



GAMS

How can I make this work ???

Arrgghh!!

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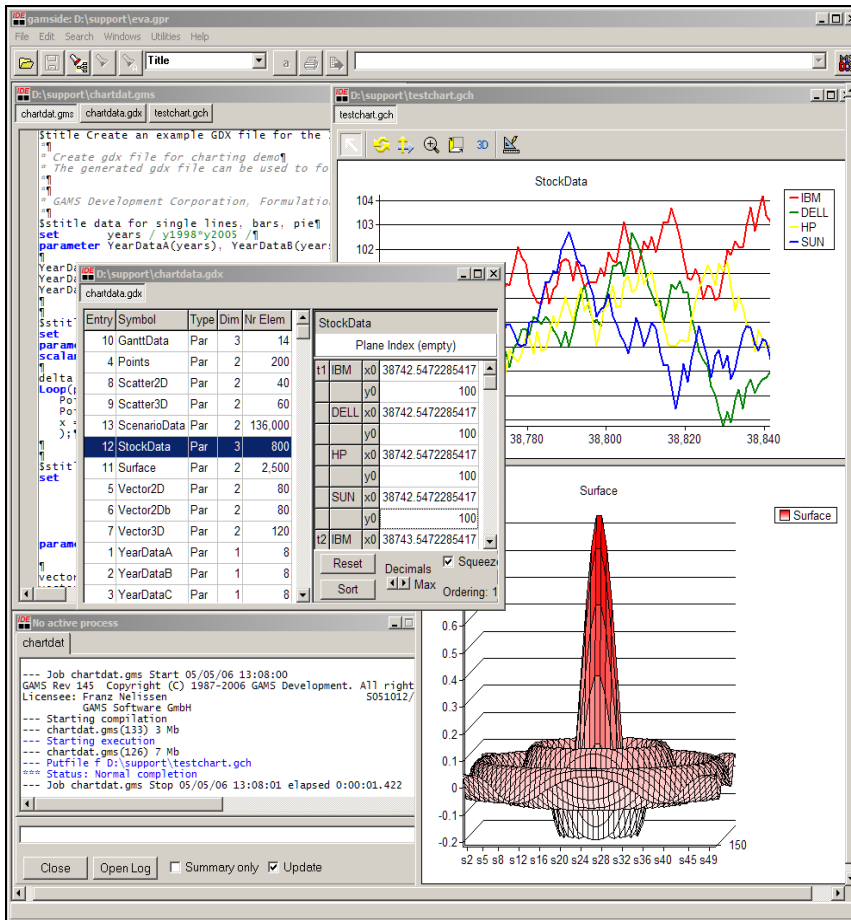
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Introduction

