

Course Materials from Basic GAMS Class
Obtaining Graphical Output from GAMS

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Obtaining Graphical Output from GAMS

Statements may be entered into a GAMS program which permit graphical displays of data computed during a GAMS run directly in a window on a PC.

The capability to obtain such displays is developed using the publicly available version of GNUPLOT that may be downloaded from the web.

Tom Rutherford at the University of Colorado originally developed such a capability and distributes it freely on his web site

<http://debreu.colorado.edu/inclib/tools.htm>

Uwe Schneider and I developed a modified version of Rutherford's package trying to achieve a simpler syntax (containing more default values than in Rutherford's work) and a simpler path to construction of the so called (in spreadsheets) XY graph where the X and Y data are not common across series. That package is freely distributed through

<http://ageco.tamu.edu/faculty/mccarl/gnuplot/gnuplot.html>.

These are a set of notes illustrating the capability, detailed user guides and software are on the above web pages.

The upstart of this is that by inserting a couple of commands in a GAMS program on a windows machine you can get a graph developed and displayed during any PC GAMS run. It will also work on XWINDOWS under LINUX with a little modification.

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Suppose we wish to draw a graph of a set of data in a GAMS program to do so we need to do three basic things to use GNUPLTTY.

First we need to download the software from <http://ageco.tamu.edu/faculty/mccarl/gnuplot/gnuplot.html> getting both the gms and windows gnuplot executable.

Second we fill a three dimensional array with a name of our choice with data. In this example ([Simplegr.gms](#) in the associated files <http://www.gams.com/mccarl/gamsgrph.zip>) lets fill a table called graphdata with data describing two lines where the first dimension is the name of the line, the second the number of the point on the line, and the third the x and y data. Such statements appear below.

```
LINES          Lines in graph /A,B/
POINTS         Points on line /1*10/
ORDINATES     ORDINATES          /X-AXIS,Y-AXIS/ ;
TABLE GRAPHDATA(LINES,POINTS,ORDINATES)
              X-AXIS    Y-AXIS
A.1           1         1
A.2           2         4
A.3           3         9
A.4           5        25
A.5          10       100
B.1           1         2
B.2           3         6
B.3           7        15
B.4          12       36;
```

