

NAG 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 a QR factorization (as a sequence of plane rotations) of a real upper triangular matrix that has been augmented by a full row.

2 Specification

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

3 Description

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, α 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

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

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 – <i>double precision</i> | <i>Input</i> |
| | <i>On entry:</i> the scalar α . | |
| 3: | X(*) – <i>double precision</i> array | <i>Input/Output</i> |
| | Note: the dimension of the array X must be at least $\max(1, 1 + (N - 1) \text{INCX})$. | |
| | <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 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(N) – **double precision** array *Output*
On exit: the values c_k , the cosines of the rotations Q_k , for $k = 1, 2, \dots, n$.
- 8: S(N) – **double precision** array *Output*
On exit: the values s_k , the sines of the rotations Q_k , for $k = 1, 2, \dots, n$.

6 Error Indicators and Warnings

None.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

None.
