

# NAG Fortran Library Routine Document

## F06QQF

**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

F06QQF performs the factorization

$$\begin{pmatrix} U \\ \alpha x^T \end{pmatrix} = Q \begin{pmatrix} R \\ 0 \end{pmatrix}$$

where  $U$  and  $R$  are  $n$  by  $n$  real upper triangular matrices,  $x$  is an  $n$  element real vector,  $\alpha$  is a real scalar, and  $Q$  is a real orthogonal matrix.

$Q$  is formed as a sequence of plane rotations

$$Q^T = Q_n \cdots Q_2 Q_1$$

where  $Q_k$  is a rotation in the  $(k, n+1)$  plane, chosen to annihilate  $x_k$ .

The 2 by 2 plane rotation part of  $Q_k$  has the form

$$\begin{pmatrix} c_k & s_k \\ -s_k & c_k \end{pmatrix}.$$

### 2 Specification

```
SUBROUTINE F06QQF (N, ALPHA, X, INCX, A, LDA, C, S)
  INTEGER          N, INCX, LDA
  double precision ALPHA, X(*), A(LDA,*), C(*), S(*)
```

### 3 Description

None.

### 4 References

None.

### 5 Parameters

- |    |                                                                                  |                     |
|----|----------------------------------------------------------------------------------|---------------------|
| 1: | N – INTEGER                                                                      | <i>Input</i>        |
|    | <i>On entry:</i> $n$ , the order of the matrices $U$ and $R$ .                   |                     |
|    | <i>Constraint:</i> $N \geq 0$ .                                                  |                     |
| 2: | ALPHA – <b>double precision</b>                                                  | <i>Input</i>        |
|    | <i>On entry:</i> the scalar $\alpha$ .                                           |                     |
| 3: | X(*) – <b>double precision</b> array                                             | <i>Input/Output</i> |
|    | <i>On entry:</i> the vector $x$ .                                                |                     |
|    | <i>On exit:</i> the tangents of the rotations $Q_k$ , for $k = 1, 2, \dots, n$ . |                     |

- 4: INCX – INTEGER *Input*  
*On entry:* the increment in the subscripts of X between successive elements of  $x$ .  
*Constraint:* INCX > 0.
- 5: A(LDA,\*) – **double precision** array *Input/Output*  
**Note:** the second dimension of the array A must be at least max(1, N).  
*On entry:* the  $n$  by  $n$  upper triangular matrix  $U$ .  
*On exit:* the upper triangular matrix  $R$ .
- 6: LDA – INTEGER *Input*  
*On entry:* the first dimension of the array A as declared in the (sub)program from which F06QQF is called.  
*Constraint:* LDA  $\geq$  max(1, N).
- 7: C(\*) – **double precision** array *Output*  
*On exit:* the values  $c_k$ , the cosines of the rotations  $Q_k$ , for  $k = 1, \dots, n$ .
- 8: S(\*) – **double precision** array *Output*  
*On exit:* the values  $s_k$ , the sines of the rotations  $Q_k$ , for  $k = 1, \dots, n$ .

## 6 Error Indicators and Warnings

None.

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