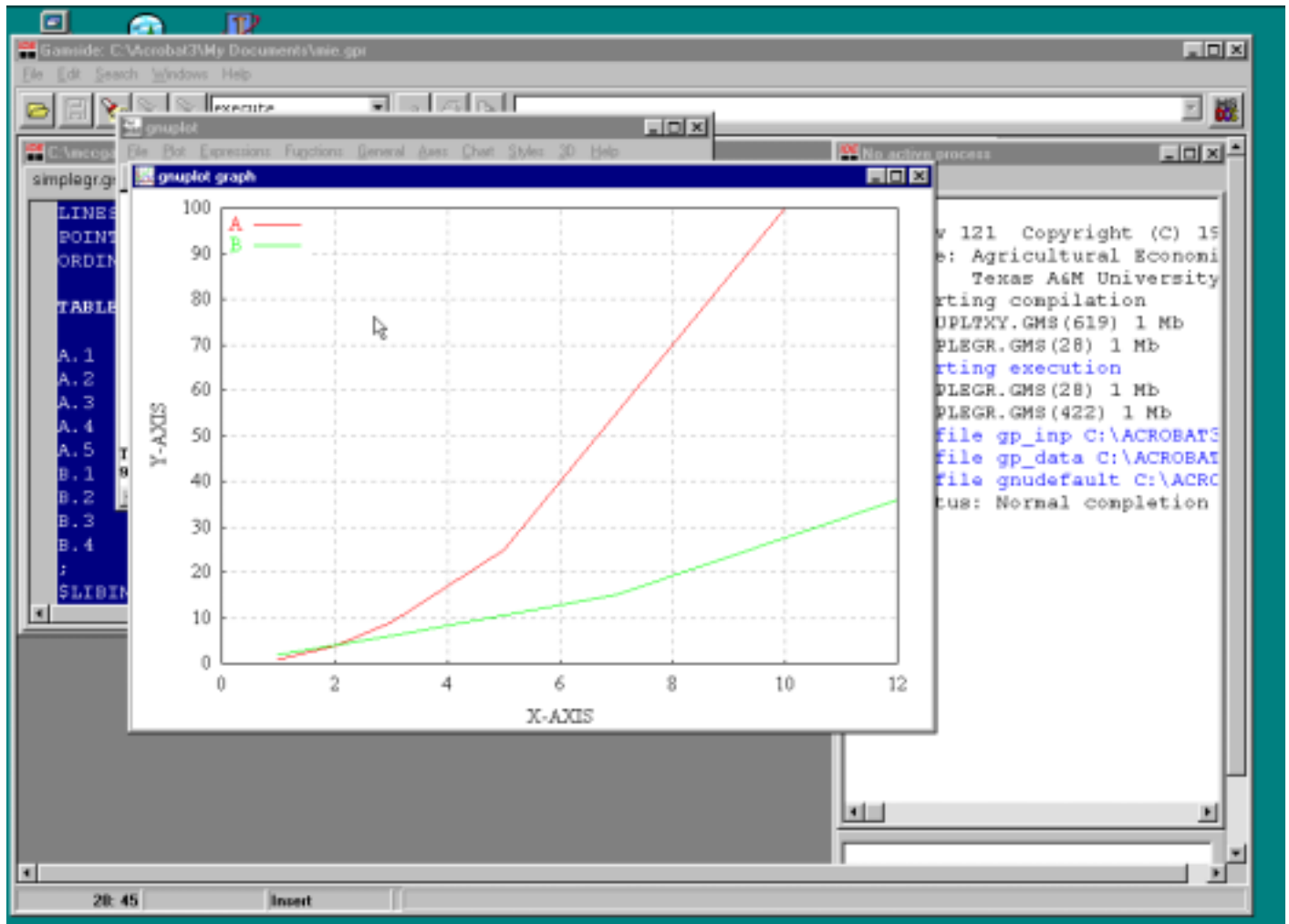
Then given the data we need to call gnupltxy which we achieve through the GAMS statement

```
$LIBINCLUDE GNUPLTTY GRAPHDATA Y-AXIS X-AXIS
```

where the first argument after the name of gnupltxy gives the array name, the second the data to put on the y axis and the third the x axis.

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In turn when we run we get two new windows that automatically open in front of the IDE



The window labeled **gnuplot graph** is the graph of our data and the window labeled **gnuplot** is the execution of the source gnuplot program..

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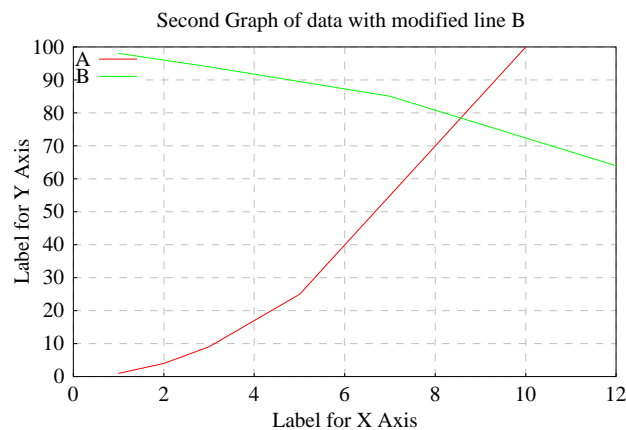
We can plot more than one line and include labels. In particular let us enter some additional commands for axis labeling and manipulation as follows ([simplegr2.gms](http://www.gams.com/mccarl/gamsgrph.zip) in <http://www.gams.com/mccarl/gamsgrph.zip>)

```
$setglobal gp_title "First Graph of data "  
$setglobal gp_xlabel "Label for X Axis"  
$setglobal gp_ylabel "Label for Y Axis"  
$LIBINCLUDE GNUPLTTY GRAPHDATA Y-AXIS X-AXIS  
GRAPHDATA("B",POINTS,"Y-axis")  
  $GRAPHDATA("B",POINTS,"Y-axis")=  
  100-GRAPHDATA("B",POINTS,"Y-axis");  
$setglobal gp_title "Second Graph of data with modified line B "  
$LIBINCLUDE GNUPLTTY GRAPHDATA Y-AXIS X-AXIS
```

The set global commands put in the labels for the axes and graph title

This yields both the first graph as above the two graphs on the next page generated in 2 windows with 4 total windows generated.

