NAG Toolbox for MATLAB

f03ad

1 Purpose

f03ad calculates the determinant of a complex matrix using an LU factorization with partial pivoting.

2 Syntax

```
[a, detr, deti, ifail] = f03ad(a, 'n', n)
```

3 Description

f03ad calculates the determinant of A using the LU factorization with partial pivoting, $PA = LU$, where P is a permutation matrix, L is lower triangular and U is unit upper triangular. The determinant of A is the product of the diagonal elements of L, with the correct sign determined by the row interchanges.

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**,$*$) – **complex 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.

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**,$*$) – **complex 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 $\max(1, \mathbf{n})$

A contains the factors L and U, except that the unit diagonal elements of U are not stored.

2: **detr – double scalar**
3: **deti – double scalar**

The real part and imaginary parts of the determinant of A.

4: **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. The factorization could not be completed. **detr** and **deti** are 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, $\mathbf{n} < 0$,
or $\mathbf{lda} < \max(1, \mathbf{n})$.

7 Accuracy

The accuracy of the determinant depends on the conditioning of the original matrix. For a detailed error analysis, see page 107 of Wilkinson and Reinsch 1971.

8 Further Comments

The time taken by f03ad is approximately proportional to n^3.

9 Example

```
a = [complex(1, +0), complex(1, +2), complex(2, +10);
     complex(1, +1), complex(0, +3), complex(-5, +14);
     complex(1, +1), complex(0, +5), complex(-8, +20)];
[aOut, detr, deti, ifail] = f03ad(a)
```

```
aOut =
   1.0000             1.0000 + 2.0000i   2.0000 +10.0000i
   1.0000 + 1.0000i   1.0000 + 2.0000i   3.2000 + 1.6000i
   1.0000 + 1.0000i   1.0000            -0.2000 + 0.4000i
detr =
     1
deti =
   4.4409e-16
ifail =
           0
```