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

\[ \text{CALL QD01A(EPS,ISUBMX,U,A,B,JCS,SINT,CINT)} \]

The double precision version

\[ \text{CALL QD01AD(EPS,ISUBMX,U,A,B,JCS,SINT,CINT)} \]

EP \( S \) 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.

IS \( \text{UBMX} \) 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.

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

\( \text{CINT} \) 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 \( a \leq x \leq b \).

It must have the form:

*The single precision version*

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

*The double precision version*

```fortran
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.