Period Distribution—PERD

The program PERD (**Per**iod **D**istribution) is a subroutine subprogram that calculates the period-frequency distribution of the given equally spaced time series data by the zero-crossing or the peak method.

PERD（**Per**iod **D**istribution）

【Purpose】

To calculate the period-frequency distribution of the given equidistant time series data by the zero-crossing method or the peak method, and compute the irregularity index.

【Usage】

（1） How to connect

```
CALL PERD (N, X, ND, DT, IND, T, NFREQ, RFREQ, EPS)
```

Argument	Type	Parameter in calling program	Return Parameter
N	I	Total number of array data X	Unchanged
X	R 1-D array (ND)	Equal interval data	Unchanged
ND	I	Dimension size of X in calling program	Unchanged
DT	R	Time interval (unit : sec)	Unchanged
IND	I	0 : Zero-crossing method 1 : Peak method	Unchanged
T	R 1-D array (20)	No need to input here	Representative value of period （unit : sec)
NFREQ	I 1-D array (20)	No need to input here	Frequency in each class
RFREQ	R 1-D array (20)	No need to input here	Relative frequency in each class (%)
EPS	R	No need to input here	Irregularity index

（2） Necessary subroutines and function subprograms

None

(3) Remarks

If there are adjacent values of the data that are equal, when you return from the subprogram, a very small number will have been added or subtracted from the value.

