

NAG Toolbox for MATLAB

f03aa

1 Purpose

f03aa calculates the determinant of a real matrix using an LU factorization with partial pivoting.

2 Syntax

```
[a, det, ifail] = f03aa(a, 'n', n)
```

3 Description

f03aa calculates the determinant of A using the LU factorization with partial pivoting, $PA = LU$, where P is a permutation matrix, L is lower triangular and U is unit upper triangular. The determinant of A is the product of the diagonal elements of L with the correct sign determined by the row interchanges.

4 References

Wilkinson J H and Reinsch C 1971 *Handbook for Automatic Computation II, Linear Algebra* Springer-Verlag

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 n by n matrix A .

5.2 Optional Input Parameters

1: **n** – int32 scalar

Default: The second dimension of the array **a**.

n , the order of the matrix A .

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

5.3 Input Parameters Omitted from the MATLAB Interface

lda, wkspce

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

A contains the factors L and U , except that the unit diagonal elements of U are not stored.

2: **det** – double scalar

The determinant of A .

3: **ifail** – **int32 scalar**

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

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

The matrix A is singular, possibly due to rounding errors. The factorization could not be completed. **det** is set to 0.0.

ifail = 2

Overflow. The value of the determinant is too large to be held in the computer.

ifail = 3

Underflow. The value of the determinant is too small to be held in the computer.

ifail = 4

On entry, $\mathbf{n} < 0$,
or $\mathbf{lda} < \max(1, \mathbf{n})$.

7 Accuracy

The accuracy of the determinant depends on the conditioning of the original matrix. For a detailed error analysis see page 107 of Wilkinson and Reinsch 1971.

8 Further Comments

The time taken by f03aa is approximately proportional to n^3 .

9 Example

```
a = [33, 16, 72;
     -24, -10, -57;
     -8, -4, -17];
[aOut, det, ifail] = f03aa(a)

aOut =
   -8.0000    0.5000    2.1250
  -24.0000    2.0000   -3.0000
   33.0000   -0.5000    0.3750
det =
     6
ifail =
     0
```