

NAG Toolbox for MATLAB

f04aj

1 Purpose

f04aj calculates the approximate solution of a set of real linear equations with multiple right-hand sides, $AX = B$, where A has been factorized by f03af.

2 Syntax

```
[b] = f04aj(a, p, b, 'n', n, 'ir', ir)
```

3 Description

To solve a set of real linear equations $AX = B$, f04aj must be preceded by a call to f03af which 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 columns x of the solution X are found by forward and backward substitution in $Ly = Pb$ and $Ux = y$, where b is a column of the right-hand sides.

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,n) – double array**
lda, the first dimension of the array, must be at least **n**.
 Details of the LU factorization, as returned by f03af.
- 2: **p(n) – double array**
 Details of the row interchanges as returned by f03af.
- 3: **b(ldb,ir) – double array**
ldb, the first dimension of the array, must be at least **n**.
 The n by r right-hand side matrix B .

5.2 Optional Input Parameters

- 1: **n – int32 scalar**
Default: The dimension of the arrays **a**, **p**. (An error is raised if these dimensions are not equal.)
n, the order of the matrix A .
Constraint: $n \geq 0$.
- 2: **ir – int32 scalar**
Default: The dimension of the array **b**.
r, the number of right-hand sides.

5.3 Input Parameters Omitted from the MATLAB Interface

lda, ldb

5.4 Output Parameters

1: **b(ldb,ir)** – double array

The array contains the solution matrix X .

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

On entry, **n** < 1,
or **ir** < 1,
or **lda** < **n**,
or **ldb** < **n**.

7 Accuracy

The accuracy of the computed solutions depends on the conditioning of the original matrix. For a detailed error analysis see page 106 of Wilkinson and Reinsch 1971.

8 Further Comments

The time taken by f04aj is approximately proportional to n^2r .

9 Example

```
a = [-8, 0.5, 2.125;  
     -24, 2, -3;  
     33, -0.5, 0.375];  
p = [3;  
     2;  
     3];  
b = [-359;  
     281;  
     85];  
[bOut] = f04aj(a, p, b)
```

```
bOut =  
     1  
    -2  
    -5
```