

NAG Library Routine Document

F07UJF (DTPTRI)

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

F07UJF (DTPTRI) computes the inverse of a real triangular matrix, using packed storage.

2 Specification

```
SUBROUTINE F07UJF (UPLO, DIAG, N, AP, INFO)
```

```
INTEGER          N, INFO
REAL (KIND=nag_wp) AP(*)
CHARACTER(1)     UPLO, DIAG
```

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

3 Description

F07UJF (DTPTRI) 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

- 1: UPLO – CHARACTER(1) *Input*
On entry: 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) *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: AP(*) – REAL (KIND=nag_wp) array Input/Output
Note: the dimension of the array AP must be at least $\max(1, N \times (N + 1)/2)$.
On entry: 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
 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
 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'.
On exit: A is overwritten by A^{-1} , using the same storage format as described above.
- 5: 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 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

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

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 F07UWF (ZTPTRI).

9 Example

This example computes the inverse of the matrix A , where

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

using packed storage.

9.1 Program Text

```

Program f07ujfe

!      F07UJF Example Program Text

!      Mark 24 Release. NAG Copyright 2012.

!      .. Use Statements ..
Use nag_library, Only: dtptri, nag_wp, x04ccf
!      .. Implicit None Statement ..
Implicit None
!      .. Parameters ..
Integer, Parameter          :: nin = 5, nout = 6
Character (1), Parameter   :: diag = 'N'
!      .. Local Scalars ..
Integer                    :: i, ifail, info, j, n
Character (1)              :: uplo
!      .. Local Arrays ..
Real (Kind=nag_wp), Allocatable :: ap(:)
!      .. Executable Statements ..
Write (nout,*) 'F07UJF Example Program Results'
!      Skip heading in data file
Read (nin,*)
Read (nin,*) n

Allocate (ap(n*(n+1)/2))

!      Read A from data file

Read (nin,*) uplo
If (uplo=='U') Then
  Read (nin,*)((ap(i+j*(j-1)/2),j=i,n),i=1,n)
Else If (uplo=='L') Then
  Read (nin,*)((ap(i+(2*n-j)*(j-1)/2),j=1,i),i=1,n)
End If

!      Compute inverse of A
!      The NAG name equivalent of dtptri is f07ujf
Call dtptri(uplo,diag,n,ap,info)

!      Print inverse

Write (nout,*)
Flush (nout)

!      ifail: behaviour on error exit
!      =0 for hard exit, =1 for quiet-soft, =-1 for noisy-soft
ifail = 0
Call x04ccf(uplo,diag,n,ap,'Inverse',ifail)

End Program f07ujfe

```

9.2 Program Data

F07UJF 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

F07UJF 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
```
