NAG Toolbox for MATLAB

g01mu

1 Purpose

g01mu returns the value of the Vavilov density function $\phi_V(\lambda;\kappa,\beta^2)$, via the function name.

It is intended to be used after a call to g01zu.

2 Syntax

```
[result, ifail] = g01mu(x, work)
```

3 Description

g01mu evaluates an approximation to the Vavilov density function $\phi_V(\lambda;\kappa,\beta^2)$ given by

$$\phi_V(\lambda;\kappa,\beta^2) = \frac{1}{2\pi i}\int_{c-i\infty}^{c+i\infty} e^{\lambda s} f(s;\kappa,\beta^2)\,ds,$$

where $\kappa > 0$ and $0 \leq \beta^2 \leq 1$, c is an arbitrary real constant and

$$f(s;\kappa,\beta^2) = C(\kappa,\beta^2)\exp\left\{s\ln\kappa + (s+\kappa\beta^2)\left[\ln\left(\frac{s}{\kappa}\right) + E_1\left(\frac{s}{\kappa}\right)\right] - \kappa\exp\left(-\frac{s}{\kappa}\right)\right\}.$$

$E_1(x) = \displaystyle\int_0^x t^{-1}(1-e^{-t})\,dt$ is the exponential integral, $C(\kappa,\beta^2) = \exp\{\kappa(1+\gamma\beta^2)\}$ and γ is Euler's constant.

The method used is based on Fourier expansions. Further details can be found in Schorr 1974.

For values of $\kappa \leq 0.01$, the Vavilov distribution can be replaced by the Landau distribution since $\lambda_V = (\lambda_L - \ln\kappa)/\kappa$. For values of $\kappa \geq 10$, the Vavilov distribution can be replaced by a Gaussian distribution with mean $\mu = \gamma - 1 - \beta^2 - \ln\kappa$ and variance $\sigma^2 = (2-\beta^2)/2\kappa$.

4 References

Schorr B 1974 Programs for the Landau and the Vavilov distributions and the corresponding random numbers *Comp. Phys. Comm.* **7** 215–224

5 Parameters

5.1 Compulsory Input Parameters

1: **x – double scalar**

The argument λ of the function.

2: **work(322) – double array**

This **must** be the same parameter **work** as returned by a previous call to g01zu.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **result – double scalar**

The result of the function.

2: **ifail – int32 scalar**

0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

ifail $= 1$

Either the initialization function has not been called prior to the first call of this function or a communication array has become corrupted.

7 Accuracy

At least five significant digits are usually correct.

8 Further Comments

g01mu can be called repeatedly with different values of λ provided that the values of κ and β^2 remain unchanged between calls. Otherwise, g01zu must be called again. This is illustrated in Section 9.

9 Example

```
x = 2.5;
rkappa = 0.4;
beta2 = 0.1;
mode = int32(0);
[xl, xu, work, ifail] = g01zu(rkappa, beta2, mode);
[result, ifail] = g01mu(x, work)
```

```
result =
    0.0837
ifail =
           0
```