NAG Fortran Library Routine Document

S18CCF

Note: before using this routine, please read the Users' Note for your implementation to check the interpretation of ***bold italicised*** terms and other implementation-dependent details.

1 Purpose

S18CCF returns a value of the scaled modified Bessel function $e^x K_0(x)$ via the routine name.

2 Specification

```
real FUNCTION S18CCF(X, IFAIL)
INTEGER              IFAIL
real                 X
```

3 Description

This routine evaluates an approximation to $e^x K_0(x)$, where K_0 is a modified Bessel function of the second kind. The scaling factor e^x removes most of the variation in $K_0(x)$.

The routine uses the same Chebyshev expansions as S18ACF, which returns the unscaled value of $K_0(x)$.

4 References

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

5 Parameters

1: X – ***real*** *Input*

On entry: the argument x of the function.

Constraint: X > 0.0.

2: IFAIL – INTEGER *Input/Output*

On entry: IFAIL must be set to 0, -1 or 1. Users who are unfamiliar with this parameter should refer to Chapter P01 for details.

On exit: IFAIL $= 0$ unless the routine detects an error (see Section 6).

For environments where it might be inappropriate to halt program execution when an error is detected, the value -1 or 1 is recommended. If the output of error messages is undesirable, then the value 1 is recommended. Otherwise, for users not familiar with this parameter the recommended value is 0. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

6 Error Indicators and Warnings

If on entry IFAIL $= 0$ or -1, explanatory error messages are output on the current error message unit (as defined by X04AAF).

Errors or warnings detected by the routine:

IFAIL $= 1$

On entry, X ≤ 0.0, K_0 is undefined.

On soft failure, S18CCF returns zero.

7 Accuracy

Relative errors in the argument are attenuated when propagated into the function value. When the accuracy of the argument is essentially limited by the ***machine precision***, the accuracy of the function value will be similarly limited by at most a small multiple of the ***machine precision***.

8 Further Comments

None.

9 Example

The example program reads values of the argument x from a file, evaluates the function at each value of x and prints the results.

9.1 Program Text

Note: the listing of the example program presented below uses ***bold italicised*** terms to denote precision-dependent details. Please read the Users' Note for your implementation to check the interpretation of these terms. As explained in the Essential Introduction to this manual, the results produced may not be identical for all implementations.

```
*     S18CCF Example Program Text
*     Mark 14 Revised.  NAG Copyright 1989.
*     .. Parameters ..
      INTEGER          NIN, NOUT
      PARAMETER        (NIN=5,NOUT=6)
*     .. Local Scalars ..
      real             X, Y
      INTEGER          IFAIL
*     .. External Functions ..
      real             S18CCF
      EXTERNAL         S18CCF
*     .. Executable Statements ..
      WRITE (NOUT,*) 'S18CCF Example Program Results'
*     Skip heading in data file
      READ (NIN,*)
      WRITE (NOUT,*)
      WRITE (NOUT,*) '     X           Y        IFAIL'
      WRITE (NOUT,*)
   20 READ (NIN,*,END=40) X
      IFAIL = 1
*
      Y = S18CCF(X,IFAIL)
*
      WRITE (NOUT,99999) X, Y, IFAIL
      GO TO 20
   40 STOP
*
99999 FORMAT (1X,1P,2e12.3,I7)
      END
```

9.2 Program Data

```
S18CCF Example Program Data
             0.0
             0.4
             0.6
             1.4
             2.5
             10.0
             1000.0
             -1.0
```

9.3 Program Results

```
 S18CCF Example Program Results

      X           Y        IFAIL

    0.000E+00   0.000E+00      1
    4.000E-01   1.663E+00      0
    6.000E-01   1.417E+00      0
    1.400E+00   9.881E-01      0
    2.500E+00   7.595E-01      0
    1.000E+01   3.916E-01      0
    1.000E+03   3.963E-02      0
   -1.000E+00   0.000E+00      1
```