NAG Toolbox

nag_lapack_dgetri (f07aj)

1 Purpose

nag_lapack_dgetri (f07aj) computes the inverse of a real matrix A, where A has been factorized by nag_lapack_dgetrf (f07ad).

2 Syntax

```
[a, info] = nag_lapack_dgetri(a, ipiv, 'n', n)
[a, info] = f07aj(a, ipiv, 'n', n)
```

3 Description

nag_lapack_dgetri (f07aj) is used to compute the inverse of a real matrix A, the function must be preceded by a call to nag_lapack_dgetrf (f07ad), which computes the LU factorization of A as $A = PLU$. The inverse of A is computed by forming U^{-1} and then solving the equation $XPL = U^{-1}$ for X.

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: **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 LU factorization of A, as returned by nag_lapack_dgetrf (f07ad).

2: **ipiv**$(:)$ – INTEGER array

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

The pivot indices, as returned by nag_lapack_dgetrf (f07ad).

5.2 Optional Input Parameters

1: **n** – INTEGER

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

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 $\max(1, \mathbf{n})$.

The factorization stores the n by n matrix A^{-1}.

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 zero. U is singular, and the inverse of A cannot be computed.

7 Accuracy

The computed inverse X satisfies a bound of the form:

$$|XA - I| \leq c(n)\epsilon|X|P|L||U|,$$

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. See Du Croz and Higham (1992).

8 Further Comments

The total number of floating-point operations is approximately $\frac{4}{3}n^3$.

The complex analogue of this function is nag_lapack_zgetri (f07aw).

9 Example

This example computes the inverse of the matrix A, where

$$A = \begin{pmatrix} 1.80 & 2.88 & 2.05 & -0.89 \\ 5.25 & -2.95 & -0.95 & -3.80 \\ 1.58 & -2.69 & -2.90 & -1.04 \\ -1.11 & -0.66 & -0.59 & 0.80 \end{pmatrix}.$$

Here A is nonsymmetric and must first be factorized by nag_lapack_dgetrf (f07ad).

9.1 Program Text

```
     function f07aj_example

fprintf('f07aj example results\n\n');

a = [ 1.80,  2.88,  2.05, -0.89;
      5.25, -2.95, -0.95, -3.80;
      1.58, -2.69, -2.90, -1.04;
     -1.11, -0.66, -0.59,  0.80];

% Factorize a
[af, ipiv, info] = f07ad(a);
```

```
% Compute inverse of a
[ainv, info] = f07aj(af, ipiv);

[ifail] = x04ca( ...
                 'General', ' ', ainv, 'Inverse');
```

9.2 Program Results

```
     f07aj example results

 Inverse
             1          2          3          4
 1      1.7720     0.5757     0.0843     4.8155
 2     -0.1175    -0.4456     0.4114    -1.7126
 3      0.1799     0.4527    -0.6676     1.4824
 4      2.4944     0.7650    -0.0360     7.6119
```