1 SUMMARY

To evaluate integrals of the form

$$\int_a^b f(t)\sin xt\,dt$$

and

$$\int_a^b f(t)\cos xt\,dt$$

to a specified absolute accuracy.

Filon's method is used where a **quadrature formula** is derived by approximating to $f(x)$ by a piecewise quadratic interpolant. The user must provide a subroutine to evaluate the function $f(x)$.

The subroutine is of greater efficiency than Simpson's rule only if $|u|>1$; the greater the value of u the more marked is the increase in efficiency.

ATTRIBUTES — **Version:** 1.0.0. **Remark:** The method is to be preferred to Simpson's Rule when $|x(b-a)|\geq 10$. **Types:** `QD01A`; `QD01AD`. **Calls:** `F` (a user subroutine). **Original date:** 1968. **Origin:** W.E.Hart, Harwell.

2 HOW TO USE THE PACKAGE

2.1 Argument list

The single precision version

```
CALL QD01A(EPS,ISUBMX,U,A,B,JCS,SINT,CINT)
```

The double precision version

```
CALL QD01AD(EPS,ISUBMX,U,A,B,JCS,SINT,CINT)
```

`EPS` is a `REAL` (`DOUBLE PRECISION` in the D version) variable which must be set by the user to the absolute accuracy required in the integral values.

`ISUBMX` is an `INTEGER` variable which must be set by the user to the maximum number of iterations the subroutine is allowed to perform (10 is suggested); this argument is a safety valve which causes a return to the calling program if convergence is not reached.

`U` is a `REAL` (`DOUBLE PRECISION` in the D version) variable which must be set by the user to the value of the constant u, see section 1.

`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 range of integration.

`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 range of integration.

`JCS` is an `INTEGER` variable which must be set by the user to select which integrals are required. The possible values are:

1 the subroutine evaluates $\int_a^b f(x) \sin ux \, dx$,

2 the subroutine evaluates $\int_a^b f(x) \cos ux \, dx$,

3 both integrals are computed.

`SINT` is a `REAL` (`DOUBLE PRECISION` in the D version) variable which is set by the subroutine to the value of the sine integral.

`CINT` is a `REAL` (`DOUBLE PRECISION` in the D version) variable which is set by the subroutine to the value of the cosine integral.

2.2 The function subroutine

The user must provide a Fortran `FUNCTION` subroutine to evaluate the function $f(x)$ for any x in the range $a \le x \le b$. It must have the form:

The single precision version

```
REAL FUNCTION F(X)
F= function value
RETURN
END
```

The double precision version

```
DOUBLE PRECISION FUNCTION F(X)
DOUBLE PRECISION X
F= function value
RETURN
END
```

Note that both single and double precision subroutines have the same name.

3 GENERAL INFORMATION

Workspace: none.

Use of common: none.

Other routines called directly: user-supplied function subroutine, see §2.2.

Input/output: none.

4 METHOD

The method used is Filon's method: a quadrature formula is derived by approximating to $f(x)$ by a piecewise quadratic interpolant.