

NAG Toolbox for MATLAB

g01ec

1 Purpose

g01ec returns the lower or upper tail probability for the χ^2 -distribution with real degrees of freedom, via the function name.

2 Syntax

```
[result, ifail] = g01ec(tail, x, df)
```

3 Description

The lower tail probability for the χ^2 -distribution with ν degrees of freedom, $P(\mathbf{x} \leq x : \nu)$ is defined by:

$$P(X \leq x : \nu) = \frac{1}{2^{\nu/2} \Gamma(\nu/2)} \int_{0.0}^x X^{\nu/2-1} e^{-X/2} dX, \quad x \geq 0, \nu > 0.$$

To calculate $P(\mathbf{x} \leq x : \nu)$ a transformation of a gamma distribution is employed, i.e., a χ^2 -distribution with ν degrees of freedom is equal to a gamma distribution with scale parameter 2 and shape parameter $\nu/2$.

4 References

Abramowitz M and Stegun I A 1972 *Handbook of Mathematical Functions* (3rd Edition) Dover Publications

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

5 Parameters

5.1 Compulsory Input Parameters

1: **tail – string**

Indicates whether the upper or lower tail probability is required.

tail = 'L'

The lower tail probability is returned, i.e., $P(\mathbf{x} \leq x : \nu)$.

tail = 'U'

The upper tail probability is returned, i.e., $P(\mathbf{x} \geq x : \nu)$.

Constraint: **tail** = 'L' or 'U'.

2: **x – double scalar**

x, the value of the χ^2 variate with ν degrees of freedom.

Constraint: **x** $\geq$ 0.0.

3: **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: g01ec may return useful information for one or more of the following detected errors or warnings.

If **ifail** = 1, 2 or 3 on exit, then g01ec returns 0.0.

ifail = 1

On entry, **tail** $\neq$ 'L' or 'U'.

ifail = 2

On entry, **x** < 0.0.

ifail = 3

On entry, **df** $\leq$ 0.0.

ifail = 4

The solution has failed to converge while calculating the Gamma variate. The result returned should represent an approximation to the solution.

7 Accuracy

A relative accuracy of five significant figures is obtained in most cases.

8 Further Comments

For higher accuracy the transformation described in Section 3 may be used with a direct call to s14ba.

9 Example

```
tail = 'Lower';
x = 8.26;
df = 20;
[result, ifail] = g01ec(tail, x, df)

result =
    0.0100
ifail =
     0
```

