NAG C Library Function Document

nag_dsb_norm (f16rec)

1 Purpose
nag_dsb_norm (f16rec) calculates, via the function name, the value of the 1-norm, the infinity-norm, the
Frobenius norm, or the maximum absolute value of the elements, of a real $n$ by $n$ symmetric band matrix.

2 Specification

```c
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

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

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

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

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

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

4 References


5 Parameters

1: order – Nag_OrderType  
   On entry: the order parameter 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 2.2.1.4 of the Essential Introduction for a more detailed
   explanation of the use of this parameter.
   Constraint: order = Nag_RowMajor or Nag_ColMajor.

2: norm – Nag_NormType  
   On entry: specifies the value to be returned:
   if norm = Nag_OneNorm, the 1-norm;
   if norm = Nag_InfNorm, the infinity-norm;
   if norm = Nag_FrobeniusNorm, the Frobenius (or Euclidean) norm;
   Input
if \( \text{norm} = \text{Nag\_MaxNorm} \), the value \( \max_{i,j} |a_{ij}| \) (not a norm).

**Constraint:** \( \text{norm} = \text{Nag\_OneNorm} \), \( \text{Nag\_InfNorm} \), \( \text{Nag\_FrobeniusNorm} \) or \( \text{Nag\_MaxNorm} \).

3: \( \text{uplo} \) – \text{Nag\_UploType} \hspace{1cm} \text{Input} \\
\( \text{On entry:} \) specifies whether the upper or lower triangular part of \( A \) is stored as follows:
- if \( \text{uplo} = \text{Nag\_Upper} \), the upper triangular part of \( A \) is stored;
- if \( \text{uplo} = \text{Nag\_Lower} \), the lower triangular part of \( A \) is stored.

**Constraint:** \( \text{uplo} = \text{Nag\_Upper} \) or \( \text{Nag\_Lower} \).

4: \( n \) – Integer \hspace{1cm} \text{Input} \\
\( \text{On entry:} \) \( n \), the order of the matrix \( A \).

**Constraint:** \( n \geq 0 \).

5: \( k \) – Integer \hspace{1cm} \text{Input} \\
\( \text{On entry:} \) \( k \), the number of sub-diagonals or super-diagonals of the matrix \( A \).

**Constraint:** \( k \geq 0 \).

6: \( ab[dim] \) – \text{const double} \hspace{1cm} \text{Input} \\
\( \text{Note:} \) the dimension, \( dim \), of the array \( ab \) must be at least \( \max(1, pdab \times n) \).

\( \text{On entry:} \) 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 \( a_{ij} \) depends on the \text{order} and \text{uplo} parameters as follows:
- if \( \text{order} = \text{Nag\_ColMajor} \) and \( \text{uplo} = \text{Nag\_Upper} \), \( a_{ij} \) is stored in \( ab[k + i - j + (j - 1) \times pdab] \), for \( j = 1, \ldots, n \) and \( i = \max(1, j - k), \ldots, j \);
- if \( \text{order} = \text{Nag\_ColMajor} \) and \( \text{uplo} = \text{Nag\_Lower} \), \( a_{ij} \) is stored in \( ab[i - j + (j - 1) \times pdab] \), for \( j = 1, \ldots, n \) and \( i = j, \ldots, \min(n, j + k) \);
- if \( \text{order} = \text{Nag\_RowMajor} \) and \( \text{uplo} = \text{Nag\_Upper} \), \( a_{ij} \) is stored in \( ab[j - i + (i - 1) \times pdab] \), for \( i = 1, \ldots, n \) and \( j = i, \ldots, \min(n, i + k) \);
- if \( \text{order} = \text{Nag\_RowMajor} \) and \( \text{uplo} = \text{Nag\_Lower} \), \( a_{ij} \) is stored in \( ab[k + j - i + (i - 1) \times pdab] \), for \( i = 1, \ldots, n \) and \( j = \max(1, i - k), \ldots, i \).

7: \( pdab \) – Integer \hspace{1cm} \text{Input} \\
\( \text{On entry:} \) the stride separating row or column elements (depending on the value of \text{order}) of the matrix \( A \) in the array \( ab \).

**Constraints:**
- if \( \text{order} = \text{Nag\_ColMajor} \), \( pdab \geq k + 1 \);
- if \( \text{order} = \text{Nag\_RowMajor} \), \( pdab \geq \max(1, n) \).

8: \( r \) – double \hspace{1cm} \text{Output} \\
\( \text{On exit:} \) the value of the norm specified by \text{norm}.

9: \( \text{fail} \) – \text{NagError} \hspace{1cm} \text{Input/Output} \\
The NAG error parameter (see the Essential Introduction).

\textit{f16rec.2} [NP3645/7]
6 Error Indicators and Warnings

NE_INT

On entry, \( n = \langle \text{value} \rangle \).
Constraint: \( n \geq 0 \).

On entry, \( k = \langle \text{value} \rangle \).
Constraint: \( k \geq 0 \).

On entry, \( pdab = \langle \text{value} \rangle \).
Constraint: \( pdab \geq k + 1 \).

NE_BAD_PARAM

On entry, parameter \( \langle \text{value} \rangle \) had an illegal value.

7 Accuracy

The BLAS standard requires accurate implementations which avoid unnecessary over/underflow (see section 2.7 of The BLAS Technical Forum Standard (2001)).

8 Further Comments

None.

9 Example

See Section 9 of the document for nag_dpbcon (f07hgc).