Bruce McCarl's GAMS Newsletter Number 25

Here I cover new developments in GAMS 22.7, and the 22.8 Beta plus future course offerings.

Features in GAMS 22.7

GAMS made available version GAMS 22.7 in May. Notable developments in this version are

Entering variable and equation attribute data

Data for variable and equation attributes may be entered through the variable and equation statement. The items that can be entered are the upper, lower and fixed bounds (.up, .lo, .fx); starting values (.l); scaling factors (.scale); marginals (.m); and priorities (.prior for variables only). The format is an extension of the variable and equation commands of one of two forms.

- The conventional variable and equation statements can be augmented with a parameter like section where values are enclosed in between /'s as follows

```
Variable x1(j) my first  / j1.up 10 , j1.lo 5, j1.scale 20, j1.l 7, j1.m 0 /;
Equation landconstrain(landtype) my land constraints
                    / cropland.scale 20, cropland.l 7, cropland.m 100 /;
```

- A table structure can be used The conventional variable and equation statements can be augmented with a parameter like section where values are enclosed in between /'s as follows

```
variable table x(i,j) initial values
                            l      m
     seattle.  new-york    50
     seattle.  Chicago    300
     san-diego.new-york   275
     san-diego.chicago         0.009;
Equation table landconstrain(landtype) my land constraints
                Scale   l   m
     cropland    20     7  100
     Pasture     10     6   30;
```

Tuple definition via a matching Operator

Mappings between tuples can be lengthy and inconvenient to enter via data statements plus difficult to compute. A new matching operator (:) has been introduced to help. For example, the two set data statements give the same result:

```
Set I / t1*t6:s3*s5 /
Set j / t1.s3,t2.s4,t3.s5 /
```

Where elements of the set before the : will be matched with elements after the : up until one runs out of elements to match. The matching will follow the order of set elements in GAMS with the first element of one set matched with the first element of the second set etc.

One may also match a set with a tuple and use all elements in the set using the command # as follows

```
sets h /h1*h24/, d /d1*d365/, dh(d,h) /#d.#h/
sets t /t1*t8760/, tdh(t,d,h) /#t:#dh/, dht/#dh:#t/
```

The resulting set tdh will then have the values:

```
t1.d1.h1, t2.d1.h2, t3.d1.h3 ..
```

while dht will have

```
d1.h1.t1,d1.h2.t2, d1.h3.t3 ...
```

An option statement also causes the matching to occur as follows
Given sets

```
Set ijk(I,j,k), x(I,j,k,l) ..
```

Use of the option command

```
Option ijk(i:j,k), x(ijk:l);
```

Results in the set `ijk` being emptied then the set `ijk` being defined according to a matching of elements of `I` with `j` for each `k` In turn then the `x` set is defined with the elements of `ijk` matched with `l`.

Other enhancements

- One can limit the amount of memory a GAMS job can use using the GAMS command line parameter or can set it by stating Heaplimit=n. If the data storage exceeds this limit, the job will be terminate with return code 10, out of memory. CONOPT also has a `HeapLimit` option which limits it's memory use.
- A parameter, variable, equation or set can have up to 20 dimensions.
- Parameter, variable etc names and set elements can have up to 63 characters
- 'Keep' and 'CurDir' can be used as command line parameters in GAMS calls
- A new variable/equation attribute `.range` can be used in calculations and gives the difference between lower and upper bounds. When this is zero the associated variable is fixed
- When using $ondelim with respect to a table statement one does not need a dummy element in the column definition
- One can define a set that has the same element domain as a parameter that is in a GDX file using `$load settodefine=parametername` where `settodefine` is the name of the set and `parametername` is the parameter in the GDX file from which to draw the domain.

Predefining a library in the IDE

One can predefine a library for use like the GAMS model library in the IDE. In particular one can alter the file idecfg.ini so it has contents like

```
[library1]
text=GAMS Model Library
file=modlib\modlib.glb

[library2]
text=GAMS Test Library
file=gtestlib\testlib.glb

[library3]
text=McCarl GAMS Classes Library
file=mccarlgams\example\modlib.glb
```

where the blue content is there by default and the red content is ones additions. In turn today the glb file for the library and all the library files must be located in the relative path given by the file=location command which would be a subdirectory of the GAMS system directory (C:\program files\GAMS22.7 on a US machine). This will change in the next release.

The development of a library is discussed in issue 2 of this newsletter at http://www.gams.com/mccarl/newsletter/news2.pdf .

GAMS 22.8 also permits retrieving the library via a command line tool.

Solvers

- A New MIP solver has been introduced that is called GAMS/SCIP. It was developed by Zuse Institute Berlin and is discussed at the link SCIP. This solver is free for academic users.
- A new MIP solver has been introduced that is called LogMIP. It solves linear and nonlinear disjunctive programming problems involving binary variables and disjunction definitions for discrete choices. LogMIP was developed by A. Vecchietti, J.J. Gil and L. Catania at INGAR (Santa Fe-Argentina) and Ignacio E. Grossmann at Carnegie Mellon University (Pittsburgh-USA). It comes free of charge with any Windows GAMS system but needs access to a liscensed solver to solve the generated MIP/MINLP models. It is discussed at the link LogMIP Website
- A new but experimental Extended Mathematical Programming (EMP) Framework is introduced for automated mathematical programming reformulations of
    - Bilevel Programs
    - Disjunctive Programs
    - Extended Nonlinear Programs
    - Embedded Optimization Complementarity Programs

  Within this solver these model types are reformulated into established math programming classes allowing use of existing solver technology. EMP comes free of charge with any licensed GAMS system but needs a subsolver to solve the generated models.
- Experimental versions of CPLEX and CONOPT are present that pass information to solvers in core without use of scratch files and speed up GAMS to solver communications. They are called CPLEXD and CONOPTD . Their use also

requires use of the command `modelname.solvelink=5;` before the solve statement.
- New libraries are present for BARON, CPLEX, CONOPT, CoinCbc, CoinGlpk, CoinIpopt, CoinBonmin and MOSEK.

GAMS 22.8 Beta

As of this week the beta of GAMS 22.8 has been released. It has several new features including

- Increased the maximum input line length to 40,000 characters and the maximum number of columns in a table to 10,000.
- The `$LOAD` directive can read the universal set from a gdx file by specifying `$LOAD id=*`.
- GAMS parameters `gdxcompress` and `gdxconvert` allow gdx files to be written into older formats
- A utility gdx2xls that places contents of an entire gdx file a Microsoft Excel spread sheet.
- A utility invert that inverts a matrix in a gdx file.
- Utilities that chan interact with Excel to open close files and that check on which Microsoft Office programs are installed.
- Extensions of gdxcopy, gdxdiff , gdxmerge, and gdxviewer.
- A command line procedure for loading model library files.
- An option to predefine a user model library in a location other than the GAMS system directory
- A new model library that contains models that demonstrate the various utilities to interface GAMS with other applications.
- Models from the book Practical Financial Optimization by Andrea Coniglio, Soren Nielsen, and Stavros A. Zenios.
- New solver libraries for Baron, CoinBonmin, CoinCbc, CoinScip, Cplex, Lindoglobal, Moseka and XA.
- An in core data passing version of BDMLP called BDMLPD.
- A new solver LS which is called the Linear Least Squares Solver

Courses offered

I teach an Advanced GAMS class Aug 5-8, 2008 (3 1/2 days) in the Colorado mountains at Frisco (near Breckenridge). The course covers such diverse topics as links to other programs like 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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