NAG Fortran Library Routine Document

G01AJF

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

G01AJF prints a histogram on a character printing device, with user control over size, positioning, and the range of data values included.

2 Specification

```
SUBROUTINE G01AJF(X, N, NSTEPX, NSTEPY, ITYPE, ISPACE, XMIN, XMAX,
1                  XSTEP, N1, MULTY, IFAIL)
INTEGER           N, NSTEPX, NSTEPY, ITYPE, ISPACE, N1, MULTY, IFAIL
real              X(N), XMIN, XMAX, XSTEP
```

3 Description

A histogram is printed using vertical bars consisting of * characters. The output is directed to the current advisory message unit (see the Users' Note for your implementation). It may be redirected by a call to X04ABF before calling G01AJF.

The following options are available:

(a) inclusion of all data values, or only of those lying within a specified range;

(b) specification of the size of the histogram in the vertical and horizontal directions and of positioning in the horizontal direction;

(c) calculation of frequencies or cumulative frequencies in the histogram.

The maximum and minimum data values used, the (integral) number of observations represented by each * in the histogram, and the step size per character position in the horizontal direction, are returned.

The histogram is headed FREQUENCY or CUM.FREQ. depending on the option selected. Each line is annotated with the minimum frequency which a bar reaching that line represents. The data maximum and minimum are printed under the histogram, unless either exceeds 9999.99 in modulus, in which case they are not printed (although they are still returned).

4 References

None.

5 Parameters

1:    X(N) – **real** array   *Input*

      On entry: the data values.

2:    N – INTEGER   *Input*

      On entry: the number of data values.

      Constraint: $N \geq 1$.

3:    NSTEPX – INTEGER   *Input/Output*

      On entry: the number of character positions to be used in the horizontal direction, i.e., the number of categories in the histogram.

On exit: if NSTEPX < 10 on entry, NSTEPX is reset to 10.

If NSTEPX > 99 on entry, NSTEPX is reset to 99.

Otherwise, NSTEPX is unchanged on exit.

4: NSTEPY – INTEGER *Input/Output*

On entry: the number of character positions to be used in the vertical direction, i.e., the maximum height of a histogram bar.

On exit: if NSTEPY < 10 on entry, NSTEPY is reset to 10.

If NSTEPY > 99 on entry, NSTEPY is reset to 99.

Otherwise, NSTEPY is unchanged on exit.

5: ITYPE – INTEGER *Input*

On entry: indicates whether a histogram of frequencies or cumulative frequencies is required.

ITYPE=0 for frequencies.

ITYPE $\neq 0$ for cumulative frequencies.

The second option effectively displays the distribution function of the data rather than the density function.

6: ISPACE – INTEGER *Input/Output*

On entry: indicates how many spaces are to be inserted at the beginning of each output line.

If ISPACE < 0 on input, ISPACE=0 is used

If ISPACE + NSTEPX + 14 > 120, then ISPACE=0 is used.

The second condition imposes an effective line length limit of 120 characters.

On exit: unchanged unless ISPACE < 0 or IPSPACE + NSTEPX + 14 > 120, in which case ISPACE is set to 0.

7: XMIN – *real* *Input/Output*
8: XMAX – *real* *Input/Output*

On entry: if XMIN < XMAX, only those values in X such that XMIN $\leq$ X(i) $\leq$ XMAX, for $i = 1, 2, \ldots, n$, are included in the histogram.

If XMIN $\geq$ XMAX, all the data are included.

On exit: if XMIN < XMAX on entry, then XMIN and XMAX are unchanged.

If XMIN $\geq$ XMAX then XMIN and XMAX contain the minimum and maximum data values respectively.

9: XSTEP – *real* *Output*

On exit: the width of each class interval.

10: N1 – INTEGER *Output*

On exit: the total number of observations actually included in the histogram.

11: MULTY – INTEGER *Output*

On exit: the number of observations represented by each * in the histogram.

12: IFAIL – INTEGER *Input/Output*

On entry: IFAIL must be set to 0, −1 or 1. Users who are unfamiliar with this parameter should refer to Chapter P01 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, for users 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 < 1.

7 Accuracy

Accuracy is limited by the number of plotting positions available.

