

# NAG Library Routine Document

## F06FAF

**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

F06FAF computes the cosine of the angle between two real vectors.

### 2 Specification

```
FUNCTION F06FAF (N, J, TOLX, X, INCX, TOLY, Y, INCY)
REAL (KIND=nag_wp) F06FAF
INTEGER          N, J, INCX, INCY
REAL (KIND=nag_wp) TOLX, X(*), TOLY, Y(*)
```

### 3 Description

F06FAF returns, via the function name, the cosine of the angle between two  $n$ -element real vectors  $x$  and  $y$ , given by the expression

$$\frac{x^T y}{\|x\|_2 \|y\|_2}.$$

If  $1 \leq j \leq n$ ,  $y$  is taken to be the unit vector  $e_j$ , in which case the array Y is not referenced.

If  $\|x\|_2 \leq \text{tolx}$ , the routine returns 2.0; if  $\|x\|_2 > \text{tolx}$  but  $\|y\|_2 \leq \text{toly}$ , the routine returns  $-2.0$ ; otherwise the value returned is in the range  $(-1.0, 1.0)$ .

### 4 References

None.

### 5 Parameters

- 1: N – INTEGER *Input*  
*On entry:*  $n$ , the number of elements in  $x$  and  $y$ .
- 2: J – INTEGER *Input*  
*On entry:* if the vector  $y$  is supplied in Y, J should be set to 0. Otherwise, J specifies the index  $j$  of the unit vector  $e_j$  to be used as  $y$ .
- 3: TOLX – REAL (KIND=nag\_wp) *Input*  
*On entry:* the value  $\text{tolx}$ , used to determine whether  $\|x\|_2$  is effectively zero.  
If TOLX is negative, the value zero is used.
- 4: X(\*) – REAL (KIND=nag\_wp) array *Input*  
**Note:** the dimension of the array X must be at least  $\max(1, 1 + (N - 1) \times |\text{INCX}|)$ .  
*On entry:* the  $n$ -element vector  $x$ .  
If  $\text{INCX} > 0$ ,  $x_i$  must be stored in  $X(1 + (i - 1) \times \text{INCX})$ , for  $i = 1, 2, \dots, N$ .  
If  $\text{INCX} < 0$ ,  $x_i$  must be stored in  $X(1 - (N - i) \times \text{INCX})$ , for  $i = 1, 2, \dots, N$ .

Intermediate elements of X are not referenced.

5: INCX – INTEGER *Input*

*On entry:* the increment in the subscripts of X between successive elements of  $x$ .

6: TOLY – REAL (KIND=nag\_wp) *Input*

*On entry:* the value  $toly$ , used to determine whether  $\|y\|_2$  is effectively zero.

If TOLY is negative, the value zero is used.

7: Y(\*) – REAL (KIND=nag\_wp) array *Input*

**Note:** the dimension of the array Y must be at least  $\max(1, 1 + (N - 1) \times |\text{INCY}|)$ .

*On entry:* if  $1 \leq J \leq N$ , Y is not referenced. Otherwise, Y holds the vector  $y$ .

If  $\text{INCY} > 0$ ,  $y_i$  must be stored in  $Y(1 + (i - 1) \times \text{INCY})$ , for  $i = 1, 2, \dots, N$ .

If  $\text{INCY} < 0$ ,  $y_i$  must be stored in  $Y(1 - (N - i) \times \text{INCY})$ , for  $i = 1, 2, \dots, N$ .

Intermediate elements of Y are not referenced.

8: INCY – INTEGER *Input*

*On entry:* the increment in the subscripts of Y between successive elements of  $y$ .

## 6 Error Indicators and Warnings

None.

## 7 Accuracy

Not applicable.

## 8 Further Comments

None.

## 9 Example

None.