

NAG Toolbox for MATLAB

f03ae

1 Purpose

f03ae computes a Cholesky factorization of a real symmetric positive-definite matrix, and evaluates the determinant.

2 Syntax

```
[a, p, d1, id, ifail] = f03ae(a, 'n', n)
```

3 Description

f03ae computes the Cholesky factorization of a real symmetric positive-definite matrix $A = LL^T$ where L is lower triangular. The determinant 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

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: **p(*)** – double array

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

The reciprocals of the diagonal elements of L .

3: **d1** – double scalar

4: **id** – int32 scalar

The determinant of A is given by $\mathbf{d1} \times 2.0^{\mathbf{id}}$. It is given in this form to avoid overflow or underflow.

5: **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. **d1** and **id** are set to zero.

ifail = 2

On entry, **n** < 0,
or **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 25 of Wilkinson and Reinsch 1971.

8 Further Comments

The time taken by f03ae is approximately proportional to n^3 .

9 Example

```
a = [6, 7, 6, 5;
      7, 11, 8, 7;
      6, 8, 11, 9;
      5, 7, 9, 11];
[aOut, p, d1, id, ifail] = f03ae(a)

aOut =
    6.0000    7.0000    6.0000    5.0000
    2.8577   11.0000    8.0000    7.0000
    2.4495    0.5941   11.0000    9.0000
    2.0412    0.6931    1.6645   11.0000

p =
    0.4082
    0.5941
    0.4639
    0.5283

d1 =
    0.0691

id =
    12
```

```
ifail =  
      0
```
