

G07DAF – NAG Fortran Library Routine Document

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 LTMDDV within the ROBETH library, see Marazzi [2].

4 References

- [1] Huber P J (1981) *Robust Statistics* Wiley
- [2] 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 | Input |
| | <i>On entry:</i> the number of observations, n . | |
| | <i>Constraint:</i> $N > 1$. | |
| 2: | X(N) — <i>real</i> array | Input |
| | <i>On entry:</i> the vector of observations, x_1, x_2, \dots, x_n . | |
| 3: | Y(N) — <i>real</i> array | Output |
| | <i>On exit:</i> the observations sorted into ascending order. | |
| 4: | XME — <i>real</i> | Output |
| | <i>On exit:</i> 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. For users not familiar with this parameter (described in Chapter P01) the recommended value is 0.
On exit: IFAIL = 0 unless the routine detects an error (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 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

```
