

NAG Library Routine Document

F06WAF (DLANSF)

Note: before using this routine, please read the Users' Note for your implementation to check the interpretation of ***bold italicised*** terms and other implementation-dependent details.

1 Purpose

F06WAF (DLANSF) returns the value of the 1-norm, the ∞ -norm, the Frobenius norm, or the maximum absolute value of the elements of a real symmetric matrix A stored in Rectangular Full Packed (RFP) format.

2 Specification

```
FUNCTION F06WAF (NORM, TRANSR, UPLO, N, AR, WORK)
REAL (KIND=nag_wp) F06WAF
INTEGER                N
REAL (KIND=nag_wp) AR(N*(N+1)/2), WORK(*)
CHARACTER(1)           NORM, TRANSR, UPLO
```

The routine may be called by its LAPACK name ***dlansf***.

3 Description

Given a real n by n symmetric matrix, A , F06WAF (DLANSF) calculates one of the values given by

$$\begin{aligned} \|A\|_1 &= \max_j \sum_{i=1}^n |a_{ij}| && \text{(the 1-norm of } A), \\ \|A\|_\infty &= \max_i \sum_{j=1}^n |a_{ij}| && \text{(the } \infty\text{-norm of } A), \\ \|A\|_F &= \left(\sum_{i=1}^n \sum_{j=1}^n |a_{ij}|^2 \right)^{1/2} && \text{(the Frobenius norm of } A), \quad \text{or} \\ &\max_{i,j} |a_{ij}| && \text{(the maximum absolute element value of } A). \end{aligned}$$

A is stored in compact form using the RFP format. The RFP storage format is described in Section 3.3.3 in the F07 Chapter Introduction.

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>

Gustavson F G, Waśniewski J, Dongarra J J and Langou J (2010) Rectangular full packed format for Cholesky's algorithm: factorization, solution, and inversion *ACM Trans. Math. Software* **37**, 2

5 Arguments

- 1: NORM – CHARACTER(1) *Input*
On entry: specifies the value to be returned.
 NORM = '1' or 'O'
 The 1-norm.
 NORM = 'I'
 The ∞ -norm.
 NORM = 'F' or 'E'
 The Frobenius (or Euclidean) norm.
 NORM = 'M'
 The value $\max_{i,j} |a_{ij}|$ (not a norm).
Constraint: NORM = '1', 'O', 'I', 'F', 'E' or 'M'.
- 2: TRANSR – CHARACTER(1) *Input*
On entry: specifies whether the RFP representation of A is normal or transposed.
 TRANSR = 'N'
 The matrix A is stored in normal RFP format.
 TRANSR = 'T'
 The matrix A is stored in transposed RFP format.
Constraint: TRANSR = 'N' or 'T'.
- 3: UPLO – CHARACTER(1) *Input*
On entry: specifies whether the upper or lower triangular part of A is stored.
 UPLO = 'U'
 The upper triangular part of A is stored.
 UPLO = 'L'
 The lower triangular part of A is stored.
Constraint: UPLO = 'U' or 'L'.
- 4: N – INTEGER *Input*
On entry: n , the order of the matrix A .
 When N = 0, F06WAF (DLANSF) returns zero.
Constraint: $N \geq 0$.
- 5: AR($N \times (N + 1)/2$) – REAL (KIND=nag_wp) array *Input*
On entry: the upper or lower triangular part (as specified by UPLO) of the n by n symmetric matrix A , in either normal or transposed RFP format (as specified by TRANSR). The storage format is described in detail in Section 3.3.3 in the F07 Chapter Introduction.
- 6: WORK(*) – REAL (KIND=nag_wp) array *Workspace*
Note: the dimension of the array WORK must be at least $\max(1, N)$ if NORM = '1', 'O' or 'I', and at least 1 otherwise.

6 Error Indicators and Warnings

None.

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

F06WAF (DLANSF) is not threaded in any implementation.

9 Further Comments

None.

10 Example

This example reads in the lower triangular part of a symmetric matrix, converts this to RFP format, then calculates the norm of the matrix for each of the available norm types.

10.1 Program Text

```

Program f06wafe

!      F06WAF Example Program Text

!      Mark 26 Release. NAG Copyright 2016.

!      .. Use Statements ..
      Use nag_library, Only: dlansf, dtrttf, nag_wp
!      .. Implicit None Statement ..
      Implicit None
!      .. Parameters ..
      Integer, Parameter          :: nin = 5, nout = 6
!      .. Local Scalars ..
      Real (Kind=nag_wp)          :: r_fro, r_inf, r_max, r_one
      Integer                     :: i, info, lda, n
      Character (1)                :: transr, uplo
!      .. Local Arrays ..
      Real (Kind=nag_wp), Allocatable :: a(:,,:), ar(:,), work(:)
!      .. Executable Statements ..
      Write (nout,*) 'F06WAF Example Program Results'

!      Skip heading in data file
      Read (nin,*)

      Read (nin,*) n, uplo, transr

      lda = n
      Allocate (a(lda,n),ar((n*(n+1))/2),work(n))

!      Read upper or lower triangle of matrix A from data file
      If (uplo=='L' .Or. uplo=='l') Then
        Do i = 1, n
          Read (nin,*) a(i,1:i)
        End Do
      Else
        Do i = 1, n
          Read (nin,*) a(i,i:n)
        End Do
      End If

!      Convert A to rectangular full packed storage in ar

!      The NAG name equivalent of dtrttf is f0lvef
      Call dtrttf(transr,uplo,n,a,lda,ar,info)

```

```

      Write (nout,*)
      Write (nout,99999)
      'Norms of symmetric matrix stored in RFP format in ar:'
      Write (nout,*)

!      The NAG name equivalent of dlansf is f06waf
      r_one = dlansf('1-norm',transr,uplo,n,ar,work)
      Write (nout,99998) 'One norm          = ', r_one

      r_inf = dlansf('Infinity',transr,uplo,n,ar,work)
      Write (nout,99998) 'Infinity norm     = ', r_inf

      r_fro = dlansf('Frobenius',transr,uplo,n,ar,work)
      Write (nout,99998) 'Frobenius norm    = ', r_fro

      r_max = dlansf('Max norm',transr,uplo,n,ar,work)
      Write (nout,99998) 'Maximum norm     = ', r_max

99999 Format (1X,A)
99998 Format (1X,A,F9.4)
      End Program f06waf

```

10.2 Program Data

```

F06WAF Example Program Data
  6  'L' 'N'                : N, UPLO, TRANSR
  1.0
  2.0  2.0
  3.0  3.0  3.0
  4.0  4.0  4.0  4.0
  5.0  5.0  5.0  5.0  5.0
  6.0  6.0  6.0  6.0  6.0  6.0 : Matrix A

```

10.3 Program Results

F06WAF Example Program Results

Norms of symmetric matrix stored in RFP format in ar:

One norm	=	36.0000
Infinity norm	=	36.0000
Frobenius norm	=	28.1247
Maximum norm	=	6.0000
