NAG Toolbox

nag_interp_1d_ratnl_eval (e01rb)

1 Purpose

nag_interp_1d_ratnl_eval (e01rb) evaluates continued fractions of the form produced by nag_interp_1d_ratnl (e01ra).

2 Syntax

```
[f, ifail] = nag_interp_1d_ratnl_eval(a, u, x, 'm', m)
[f, ifail] = e01rb(a, u, x, 'm', m)
```

3 Description

nag_interp_1d_ratnl_eval (e01rb) evaluates the continued fraction

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

where

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

and

$$R_1(x) = 0$$

for a prescribed value of x. nag_interp_1d_ratnl_eval (e01rb) is intended to be used to evaluate the continued fraction representation (of an interpolatory rational function) produced by nag_interp_1d_ratnl (e01ra).

4 References

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

5 Parameters

5.1 Compulsory Input Parameters

1: **a**(**m**) – REAL (KIND=nag_wp) array

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

2: **u**(**m**) – REAL (KIND=nag_wp) array

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).

3: **x** – REAL (KIND=nag_wp)

The value of x at which the continued fraction is to be evaluated.

5.2 Optional Input Parameters

1: **m** – INTEGER

Default: the dimension of the arrays **a**, **u**. (An error is raised if these dimensions are not equal.)

m, the number of terms in the continued fraction.

Constraint: **m** ≥ 1.

5.3 Output Parameters

1: **f** – REAL (KIND=nag_wp)

The value of the continued fraction corresponding to the value of x.

2: **ifail** – INTEGER

ifail $= 0$ unless the function detects an error (see Section 5).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

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.

ifail $= -399$

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

ifail $= -999$

Dynamic memory allocation failed.

7 Accuracy

See Section 7 in nag_interp_1d_ratnl (e01ra).

8 Further Comments

The time taken by nag_interp_1d_ratnl_eval (e01rb) is approximately proportional to m.

9 Example

This example reads in the arguments a_j and u_j of a continued fraction (as determined by the example for nag_interp_1d_ratnl (e01ra)) and evaluates the continued fraction at a point x.

9.1 Program Text

```
function e01rb_example

fprintf('e01rb example results\n\n');

% Calculate rational approximation coefficients
x = [0:4];
f = [4   2   4   7   10.4];

[m, a, u, ifail] = e01ra( ...
                          x, f);

% Evaluate at single point
x = 6;
```

```
[f, ifail] = e01rb( ...
                    a, u, x, 'm', m);

fprintf('x    = %12.4e\n',x);
fprintf('R(x) = %12.4e\n',f);
```

9.2 Program Results

```
     e01rb example results

x    =   6.0000e+00
R(x) =   1.7714e+01
```