

NAG Toolbox for MATLAB

g01ea

1 Purpose

g01ea returns a one or two tail probability for the standard Normal distribution, via the function name.

2 Syntax

```
[result, ifail] = g01ea(tail, x)
```

3 Description

The lower tail probability for the standard Normal distribution, $P(\mathbf{x} \leq x)$ is defined by:

$$P(X \leq x) = \int_{-\infty}^x Z(X) dX,$$

where

$$Z(X) = \frac{1}{\sqrt{2\pi}} e^{-X^2/2}, -\infty < X < \infty.$$

The relationship

$$P(X \leq x) = \frac{1}{2} \operatorname{erfc}\left(\frac{-x}{\sqrt{2}}\right)$$

is used, where erfc is the complementary error function, and is computed using s15ad. For the upper tail probability the relationship $P(\mathbf{x} \geq x) = P(\mathbf{x} \leq -x)$ is used and for the two tail significance level probability twice the probability obtained from the absolute value of x is returned.

When the two tail confidence probability is required the relationship

$$P(X \leq |x|) - P(X \leq -|x|) = \operatorname{erf}\left(\frac{|x|}{\sqrt{2}}\right),$$

is used, where erf is the error function, and is computed using s15ae.

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 which tail the returned probability should represent.

tail = 'L'

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

tail = 'U'

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

tail = 'S'

The two tail (significance level) probability is returned, i.e., $P(\mathbf{x} \geq |x|) + P(\mathbf{x} \leq -|x|)$.

tail = 'C'

The two tail (confidence interval) probability is returned, i.e., $P(\mathbf{x} \leq |x|) - P(\mathbf{x} \leq -|x|)$.

Constraint: **tail** = 'L', 'U', 'S' or 'C'.

2: **x** – double scalar

x, the value of the standard Normal variate.

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

Errors or warnings detected by the function:

If **ifail** $\neq$ 0, then g01ea returns 0.0.

ifail = 1

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

7 Accuracy

Accuracy is limited by *machine precision*. For detailed error analysis see s15ad and s15ae.

8 Further Comments

None.

9 Example

```
tail = 'L';
x = 1.96;
[result, ifail] = g01ea(tail, x)
```

```
result =  
    0.9750  
ifail =  
        0
```
