

NAG Toolbox for MATLAB

g01ef

1 Purpose

g01ef returns the lower or upper tail probability of the gamma distribution, with parameters α and β , via the function name.

2 Syntax

```
[result, ifail] = g01ef(tail, g, a, b)
```

3 Description

The lower tail probability for the gamma distribution with parameters α and β , $P(\mathbf{g} \leq g)$, is defined by:

$$P(G \leq g; \alpha, \beta) = \frac{1}{\beta^\alpha \Gamma(\alpha)} \int_0^g G^{\alpha-1} e^{-G/\beta} dG, \quad \alpha > 0.0, \beta > 0.0$$

The mean of the distribution is $\alpha\beta$ and its variance is $\alpha\beta^2$. The transformation $Z = \frac{\mathbf{g}}{\beta}$ is applied to yield the following incomplete gamma function in normalized form,

$$P(G \leq g; \alpha, \beta) = P(Z \leq g/\beta : \alpha, 1.0) = \frac{1}{\Gamma(\alpha)} \int_0^{g/\beta} Z^{\alpha-1} e^{-Z} dZ.$$

This is then evaluated using s14ba.

4 References

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, that is $P(\mathbf{g} \leq g : \alpha, \beta)$.

tail = 'U'

The upper tail probability is returned, that is $P(\mathbf{g} \geq g : \alpha, \beta)$.

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

2: **g – double scalar**

g, the value of the gamma variate.

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

3: **a – double scalar**

The parameter α of the gamma distribution.

Constraint: **a** $>$ 0.0.

4: **b – double scalar**

The parameter β of the gamma distribution.

Constraint: **b** > 0.0.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters1: **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

Errors or warnings detected by the function:

If **ifail** = 1, 2, 3 or 4 on exit, then g01ef returns 0.0.

ifail = 1

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

ifail = 2

On entry, **g** < 0.0.

ifail = 3

On entry, **a** $\leq$ 0.0,
or **b** $\leq$ 0.0.

ifail = 4

The solution did not converge in 600 iterations. See s14ba. The probability returned should be a reasonable approximation to the solution.

7 Accuracy

The result should have a relative accuracy of *machine precision*. There are rare occasions when the relative accuracy attained is somewhat less than *machine precision* but the error should not exceed more than 1 or 2 decimal places. Note also that there is a limit of 18 decimal places on the achievable accuracy, because constants in s14ba are given to this precision.

8 Further Comments

The time taken by g01ef varies slightly with the input parameters g , α and β .

9 Example

```
tail = 'Lower';  
g = 15.5;  
a = 4;  
b = 2;  
[result, ifail] = g01ef(tail, g, a, b)
```

```
result =  
    0.9499  
ifail =  
        0
```
