

NAG Toolbox

nag_det_real_gen (f03ba)

1 Purpose

nag_det_real_gen (f03ba) computes the determinant of a real n by n matrix A . nag_lapack_dgetrf (f07ad) must be called first to supply the matrix A in factorized form.

2 Syntax

```
[d, id, ifail] = nag_det_real_gen(a, ipiv, 'n', n)
[d, id, ifail] = f03ba(a, ipiv, 'n', n)
```

3 Description

nag_det_real_gen (f03ba) computes the determinant of a real n by n matrix A that has been factorized by a call to nag_lapack_dgetrf (f07ad). The determinant of A is the product of the diagonal elements of U 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,:) – REAL (KIND=nag_wp) array

The first dimension of the array **a** must be at least **n**.

The second dimension of the array **a** must be at least **n**.

The n by n matrix A in factorized form as returned by nag_lapack_dgetrf (f07ad).

2: **ipiv**(n) – INTEGER array

The row interchanges used to factorize matrix A as returned by nag_lapack_dgetrf (f07ad).

5.2 Optional Input Parameters

1: **n** – INTEGER

Default: the first dimension of the array **a** and the dimension of the array **ipiv**. (An error is raised if these dimensions are not equal.)

n , the order of the matrix A .

Constraint: **n** > 0.

5.3 Output Parameters

1: **d** – REAL (KIND=nag_wp)

2: **id** – INTEGER

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

3: **ifail** – INTEGER

ifail = 0 unless the function detects an error (see Section 5).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

Constraint: $n \geq 1$.

ifail = 3

Constraint: $lda \geq n$.

ifail = 4

The matrix A is approximately singular.

ifail = -99

An unexpected error has been triggered by this routine. Please contact NAG.

ifail = -399

Your licence key may have expired or may not have been installed correctly.

ifail = -999

Dynamic memory allocation failed.

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 `nag_det_real_gen` (f03ba) is approximately proportional to n .

9 Example

This example computes the LU factorization with partial pivoting, and calculates the determinant, of the real matrix

$$\begin{pmatrix} 33 & 16 & 72 \\ -24 & -10 & -57 \\ -8 & -4 & -17 \end{pmatrix}.$$

9.1 Program Text

```
function f03ba_example
fprintf('f03ba example results\n\n');

a = [ 33, 16, 72;
     -24, -10, -57;
     -8, -4, -17];
% Compute LU factorisation of a
[a, ipiv, info] = f07ad(a);

fprintf('\n');
```

```
[ifail] = x04ca('g', 'n', a, 'Array a after factorization');  
  
fprintf('\nPivots:\n');  
fprintf(' %d', ipiv);  
fprintf('\n\n');  
  
[d, id, ifail] = f03ba(a, ipiv);  
  
fprintf('d = %13.5f id = %d\n', d, id);  
fprintf('Value of determinant = %13.5e\n', d*2^id);
```

9.2 Program Results

f03ba example results

Array a after factorization

	1	2	3
1	33.0000	16.0000	72.0000
2	-0.7273	1.6364	-4.6364
3	-0.2424	-0.0741	0.1111

Pivots:

1 2 3

d = 0.37500 id = 4
Value of determinant = 6.00000e+00
