Quant Management Assignment#6

#This notebook contains the code for the Assignment 6.

#Install lpSolveAPI package if not alresdy installed

```
#install.packages('lpSolveAPI')
```

Load the library

```
library(lpSolveAPI)
```

Solution 1 using inequalities

Let us set up the Linear problem. Note that we have 6 decision variables and 5 constraints.

```
lprec <- make.lp(5, 6)
```

Set the minimization objective function

```
set.objfn(lprec, c(622, 614, 630, 641, 645, 649))
lp.control(lprec,sense='min')
```

Set values for the rows (set the Left hand side constraints)

```
set.row(lprec, 1, c(1, 1, 1), indices = c(1, 2, 3))
set.row(lprec, 2, c(1, 1, 1), indices = c(4, 5, 6))
set.row(lprec, 3, c(1, 1), indices = c(1, 4))
set.row(lprec, 4, c(1, 1), indices = c(2, 5))
set.row(lprec, 5, c(1, 1), indices = c(3, 6))
```

Set the right hand side values

```
rhs <- c(100, 120, 80, 60, 70)
set.rhs(lprec, rhs)
```

Set constraint type and set variable types and bound

```
set.constr.type(lprec, c("<=", "<=", "=<", "=<", "="))
set.bounds(lprec, lower = rep(0, 6))
```

Finally, name the decision variables (column) and constraints (rows)

```
lp.rownames <- c("CapacityA", "CapacityB", "DemandW1", "DemandW2", "DemandW3")
lp.colnames <- c("PlantAW1", "PlantAW2", "PlantAW3","PlantBW1", "PlantBW2", "PlantBW3")
dimnames(lprec) <- list(lp.rownames, lp.colnames)
```

View the linear problem object to make sure it's correct

```
lprec
```

```
## Model name:
##            PlantAW1  PlantAW2  PlantAW3  PlantBW1  PlantBW2  PlantBW3
## Minimize        622       614       630       641       645       649
## CapacityA         1         1         1         0         0         0  <=  100
## CapacityB         0         0         0         1         1         1  <=  120
## DemandW1          1         0         0         1         0         0   =   80
## DemandW2          0         1         0         0         1         0   =   60
## DemandW3          0         0         1         0         0         1   =   70
## Kind            Std       Std       Std       Std       Std       Std
## Type           Real      Real      Real      Real      Real      Real
## Upper           Inf       Inf       Inf       Inf       Inf       Inf
## Lower             0         0         0         0         0         0
```

Save this into a file

```
write.lp(lprec, filename = "AED.lp", type = "lp")
```

Now, solve the model

```
solve(lprec)
```

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

Show the value of objective function, variables, constraints and slack

```
get.objective(lprec)
```

```
## [1] 132790
```

```
get.variables(lprec)
```

```
## [1]  0 60 40 80  0 30
```

```
get.constraints(lprec)
```

```
## [1] 100 110  80  60  70
```

```
get.constraints(lprec) - rhs
```

```
## [1] -2.842171e-14 -1.000000e+01 -1.421085e-14  0.000000e+00  0.000000e+00
```

Solution 2: Using Dummy Variables

Let us set up the Linear problem. Note that we had 8 decision variables and 6 constraints.

```
lprec1 <- make.lp(6, 8)
```

Set the minimization objective function

```
set.objfn(lprec1, c(622, 614, 630, 0, 641, 645, 649, 0))
lp.control(lprec1, sense='min')
```

Set values for the rows (set the Left hand side constraints)

```
set.row(lprec1, 1, c(1, 1, 1, 1), indices = c(1, 2, 3, 4))
set.row(lprec1, 2, c(1, 1, 1, 1), indices = c(5, 6, 7, 8))
set.row(lprec1, 3, c(1, 1), indices = c(1, 5))
set.row(lprec1, 4, c(1, 1), indices = c(2, 6))
set.row(lprec1, 5, c(1, 1), indices = c(3, 7))
set.row(lprec1, 6, c(1, 1), indices = c(4, 8))
```

Set the right hand side values

```
rhs <- c(100, 120, 80, 60, 70, 10)
set.rhs(lprec1, rhs)
```

Set constraint type and set variable types and bound

```
set.constr.type(lprec1, c("=", "=", "=", "=", "=", "="))
set.bounds(lprec1, lower = rep(0, 8))
```

Finally, name the decision variables (column) and constraints (rows)

```
lp.rownames <- c("CapacityA", "CapacityB", "DemandW1", "DemandW2", "DemandW3", "DemandW4")
lp.colnames <- c("PlantAW1", "PlantAW2", "PlantAW3", "PlanntAW4", "PlantBW1", "PlantBW2", "PlantBW3", "PlantBW4")
dimnames(lprec1) <- list(lp.rownames, lp.colnames)
```

View the linear program object to make sure it's correct

```
lprec1
```

```
## Model name:
##            PlantAW1    PlantAW2    PlantAW3   PlanntAW4    PlantBW1    PlantBW2    PlantBW3    PlantBW4
## Minimize        622         614         630           0         641         645         649           0
## CapacityA         1           1           1           1           0           0           0           0  =  100
## CapacityB         0           0           0           0           1           1           1           1  =  120
## DemandW1          1           0           0           0           1           0           0           0  =   80
## DemandW2          0           1           0           0           0           1           0           0  =   60
## DemandW3          0           0           1           0           0           0           1           0  =   70
## DemandW4          0           0           0           1           0           0           0           1  =   10
## Kind            Std         Std         Std         Std         Std         Std         Std         Std
## Type           Real        Real        Real        Real        Real        Real        Real        Real
## Upper           Inf         Inf         Inf         Inf         Inf         Inf         Inf         Inf
## Lower             0           0           0           0           0           0           0           0
```

Now solve the model

```
solve(lprec1)
```

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

Show the value of objective function, variables, constraints and slack

```
get.objective(lprec1)
```

```
## [1] 132790
```

```
get.variables(lprec1)
```

```
## [1]  0 60 40  0 80  0 30 10
```

```
get.constraints(lprec1)
```

```
## [1] 100 120  80  60  70  10
```

```
get.constraints(lprec1) - rhs
```

```
## [1]  0.000000e+00  0.000000e+00  0.000000e+00 -7.105427e-15  0.000000e+00
## [6]  3.552714e-15
```

Also,We can now read the lp formulation using an lp file and solve it. I am using the same lp file which I have saved above.

Read from file and solve it

```
x <- read.lp("AED.lp")     # create an lp object x
x                          # display x
```

```
## Model name:
##            PlantAW1  PlantAW2  PlantAW3  PlantBW1  PlantBW2  PlantBW3
## Minimize        622       614       630       641       645       649
## CapacityA         1         1         1         0         0         0  <=  100
## CapacityB         0         0         0         1         1         1  <=  120
## DemandW1          1         0         0         1         0         0   =   80
## DemandW2          0         1         0         0         1         0   =   60
## DemandW3          0         0         1         0         0         1   =   70
## Kind            Std       Std       Std       Std       Std       Std
## Type           Real      Real      Real      Real      Real      Real
## Upper           Inf       Inf       Inf       Inf       Inf       Inf
## Lower             0         0         0         0         0         0
```

```
solve(x)                   # Solution
```

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

```
get.objective(x)           # get objective value
```

```
## [1] 132790
```

```
get.variables(x)           # get values of decision variables
```

```
## [1]  0 60 40 80  0 30
```

```
get.constraints(x)         # get constraints
```

```
## [1] 100 110  80  60  70
```