GAMS
General Algebraic Modeling System

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GAMS Software GmbH
www.gams.de
GAMS Development Corporation
www.gams.com
Algebraic Modeling Languages

- High-level programming languages for large scale mathematical optimization problems
- Algebraic formulation
  - Syntax similar to mathematical notation
  - Does not contain any hints how to process it
- Do not solve optimization problems directly, but call appropriate external algorithms

Goals

- Efficient handling of mathematical optimization problems
- Simplify model building and solution process
- Increase productivity and support maintainable models
- Support of decision making process
GAMS at a Glance

**General Algebraic Modeling System**

- Roots: World Bank, 1976
- Went commercial in 1987
- GAMS Development Corp.
- GAMS Software GmbH
- Broad academic & commercial user community and network
GAMS’ Fundamental concepts

- Different layers with separation of
  - model and data
  - model and solution methods
  - model and operating system
  - model and interface

- Balanced mix of declarative and procedural elements
- Open architecture and interfaces to other systems
- Platform independence
**Typical Application Areas**

- Agricultural Economics
- Chemical Engineering
- Econometrics
- Environmental Economics
- Finance
- International Trade
- Macro Economics
- Management Science/OR
- Micro Economics
- Applied General Equilibrium
- Economic Development
- Energy
- Engineering
- Forestry
- Logistics
- Military
- Mathematics
- Physics

* Illustrative examples in the GAMS Model Library
Downloads by Platform

GAMS 22.5
~525 downloads/week

GAMS 22.6
~590 downloads/week

GAMS 22.7
~590 downloads a week
GAMS at a Glance

**General Algebraic Modeling System**

- Algebraic Modeling Language
- 25+ Integrated Solvers
- 10+ Supported MP classes
- 10+ Supported Platforms
- Connectivity- & Productivity Tools
  - IDE
  - Model Libraries
  - GDX, Interfaces & Tools
  - Grid Computing
  - Benchmarking
  - Compression & Encryption
  - Deployment System
  - …
### Supported Model Types (GAMS 22.8)

<table>
<thead>
<tr>
<th>Solver/Model type availability - 22.8 Aug 1, 2008</th>
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<tbody>
<tr>
<td><strong>LP</strong></td>
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<td>DEA</td>
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<tr>
<td>Kestrel</td>
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Contributed Plug&Play solvers: AMPLwrap

Contributed solvers: DEA, Kestrel
## Supported Platforms (GAMS 22.8)

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1. **GAMS distribution for HP-UX is 22.1.**
2. **GAMS distribution for SGI IRIX is 22.3.**
3. **GAMS distribution for DEC Alpha is 22.7.**

### Contributed Plug&Play solvers

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For backward compatibility we maintain older versions of operating systems and solvers. Please call.
System Overview

Connectivity Tools
- Uniform Data Exchange:
  - ASCII
  - GDX (ODBC, SQL, XLS, XML)
- GDX Tools
- Component Library with Interfaces to C++, Java, .NET,…
- Ext. programs
  - EXCEL
  - MATLAB
  - GNUPLOT, …
- CONVERT

Productivity Tools
- Integrated Development Environment
- Integrated Data Browser and Charting Engine
- Model Libraries
- Benchmarking and Deployment
- Model Debugger and Profiler
- Transparent and reproducible Quality Assurance and Testing System
- Data and Model Encryption
- Grid Computing
- Scenario Reduction
- MPSGE for general equilibrium modeling

User Interfaces

Interactive • API / Batch

GAMS Language Compiler and Execution System

Solvers
LP/MIP-QCP-MIQCP-NLP/DNLP-MINLP-CNS-MCP-MPEC, global, and stochastic

ALPHAEC, BARON, COIN, CONOPT, CPLEX, DECIS, DICOPT, KNITRO, LGO, LINDO, MINOS, MOSEK, OQNLP, PATH, SNOPT, XA, XPRESS, …
Hands-on! Installing GAMS

export PATH=/home/jhjagla/gams:$PATH
What is a Model?

• Mathematical Programming (MP) Model
  – List of Equations

• Collection of several intertwined MP Models
  – Data Preparation
  – Data Calibration
  – “Solution” Module (e.g. sequential, parallel, loop)
  – Report Module
Minimize Transportation cost
subject to Demand satisfaction at markets
Supply constraints
\[
\sum_{(c,p): (c,p) \in \mathcal{N}} t_{\text{cost}} \cdot \text{dist}(c, p) \cdot x_{p}^{c} \rightarrow \min
\]

\[
\sum_{(c,p): (c,p) \in \mathcal{N}} x_{p}^{c} \leq \sup(c) \quad \forall c
\]

\[
\sum_{(c,p): (c,p) \in \mathcal{N}} x_{p}^{c} \geq \text{dem}(p) \quad \forall p
\]

\[
x_{p}^{c} \geq 0 \quad \forall c, p : (c, p) \in \mathcal{N}
\]
GAMS Algebra

Variables
x(i,j) shipment quantities in cases
z total transportation costs in thousands of dollars;

Positive Variable x;

Equations
cost define objective function
supply(i) observe supply limit at plant i
demand(j) satisfy demand at market j;

cost ..  z  =e=  sum((i,j), c(i,j)*x(i,j)) ;

supply(i) ..  sum(j, x(i,j))  =l=  a(i) ;
demand(j) ..  sum(i, x(i,j))  =g=  b(j) ;

Model transport /all/ ;
Hands-on! IDE - A Guided Tour

- Project Management
- Documentation
  - User’s Guide
  - McCarl User’s Guide
  - Solver Manuals
- Model Library
- Solver Selection
- Option Editor
- Listing file
  - Tree view
  - Error navigation
- Spell checking
GAMS Talks at OR 2008

GAMS’ Extended Mathematical Programming Framework

Jan-Hendrik Jagla
Wednesday, 14:45 - 16:15
J 2101

Is Utility Computing suitable for providing Mathematical Programming Resources

Franz Nelissen
Friday, 13:15-14:45
K 1004
GAMS on the Web

Download  www.gams.de  www.gams.com

Help and Support
Support Wiki  http://support.gams-software.com
Interfaces Wiki  http://interfaces.gams-software.com
User Group  http://www.gams.com/maillist/gams_l.htm
Google Group  http://groups.google.de/group/gamsworld

Search all GAMS Websites  http://www.gams.com/search.htm
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