

# NAG 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 (KIND=nag_wp) A(M), U(M), X, F
```

### 3 Description

E01RBF evaluates the continued fraction

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

where

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

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 Arguments

- 1: M – INTEGER *Input*  
*On entry:*  $m$ , the number of terms in the continued fraction.  
*Constraint:*  $M \geq 1$ .
- 2: A(M) – REAL (KIND=nag\_wp) array *Input*  
*On entry:* A( $j$ ) must be set to the value of the parameter  $a_j$  in the continued fraction, for  $j = 1, 2, \dots, m$ .
- 3: U(M) – REAL (KIND=nag\_wp) array *Input*  
*On entry:* U( $j$ ) must be set to the value of the parameter  $u_j$  in the continued fraction, for  $j = 1, 2, \dots, m-1$ . (The element U( $m$ ) is not used).
- 4: X – REAL (KIND=nag\_wp) *Input*  
*On entry:* the value of  $x$  at which the continued fraction is to be evaluated.

5: F – REAL (KIND=nag\_wp)

*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. If you are unfamiliar with this argument you should refer to Section 3.4 in How to Use the NAG Library and its Documentation 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 argument, 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

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

IFAIL =  $-99$

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

See Section 3.9 in How to Use the NAG Library and its Documentation for further information.

IFAIL =  $-399$

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

See Section 3.8 in How to Use the NAG Library and its Documentation for further information.

IFAIL =  $-999$

Dynamic memory allocation failed.

See Section 3.7 in How to Use the NAG Library and its Documentation for further information.

## 7 Accuracy

See Section 7 in E01RAF.

## 8 Parallelism and Performance

E01RBF is not threaded in any implementation.

## 9 Further Comments

The time taken by E01RBF is approximately proportional to  $m$ .

## 10 Example

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

## 10.1 Program Text

```

Program e01rbfe

!      E01RBF Example Program Text

!      Mark 26 Release. NAG Copyright 2016.

!      .. Use Statements ..
      Use nag_library, Only: e01rbf, nag_wp
!      .. Implicit None Statement ..
      Implicit None
!      .. Parameters ..
      Integer, Parameter          :: m = 4, nin = 5, nout = 6
!      .. Local Scalars ..
      Real (Kind=nag_wp)          :: f, x
      Integer                     :: i, ifail
!      .. Local Arrays ..
      Real (Kind=nag_wp)          :: a(m), u(m)
!      .. 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

      ifail = 0
      Call e01rbf(m,a,u,x,f,ifail)

      Write (nout,*)
      Write (nout,99999) 'X =', x
      Write (nout,*)
      Write (nout,99999) 'The value of R(X) is ', f

99999 Format (1X,A,1P,E12.4)
End Program e01rbfe

```

## 10.2 Program Data

```

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

```

## 10.3 Program Results

```

E01RBF Example Program Results

X =  6.0000E+00

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

```

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