

NAG Library Routine Document

G01ASF

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

G01ASF produces a specified number of box and whisker plots on a character printing device, with a chosen number of character positions in each direction.

2 Specification

```

SUBROUTINE G01ASF(PRT, M, N, X, LDX, NSTEPX, NSTEPY, PLOT, LDPLLOT, WORK,
1 IWORK, IFAIL)
    INTEGER          M, N(M), LDX, NSTEPX, NSTEPY, LDPLLOT, IWORK(LDX),
1 IFAIL
    double precision X(LDX,M), WORK(5*M)
    CHARACTER*1      PRT, PLOT(LDPLLOT,NSTEPX)

```

3 Description

G01ASF produces a series of box and whisker plots representing m data batches each of size n_i , for $i = 1, 2, \dots, m$. A box and whisker plot is a diagrammatic representation of the five-point summary of a data batch. The plot consists of a box spanning the hinges with the median indicated by a third line and two whiskers to represent the extreme values. The five-point summary is calculated internally and is returned in the workspace array.

The plot is returned in the character array PLOT. The size of the plot may be controlled using the parameters NSTEPX and NSTEPY. Optionally the plot can be output to an external file, in which case output is directed to the current advisory message unit as defined by X04ABF.

An axis corresponding to the y axis is drawn and annotated and data points are plotted to the nearest character position.

4 References

Erickson B H and Nosanchuk T A (1985) *Understanding Data* Open University Press, Milton Keynes
 Tukey J W (1977) *Exploratory Data Analysis* Addison–Wesley

5 Parameters

- 1: PRT – CHARACTER*1 *Input*
On entry: indicates whether the box and whisker plot is to be output to an external file.
 PRT = 'N'
 The box and whisker plot is not output to an external file.
 PRT = 'P'
 The box and whisker plot is output to the current advisory message unit as defined by X04ABF.
Constraint: PRT = 'P' or 'N'.

- 2: M – INTEGER *Input*
On entry: m , the number of data batches that are to be represented.
Constraint: $M > 0$.
- 3: N(M) – INTEGER array *Input*
On entry: $N(i)$ contains the number of observations in the i th batch, n_i , for $i = 1, 2, \dots, m$.
 If $n_i < 5$ the i th batch is omitted from the plot.
Constraint: at least one $N(i)$, for $i = 1, 2, \dots, m$, must be greater than or equal to 5.
- 4: X(LDX,M) – **double precision** array *Input*
On entry: the i th column of X must contain the data for the i th batch, that is $X(j, i)$ must contain the j th observation of the i th batch, for $j = 1, 2, \dots, n_i$ and $i = 1, 2, \dots, m$.
- 5: LDX – INTEGER *Input*
On entry: the first dimension of the array X and the dimension of the array IWORK as declared in the (sub)program from which G01ASF is called.
Constraint: $LDX \geq \max\{N(i)\}$.
- 6: NSTEPX – INTEGER *Input*
On entry: the number of character positions to be plotted in the x -direction.
Constraint: $NSTEPX \geq \max(19, (15 \times M/4 + 9))$.
- 7: NSTEPY – INTEGER *Input*
On entry: the number of character positions to be plotted in the y -direction.
Constraint: $NSTEPY \geq 9$.
- 8: PLOT(LDPLOT,NSTEPX) – CHARACTER*1 array *Output*
On exit: contains the box and whisker plots.
- 9: LDPLOT – INTEGER *Input*
On entry: the first dimension of the array PLOT as declared in the (sub)program from which G01ASF is called.
Constraint: $LDPLOT \geq NSTEPY$.
- 10: WORK($5 \times M$) – **double precision** array *Output*
On exit: $WORK(j)$, for $j = (i - 1) \times 5 + 1, (i - 1) \times 5 + 2, \dots, (i - 1) \times 5 + 5$, contains the five-point summary of the i th batch.
- 11: IWORK(LDX) – INTEGER array *Workspace*
- 12: IFAIL – INTEGER *Input/Output*
On entry: IFAIL must be set to 0, -1 or 1. If you are unfamiliar with this parameter you should refer to Section 3.3 in the Essential Introduction for details.
On exit: IFAIL = 0 unless the routine detects an error (see Section 6).
 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 parameter, the recommended value is 0. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

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:

$IFAIL = 1$

On entry, $N(i) < 5$ for some i , for $i = 1, 2, \dots, m$. For each batch where this occurs, 5 crosses are plotted in a vertical line to indicate that insufficient data was provided to produce a five-point summary and box-plot for that particular batch.

