NAG Toolbox for MATLAB

f07jd

1 Purpose

f07jd computes the modified Cholesky factorization of a real n by n symmetric positive-definite tridiagonal matrix A.

2 Syntax

```
[d, e, info] = f07jd(d, e, 'n', n)
```

3 Description

f07jd factorizes the matrix A as

$$A = LDL^{\mathrm{T}},$$

where L is a unit lower bidiagonal matrix and D is a diagonal matrix with positive diagonal elements. The factorization may also be regarded as having the form $U^{\mathrm{T}}DU$, where U is a unit upper bidiagonal matrix.

4 References

None.

5 Parameters

5.1 Compulsory Input Parameters

1: **d**$(*)$ – **double array**

Note: the dimension of the array **d** must be at least $\max(1, \mathbf{n})$.

Must contain the n diagonal elements of the matrix A.

2: **e**$(*)$ – **double array**

Note: the dimension of the array **e** must be at least $\max(1, \mathbf{n} - 1)$.

Must contain the $(n - 1)$ subdiagonal elements of the matrix A.

5.2 Optional Input Parameters

1: **n – int32 scalar**

Default: The dimension of the array **d**.

n, the order of the matrix A.

Constraint: $\mathbf{n} \geq 0$.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **d**$(*)$ **– double array**

Note: the dimension of the array **d** must be at least $\max(1, \mathbf{n})$.

Contains the n diagonal elements of the diagonal matrix D from the LDL^{T} factorization of A.

2: **e**$(*)$ **– double array**

Note: the dimension of the array **e** must be at least $\max(1, \mathbf{n} - 1)$.

Contains the $(n - 1)$ subdiagonal elements of the lower bidiagonal matrix L. **e** can also be regarded as containing the $(n - 1)$ superdiagonal elements of the upper bidiagonal matrix U.

3: **info – int32 scalar**

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

6 Error Indicators and Warnings

Errors or warnings detected by the function:

info $= -i$

If **info** $= -i$, parameter i had an illegal value on entry. The parameters are numbered as follows: 1: **n**, 2: **d**, 3: **e**, 4: **info**.

info > 0

If **info** $= i$, the leading minor of order i is not positive-definite. If $i < \mathbf{n}$, the factorization could not be completed, while if $i = \mathbf{n}$, the factorization was completed, but $\mathbf{d}(\mathbf{n}) \leq 0$.

7 Accuracy

The computed factorization satisfies an equation of the form

$$A + E = LDL^{\mathrm{T}},$$

where

$$\|E\|_{\infty} = O(\epsilon)\|A\|_{\infty}$$

and ϵ is the ***machine precision***.

Following the use of this function, f07je can be used to solve systems of equations $AX = B$, and f07jg can be used to estimate the condition number of A.

8 Further Comments

The total number of floating-point operations required to factorize the matrix A is proportional to n.

The complex analogue of this function is f07jr.

9 Example

```
d = [4;
     10;
     29;
     25;
     5];
e = [-2;
```

```
     -6;
     15;
     8];
[dOut, eOut, info] = f07jd(d, e)
```

```
dOut =
     4
     9
    25
    16
     1
eOut =
   -0.5000
   -0.6667
    0.6000
    0.5000
info =
           0
```