NAG Toolbox

nag_lapack_dtrtri (f07tj)

1 Purpose

nag_lapack_dtrtri (f07tj) computes the inverse of a real triangular matrix.

2 Syntax

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

3 Description

nag_lapack_dtrtri (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** – CHARACTER(1)

Specifies 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** – CHARACTER(1)

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**$(lda, :)$ – REAL (KIND=nag_wp) array

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

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

The n by n triangular 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** – INTEGER

Default: the first dimension of the array **a** and the second dimension of the array **a**.

n, the order of the matrix A.

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

5.3 Output Parameters

1: **a**$(lda, :)$ – REAL (KIND=nag_wp) array

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

The second dimension of the array **a** will be $\max(1, \mathbf{n})$.

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

2: **info** – INTEGER

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

6 Error Indicators and Warnings

info < 0

If **info** $= -i$, argument i had an illegal value. An explanatory message is output, and execution of the program is terminated.

info > 0 (*warning*)

Element $\langle value \rangle$ of the diagonal is exactly zero. A is singular its inverse cannot 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 nag_lapack_ztrtri (f07tw).

9 Example

This example computes the inverse of the matrix A, where

$$A = \begin{pmatrix} 4.30 & 0.00 & 0.00 & 0.00 \\ -3.96 & -4.87 & 0.00 & 0.00 \\ 0.40 & 0.31 & -8.02 & 0.00 \\ -0.27 & 0.07 & -5.95 & 0.12 \end{pmatrix}.$$

9.1 Program Text

```
     function f07tj_example

fprintf('f07tj example results\n\n');

% Invert A, where A is Lower triangular
a = [ 4.30,  0,     0,    0;
     -3.96, -4.87,  0,    0;
      0.40,  0.31, -8.02, 0;
     -0.27,  0.07, -5.95, 0.12];

% Compute inverse
uplo = 'L';
diag = 'N';
[ainv, info] = f07tj(uplo, diag, a);

% Dispaly inverse
[ifail] = x04ca( ...
                 uplo, diag, ainv, 'Inverse');
```

9.2 Program Results

```
     f07tj example results

 Inverse
             1          2          3          4
 1      0.2326
 2     -0.1891    -0.2053
 3      0.0043    -0.0079    -0.1247
 4      0.8463    -0.2738    -6.1825     8.3333
```