GAMS at a Glance

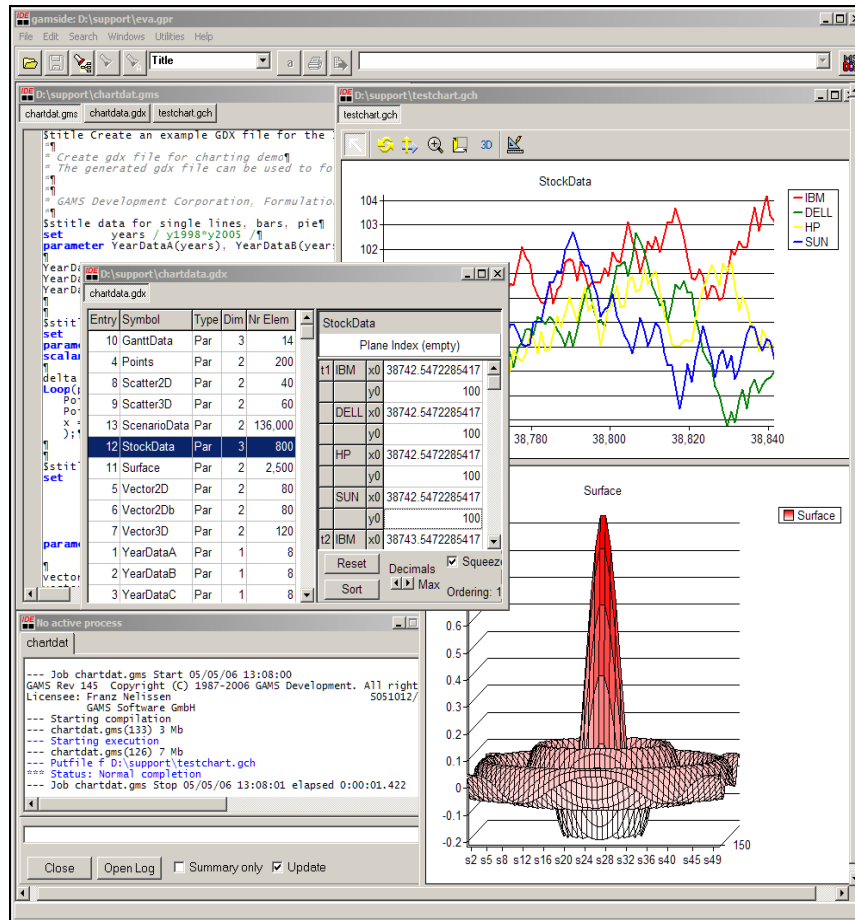


Algebraic Modeling System

- Facilitates the formulation of mathematical optimization problems in an algebraic notation
 - ➔ Simplified model building
- Provides links to appropriate state-of-the-art external algorithms
 - ➔ Efficient solution process

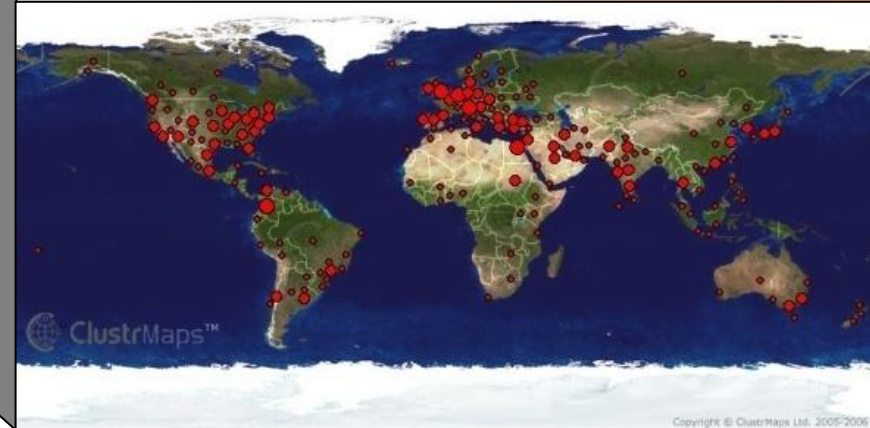


GAMS at a Glance



General Algebraic Modeling System

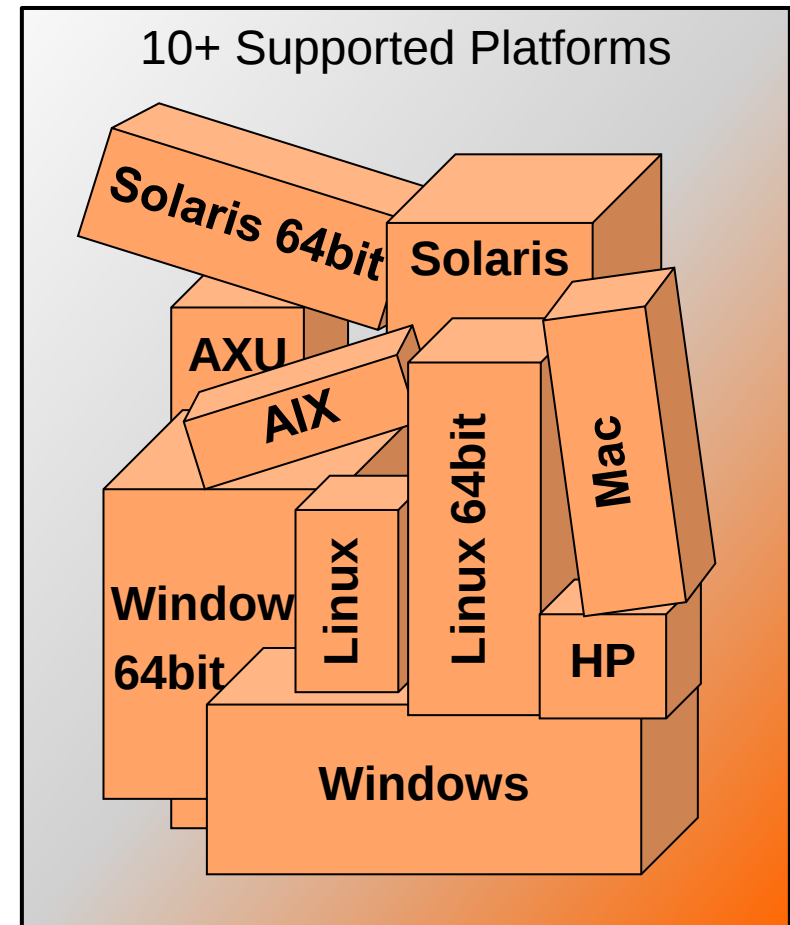
- Roots: World Bank, 1976
- Went commercial in 1987
- GAMS Development Corp.
- GAMS Software GmbH
- Broad academic & commercial user community and network





