# WARPPF

## PURPOSE

Compute the Waring percent point function.

## DESCRIPTION

The Waring distribution has the following probability density function:

$$p(x, c, a) = \frac{(c-a)(a+x-1)!c!}{c(a-1)!(c+x)} \qquad x = 0, 1, 2, ... \qquad \textbf{(EQ Aux-324)}$$

where c and a are positive shape parameters with c being larger than a.

The Waring distribution is a generalization of the Yule distribution. The Yule distribution is a special case of the Waring distribution with a = 1. The Yule distribution is often given in the following form:.

$$p(x, p) = \frac{p(p!)(x-1)!}{(x+p)!} \qquad x = 1, 2, ... \qquad \textbf{(EQ Aux-325)}$$

where p is a positive parameter.

In the DATAPLOT WARPDF routine, if the a parameter is omitted or set to 1, the formula for the Yule distribution is used rather than the Waring distribution formula.

The percent point function is the inverse of the cumulative distribution function. The cumulative distribution sums the probability from 0 to the given x value. The percent point function takes a cumulative probability value and computes the corresponding x value. The Waring percent point function is computed using a bisection method. The input value is a real number between 0 and 1 (since it corresponds to a probability).

## SYNTAX

LET <y2> = WARPPF(<y1>,<c>,<a>) <SUBSET/EXCEPT/FOR qualification>

where <y1> is a non-negative integer number, parameter, or variable;

<c> is a positive number, parameter, or variable that specifies the first shape parameter;

<a> is a positive number, parameter, or variable that specifies the second shape parameter;

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

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

If the <a> parameter is omitted or set to 1, this routine calculates the Yule cumulative distribution function. If <a> is larger than <c>, an error message is printed.

## EXAMPLES

```
LET A = WARPPF(0.9,5,2)
LET A = WARPPF(0.9,3)
LET X2 = WARPPF(P,C,A)
```

## NOTE

The Waring distribution can have very long tails, particularly for values of a and c less than 1. Some algorithm work needs to be done for this case. Currently, if the input p value would result in a value greater than 2,000,000 a warning message is printed and no further calculation is performed. Also, this routine can be somewhat slow for values of a and c less than 1.

## DEFAULT

None

## SYNONYMS

None

## RELATED COMMANDS

| | | |
|---|---|---|
| WARCDF | = | Compute the Waring cumulative distribution function. |
| WARPPF | = | Compute the Waring percent point function. |
| GEOCDF | = | Compute the geometric cumulative distribution function. |
| GEOPDF | = | Compute the geometric probability density function. |

| | | |
|---|---|---|
| GEOPPF | = | Compute the geometric percent point function. |
| DLGCDF | = | Compute the logarithmic series cumulative distribution function. |
| DLGPDF | = | Compute the logarithmic series probability density function. |
| DLGPPF | = | Compute the logarithmic series percent point function. |

## REFERENCE

"Discrete Univariate Distributions," 2nd. ed., Johnson, Kotz, and Kemp, John Wiley & Sons, 1994 (pp. 274-279).

## APPLICATIONS

Data Analysis

## IMPLEMENTATION DATE

95/4

## PROGRAM 1

```
LET ZA = DATA 0.5 0.5 0.5 0.5 2.0 2.0 2.0 2.0 4.0 4.0 4.0 4.0
LET ZC = DATA 0.6 1.0 1.5 2.0 2.1 3.0 4.0 5.0 4.1 5.0 6.0 8.0
TITLE AUTOMATIC; XTIC OFFSET 0.1 0.1
SPIKE ON; LINE BLANK
MULTIPLOT 3 3; MULTIPLOT CORNER COORDINATES 0 0 100 100
LOOP FOR K = 1 1 12
    LET A = ZA(K)
    LET C = ZC(K)
    X1LABEL A = ^A
    X2LABEL C = ^C
    PLOT WARPPF(P,C,A) FOR P = 0.05 0.05 0.95
END OF LOOP
END OF MULTIPLOT
```

PROGRAM 2

```
LET Z = SEQUENCE 0.2 0.2 2.4
TITLE AUTOMATIC
XTIC OFFSET 0.1 0.1
SPIKE ON
LINE BLANK
MULTIPLOT CORNER COORDINATES 0 0 100 100
.
MULTIPLOT 4 3
LOOP FOR K = 1 1 12
    LET P = Z(K)
    X1LABEL YULE DISTRIBUTION, P = ^P
    PLOT WARPPF(X,P) FOR X = 0.1 0.1 .91
END OF LOOP
END OF MULTIPLOT
```