

NCTCDF**PURPOSE**

Compute the non-central t cumulative distribution function with degrees of freedom parameters ν and with non-centrality parameter δ .

DESCRIPTION

Given the random variable $Y = Z/\text{SQRT}(X/\nu)$ where Z is a normal distribution with mean δ and a standard deviation of 1 and X is a central chi-square distribution with ν degrees of freedom, then Y has a non-central t distribution. A formula for the probability density function is given in the Evans, Hastings, and Peacock book (see the REFERENCE section below). One formula for the cumulative distribution function is:

$$F(t) = \Phi(-\delta) + \sum_{j=0}^{\infty} \left(p_j I_x \left(j + \frac{1}{2}, \frac{\nu}{2} \right) + q_j I_x \left(j + 1, \frac{\nu}{2} \right) \right) \quad (\text{EQ 8-280})$$

where

$$x = \frac{t^2}{t + \nu} \quad (\text{EQ 8-281})$$

$$p_j = \frac{e^{-\frac{\delta^2}{2}} \left(\frac{\delta^2}{2} \right)^j}{2j!} \quad (\text{EQ 8-282})$$

$$q_j = \frac{\delta e^{-\frac{\delta^2}{2}} \left(\frac{\delta^2}{2} \right)^j}{2 \left(\sqrt{2} \Gamma \left(j + \frac{3}{2} \right) \right)} \quad (\text{EQ 8-283})$$

and where Φ is the standard normal cumulative distribution function, I_x is the incomplete beta function ratio, and Γ is the gamma function. See the documentation for the BETAI command in this chapter and the GAMMA command in the Mathematical Library Functions chapter for a description of these functions.

SYNTAX

LET <y2> = NCTCDF(<y1>,<v>,<delta>) <SUBSET/EXCEPT/FOR qualification>

where <y1> is a number, parameter, or variable;

<y2> is a variable or a parameter (depending on what <y1> is) where the computed cdf value is stored;

<v> is a non-negative number, parameter or variable that specifies the degrees of freedom parameter;

<delta> is a non-negative number, parameter or variable that specifies the non-centrality parameter;

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

EXAMPLES

LET A = NCTCDF(0.7,1,1)

LET A = NCTCDF(3,10,10)

LET Y = NCTCDF(95,10,100)

NOTE 1

DATAPLOT uses algorithm AS 243 (see the REFERENCE section below) obtained from the statlib archive to compute the non-central t cdf. It uses the DBETAI and DLNGAM routines from the SLATEC library rather than the corresponding algorithms from the Applied Statistics series to compute the log gamma and incomplete beta functions. It uses the DATAPLOT normal cdf function rather than AS 66. If the AS algorithm fails, which can happen for large values of the non-centrality parameter, the doubly non-central t function is called (this works for much larger values of the non-centrality parameter).

NOTE 2

DATAPLOT also supports the central t and the doubly non-central t distributions (see the documentation for TCDF and DNTCDF). The DNTCDF function can be used for the singly non-central t as well, although it uses a different algorithm. The NCTCDF can also be used for the central t cdf.

DEFAULT

None

SYNONYMS

None

RELATED COMMANDS

NCTPPF	=	Compute the singly non-central t percent point function.
DNTCDF	=	Compute the doubly non-central t cumulative distribution function.
DNTPPF	=	Compute the doubly non-central t percent point function.
TCDF	=	Compute the t cumulative distribution function.
TPDF	=	Compute the t probability density function.
TPPF	=	Compute the t percent point function.
NCFCDF	=	Compute the non-central F cumulative distribution function.
NCBCDF	=	Compute the non-central beta cumulative distribution function.

REFERENCE

"Cumulative Distribution Function for the Non-central t Distribution," Lenth, Applied Statistics, Vol. 38, No. 1, 1988, pp. 185-188.

"Statistical Distributions," 2nd Edition, Evans, Hastings, and Peacock, 1970 (chapter 38).

APPLICATIONS

Hypothesis Testing

IMPLEMENTATION DATE

94/9

PROGRAM

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TITLE AUTOMATIC
XILABEL X
YILABEL PROBABILITY
PLOT NCTCDF(X,10,1) FOR X = -5 0.1 10
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