

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 routine name.

2 Specification

```
double precision FUNCTION S18CCF(X, IFAIL)
      INTEGER                                IFAIL
double precision                                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 – ***double precision*** *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.

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, 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.**

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, $X \leq 0.0$, 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

This example 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

```
*      S18CCF Example Program Text
*      Mark 14 Revised. NAG Copyright 1989.
*      .. Parameters ..
INTEGER          NIN, NOUT
PARAMETER        (NIN=5,NOUT=6)
*      .. Local Scalars ..
DOUBLE PRECISION X, Y
INTEGER          IFAIL
*      .. External Functions ..
DOUBLE PRECISION 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)
*
   IF (IFAIL.GE.0) THEN
      WRITE (NOUT,99999) X, Y, IFAIL
      GO TO 20
   ELSE
      WRITE (NOUT,99998) IFAIL
   END IF
40 CONTINUE
*
99999 FORMAT (1X,1P,2E12.3,I7)
99998 FORMAT (1X,' ** S18CCF returned with IFAIL = ',I5)
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
