

NAG Library Routine Document

S18CEF

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

S18CEF returns a value of the scaled modified Bessel function $e^{-|x|}I_0(x)$ via the routine name.

2 Specification

double precision FUNCTION S18CEF(X, IFAIL)

INTEGER IFAIL

double precision X

3 Description

S18CEF evaluates an approximation to $e^{-|x|}I_0(x)$, where I_0 is a modified Bessel function of the first kind. The scaling factor $e^{-|x|}$ removes most of the variation in $I_0(x)$.

The routine uses the same Chebyshev expansions as S18AEF, which returns the unscaled value of $I_0(x)$.

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.

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

There are no actual failure exits from this routine. IFAIL is always set to zero. This parameter is included for compatibility with other routines in this chapter.

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

```
*      S18CEF 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 S18CEF
      EXTERNAL          S18CEF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'S18CEF 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 = S18CEF(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,' ** S18CEF returned with IFAIL = ',I5)
      END
```

9.2 Program Data

```
S18CEF Example Program Data
      0.0
      0.5
      1.0
      3.0
      6.0
      10.0
      1000.0
      -1.0
```

9.3 Program Results

S18CEF Example Program Results

X	Y	IFAIL
0.000E+00	1.000E+00	0
5.000E-01	6.450E-01	0
1.000E+00	4.658E-01	0
3.000E+00	2.430E-01	0
6.000E+00	1.667E-01	0
1.000E+01	1.278E-01	0
1.000E+03	1.262E-02	0
-1.000E+00	4.658E-01	0
