

NAG Toolbox for MATLAB

g01ed

1 Purpose

g01ed returns the probability for the lower or upper tail of the **f** or variance-ratio distribution with real degrees of freedom, via the function name.

2 Syntax

```
[result, ifail] = g01ed(tail, f, df1, df2)
```

3 Description

The lower tail probability for the **f**, or variance-ratio distribution, with ν_1 and ν_2 degrees of freedom, $P(\mathbf{f} \leq f : \nu_1, \nu_2)$, is defined by:

$$P(F \leq f : \nu_1, \nu_2) = \frac{\nu_1^{\nu_1/2} \nu_2^{\nu_2/2} \Gamma((\nu_1 + \nu_2)/2)}{\Gamma(\nu_1/2) \Gamma(\nu_2/2)} \int_0^f F^{(\nu_1-2)/2} (\nu_1 F + \nu_2)^{-(\nu_1+\nu_2)/2} dF,$$

for $\nu_1, \nu_2 > 0, f \geq 0$.

The probability is computed by means of a transformation to a beta distribution, $P_\beta(B \leq \beta : a, b)$:

$$P(F \leq f : \nu_1, \nu_2) = P_\beta\left(B \leq \frac{\nu_1 f}{\nu_1 f + \nu_2} : \nu_1/2, \nu_2/2\right)$$

and using a call to g01ee.

For very large values of both ν_1 and ν_2 , greater than 10^5 , a normal approximation is used. If only one of ν_1 or ν_2 is greater than 10^5 then a χ^2 approximation is used, see Abramowitz and Stegun 1972.

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 an upper or lower tail probability is required.

tail = 'L'

The lower tail probability is returned, i.e., $P(\mathbf{f} \leq f : \nu_1, \nu_2)$.

tail = 'U'

The upper tail probability is returned, i.e., $P(\mathbf{f} \geq f : \nu_1, \nu_2)$.

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

2: **f – double scalar**

f , the value of the **f** variate.

Constraint: **f** ≥ 0 .

3: **df1 – double scalar**

The degrees of freedom of the numerator variance, ν_1 .

Constraint: **df1** > 0.0.

4: **df2 – double scalar**

The degrees of freedom of the denominator variance, ν_2 .

Constraint: **df2** > 0.0.

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: g01ed may return useful information for one or more of the following detected errors or warnings.

If **ifail** = 1, 2 or 3 on exit, then g01ed returns 0.0.

ifail = 1

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

ifail = 2

On entry, **f** < 0.0.

ifail = 3

On entry, **df1** $\leq$ 0.0,
or **df2** $\leq$ 0.0.

ifail = 4

f is too far out into the tails for the probability to be evaluated exactly. The result tends to approach 1.0 if x is large, or 0.0 if x is small. The result returned is a good approximation to the required solution.

7 Accuracy

The result should be accurate to five significant digits.

8 Further Comments

For higher accuracy g01ee can be used along with the transformations given in Section 3.

9 Example

```
tail = 'Lower';  
f = 5.5;  
df1 = 1.5;  
df2 = 25.5;  
[result, ifail] = g01ed(tail, f, df1, df2)
```

```
result =  
    0.9837  
ifail =  
        0
```
