GAUSSX 9.0 Update

By Econotron Software, Inc.

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GAUSSX™

Now Available!

New Routines:

- PANEL—cross-section time series analysis
- SURVIVAL—nonparametric survival estimation

New Tests:

- Normality tests—AD, SW, SF, PPC
- Distribution test—PIT

New Processes:

- Additional survival processes
- Cox proportional hazards model

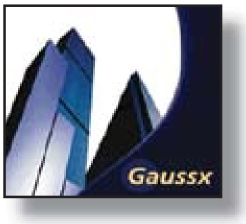
New Functions:

- Utility functions—PERMS, COMBS, INTERP2
- Inverse hyperbolic functions
- Transforms vector to a normal variate—NORMAL
- Invert a function—INVERT
- Random number generation for any distribution—RNDGEN
- Statistical function library

Enhancements

- 64-bit support
- Cox Snell and martingale residuals
- Enhanced print option
- Krinsky-Robb standard errors

This upgrade ensures compatibility with GAUSS 9.0, as well as augmenting the econometric capabilities of Gaussx. A summary of the new routines are described below. A more detailed description of these routines is available at



http://www.econotron.com/gaussx/readme2.htm

A full description of Gaussx is available at

http://www.econotron.com/gaussx

Product Details

- **PANEL—cross-section time series analysis**

PANEL estimates the coefficients of a linear regression model for panel data—data in which there are several observations or time periods for each individual. Both fixed effects and random effects (error components model) for balanced and unbalanced models are supported. The Hausman test for testing the orthogonality of the random effects and the regressors, and the Bresuch Pagan test for random effects are implemented.

Example

```
PANEL (p,d) y c x1 x2 x3;
   IDENT = cusip;
PANEL (p,d) y c x1 x2 x3;
   IDENT = cusip;
   MODE = random;
```

The first estimation is for a fixed effects model (default), with the panel identifier specified in the cusip variable. The second estimation is for the effects model.

- **SURVIVAL—nonparametric survival estimation**

The SURVIVAL command computes non parametric estimates of survival measures using either the Kaplan-Meier or Nelson-Aalan algorithms. The survival measures are:

The survival rate.
The cumulative failure rate.
The hazard rate.
The cumulative hazard rate.

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For each measure, the rate, the standard error, and the lower and upper confidence band are reported for each observation. Censoring and grouping are supported.

Example:

```
SURVIVAL (p,d) cf cferr;
    MODE = cumfail;
    VLIST = y ;
        CENSOR = cen;
```

This provides the Kaplan-Meier measures for the cumulative failure rate of y, using the censoring information in cen; the failure rate and its standard error are stored in cf and cferr respectively.

♦ Normality tests—AD, SW, SF, PPC

The following normality tests have been added:

AD	Anderson Darling
SW	Shapiro Wilks
SF	Shapiro Francia
PPC	Probability plot correlation

In each case, both uncensored and Type I right censored samples are supported, and p-values are reported.

Example:

```
test (p) vseries;
    method = ad;
test (p) vseries;
    method = sw;
    censor = cen;
```

The probability plot correlation test can provide correlation estimates and p-values for 14 distributions, as well as Q-Q plots.

♦ Tests of Distributions—PIT (Probability Integral Transformation)

Typically, survival analysis requires the specification of the underlying survival distribution, such as Weibull, lognormal, etc. The PIT test evaluates the CDF (or equivalently the survival rate) using the estimated coefficients. Under the null ofthe specified distribution, the CDF will be distributed uniform. The PIT test evaluates the probability plot correlation (PPC) in this context, as well as the associated p-value.

An adjustment is required to the probability integral transformation to take into account that the distributional parameters are estimated. Thus the upper and lower bounds of the PPC coefficient are derived, along with their associated p-values.

The test is available for all duration models, and for censored or uncensored data.

Example:

```
FRML eq0 indx = b0 +b1*arrtemp + b2*plant;
FRML eq1 llfn = lognorm(failuret,indx,
   scale);
ML (p,i) eq0 eq1;
TEST (p) failuret;
    METHOD = PIT;
```

This test will determine if the assumption of log normality can be rejected.

♦ Additional survival models

Survival analysis uses models that predict failure time. Data can be full or censored. The following additional survival models have been added:

Beta	Pareto
Cox (see below)	Pearson
Gompertz	

♦ Cox proportional hazards model

The Cox proportional hazards model is used extensively in biomedical research. It is implemented using the same format as other parametric survival models. Right censoring is supported, and ties are treated using the Breslow, Efron, Exact or Discrete methodologies.

