

NAG Toolbox for MATLAB

f07jg

1 Purpose

f07jg computes the reciprocal condition number of a real n by n symmetric positive-definite tridiagonal matrix A , using the LDL^T factorization returned by f07jd.

2 Syntax

```
[rcond, info] = f07jg(d, e, anorm, 'n', n)
```

3 Description

f07jg should be preceded by a call to f07jd, which computes a modified Cholesky factorization of the matrix A as

$$A = LDL^T,$$

where L is a unit lower bidiagonal matrix and D is a diagonal matrix, with positive diagonal elements. f07jg then utilizes the factorization to compute $\|A^{-1}\|_1$ by a direct method, from which the reciprocal of the condition number of A , $1/\kappa(A)$ is computed as

$$1/\kappa_1(A) = 1/(\|A\|_1\|A^{-1}\|_1).$$

$1/\kappa(A)$ is returned, rather than $\kappa(A)$, since when A is singular $\kappa(A)$ is infinite.

4 References

Higham N J 2002 *Accuracy and Stability of Numerical Algorithms* (2nd Edition) SIAM, Philadelphia

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 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 $\max(1, \mathbf{n} - 1)$.

Must contain the $(n - 1)$ subdiagonal elements of the unit lower bidiagonal matrix L . **e** can also be regarded as the superdiagonal of the unit upper bidiagonal matrix U from the $U^T D U$ factorization of A .

3: **anorm** – double scalar

$\|A\|_1$. **anorm** may be computed by calling Missing 'id' with the argument **norm_p** = 'O', and must be computed either before calling f07jd, or else from a copy of the original 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: $n \geq 0$.

5.3 Input Parameters Omitted from the MATLAB Interface

work

5.4 Output Parameters

1: **rcond** – double scalar

The reciprocal condition number, $1/\kappa_1(A) = 1/(\|A\|_1\|A^{-1}\|_1)$.

2: **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: **anorm**, 5: **rcond**, 6: **work**, 7: **info**.

It is possible that **info** refers to a parameter that is omitted from the MATLAB interface. This usually indicates that an error in one of the other input parameters has caused an incorrect value to be inferred.

7 Accuracy

The computed condition number will be the exact condition number for a closely neighbouring matrix.

8 Further Comments

The condition number estimation requires $O(n)$ floating-point operations.

See Section 15.6 of Higham 2002 for further details on computing the condition number of tridiagonal matrices.

The complex analogue of this function is f07ju.

9 Example

```
d = [4;
      9;
      25;
      16;
      1];
e = [-0.5;
     -0.6666666666666666;
      0.6;
      0.5];
anorm = 50;
[rcond, info] = f07jg(d, e, anorm)

rcond =
    0.0095
```

info = 0
