Symbolic Tools / Symbolic Tools GE

By Econotron Software, Inc.

GAUSS™

Now Available!

Key Features:

- **Automatic Differentiation for GAUSS and the GAUSS Engine is now available with Econotron's Symbolic Tools!**
- **Symbolic Arithmetic**
- **Exact Linear Algebra**
- **Language Extension.**
- **User Defined Precision**

Econotron Software

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Symbolic Tools augments the numeric and graphical capabilities of GAUSS and the GAUSS Engine with additional mathematical functionality based on symbolic computations, including automatic differentiation, symbolic algebra, exact linear algebra, language extension and user defined precision. The computational work of Symbolic Tools is carried out by the Maple kernel.

Product Details:

- **Automatic Differentiation.** Symbolic Tools enables GAUSS to undertake automatic differentiation, by creating procs that return analytical gradients and Hessians, which can then be used by Aptech's GAUSS Applications such as MAXLIK, Optimization, NLP or CML.
- **Symbolic Arithmetic.** This includes analytic differentiation and integration, automatic differentiation, as well as simplification.
- **Exact Linear Algebra.** This permits access to the full functionality of Maple, including all the mathematical functions and matrix forms, from within GAUSS, thus effectively extending the GAUSS language.
- **Language Extension.** This permits access to the full functionality of Maple, including all the mathematical functions and matrix forms, from within GAUSS, thus effectively extending the GAUSS language.
- **User Defined Precision.** Numerical evaluation of functions can occur at any specified level of accuracy.
- **Examples:** Over 180 GAUSS examples are included, as well as 10 AD examples, including ARCH and GARCH.

Free Trial Download: **http://www.econotron.com/symbolic/download/symbolic_eval.zip**

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- **Maple Kernal**. The computational work in Symbolic Tools is carried out by the Maple kernel using the Open Maple API. Maple is a symbolic mathematics package developed at the University of Waterloo. Symbolic Tools provides for an interface between GAUSS and the Maple Kernel. This interface permits code to be evaluated symbolically in Maple, and the results returned to GAUSS, or to create a GAUSS proc based on Maple's symbolic results.
- **Automatic Differentiation.** One of the main uses of Symbolic Tools is to enable GAUSS to undertake Automatic Differentiation. Optimization packages, such as Aptech System's GAUSS Application MAXLIK, Optimization, CML or NLP can use procedures that return the gradient and/or Hessian, instead of doing forward differencing. Thus, as a trivial example, if the function being optimized were Ln(b), then the analytic gradient would be 1/b, and the analytic Hessian -1/b^2. Symbolic Tools can create compiled procs for the analytic gradient or Hessian of a likelihood, on the fly. The time savings are impressive. Using Monte Carlo simulation of a Tobit model with 2000 observations and 11 parameters, the AD gradient took 10% of the time required for forward differences using gradp - ie. approximately a 10 fold speed improvement. Similar results were also obtained for the Hessian, with the additional advantage that the AD methodology generated much more precise estimates of the gradients and Hessian. The process of creating a proc based on symbolic code is a one line operation using the "symproc" command. Symproc takes four arguments - the proc name, the input argument(s), the output argument, and the code. The code is simply GAUSS code, such as a likelihood, put in a string. The call to symproc translates the code to Maple, executes the code in the Maple kernel, creates the equivalent GAUSS proc, and compiles the proc, so that it can be called immediately.
- **Language Extension.** Symbolic Tools extends the GAUSS language by returning symbolic values to GAUSS as strings. Symbolic values are evaluated in the Maple kernel at some value and returned to GAUSS where they are evaluated numerically. The Symbolic Tools "symmaple" command allows GAUSS to access any Maple function, and returns the numeric result to GAUSS.
- **Exact Linear Algebra.** Using symbolic arithmetic, exact solutions to matrix forms can be evaluated. Thus the determinant of a 2x2 matrix with elements {a b c d} is returned as ad-bc (as a string). With numeric elements, all matrix forms are evaluated symbolically - inverse, eigen values, jacobians, Hessians, etc. The resulting increase in numerical precision can be quite impressive.
- **Analytical Calculus**. Analytical differentiation and integration are easily carried out by Symbolic Tools. For example, if we wish to integrae the function 1/(1+x^2), we can use the GAUSS command intquad to do the integration, send the code to Maple using the "symrun" command, and return the result (arctan) as a string. The integral can be evaluated at a point by specifying a numeric value for x (using "symput"), and returning the result using "symget".

Platforms: Symbolic Tools requires the GAUSS Mathematical & Statistical System for Windows or the GAUSS Engine for Windows v 4.0 or higher, and Maple 9 or higher.

If You Already Own Maple 9

Contact Aptech or your local dealer for pricing & information:

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See our Website for the Dealer near you:
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If You Do NOT Already Own Maple 9:

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