

NAG Toolbox for MATLAB

g01fc

1 Purpose

g01fc returns the deviate associated with the given lower tail probability of the χ^2 -distribution with real degrees of freedom, via the function name.

2 Syntax

```
[result, ifail] = g01fc(p, df)
```

3 Description

The deviate, x_p , associated with the lower tail probability p of the χ^2 -distribution with ν degrees of freedom is defined as the solution to

$$P(X \leq x_p : \nu) = p = \frac{1}{2^{\nu/2} \Gamma(\nu/2)} \int_0^{x_p} e^{-X/2} X^{\nu/2-1} dX, \quad 0 \leq x_p < \infty; \nu > 0.$$

The required x_p is found by using the relationship between a χ^2 -distribution and a gamma distribution, i.e., a χ^2 -distribution with ν degrees of freedom is equal to a gamma distribution with scale parameter 2 and shape parameter $\nu/2$.

For very large values of ν , greater than 10^5 , Wilson and Hilferty's Normal approximation to the χ^2 is used; see Kendall and Stuart 1969.

4 References

Best D J and Roberts D E 1975 Algorithm AS91. The percentage points of the χ^2 distribution *Appl. Statist.* **24** 385–388

Hastings N A J and Peacock J B 1975 *Statistical Distributions* Butterworths

Kendall M G and Stuart A 1969 *The Advanced Theory of Statistics (Volume 1)* (3rd Edition) Griffin

5 Parameters

5.1 Compulsory Input Parameters

1: **p – double scalar**

p , the probability from the required χ^2 -distribution.

Constraint: $0.0 \leq p < 1.0$.

2: **df – double scalar**

ν , the degrees of freedom of the χ^2 -distribution.

Constraint: **df** > 0.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **result** – double scalar

The result of the function.

2: **ifail** – int32 scalar

0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Note: g01fc may return useful information for one or more of the following detected errors or warnings.

If **ifail** = 1, 2, 3 or 5 on exit, then g01fc returns 0.0.

ifail = 1

On entry, **p** < 0.0,
or **p** ≥ 1.0.

ifail = 2

On entry, **df** ≤ 0.

ifail = 3

p is too close to 0 or 1 for the result to be calculated.

ifail = 4

The solution has failed to converge. The result should be a reasonable approximation.

ifail = 5

The series used to calculate the gamma probabilities has failed to converge. This is an unlikely error exit.

7 Accuracy

The results should be accurate to five significant digits for most parameter values. Some accuracy is lost for *p* close to 0.0.

8 Further Comments

For higher accuracy the relationship described in Section 3 may be used and a direct call to g01ff made.

9 Example

```
p = 0.01;  
df = 20;  
[result, ifail] = g01fc(p, df)  
  
result =  
      8.2604  
ifail =  
      0
```