

NAG Toolbox for MATLAB

e01bh

1 Purpose

e01bh evaluates the definite integral of a piecewise cubic Hermite interpolant over the interval $[a, b]$.

2 Syntax

```
[pint, ifail] = e01bh(x, f, d, a, b, 'n', n)
```

3 Description

e01bh evaluates the definite integral of a piecewise cubic Hermite interpolant, as computed by e01be, over the interval $[a, b]$.

If either a or b lies outside the interval from $\mathbf{x}(1)$ to $\mathbf{x}(\mathbf{n})$ computation of the integral involves extrapolation and a warning is returned.

The function is derived from function PCHIA in Fritsch 1982.

4 References

Fritsch F N 1982 PCHIP final specifications *Report UCID-30194* Lawrence Livermore National Laboratory

5 Parameters

5.1 Compulsory Input Parameters

- 1: **$\mathbf{x}(\mathbf{n})$ – double array**
- 2: **$\mathbf{f}(\mathbf{n})$ – double array**
- 3: **$\mathbf{d}(\mathbf{n})$ – double array**

$\mathbf{n}$, $\mathbf{x}$, $\mathbf{f}$ and $\mathbf{d}$ must be unchanged from the previous call of e01be.

- 4: **$\mathbf{a}$ – double scalar**

- 5: **$\mathbf{b}$ – double scalar**

The interval $[a, b]$ over which integration is to be performed.

5.2 Optional Input Parameters

- 1: **$\mathbf{n}$ – int32 scalar**

Default: The dimension of the arrays **$\mathbf{x}$, $\mathbf{f}$, $\mathbf{d}$** . (An error is raised if these dimensions are not equal.)

$\mathbf{n}$, $\mathbf{x}$, $\mathbf{f}$ and $\mathbf{d}$ must be unchanged from the previous call of e01be.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

- 1: **$\mathbf{pint}$ – double scalar**

The value of the definite integral of the interpolant over the interval $[a, b]$.

2: **ifail** – **int32 scalar**

0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

On entry, **n** < 2.

ifail = 2

The values of **x**(*r*), for *r* = 1, 2, ..., **n**, are not in strictly increasing order.

ifail = 3

On entry, at least one of **a** or **b** lies outside the interval [**x**(1),**x**(**n**)], and extrapolation was performed to compute the integral. The value returned is therefore unreliable.

7 Accuracy

The computational error in the value returned for **pint** should be negligible in most practical situations.

8 Further Comments

The time taken by e01bh is approximately proportional to the number of data points included within the interval [*a*, *b*].

9 Example

```
x = [7.99;
      8.09;
      8.19;
      8.699999999999999;
      9.199999999999999;
      10;
      12;
      15;
      20];
f = [0;
      2.7643e-05;
      0.043749;
      0.16918;
      0.46943;
      0.94374;
      0.99864;
      0.99992;
      0.99999];
d = [0;
      0.00055251;
      0.33587;
      0.34944;
      0.59696;
      0.060326;
      0.000898335;
      2.93954e-05;
      0];
a = 7.99;
b = 20;
[pint, ifail] = e01bh(x, f, d, a, b)
```

```
pint =  
    10.7648  
ifail =  
        0
```