GAMS' Fundamental concepts

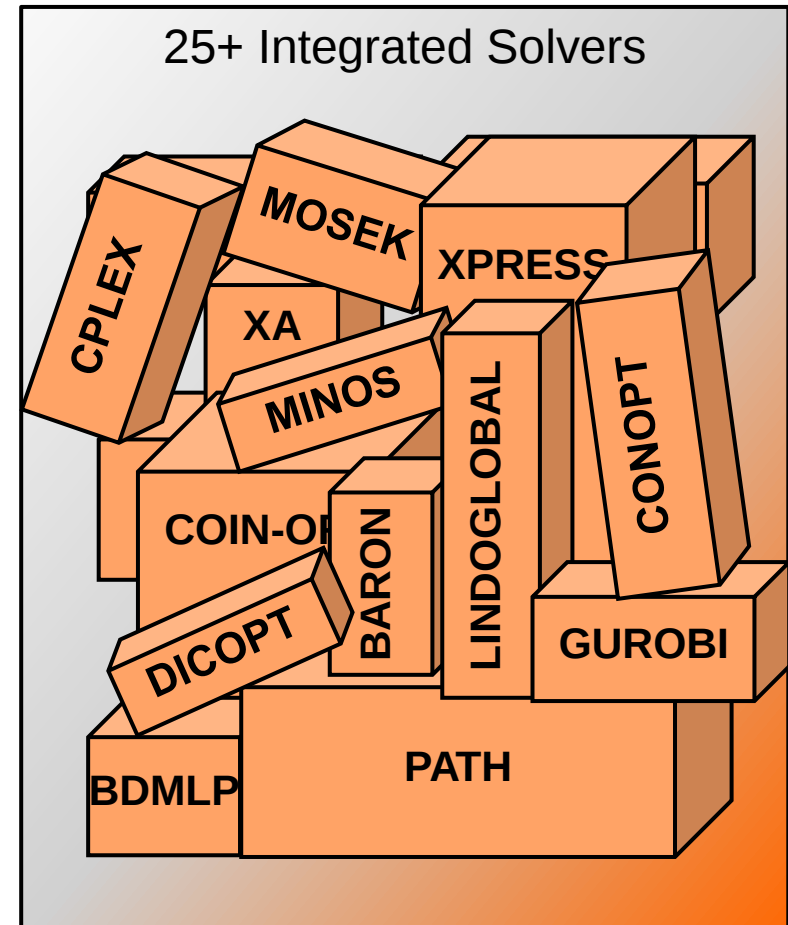
- **Platform independence**
- Hassle-free switch of solution methods & model types
- Open architecture and interfaces to other systems
- Balanced mix of declarative and procedural elements





GAMS' Fundamental concepts

- Platform independence
- **Hassle-free switch of solution methods & model types**
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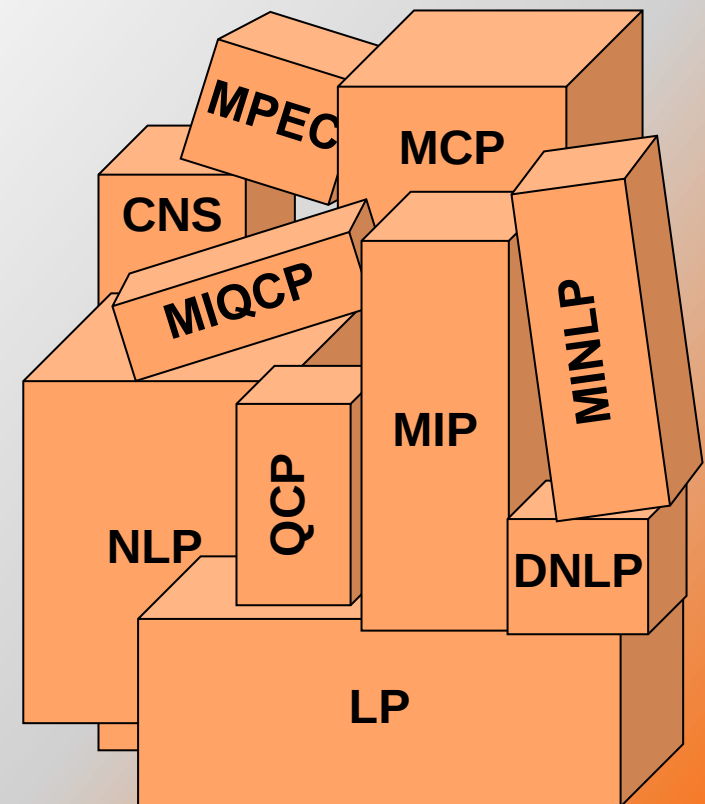




