

NAG Toolbox for MATLAB

f03ab

1 Purpose

f03ab calculates the determinant of a real symmetric positive-definite matrix using a Cholesky factorization.

2 Syntax

```
[a, det, ifail] = f03ab(a, 'n', n)
```

3 Description

The determinant of A is calculated using the Cholesky factorization $A = LL^T$, where L is lower triangular. The determinant of A is the product of the squares of the diagonal elements of L .

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 upper triangle of the n by n positive-definite symmetric matrix A . The elements of the array below the diagonal need not be set.

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

The subdiagonal elements of the lower triangular matrix L . The upper triangle of A is unchanged.

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 not positive-definite, 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, **n** < 0,
or **lda** < max(1, **n**).

7 Accuracy

The accuracy of the determinant depends on the conditioning of the original matrix. For a detailed error analysis see page 25 of Wilkinson and Reinsch 1971.

8 Further Comments

The time taken by f03ab is approximately proportional to n^3 .

9 Example

```
a = [5, 7, 6, 5;
      7, 10, 8, 7;
      6, 8, 10, 9;
      5, 7, 9, 10];
[aOut, det, ifail] = f03ab(a)

aOut =
    5.0000    7.0000    6.0000    5.0000
    3.1305   10.0000    8.0000    7.0000
    2.6833   -0.8944   10.0000    9.0000
    2.2361         0    2.1213   10.0000
det =
    1.0000
ifail =
         0
```