NAG Fortran Library Routine Document

E01RBF

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

E01RBF evaluates continued fractions of the form produced by E01RAF.

2 Specification

```
SUBROUTINE E01RBF(M, A, U, X, F, IFAIL)
INTEGER           M, IFAIL
real              A(M), U(M), X, F
```

3 Description

E01RBF evaluates the continued fraction

$$R(x) = a_1 + R_m(x)$$

where

$$R_i(x) = \frac{a_{m-i+2}(x - u_{m-i+1})}{1 + R_{i-1}(x)}, \quad \text{for} \quad i = m, m-1, \ldots, 2.$$

and

$$R_1(x) = 0$$

for a prescribed value of x. E01RBF is intended to be used to evaluate the continued fraction representation (of an interpolatory rational function) produced by E01RAF.

4 References

Graves-Morris P R and Hopkins T R (1981) Reliable rational interpolation *Numer. Math.* **36** 111–128

5 Parameters

1: M – INTEGER *Input*

On entry: m, the number of terms in the continued fraction.

Constraint: M ≥ 1.

2: A(M) – ***real*** array *Input*

On entry: A(j) must be set to the value of the parameter a_j in the continued fraction, for $j = 1, 2, \ldots, m$.

3: U(M) – ***real*** array *Input*

On entry: U(j) must be set to the value of the parameter u_j in the continued fraction, for $j = 1, 2, \ldots, m-1$. (The element U(m) is not used).

4: X – ***real*** *Input*

On entry: the value of x at which the continued fraction is to be evaluated.

5: F – ***real*** *Output*

On exit: the value of the continued fraction corresponding to the value of x.

6: 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 $= 1$

The value of X corresponds to a pole of $R(x)$ or is so close that an overflow is likely to ensue.

7 Accuracy

See Section 7 of the document for E01RAF.

8 Further Comments

The time taken by the routine is approximately proportional to m.

9 Example

This example program reads in the parameters a_j and u_j of a continued fraction (as determined by the example for E01RAF) and evaluates the continued fraction at a point x.

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.

```
*     E01RBF Example Program Text
*     Mark 14 Revised.  NAG Copyright 1989.
*     .. Parameters ..
      INTEGER          M
      PARAMETER        (M=4)
      INTEGER          NIN, NOUT
      PARAMETER        (NIN=5,NOUT=6)
*     .. Local Scalars ..
      real             F, X
      INTEGER          I, IFAIL
*     .. Local Arrays ..
      real             A(M), U(M)
*     .. External Subroutines ..
      EXTERNAL         E01RBF
*     .. Executable Statements ..
      WRITE (NOUT,*) 'E01RBF Example Program Results'
*     Skip heading in data file
      READ (NIN,*)
      READ (NIN,*) (A(I),I=1,M)
```

```
      READ (NIN,*) (U(I),I=1,M-1)
      READ (NIN,*) X
      WRITE (NOUT,*)
      WRITE (NOUT,99999) 'X =', X
      IFAIL = 0
*
      CALL E01RBF(M,A,U,X,F,IFAIL)
*
      WRITE (NOUT,*)
      WRITE (NOUT,99999) 'The value of R(X) is ', F
      STOP
*
99999 FORMAT (1X,A,1P,e12.4)
      END
```

9.2 Program Data

```
E01RBF Example Program Data
   4.000   1.000   0.750  -1.000
   0.000   3.000   1.000
   6.000
```

9.3 Program Results

```
 E01RBF Example Program Results

 X =  6.0000E+00

 The value of R(X) is   1.7714E+01
```