NAG Toolbox for MATLAB

g01ab

1 Purpose

g01ab computes the means, standard deviations, corrected sums of squares and products, maximum and minimum values, and the product-moment correlation coefficient for two variables. Unequal weighting may be given.

2 Syntax

```
[wt, res, ifail] = g01ab(x1, x2, 'n', n, 'wt', wt)
```

3 Description

The data consist of two samples of n observations, denoted by x_i, and y_i, for $i = 1, 2, \ldots, n$, with corresponding weights w_i, for $i = 1, 2, \ldots, n$.

If no specific weighting is given, then each w_i is set to 1.0 in g01ab.

The quantities calculated are:

(a) The sum of weights,

$$W = \sum_{i=1}^{n} w_i.$$

(b) The means,

$$\bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{W}, \qquad \bar{y} = \frac{\sum_{i=1}^{n} w_i y_i}{W}.$$

(c) The corrected sums of squares and products

$$c_{11} = \sum_{i=1}^{n} w_i (x_i - \bar{x})^2$$

$$c_{21} = c_{12} = \sum_{i=1}^{n} w_i (x_i - \bar{x})(y_i - \bar{y})$$

$$c_{22} = \sum_{i=1}^{n} w_i (y_i - \bar{y})^2.$$

(d) The standard deviations

$$s_j = \sqrt{\frac{c_{jj}}{d}}, \qquad \text{where} \qquad j = 1, 2 \qquad \text{and} \qquad d = W - \frac{\sum_{i=1}^{n} w_i^2}{W}.$$

(e) The product-moment correlation coefficient

$$R = \frac{c_{12}}{\sqrt{c_{11} c_{22}}}.$$

(f) The minimum and maximum elements in each of the two samples.

(g) The number of pairs of observations, m, for which $w_i > 0$, i.e., the number of **valid** observations. The quantities in (d) and (e) above will only be computed if $m \geq 2$. All other items are computed if $m \geq 1$.

4 References

None.

5 Parameters

5.1 Compulsory Input Parameters

1: **x1**(**n**) – **double array**

The observations from the first sample, x_i, for $i = 1, 2, \ldots, n$.

2: **x2**(**n**) – **double array**

The observations from the second sample, y_i, for $i = 1, 2, \ldots, n$.

5.2 Optional Input Parameters

1: **n** – **int32 scalar**

Default: The dimension of the arrays **x1**, **x2**, **wt**. (An error is raised if these dimensions are not equal.)

n, the number of pairs of observations.

Constraint: **n** ≥ 1.

2: **wt**(**n**) – **double array**

If **wt** is non null, then the elements of **wt** must contain the weights, w_i, associated with the pairs of observations, x_i, y_i, for $i = 1, 2, \ldots, n$.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **wt**(**n**) – **double array**

If **wt** was non null on input, then the elements of **wt** are unchanged.

If **wt** was null on input each element of **wt** will be assigned the value 1.0.

2: **res**(**13**) – **double array**

The elements of **res** contain the following results:

res(1) mean of the first sample, $\bar{x}$;
res(2) mean of the second sample, $\bar{y}$;
res(3) standard deviation of the first sample, s_1;
res(4) standard deviation of the second sample, s_2;
res(5) corrected sum of squares of the first sample, c_{11};
res(6) corrected sum of products of the two samples, c_{12};
res(7) corrected sum of squares of the second sample, c_{22};
res(8) product-moment correlation coefficient, R;
res(9) minimum of the first sample;
res(10) maximum of the first sample;
res(11) minimum of the second sample;
res(12) maximum of the second sample;
res(13) sum of weights, $\sum_{i=1}^{n} w_i$ (= **n**, if **wt** is null on entry).

3: **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, $\mathbf{n} < 1$.

ifail $= 2$

The number of valid cases, m, is 1, hence the standard deviation, 3(d), and the product-moment correlation coefficient, 3(e), cannot be calculated.

ifail $= 3$

The number of valid cases, m, is 0, or at least one of the weights is negative.

7 Accuracy

The method used is believed to be stable.

8 Further Comments

The time taken by g01ab increases linearly with n.

9 Example

```
x1 = [350;
      550;
      380;
      510;
      1270;
      300;
      2630;
      810;
      140;
      450;
      2280;
      250;
      540;
      720;
      90;
      480;
      180;
      3160;
      220;
      860;
      300;
      1460;
      400;
      620;
      120;
      780;
      230;
      1070;
      160];
x2 = [47;
      95;
      211;
```

```
     122;
     530;
     38;
     278;
     309;
     75;
     43;
     407;
     142;
     89;
     159;
     35;
     103;
     78;
     969;
     120;
     333;
     73;
     147;
     30;
     100;
     55;
     145;
     101;
     468;
     86];
[wtOut, res, ifail] = g01ab(x1, x2)
```

```
wtOut =
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
     1
res =
   1.0e+07 *
    0.0001
    0.0000
    0.0001
    0.0000
    1.6396
    0.3483
    0.1132
    0.0000
    0.0000
    0.0003
```

```
    0.0000
    0.0001
    0.0000
ifail =
           0
```