NAG Toolbox for MATLAB

e01bf

1 Purpose

e01bf evaluates a piecewise cubic Hermite interpolant at a set of points.

2 Syntax

```
[pf, ifail] = e01bf(x, f, d, px, 'n', n, 'm', m)
```

3 Description

e01bf evaluates a piecewise cubic Hermite interpolant, as computed by e01be, at the points $\mathbf{px}(i)$, for $i = 1, 2, \ldots, m$. If any point lies outside the interval from $\mathbf{x}(1)$ to $\mathbf{x}(\mathbf{n})$, a value is extrapolated from the nearest extreme cubic, and a warning is returned.

The function is derived from function PCHFE 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: **x(n) – double array**

2: **f(n) – double array**

3: **d(n) – double array**

n, **x**, **f** and **d** must be unchanged from the previous call of e01be.

4: **px(m) – double array**

The m values of x at which the interpolant is to be evaluated.

5.2 Optional Input Parameters

1: **n – int32 scalar**

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

n, **x**, **f** and **d** must be unchanged from the previous call of e01be.

2: **m – int32 scalar**

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

m, the number of points at which the interpolant is to be evaluated.

Constraint: $\mathbf{m} \geq 1$.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **pf(m) – double array**

pf(i) contains the value of the interpolant evaluated at the point **px**(i), for $i = 1, 2, \ldots, m$.

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, $\mathbf{n} < 2$.

ifail $= 2$

The values of **x**(r), for $r = 1, 2, \ldots, \mathbf{n}$, are not in strictly increasing order.

ifail $= 3$

On entry, $\mathbf{m} < 1$.

ifail $= 4$

At least one of the points **px**(i), for $i = 1, 2, \ldots, \mathbf{m}$, lies outside the interval $[\mathbf{x}(1), \mathbf{x}(\mathbf{n})]$, and extrapolation was performed at all such points. Values computed at such points may be very unreliable.

7 Accuracy

The computational errors in the array **pf** should be negligible in most practical situations.

8 Further Comments

The time taken by e01bf is approximately proportional to the number of evaluation points, m. The evaluation will be most efficient if the elements of **px** are in nondecreasing order (or, more generally, if they are grouped in increasing order of the intervals $[\mathbf{x}(r-1), \mathbf{x}(r)]$). A single call of e01bf with $m > 1$ is more efficient than several calls with $m = 1$.

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];
px = [7.99;
     9.191000000000001;
     10.392;
     11.593;
     12.794;
     13.995;
     15.196;
     16.397;
     17.598;
     18.799;
     20];
[pf, ifail] = e01bf(x, f, d, px)
```

```
pf =
         0
    0.4640
    0.9645
    0.9965
    0.9992
    0.9998
    0.9999
    1.0000
    1.0000
    1.0000
    1.0000
ifail =
           0
```