## 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 $g_i = S'(x_i)$, $i$=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.

**ATTRIBUTES — Version:** 1.0.0. **Types:** QG02A; QG02AD. **Calls:** QG01, TG02. **Original date:** March 1974. **Origin:** M.J.Hopper, Harwell.

## 2 HOW TO USE THE PACKAGE

### 2.1 Argument list and calling sequence

*The single precision version*

```
Q=QG02A(A,B,N,XI,S,G)
```

*The double precision version*

```
DOUBLE PRECISION Q
  _       _
Q=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:** $n \geq 2$, $\xi_1 < \xi_2 < ... < \xi_n$.

## 4 METHOD

The subroutine first makes sure that the limits *a* and *b* are sensible, then calss 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.