GAMS' Fundamental concepts

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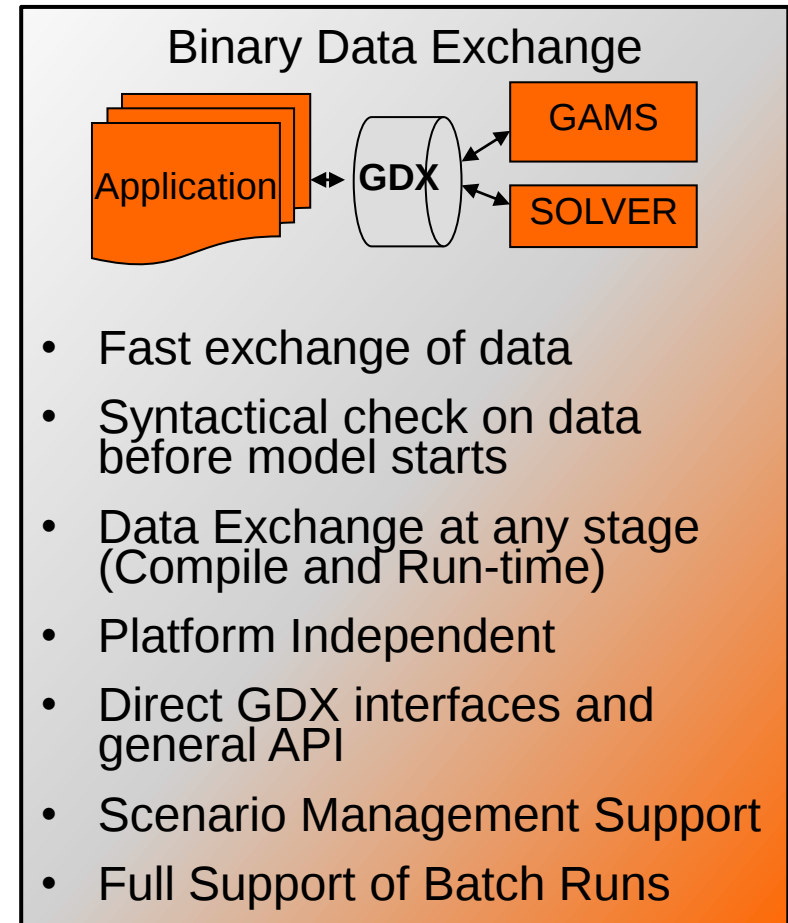
10+ Supported MP classes





GAMS' Fundamental concepts

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GAMS' Fundamental concepts

- Platform independence
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Declaration of..

- Sets
- Parameters
- Variables
- Equations
- Models
- ...

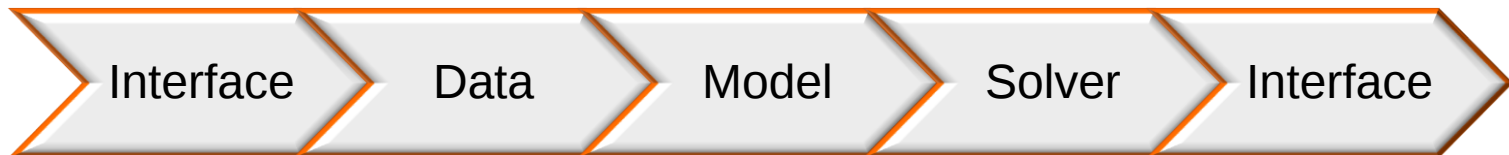
Procedural Elements like...

- loops
- if-then-else
- ...



GAMS' Fundamental concepts

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



→ **Models benefit from**

- advancing hardware
- enhanced / new solver technology
- improved / upcoming interfaces to other systems



New GAMS Distribution 23.6.0

Currently in beta

www.gams.com/beta

- Chk4Upd
- Python API
- GAMSIDE updates
- XLSDump
- New Solver Libraries (COIN-OR, CPLEX, GUROBI, KNITRO, MOSEK, SCIP, XPRESS)
- New library models (DATA LIB, EMPLIB, MODELLIB, TESTLIB)
- Internal reorganization



GAMS Talks at INFORMS 2010

Monday

Session: Python for Optimization

(MB18, 11:00-12:30)

- **Recent Enhancements in GAMS**
Michael Bussieck

Session: Modeling Languages I

(MC18, 13:30-15:00)

- **Stochastic Optimization: Recent Enhancements in Algebraic Modeling Systems**
Michael Bussieck



