

NAG Library Function Document

nag_dsb_norm (f16rec)

1 Purpose

nag_dsb_norm (f16rec) calculates the value of the 1-norm, the ∞ -norm, the Frobenius norm or the maximum absolute value of the elements of a real n by n symmetric band matrix.

2 Specification

```
#include <nag.h>
#include <nagf16.h>

void nag_dsb_norm (Nag_OrderType order, Nag_NormType norm,
                  Nag_UploType uplo, Integer n, Integer k, const double ab[],
                  Integer pdab, double *r, NagError *fail)
```

3 Description

Given a real n by n symmetric band matrix, A , nag_dsb_norm (f16rec) calculates one of the values given by

$$\|A\|_1 = \max_j \sum_{i=1}^n |a_{ij}|,$$

$$\|A\|_\infty = \max_i \sum_{j=1}^n |a_{ij}|,$$

$$\|A\|_F = \left(\sum_{i=1}^n \sum_{j=1}^n |a_{ij}|^2 \right)^{1/2}$$

or

$$\max_{i,j} |a_{ij}|.$$

Note that, since A is symmetric, $\|A\|_1 = \|A\|_\infty$.

4 References

Basic Linear Algebra Subprograms Technical (BLAST) Forum (2001) *Basic Linear Algebra Subprograms Technical (BLAST) Forum Standard* University of Tennessee, Knoxville, Tennessee <http://www.netlib.org/blas/blast-forum/blas-report.pdf>

5 Arguments

1: **order** – Nag_OrderType *Input*

On entry: the **order** argument specifies the two-dimensional storage scheme being used, i.e., row-major ordering or column-major ordering. C language defined storage is specified by **order** = Nag_RowMajor. See Section 2.3.1.3 in How to Use the NAG Library and its Documentation for a more detailed explanation of the use of this argument.

Constraint: **order** = Nag_RowMajor or Nag_ColMajor.

- 2: **norm** – Nag_NormType *Input*
On entry: specifies the value to be returned.
norm = Nag_OneNorm
The 1-norm.
norm = Nag_InfNorm
The ∞ -norm.
norm = Nag_FrobeniusNorm
The Frobenius (or Euclidean) norm.
norm = Nag_MaxNorm
The value $\max_{i,j} |a_{ij}|$ (not a norm).
Constraint: **norm** = Nag_OneNorm, Nag_InfNorm, Nag_FrobeniusNorm or Nag_MaxNorm.
- 3: **uplo** – Nag_UploType *Input*
On entry: specifies whether the upper or lower triangular part of A is stored.
uplo = Nag_Upper
The upper triangular part of A is stored.
uplo = Nag_Lower
The lower triangular part of A is stored.
Constraint: **uplo** = Nag_Upper or Nag_Lower.
- 4: **n** – Integer *Input*
On entry: n , the order of the matrix A .
If $n = 0$, then **n** is set to zero.
Constraint: **n** ≥ 0 .
- 5: **k** – Integer *Input*
On entry: k , the number of subdiagonals or superdiagonals of the matrix A .
Constraint: **k** ≥ 0 .
- 6: **ab**[*dim*] – const double *Input*
Note: the dimension, *dim*, of the array **ab** must be at least $\max(1, \mathbf{pdab} \times \mathbf{n})$.
On entry: the n by n symmetric band matrix A .
This is stored as a notional two-dimensional array with row elements or column elements stored contiguously. The storage of elements of A_{ij} , depends on the **order** and **uplo** arguments as follows:
- ```

if order = Nag_ColMajor and uplo = Nag_Upper,
 A_{ij} is stored in ab[$k + i - j + (j - 1) \times \mathbf{pdab}$], for $j = 1, \dots, n$ and
 $i = \max(1, j - k), \dots, j$;
if order = Nag_ColMajor and uplo = Nag_Lower,
 A_{ij} is stored in ab[$i - j + (j - 1) \times \mathbf{pdab}$], for $j = 1, \dots, n$ and
 $i = j, \dots, \min(n, j + k)$;
if order = Nag_RowMajor and uplo = Nag_Upper,
 A_{ij} is stored in ab[$j - i + (i - 1) \times \mathbf{pdab}$], for $i = 1, \dots, n$ and
 $j = i, \dots, \min(n, i + k)$;
if order = Nag_RowMajor and uplo = Nag_Lower,
 A_{ij} is stored in ab[$k + j - i + (i - 1) \times \mathbf{pdab}$], for $i = 1, \dots, n$ and
 $j = \max(1, i - k), \dots, i$.

```

- 7:     **pdab** – Integer *Input*  
       *On entry:* the stride separating row or column elements (depending on the value of **order**) of the matrix *A* in the array **ab**.  
       *Constraint:* **pdab**  $\geq$  **k** + 1.
- 8:     **r** – double \* *Output*  
       *On exit:* the value of the norm specified by **norm**.
- 9:     **fail** – NagError \* *Input/Output*  
       The NAG error argument (see Section 2.7 in How to Use the NAG Library and its Documentation).

## 6 Error Indicators and Warnings

### NE\_ALLOC\_FAIL

Dynamic memory allocation failed.  
 See Section 2.3.1.2 in How to Use the NAG Library and its Documentation for further information.

### NE\_BAD\_PARAM

On entry, argument  $\langle value \rangle$  had an illegal value.

### NE\_INT

On entry, **k** =  $\langle value \rangle$ .  
 Constraint: **k**  $\geq$  0.  
 On entry, **n** =  $\langle value \rangle$ .  
 Constraint: **n**  $\geq$  0.

### NE\_INT\_2

On entry, **pdab** =  $\langle value \rangle$ , **k** =  $\langle value \rangle$ .  
 Constraint: **pdab**  $\geq$  **k** + 1.

### NE\_INTERNAL\_ERROR

An unexpected error has been triggered by this function. Please contact NAG.  
 See Section 2.7.6 in How to Use the NAG Library and its Documentation for further information.

### NE\_NO\_LICENCE

Your licence key may have expired or may not have been installed correctly.  
 See Section 2.7.5 in How to Use the NAG Library and its Documentation for further information.

## 7 Accuracy

The BLAS standard requires accurate implementations which avoid unnecessary over/underflow (see Section 2.7 of Basic Linear Algebra Subprograms Technical (BLAST) Forum (2001)).

## 8 Parallelism and Performance

nag\_dsb\_norm (f16rec) is not threaded in any implementation.

## **9 Further Comments**

None.

## **10 Example**

See Section 10 in nag\_dpbcon (f07hgc).

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