

NAG Library Routine Document

G01AUF

Note: before using this routine, please read the Users' Note for your implementation to check the interpretation of *bold italicised* terms and other implementation-dependent details.

1 Purpose

G01AUF combines sets of summaries produced by G01ATF.

2 Specification

```
SUBROUTINE G01AUF (B, MRCOMM, PN, XMEAN, XSD, XSKEW, XKURT, XMIN, XMAX,      &
                  RCOMM, IFAIL)
INTEGER          B, PN, IFAIL
REAL (KIND=nag_wp) MRCOMM(20,B), XMEAN, XSD, XSKEW, XKURT, XMIN, XMAX,      &
                  RCOMM(20)
```

3 Description

Assume a dataset containing n observations, denoted by $x = \{x_i : i = 1, 2, \dots, n\}$ and a set of weights, $w = \{w_i : i = 1, 2, \dots, n\}$, has been split into b blocks, and each block summarised via a call to G01ATF. Then G01AUF takes the b communication arrays returned by G01ATF and returns the mean (\bar{x}), standard deviation (s_2), coefficients of skewness (s_3) and kurtosis (s_4), and the maximum and minimum values for the whole dataset.

For a definition of \bar{x} , s_2 , s_3 and s_4 see Section 3 in G01ATF.

4 References

West D H D (1979) Updating mean and variance estimates: An improved method *Comm. ACM* **22** 532–555

5 Arguments

- | | | |
|----|--|----------------------------|
| 1: | B – INTEGER | <i>Input</i> |
| | <i>On entry:</i> b , the number of blocks the full dataset was split into. | |
| | <i>Constraint:</i> $B \geq 1$. | |
| 2: | MRCOMM(20,B) – REAL (KIND=nag_wp) array | <i>Communication Array</i> |
| | <i>On entry:</i> the j th column of MRCOMM must contain the information returned in RCOMM from one of the runs of G01ATF. | |
| 3: | PN – INTEGER | <i>Output</i> |
| | <i>On exit:</i> the number of valid observations, that is the number of observations with $w_i > 0$, for $i = 1, 2, \dots, n$. | |
| 4: | XMEAN – REAL (KIND=nag_wp) | <i>Output</i> |
| | <i>On exit:</i> \bar{x} , the mean. | |
| 5: | XSD – REAL (KIND=nag_wp) | <i>Output</i> |
| | <i>On exit:</i> s_2 , the standard deviation. | |

- 6: XSKEW – REAL (KIND=nag_wp) Output
On exit: s_3 , the coefficient of skewness.
- 7: XKURT – REAL (KIND=nag_wp) Output
On exit: s_4 , the coefficient of kurtosis.
- 8: XMIN – REAL (KIND=nag_wp) Output
On exit: the smallest value.
- 9: XMAX – REAL (KIND=nag_wp) Output
On exit: the largest value.
- 10: RCOMM(20) – REAL (KIND=nag_wp) array Communication Array
On exit: an amalgamation of the information held in MRCOMM. This is in the same format as RCOMM from G01ATF.
- 11: IFAIL – INTEGER Input/Output
On entry: IFAIL must be set to 0, -1 or 1. If you are unfamiliar with this argument you should refer to Section 3.4 in How to Use the NAG Library and its Documentation for details.
 For environments where it might be inappropriate to halt program execution when an error is detected, the value -1 or 1 is recommended. If the output of error messages is undesirable, then the value 1 is recommended. Otherwise, if you are not familiar with this argument, the recommended value is 0. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**
On exit: IFAIL = 0 unless the routine detects an error or a warning has been flagged (see Section 6).

6 Error Indicators and Warnings

If on entry IFAIL = 0 or -1, explanatory error messages are output on the current error message unit (as defined by X04AAF).

Errors or warnings detected by the routine:

IFAIL = 11

On entry, B = $\langle value \rangle$.
 Constraint: $B \geq 1$.

IFAIL = 21

On entry, MRCOMM is not in the expected format.

IFAIL = 31

On entry, the number of valid observations is zero.

IFAIL = 51

On exit we were unable to calculate XSKEW or XKURT. A value of 0 has been returned.

