

NAG Library Routine Document

S18CDF

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

S18CDF returns a value of the scaled modified Bessel function $e^x K_1(x)$ via the routine name.

2 Specification

```
double precision FUNCTION S18CDF(X, IFAIL)
INTEGER                                IFAIL
double precision                                X
```

3 Description

S18CDF evaluates an approximation to $e^x K_1(x)$, where K_1 is a modified Bessel function of the second kind. The scaling factor e^x removes most of the variation in $K_1(x)$.

The routine uses the same Chebyshev expansions as S18ADF, which returns the unscaled value of $K_1(x)$.

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_1 is undefined. On soft failure S18CDF returns zero.

IFAIL = 2

On entry, X is too close to zero, as determined by the value of the safe-range parameter X02AMF: there is a danger of causing overflow. On soft failure, S18CDF returns the reciprocal of the safe-range parameter.

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

```
*      S18CDF 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 S18CDF
      EXTERNAL         S18CDF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'S18CDF 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 = S18CDF(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,' ** S18CDF returned with IFAIL = ',I5)
      END
```

9.2 Program Data

S18CDF Example Program Data

```

0.0
0.4
0.6
1.4
2.5
10.0
1000.0
-1.0

```

9.3 Program Results

S18CDF Example Program Results

X	Y	IFAIL
0.000E+00	0.000E+00	1
4.000E-01	3.259E+00	0
6.000E-01	2.374E+00	0
1.400E+00	1.301E+00	0
2.500E+00	9.002E-01	0
1.000E+01	4.108E-01	0
1.000E+03	3.965E-02	0
-1.000E+00	0.000E+00	1
