Author(s) : G.A. Erskine
Submitter : K.S. Kölbig
Language : Fortran

Library: MATHLIB
Submitted: 07.06.1992
Revised:

N-Point Gaussian Quadrature

Function subprograms RGQUAD and DGQUAD calculate the approximate value of the integral

$$\int_a^b f(t)dt$$

using the N-point Gauss-Legendre quadrature formula corresponding to the interval $[a,b]$.

Subroutine subprograms RGSET and DGSET store, for subsequent use, the abscissae x_i and the weights w_i of the N-point Gauss-Legendre quadrature formula corresponding to the interval $[a,b]$.

The following values of N may be used: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 24, 32, 40, 48, 64, 80, 96.

RGQUAD, RGSET and DGQUAD, DGSET are independent subprograms: it is not necessary, for instance, to call DGSET in order to use DGQUAD, or vice-versa.

On CDC and Cray computers, the double-precision versions DGQUAD and DGSET are not provided.

Structure:

SUBROUTINE and FUNCTION subprograms
User Entry Names: RGQUAD, RGSET, DGQUAD, DGSET
Internal Entry Names: D107R1, D107D1
Files Referenced: Unit 6
External References: MTLMTR (N002), ABEND (Z035), User-supplied FUNCTION subprogram

Usage:

To calculate the integral:

For t = R (type REAL), t = D (type DOUBLE PRECISION),

```
tGQUAD(F,A,B,N)
```

has, in any arithmetic expression, the value $\sum_{i=1}^{N} w_i f(x_i)$ which is an approximation to the given integral.

To store the abscissae x_i and the weights w_i:

```
CALL tGSET(A,B,N,X,W)
```

F (type according to t) Name of a user-supplied FUNCTION subprogram, declared EXTERNAL in the calling program. This subprogram must set F(X) = f(X).

A,B (type according to t) End-points a and b of the integration interval.

N (INTEGER) Number N of quadrature points.

X,W (type according to t) One-dimensional arrays. On exit, X(i) and W(i) contain x_i and w_i, $(i = 1, 2, \ldots, N)$, respectively.

Method:

The values of x_i and w_i are computed by linearly scaling values obtained from a stored table corresponding to the interval $[-1,+1]$.

Accuracy:

The absolute error of RGQUAD and DGQUAD is proportional to the value of the $(2N)$th derivative of f at some internal point of the interval $[a, b]$ (see Ref. 1).

Error handling:

Error D107.1: The value N does not appear in the list given above. A message is written on Unit 6, unless subroutine MTLSET (N002) has been called. If the subprogram referenced is RGQUAD or DGQUAD, the function value is set equal to zero.

References:

1. A.H. Stroud and D. Secrest, Gaussian quadrature formulas, (Prentice-Hall, Englewood Cliffs 1966).

•