NAME

qglqfd – Gauss-Laguerre logarithmic Quadrature with Function and Derivative values

SYNOPSIS

Fortran (77, 90, 95, HPF):

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

```
SUBROUTINE qglqfd(x, w, deltaw, deltax, alpha, nquad, ierr)
REAL*16      alpha,    deltax(*),   deltaw(*),   w(*)
REAL*16      x(*)
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 qglqfd(fortran_quadruple_precision x_[],
        fortran_quadruple_precision w_[],
        fortran_quadruple_precision deltaw_[],
        fortran_quadruple_precision deltax_[],
        const fortran_quadruple_precision * alpha_,
        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

$$\int_0^\infty x^\alpha e^{-x} \ln(x) f(x) dx$$

as the quadrature sum:

$$\sum_{i=1}^{N}[\delta W_i(\alpha) f(x_i(\alpha)) + \delta x_i(\alpha) f'(x_i(\alpha))]$$

The nonlogarithmic ordinary Gauss-Laguerre integral

$$\int_0^\infty x^\alpha e^{-x} f(x) dx$$

can be computed from the quadrature sum

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

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 values of the function *and its derivative* at N (== **nquad**) points. For a derivative-free quadrature at 2N points, see the companion routine, qglqf().

On entry:

alpha Power of x in the integrand (**alpha** > –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 both parts of the quadrature, denoted $x_i(\alpha)$ above.

w(1. .**nquad**) Internal weights of both parts of the quadrature, denoted W_i(\alpha) above.

deltaw(1. .**nquad**) Weights of the second part of the quadrature, denoted \delta W_i(\alpha) above.

deltax(1. .**nquad**) Weights of the first part of the quadrature, denoted \delta x_i 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).

The integral can then be computed by code like this:

```
   sum = 0.0q+00
   do 10 i = 1,nquad
      sum = sum + deltaw(i)*f(x(i)) + deltax(i)*fprime(x(i))
10 continue
```

where `fprime(x(i))` is the derivative of the function f(x) with respect to x, evaluated at x = `x(i)`.

The nonlogarithmic integral can be computed by:

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

SEE ALSO

qglqf(3), **qglqrc**(3).

AUTHORS

The algorithms and code are described in detail in the paper

Fast Gaussian Quadrature for Two Classes of Logarithmic Weight Functions

in ACM Transactions on Mathematical Software, Volume ??, Number ??, Pages ????--???? and ????--????, 20xx, by

Nelson H. F. Beebe
Center for Scientific Computing
University of Utah
Department of Mathematics, 110 LCB
155 S 1400 E RM 233
Salt Lake City, UT 84112-0090
Tel: +1 801 581 5254
FAX: +1 801 581 4148
Email: `beebe@math.utah.edu`, `beebe@acm.org`, `beebe@computer.org`
WWW URL: `http://www.math.utah.edu/~beebe`

and

James S. Ball
University of Utah
Department of Physics
Salt Lake City, UT 84112-0830
USA
Tel: +1 801 581 8397
FAX: +1 801 581 6256
Email: `ball@physics.utah.edu`
WWW URL: `http://www.physics.utah.edu/people/faculty/ball.html`