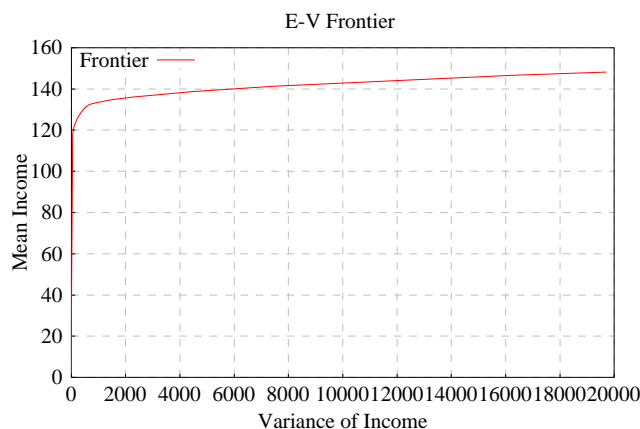
Many more options are possible as listed in the documentation. Many are embedded in the file [plotopts.gms](http://www.gams.com/mccarl/gamsgrph.zip) in <http://www.gams.com/mccarl/gamsgrph.zip>



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Calculated data from a model solution can also be included as illustrated by the code segment from the portfolio example.([evportfo.gms](http://www.gams.com/mccarl/gamsgrph.zip) in <http://www.gams.com/mccarl/gamsgrph.zip>)

```
LOOP (RAPS,RAP=RISKAVER(RAPS);
      SOLVE EVPORTFOL USING NLP MAXIMIZING OBJ ;
      VAR = SUM(STOCK, SUM(STOCKS,
        INVEST.L(STOCK)*COVAR(STOCK,STOCKS)*INVEST.L(STOCKS))) ;
      OUTPUT("RAP",RAPS)=RAP;
      OUTPUT(STOCKS,RAPS)=INVEST.L(STOCKS);
      OUTPUT("OBJ",RAPS)=OBJ.L;
      OUTPUT("MEAN",RAPS)=SUM(STOCKS, MEAN(STOCKS) * INVEST.L(STOCKS));
      OUTPUT("VAR",RAPS) = VAR;
      OUTPUT("STD",RAPS)=SQRT(VAR);
      OUTPUT("SHADPRICE",RAPS)=INVESTAV.M;
      OUTPUT("IDLE",RAPS)=FUNDS-INVESTAV.L );
parameter graphit (*,raps,*);
graphit("Frontier",raps,"Mean")=OUTPUT("MEAN",RAPS);
graphit("frontier",raps,"Var")=OUTPUT("std",RAPS)**2;
*$include gnu_opt.gms
* titles
$setglobal gp_title "E-V Frontier "
$setglobal gp_xlabel "Variance of Income"
$setglobal gp_ylabel "Mean Income"
$libinclude gnupltxy graphit mean var
```



This segment saves solution dependent mean and variance data into the array output then that data is copied into a parameter called graphit which is in turn sent to gnupltxy

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When using gnuplotxy several things need to be present

1. The gnuplot executable needs to be in the gams system directory (nominally `c:\program files\gams20.0\`) It is downloadable through my website and is called `wgnuplot.exe`
2. the `gnuplotxy.gms` file must be in the `inclib` directory under the GAMS system directory (nominally `c:\program files\gams20.0\inclib\`).

Similar procedures are employed for using Rutherford's package.

Once a graph is in the window a right click on it makes it available for cut and paste.