IFAIL = 52

On exit we were unable to calculate XSD, XSKEW or XKURT. A value of 0 has been returned.

IFAIL = -99

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

See Section 3.9 in How to Use the NAG Library and its Documentation for further information.

IFAIL = -399

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

See Section 3.8 in How to Use the NAG Library and its Documentation for further information.

IFAIL = -999

Dynamic memory allocation failed.

See Section 3.7 in How to Use the NAG Library and its Documentation for further information.

7 Accuracy

Not applicable.

8 Parallelism and Performance

G01AUF is not threaded in any implementation.

9 Further Comments

The order that the *b* communication arrays are stored in MRCOMM is arbitrary. Different orders can lead to slightly different results due to numerical accuracy of floating-point calculations.

Both G01AUF and G01ATF consolidate results from multiple summaries. Whereas the former can only be used to combine summaries calculated sequentially, the latter combines summaries calculated in an arbitrary order allowing, for example, summaries calculated on different processing units to be combined.

10 Example

This example summarises some simulated data. The data is supplied in three blocks, the first consisting of 21 observations, the second 51 observations and the last 28 observations. Summaries are produced for each block of data separately and then an overall summary is produced.

10.1 Program Text

```

Program g01aufe
!   G01AUF Example Program Text

!   Mark 26 Release. NAG Copyright 2016.

!   .. Use Statements ..
Use nag_library, Only: g01atf, g01auf, nag_wp
!   .. Implicit None Statement ..
Implicit None
!   .. Parameters ..
Integer, Parameter          :: nin = 5, nout = 6
!   .. Local Scalars ..
Real (Kind=nag_wp)         :: xkurt, xmax, xmean, xmin, xsd, xskew
Integer                    :: b, i, ifail, iwt, j, nb, pn
!   .. Local Arrays ..
Real (Kind=nag_wp), Allocatable :: mrcomm(:,,:), wt(:), x(:)
Real (Kind=nag_wp)         :: rcomm(20)
!   .. Executable Statements ..
Write (nout,*) 'G01AUF Example Program Results'
Write (nout,*)

```

```

!      Skip heading in data file
      Read (nin,*)

!      Read in the number of block of data we have
      Read (nin,*) b

      Allocate (mrcomm(20,b))

!      Loop over each block of data
      Do i = 1, b
!        Read in the number of observations in this block and the weight flag
          Read (nin,*) nb, iwt

!        Allocate X to the required size
          Allocate (x(nb))

!        Read in the data for this block
          If (iwt==0) Then
              Allocate (wt(0))
              Read (nin,*) x(1:nb)
          Else
              Allocate (wt(nb))
              Read (nin,*)(x(j),wt(j),j=1,nb)
          End If

!        IFAIL = 53, 71 or 72 are warnings and so we don't want to terminate
!        on any nonzero IFAIL. Therefore we set the flag for a quiet exit
          ifail = 1

!        Summarise this block of data
          pn = 0
          Call g01atf(nb,x,iwt,wt,pn,xmean,xsd,xskew,xkurt,xmin,xmax,      &
              mrcomm(1:20,i),ifail)
          If (ifail/=0 .And. ifail/=71 .And. ifail/=72 .And. ifail/=53) Then
              Write (nout,*) 'G01ATF failed with IFAIL = ', ifail
              Exit
          End If

!        Display the results for this block
          Write (nout,99999) 'Summary for block ', i
          If (ifail==53) Then
              Write (nout,*)                                     &
                  'No valid observations supplied. All weights are zero.'
          Else
              Write (nout,99997) pn, 'valid observations'
              Write (nout,99998) ' Mean          ', xmean
              If (ifail==72) Then
                  Write (nout,*)                                     &
                      ' Unable to calculate the standard deviation, skewness or ', &
                      'kurtosis'
              Else
                  Write (nout,99998) ' Std devn          ', xsd
                  If (ifail==71) Then
                      Write (nout,*) ' Unable to calculate the skewness or kurtosis'
                  Else
                      Write (nout,99998) ' Skewness          ', xskew
                      Write (nout,99998) ' Kurtosis          ', xkurt
                  End If
              End If
              Write (nout,99998) ' Minimum          ', xmin
              Write (nout,99998) ' Maximum          ', xmax
          End If
          Write (nout,*)

          Deallocate (x,wt)
      End Do

!      If (ifail==0 .Or. ifail==71 .Or. ifail==72 .Or. ifail==53) Then
!      Combine the summaries across all the blocks
      Call g01auf(b,mrcomm,pn,xmean,xsd,xskew,xkurt,xmin,xmax,rcomm,ifail)

