

nag_ran_sample_vec (g05ejc)**1. Purpose**

nag_ran_sample_vec (g05ejc) selects a pseudo-random sample without replacement from an integer vector.

2. Specification

```
#include <nag.h>
#include <nagg05.h>
```

```
void nag_ran_sample_vec(Integer ia[], Integer n, Integer iz[],
                       Integer m, NagError *fail)
```

3. Description

The function performs a single pseudo-random selection of m elements from vector **ia** of length n and then places them in vector **iz**. Their order in **ia** will be preserved in **iz**. Each of the $\binom{n}{m}$ possible combinations of elements of **ia** may be regarded as being equiprobable.

4. Parameters**ia[n]**

Input: the population to be sampled.

nInput: the number of elements in the vector to be sampled.
Constraint: $n \geq 1$.**iz[m]**

Output: the selected sample.

mInput: the sample size.
Constraint: $1 \leq m \leq n$.**fail**

The NAG error parameter, see the Essential Introduction to the NAG C Library.

5. Error Indications and Warnings**NE_INT_ARG_LT**On entry, **n** must not be less than 1: **n** = *<value>*.
On entry, **m** must not be less than 1: **m** = *<value>*.**NE_2_INT_ARG_GT**On entry, **m** = *<value>* while **n** = *<value>*.
These parameters must satisfy $m \leq n$.**6. Further Comments**

If n is greater than 60 it is theoretically impossible to generate all $\binom{n}{m}$ combinations unless m is near 1 or near n . This is because the number of possible combinations exceeds the cycle length of the internal random number generator.

The time taken by the function is of order n .

In order to sample other kinds of objects (i.e., vectors, or matrices of higher dimensions), the following technique may be used:

- (a) Set $\mathbf{ia}[i - 1] = i$, for $i = 1, 2, \dots, n$ (where n is the number of objects)
- (b) Use nag_ran_sample_vec to take a sample from \mathbf{ia} and put it into \mathbf{iz}
- (c) Use the contents of \mathbf{iz} as a set of indices to access the relevant object.

In order to divide a population into several groups, nag_ran_permut_vec (g05ehc) is more efficient.

6.1. Accuracy

Not applicable.

6.2. References

Kendall M G and Stuart A (1969) *The Advanced Theory of Statistics (Vol 2)*. (3rd Edn) Griffin, London.

Knuth D E (1981) *The Art of Computer Programming (Vol 2)*. (2nd Edn) Addison-Wesley.

7. See Also

nag_ran_permut_vec (g05ehc)

8. Example

From a vector containing 0 and the first 7 positive integers in ascending order, random samples of size 1,2,...,8 are selected and printed.

8.1. Program Text

```

/* nag_ran_sample_vec(g05ejc) Example Program
 *
 * Copyright 1994 Numerical Algorithms Group.
 *
 * Mark 3, 1994.
 */

#include <nag.h>
#include <stdio.h>
#include <nag_stdlib.h>
#include <nagg05.h>

#define NMAX 8

main()
{
    Integer i, n, m, k;
    Integer ia[NMAX], ib[NMAX];
    Integer seed = 0;

    Vprintf("g05ejc Example Program Results\n");
    g05cbc(seed);
    n = NMAX;

    for (i = 0; i < n; ++i)
        ia[i] = i;

    Vprintf ("\nSamples from the first %ld integers \n\n", n);
    Vprintf("Sample size          Values \n");

    for (m = 1; m <= n; ++m)
    {
        g05ejc(ia, n, ib, m, NAGERR_DEFAULT);
        Vprintf("          %ld          ", m);
        for (k = 0; k < m; ++k)
            Vprintf("%ld ", ib[k]);
        Vprintf("\n");
    }
    exit(EXIT_SUCCESS);
}

```

8.2. Program Data

None.

8.3. Program Results

g05ejc Example Program Results

Samples from the first 8 integers

| Sample size | Values |
|-------------|-----------------|
| 1 | 5 |
| 2 | 0 6 |
| 3 | 0 2 3 |
| 4 | 0 1 5 7 |
| 5 | 0 2 3 5 6 |
| 6 | 0 1 2 3 4 5 |
| 7 | 0 1 2 3 5 6 7 |
| 8 | 0 1 2 3 4 5 6 7 |
