How can I make this work...

arrgghh?

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Introduction
GAMS at a Glance

Algebraic Modeling System

- Facilitates to formulate mathematical optimization problems similar to 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 at a Glance

25+ Integrated Solvers
GAMS at a Glance

10+ Supported MP classes
GAMS at a Glance

10+ Supported Platforms

- Solaris 64bit
- Solaris
- AXU
- AIX
- Linux 64bit
- Mac
- HP
- Windows 64bit
- Windows
- Linux
GAMS’ Fundamental concepts

- Platform independence

- Open architecture and interfaces to other systems

- Balanced mix of declarative and procedural elements
  - Declaration of Sets, Parameters, Variables, Equations, Models, …
  - Procedural Elements like loops, if-then-else, …

- Layers of separation
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 23.5

Released July, 4th!

[www.gams.com/download](http://www.gams.com/download)

## Download GAMS Distribution 23.5.1 - July 4, 2010

*Note: To deliver GAMS with the best performance we are using the Amazon CloudFront web service, a global network of edge locations for content delivery.*

Please consult the [release notes](http://www.gams.com/release2351.htm) before downloading a system. The installation notes for Windows and UNIX and the complete system documentation are included in any system.

### Windows

<table>
<thead>
<tr>
<th>Platform</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 64 bit</td>
<td>Windows 7 x64, Windows Vista x64, Windows XP x64, Windows Server 2008 x64, Windows Server 2003 x64, and compatible on AMD- or Intel-based (x64_64) architectures</td>
</tr>
</tbody>
</table>

### Unix

<table>
<thead>
<tr>
<th>Platform</th>
<th>Details</th>
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<tbody>
<tr>
<td>AIX</td>
<td>AIX 5.3 or higher, PowerPC chip, 64 bit (ppc_64)</td>
</tr>
<tr>
<td>Digital UNIX</td>
<td>Digital Unix 4 or higher on DEC Alpha (aixp_64). Please note that the current GAMS distribution for Digital Unix is 22.7</td>
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<tr>
<td>HP-UX</td>
<td>HP-UX 11 or higher on HP PA-RISC (hppx_32). Please note that the current GAMS distribution for HP-UX is 22.1</td>
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<tr>
<td>Linux 32 bit</td>
<td>AMD- or Intel-based (x86_32) Intel-based 32-bit Linux systems. Most likely these will have a 2.4 X kernel or higher. The software was built with Intel’s Linux compilers, ver 11.1 or higher.</td>
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<tr>
<td>Linux 64 bit</td>
<td>AMD- or Intel-based (x64_64) Linux systems. These were built on a 2.6 kernel with Intel’s Linux compilers, ver 11.1 or higher.</td>
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<td>Mac OS X Intel 32 bit</td>
<td>Macintosh Intel-based systems (x86_32) built on Darwin 9. Please note that this is a Mac OS X Terminal application and must be installed and executed using the command line interface.</td>
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<tr>
<td>Mac OS X Intel 64 bit</td>
<td>Macintosh Intel-based systems (x64_64) built on Darwin 9. Please note that this is a Mac OS X Terminal application and must be installed and executed using the command line interface.</td>
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<tr>
<td>Mac OS X PPC</td>
<td>Macintosh PowerPC-based systems for G4/G5 processors (ppc64) built on Darwin 8.4. Please note that the current GAMS distribution for Mac OS X PPC is 23.3 and that this is a Mac OS X Terminal application and must be installed and executed using the command line interface.</td>
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<tr>
<td>Solaris SPARC 22 bit</td>
<td>Solaris 2.8 or higher on SUN Sparc (sparc_32). Missing Font Pit Time Environment?</td>
</tr>
<tr>
<td>Solaris SPARC 64 bit</td>
<td>Solaris 2.8 or higher on SUN Sparc (sparc_64)</td>
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<tr>
<td>Solaris x64 64 bit</td>
<td>Solaris 10 or higher on AMD- or Intel-based 64-bit (x64_64)</td>
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</table>

Please also visit the information about the [distribution history, changes, and incremental updates](http://www.gams.com/distribution_history.htm). For older distributions please follow [this link](http://www.gams.com/distribution_history.htm). There are some [mailing lists](http://www.gams.com/mailing_lists.htm), which will inform you about
MONDAY

