# NAG Toolbox

# nag_rand_dist_triangular (g05sp)

## 1 Purpose

nag_rand_dist_triangular (g05sp) generates a vector of pseudorandom numbers from a triangular distribution with parameters $x_{\min}$, $x_{\mathrm{med}}$ and $x_{\max}$.

## 2 Syntax

```
[state, x, ifail] = nag_rand_dist_triangular(n, xmin, xmed, xmax, state)
[state, x, ifail] = g05sp(n, xmin, xmed, xmax, state)
```

## 3 Description

The triangular distribution has a PDF (probability density function) that is triangular in profile. The base of the triangle ranges from $x = x_{\min}$ to $x = x_{\max}$ and the PDF has a maximum value of $\dfrac{2}{x_{\max} - x_{\min}}$ at $x = x_{\mathrm{med}}$. If $x_{\min} = x_{\mathrm{med}} = x_{\max}$ then $x = x_{\mathrm{med}}$ with probability 1; otherwise the triangular distribution has PDF:

$$f(x) = \frac{x - x_{\min}}{x_{\mathrm{med}} - x_{\min}} \times \frac{2}{x_{\max} - x_{\min}} \quad \text{if } x_{\min} \leq x \leq x_{\mathrm{med}},$$

$$f(x) = \frac{x_{\max} - x}{x_{\max} - x_{\mathrm{med}}} \times \frac{2}{x_{\max} - x_{\min}} \quad \text{if } x_{\mathrm{med}} < x \leq x_{\max},$$

$$f(x) = 0 \quad \text{otherwise.}$$

One of the initialization functions nag_rand_init_repeat (g05kf) (for a repeatable sequence if computed sequentially) or nag_rand_init_nonrepeat (g05kg) (for a non-repeatable sequence) must be called prior to the first call to nag_rand_dist_triangular (g05sp).

## 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: **n** – INTEGER

$n$, the number of pseudorandom numbers to be generated.

*Constraint*: $\mathbf{n} \geq 0$.

2: **xmin** – REAL (KIND=nag_wp)

The end point $x_{\min}$ of the triangular distribution.

3: **xmed** – REAL (KIND=nag_wp)

The median of the distribution $x_{\mathrm{med}}$ (also the location of the vertex of the triangular distribution at which the PDF reaches a maximum).

*Constraint*: **xmed** $\geq$ **xmin**.

4: **xmax** – REAL (KIND=nag_wp)

The end point $x_{\mathrm{max}}$ of the triangular distribution.

*Constraint*: **xmax** $\geq$ **xmed**.

5: **state**$(:)$ – INTEGER array

**Note**: the actual argument supplied **must** be the array **state** supplied to the initialization routines nag_rand_init_repeat (g05kf) or nag_rand_init_nonrepeat (g05kg).

Contains information on the selected base generator and its current state.

### 5.2 Optional Input Parameters

None.

### 5.3 Output Parameters

1: **state**$(:)$ – INTEGER array

Contains updated information on the state of the generator.

2: **x**$(\mathbf{n})$ – REAL (KIND=nag_wp) array

The $n$ pseudorandom numbers from the specified triangular distribution.

3: **ifail** – INTEGER

**ifail** $= 0$ unless the function detects an error (see Section 5).

## 6 Error Indicators and Warnings

Errors or warnings detected by the function:

**ifail** $= 1$

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

**ifail** $= 3$

Constraint: **xmed** $\geq$ **xmin**.

**ifail** $= 4$

Constraint: **xmax** $\geq$ **xmed**.

**ifail** $= 5$

On entry, **state** vector has been corrupted or not initialized.

**ifail** $= -99$

An unexpected error has been triggered by this routine. Please contact NAG.

**ifail** $= -399$

Your licence key may have expired or may not have been installed correctly.

**ifail** $= -999$

Dynamic memory allocation failed.

## 7 Accuracy

Not applicable.

## 8 Further Comments

None.

## 9 Example

This example prints five pseudorandom numbers from a triangular distribution with parameters $x_{\min} = -1.0$, $x_{\text{med}} = 0.5$ and $x_{\max} = 1.0$, generated by a single call to nag_rand_dist_triangular (g05sp), after initialization by nag_rand_init_repeat (g05kf).

### 9.1 Program Text

```
function g05sp_example

fprintf('g05sp example results\n\n');

% Initialize the base generator to a repeatable sequence
seed  = [nag_int(1762543)];
genid = nag_int(1);
subid = nag_int(1);
[state, ifail] = g05kf( ...
                        genid, subid, seed);

% Number of variates
n = nag_int(5);

% Parameters
xmin = -1;
xmed = 0.5;
xmax = 1;

% Generate variates from a triangular distribution
[state, x, ifail] = g05sp( ...
                           n, xmin, xmed, xmax, state);

disp('Variates');
disp(x);
```

### 9.2 Program Results

```
g05sp example results

Variates
    0.3817
   -0.4348
    0.4960
    0.5509
   -0.4398
```