

NAG Toolbox for MATLAB

f01ad

1 Purpose

f01ad calculates the approximate inverse of a real symmetric positive-definite matrix, using a Cholesky factorization.

2 Syntax

```
[a, ifail] = f01ad(a, 'n', n)
```

3 Description

To compute the inverse X of a real symmetric positive-definite matrix A , f01ad first computes a Cholesky factorization of A as $A = LL^T$, where L is lower triangular. It then computes L^{-1} and finally forms X as the product $L^{-T}L^{-1}$.

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 $n + 1$

The second dimension of the array must be at least $\max(1, n)$

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: $n \geq 0$.

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 $n + 1$

The second dimension of the array must be at least $\max(1, n)$

The lower triangle of the inverse matrix X is stored in the elements of the array below the diagonal, in rows 2 to $n + 1$; x_{ij} is stored in $\mathbf{a}(i + 1, j)$ for $i \geq j$. The upper triangle of the original matrix is unchanged.

2: **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.

ifail = 2

On entry, **n** < 0,
or **lda** < **n** + 1.

7 Accuracy

The accuracy of the computed inverse depends on the conditioning of the original matrix. For a detailed error analysis see page 39 of Wilkinson and Reinsch 1971.

8 Further Comments

The time taken by f01ad is approximately proportional to n^3 . f01ad calls functions f07fd and f07fj from LAPACK.

9 Example

```
a = [5, 7, 6, 5;
      7, 10, 8, 7;
      6, 8, 10, 9;
      5, 7, 9, 10;
      0, 0, 0, 0];
[aOut, ifail] = f01ad(a)

aOut =
    5.0000    7.0000    6.0000    5.0000
   68.0000   10.0000    8.0000    7.0000
  -41.0000   25.0000   10.0000    9.0000
  -17.0000   10.0000    5.0000   10.0000
   10.0000   -6.0000   -3.0000    2.0000
ifail =
      0
```