NAG C Library Function Document

nag_1d_ratnl_eval (e01rbc)

1 Purpose

nag_1d_ratnl_eval (e01rbc) evaluates continued fractions of the form produced by nag_1d_ratnl_interp (e01rac).

2 Specification

```c
void nag_1d_ratnl_eval (Integer m, const double a[], const double u[], double x, double *f, NagError *fail)
```

3 Description

nag_1d_ratnl_eval (e01rbc) 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 \( x \). nag_1d_ratnl_eval (e01rbc) is intended to be used to evaluate the continued fraction representation (of an interpolatory rational function) produced by nag_1d_ratnl_interp (e01rac).

4 References


5 Parameters

1: \( m \) – Integer \( \quad \text{Input} \)
   
   On entry: \( m \), the number of terms in the continued fraction.

   Constraint: \( m \geq 1 \).

2: \( a[m] \) – const double \( \quad \text{Input} \)
   
   On entry: \( a[j-1] \) must be set to the value of the parameter \( a_j \) in the continued fraction, for \( j = 1, 2, \ldots, m \).

3: \( u[m] \) – const double \( \quad \text{Input} \)
   
   On entry: \( u[j-1] \) 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: \( x \) – double \( \quad \text{Input} \)
   
   On entry: the value of \( x \) at which the continued fraction is to be evaluated.

5: \( f \) – double * \( \quad \text{Output} \)
   
   On exit: the value of the continued fraction corresponding to the value of \( x \).
6:  fail – NagError *

The NAG error parameter (see the Essential Introduction).

6  Error Indicators and Warnings

NE_POLE_PRESENT
x corresponds to a pole of $R(x)$, or is very close. $x = (value)$.

NE_BAD_PARAM
On entry, parameter (value) had an illegal value.

NE_INTERNAL_ERROR
An internal error has occurred in this function. Check the function call and any array sizes. If the
call is correct then please consult NAG for assistance.

7  Accuracy

See Section 7 of the document for nag_1d_ratnl_interp (e01rac).

8  Further Comments

The time taken by the function 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 nag_1d_ratnl_interp (e01rac)) and evaluates the continued fraction at a point $x$.

9.1  Program Text

/* nag_1d_ratnl_eval (e01rbc) Example Program.
   *
   * Copyright 2001 Numerical Algorithms Group.
   *
   */
#include <stdio.h>
#include <nag.h>
#include <nag_stdlib.h>
#include <nage01.h>

int main(void)
{
    /* Scalars */
    double f, x;
    Integer exit_status, i, m;
    NagError fail;

    /* Arrays */
    double *a = 0, *u = 0;

    exit_status = 0;
    INIT_FAIL(fail);
    Vprintf("e01rbc Example Program Results\n");

    /* Skip heading in data file */
    Vscanf("%*[\n ] ");
    m = 4;
/* Allocate memory */
if (!(a = NAG_ALLOC(m, double)) ||
!u = NAG_ALLOC(m, double))
{
  Vprintf("Allocation failure\n");
  exit_status = -1;
  goto END;
}
for (i = 1; i <= m; ++i)
  Vscanf("%lf", &a[i-1]);
Vscanf("%*[\n] ");
for (i = 1; i <= m - 1; ++i)
  Vscanf("%lf", &u[i-1]);
Vscanf("%*[\n] ");
Vscanf("%lf%*[\n] ", &x);
Vprintf("\n");
Vprintf("x = %11.4e\n", x);
e01rbc(m, a, u, x, &f, &fail);
Vprintf("\n");
Vprintf("The value of R(x) is %12.4e\n", f);
END:
  if (a) NAG_FREE(a);
  if (u) NAG_FREE(u);
  return exit_status;
}

9.2 Program Data

9.3 Program Results

The value of R(x) is 1.7714e+01