บรรณานุกรม

ภาษาไทย

หนังสือ

อุทุมพร จามรมาน. การสังเคราะห์งานวิจัยเชิงปริมาณ. กรุงเทพมหานคร: โรงพิมพ์จุฬาลงกรณ์มหาวิทยาลัย, 2527.

อุทุมพร ทองอุไทย. แผนวิเคราะห์ข้อมูลพฤติกรรมศาสตร์. กรุงเทพมหานคร: โรงพิมพ์เจริญผล, 2523.

เอกสารอื่น ๆ

กรรณิกา เลียงเจริญสิทธิ์. "ขนาดตัวอย่างที่เหมาะสมสำหรับการทดสอบสัมประสิทธิ์สหสัมพันธ์ของข้อมูลที่มีการแจกแจงแบบไบวารีเอทนอร์มอล." วิทยานิพนธ์ปริญญามหาบัณฑิต ภาควิชาสถิติ บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย, 2527.

ชะไมพร ธรรมวัฒน์ไพศาล. "วิธีการประมาณค่าที่ขาดหายไปในการวิเคราะห์การถดถอย." วิทยานิพนธ์ปริญญามหาบัณฑิต ภาควิชาสถิติ บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย, 2522.

พรศิริ หมื่นไชยศรี. "การเปรียบเทียบวิธีการประมาณค่าสูญหายในการวิเคราะห์ตัวแปรพหุ." วิทยานิพนธ์ปริญญามหาบัณฑิต ภาควิชาสถิติ บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย, 2529.

ภาษาต่างประเทศ

หนังสือ

Babbie, Earl R. The Practice of Social research. 4th ed. California: Wadsworth Publishing Co., 1986.

Brownlee, K.A. Statistical Theory and Methodology in Science and Engineering. 2nd ed. New York: John Wiley & Sons, Inc., 1965.

Cochran, William G. Sampling Techniques. 3rd ed. New York: John Wiley & Sons, 1977.

Cochran, William G., and Cox, Gertrude M. Experimental Design. 2nd ed. New York: John Wiley & Sons, 1957.

Cohen, Jacob., and Cohen, Patricia. Applied Multiple Regression Correlation Analysis for the Behavioral Sciences. 2nd ed. New Jersey: Lawrence Erlbaum Associates, Inc. Publishers, 1983.

Gupta, S.P. Statistics methods. Newdelhi: Sutan Chand & Sons, 1980.

Hays, William L. Statistics. New York: Holt, Rinchart and Winston, Inc., 1963.

Keppel, Geoffrey. Design and Analysis: A Researcher's Handbook. 2nd ed. Englewood Cliffs, New Jersey: Prentice Hall, 1982.

Kerlinger, Fred N. Foundations of Behavioral Research. New York: Holt, Rinehart and Winston, Inc., 1964.

Lee, Wayne. Experimental Design and Analysis. San Francisco: W.H. Freeman and Company, 1975.

Marascuilo, Leonard A. Statistical Methods for Behavioral Science Research. New York: McGraw-Hill Inc., 1971.

Marascuilo, Leonard A., and Levin, Joel R. Multivariate Statistics in the Social Science : A Researcher's Guide. Monterey, California: Brooks Cole, 1983.

Morrison, Donald F. Multivariate Statistical Methods. 2nd ed. New York: McGraw-Hill, 1976.

Shannon, Robert E. System Simulation. New York: Prentice-Hall, 1975.

Sims, A.C.P. Importance of a high tracing rate in long term medical follow-up studies. Lancet, 1973.

Tabachnick, Barbara G., and Fiddell, Linda S. Using Multivariate Statistics. New York: Hasper & Row, 1983.

Wilks, S.S. Mathematical Statistics. New York: John Wiley & Sons, Inc., 1962.

Winer, B.J. Statistical Principles in Experimental Design. 2nd ed. Tokyo: Kosaido Printing Co., 1971.

Yamane, Taro. Statistics : An Introductory Analysis. 2nd ed. New York: Harper & Row, 1967.

Zarkovich, S.S. Quality of Statistical Data. Rome: FAO, 1966.

บทความ

Afifi, A.A., and Elashoff, R.M. "Missing Observations in Multivariate Statitics I-Review of the Literature." Journal of the American Statistical Association 61(September 1966): 595-604.

