

## **NAG Library Chapter Introduction**

### **f03 – Determinants**

#### **Contents**

<b>1</b>	<b>Scope of the Chapter</b> .....	<b>2</b>
<b>2</b>	<b>Background to the Problems</b> .....	<b>2</b>
<b>3</b>	<b>Recommendations on Choice and Use of Available Functions</b> .....	<b>2</b>
<b>4</b>	<b>Decision Trees</b> .....	<b>2</b>
<b>5</b>	<b>Functionality Index</b> .....	<b>2</b>
<b>6</b>	<b>Auxiliary Functions Associated with Library Function Arguments</b> .....	<b>3</b>
<b>7</b>	<b>Functions Withdrawn or Scheduled for Withdrawal</b> .....	<b>3</b>
<b>8</b>	<b>References</b> .....	<b>3</b>

# 1 Scope of the Chapter

This chapter is concerned with the calculation of determinants of square matrices.

# 2 Background to the Problems

The functions in this chapter compute the determinant of a square matrix  $A$ . The matrix is assumed to have first been decomposed into triangular factors

$$A = LU,$$

using functions from Chapter f07.

If  $A$  is positive definite, then  $U = L^T$ , and the determinant is the product of the squares of the diagonal elements of  $L$ . Otherwise, the functions in this chapter use the Dolittle form of the  $LU$  decomposition, where  $L$  has unit elements on its diagonal. The determinant is then the product of the diagonal elements of  $U$ , taking account of possible sign changes due to row interchanges.

To avoid overflow or underflow in the computation of the determinant, some scaling is associated with each multiplication in the product of the relevant diagonal elements. The final value is represented by

$$\det A = d \times 2^{id}$$

where  $id$  is an integer and

$$\frac{1}{16} \leq |d| < 1.$$

For complex valued determinants the real and imaginary parts are scaled separately.

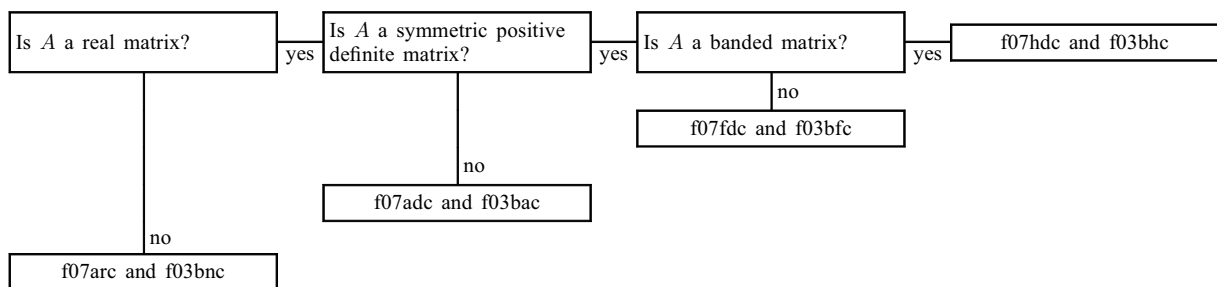
# 3 Recommendations on Choice and Use of Available Functions

It is extremely wasteful of computer time and storage to use an inappropriate function, for example to use a function requiring a complex matrix when  $A$  is real. Most programmers will know whether their matrix is real or complex, but may be less certain whether or not a real symmetric matrix  $A$  is positive definite, i.e., all eigenvalues of  $A > 0$ . A real symmetric matrix  $A$  not known to be positive definite must be treated as a general real matrix.

# 4 Decision Trees

## Tree 1

**Note:** if at any stage the answer to a question is ‘Don't know’ this should be read as ‘No’.



# 5 Functionality Index

Determinants of factorized matrices,

complex matrix .....	nag_det_complex_gen (f03bnc)
real matrix .....	nag_det_real_gen (f03bac)
real symmetric band positive definite matrix .....	nag_det_real_band_sym (f03bhc)
real symmetric positive definite matrix .....	nag_det_real_sym (f03bfc)

## 6 Auxiliary Functions Associated with Library Function Arguments

None.

## 7 Functions Withdrawn or Scheduled for Withdrawal

The following lists all those functions that have been withdrawn since Mark 23 of the Library or are scheduled for withdrawal at one of the next two marks.

<b>Withdrawn Function</b>	<b>Mark of Withdrawal</b>	<b>Replacement Function(s)</b>
nag_real_cholesky (f03aec)	25	nag_dpotrf (f07fdc) and nag_det_real_sym (f03bfc)
nag_real_lu (f03afc)	25	nag_dgetrf (f07adc) and nag_det_real_gen (f03bac)
nag_complex_lu (f03ahc)	25	nag_zgetrf (f07arc) and nag_det_complex_gen (f03bnc)

## 8 References

Fox L (1964) *An Introduction to Numerical Linear Algebra* Oxford University Press

Wilkinson J H and Reinsch C (1971) *Handbook for Automatic Computation II, Linear Algebra* Springer-Verlag

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