GAMS Talks at INFORMS 2010

Tuesday

Session: Solver Interface APIs

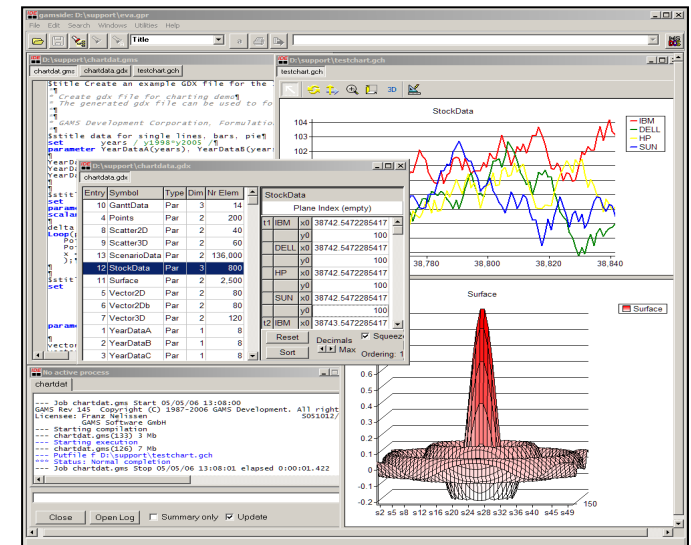
(TC40, 13:30-15:00)

- **GMO: GAMS' Next-Generation Model API**
Steve Dirkse



Integrated Development Environment

- Project management
- Editor / Syntax coloring / Spell checking
- Launching and monitoring of (multiple) GAMS processes
- Listing file / Tree view / Syntax-error navigation
- Solver selection / Option selection
- GDX viewer
 - Data cube
 - Data export (e.g. to MS Excel)
 - Charting facilities
- Model libraries
- Documentation





Benjamin Breen



GAMS and Excel, scenarios

From Benjamin Breen:

- How to export data to Excel
- Can I solve several scenarios in a loop using GAMS?



GAMS and Excel, scenarios

```
IDE gamside: C:\tmp\tmp.gpr - [C:\tmp\trnsportScen.gms]
IDE File Edit Search Windows Utilities Model Libraries Help
[Folder] [Save] [Print] [Run] [VarCov] [a] [Print] [Run]
trnsportScen.gms

set scen /s1*s3/;
parameter bscen(j,scen);
bscen(j,'s1') = 0.8*b(j);
bscen(j,'s2') = 0.9*b(j);
bscen(j,'s3') = 1.0*b(j);

parameter solscen(i,j,scen);

loop(scen,
    b(j) = bscen(j,scen);
    Solve transport using lp minimizing z ;
    solscen(i,j,scen) = x.l(i,j);
);

execute_unload 'solscen' solscen;
execute 'gdxxrw solscen.gdx o=sol.xlsx par solscen rng=sheet2!';
```



Paul Bepswa



Writing data to XLS is slow

From Paul Bepswa:

- My main problem at the moment is writing GAMS output to a spreadsheet application (Microsoft EXCEL in my case). The problem is it seems like I have to write a read/write line for each parameter that I need to process in Excel, and as a result the process is very slow.
- Is there code that I could use to select groups of parameters or the whole 'display' command to write directly to a spreadsheet?



Writing data to XLS is slow

- MS Office has significant overhead for each file opened
- Combine all writes to one .xls file into one gdxrw call
- Example: reportWriter.zip
- Example: gdx2xls, IDE's GDX browser

The screenshot shows the GAMS IDE interface. The title bar indicates the file path is C:\austin2010\workshop\prep.gpr. The menu bar includes File, Edit, Search, Windows, Utilities, Model Libraries, and Help. The toolbar contains icons for file operations and a dropdown menu set to 'wt'. Below the toolbar, a sub-window shows the file path C:\austin2010\workshop\copper.gms and tabs for bepswa.gdx, copper.gms, and copper.lst. The main text area contains the following code:

```
execute_unload 'bepswa';  
execute 'gdx2xls bepswa';  
* also right-click in the IDE's GDX browser
```



Ernest Wu



GAMS and Databases

From Ernest Wu:

- Could GAMS read data from and write data to, directly, SQL server? Or it has to do this via Excel?



GAMS and Databases

<http://interfaces.gams-software.com>

- This Wiki illustrates how GAMS can exchange data with other programs, and how GAMS can be called from familiar programming environments

<http://interfaces.gams-software.com/doku.php?id=databases:databases>

- DB2
- MS Access
- MySQL
- Oracle
- SQL Server
- Sybase



GAMS and Databases

- GAMS Data Library
 - SalesProfitDB5 (sql2gms)
 - SalesProfitDB2c (mdb2gms, multiple fields)
 - SalesProfitDB3 (mdb2gms, multiple queries)
- Windows only!
- Multiple ways to connect:
 - Directly through DB driver
 - Data Source Name DSN (ODBC)
- ASCII or GDX
- Writing to Databases
 - Gdx2access, gdxviewer



GAMS Support



Cplex Error 1001: Out of Memory

From GAMS Support:

Hi,

We are using GAMS here at our university. In the process of building a very large scale LP model, we have encountered a problem of CPLEX Error 1001: Out of memory.