_____. "Missing Observations in Multivariate Statistics II - Point Estimations in Simple Linear Regression." Journal of the American Statistical Association 62(March 1967): 10-29.

_____. "Missing Observations in Multivariate Statistics III - Large Sample Analysis of Simple Linear Regression." Journal of the American Statistical Association 64(March 1969): 337-358.

Afifi, A.A., and Elashoff, R.M. "Missing Observations in Multivariat Statistics IV - A note on Simple Linear Regression." Journal of the American Statistical Association 64 (March 1969): 359-365.

Chan, Linda S. and Dunn, Olive Jean. "The treatment of missing values in discriminant analysis I the sampling experiment." Journal of the American Statistical Association 67(1972): 473-477.

Finkbeiner, Carl. "Estimation for the multiple factor model when data are missing." Psychometrika 44(December 1979): 409-420.

Gleason, Terry C., and Staelin, Richard. "A proposal for handling missing data." Psychometrika 40(June 1975): 229-251.

Kelejian, H.H. "Missing Observations in Multivariate Regression-Efficiency of First Order Regression Method." Journal of the American Statistical Association 64(1969): 1609-1616.

Oger, Daniel J. "Correlation and the Coefficient of Determination." Psychological Bulletin 97(1985): 307-315.

Welch, W.P., Frank, Richard G. and Costello. Anthony J. "Missing Data in Psychiatric Research : A Solution." Psychological Bulletin 94(1983): 177-180.

Young, Forrest W. "Quantitative analysis of qualitative data." Psychometrika 46(December 1981): 357-370.

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*************************************************************
*                                                           *
*      THE COMPUTER PROGRAM USED IN THIS STUDY IS           *
*                  WRITTEN IN FORTRAN 77                    *
*-----------------------------------------------------------*
*      IT IS DESIGNED TO COMPARE THE ACCURACY AMONG         *
*      THREE ESTIMATION METHODS IN ESTIMATING THE           *
*         MISSING DATA FOR SMALL SAMPLES SIZE               *
*-----------------------------------------------------------*
*                                                           *
*              DESCRIPTION OF VARIABLES                     *
*                                                           *
*-----------------------------------------------------------*
*    N       =  SAMPLE SIZE                                 *
*    RHO     =  CORRELATION COEFFICIENT                     *
*    NR      =  REPETITION FOR 4000 TIMES                   *
*    NR0     =  ALL MISSING DATA                            *
*    NR1     =  MISSING DATA IN THE FIRST DATA REGION       *
*    NR2     =  MISSING DATA IN THE SECOND DATA REGION      *
*    NR3     =  MISSING DATA IN THE THIRD DATA REGION       *
*    MIS     =  VALUE OF MISSING DATA IN EACH TIMES         *
*    MDX1    =  DIFFERENCE OF MISSING DATA AND VALUE        *
*               FROM ESTIMATOR METHODS 1;IN THE SAME        *
*               WAYS WITH VARIABLES "MDX2" AND "MDX3"       *
*    MDX1R1  =  THE VALUE OF VARIABLE "MDX1" CLASSIFIED     *
*               IN THE FIRST DATA REGION ;IN THE SAME       *
*               WAYS WITH OTHER VARIABLES                   *
*    MSX1    =  THE VALUE OF VARIABLE "MDX1" SQUARE;IN      *
*               THE SAME WAYS WITH OTHER VARIABLES          *
*    MSX1R1  =  THE VALUE OF VARIABLE "MDX1R1" SQUARE;      *
*               IN THE SAME WAYS WITH OTHER VARIABLES       *
*                                                           *
*************************************************************
```

