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

\[
\text{[result, ifail]} = \text{s15ac}(x)
\]

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

\[
Q(x) = \frac{1}{2} \text{erfc}\left(\frac{x}{\sqrt{2}}\right)
\]

and it calls s15ad to obtain the necessary value of \( \text{erfc} \), the complementary error function.

4 References


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: \( \text{result} \) – double scalar
   The result of the function.
2: \( \text{ifail} \) – int32 scalar
   ifail = 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

\[ |\epsilon| \approx \frac{x e^{-x^2/2}}{\sqrt{2\pi}Q(x)} \delta. \]

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

\[ |E| \approx \frac{x e^{-x^2/2}}{\sqrt{2\pi}} \delta \]

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

8 Further Comments

None.

9 Example

\begin{verbatim}
x = -20;
[result, ifail] = s15ac(x)

result = 1
ifail = 0
\end{verbatim}