

NAG Toolbox for MATLAB

g01aa

1 Purpose

g01aa calculates the mean, standard deviation, coefficients of skewness and kurtosis, and the maximum and minimum values for a set of ungrouped data. Weighting may be used.

2 Syntax

```
[iwt, wt, xmean, s2, s3, s4, xmin, xmax, wtsum, ifail] = g01aa(x, 'n',  
n, 'wt', wt)
```

3 Description

The data consist of a single sample of n observations, denoted by x_i , with corresponding weights, w_i , for $i = 1, 2, \dots, n$.

If no specific weighting is required, then each w_i is set to 1.

The quantities computed are:

(a) The sum of the weights

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

(b) Mean

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

(c) Standard deviation

$$s_2 = \sqrt{\frac{\sum_{i=1}^n w_i (x_i - \bar{x})^2}{d}}, \quad \text{where} \quad d = W - \frac{\sum_{i=1}^n w_i^2}{W}.$$

(d) Coefficient of skewness

$$s_3 = \frac{\sum_{i=1}^n w_i (x_i - \bar{x})^3}{d \times s_2^3}.$$

(e) Coefficient of kurtosis

$$s_4 = \frac{\sum_{i=1}^n w_i (x_i - \bar{x})^4}{d \times s_2^4} - 3.$$

(f) Maximum and minimum elements of the sample.

(g) The number of observations for which $w_i > 0$, i.e., the number of **valid** observations. Suppose m observations are valid, then the quantities in , and will be computed if $m \geq 2$, and will be based on $m - 1$ degrees of freedom. The other quantities are evaluated provided $m \geq 1$.

4 References

None.

5 Parameters

5.1 Compulsory Input Parameters

- 1: **x(n)** – **double array**
 The sample observations, x_i , for $i = 1, 2, \dots, n$.

5.2 Optional Input Parameters

- 1: **n** – **int32 scalar**
Default: The dimension of the arrays **x**, **wt**. (An error is raised if these dimensions are not equal.)
 n , the number of observations.
Constraint: $n \geq 1$.
- 2: **wt(n)** – **double array**
 If **iwt** = 1, then the elements of **wt** must contain the weights associated with the observations, w_i , for $i = 1, 2, \dots, n$.
 If **iwt** = 0, then the elements of **wt** need not be set.

5.3 Input Parameters Omitted from the MATLAB Interface

iwt

5.4 Output Parameters

- 1: **iwt** – **int32 scalar**
iwt is used to indicate the number of valid observations, m ; see in Section 3 above.
- 2: **wt(n)** – **double array**
 If **iwt** = 1 the elements of **wt** are unchanged.
 If **iwt** = 0 each element of **wt** will be assigned the value 1.0.
- 3: **xmean** – **double scalar**
 The mean, $\bar{x}$.
- 4: **s2** – **double scalar**
 The standard deviation, s_2 .
- 5: **s3** – **double scalar**
 The coefficient of skewness, s_3 .
- 6: **s4** – **double scalar**
 The coefficient of kurtosis, s_4 .
- 7: **xmin** – **double scalar**
 The smallest value in the sample.
- 8: **xmax** – **double scalar**
 The largest value in the sample.

9: **wtsum – double scalar**

The sum of the weights in the array **wt**, that is $\sum_{i=1}^n w_i$. This will be **n** if **iwt** was 0 on entry.

10: **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, **n** < 1.

ifail = 2

The number of valid cases, *m*, is 1. In this case, standard deviation and coefficients of skewness and of kurtosis cannot be calculated.

ifail = 3

Either the number of valid cases is 0, or at least one weight is negative.

7 Accuracy

The method used is believed to be stable.

8 Further Comments

The time taken by g01aa is approximately proportional to *n*.

9 Example

```
x = [193;
      216;
      112;
      161;
      92;
      140;
      38;
      33;
      279;
      249;
      473;
      339;
      60;
      130;
      20;
      50;
      257;
      284;
      447;
      52;
      67;
      61;
      150;
      2200];
[iwt, wt, xmean, s2, s3, s4, xmin, xmax, wtsum, ifail] = g01aa(x)
```

```
iwt =                24
wt =
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
    1
xmean =      254.2917
s2 =      433.5318
s3 =       3.8951
s4 =      14.6653
xmin =       20
xmax =      2200
wtsum =      24
ifail =      0
```