

**NAME**

glqf – Gauss-Laguerre logarithmic Quadrature with Function values

**SYNOPSIS**

Fortran (77, 90, 95, HPF):

```
f77 [ flags ] file(s) ... -L/usr/local/lib -lgjl
      SUBROUTINE glqf(x, w, wxm1, y, z, alpha, nquad, ierr)
      DOUBLE PRECISION alpha, w(*), wxm1(*), 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 glqf(fortran_double_precision x[],
          fortran_double_precision w[],
          fortran_double_precision wxm1[],
          fortran_double_precision y[],
          fortran_double_precision z[],
          const fortran_double_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

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

The nonlogarithmic 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  $2 \cdot \mathbf{nquad} - 2$  (logarithmic) or  $2 \cdot \mathbf{nquad} - 1$  (nonlogarithmic).

This form of the quadrature requires only values of the function at  $2 \cdot \mathbf{nquad}$  points. For a faster, and slightly more accurate, quadrature that requires values of the function and its derivative at  $\mathbf{nquad}$  points, see the companion routine, glqfd().

On entry:

**alpha** Power of  $x$  in the integrand ( $\mathbf{alpha} > -1$ ).

**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:

<b>x(1..nquad)</b>	Nodes of the first part of the quadrature, denoted $x_i(\alpha)$ above.
<b>w(1..nquad)</b>	Weights of the first part of the quadrature, denoted $W_i(\alpha)$ above.
<b>wxm1(1..nquad)</b>	Scaled weights of the first part of the quadrature, <b>wxm1</b> (i) = <b>w</b> (i)*( <b>x</b> (i) - 1).
<b>y(1..nquad)</b>	Nodes of the second part of the quadrature, denoted $y_i(\alpha)$ above.
<b>z(1..nquad)</b>	Weights of the second part of the quadrature, denoted $Z_i(\alpha)$ above.
<b>ierr</b>	Error indicator: = 0 (success), 1 (eigensolution could not be obtained), 2 (destructive overflow), 3 ( <b>nquad</b> out of range), 4 ( <b>alpha</b> out of range).

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

```

sum = 0.0d+00
do 10 i = 1,nquad
    sum = sum + wxm1(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

**glqfd(3)**, **glqrc(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

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