NAG Library Routine Document

G08CLF

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

G08CLF calculates the Anderson–Darling goodness-of-fit test statistic and its probability for the case of an unspecified exponential distribution.

2 Specification

```
SUBROUTINE G08CLF (N, ISSORT, Y, YBAR, A2, AA2, P, IFAIL)

INTEGER            N, IFAIL
REAL (KIND=nag_wp) Y(N), YBAR, A2, AA2, P
LOGICAL            ISSORT
```

3 Description

Calculates the Anderson–Darling test statistic A^2 (see G08CHF) and its upper tail probability for the small sample correction:

$$\text{Adjusted } A^2 = A^2(1 + 0.6/n),$$

for n observations.

4 References

Anderson T W and Darling D A (1952) Asymptotic theory of certain 'goodness-of-fit' criteria based on stochastic processes *Annals of Mathematical Statistics* **23** 193–212

Stephens M A and D'Agostino R B (1986) *Goodness-of-Fit Techniques* Marcel Dekker, New York

5 Parameters

1: N – INTEGER *Input*

On entry: n, the number of observations.

Constraint: N > 1.

2: ISSORT – LOGICAL *Input*

On entry: set ISSORT = .TRUE. if the observations are sorted in ascending order; otherwise the routine will sort the observations.

3: Y(N) – REAL (KIND=nag_wp) array *Input*

On entry: y_i, for $i = 1, 2, \ldots, n$, the n observations.

Constraint: if ISSORT = .TRUE., values must be sorted in ascending order. Each y_i must be greater than zero.

4: YBAR – REAL (KIND=nag_wp) *Output*

On exit: the maximum likelihood estimate of mean.

5: A2 – REAL (KIND=nag_wp) *Output*

On exit: A^2, the Anderson–Darling test statistic.

6: AA2 – REAL (KIND=nag_wp) *Output*

On exit: the adjusted A^2.

7: P – REAL (KIND=nag_wp) *Output*

On exit: p, the upper tail probability for the adjusted A^2.

8: 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.

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.**

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 $= 1$

On entry, N < 2.

IFAIL $= 3$

The data in Y is not sorted in ascending order.

IFAIL $= 9$

The data in Y must be greater than zero.

7 Accuracy

Probabilities are calculated using piecewise polynomial approximations to values estimated by simulation.

8 Further Comments

None.

9 Example

This example calculates the A^2 statistics for data assumed to arise from an unspecified exponential distribution and calculates the p-value.

9.1 Program Text

```
    Program g08clfe

!     Mark 24 Release. NAG Copyright 2012.

!     .. Use Statements ..
      Use nag_library, Only: g08clf, nag_wp
!     .. Implicit None Statement ..
      Implicit None
!     .. Parameters ..
      Integer, Parameter               :: nin = 5, nout = 6
!     .. Local Scalars ..
      Real (Kind=nag_wp)               :: a2, aa2, p, ybar
      Integer                          :: i, ifail, n
      Logical                          :: issort
!     .. Local Arrays ..
      Real (Kind=nag_wp), Allocatable  :: y(:)
!     .. Executable Statements ..
      Write (nout,*) 'G08CLF Example Program Results'
      Write (nout,*)

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

!     Read number of observations
      Read (nin,*) n

!     Memory allocation
      Allocate (y(n))

!     Read observations
      Read (nin,*)(y(i),i=1,n)

!     Let g08clf sort the data
      issort = .False.

!     Calculate A-squared and probability
      ifail = 0
      Call g08clf(n,issort,y,ybar,a2,aa2,p,ifail)

!     Results
      Write (nout,'(1X,A,E11.4)') &
        'H0: data from exponential distribution with mean', ybar
      Write (nout,'(1X,A,1X,F8.4)') 'Test statistic, A-squared: ', a2
      Write (nout,'(1X,A,1X,F8.4)') 'Adjusted A-squared:        ', aa2
      Write (nout,'(1X,A,1X,F8.4)') 'Upper tail probability:    ', p

    End Program g08clfe
```

9.2 Program Data

```
G08CLF Example Program Data
26 :: n
0.4782745 1.2858962 1.1163891 2.0410619 2.2648109 0.0833660 1.2527554
0.4031288 0.7808981 0.1977674 3.2539440 1.8113504 1.2279834 3.9178773
1.4494309 0.1358438 1.8061778 6.0441929 0.9671624 3.2035042 0.8067364
0.4179364 3.5351774 0.3975414 0.6120960 0.1332589 :: end of observations
```

9.3 Program Results

```
 G08CLF Example Program Results

 H0: data from exponential distribution with mean 0.1524E+01
 Test statistic, A-squared:    0.1616
 Adjusted A-squared:           0.1654
 Upper tail probability:       0.9831
```