

NAG Toolbox for MATLAB

f04ar

1 Purpose

f04ar calculates the approximate solution of a set of real linear equations with a single right-hand side, using an LU factorization with partial pivoting.

2 Syntax

```
[a, c, ifail] = f04ar(a, b, 'n', n)
```

3 Description

Given a set of linear equations, $Ax = b$, the function first computes an LU factorization of A with partial pivoting, $PA = LU$, where P is a permutation matrix, L is lower triangular and U is unit upper triangular. The approximate solution x is found by forward and backward substitution in $Ly = Pb$ and $Ux = y$, where b is the right-hand side.

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 .

2: **b(*)** – double array

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

The right-hand side vector b .

5.2 Optional Input Parameters

1: **n** – int32 scalar

Default: The second dimension of the array **a** The dimension of the array **b**.
 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 $\max(1, n)$

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

The array contains the lower triangular matrix L and the off-diagonal elements of the upper triangular matrix U . The unit diagonal elements of U are not stored.

2: **c(*)** – double array

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

The solution vector x .

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.

ifail = 2

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

7 Accuracy

The accuracy of the computed solution 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 f04ar is approximately proportional to n^3 .

9 Example

```
a = [33, 16, 72;
      -24, -10, -57;
      -8, -4, -17];
b = [-359;
      281;
      85];
[aOut, c, ifail] = f04ar(a, b)

aOut =
   -8.0000    0.5000    2.1250
  -24.0000    2.0000   -3.0000
   33.0000   -0.5000    0.3750
c =
     1
    -2
    -5
ifail =
```

0