Session: Optimization Modeling I
(Room 6.2.47, 12:20-13:40)
• Stochastic Optimization: Recent Enhancements in Algebraic Modeling Systems
  *Lutz Westermann*

Session: Optimization Modeling II
(Room 6.2.47, 14:00-15:20)
• Recent Enhancements in GAMS
  *Jan-Hendrik Jagla*
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
Tânia Ramos
Sequential GAMS Runs

From Tânia Ramos:

Is it possible to schedule sequential runs in GAMS? For instance, I have 3 models to run for 8 hours each; when the first model stops, is it possible to start another model automatically? Is it possible to create a kind of queuing line for independent models?
Sequential GAMS runs

```gams
set mdl / trnsport
  blend
  prodmix /

  slv(mdl) / trnsport  cplex
  blend  gurobi
  prodmix  xpress /

file fx; put fx;

loop (mdl,
    put_utility 'shell' / 'gamslib -q' mdl.tl:0 ;
    put_utility 'shell' / 'gams' mdl.tl:0 ' lp=' slv.te(mdl) ' lo=%GAMS.lo%';
    if(errorlevel,
        put_utility 'log' / '*** Error while running Model ' mdl.tl:0
        ' with Solver ' slv.te(mdl) ;
    );
);```

file fx; put fx;
From Tânia Ramos:

When we use more than 1 thread, the results obtained are not always the same. For instance, if I run a model today with 8 threads, and tomorrow I run it again, the results obtained could not be the same; the results are always the same if I ran with just 1 thread, but with more than 1 thread I couldn´t replicate the results. It is possible to have the same results when using more than 1 thread?
Deterministic Results with multiple Threads

```plaintext
set runs /0*9/;
execute 'gamslib -q dice';
execute 'echo threads=2 > cplex.opt';

loop(runs,
    put_utility 'log' / '**** Starting dice: ' runs.tl:0;
    put_utility 'shell' / 'gams dice lp=cplex lo=2 optfile=1 gdx=diceOpp' runs.tl:0;
    if(errorlevel,
        put_utility 'log' / '**** Error while running dice: ' runs.tl:0
    );
);

execute 'gdxmerge diceOpp* id=wnx output=opportunistic';

execute 'echo parallelmode=1 >> cplex.opt';

loop(runs,
    put_utility 'log' / '**** Starting dice: ' runs.tl:0;
    put_utility 'shell' / 'gams dice lp=cplex lo=2 optfile=1 gdx=diceDet' runs.tl:0;
    if(errorlevel,
        put_utility 'log' / '**** Error while running dice: ' runs.tl:0
    );
);

