Interfacing NEOS from R
The R package rneos

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Overview

- Network-Enabled Optimization System (NEOS)
  - Overview
  - Available Solvers
  - Interfaces
- The R package rneos
  - Overview
  - Implementation of the API
  - Example
- Outlook
Overview

**http://www.neos-server.org**

Server framework for solving optimization problems.

**Why using NEOS?**
- Optimization software does not need to be installed locally.
- Computational burdensome problems are transferred to remote machines.

**Help:** via Email, FAQ, User Guide (Wiki).
NEOS

Optimization problems (in alphabetical order)

- Bound Constrained Optimization
- Combinatorial Optimization and Integer Programming
- Complementarity Problems
- Global Optimization
- Linear Network Programming
- Linear Programming
- Mixed Integer Linear Programming
- Mixed Integer Nonlinearly Constrained Optimization
- Nonlinearly Constrained Optimization
- Non-differentiable Optimization
- Semidefinite Programming
- Semi-infinite Optimization
- Stochastic Linear Programming
- Second Order Conic Programming
- Unconstrained Optimization
NEOS Interfaces

- Through Internet: Upload of model and data files
- Through Email: Upload of model and data files
- AMPL/GAMS via Kestrel
- NEOS API (XML-RPC): Available clients
  - Python
  - Perl
  - PHP
  - C and C++
  - Java
  - Ruby
  - and now, in R, too

In all four cases, the input is dependent on the chosen solver; but problems casted in AMPL and/or GAMS are most commonly encountered.
R package rneos
Overview

- Implementation of XML-RPC client-side API
- Employs S4 classes and methods (NAMESPACE)
- Dependencies: XMLRPC, RCurl, XML
- Availability:
  - R-Forge: http://r-forge.r-project.org/projects/rneos/
  - CRAN:
    http://cran.r-project.org/web/packages/rneos/index.html
R package rneos

Package Structure

- Classes: NeosComm, NeosXml, NeosJob, NeosAns
- Functions:
  - API: NemailHelp(), NgetFinalResults(), NgetFinalResultsNonBlocking(), NgetIntermediateResults(), NgetIntermediateResultsNonBlocking(), NgetJobInfo(), NgetJobStatus(), NgetSolverTemplate(), Nhelp(), NkillJob(), NlistAllSolvers(), NlistCategories(), NlistSolversInCategory(), Nping(), NprintQueue(), NsubmitJob(), Nversion(), Nwelcome()
  - Utility: CreateNeosComm(), CreateXmlString()
- Methods: show, update

Nota bene: API functions are prefixed with 'N', hence Nfoo() designates the API function foo.
R package rneos

Workflow: Two-Stage in GMS

$TITLE Stochastic Two-stage program
* TwoStageStochastic.gms: Stochastic Two-stage program.
* Consiglio, Nielsen and Zenios.
* PRACTICAL FINANCIAL OPTIMIZATION: A Library of GAMS Models, Section 6.3.1

SET Assets Available assets
    /Stock, Put_1, Call_1, Put_2, Call_2/;
SET Assets_1(Assets) Assets available up to the end of the first stage
    /Stock, Put_1, Call_1/;
SET Assets_2(Assets) Assets available up to the end of the second stage
    /Stock, Put_2, Call_2/;

SET Scenarios Set of scenarios
    /SS_1 * SS_3/;
ALIAS (Assets, i);
ALIAS (Assets_1, j);
ALIAS (Assets_2, k);
ALIAS (Scenarios, l);

PARAMETER pr(l) Scenario probability
    /SS_1 = 0.25,
      SS_2 = 0.50,
      SS_3 = 0.25/;

PARAMETER P_1(j) Asset prices at the beginning of the first stage
    /Stock = 43,
      Put_1 = 0.81,
      Call_1 = 4.76/;
R package rneos

Workflow: Two-Stage in GMS (cont’d.)

TABLE P_2(1,i) Asset prices (values) at the beginning of the second stage

<table>
<thead>
<tr>
<th></th>
<th>Stock</th>
<th>Put_1</th>
<th>Call_1</th>
<th>Put_2</th>
<th>Call_2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS_1</td>
<td>44</td>
<td>1</td>
<td>0</td>
<td>0.92</td>
<td>4.43</td>
</tr>
<tr>
<td>SS_2</td>
<td>36</td>
<td>0</td>
<td>4</td>
<td>1.40</td>
<td>0.85</td>
</tr>
<tr>
<td>SS_3</td>
<td>47</td>
<td>2</td>
<td>0</td>
<td>3.02</td>
<td>6.82</td>
</tr>
</tbody>
</table>

TABLE V(l,k) Asset prices (values) at the end of the second stage

<table>
<thead>
<tr>
<th></th>
<th>Stock</th>
<th>Put_2</th>
<th>Call_2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS_1</td>
<td>48</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>SS_2</td>
<td>32</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SS_3</td>
<td>55</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

POSITIVE VARIABLES

x(j) First-stage holdings
y(l,k) Second-stage holdings;

VARIABLE

z Objective function value;

EQUATIONS

BudgetCon Equation defining the budget constraint
ObjDef Objective function definition
MinReturnCon(l) Equation defining the minimum return constraint
RebalanceCon(l) Equation defining the rebalance constraint;

ObjDef .. z =E= SUM((k,l), pr(l) * V(l,k) * y(l,k));
BudgetCon .. SUM(j, P_1(j) * x(j)) =L= 10000;
MinReturnCon(l) .. SUM(k, V(l,k) * y(l,k)) =G= 11500;
RebalanceCon(l) .. SUM(j, P_2(l,j) * x(j)) =G= SUM(k, P_2(l,k) * y(l,k));

MODEL StochasticTwoStage /ALL/;
SOLVE StochasticTwoStage MAXIMIZING z USING LP;
DISPLAY x.l,z.l;
R package rneos

Work flow: Using rneos

```r
library(rneos)
## NEOS: ping
Nping()
## NEOS: listCategories
NlistCategories()
## NEOS: listSolversInCategory
NlistSolversInCategory(category = "lp")
## NEOS: getSolverTemplate
template <- NgetSolverTemplate(category = "lp", solvername = "MOSEK", inputMethod = "GAMS")

modc <- paste(paste(readLines("TwoStageStochastic.gms"), collapse = "\n"), "\n")
cat(modc)

argslist <- list(model = modc, options = ",", wantlog = ",", comments = ")

xmls <- CreateXmlString(neosxml = template, cdatalist = argslist)
## NEOS: printQueue
NprintQueue()
## NEOS: submitJob
(test <- NsubmitJob(xmlstring = xmls, user = "rneos", interface = ",", id = 0))
## NEOS: getJobStatus
NgetJobStatus(obj = test)
## NEOS: getFinalResults
NgetFinalResults(obj = test)
```
Intended package enhancements:

- Offer methods for updating model specifications
- Offer methods for updating data/parameters of optimization problems.
- Implement API for solver maintenance.


