

NAG Fortran Library Routine Document

G07DAF

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

G07DAF finds the median, median absolute deviation, and a robust estimate of the standard deviation for a set of ungrouped data.

2 Specification

```
SUBROUTINE G07DAF(N, X, Y, XME, XMD, XSD, IFAIL)
INTEGER          N, IFAIL
real           X(N), Y(N), XME, XMD, XSD
```

3 Description

The data consists of a sample of size n , denoted by x_1, x_2, \dots, x_n , drawn from a random variable X .

G07DAF first computes the median,

$$\theta_{med} = \text{med}_i\{x_i\},$$

and from this the median absolute deviation can be computed,

$$\sigma_{med} = \text{med}_i\{|x_i - \theta_{med}|\}.$$

Finally, a robust estimate of the standard deviation is computed,

$$\sigma'_{med} = \sigma_{med} / \Phi^{-1}(0.75)$$

where $\Phi^{-1}(0.75)$ is the value of the inverse standard Normal function at the point 0.75.

G07DAF is based upon subroutine LTMDV within the ROBETH library, see Marazzi (1987).

4 References

Huber P J (1981) *Robust Statistics* Wiley

Marazzi A (1987) Subroutines for robust estimation of location and scale in ROBETH *Cah. Rech. Doc. IUMSP, No. 3 ROB 1* Institut Universitaire de Médecine Sociale et Préventive, Lausanne

5 Parameters

- | | | |
|----|---|---------------|
| 1: | N – INTEGER | <i>Input</i> |
| | <i>On entry:</i> the number of observations, n . | |
| | <i>Constraint:</i> $N > 1$. | |
| 2: | X(N) – real array | <i>Input</i> |
| | <i>On entry:</i> the vector of observations, x_1, x_2, \dots, x_n . | |
| 3: | Y(N) – real array | <i>Output</i> |
| | <i>On exit:</i> the observations sorted into ascending order. | |

- 4: XME – *real* Output
On exit: the median, θ_{med} .
- 5: XMD – *real* Output
On exit: the median absolute deviation, σ_{med} .
- 6: XSD – *real* Output
On exit: the robust estimate of the standard deviation, σ'_{med} .
- 7: 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, $N \leq 1$.

7 Accuracy

The computations are believed to be stable.

8 Further Comments

Unless otherwise stated in the implementation document, the routine may be called with the same actual array supplied for parameters X and Y, in which case the sorted data values will overwrite the original contents of X. However this is not standard Fortran 77, and may not work on all systems.

9 Example

The following program reads in a set of data consisting of eleven observations of a variable X. The median, median absolute deviation and a robust estimate of the standard deviation are calculated and printed along with the sorted data in output array Y.

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.

```
*      G07DAF Example Program Text
*      Mark 14 Revised.  NAG Copyright 1989.
*      .. Parameters ..
INTEGER          NIN, NOUT
PARAMETER       (NIN=5,NOUT=6)
INTEGER          NMAX
PARAMETER       (NMAX=25)
```

```

*   .. Local Scalars ..
   real          XMD, XME, XSD
   INTEGER       I, IFAIL, N
*   .. Local Arrays ..
   real          X(NMAX), Y(NMAX)
*   .. External Subroutines ..
   EXTERNAL      G07DAF
*   .. Executable Statements ..
   WRITE (NOUT,*) 'G07DAF Example Program Results'
*   Skip heading in data file
   READ (NIN,*)
   READ (NIN,*) N
   WRITE (NOUT,*)
   IF (N.LE.NMAX) THEN
       READ (NIN,*) (X(I),I=1,N)
       IFAIL = 0
*
       CALL G07DAF(N,X,Y,XME,XMD,XSD,IFAIL)
*
       WRITE (NOUT,*) 'Output Y:'
       WRITE (NOUT,99999) (Y(I),I=1,N)
       WRITE (NOUT,*)
       WRITE (NOUT,99998) 'XME = ', XME, ', XMD = ', XMD, ', XSD = ',
+      XSD
   ELSE
       WRITE (NOUT,99997) 'N is out of range: N =', N
   END IF
   STOP
*
99999 FORMAT (1X,11F7.3)
99998 FORMAT (1X,A,F6.3,A,F6.3,A,F6.3)
99997 FORMAT (1X,A,I5)
   END

```

9.2 Program Data

G07DAF Example Program Data

```

11      : N, NUMBER OF OBSERVATIONS
13.0 11.0 16.0 5.0 3.0 18.0 9.0 8.0 6.0 27.0 7.0 : X, OBSERVATIONS

```

9.3 Program Results

G07DAF Example Program Results

Output Y:

```

3.000 5.000 6.000 7.000 8.000 9.000 11.000 13.000 16.000 18.000 27.000

```

```

XME = 9.000, XMD = 4.000, XSD = 5.930

```