Baseline survivor, hazard and cumulative hazard are supported, as well as the ordinary survivor measures. Residuals include Cox-Snell, martingale, deviance, Schoenfeld, scaled Schoenfeld and score.

Example:

```
FRML cq0 indx =  b1*arrtemp + b2*plant;
FRML cq1 llfn = cox(failuret,indx,2);
ML (p,i) cq0 cq1;
DURATION res reserr;
    MODE = mgale;
DURATION sv sverr svlb svub;
    MODE = survival
```

The example shows an ML estimation of a Cox proportional hazards model with two covariates (arrtemp, plant), using the Efron method for ties. The first duration command estimates the martingale residuals and their standard error; the second estimates the survival function, its standard error and the 95% lower and upper bounds.

♦ Utility functions—PERMS, COMBS, INTERP2

PERMS computes the n! permutations of a vector of length n.
COMBS computes all the k combinations of a vector of length n.
INTERP2 does a two dimensional data interpolation (table lookup)

♦ Inverse hyperbolic functions

ARCCOSH—Inverse cosh function
ARCSINH—Inverse sinh function
ARCTANH—Inverse tanh function

♦ Transforms vector to a normal variate—NORMAL

NORMAL transforms a vector such that the transformed vector is distributed standard normal, using either the BoxCox or the Johnson transformation.

Example:

```
NORMAL (p) ndta;
    METHOD = johnson;
    VLIST = dta;
```

This example transforms the vector DTA using the Johnson transformation to a new vector NDTA which follows a standard normal distribution.

♦ **Invert a function—INVERT**

INVERT computes the inverse of a function. Given a function f(x,z), INVERT returns the value of x such that f(x,z) = K.

Example:

```
proc sincos(x,z);
   retp(sin(x).*cos(x));
endp;
kvec = { .3, .4, .5 };
x0 = .2;
ix = invert(&sincos,x0,0,kvec);
```

This example inverts the sincos function for the values shown in kvec.

♦ **Random number generation for any distribution—RNDGEN**

RNDGEN creates (pseudo) random numbers from any distribution, given the CDF for that distribution. Argument constraints are permitted.

Example:

```
proc beta_cdf(x,dta,pvec);
   local v1, v2, cdf;
   v1=pvec[1];
   v2=pvec[2];
   cdf = cdfbeta(x,v1,v2);
   retp(cdf);
endp;
   pvec = { .3, .5 };
   cns = 3;
   dta = 0;
   y = RNDGEN(&beta_cdf,100,1,dta,pvec,cns);
```

This generates a random sample of 100 observations from a beta distribution with shape parameters .3 and .5. Since the argument for a beta variate lies in the range {0:1}, cns is specified as 3.

♦ **Statistical Function Library**

For each of the distributions given below, the following functionality is provided:

fn_llf	likelihood function
fn_pdf	probability density function
fn_cdf	cumulative density function
fn_cdfi	inverse cumulative density function
fn_rnd	random number generator

Continuous functions:

Beta	Log Logistic
Cauchy	Log Normal
Chisquared	Normal
Exponential	Pareto
F	Pearson
Gamma	Smallest Extreme Value
Half Normal	Students t
Inverse Gaussian	Triangular
Laplace	Uniform
Largest Extreme Value	Von Mises
Levy	Weibull
Logistic	

Discrete functions:

Bernoulli	Negative Binomial
Binomial	Poisson
Geometric	Uniform
Hypergeometric	

♦ **64 bit support**

Windows installation and menu programming modules have been updated to support 64bit chip sets.

♦ **Survival model residuals**

The following residuals for survival models are supported using the Duration command:

The Cox-Snell residual.
The deviance residual.
The martingale residual.
The estimation residual.
The standardized residual.
The Schoenfeld residuals.
The scaled Schoenfeld residuals.
The efficient score residuals.

For each residual, the residual, the standard error, and the lower and upper confidence band are reported

♦ **Enhanced print option**

The number of lines printed per page using the PRINT command can be controlled using MAXLINES under the Gaussx OPTION command.

♦ **Krinsky-Robb standard errors in ANALYZ**

ANALYZ estimates the value and standard errors for a non-linear function of estimated parameters. The standard method for calculating the standard error is the 'delta' method. As an alternative, the Krinsky-Robb simulation can be specified—it is often used in WTP (willingness to pay) models.

```
FRML eq1 y = b1 + b2*x1 + b3*x2;
NLS eq1;
FRML ea1 c1 = (b2+b3)/b1;
ANALYZ ea1;
   METHOD = KR;
   REPLIC = 10000;
```

This creates the parameter c1, and estimates its standard error using 10000 simulations of the original parameters, drawn from a multivariate normal distribution with the estimated covariance matrix.

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