

## NAG Toolbox

### nag\_stat\_summary\_1var (g01aa)

## 1 Purpose

nag\_stat\_summary\_1var (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.

**Note:** This function is scheduled to be withdrawn, please see g01aa in Advice on Replacement Calls for Withdrawn/Superseded Routines..

## 2 Syntax

```
[xmean, s2, s3, s4, xmin, xmax, iwt, wtsum, ifail] = nag_stat_summary_1var(x,
'n', n, 'wt', wt)
[xmean, s2, s3, s4, xmin, xmax, iwt, wtsum, ifail] = g01aa(x, 'n', n, 'wt', wt)
```

**Note:** the interface to this routine has changed since earlier releases of the toolbox:

At Mark 23: **wt** is no longer an output parameter; output parameters were reordered.

## 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 (c), (d) and (e) 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)** – REAL (KIND=nag\_wp) array

The sample observations,  $x_i$ , for  $i = 1, 2, \dots, n$ .

### 5.2 Optional Input Parameters

1: **n** – INTEGER

*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)** – REAL (KIND=nag\_wp) array

If the user wishes to supply weights then the elements of **wt** must contain the weights associated with the observations,  $w_i$ , for  $i = 1, 2, \dots, n$ .

### 5.3 Output Parameters

1: **xmean** – REAL (KIND=nag\_wp)

The mean,  $\bar{x}$ .

2: **s2** – REAL (KIND=nag\_wp)

The standard deviation,  $s_2$ .

3: **s3** – REAL (KIND=nag\_wp)

The coefficient of skewness,  $s_3$ .

4: **s4** – REAL (KIND=nag\_wp)

The coefficient of kurtosis,  $s_4$ .

5: **xmin** – REAL (KIND=nag\_wp)

The smallest value in the sample.

6: **xmax** – REAL (KIND=nag\_wp)

The largest value in the sample.

7: **iwt** – INTEGER

*iwt* is used to indicate the number of valid observations,  $m$ ; see (g) in Section 3 above.

8: **wtsum** – REAL (KIND=nag\_wp)

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.

9: **ifail** – INTEGER

**ifail** = 0 unless the function detects an error (see Section 5).

## 6 Error Indicators and Warnings

Errors or warnings detected by the function:

**ifail** = 1

On entry, **n** < 1.

**ifail** = 2 (*warning*)

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.

**ifail** = -99

An unexpected error has been triggered by this routine. Please contact NAG.

**ifail** = -399

Your licence key may have expired or may not have been installed correctly.

**ifail** = -999

Dynamic memory allocation failed.

## 7 Accuracy

The method used is believed to be stable.

## 8 Further Comments

The time taken by nag\_stat\_summary\_1var (g01aa) is approximately proportional to  $n$ .

## 9 Example

This example summarises an (optionally weighted) dataset and displays the results.

### 9.1 Program Text

```
function g01aa_example

fprintf('g01aa example results\n\n');

% Data
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];
n = size(x,2);

% Get simple statistics of data
[xmean, s2, s3, s4, xmin, xmax, iwt, wts, ifail] = ...
g01aa(x);

fprintf('Number of cases      %7d\n',n);
fprintf('Data as input -\n');
fprintf('%12.1f%12.1f%12.1f%12.1f%12.1f\n',x)
fprintf('\n\n');

fprintf('No. of valid cases %7d\n',iwt);
fprintf('Mean                 %7.1f\n',xmean);
fprintf('Minimum              %7.1f\n',xmin);
fprintf('Maximum              %7.1f\n',xmax);
fprintf('Sum of weights       %7.1f\n',wts);
fprintf('Std devn             %7.1f\n',s2);
fprintf('Skewness              %7.1f\n',s3);
fprintf('Kurtosis              %7.1f\n',s4);

```

## 9.2 Program Results

g01aa example results

Number of cases	24			
Data as input -				
193.0	216.0	112.0	161.0	92.0
140.0	38.0	33.0	279.0	249.0
473.0	339.0	60.0	130.0	20.0
50.0	257.0	284.0	447.0	52.0
67.0	61.0	150.0	2200.0	
No. of valid cases	24			
Mean	254.3			
Minimum	20.0			
Maximum	2200.0			
Sum of weights	24.0			
Std devn	433.5			
Skewness	3.9			
Kurtosis	14.7			

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