

## NAG Toolbox

### nag\_rand\_dist\_expmix (g05sg)

#### 1 Purpose

nag\_rand\_dist\_expmix (g05sg) generates a vector of pseudorandom numbers from an exponential mix distribution composed of  $m$  exponential distributions each having a mean  $a_i$  and weight  $w_i$ .

#### 2 Syntax

```
[state, x, ifail] = nag_rand_dist_expmix(n, a, wgt, state, 'nmix', nmix)
```

```
[state, x, ifail] = g05sg(n, a, wgt, state, 'nmix', nmix)
```

#### 3 Description

The distribution has PDF (probability density function)

$$f(x) = \sum_{i=1}^m \frac{1}{a_i} w_i e^{-x/a_i} \quad \text{if } x \geq 0,$$

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

where  $\sum_{i=1}^m w_i = 1$  and  $a_i > 0$ ,  $w_i \geq 0$ .

nag\_rand\_dist\_expmix (g05sg) returns the values  $x_i$  by selecting, with probability  $w_j$ , random variates from an exponential distribution with argument  $a_j$ .

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\_expmix (g05sg).

#### 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: **n** – INTEGER

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

*Constraint:*  $n \geq 0$ .

2: **a(nmix)** – REAL (KIND=nag\_wp) array

The  $m$  parameters  $a_i$  for the  $m$  exponential distributions in the mix.

*Constraint:*  $a^{(i)} > 0.0$ , for  $i = 1, 2, \dots, \text{nmix}$ .

3: **wgt(nmix)** – REAL (KIND=nag\_wp) array

The  $m$  weights  $w_i$  for the  $m$  exponential distributions in the mix.

Constraints:

$$\sum_{i=1}^m \mathbf{wgt}(i) = 1.0;$$

$$\mathbf{wgt}(i) \geq 0.0, \text{ for } i = 1, 2, \dots, m.$$

4: **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

1: **nmix** – INTEGER

*Default:* the dimension of the arrays **a**, **wgt**. (An error is raised if these dimensions are not equal.)

*m*, the number of exponential distributions in the mix.

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

## 5.3 Output Parameters

1: **state**(:) – INTEGER array

Contains updated information on the state of the generator.

2: **x**(**n**) – REAL (KIND=`nag_wp`) array

The *n* pseudorandom numbers from the specified exponential mix 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** = 2

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

**ifail** = 3

Constraint: **a**(*i*) > 0.0.

**ifail** = 4

Constraint: sum of **wgt** = 1.0.

Constraint: **wgt**(*i*)  $\geq$  0.0.

**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 the first five pseudorandom numbers from an exponential mix distribution comprising three exponential distributions with parameters  $a_1 = 1.0$ ,  $a_2 = 5.0$  and  $a_3 = 2.0$ , and with respective weights 0.5, 0.3 and 0.2. The numbers are generated by a single call to `nag_rand_dist_expmix` (g05sg), after initialization by `nag_rand_init_repeat` (g05kf).

### 9.1 Program Text

```
function g05sg_example

fprintf('g05sg 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
a = [1; 5; 2];
wgt = [0.5; 0.3; 0.2];

% Generate variates from an exponential mix distribution
[state, x, ifail] = g05sg( ...
                        n, a, wgt, state);

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

### 9.2 Program Results

```
g05sg example results

Variates
    0.4520
    2.2398
    1.4649
    0.2253
   11.2884
```

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