Recent Enhancements in GAMS

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Agenda

- What is GAMS?
- Overview of Enhancements
- Paver 2
- Youtube Channel: GAMS lessons
- Summary
Algebraic Modeling Languages (AML)

1. High-level computer programming languages
   - Formulation of mathematical optimization problems
   - Notation similar to algebraic notation

2. Do not solve problems directly, but offer links to state-of-the-art algorithms ("solver-links")

Source: http://en.wikipedia.org/wiki/Algebraic_modeling_language
What does a modeler have to think about?

1. Application
2. Mathematics
3. Programming
4. Performance
5. Scalability
6. Connectivity
7. Deployment
8. Maintenance (Life Cycle)
9. ...

GAMS makes modeling easier
Design Principle

1. Simple modeling language with a balanced mix of declarative and procedural elements

2. Open architecture and interfaces to other systems, independent layers
General Algebraic Modeling System

Broad User Community and Network

GAMS used in more than 120 countries

Number of visits to GAMS download website

25+ Years GAMS Development
## Broad Range of Application Areas

<table>
<thead>
<tr>
<th>Agricultural Economics</th>
<th>Applied General Equilibrium</th>
</tr>
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<tbody>
<tr>
<td>Chemical Engineering</td>
<td>Economic Development</td>
</tr>
<tr>
<td>Econometrics</td>
<td>Energy</td>
</tr>
<tr>
<td>Environmental Economics</td>
<td>Engineering</td>
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<tr>
<td>Finance</td>
<td>Forestry</td>
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<tr>
<td>International Trade</td>
<td>Logistics</td>
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<tr>
<td>Macro Economics</td>
<td>Military</td>
</tr>
<tr>
<td>Management Science/OR</td>
<td>Mathematics</td>
</tr>
<tr>
<td>Micro Economics</td>
<td>Physics</td>
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</tbody>
</table>
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Upcoming release – **GAMS 24.3**
(estimated release date: August 2014)

Enhancements during last year

- GAMS System Updates
- Solver Updates
- New Tools and API Updates
- New Model Library Examples
Enhancements during last year

GAMS System Updates
- Singleton set
- Obfuscate restart file
- CPP function library
  - Automatic differentiation
  - Multi-variate Normal Distributions

Solver Updates for > 15 solvers
- BARON 14.0.0: Significant advances in the handling of integer programs
- CONOPT: New option to control definitional equations.
- GUSS/Scenario solver can now be combined with the GAMS Grid Facility.
Singleton set

A singleton set is a set that has at most one element.

Set i /a,b,c/;
Singleton Set first(i) /a/;
  last(i) /c/;
Parameter p(i) /a 1
  b 2
  c 3 /
Parameter val1, val2;
val1=p(first);
val2=p(last);
Display val1, val2;

Compilation
Execution
Display
  val1
  val2

11 PARAMETER val1 = 1.000
PARAMETER val2 = 3.000
Obfuscate restart file
Enhancements during last year

**New tools and API updates**

- **GDXRENAME**: Rename the same unique elements in a GDX file using a mapping given by a second GDX file.

- **GDXDUMP**: new option `SymbolsAsSet` - to write the symbol table for a set as data.

- **.NET, Java and Python** fixes and improvements.

**New Model Library Examples**

- New examples to:
  - Model Library = 7
  - Test Library = 48
  - Data Utilities = 5
  - EMP Library = 4
  - Total > 1250 models

Note: The GAMS System includes also a Practical Financial Optimization Models Library.
GDXRENAME Tool
SpawnGAMSAccess (Datalib,#87)

GAMS Main Control of Solution Process

- Starting compilation
  - Import gams(64): 0.2 Mb
  - GDS files: 1.0 Kb
  - Solution file: 0.2 Kb
- Reading data...
- Starting Compiler
- Saving option names to file (Option file)
- Read option names 1 time
- LP: Problem: 1 row and 1 column
- Reduced LP: 5 rows, 6 columns, and 12 nonzero
- Problem time: 0.00 sec (0.000000 sec)
- Solution time: 0.000000 sec

Iteration Dual Objective In Variable Out Variable
1 72.125000 A(San Diego, New York) demand New York slack
2 115.825000 A(Salt Lake City, Chicago) demand Chicago slack
3 153.675000 A(San Diego, Houston) demand(Chicago) slack
4 153.675000 A(San Diego, Houston) demand(Chicago) slack
- LP: Solution found
- Objective: 153.675000
- Presolving execution
- Import gams(67): 2 Mb
- Reading solution for model transport
- Import gams(79): 3 Mb
- Status: Normal completion
- Job import gams Stop 07/11/14 13:12:46 elapsed 0:00:08.071
SpawnGAMSAccess (Datalib,#87)

The Access VBA code is in control

From VBA we can write a GDX file either with:
- GDXAPI
- MDB2GMS tool

Spawn GAMS. Note that we can also control (stop) the GAMS solver.