```

```

!      Display the combined results
      Write (nout,99999) 'Summary for the combined data'
      If (ifail==53) Then
        Write (nout,*)
        'No valid observations supplied. All weights are zero.'
      Else
        Write (nout,99997) pn, 'valid observations'
        Write (nout,99998) ' Mean          ', xmean
        If (ifail==72) Then
          Write (nout,*)
          'Unable to calculate the standard deviation, skewness and ',
          'kurtosis'
        Else
          Write (nout,99998) ' Std devn          ', xsd
          If (ifail==71) Then
            Write (nout,*) ' Unable to calculate the skewness and kurtosis'
          Else
            Write (nout,99998) ' Skewness          ', xskew
            Write (nout,99998) ' Kurtosis          ', xkurt
          End If
        End If
        Write (nout,99998) ' Minimum          ', xmin
        Write (nout,99998) ' Maximum          ', xmax
      End If
    End If

99999 Format (1X,A,I0,A)
99998 Format (1X,A,F13.2)
99997 Format (1X,I0,1X,A)
      End Program g01aufe

```

10.2 Program Data

G01AUF Example Program Data

```

3
21 1
-0.62 4.91 -1.92 0.25
-1.72 3.90 -6.35 3.75
 2.00 1.17  7.65 3.19
 6.15 2.66  3.81 0.02
 4.87 3.59 -0.51 3.63
 6.88 4.83 -5.85 3.72
-0.72 1.72  0.66 0.78
 2.23 4.74 -1.61 1.72
-0.15 3.94 -1.15 1.33
-8.74 0.51 -3.94 2.40
 3.61 3.90
 51 0
-0.66 -2.39 -6.25 1.23 2.27 -2.27
10.12 8.29 -2.99 8.71 -0.74 0.02
 1.22 1.70 4.30 2.99 -0.83 -1.00
 6.57 2.32 -3.47 -1.41 -5.26 0.53
 1.80 4.79 -3.04 1.20 -3.21 -3.75
 0.86 1.27 -5.95 -5.27 1.63 3.59
-0.01 -1.38 -4.71 -4.82 3.55 0.46
 2.57 1.76 -4.05 1.23 -1.99 3.20
-0.65 8.42 -6.01
 28 0
 1.13 -8.86 5.92 -1.71 -3.99 6.57
-2.01 -2.29 -1.11 7.14 4.84 -4.44
-3.32 10.25 -2.11 8.02 -7.31 2.80
-1.20 1.01 1.37 -2.28 1.28 -3.95
 3.43 -0.61 4.85 -0.11

```

```

:: B
:: NB,IWT (1st block)

:: End of X,WT for 1st block
:: NB,IWT (2nd block)

:: End of X for 2nd block
:: NB,IWT (3rd block)

:: End of X for 3rd block

```

10.3 Program Results

G01AUF Example Program Results

Summary for block 1

21 valid observations

Mean	0.73
Std devn	4.40
Skewness	-0.05
Kurtosis	-1.00
Minimum	-8.74
Maximum	7.65

Summary for block 2

51 valid observations

Mean	0.28
Std devn	3.96
Skewness	0.46
Kurtosis	-0.16
Minimum	-6.25
Maximum	10.12

Summary for block 3

28 valid observations

Mean	0.48
Std devn	4.65
Skewness	0.19
Kurtosis	-0.58
Minimum	-8.86
Maximum	10.25

Summary for the combined data

100 valid observations

Mean	0.51
Std devn	4.24
Skewness	0.18
Kurtosis	-0.59
Minimum	-8.86
Maximum	10.25