$IFAIL = 2$

On entry, $NSTEPX < \max(19, 15 \times M/4 + 9)$. This indicates that the data region defined by $NSTEPX$ is too small to produce the required plot.

$IFAIL = 3$

On entry, $NSTEPY < 9$.

$IFAIL = 4$

On entry, $LDPLOT < NSTEPY$.

$IFAIL = 5$

On entry, $PRT \neq 'P'$ or $'N'$.

$IFAIL = 6$

On entry, $LDX < \max(N(i))$, for $i = 1, 2, \dots, m$.

$IFAIL = 7$

The number of observations in all batches is less than 5.

$IFAIL = 8$

On entry, the data values are all identical.

7 Accuracy

If the range of observations in a particular batch is too small to allow each item of the five-point summary to be plotted separately, then a sequence of stars are plotted at the median point of the batch to indicate that the full box-plot could not be plotted.

8 Further Comments

The time taken by G01ASF increases with m and n_i , for $i = 1, 2, \dots, m$.

9 Example

The following program produces a box and whisker plot for each one of 5 data batches of sizes 5, 6, 8, 8 and 7 respectively and prints the 5 box and whisker plots on the current advisory message unit.

9.1 Program Text

```

*      G01ASF Example Program Text
*      Mark 14 Release. NAG Copyright 1989.
*      .. Parameters ..
      INTEGER          NIN, NOUT
      PARAMETER        (NIN=5,NOUT=6)
      INTEGER          NMAX, LDX
      PARAMETER        (NMAX=5,LDX=10)
*      .. Local Scalars ..
      INTEGER          I, IFAIL, J, LDPLLOT, M, NSTEPX, NSTEPY, OUTCHN
*      .. Local Arrays ..
      DOUBLE PRECISION WORK(5*NMAX), X(LDX,NMAX)
      INTEGER          IWORK(LDX), N(NMAX)
      CHARACTER        PLOT(60,132)
*      .. External Subroutines ..
      EXTERNAL         G01ASF, X04ABF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'G01ASF Example Program Results'
      OUTCHN = NOUT
*      Skip heading in data file
      READ (NIN,*)
*      Set advisory message unit for plot output to OUTCHN
      CALL X04ABF(1,OUTCHN)
      READ (NIN,*) M, (N(I),I=1,M)
      READ (NIN,*) NSTEPX, NSTEPY
      DO 20 J = 1, M
        READ (NIN,*) (X(I,J),I=1,N(J))
20  CONTINUE
      LDPLLOT = NSTEPY
      IFAIL = 1
      WRITE (NOUT,*)
*
      CALL G01ASF('Print',M,N,X,LDX,NSTEPX,NSTEPY,PLOT,LDPLLOT,WORK,
+              IWORK,IFAIL)
*
      IF (IFAIL.NE.0) THEN
        WRITE (NOUT,*)
        WRITE (NOUT,99999) ' ** G01ASF returned with IFAIL = ', IFAIL
      END IF
*
99999 FORMAT (1X,A,I5)
      END

```

9.2 Program Data

```

G01ASF Example Program Data
  5   5   6   8   8   7
 55  21
-9.0 -7.3 -4.9 -2.4 -0.6
-5.6 12.0 -9.0 -3.9 -2.4 -7.3
-9.0 12.0 -6.0 -3.0  0.0  3.0  6.0  9.0
12.0 10.0 10.0  8.0  6.0  4.0  4.0 -9.0
-5.0  8.0  1.5 -3.2 -3.2  6.2  6.2
                                :N(i)
                                :NSTEPX NSTEPY
                                :X(i,j)

```

9.3 Program Results

G01ASF Example Program Results

```

0.1E+02+      ---      ---      ---
      :      :      :
      :      :      :
0.8E+01+      :      :      :
      :      :      :
      :      :      :
      :      :      :
0.4E+01+      :      :      :
      :      :      :
      :      :      :
      :      :      :

```

	:	:	:	:	:	:
-0.6E+00+	---	:	:	:	:	:
	:	:	:	:	:	:
	----	----	:	:	:	----
	:	:	:	:	:	:
-0.5E+01+	----	----	----	:	:	----
	:	:	:	:	:	:
	----	----	:	:	:	:
	:	:	:	:	:	:
-0.9E+01+	---	---	---	---	:	: