

NAG Toolbox for MATLAB

f07aj

1 Purpose

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

2 Syntax

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

3 Description

f07aj is used to compute the inverse of a real matrix A , the function must be preceded by a call to 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,*)** – 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 LU factorization of A , as returned by f07ad.

2: **ipiv(*)** – int32 array

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

The pivot indices, as returned by f07ad.

5.2 Optional Input Parameters

1: **n** – int32 scalar

Default: The second dimension of the array **a** The dimension of the array **ipiv**.
 n , the order of the matrix A .

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

5.3 Input Parameters Omitted from the MATLAB Interface

lda, work, lwork

5.4 Output Parameters

1: **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 factorization contains the n by n matrix A^{-1} .

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: **n**, 2: **a**, 3: **lda**, 4: **ipiv**, 5: **work**, 6: **lwork**, 7: **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 , the i th diagonal element of the factor U 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 f07aw.

9 Example

```
a = [5.25, -2.95, -0.95, -3.8;
      0.3428571428571429, 3.891428571428571, 2.375714285714285,
      0.4128571428571428;
      0.300952380952381, -0.4631179637787567, -1.513859275575135,
      0.2948206069505628;
      -0.2114285714285714, -0.3298825256975037, 0.004723367663983707,
      0.1313732394878517];
ipiv = [int32(2);
        int32(2);
        int32(3);
        int32(4)];
[aOut, info] = f07aj(a, ipiv)

aOut =
    1.7720    0.5757    0.0843    4.8155
   -0.1175   -0.4456    0.4114   -1.7126
    0.1799    0.4527   -0.6676    1.4824
    2.4944    0.7650   -0.0360    7.6119
info =
```

0
