A Quick Start for The R Interface to LINDO API

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1 Introduction

The package *rLindo* is an R interface to LINDO API C functions. It supports Linear, Integer, Quadratic, Conic, General Nonlinear, Global, and Stochastic models.

2 Installation

To install the package, it requires the installation of LINDO API 8.0 as well. See file INSTALL for details of the installation and platform specifications.

3 Usage

To use the package users must have a valid license file named lndapi80.lic under the folder LINDOAPI_HOME/license. The R interface function names use the convention of 'r' + name of LINDO API function, e.g. *rLScreateEnv* in the R interface corresponds to *LScreateEnv* in LINDO API. All LINDO parameters and constants are the same with LINDO API.

4 General commands

To load the package, use the command:

```
> library(rLindo)
```

To generate a LINDO API environment object, use the command:

```
> rEnv <- rLScreateEnv()
```

To generate a LINDO API model object, use the command:

```
> rModel <- rLScreateModel(rEnv)
```

5 An application to the least absolute deviations estimation

5.1 Least absolute deviations (LAD) estimation

Let
n = number of observations,
k = number of explanatory variables,
d_i = value of the dependent variable in observation i, for $i = 1, 2, ..., n$,
e_{ij} = value of the jth independent variable in observation i, for $i = 1, 2, ..., n$ and $j = 1, 2, ..., k$,
x_j = prediction coefficient applied to the jth explanatory variable,
ω_i = error of the forecast formula applied to the ith observation,

A LAD regression can be described as the following:
Minimize

$$|\omega_1| + |\omega_2| + |\omega_3| + ... + |\omega_n|$$

subject to

$$\omega_i = d_i - x_0 - \sum_{j=1}^{k} e_{ij} x_j$$

where ω_j, x_j are unconstrained in sign.

Linear programming can be applied to this problem if we define:

$$u_i - v_i = \omega_i$$

then the LAD regression model can be rewritten as:
Minimize

$$u_1 + v_1 + u_2 + v_2 + ... + u_n + v_n$$

subject to

$$u_i - v_i = d_i - x_0 - \sum_{j=1}^{k} e_{ij} x_j$$

where u_i and v_i are nonnegative, x_j are unconstrained in sign.

5.2 An example

We have five observations on a single explanatory variable,

d_i	e_{i1}
2	1
3	2
4	4
5	6
8	7

Then the linear programming model for the LAD regression is:
Minimize

$$U_1 + V_1 + U_2 + V_2 + U_3 + V_3 + U_4 + V_4 + U_5 + V_5$$

subject to

$$U_1 - V_1 = 2 - X_0 - X_1$$
$$U_2 - V_2 = 3 - X_0 - 2X_1$$
$$U_3 - V_3 = 4 - X_0 - 4X_1$$
$$U_4 - V_4 = 5 - X_0 - 6X_1$$
$$U_5 - V_5 = 8 - X_0 - 7X_1$$

All variables are nonnegative.

5.3 Solve the linear programming model in R

Using the R interface to LINDO API, we can solve the above linear programming model.

#load the package

```
> library(rLindo)
```

#create LINDO enviroment object

```
> rEnv <- rLScreateEnv()
```

#create LINDO model object

```
> rModel <- rLScreateModel(rEnv)
```

#disable printing log

```
> rLSsetPrintLogNull(rModel)

$ErrorCode
[1] 0
```

#number of variables

```
> nVars <- 12
```

#number of constraints

```
> nCons <- 5
```

#maximize or minimize the objective function

```
> nDir <- LS_MIN
```

#objective constant

```
> dObjConst <- 0.
```

#objective coefficients

```
> adC <- c(1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 0., 0.)
```

#right hand side coefficients of the constraints

```
> adB <- c( 2., 3., 4., 5., 8.)
```

#constraint types are all Equality

```
> acConTypes <- "EEEEE"
```

#number of nonzeros in LHS of the constraints

```
> nNZ <- 20
```

#index of the first nonzero in each column

```
> anBegCol <- c( 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20)
```

#nonzero coefficients of the constraint matrix by column

```
> adA <- c(1.0,-1.0,1.0,-1.0,1.0,-1.0,1.0,-1.0,1.0,-1.0,
+          1.0,1.0,1.0,1.0,1.0,1.0,2.0,4.0,6.0,7.0)
```

#row indices of the nonzeros in the constraint matrix by column

```
> anRowX <- c(0,0,1,1,2,2,3,3,4,4,0,1,2,3,4,0,1,2,3,4)
```

#lower bound of each variable (X0 and X1 are unconstrained)

```
> pdLower <- c(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -LS_INFINITY, -LS_INFINITY)
```

#load the data into the model object

```
> rLSloadLPData(rModel, nCons, nVars, nDir, dObjConst, adC, adB, acConTypes,
+               nNZ, anBegCol, NULL, adA, anRowX, pdLower, NULL)
```

```
$ErrorCode
[1] 0
```

#solve the model.

```
> rLSoptimize(rModel,LS_METHOD_FREE)

$ErrorCode
[1] 0

$pnStatus
[1] 2
```

#retrieve value of the objective and display it

```
> rLSgetDInfo(rModel,LS_DINFO_POBJ)

$ErrorCode
[1] 0

$pdResult
[1] 2.666667
```

#get primal solution and display it

```
> rLSgetPrimalSolution(rModel)

$ErrorCode
[1] 0

$padPrimal
 [1] 0.0000000 0.0000000 0.3333333 0.0000000 0.0000000 0.0000000 0.0000000
 [8] 0.3333333 2.0000000 0.0000000 1.3333333 0.6666667
```

#get dual solution and display it

```
> rLSgetDualSolution(rModel)

$ErrorCode
[1] 0

$padDual
[1] -0.3333333  1.0000000 -0.6666667 -1.0000000  1.0000000
```

#delete enviroment and model objects to free memory

```
> rLSdeleteModel(rModel)
```

```
$ErrorCode
[1] 0

> rLSdeleteEnv(rEnv)

$ErrorCode
[1] 0
```

Then the optimal value for X_0 and X_1 specify the prediction formula:

$$d_i = 1.3333 + 0.666667e_{i1}$$