VRS", "VI
as.data.frame(Weights_tbl)   #the table summerieses  the weights for inputs and outputs for  each facil
```

```
##      FDH FDH FDH FDH FDH FDH       CRS        CRS CRS       CRS       VRS
## Fac1   1   0   0   0   0   0 1.0000000 0.00000000   0 0.0000000 1.0000000
## Fac2   0   1   0   0   0   0 0.0000000 1.00000000   0 0.0000000 0.0000000
## Fac3   0   0   1   0   0   0 0.0000000 0.00000000   1 0.0000000 0.0000000
## Fac4   0   0   0   1   0   0 0.0000000 0.00000000   0 1.0000000 0.0000000
## Fac5   0   0   0   0   1   0 0.2000000 0.08048142   0 0.5383307 0.0000000
## Fac6   0   0   0   0   0   1 0.3428571 0.39499264   0 0.1310751 0.4014399
##            VRS VRS VRS       VRS       IRS       IRS IRS IRS       IRS
## Fac1 0.0000000   0   0 0.0000000 1.0000000 0.0000000   0   0 0.0000000
## Fac2 1.0000000   0   0 0.0000000 0.0000000 1.0000000   0   0 0.0000000
## Fac3 0.0000000   1   0 0.0000000 0.0000000 0.0000000   1   0 0.0000000
## Fac4 0.0000000   0   1 0.0000000 0.0000000 0.0000000   0   1 0.0000000
## Fac5 0.0000000   0   0 1.0000000 0.0000000 0.0000000   0   0 1.0000000
## Fac6 0.3422606   0   0 0.2562995 0.4014399 0.3422606   0   0 0.2562995
##            DRS        DRS DRS       DRS FRH FRH FRH FRH FRH FRH
## Fac1 1.0000000 0.00000000   0 0.0000000   1   0   0   0   0   0
## Fac2 0.0000000 1.00000000   0 0.0000000   0   1   0   0   0   0
## Fac3 0.0000000 0.00000000   1 0.0000000   0   0   1   0   0   0
## Fac4 0.0000000 0.00000000   0 1.0000000   0   0   0   1   0   0
## Fac5 0.2000000 0.08048142   0 0.5383307   0   0   0   0   1   0
## Fac6 0.3428571 0.39499264   0 0.1310751   0   0   0   0   0   1
```

```
###DEA Analysis Summary for Hope Vally Health Care Association: Under FDH and FRH all facilities are ef
```