1 SUMMARY

To integrate a cubic spline \( S(x) \) between limits \( a \) and \( b \) which need not be knot points, i.e. given knots \( \xi_i \), function values \( S_i = S(\xi_i) \) and derivative values \( g_i = S'(\xi_i) \), \( i = 1, 2, ..., n \) \( (n \geq 2) \) evaluates the integral

\[
\int_a^b S(x) \, dx
\]

where \( S(x) \) is defined as zero outside the range of its knots.


2 HOW TO USE THE PACKAGE

2.1 Argument list and calling sequence

The single precision version

\[ Q = \text{QG02A}(A, B, N, XI, S, G) \]

The double precision version

\[ \text{DOUBLE PRECISION } Q \]
\[ Q = \text{QG02AD}(A, B, N, XI, S, G) \]

The arguments

\[ A \] is a REAL (DOUBLE PRECISION in the D version) variable which must be set by the user to \( a \) the lower limit of the integration. See next argument.

\[ B \] is a REAL (DOUBLE PRECISION in the D version) variable which must be set by the user to \( b \) the upper limit of the integration.

If either \( A \) or \( B \) is outside the range of \( \xi_1 \) to \( \xi_n \) the integral is evaluated on the assumption that \( S(x) = 0 \) for \( x < \xi_1 \) or \( x > \xi_n \). If \( a > b \) the sign of the integral is reversed.

\[ N \] is an INTEGER variable which must be set by the user to \( n \) the number of knot points. Restriction: \( n \geq 2 \).

\[ XI \] is a REAL (DOUBLE PRECISION in the D version) array of length at least \( n \) which must be set by the user to the knot values \( \xi_i \), \( i = 1, 2, ..., n \). The knots must be ordered and distinct so that \( \xi_1 < \xi_2 < ... < \xi_n \).

\[ S \] is a REAL (DOUBLE PRECISION in the D version) array of length at least \( n \) which must be set by the user to the spline values \( S_i = S(\xi_i) \), \( i = 1, 2, ..., n \).

\[ G \] is a REAL (DOUBLE PRECISION in the D version) array of length at least \( n \) which must be set by the user to the first derivative values of the spline at the knots, i.e. set to \( g_i = S'(\xi_i) \) \( i = 1, 2, ..., n \).

Function value

QG02A and QG02AD are Fortran FUNCTION subroutines and will be set to the value of the integral on return.
3 GENERAL INFORMATION

Use of common: references the common block TG02B/BD associated with TG02A/AD.

Workspace: none.

Other routines called directly: TG02A/AD and QG01A/AD.

Input/output: none.

Restrictions: \( n \geq 2, \xi_{i} < \xi_{2} < \ldots < \xi_{n} \).

4 METHOD

The subroutine first makes sure that the limits \( a \) and \( b \) are sensible, then calls TG02 to obtain values and first derivative values at \( a \) and \( b \). It then calls QG01 to obtain the integral over any complete range of knots within \((a,b)\) and finally adds in the contributions from the two ends.