8 Further Comments

The time taken by the routine increases with N, NSTEPX and NSTEPY.

A total of $(\text{NSTEPX} + \text{ISPACE} + 14)$ character positions are used in the horizontal direction, not including the carriage control character. It is important that this total does not exceed the maximum line length available on the output device.

A total of $(\text{NSTEPY} + 3)$ output lines are normally generated, one less if XMIN and/or XMAX is too large in modulus to be printed.

9 Example

A sample of 50 random numbers (which were generated by G05DDF) form the data, which correspond to a Normal distribution with mean and standard deviation both equal to 5.0. A histogram of the entire sample is drawn first, followed by a cumulative histogram of all data values lying between -10.0 and 5.0. The first histogram is indented 10 character positions. Note the use of X04ABF to direct the output to unit number 6.

9.1 Program Text

Note: the listing of the example program presented below uses ***bold italicised*** terms to denote precision-dependent details. Please read the Users' Note for your implementation to check the interpretation of these terms. As explained in the Essential Introduction to this manual, the results produced may not be identical for all implementations.

```
*     G01AJF Example Program Text
*     Mark 14 Revised.  NAG Copyright 1989.
*     .. Parameters ..
      INTEGER           N
      PARAMETER         (N=50)
      INTEGER           NIN, NOUT
      PARAMETER         (NIN=5,NOUT=6)
*     .. Local Scalars ..
      real              XMAX, XMIN, XSTEP
      INTEGER           I, IFAIL, ISPACE, ITYPE, MULTY, N1, NSTEPX,
     +                  NSTEPY
*     .. Local Arrays ..
      real              X(N)
*     .. External Subroutines ..
      EXTERNAL          G01AJF, X04ABF
*     .. Executable Statements ..
      WRITE (NOUT,*) 'G01AJF Example Program Results'
```

```
*     Skip heading in data file
      READ (NIN,*)
      READ (NIN,*) (X(I),I=1,N)
      WRITE (NOUT,*)
      NSTEPX = 10
      NSTEPY = 10
      ITYPE = 0
      ISPACE = 10
      XMIN = 0.0e0
      XMAX = 0.0e0
      CALL X04ABF(1,NOUT)
      IFAIL = 0
*
      CALL G01AJF(X,N,NSTEPX,NSTEPY,ITYPE,ISPACE,XMIN,XMAX,XSTEP,N1,
     +            MULTY,IFAIL)
*
      WRITE (NOUT,*)
      WRITE (NOUT,*)
      WRITE (NOUT,*)
      ITYPE = 1
      ISPACE = 0
      XMIN = -10.0e0
      XMAX = 5.0e0
      IFAIL = 0
*
      CALL G01AJF(X,N,NSTEPX,NSTEPY,ITYPE,ISPACE,XMIN,XMAX,XSTEP,N1,
     +            MULTY,IFAIL)
*
      STOP
      END
```

9.2 Program Data

```
G01AJF Example Program Data
   2.68   8.23   0.11   1.39  -2.77  -1.17   3.49   7.39   5.22   5.44
   7.06   6.17  -4.44   5.98  14.02   8.06  10.96   0.99   7.87   4.85
   9.76   3.30   4.45   7.02   5.43   3.57   1.98   3.09  -2.66   5.04
  14.52  -0.61   5.04   6.85   3.94   4.87   3.82   5.93   7.89   9.48
   6.81   6.91   7.76   6.21   0.55  -2.44  18.09   6.19   9.19  10.55
```

9.3 Program Results

```
 G01AJF Example Program Results

          FREQUENCY
          20 .              .  20
          18 .              .  18
          16 .              .  16
          14 .              .  14
          12 .      *       .  12
          10 .     **       .  10
           8 .    ***       .   8
           6 .    ***       .   6
           4 .* *****       .   4
           2 .******* * .       2
             ------------
             -4.44    18.09




  CUM. FREQ.
     30 .              .  30
     27 .              .  27
     24 .              .  24
     21 .          *.  21
     18 .          *.  18
     15 .         **.  15
     12 .         **.  12
      9 .        ***.   9
      6 .       ****.   6
```

```
    3   .    ******.    3
        ------------
    -10.00     5.00
```