【Program List】

```
C  * * * * * * * * * * * * * * * * * * * * * * *                    PERD   1
C     SUBROUTINE FOR PERIOD DISTRIBUTION                              PERD   2
C  * * * * * * * * * * * * * * * * * * * * * * *                    PERD   3
C                                                                     PERD   4
C                        CODED BY Y.OHSAKI                            PERD   5
C                                                                     PERD   6
C     PURPOSE                                                         PERD   7
C       TO COMPUTE THE PERIOD-FREQUENCY DISTRIBUTION OF A TIME SERIES PERD   8
C       OF EQUI-SPACED DATA BY MEANS OF ZERO-CROSSING OR PEAK METHOD  PERD   9
C                                                                     PERD  10
C     USAGE                                                           PERD  11
C       CALL PERD(N,X,ND,DT,IND,T,NFREQ,RFREQ,EPS)                    PERD  12
C                                                                     PERD  13
C     DESCRIPTION OF ARGUMENTS                                        PERD  14
C       N          - TOTAL NUMBER OF DATA                             PERD  15
C       X(ND)      - EQUI-SPACED DATA                                 PERD  16
C       ND         - DIMENSION OF X IN CALLING PROGRAM                PERD  17
C       DT         - TIME INCREMENT OF DATA IN SEC                    PERD  18
C       IND        - IF IND.EQ.0, ZERO-CROSSING METHOD                PERD  19
C                    IF IND.EQ.1, PEAK METHOD                         PERD  20
C       T(20)      - PERIODS IN SEC                                   PERD  21
C       NFREQ(20)  - FREQUENCY IN EACH CLASS OF PERIOD                PERD  22
C       RFREQ(20)  - RELATIVE FREQUENCY IN EACH CLASS OF PERIOD IN    PERD  23
C                    PERCENT                                          PERD  24
C       EPS        - IRREGULARITY INDEX                               PERD  25
C                                                                     PERD  26
C     SUBROUTINES AND FUNCTION SUBPROGRAMS REQUIRED                   PERD  27
C       NONE                                                          PERD  28
C                                                                     PERD  29
      SUBROUTINE PERD(N,X,ND,DT,IND,T,NFREQ,RFREQ,EPS)                PERD  30
C                                                                     PERD  31
      DIMENSION X(ND),T(20),NFREQ(20),RFREQ(20)                       PERD  32
      DIMENSION BOUND(21)                                             PERD  33
      DATA      BOUND/0.05,0.06,0.07,0.08,0.10,0.12,0.15,0.18,0.22,   PERD  34
     *               0.27,0.32,0.40,0.50,0.60,0.75,0.90,1.10,1.30,    PERD  35
     *               1.60,2.00,2.50/                                  PERD  36
C                                                                     PERD  37
C     INITIALIZATION                                                  PERD  38
C                                                                     PERD  39
      DO 110 I=1,20                                                   PERD  40
      T(I)=(BOUND(I)+BOUND(I+1))/2.                                   PERD  41
      NFREQ(I)=0                                                      PERD  42
  110 CONTINUE                                                        PERD  43
      XMIN=99999.                                                     PERD  44
```

```
      DO 120 M=1,N                                                      PERD  45
      IF(X(M).EQ.0.) GO TO 120                                          PERD  46
      XMIN=AMIN1(XMIN,ABS(X(M)))                                        PERD  47
  120 CONTINUE                                                          PERD  48
      ZERO=XMIN/1000.                                                   PERD  49
      IF(X(1).EQ.0.0) X(2)=X(2)+ZERO                                    PERD  50
      DO 130 M=2,N-1                                                    PERD  51
      IF(ABS(X(M)-X(M+1)).GT.ZERO) GO TO 130                            PERD  52
      X(M+1)=X(M)+SIGN(ZERO,X(M)-X(M-1))                                PERD  53
  130 CONTINUE                                                          PERD  54
      NO=0                                                              PERD  55
      DO 140 M=1,N-1                                                    PERD  56
      IF(X(M).EQ.0..OR.X(M)*X(M+1).LT.0.) GO TO 150                     PERD  57
  140 CONTINUE                                                          PERD  58
  150 TZ1=(REAL(M-1)+ABS(X(M)/(X(M)-X(M+1))))*DT                        PERD  59
      NZ=1                                                              PERD  60
      IF(X(M+1).GT.0.) NO=NO+1                                          PERD  61
      MZ1=M+1                                                           PERD  62
      DO 160 M=2,N-1                                                    PERD  63
      IF(X(M)-X(M-1).LT.0..OR.X(M+1)-X(M).GT.0.) GO TO 160              PERD  64
      GO TO 170                                                         PERD  65
  160 CONTINUE                                                          PERD  66
  170 TPP1=REAL(M-1)*DT                                                 PERD  67
      NP=1                                                              PERD  68
      MPP1=M+1                                                          PERD  69
      IF(IND.EQ.0) GO TO 200                                            PERD  70
      DO 180 M=2,N-1                                                    PERD  71
      IF(X(M)-X(M-1).GT.0..OR.X(M+1)-X(M).LT.0.) GO TO 180              PERD  72
      GO TO 190                                                         PERD  73
  180 CONTINUE                                                          PERD  74
  190 TPM1=REAL(M-1)*DT                                                 PERD  75
      MPM1=M+1                                                          PERD  76
C                                                                       PERD  77
C     ZERO-CROSSING METHOD                                              PERD  78
C                                                                       PERD  79
  200 DO 260 M=MZ1,N                                                    PERD  80
      IF(M.EQ.N) GO TO 210                                              PERD  81
      IF(X(M)*X(M+1).GT.0.) GO TO 260                                   PERD  82
      IF(X(M).EQ.0..AND.X(M-1)*X(M+1).GT.0..OR.X(M+1).EQ.0.) GO TO 260  PERD  83
      TZ2=(REAL(M-1)+ABS(X(M)/(X(M)-X(M+1))))*DT                        PERD  84
      GO TO 220                                                         PERD  85
  210 IF(X(N).NE.0.) GO TO 260                                          PERD  86
      TZ2=REAL(N-1)*DT                                                  PERD  87
  220 TT=(TZ2-TZ1)*2.                                                   PERD  88
      TZ1=TZ2                                                           PERD  89
C                                                                       PERD  90
C     FREQUENCY COUNT                                                   PERD  91
C                                                                       PERD  92
      IF(TT.LE.BOUND(1).OR.TT.GT.BOUND(21)) GO TO 260                   PERD  93
      IF(IND.EQ.1) GO TO 250                                            PERD  94
      DO 230 I=1,20                                                     PERD  95
      IF(TT.GT.BOUND(I+1)) GO TO 230                                    PERD  96
```

```
      NFREQ(I)=NFREQ(I)+1                                              PERD  97
      GO TO 240                                                        PERD  98
  230 CONTINUE                                                         PERD  99
  240 NZ=NZ+1                                                          PERD 100
  250 IF(X(M-1).LT.0.) NO=NO+1                                         PERD 101
  260 CONTINUE                                                         PERD 102
      TOTAL=REAL(NZ-1)                                                 PERD 103
C                                                                      PERD 104
C     PEAK METHOD                                                      PERD 105
C                                                                      PERD 106
      GRAD=1.                                                          PERD 107
      MP1=MPP1                                                         PERD 108
      TP1=TPP1                                                         PERD 109
  270 DO 300 M=MP1,N-1                                                 PERD 110
      IF((X(M)-X(M-1))*GRAD.LT.0..OR.(X(M+1)-X(M))*GRAD.GT.0.)         PERD 111
     * GO TO 300                                                       PERD 112
      TP2=REAL(M-1)*DT                                                 PERD 113
      TT=TP2-TP1                                                       PERD 114
      TP1=TP2                                                          PERD 115
      IF(TT.LE.BOUND(1).OR.TT.GT.BOUND(21)) GO TO 300                  PERD 116
      IF(IND.EQ.0) GO TO 290                                           PERD 117
      DO 280 I=1,20                                                    PERD 118
      IF(TT.GT.BOUND(I+1)) GO TO 280                                   PERD 119
      NFREQ(I)=NFREQ(I)+1                                              PERD 120
      GO TO 290                                                        PERD 121
  280 CONTINUE                                                         PERD 122
  290 NP=NP+1                                                          PERD 123
  300 CONTINUE                                                         PERD 124
      IF(GRAD.GT.0.) NM=NP                                             PERD 125
      IF(IND.EQ.0) GO TO 310                                           PERD 126
      GRAD=GRAD-2.                                                     PERD 127
      MP1=MPM1                                                         PERD 128
      TP1=TPM1                                                         PERD 129
      IF(GRAD.GT.-2.) GO TO 270                                        PERD 130
      TOTAL=REAL(NP-1)                                                 PERD 131
C                                                                      PERD 132
C     RELATIVE FREQ. AND IRREGULARITY INDEX                            PERD 133
C                                                                      PERD 134
  310 DO 320 I=1,20                                                    PERD 135
      RFREQ(I)=REAL(NFREQ(I))/TOTAL*100.                               PERD 136
  320 CONTINUE                                                         PERD 137
      IF(NM.LE.NO) GO TO 330                                           PERD 138
      EPS=SQRT(1.-(REAL(NO)/REAL(NM))**2)                              PERD 139
      RETURN                                                           PERD 140
  330 EPS=0.                                                           PERD 141
      RETURN                                                           PERD 142
      END                                                              PERD 143
```

