NAG 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 function name.

2   Specification

```
FUNCTION S18CCF (X, IFAIL)
REAL (KIND=nag_wp) S18CCF

INTEGER            IFAIL
REAL (KIND=nag_wp) X
```

3   Description

S18CCF 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 (KIND=nag_wp)   *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. If you are unfamiliar with this parameter you should refer to Section 3.3 in the Essential Introduction for details.

   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, if you are 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.**

   On exit: IFAIL = 0 unless the routine detects an error or a warning has been flagged (see Section 6).

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 softfailure, S18CCF returns zero.

IFAIL $= -99$

An unexpected error has been triggered by this routine. Please contact NAG.

See Section 3.8 in the Essential Introduction for further information.

IFAIL $= -399$

Your licence key may have expired or may not have been installed correctly.

See Section 3.7 in the Essential Introduction for further information.

IFAIL $= -999$

Dynamic memory allocation failed.

See Section 3.6 in the Essential Introduction for further information.

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 Parallelism and Performance

Not applicable.

9 Further Comments

None.

10 Example

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

10.1 Program Text

```
    Program s18ccfe

!      S18CCF Example Program Text

!      Mark 25 Release. NAG Copyright 2014.

!      .. Use Statements ..
      Use nag_library, Only: nag_wp, s18ccf
!      .. Implicit None Statement ..
      Implicit None
!      .. Parameters ..
      Integer, Parameter                 :: nin = 5, nout = 6
!      .. Local Scalars ..
```

```
        Real (Kind=nag_wp)                   :: x, y
        Integer                              :: ifail, ioerr
!       .. Executable Statements ..
        Write (nout,*) 'S18CCF Example Program Results'

!       Skip heading in data file
        Read (nin,*)

        Write (nout,*)
        Write (nout,*) '     X             Y'
        Write (nout,*)

data: Do
        Read (nin,*,Iostat=ioerr) x

        If (ioerr<0) Then
          Exit data
        End If

        ifail = -1
        y = s18ccf(x,ifail)

        If (ifail<0) Then
          Exit data
        End If

        Write (nout,99999) x, y
      End Do data

99999 Format (1X,1P,2E12.3)
    End Program s18ccfe
```

10.2 Program Data

```
S18CCF Example Program Data
          0.4
          0.6
          1.4
          2.5
         10.0
       1000.0
```

10.3 Program Results

```
 S18CCF Example Program Results

     X             Y

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