

NAG Toolbox for MATLAB

g05qd

1 Purpose

g05qd generates a random two-way table.

2 Syntax

```
[x, iseed, r, ifail] = g05qd(mode, tottr, totc, igen, iseed, r, 'nrow',  
nrow, 'ncol', ncol, 'nr', nr)
```

3 Description

Given m row totals R_i and n column totals C_j (with $\sum_{i=1}^m R_i = \sum_{j=1}^n C_j = T$, say), g05qd will generate a pseudo-random two-way table of integers such that the row and column totals are satisfied.

The method used is based on that described by Patefield 1981 which is most efficient when T is large relative to the number of table entries $m \times n$ (i.e., $T > 2mn$). Entries are generated one row at a time and one entry at a time within a row. Each entry is generated using the conditional probability distribution for that entry given the entries in the previous rows and the previous entries in the same row.

A reference vector is used to store computed values that can be reused in the generation of new tables with the same row and column totals. g05qd can be called to simply set up the reference vector, or to generate a two-way table using a reference vector set up in a previous call, or it can combine both functions in a single call.

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 g05qd.

4 References

Patefield WM 1981 An efficient method of generating $R \times C$ tables with given row and column totals *Appl. Stats.* **30** 91–97

5 Parameters

5.1 Compulsory Input Parameters

1: **mode** – int32 scalar

A code for selecting the operation to be performed by the function.

mode = 0

Set up reference vector only.

mode = 1

Generate two-way table using reference vector set up in a prior call to g05qd.

mode = 2

Set up reference vector and generate two-way table.

Constraint: $0 \leq \mathbf{mode} \leq 2$.

2: **tottr(nrow)** – int32 array

The m row totals, R_i , for $i = 1, 2, \dots, m$.

Constraints:

$$\begin{aligned} \mathbf{totr}(i) &\geq 0, \text{ for } i = 1, 2, \dots, m; \\ \sum_{i=1}^m \mathbf{totr}(i) &= \sum_{j=1}^n \mathbf{totc}(j). \end{aligned}$$

3: **totc(ncol) – int32 array**

The n column totals, C_j , for $j = 1, 2, \dots, n$.

Constraints:

$$\begin{aligned} \mathbf{totc}(j) &\geq 0, \text{ for } j = 1, 2, \dots, n; \\ \sum_{j=1}^n \mathbf{totc}(j) &= \sum_{i=1}^m \mathbf{totr}(i). \end{aligned}$$

4: **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.

5: **iseed(4) – int32 array**

Contains values which define the current state of the selected generator.

6: **r(nr) – double array**

If **mode** = 1, the reference vector from the previous call to g05qd.

5.2 Optional Input Parameters

1: **nrow – int32 scalar**

Default: The dimension of the array **totr**.

m , the number of rows in the table.

Constraint: **nrow** ≥ 2 .

2: **ncol – int32 scalar**

Default: The dimension of the array **totc** and the second dimension of the array **x**. (An error is raised if these dimensions are not equal.)

$> n$, the number of columns in the table.

Constraint: **ncol** ≥ 2 .

3: **nr – int32 scalar**

Default: The dimension of the array **r**.

Constraint: **nr** $\geq \sum_{i=1}^{\mathbf{nrow}} \mathbf{totr}(i) + 4$.

5.3 Input Parameters Omitted from the MATLAB Interface

ldx, iw, liw

5.4 Output Parameters

1: **x(ldx,ncol)** – **int32** array

If **mode** = 1 or 2, a pseudo-random two-way m by n table, X , with element $x(i,j)$ containing the (i,j) th entry in the table such that $\sum_{i=1}^{\text{nrow}} x(i,j) = \text{totc}(j)$ and $\sum_{j=1}^{\text{ncol}} x(i,j) = \text{totr}(i)$

2: **iseed(4)** – **int32** array

Contains updated values defining the new state of the selected generator.

3: **r(nr)** – **double** array

The reference vector.

4: **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, **mode** < 0,
or **mode** > 2.

ifail = 2

On entry, **nrow** < 2,
or **ncol** < 2.

ifail = 3

On entry, **ldx** < **nrow**.

ifail = 4

At least one element of **totr** or **totc** is negative.

ifail = 5

The arrays **totr** and **totc** do not sum to the same total.

ifail = 6

On entry, **nr** is too small when **mode** = 0 or 2 (see Section 5).

ifail = 7

The value of **nrow** or **ncol** is not the same as when **r** was set up in a previous call with **mode** = 0 or 2.

ifail = 8

On entry, **liw** < **ncol**.

7 Accuracy

None.

8 Further Comments

None.

9 Example

```
mode = int32(2);
totr = [int32(9);
        int32(11);
        int32(7);
        int32(23)];
totc = [int32(16);
        int32(17);
        int32(17)];
igen = int32(1);
iseed = [int32(1762543);
         int32(9324783);
         int32(42344);
         int32(742355)];
r = zeros(60, 1);
[x, iseedOut, rOut, ifail] = g05qd(mode, totr, totc, igen, iseed, r)
```

```
x =
      3      1      5
      4      3      4
      0      5      2
      9      8      6

iseedOut =
    1833294
    12104498
    1897623
    8265990

rOut =
    array elided

ifail =
      0
```