NAG Toolbox for MATLAB

g05ll

1 Purpose

g05ll generates a vector of pseudo-random numbers from a Cauchy distribution with median a and semi-interquartile range b.

2 Syntax

```
[x, iseed, ifail] = g05ll(xmed, semiqr, n, igen, iseed)
```

3 Description

The distribution has PDF (probability density function)

$$f(x) = \frac{1}{\pi b\left(1 + \left(\frac{x-a}{b}\right)^2\right)}.$$

g05ll returns the value

$$a + b\frac{2y_1 - 1}{y_2},$$

where y_1 and y_2 are a pair of consecutive pseudo-random numbers from a uniform distribution over $(0, 1)$, such that

$$(2y_1 - 1)^2 + y_2^2 \leq 1.$$

One of the initialization functions g05kb (for a repeatable sequence if computed sequentially) or g05kc (for a non-repeatable sequence) must be called prior to the first call to g05ll.

4 References

Kendall M G and Stuart A 1969 *The Advanced Theory of Statistics (Volume 1)* (3rd Edition) Griffin

Knuth D E 1981 *The Art of Computer Programming (Volume 2)* (2nd Edition) Addison–Wesley

5 Parameters

5.1 Compulsory Input Parameters

1: **xmed – double scalar**

a, the median of the distribution.

2: **semiqr – double scalar**

b, the semi-interquartile range of the distribution.

Constraint: **semiqr** ≥ 0.0.

3: **n – int32 scalar**

n, the number of pseudo-random numbers to be generated.

Constraint: **n** ≥ 0.

4: **igen – int32 scalar**

Must contain the identification number for the generator to be used to return a pseudo-random number and should remain unchanged following initialization by a prior call to g05kb or g05kc.

5: **iseed**(4) **– int32 array**

Contains values which define the current state of the selected generator.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **x**$(*)$ **– double array**

Note: the dimension of the array **x** must be at least $\max(1, \mathbf{n})$.

The n pseudo-random numbers from the specified Cauchy distribution.

2: **iseed**(4) **– int32 array**

Contains updated values defining the new state of the selected generator.

3: **ifail – int32 scalar**

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

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail $= 1$

On entry, $\mathbf{n} < 0$.

ifail $= 2$

On entry, **semiqr** < 0.0.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

```
xmed = 1;
semiqr = 2;
n = int32(5);
igen = int32(1);
iseed = [int32(1762543);
     int32(9324783);
```

```
     int32(42344);
     int32(742355)];
[x, iseedOut, ifail] = g05ll(xmed, semiqr, n, igen, iseed)
```

```
x =
    0.4962
    1.8604
    0.2698
    1.0859
   -3.9829
iseedOut =
    10047502
    10373876
     6690993
    12633503
ifail =
           0
```