

NAG Toolbox for MATLAB

f07tj

1 Purpose

f07tj computes the inverse of a real triangular matrix.

2 Syntax

```
[a, info] = f07tj(uplo, diag, a, 'n', n)
```

3 Description

f07tj forms the inverse of a real triangular matrix A . 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: **a(lda,*)** – double array

The first dimension of the array **a** must be at least $\max(1, \mathbf{n})$

The second dimension of the array must be at least $\max(1, \mathbf{n})$

The n by n matrix A .

If **uplo** = 'U', A is upper triangular and the elements of the array below the diagonal are not referenced.

If **uplo** = 'L', A is lower triangular and the elements of the array above the diagonal are not referenced.

If **diag** = 'U', the diagonal elements of A are assumed to be 1, and are not referenced.

5.2 Optional Input Parameters

1: **n** – **int32 scalar**

Default: The second dimension of the array **a**.

n , the order of the matrix A .

Constraint: $n \geq 0$.

5.3 Input Parameters Omitted from the MATLAB Interface

lda

5.4 Output Parameters

1: **a(lda,*)** – **double array**

The first dimension of the array **a** must be at least $\max(1, n)$

The second dimension of the array must be at least $\max(1, n)$

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: **a**, 5: **lda**, 6: **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.

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

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

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 f07tw.

9 Example

```

uplo = 'L';
diag = 'N';
a = [4.3, 0, 0, 0;
     -3.96, -4.87, 0, 0;
     0.4, 0.31, -8.02, 0;
     -0.27, 0.07, -5.95, 0.12];
[aOut, info] = f07tj(uplo, diag, a)

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

```