NAG Toolbox for MATLAB

f07uj

1 Purpose

f07uj computes the inverse of a real triangular matrix, using packed storage.

2 Syntax

```
[ap, info] = f07uj(uplo, diag, n, ap)
```

3 Description

f07uj forms the inverse of a real triangular matrix A, using packed storage. Note that the inverse of an upper (lower) triangular matrix is also upper (lower) triangular.

4 References

Du Croz J J and Higham N J 1992 Stability of methods for matrix inversion *IMA J. Numer. Anal.* **12** 1–19

5 Parameters

5.1 Compulsory Input Parameters

1: **uplo – string**

Indicates whether A is upper or lower triangular.

uplo = 'U'

A is upper triangular.

uplo = 'L'

A is lower triangular.

Constraint: **uplo** = 'U' or 'L'.

2: **diag – string**

Indicates whether A is a nonunit or unit triangular matrix.

diag = 'N'

A is a nonunit triangular matrix.

diag = 'U'

A is a unit triangular matrix; the diagonal elements are not referenced and are assumed to be 1.

Constraint: **diag** = 'N' or 'U'.

3: **n – int32 scalar**

n, the order of the matrix A.

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

4: **ap**$(*)$ **– double array**

Note: the dimension of the array **ap** must be at least $\max(1, \mathbf{n} \times (\mathbf{n}+1)/2)$.

The n by n triangular matrix A, packed by columns.

More precisely,

if **uplo** = 'U', the upper triangle of A must be stored with element A_{ij} in $\mathbf{ap}(i+j(j-1)/2)$ for $i \leq j$;
if **uplo** = 'L', the lower triangle of A must be stored with element A_{ij} in $\mathbf{ap}(i+(2n-j)(j-1)/2)$ for $i \geq j$.

If **diag** = 'U', the diagonal elements of A are assumed to be 1, and are not referenced; the same storage scheme is used whether **diag** = 'N' or 'U'.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **ap**$(*)$ **– double array**

Note: the dimension of the array **ap** must be at least $\max(1, \mathbf{n} \times (\mathbf{n}+1)/2)$.

A contains A^{-1}, using the same storage format as described above.

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: **uplo**, 2: **diag**, 3: **n**, 4: **ap**, 5: **info**.

info > 0

If **info** $= i$, $a(i,i)$ is exactly zero; A is singular and its inverse can not be computed.

7 Accuracy

The computed inverse X satisfies

$$|XA - I| \leq c(n)\epsilon|X||A|,$$

where $c(n)$ is a modest linear function of n, and ϵ is the ***machine precision***.

Note that a similar bound for $|AX - I|$ cannot be guaranteed, although it is almost always satisfied.

The computed inverse satisfies the forward error bound

$$\left|X - A^{-1}\right| \leq c(n)\epsilon\left|A^{-1}\right||A||X|.$$

See Du Croz and Higham 1992.

8 Further Comments

The total number of floating-point operations is approximately $\frac{1}{3}n^3$.

The complex analogue of this function is f07uw.

9 Example

```
uplo = 'L';
diag = 'N';
n = int32(4);
ap = [4.3;
     -3.96;
     0.4;
     -0.27;
     -4.87;
     0.31;
     0.07000000000000001;
     -8.02;
     -5.95;
     0.12];
[apOut, info] = f07uj(uplo, diag, n, ap)
```

```
apOut =
    0.2326
   -0.1891
    0.0043
    0.8463
   -0.2053
   -0.0079
   -0.2738
   -0.1247
   -6.1825
    8.3333
info =
           0
```