Bruce McCarl's GAMS Newsletter Number 30

This newsletter covers

- A new documentation version
- Developments in the GAMS 23.6 release
- Some licensing developments
- File compression and encryption
- The solver option file builder
- GAMS API capability
- Use of multiple processers when solving.
- Future courses I will teach

Expanded GAMS User Guide by McCarl et al.

I updated the User's Guide to reflect 23.6 with changes added here and there. This can be found at http://www.gams.com/dd/docs/bigdocs/gams2002/mccarlgamsuserguide.pdf and will be in upcoming GAMS releases.

GAMS Features in Release 23.6

New language elements

- A new interface to MATLAB, called GDXMRW has been developed and is explained at: http://www.gams.com/dd/docs/tools/gdxmrw.pdf
- A function was added that generates random numbers from the binomial distribution RandBinomial(n,p) where n is the number of trials and p probability of success for each trial.
- Allowed the gams date and release functions to be used in $eval and equation definitions [..]. The allowable functions are jdate, jtime, gyear, gmonth, gday, gdow, gleap, ghour, gminute, gsecond, gmillisec, jstart, jnow, gamsversion, and gamsrelease.
- Changed the operator precedence order of IMP (->), EQV (<=>), OR and XOR. They used to have the same order and now OR and XOR are done before IMP and EQV.
- Introduced an option for the GDX and RF parameters in the command line.
- Adding the command gdx=default will create a gdx file with the GMS file root name and a GDX extension. Thus gams trnsport gdx=default will write the file trnsport.gdx.
- Adding rf=default creates a reference file with the GMS file root name and a REF extension. Thus gams trnsport rf=default will write the reference file trnsport.ref.
- Added a command line parameter threads that controls the number of threads or CPU cores to be used by a solver, if the solver supports parallel solver threads. It can also be set as a GAMS option or model attribute. Non-positive values are interpreted as the number of cores to leave free so setting threads to 0 uses all available cores while setting threads to -1 leaves one core free for other tasks. This does not work for limiting the cores used in Grid computing.
- Added a parameter gridscript that allows a script to be used when submitting grid computing jobs.

IDE features

The *Find in Files* option now allows you to identify sub-directories and to exclude them from the search.

New utilities

Two new utilities were added

Chk4Upd - Checks if there is a newer version of GAMS available than the one being used. It also checks for the newest version you can run with your license. By default it uses the gamslice.txt located in the GAMS system directory. Alternatively, you can specify another license in the command line. It is integrated in the GAMS IDE under the Help menu at the Check for GAMS Update choice.

XLSDump - Writes all worksheets of an Excel workbook to a gdx file. Unlike GDXXRW, the program does not require that Excel is installed. This works only on Windows platforms.

Licensing Developments

GAMS has introduced a new generic license which supports all platforms on which GAMS is able to run (i.e. it can be employed on more than one type of computer operating system – such as Windows and LINUX). It requires distribution 23.6 or newer to work. Pricing and details can be received from your GAMS distributor.

GAMS offers a free academic solver link license through the OSI Solver interface to members of the solver partners academic initiative programs. As of now this involves CPLEX, GUROBI, MOSEK, and XPRESS. Details are available through http://support.gams-software.com/doku.php?id=solver:academic_programs_by_solver_partners

GDXXRW Features in release 23.6

You can cause GDXXRW to write data subject to an automatic filter specified in Excel. The syntax for this involves adding **filter=n** to the GDXXRW call. When n=0 is the default condition and uses no filter, n=1 turns the filter and applies it to the row just above the data, n=2 turns the filter and applies it to the row 2 rows above the data, n=k turns the filter and applies it to the row k rows above the data. The Expanded use guide provides an example.

Solver developments in release 23.6

A number of solver developments took place with

- New libraries for Baron, BONMIN, CSDP, CONOPT, CPLEX, EMP, GUROBI, KNITRO, LGO, LINDOGLOBAL, MOSEK, SCIP, XA, and XPRESS.
- Substantial new options and features in changes in CPLEX largely involving MIP and thread features.
- Substantial new options and features in changes in GUROBI which has new features involving Quadratic programming, Concurrent optimization, MIP performance, LP performance, Delayed MIP strategy change, and LP algorithm choice. It also has a number of new MIP and other options
- Free academic licensing facilities as discussed above.