Is there any advice you can give to overcome this issue?

Best regards,

...



Cplex Error 1001: Out of Memory

Potential resolutions:

- Use the GAMS option solvelink 0 (and not 1, 2, 3, 4 or 5)
- Save memory by not passing on names to the solver:
model_name.dictfile=0
- Use a Cplex option file:
 - Do not load GAMS names (names no)
 - Do not use multiple threads (threads 1)
 - Conserve memory where possible (memoryemphasis 1)
 - Use the Simplex algorithm (lpmethod 1 or 2) instead of the Barrier algorithm (lpmethod 4)
 - MIP: Let Cplex store information on disk (nodefileind 2/3)
- Add more memory (and/or upgrade to 64 Bit OS)
- Reduce the size of the model



How to stay Up To Date

<http://www.gams.com/maillist/>

[\[Home](#) | [Support](#) | [Sales](#) | [Solvers](#) | [Documentation](#) | [Model Libraries](#) | [Search](#) | [Contact Us \]](#)

The GAMS Mailing List

GAMS users worldwide use the list name GAMS-L to exchange information about GAMS. GAMS-L is open to everyone around the world and can easily be reached via the Internet.

[Subscribe \(and more information\)](#)

Bruce McCarl's GAMS Newsletter

With his newsletter Bruce McCarl wants to provide some additional information on the use and features which emerge as GAMS develops. He intends to periodically issue a very short newsletter that informs people of things that are new and or under documented as well as opportunities to learn more about GAMS features and usage.

[Archive/Subscribe/Unsubscribe](#)

The GAMS Release Mailing List

For people interested in receiving the latest information about new GAMS releases and trying out beta releases.

[Subscribe/Unsubscribe](#)

Please visit us at our booth in the exhibit area!



Ali Haji Agha Bozorgi



Integer variables have upper bound of 100

From Ali Haji Agha Bozorgi:

- I tried to use the MINLP to solve a very basic problem in dynamic pricing. Unfortunately, there is a limit for integer variables in GAMS of 100, so I couldn't develop my model.
- I seek at least a higher limit on that, or even not to limit it at all.



Integer variables have upper bound of 100

```
IDE gamside: C:\austin2010\workshop\prep.gpr
File Edit Search Windows Utilities Model Libraries Help
[Icons] wt {a} [pf4=2]

IDE C:\austin2010\workshop\intLimit.gms
bepswa.gdx copper.gms copper.lst intLimit.gms intLimit.lst

Model transport /all/ ;

$ontext
Integer variable x;
1. Run with pf4=0, 2 or 3 - look up pf4 in docs
2. Set upper bounds
3. Set fractional demands, use .slack to view slacks, then use .prior.
$offtext

x.up(I,J) = 1e4;
x.prior(I,'topeka') = INF;
Solve transport using mip minimizing z ;
parameter dslack(J);
dslack(J) = demand.slack(J);
display dslack;
parameter sInfeas(I);
sInfeas(I) = supply.infeas|I);
display sInfeas;
```



Xiongfei Zhang



Solving Bilevel Programs

From Xiongfei Zhang:

- When doing my research, I always encounter bilevel programming problems. I try to solve them using GAMS. But I haven't found any introductions to this kind of problems in the user guide.



Bilevel Model

Conejo A J, Castillo E, Minguez R, and Garcia-Bertrand R; Decomposition Techniques in Mathematical Programming, Springer, Berlin, 2006.

```
variables z,x1,x2,x3,x4,h1,h2,u1,u2,u3,u4,v1,v2,v3,v4;  
equations defobj,defh1,defh2,a1,e1,e2;
```

```
defobj.. z =e= sqr(x1+x2-2) + sqr(x3+x4-2);  
a1.. x1-x2 =e= 3;
```

Outer Problem

```
defh1.. h1 =e= sqr(u1-x1) + sqr(u2-x2) + sqr(u3-x3) + sqr(u4-x4);  
e1.. 3*u1 + u2 + 2*u3 + u4 =e= 6;
```

Inner Problem 1

```
defh2.. h2 =e= sqr(v1-x1) + sqr(v2-x2) + sqr(v3-x3) + sqr(v4-x4);  
e2.. v1 + v2 + v3 + 2*v4 =e= 7;
```

Inner Problem 2

```
model bilevel / a1 /
```



EMP Information File + EMP Summary Log

```
option nlp=emp;  
  
$onecho > %emp.info%  
bilevel x1 x2 x3 x4  
min h1 defh1 e1  
min h2 defh2 e2  
$offecho  
  
solve bilevel us nlp min z;
```

Extended Mathematical Programming (EMP)

--- EMP Summary (errors=0)

Adjusted Equations = 0

Dual Variable Maps = 0

Dual Equation Maps = 0

Bilevel Followers = 2

Disjunctions = 0

--- The model C:\home\distrib\tvis_alpha\convtest\emp\225a\emp.scr will be solved by GAMS



Solving Bilevel Programs

- Take ccmg71 from EMPLIB
- Create option file using option editor: dict, scalar files
- Run it!



