BVNCDF

PURPOSE

Compute the bivariate normal cumulative distribution function with zero means, standard deviations of one, and a correlation of p.

DESCRIPTION

The cumulative distribution function for the standard bivariate normal distribution has the formula:

$$F(x1, x2, p) = \left(\frac{1}{2\pi\sqrt{1-\rho^2}}\right)\int_{-\infty}^{x1}\int_{-\infty}^{x2} \exp\left(-\frac{u^2 - 2\rho uv + v^2}{2(1-\rho^2)}\right)dudv \qquad \textbf{(EQ 8-122)}$$

The first two input values can be any real number. The third input argument should be in the interval (-1,1). A correlation of +/-1 is treated as a special case. In this case, the univariate normal cdf function is used with the minimum of x1 and x2 as the argument.

SYNTAX

LET <y> = BVNCDF(<x1>,<x2>,<p>) <SUBSET/EXCEPT/FOR qualification>

where <x1> is a number, parameter, or variable;

<x2> is a number, parameter, or variable;

<p> is a number, parameter, or variable in the interval (-1,1);

<y> is a variable or a parameter (depending on what <x1>, <x2>, and <p> are) where the computed cdf values are stored;

and where the <SUBSET/EXCEPT/FOR qualification> is optional.

EXAMPLES

```
LET A = BVNCDF(-2,-2,0)
LET A = BVNCDF(-2,-2,.8)
LET Y = BVNCDF(H,K,CORR)
```

NOTE 1

For a non-standard bivariate normal distribution with means XBAR1 and XBAR2 and standard deviations SD1 and SD2, calculate the cdf by doing something like the following:

```
LET H = -2
LET K = -1
LET P = 0
LET X1 = (H-XBAR1)/SD1
LET X2 = (K-XBAR2)/SD2
LET CDF = BVNCDF(X1,X2,P)
PRINT "CDF VALUE FOR ^H, ^K, AND ^P = ^H, ^K, ^CDF"
```

NOTE 2

DATAPLOT uses the algorithm of Owen (see REFERENCE section below) to compute the bivariate cdf value. It uses algorithm AS R80 from the Applied Statistics journal to compute an integral used by this method. The AS R80 algorithm was obtained from the statlib archive.

DEFAULT

None

SYNONYMS

None

RELATED COMMANDS

NORCDF	=	Compute the normal cumulative distribution function.
NORPDF	=	Compute the normal probability density function.
NORPPF	=	Compute the normal percent point function.
CHSCDF	=	Compute the chi-square cumulative distribution function.
CHSPDF	=	Compute the chi-square probability density function.
CHSPPF	=	Compute the chi-square percent point function.
FCDF	=	Compute the F cumulative distribution function.

FPDF	=	Compute the F probability density function.
FPPF	=	Compute the F percent point function.
TCDF	=	Compute the T cumulative distribution function.
TPDF	=	Compute the T probability density function.
TPPF	=	Compute the T percent point function.

REFERENCE

"Tables for Computing Bivariate Normal Probabilities," Owen, Annals of Mathematical Statistics, Volume 27, 1956 (pp. 1075-1090).

"Algorithm AS R80, A Remark on Algorithm AS 76: An Integral Useful in Calculating Noncentral t and Bivariate Normal Probabilities,", Boys, Applied Statistics, Volume 38, No. 3, 1989.

"Continuous Univariate Distributions," Houghton and Mifflin, Johnson and Kotz, 1970.

APPLICATIONS

Data Analysis

IMPLEMENTATION DATE

94/10

PROGRAM

```
TITLE AUTOMATIC; Y1LABEL PROBABILITY; X1LABEL X1
MULTIPLOT 2 2; MULTIPLOT CORNER COORDINATES 0 0 100 100
LET X2 = -1
PLOT BVNCDF(X1,X2,0) FOR X1 = -3. 0.1 3
LET X2 = 2
PLOT BVNCDF(X1,X2,0) FOR X1 = -3. 0.1 3
LET P = 0.3
PLOT BVNCDF(X1,X2,P) FOR X1 = -3. 0.1 3
X1LABEL; Y1LABEL; TITLE P=0.5
3D-PLOT BVNCDF(X1,X2,0.5) FOR X1 = -2. 0.2 2 FOR X2 = -2 0.2 2
END OF MULTIPLOT
```