NAME

gjqf − Gauss-Jacobi logarithmic Quadrature with Function values

SYNOPSIS

Fortran (77, 90, 95, HPF):

f77 *[flags] file(s) . . . -L/usr/local/lib -lgjl*

SUBROUTINE gjqf(x, w, y, z, alpha, beta, nquad, ierr)
DOUBLE PRECISION alpha, beta, w(*), x(*)
DOUBLE PRECISION y(*), z(*)
INTEGER ierr, nquad

C (K&R, 89, 99), C++ (98):

cc *[flags] -I/usr/local/include file(s) . . . -L/usr/local/lib -lgjl*

Use

#include <gjl.h>

to get this prototype:

void gjqf(fortran_double_precision x_[],
fortran_double_precision w_[],
fortran_double_precision y_[],
fortran_double_precision z_[],
const fortran_double_precision * alpha_,
const fortran_double_precision * beta_,
const fortran_integer * nquad_,
fortran_integer * ierr_);

NB: The definition of C/C++ data types **fortran_** *xxx*, and the mapping of Fortran external names to C/C++ external names, is handled by the C/C++ header file. That way, the same function or subroutine name can be used in C, C++, and Fortran code, independent of compiler conventions for mangling of external names in these programming languages.

DESCRIPTION

Compute the nodes and weights for the evaluation of the integral

$$\int_{-1}^{1} (1-x)^\alpha(1+x)^\beta\ln(1+x)f(x)dx \quad (\alpha > -1, \beta > -1)$$

as the quadrature sum

$$\sum_{i=1}^N[W_i(\alpha,\beta) (\ln 2) f(x_i(\alpha,\beta)) - Z_i(\alpha,\beta)f(y_i(\alpha,\beta))]$$

The nonlogarithmic ordinary Gauss-Jacobi integral

$$\int_{-1}^{1} (1-x)^\alpha(1+x)^\beta f(x)dx \quad (\alpha > -1, \beta > -1)$$

can be computed from the quadrature sum

$$\sum_{i=1}^N[W_i(\alpha,\beta) f(x_i(\alpha,\beta)]$$

The quadrature is exact to machine precision for f(x) of polynomial order less than or equal to 2***nquad** − 1.

This form of the quadrature requires only values of the function, at 2***nquad** points. For a faster, and slightly more accurate, quadrature that requires values of the function and its derivative at **nquad** points, see the companion routine, gjqfd().

On entry:

alpha Power of (1−x) in the integrand (**alpha** > −1).

beta Power of (1+x) in the integrand (**beta** > −1).

nquad Number of quadrature points to compute. It must be less than the limit MAXPTS defined in the header file, *maxpts.inc*. The default value chosen there should be large enough for any realistic application.

On return:

x(1. .**nquad**) Nodes of the Jacobi quadrature, denoted x_i(\alpha,\beta) above.

w(1. .**nquad**) Weights of the Jacobi quadrature, denoted W_i(\alpha,\beta) above.

y(1. .**nquad**) Nodes of the quadrature for −(1−x)^\alpha * (1+x)^\beta ln((1+x)/2), denoted y_i(\alpha,\beta) above.

z(1. .**nquad**) Weights of the quadrature for −(1−x)^\alpha * (1+x)^\beta ln((1+x)/2), denoted Z_i(\alpha,\beta) above.

ierr Error indicator:
= 0 (success),
1 (eigensolution could not be obtained),
2 (destructive overflow),
3 (**nquad** out of range),
4 (**alpha** out of range),
5 (**beta** out of range).

The logarithmic integral can then be computed by code like this:

```
      dlgtwo = dlog(2.0d+00)
      sum = 0.0d+00
      do 10 i = 1,nquad
          sum = sum + dlgtwo*w(i)*f(x(i)) - z(i)*f(y(i))
   10 continue
```

The nonlogarithmic integral can be computed by:

```
      sum = 0.0d+00
      do 20 i = 1,nquad
          sum = sum + w(i)*f(x(i))
   20 continue
```

SEE ALSO

gjqfd(3), **gjqrc**(3).

AUTHORS

The algorithms and code are described in detail in the paper

Fast Gaussian Quadrature for Two Classes of Logarithmic Weight Functions

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