

# NAG Toolbox for MATLAB

## g05lb

### 1 Purpose

g05lb generates a vector of pseudo-random numbers taken from a Student's  $t$ -distribution with  $\nu$  degrees of freedom.

### 2 Syntax

```
[x, iseed, ifail] = g05lb(df, n, igen, iseed)
```

### 3 Description

The distribution has PDF (probability density function)

$$f(x) = \frac{\left(\frac{\nu-1}{2}\right)!}{\left(\frac{1}{2}\nu - 1\right)! \sqrt{\pi\nu} \left(1 + \frac{x^2}{\nu}\right)^{\frac{1}{2}(\nu+1)}}.$$

g05lb calculates the values

$$y_i \sqrt{\frac{\nu}{z_i}}, \quad i = 1, \dots, n$$

where the  $y_i$  are generated by g05la from a Normal distribution with mean 0 and variance 1.0, and the  $z_i$  are generated by g05lf from a gamma distribution with parameters  $\frac{1}{2}\nu$  and 2 (i.e., from a  $\chi^2$ -distribution with  $\nu$  degrees of freedom).

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 g05lb.

### 4 References

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

### 5 Parameters

#### 5.1 Compulsory Input Parameters

1: **df – int32 scalar**

$\nu$ , the number of degrees of freedom of the distribution.

*Constraint:* **df**  $\geq 1$ .

2: **n – int32 scalar**

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

*Constraint:* **n**  $\geq 0$ .

3: **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.

4: **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:  **$\mathbf{x}(\ast)$  – double array**

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

The  $n$  pseudo-random numbers from the specified Student's  $t$ -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, **df** < 1.

**ifail = 2**

On entry, **n** < 0.

## 7 Accuracy

Not applicable.

## 8 Further Comments

The time taken by g05lb increases with  $\nu$ .

## 9 Example

```
df = int32(5);
n = int32(5);
igen = int32(1);
iseed = [int32(1762543);
         int32(9324783);
         int32(42344);
         int32(742355)];
[x, iseedOut, ifail] = g05lb(df, n, igen, iseed)
```

```
x =
    2.3726
   -0.8473
   -0.0452
   -1.3595
   -0.5932
```

```
iseedOut =  
    16736192  
    9444300  
    11864102  
    12267461  
ifail =  
    0
```

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