GAMS user list



Java Interface to GAMS

From GAMS user list:

Hello,

is there a Java interface for GAMS?

Thanks.

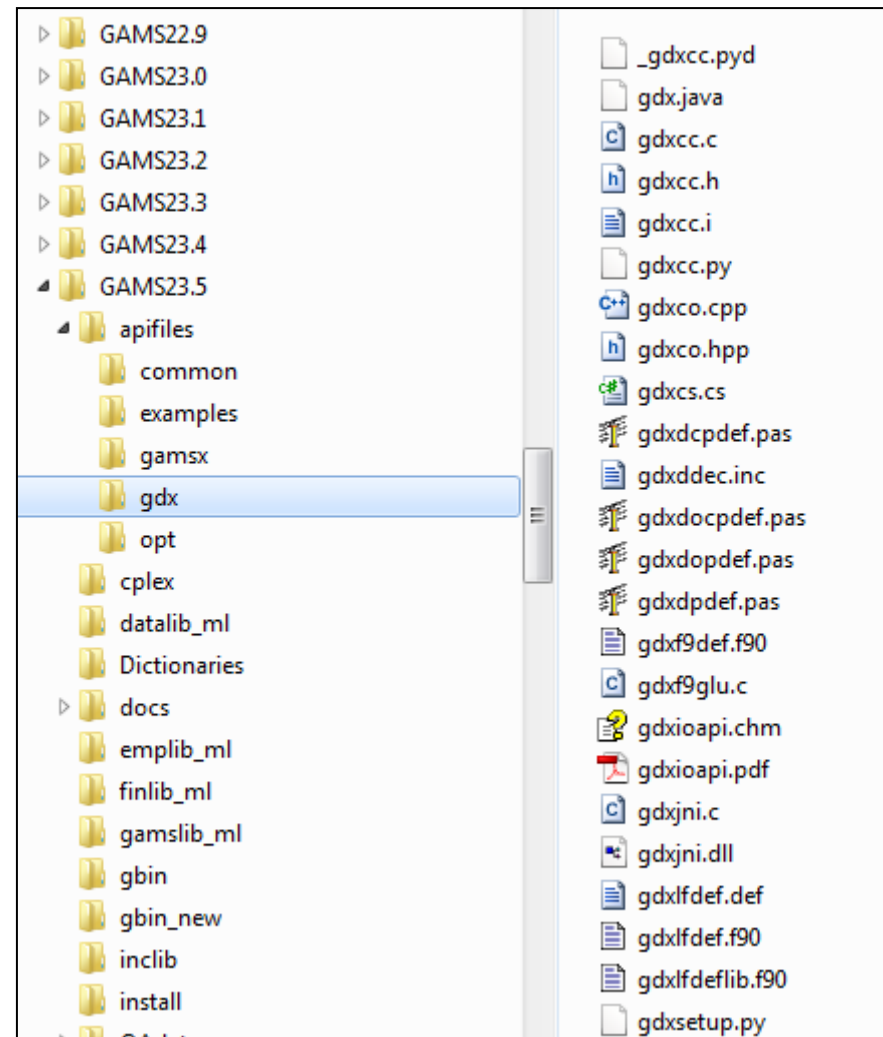
Regards,

...



Distributed GAMS APIs

- Component Libraries
 - GAMS
 - GDX
 - Option
- Supported languages
 - C, C++, C#
 - Delphi
 - Fortran
 - Java
 - VBA, VB.Net
 - Python
- Examples/Documentation





Calling GAMS from your Application

Creating Input for GAMS Model

→ Data handling using **GDX** API

Callout to GAMS

→ GAMS option settings using **Option** API

→ Starting GAMS using **GAMS** API

Reading Solution from GAMS Model

→ Data handling using **GDX** API



Calling GAMS from Java

```
if(gdx.Created(SysDir, Msg) != 1) {  
    System.out.println("Cannot create GDX object: " + Msg[0]);  
    ok = false;  
}  
  
if(ok && gamsx.Created(SysDir, Msg) != 1) {  
    System.out.println("Cannot create GAMSX object: " + Msg[0]);  
    ok = false;  
}  
  
if(ok && opt.Created(SysDir, Msg) != 1) {  
    System.out.println("Cannot create Option object: " + Msg[0]);  
    ok = false;  
}
```

```
if(ok && !WriteModelData(fngdxinp)){  
    System.out.println("Model data not written");  
    ok = false;  
}
```