We use GDXDUMP to write a text file that is transferred to Access.

Notes.
The GAMS model is saved in an Access Memo field.
A temporary model can be modified in the GAMSIDE and executed from Access.
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Paver 2

www.gamsworld.org/performance/paver2/
PAVER server (Performance Analysis and Visualization for Effortless Reproducibility)

Complete rewrite PAVER 2.0, 2013 (Python)

New functionality:
- Consistency checks
- Comparison against solution database
- Many more metrics

Open source (COIN-OR project)
PAVER 2

This tools is meant to simplify the task of performance data comparison and visualization. Some description of it can be found in:

Michael R. Bussieck, Steven P. Dirkse, Stefan Vigerske

Download PAVER 2:

- paver.zip (15MB)
- README

There exists also an online PAVER, but the preferred way to use the tool is to download and execute it on the users machine.

For questions or comments please contact the PAVER 2 author.

Examples

PAVER 2 comes with a number of examples that demonstrate input format and functionality of the scripts.

LP Benchmark I

Input: lp1gen.trc lp2gen.trc lp3gen.trc linlib solu

PAVER 2 call: python paver.py lp1gen.trc lp2gen.trc lp3gen.trc lp3gen.trc linlib.solu --writexml linlib.gen
**Paver 2**

**PAVER 2 SERVER - Performance Analysis Web Submission Tool**

The PAVER web-submission tool runs the PAVER performance tool locally. To submit a trace file, choose it from the list and click on **Submit trace files**. If you find this tool useful, please consider citing the paper M. Bussieck, S. Dirkse, S. Vigerske (2013). PAVER 2.0: An Open Source Tool for Performance Analysis of Mathematical Programs, Computational Optimization and Applications, 56:3, 701-733.

**Optional Settings:**

- **Relative Tolerance on Bounds:** 1e-6 (Consistency Checks)
- **Absolute Tolerance on Bounds:** 0.0001 (Consistency Checks)
- **(Primal) Feasibility Tolerance:** 2e-6 (Consistency Checks w.r.t. Examiner computed values)
- **Optimality (Dual Feasibility) Tolerance:** 2e-6 (Consistency Checks w.r.t. Examiner computed values)
- **Reference Solver (Name):**
  - **Shift for Time (s):** 10 (Performance Evaluation)
  - **Shift for Number of Nodes:** 100 (Performance Evaluation)
  - **Minimal Time:** 1 (Performance Evaluation)
  - **Time in case of failure:** (Performance Evaluation)
  - **Number of Nodes in case of failure:** (Performance Evaluation)
  - **(Relative) Gap Tolerance:** 1e-6 (Performance Evaluation)
  - **Threshold for being relatively faster:** 0.1 (Performance Evaluation)
  - **Threshold for relatively better obj. value:** 0.1 (Performance Evaluation)
  - **Regard Dual Bounds (if available):**
  - **Number of ticks (points):** 40 (Performance Profiles)
  - **Extended Performance Profiles:** (Performance Profiles)
  - **Include virt. best solver:**
  - **Option file name is runname:** (Reading)

**For questions or comments please contact the Paver 2 author.**
Paver 2

Analysis Results

Your data was successfully submitted to the PAVER - Performance Analysis System. You can also download the results at:

Submit data:

Date/Time: Mon Jul 1 16:02:46 EDT 2013

Log file

Solver Runs

- Thorin
- Gimli
- Bombur
- Balin
- Bifur

Solving Data

Statistics (Counts and Means)

Performance Profiles
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www.youtube.com/channel/UCfTAizXPo4vN54CC-Zs9TTg
Youtube Channel: GAMS lessons

An Introduction to Sets in GAMS
1 day ago - 8 views
In this video we will give an introduction to static sets, dynamic sets, and multi-dimensional sets. Furthermore, we will write a GAMS program that aims to illustrate how sets can be use....

Install the Windows Version of GAMS on a Mac by Using Wine
2 months ago - 188 views
We will setup the graphical user interface for GAMS, GAMSIDE, on a Mac by using a third party software called Wine.

How to Install the Native GAMS Version on a Mac
2 months ago - 154 views
We will make a apple script that launches a terminal window, which is set up in a way that GAMS keywords can be immediately used.
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Thank You

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