assignment8

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```
library(Benchmarking)
```

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

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

```
## 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(lpSolveAPI)
library(quadprog)
library(ucminf)
```

#setting up matrix

```
inputs = matrix(c(150, 400, 320, 520, 350, 320, 0.2, 0.7, 1.2, 2.0, 1.2, 0.7), ncol = 2)
#inputs
outputs = matrix(c(14000, 14000, 42000, 28000, 19000, 14000, 3500, 21000, 10500, 42000,
25000, 15000), ncol = 2)
colnames(inputs) <- c("staff hours/day","supplies/day")
colnames(outputs) <- c("reimbursed", "privately paid")
```

#VRS

```
hv_vrs =  dea(inputs, outputs, RTS = "vrs") #solve lp problem
e_vrs = eff(hv_vrs)
e_vrs
```

```
## [1] 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 0.8963283
```

```
peers(hv_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
```

```
lambda(hv_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
```

#FDH

```
hv_fdh =  dea(inputs, outputs, RTS = "fdh") #solve lp problem
e_fdh = eff(hv_fdh)
e_fdh
```

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

```
peers(hv_fdh)
```

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

```
lambda(hv_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
```

#CRS

```
hv_crs =  dea(inputs, outputs, RTS = "crs") #solve lp problem
e_crs = eff(hv_crs)
e_crs
```

```
## [1] 1.0000000 1.0000000 1.0000000 1.0000000 0.9774987 0.8674521
```

```
peers(hv_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
```

```
lambda(hv_crs)
```

```
##             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
```

#IRS

```
hv_irs =  dea(inputs, outputs, RTS = "irs") #solve lp problem
e_irs = eff(hv_irs)
e_irs
```

```
## [1] 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 0.8963283
```

```
peers(hv_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
```

```
lambda(hv_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
```

#DRS

```
hv_drs =  dea(inputs, outputs, RTS = "drs") #solve lp problem
e_drs = eff(hv_drs)
e_drs
```

```
## [1] 1.0000000 1.0000000 1.0000000 1.0000000 0.9774987 0.8674521
```

```
peers(hv_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
```

```
lambda(hv_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
```

#FRH

```
hv_frh =  dea(inputs, outputs, RTS = "add") #solve lp problem
e_frh = eff(hv_frh)
e_frh
```

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

```
peers(hv_frh)
```

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

```
lambda(hv_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
```

```
table = cbind(inputs, outputs, e_vrs, e_fdh, e_crs, e_irs, e_drs, e_frh)
table
```

```
##      staff hours/day supplies/day reimbursed privately paid     e_vrs e_fdh
## [1,]             150           0.2      14000            3500 1.0000000     1
## [2,]             400           0.7      14000           21000 1.0000000     1
## [3,]             320           1.2      42000           10500 1.0000000     1
## [4,]             520           2.0      28000           42000 1.0000000     1
## [5,]             350           1.2      19000           25000 1.0000000     1
## [6,]             320           0.7      14000           15000 0.8963283     1
##          e_crs     e_irs     e_drs e_frh
## [1,] 1.0000000 1.0000000 1.0000000     1
## [2,] 1.0000000 1.0000000 1.0000000     1
## [3,] 1.0000000 1.0000000 1.0000000     1
## [4,] 1.0000000 1.0000000 1.0000000     1
## [5,] 0.9774987 1.0000000 0.9774987     1
## [6,] 0.8674521 0.8963283 0.8674521     1
```

Under VRS, all facilities but 6 are efficient, which operates at 89.63% efficiency. DMU(6) is peers with 1,2,5 with weights of.40, .34, and .26.

Under FDH, all DMUs are efficient. There are no peers.

Under CRS, DMU(1-4) are efficent, and DMUs(5,6) is 97.8% and 86.74% efficient respectively. DMU(5,6) have peer units with DMU(1,2,4) with weights of .2, .08, and .54 (DMU(5)) and .34, .39, and .13 (DMU(6)).

Under IRS, all DMUs except DMU(6) are efficient, with DMU(6) having an efficiency of 89.63%. DMU(6) has peer units with DMU(1,2,5) with weights of .4, .34, .26.

Under DRS, DMU(1-4) are efficent, and DMUs(5,6) is 97.8% and 86.74% efficient respectively. DMU(5,6) have peer units with DMU(1,2,4) with weights of .2, .08, and .54 (DMU(5)) and .34, .39, and .13 (DMU(6)).

Under FRH, all DMUs are efficient. There are no peers.

#FRH or FDH are the most suitable models for Hope Valley.