

NAG Toolbox for MATLAB

s15ac

1 Purpose

s15ac returns the value of the complement of the cumulative Normal distribution function, $Q(x)$, via the function name.

2 Syntax

```
[result, ifail] = s15ac(x)
```

3 Description

s15ac evaluates an approximate value for the complement of the cumulative Normal distribution function

$$Q(x) = \frac{1}{\sqrt{2\pi}} \int_x^\infty e^{-u^2/2} du.$$

The function is based on the fact that

$$Q(x) = \frac{1}{2} \operatorname{erfc}\left(\frac{x}{\sqrt{2}}\right)$$

and it calls s15ad to obtain the necessary value of *erfc*, the complementary error function.

4 References

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

5 Parameters

5.1 Compulsory Input Parameters

1: **x – double scalar**

The argument x of the function.

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

There are no failure exits from this function. The parameter **ifail** is included for consistency with other functions in this chapter.

7 Accuracy

Because of its close relationship with *erfc* the accuracy of this function is very similar to that in s15ad. If ϵ and δ are the relative errors in result and argument, respectively, then in principle they are related by

$$|\epsilon| \simeq \left| \frac{x e^{-x^2/2}}{\sqrt{2\pi} Q(x)} \delta \right|.$$

For x negative or small positive this factor is always less than one and accuracy is mainly limited by **machine precision**. For large positive x we find $\epsilon \sim x^2 \delta$ and hence to a certain extent relative accuracy is unavoidably lost. However the absolute error in the result, E , is given by

$$|E| \simeq \left| \frac{x e^{-x^2/2}}{\sqrt{2\pi}} \delta \right|$$

and since this factor is always less than one absolute accuracy can be guaranteed for all x .

8 Further Comments

None.

9 Example

```
x = -20;  
[result, ifail] = s15ac(x)  
  
result =  
      1  
ifail =  
      0
```