File compression and encryption

GAMS contains a feature for encrypting or compressing files and reading them in the program. The compression and decompression of files is available in the base system. The encryption requires a special license file. To do this, three dollar commands are used in a GAMS file:

```
$Compress   source.gms targetfilename.gms
$Decompress compressedsource.gms targetfilename.gms
$Encrypt    source.gms targetfilename
```

Each takes the source and creates the target. Compressed or encrypted source files can be automatically read by GAMS, although for the encrypted file this requires the special license. All compressed and encrypted files are platform independent. The GAMS model library file CEFILES.gms illustrates usage of these files. This is covered in the Expanded User Guide (McCarl) accessible through the IDE and can be found by searching for compress.

Automatic Solver option file generation

Option files are the route via which users can affect the ways that solvers work. A couple of years ago, GAMS put in an option file editor into the GAMSIDE that allows you to see all available options and select their values. It is accessible through the utilities menu of the IDE under the Solver Option File choice. For some solvers there are many options and you need to know what you are looking for. To support your search, you can read the relevant parts of the Solver Manual.

GAMS APIs

GAMS has API files that facilitate the interaction of programs written in C, C++, C#, Delphi, Fortran 90, Java, Python and Visual Basic with GDX files, GAMS program usage for job submission and solution extraction and GAMS option file manipulation. Here I attempt a very basic coverage as I have not ever used them and would need substantial help to even get started.

The first API is one that facilitates extraction of items from GDX files into programs and the writing of data into GDX files. Documentation is available in a CHM or pdf file in the apifiles/gdx subdirectory of the GAMS system. It covers Writing data to a GDX file using

strings, and integers, Reading data from a GDX file using strings, integers and a filter plus provides examples and file definitions. Some material on compilation appears under the apifiles/examples directory in the file readme.txt.

The second API allows interfacing with GAMS to run jobs. No documentation is available. There are several examples of visual basic interface in the model library and some language specific code in the gamsx subdirectory of the apifiles part of the GAMS system directory.

The third API allows you how to interface with solver options. Again no documentation is available. There is some language specific code in the opt subdirectory of the apifiles part of the GAMS system directory.

Across all of these code in different languages is provided.

Using Multiple processors on your machine

GAMS allows you to solve multiple problems using the multiple cores available on your computer. Some solvers support parallel solver threads, as discussed above. Another approach involves Grid computing as covered in the Expanded User Guide. An example is provided in the model library file trnsgrid.gms. The active part of it (with a small modification in the definition of repy) is below

```
parameter repx(s,i,j) solution report
        repy(s,solveinfo) summary report;
repy(s,'solvestat') = na;
repy(s,'modelstat') = na;
*we use the handle parameter to indicate that the solution has been collected
repeat
  loop(s$handlecollect(h(s)),
    repx(s,i,j) = x.l(i,j);
    repy(s,'solvestat') = transport.solvestat;
    repy(s,'modelstat') = transport.modelstat;
    repy(s,'resusd'   ) = transport.resusd;
    repy(s,'objval')    = transport.objval;
    display$handledelete(h(s)) 'trouble deleting handles' ;
    h(s) = 0 ) ;    // indicate that we have loaded the solution
    display$sleep(card(h)*0.2) 'was sleeping for some time';
until card(h) = 0 or timeelapsed > 10;  // wait until all models are loaded
display repx, repy;
```

In this code

- Loop solves each problem where the set s identifies those problems
- Repx saves the solution values of the variable x (note in general all the problem variables would need to be saved).
- Repy saves the overall solution information on the problem (solution termination status, model optimality etc status, time used and objective function value)
- This code would use each of the multiprocessor cores as they become available.

In general this feature lets you use multiple machines but it can take a lot of setup to network the machines particularly in a Windows environment.

Courses offered

I will be teaching

- Basic GAMS class June 7-9, 2011 (3 days) in the Colorado mountains at Frisco (near Breckenridge). The course starts, assuming you don't know gams and moves through basic topics on use, conditionals, expressing models, controlling output, links to spreadsheets among other topics.
- Advanced GAMS class Aug 2-4, 2011 (3 days) in the Colorado mountains at Frisco (near Breckenridge). The course covers such diverse topics as links to other programs like macros, spreadsheets, speeding up GAMS, scaling, debugging, improving output and advanced basis use along with many other topics.
- Further information and other courses are listed on http://www.gams.com/courses.htm.

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