Linear Programming

Attachment: MSDS_R_LinearProgramming.r

I used the following ***scenario*** from the exercise #1 for the linear programming assignment:

A farmer has 10 acres to plant in wheat and rye. He has to plant at least 7 acres. However, he has only $1200 to spend and each acre of wheat costs $200 to plant and each acre of rye costs $100 to plant. Moreover, the farmer has to get the planting done in 12 hours and it takes an hour to plant an acre of wheat and 2 hours to plant an acre of rye. If the profit is $500 per acre of wheat and $300 per acre of rye how many acres of each should be planted to maximize profits?

First, I attached lpSolveAPI package using the following code:

```
> ###Load packages
> library("lpSolveAPI")
```

Then, I used it to create an lvSolve linear programming model object lprec using the following code:

```
> #Create lpSolve linear programming model object
> lprec <- make.lp(0, 2) #model with 0 rows and 2 columns as we have 2 crops
> lp.control(lprec, sense="max")#maximization problem
```

It is a maximization problem that has o rows and 2 columns for 2 types of crops – wheat and rye.

```
> #Create lpSolve linear programming model object
> lprec <- make.lp(0, 2) #model with 0 rows and 2 columns as we have 2 crops
> lp.control(lprec, sense="max")#maximization problem
$`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
```

Next step is to set the objective function – maximizing the total profit given that each acre of wheat brings #500 and each acre of rye can bring $300. I used the following:

```
> #set objective function
> set.objfn(lprec, c(500, 300)) #profit $500/acre of wheat and $300/acre of rye
```

Next, I added constraints to the model.

Total expenses for planning should not exceed $1200, and each acre of wheat required $200 to plant and $100 for each acre of rye:

```
> #######Add constraints############
>
> #cost constraint: $200 to plant each acre of wheat, $100 to plant each acre of rye,
> #total cost not to exceed  1200
> add.constraint(lprec, c(200, 100), "<=", 1200)
```

Planting time can not exceed 12 hours total, and each acre of wheat requires 1 hour of labor and each acre of rye requires 2 hours of labor. So, the labor constraints can be coded as follow:

```
> #1 hour of labor per acre of wheat, 2 hours of labor per acre of rye
> #Total planting time not to exceed 12 hours
> add.constraint(lprec, c(1,2), "<=", 12)
```

Next, the are area constraints. There are total 10 acres available for planting, and minimum 7 acres out of this area have to be used for planting:

```
> #Area constraint
> #10 acres available to plant, need to palnt at least 7 acres
> add.constraint(lprec, c(1,1), "<=", 10) # 10 acre total available
> add.constraint(lprec, c(1,1), ">=", 7) #need to seed 7 acres mimimum
```

It resulted in the following linear programming model:

```
> lprec #Display model parameteres
Model name:
            C1    C2
Maximize   500   300
R1         200   100  <=  1200
R2           1     2  <=    12
R3           1     1  <=    10
R4           1     1  >=     7
Kind       Std   Std
Type      Real  Real
Upper      Inf   Inf
Lower        0     0
```

The final step is to solve the problem and to display the optimized objective and the appropriate variables. Blow is the resulting output:

```
> #find solution
> solve(lprec)
[1] 0
> get.objective(lprec)
```

```
[1] 3200
> get.variables(lprec)
[1] 4 4
> lprec #Display model parameteres
Model name:
            C1    C2
Maximize   500   300
R1         200   100  <=  1200
R2           1     2  <=    12
R3           1     1  <=    10
R4           1     1  >=     7
Kind       Std   Std
Type      Real  Real
Upper      Inf   Inf
Lower        0     0
> #find solution
> solve(lprec)
[1] 0
> get.objective(lprec)
[1] 3200
> get.variables(lprec)
[1] 4 4
```

Conclusion:

Given the constraint described in the problem the maximum amount of profit that is possible to receive is $3,200. The result can be obtained if 4 acres are seeded with wheat and 4 acres are dedicated to rye.