【Example】

The period-frequency distribution of El Centro seismic waves is obtained by the zero-crossing method. The main program is as follows, and the output is shown in Table 2-2.

```
      CHARACTER NAME*50
      DIMENSION DATA(800),T(20),NFREQ(20),RFREQ(20)
C
      READ(5,501) NAME,DT,NN,(DATA(M),M=1,NN)
      CALL PERD(NN,DATA,800,DT,0,T,NFREQ,RFREQ,EPS)
      WRITE(6,601) NAME,(T(I),NFREQ(I),RFREQ(I),I=1,20)
      WRITE(6,602) EPS
      STOP
C
 501  FORMAT(A50,F10.0,I10/(8F10.0))
 601  FORMAT(A50//T3,'-- ZERO CROSSING METHOD --'//T5,'PERIOD(SEC)',
     *       TR5,'FREQUENCY',TR5,'RELATIVE FREQ.(PERCENT)'//
     *       (F12.3,I16,F20.2) )
 602  FORMAT(/T5,'IRREGULARITY INDEX',F8.3)
      END
```

Output：

```
-- ZERO CROSSING METHOD --

  PERIOD(SEC)      FREQUENCY      RELATIVE FREQ.(PERCENT)

     0.055               1                1.64
     0.065               2                3.28
     0.075               2                3.28
     0.090               5                8.20
     0.110               5                8.20
     0.135               7               11.48
     0.165               4                6.56
     0.200               8               13.11
     0.245              10               16.39
     0.295               4                6.56
     0.360               2                3.28
     0.450               4                6.56
     0.550               4                6.56
     0.675               1                1.64
     0.825               2                3.28
     1.000               0                0.00
     1.200               0                0.00
     1.450               0                0.00
     1.800               0                0.00
     2.250               0                0.00

  IRREGULARITY INDEX   0.779
```