NAG Toolbox for MATLAB

g05za

1   Purpose

g05za is used to select the underlying mechanism for generating pseudo-random numbers in subsequent calls to other functions in this chapter from g05ka through to g05pc.

2   Syntax

```
g05za(cgen)
```

3   Description

There are two underlying mechanisms that can be used by the functions g05ka–g05pc in this chapter for generating pseudo-random numbers. The first mechanism can be selected by calling g05za with its parameter set to 'O' while the second mechanism can be selected by calling g05za with its parameter set to 'W'. Any other parameter setting results in the default mechanism being selected. The statistical properties of the two mechanisms are different; it is therefore **not** recommended that you select different mechanisms from within the same program.

The first mechanism is that used in the NAG Fortran Library (up to Mark 19) and in Release 1 of the NAG Fortran SMP Library. It employs a single generator of cycle length 2^{57} that uses the multiplicative congruential algorithm (see Knuth 1981):

$$b_{i+1} = 13^{13} \times b_i \bmod 2^{59},$$

where the integer b_{i+1} is divided by 2^{59} to yield a real value y, which is guaranteed to satisfy

$$0 < y < 1.$$

It is important to note that only one process (or thread) can use functions in this chapter to generate pseudo-random numbers at any one time when this first mechanism is selected. For example, it is not safe to select the first mechanism and then call functions in this chapter from within your own defined 'parallel region'.

The second mechanism uses a variant of the multiplicative congruential algorithm known as the Wichmann–Hill algorithm (see Maclaren 1989) (see the G05 Chapter Introduction) and contains 273 independent generators with cycle length of around 2^{80}. This mechanism is the recommended choice for selection prior to calling other functions in this chapter.

It may be that you wish to select only the default mechanism and so do not require to call g05za prior to calling other functions in this chapter.

4   References

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

Maclaren N M 1989 The generation of multiple independent sequences of pseudorandom numbers *Appl. Statist.* **38** 351–359

5   Parameters

5.1   Compulsory Input Parameters

1:    **cgen – string**

   Indicates which underlying mechanism is to be used for generating pseudo-random numbers.

> **cgen** = 'O'
>
>> Use first (Original) mechanism as described in Section 3.
>
> **cgen** = 'W'
>
>> Use second (Wichmann–Hill) mechanism as described in Section 3.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

None.

6   Error Indicators and Warnings

None.

7   Accuracy

Not applicable.

8   Further Comments

The first mechanism for generating pseudo-random numbers is to be used primarily for those wishing to replicate results from code (calling functions in this chapter) previously linked to the NAG Fortran Library (Mark 19 or earlier) or to Release 1 of the NAG Fortran SMP Library. It is only safe to use this mechanism when the executable is run as a single process (thread).

For all other purposes it is recommended that the second mechanism (Wichmann–Hill generators) be selected at the start of any program making calls to functions in this chapter.

9   Example

```
cgen = 'W';
nruns = int32(0);
ncount = zeros(6, 1, 'int32');

g05za('W');
g05cb(int32(6*273+111));
for i=1:10
  if i == 1
    cl = 'F';
  elseif i == 10
    cl = 'L';
  else
    cl = 'I';
  end

  [x] = g05fa(0, 1, int32(10000));

  [nruns, ncount, ex, cov, chi, df, prob, ifail] = g08ea(cl, x, int32(0),
nruns, ncount);

  if (ifail ~= 0), break, end;
end
```

```
if (ifail == 0 || ifail == 10)
  if (prob >= 0.05)
    fprintf('\nGenerated sequence passes runs up test\n');
  else
    fprintf('\nGenerated sequence fails runs up test\n');
  end
end
```

```
Generated sequence passes runs up test
```