NAG Library Function Document

nag_dge_norm (f16rac)

1 Purpose
nag_dge_norm (f16rac) calculates the value of the 1-norm, the \( \infty \)-norm, the Frobenius norm, or the maximum absolute value of the elements of a real \( m \) by \( n \) matrix.

2 Specification
```c
#include <nag.h>
#include <nagf16.h>
void nag_dge_norm (Nag_OrderType order, Nag_NormType norm, Integer m, Integer n, const double a[], Integer pda, double *r, NagError *fail)
```

3 Description
Given a real \( m \) by \( n \) matrix, \( A \), nag_dge_norm (f16rac) calculates one of the values given by

\[
\|A\|_1 = \max_j \sum_{i=1}^{m} |a_{ij}|
\]

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

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

or

\[
\max_{i,j} |a_{ij}|
\]

4 References

5 Arguments
1: \textbf{order} – Nag_OrderType
   
   \textit{Input}
   
   \textit{On entry}: the \textit{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 \textit{order} = Nag_RowMajor. See Section 3.2.1.3 in the Essential Introduction for a more detailed explanation of the use of this argument.

   \textit{Constraint}: \textit{order} = Nag_RowMajor or Nag_ColMajor.
2: \texttt{norm} – Nag\_NormType \hspace{1cm} \textit{Input}

\textit{On entry:} specifies the value to be returned.

\texttt{norm} = Nag\_OneNorm
\hspace{1cm} The 1-norm.

\texttt{norm} = Nag\_InfNorm
\hspace{1cm} The $\infty$-norm.

\texttt{norm} = Nag\_FrobeniusNorm
\hspace{1cm} The Frobenius (or Euclidean) norm.

\texttt{norm} = Nag\_MaxNorm
\hspace{1cm} The value $\max_{i,j} |a_{ij}|$ (not a norm).

\textit{Constraint:} \texttt{norm} = Nag\_OneNorm, Nag\_InfNorm, Nag\_FrobeniusNorm or Nag\_MaxNorm.

3: \texttt{m} – Integer \hspace{1cm} \textit{Input}

\textit{On entry:} \texttt{m}, the number of rows of the matrix \texttt{A}.

If \texttt{m} = 0, then \texttt{r} is set to zero.

\textit{Constraint:} \texttt{m} $\geq$ 0.

4: \texttt{n} – Integer \hspace{1cm} \textit{Input}

\textit{On entry:} \texttt{n}, the number of columns of the matrix \texttt{A}.

If \texttt{n} = 0, then \texttt{r} is set to zero.

\textit{Constraint:} \texttt{n} $\geq$ 0.

5: \texttt{a[dim]} – const double \hspace{1cm} \textit{Input}

\textit{Note:} the dimension, \texttt{dim}, of the array \texttt{a} must be at least

\begin{align*}
\max(1, \texttt{pda} \times \texttt{n}) & \quad \text{when} \ \texttt{order} = \text{Nag\_ColMajor}; \\
\max(1, \texttt{m} \times \texttt{pda}) & \quad \text{when} \ \texttt{order} = \text{Nag\_RowMajor}.
\end{align*}

If \texttt{order} = Nag\_ColMajor, $A_{ij}$ is stored in \texttt{a}[$(j - 1) \times \texttt{pda} + i - 1$].

If \texttt{order} = Nag\_RowMajor, $A_{ij}$ is stored in \texttt{a}[$(i - 1) \times \texttt{pda} + j - 1$].

\textit{On entry:} the \texttt{m} by \texttt{n} matrix \texttt{A}.

6: \texttt{pda} – Integer \hspace{1cm} \textit{Input}

\textit{On entry:} the stride separating row or column elements (depending on the value of \texttt{order}) in the array \texttt{a}.

\textit{Constraints:}

\begin{align*}
\text{if} \ \texttt{order} = \text{Nag\_ColMajor}, \texttt{pda} & \geq \max(1, \texttt{m}); \\
\text{if} \ \texttt{order} = \text{Nag\_RowMajor}, \texttt{pda} & \geq \texttt{n}.
\end{align*}

7: \texttt{r} – double * \hspace{1cm} \textit{Output}

\textit{On exit:} the value of the norm specified by \texttt{norm}.

8: \texttt{fail} – NagError * \hspace{1cm} \textit{Input/Output}

The NAG error argument (see Section 3.6 in the Essential Introduction).
6 Error Indicators and Warnings

**NE_ALLOC_FAIL**
Dynamic memory allocation failed.
See Section 3.2.1.2 in the Essential Introduction for further information.

**NE_BAD_PARAM**
On entry, argument \(\langle value\rangle\) had an illegal value.

**NE_INT**
On entry, \(m = \langle value\rangle\).
Constraint: \(m \geq 0\).
On entry, \(n = \langle value\rangle\).
Constraint: \(n \geq 0\).

**NE_INT_2**
On entry, \(pda = \langle value\rangle\), \(m = \langle value\rangle\).
Constraint: \(pda \geq \max(1, m)\).
On entry, \(pda = \langle value\rangle\) and \(n = \langle value\rangle\).
Constraint: \(pda \geq n\).

**NE_INTERNAL_ERROR**
An internal error has occurred in this function. Check the function call and any array sizes. If the call is correct then please contact NAG for assistance.
An unexpected error has been triggered by this function. Please contact NAG.
See Section 3.6.6 in the Essential Introduction for further information.

**NE_NO_LICENCE**
Your licence key may have expired or may not have been installed correctly.
See Section 3.6.5 in the Essential Introduction 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
Not applicable.

9 Further Comments
None.

10 Example
See Section 10 in nag_dgecon (f07agc) and nag_dtrsna (f08qlc).