

NAG Library Routine Document

F07TJF (DTRTRI)

Note: before using this routine, please read the Users' Note for your implementation to check the interpretation of *bold italicised* terms and other implementation-dependent details.

1 Purpose

F07TJF (DTRTRI) computes the inverse of a real triangular matrix.

2 Specification

```
SUBROUTINE F07TJF(UPLO, DIAG, N, A, LDA, INFO)
  INTEGER          N, LDA, INFO
  double precision A(LDA,*)
  CHARACTER*1     UPLO, DIAG
```

The routine may be called by its LAPACK name *dtrtri*.

3 Description

F07TJF (DTRTRI) 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

- 1: UPLO – CHARACTER*1 *Input*
On entry: 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 – CHARACTER*1 *Input*
On entry: 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 – INTEGER *Input*
On entry: n , the order of the matrix A .
Constraint: $N \geq 0$.

4: A(LDA,*) – *double precision* array *Input/Output*

Note: the second dimension of the array A must be at least $\max(1, N)$.

On entry: 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.

On exit: A is overwritten by A^{-1} , using the same storage format as described above.

5: LDA – INTEGER *Input*

On entry: the first dimension of the array A as declared in the (sub)program from which F07TJF (DTRTRI) is called.

Constraint: $LDA \geq \max(1, N)$.

6: INFO – INTEGER *Output*

On exit: INFO = 0 unless the routine detects an error (see Section 6).

6 Error Indicators and Warnings

Errors or warnings detected by the routine:

INFO < 0

If INFO = $-i$, the i th parameter had an illegal value. An explanatory message is output, and execution of the program is terminated.

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 routine is F07TWF (ZTRTRI).

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

```
*      F07TJF Example Program Text
*      Mark 15 Release. NAG Copyright 1991.
*      .. Parameters ..
INTEGER          NIN, NOUT
PARAMETER       (NIN=5,NOUT=6)
INTEGER          NMAX, LDA
PARAMETER       (NMAX=8,LDA=NMAX)
CHARACTER       DIAG
PARAMETER       (DIAG='N')
*      .. Local Scalars ..
INTEGER          I, IFAIL, INFO, J, N
CHARACTER       UPLO
*      .. Local Arrays ..
DOUBLE PRECISION A(LDA,NMAX)
*      .. External Subroutines ..
EXTERNAL        DTRTRI, X04CAF
*      .. Executable Statements ..
WRITE (NOUT,*) 'F07TJF Example Program Results'
*      Skip heading in data file
READ (NIN,*)
READ (NIN,*) N
IF (N.LE.NMAX) THEN
*
*      Read A from data file
*
      READ (NIN,*) UPLO
      IF (UPLO.EQ.'U') THEN
        READ (NIN,*) ((A(I,J),J=I,N),I=1,N)
      ELSE IF (UPLO.EQ.'L') THEN
        READ (NIN,*) ((A(I,J),J=1,I),I=1,N)
      END IF
*
*      Compute inverse of A
*
      CALL DTRTRI(UPLO,DIAG,N,A,LDA,INFO)
*
*      Print inverse
*
      WRITE (NOUT,*)
      IFAIL = 0
      CALL X04CAF(UPLO,DIAG,N,N,A,LDA,'Inverse',IFAIL)
END IF
*
      END
```

9.2 Program Data

```
F07TJF Example Program Data
  4                               :Value of N
  'L'                             :Value of UPLO
  4.30
 -3.96  -4.87
  0.40   0.31  -8.02
 -0.27   0.07  -5.95   0.12   :End of matrix A
```

9.3 Program Results

F07TJF Example Program 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