Creating Input for GAMS Model

```
if(ok && !CallGams(SysDir)){  
    System.out.println("Call to GAMS failed");  
    ok = false;  
}
```

Callout to GAMS

```
if(ok && !ReadSolutionData("results.gdx")  
    System.out.println("Could not read solution back");
```

Reading Solution from GAMS Model



Calling GAMS from Java cont'd

Creating Input for GAMS Model

```
static boolean WriteModelData(String fngdxfile){
    String[] Msg = new String[1];
    int[] ErrNr = new int[1];

    gdx.OpenWrite(fngdxfile, "Example1", ErrNr);
    if(ErrNr[0] != 0){
        gdx.ErrorStr(ErrNr[0], Msg);
        if(Msg[0].compareTo("") != 0) System.out.println("*** Error gdxOpenWrite: " + Msg[0]);
        return false;
    }
    if(gdx.DataWriteStrStart("Demand", "Demand data", 1, gamsglobals.dt_par, 0) == 0){
        ReportGDLError("DataWriteStrStart");
        return false;
    }

    WriteData("New-York", 324.0);
    WriteData("Chicago", 299.0);
    WriteData("Topeka", 274.0);

    if(gdx.DataWriteDone() == 0)
        ReportGDLError("WriteData");
    ErrNr[0] = gdx.GetLastError();
    if(ErrNr[0] != 0){
        gdx.ErrorStr(ErrNr[0], Msg);
        if(Msg[0].compareTo("") != 0) System.out.println("*** Error while writing GDX File: " + Msg[0]);
        return false;
    }

    ErrNr[0] = gdx.Close();
    if(ErrNr[0] != 0){
        gdx.ErrorStr(ErrNr[0], Msg);
        if(Msg[0].compareTo("") != 0) System.out.println("*** Error gdxClose: " + Msg[0]);
        return false;
    }
    return true;
}
```



Calling GAMS from Java cont'd

Callout to GAMS

```
static boolean CallGams(String SysDir){
    String[] Msg = new String[1];
    int[] ErrNr =new int[1];
    int n;

    if(opt.ReadDefinition(SysDir + "/optgams.def") != 0){
        System.out.println("*** Error ReadDefinition, cannot read def file:" + SysDir + "/optgams.def");
        return false;
    }

    n = opt.LookUp("SysDir") + 1;
    if(n<1) {
        System.out.println("*** Error LookUp: Cannot find option SysDir");
        return false;
    }
    opt.SetStrNr(n, SysDir);

    n = opt.LookUp("Input") + 1;
    if(n<1) {
        System.out.println("*** Error LookUp: Cannot find option Input");
        return false;
    }
    opt.SetStrNr(n, "model2.gms");

    n = opt.LookUp("LogOption") + 1;
    if(n<1) {
        System.out.println("*** Error LookUp: Cannot find option LogOption");
        return false;
    }
    opt.SetIntNr(n, 2); //write .log and .lst files

    ErrNr[0] = gamsx.RunExecDLL(opt.GetoptPtr(), SysDir, 1, Msg);
    if(ErrNr[0] != 0){
        System.out.println("*** Error RunExecDLL: Error in GAMS call = " + ErrNr[0]);
        return false;
    }
    return true;
}
```



Calling GAMS from Java cont'd

Reading Solution from GAMS Model

```
static boolean ReadSolutionData(String fngdxfile){
    int[] Dim = new int[1];
    String[] Msg = new String[1];
    int[] ErrNr = new int[1];
    int[] VarNr = new int[1];
    String[] VarName = new String[1];
    int[] VarTyp = new int[1];
    int[] NrRecs = new int[1];

   .gdx.OpenRead(fngdxfile, ErrNr);
    if(ErrNr[0] != 0){
       .gdx.ErrorStr(ErrNr[0], Msg);
        if(Msg[0].compareTo("") != 0) System.out.println("*** Error OpenWrite: " + Msg[0]);
        return false;
    }

    VarName[0] = "result";
    if(!..gdx.FindSymbol(VarName[0], VarNr) == 0){
        System.out.println("*** Error FindSymbol: Could not find variable " + VarName[0]);
        return false;
    }

    ..gdx.SymbolInfo(VarNr[0], VarName, Dim, VarTyp);
    if((Dim[0] != 2) || (VarTyp[0] != gamsglobals.dt_var)){
        System.out.println("*** Error SymbolInfo: " + VarName[0] + " is not a two dimensional variable");
        return false;
    }

    if(!..gdx.DataReadStrStart(VarNr[0], NrRecs) == 0){
        ReportGDSError("DataReadStrStart");
        return false;
    }

    ReadData(Dim[0]);
    ..gdx.DataReadDone();
    ..gdx.Close();
    return true;
}
```