execute 'gdxmerge diceDet* id=wnx output=deterministic';
```
Dra. Marian G. Marcovecchio
Dra. Marian G. Marcovecchio

I work in global optimization techniques, then I try to develop global optimization algorithms. I have implemented them in GAMS environment, using the GAMS solvers.

Specifically, I use local solvers for each iteration of my algorithms. As most of the deterministic global optimization algorithms, a convex (or linear) problem must be solved in different regions. These problems underestimate the global optimum of the original non-convex problem.

.....
Dra. Marian G. Marcovecchio

... However, I have experimented troubles with problems having lots of variables and constraints. Specifically, I solve a convex or linear problem and sometimes the state is 'unfeasible' when actually the problem is feasible. As I implement loops (while, for), I need guaranties that the feasibility or unfeasibility of the problem is well determined in any region, since I can't provide a good initial point valid for any general region, beforehand.

...
Furthermore, I solve a linear problem with CPLEX and the result is: 'Optimal solution found, but with infeasibilities after unscaling', the Model Status is 1 but the Solver Status is 4. I would like to have some guaranties when a convex or linear problem is solved. That means: the feasibility or unfeasibility is well determined and it is not dependent of the initial point. Otherwise, I would like to know the Solver limitations in these cases.
Dra. Marian G. Marcovecchio

- Algorithm implemented in GAMS to solve non-convex models to global optimality

- A sequence of convex/linear models that underestimate the global optimum

- Submodel have a lot of variables/equations

- GAMS Solver (CPLEX) declares submodel ‘Infeasible’ or 'Optimal solution found, but with infeasibilities after unscaling'
Dra. Marian G. Marcovecchio

- Why does the solver report infeasibilities although I know the model is feasible?

→ Solvers have a hard time if model is scaled badly due to tolerances

→ Keep coefficients in a reasonable range, best $[1e^{-3}, 1e3]$

→ You can use ‘modelname.scaleopt’ and ‘var.scale’
Scaling

How do I find out?

1. Capture an instance with dumpopt=11
   - gams mymodel dumpopt=11
   \[\rightarrow\] mymodel.dmp with all source and data

2. Capture an instance with Convert
   - gams mymodel modeltype=convert
   or
   - option nlp=convert;
     solve m4 using nlp minimizing z;
   - various options:
     gams (scalar), dict, jacobian, hessian
Scaling

How do I find out?

3. Check the equation listing:
   ---- E1 =E=
   E1. - (2.581140E+7)*X - Y =E= 0 ;
   (LHS = 4.1541556E+9, INFES = 4.1541556E+9 ***)

4. Let CPLEX write some statistics about the quality of the solution
   ‘quality 1’

<table>
<thead>
<tr>
<th></th>
<th>unscaled</th>
<th>sum</th>
<th>max</th>
<th>scaled</th>
<th>sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>primal infeasibility</td>
<td>1.066e-014</td>
<td>1.599e-014</td>
<td>1.066e-014</td>
<td>1.599e-014</td>
<td></td>
</tr>
<tr>
<td>dual infeasibility</td>
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<td>2.443e-013</td>
<td>1.137e-013</td>
<td>2.443e-013</td>
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<tr>
<td>primal residual</td>
<td>6.366e-012</td>
<td>5.885e-011</td>
<td>2.387e-012</td>
<td>5.885e-011</td>
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<tr>
<td>dual residual</td>
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<td>1.314e-011</td>
<td>1.979e-012</td>
<td>1.314e-011</td>
<td></td>
</tr>
<tr>
<td>primal solution vector</td>
<td>2.253e+004</td>
<td>5.598e+005</td>
<td>4.621e+003</td>
<td>3.815e+005</td>
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<tr>
<td>dual solution vector</td>
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<td>2.902e+005</td>
<td>2.916e+004</td>
<td>4.591e+005</td>
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<tr>
<td>slacks</td>
<td>2.170e+004</td>
<td>6.722e+005</td>
<td>3.800e+003</td>
<td>6.101e+004</td>
<td></td>
</tr>
<tr>
<td>reduced costs</td>
<td>1.000e+006</td>
<td>6.252e+008</td>
<td>6.553e+007</td>
<td>1.078e+009</td>
<td></td>
</tr>
</tbody>
</table>

Condition number of the scaled basis matrix = 2.754e+006
Are there any guarantees when a convex or linear problem is solved?

→ No, there are no general guarantees since each solver has its tolerances

→ Solver status will be accurate if model is scaled reasonably
GAMS Support
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
GAMS user list
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

```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;
}

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

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

Creating Input for GAMS Model

Callout to GAMS

Reading Solution from GAMS Model
Calling GAMS from Java cont’d

```java
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) {
        ReportGDXError("DataWriteStrStart");
        return false;
    }

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

    if (gdx.DataWriteDone() == 0)
        ReportGDXError("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;
}
```

Creating Input for GAMS Model
Calling GAMS from Java cont’d

```java
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

```java
static boolean ReadSolutionData(String fNameGdxfile){
    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(fNameGdxfile, 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) {
        ReportGDXError("DataReadStrStart");
        return false;
    }

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

I’m a beginner with GAMS and I’m trying to build a dynamic CGE model in MPSGE. My problem is with the calibration process of the model. The model does not calibrate as can be seen in the following solution:

```plaintext
**** SOLVER STATUS        2 Iteration Interrupt
**** MODEL STATUS          6 Intermediate Infeasible

---- 1823 The precision of the benchmark dataset is:
      MODEL MPS_DYN.ObjVal      = 2.07061E+13

---- 1824 MPSGE model does not calibrate
**** Exec Error at line 1824: Execution halted: abort$1 'MPSGE model does not calibrate'
```
How to keep Up To Date

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

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.

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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.

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