```
C-----------------------------------------------------------------------
C-----     TEST BIVARIATE NORMAL DISTRIBUTION WHEN THE VALUE       ------
C-----     OF MEAN=500,VARIANCE=100 ,AND RHO = 0.2,0.4 & 0.6       ------
C-----------------------------------------------------------------------
      DIMENSION MX(10000),MY(10000)
      DOUBLE PRECISION SXX,SXY,SYY
      COMMON IA
      DO 10 RHO =  0.2,.6,.2
      IA        =  65539
      SX        =  0.
      SY        =  0.
      N         =  10000
      DO 20 J   =  1,N
      CALL NORMAL(Y1,Y2)
         YY1    =  Y1*10.+500.
         Y0     =  500+RHO*(YY1-500)+SQRT(100.-100*RHO**2)*Y2
         MX1    =  YY1
         MY1    =  Y0
         MX(J)  =  2*YY1 - MX1
         MY(J)  =  2*Y0 - MY1
         SX     =  SX  + MX(J)
         SY     =  SY  + MY(J)
20    CONTINUE
      XMEAN     =  SX/N
      YMEAN     =  SY/N
      CALL VAR   (MX,N,XMEAN,VRX)
      CALL VAR   (MY,N,YMEAN,VRY)
      SDX       =  SQRT (VRX)
      SDY       =  SQRT (VRY)
      CALL SKEW  (MX,N,XMEAN,SDX,SKX)
      CALL SKEW  (MY,N,YMEAN,SDY,SKY)
      CALL KURTO (MX,N,XMEAN,SDX,RKX)
      CALL KURTO (MY,N,YMEAN,SDY,RKY)
      ZXZY      =  0.
      DO 30 I   =  1,N
      ZXZY      =  ZXZY +((MX(I)-XMEAN)/SDX)*((MY(I)-YMEAN)/SDY)
30    CONTINUE
      RXY       =  ZXZY/N
      WRITE(6,100) RHO,RXY
      WRITE(6,200)
      WRITE(6,300) XMEAN,VRX,SKX,RKX
      WRITE(6,300) YMEAN,VRY,SKY,RKY
100   FORMAT(//36X,'RHO  = ',F4.2,T55,'RXY = ',F9.4)
200   FORMAT(17X,'MEAN',13X,'VARIANCE',12X,'SKEWNESS',14X,'KURTOSIS'//)
300   FORMAT(10X,F12.4,3(8X,F12.4))
10    CONTINUE
      STOP
      END
C---------------------  SUBROUTINE  VARIANCE -------------------------
      SUBROUTINE VAR (MX,N,AMEAN,VR)
      DIMENSION MX(N)
      SX      =  0.
      DO 10 I=  1,N
10    SX      =  SX+(MX(I)-AMEAN)**2
      VR      =  SX/N
      RETURN
      END
C---------------------  SUBROUTINE  SKEWNESS -------------------------
      SUBROUTINE SKEW (MX,N,AMEAN,SD,SK)
      DIMENSION MX(N)
      SA      =  0.
      DO 20 I=  1,N
20    SA      =  SA+(MX(I)-AMEAN)**3
      B       =  SD**3
      SK      =  SA/(N*B)
      RETURN
      END
C---------------------  SUBROUTINE  KURTOSIS -------------------------
      SUBROUTINE KURTO (MX,N,AMEAN,SD,RK)
      DIMENSION MX(N)
      SA      =  0.
      DO 30 I=  1,N
30    SA      =  SA+(MX(I)-AMEAN)**4
      B       =  SD**4
      RK      =  SA/(N*B)
      RETURN
      END
```

```
C------------------------------------------------------------------------
C------   NUMBER OF MISSING DATA = 1,N=5 ,AND RHO=0.2,0.4 & 0.6   ------
C------------------------------------------------------------------------

      DIMENSION MDX1(4000),MDX2(4000),MDX3(4000),MSX1(4000),MSX2(4000),
     *          MSX3(4000),MDX1R1(1100),MDX1R2(2200),MDX1R3(1100),
     *          MDX2R1(1100),MDX2R2(2200),MDX2R3(1100),MDX3R1(1100),
     *          MDX3R2(2200),MDX3R3(1100),MSX1R1(1100),MSX1R2(2200),
     *          MSX1R3(1100),MSX2R1(1100),MSX2R2(2200),MSX2R3(1100),
     *          MSX3R1(1100),MSX3R2(2200),MSX3R3(1100),MX(15),MY(15),
     *          SUM(3),SUM1(3),SUM2(3),SUM3(3),MIS(1)
      DOUBLE PRECISION SSQ(3),SSQ1(3),SSQ2(3),SSQ3(3)
      COMMON IA
      N           =  5
      DO 100 RHO  =  0.2,0.6,0.2
      IA          =  65539
      NR1         =  0
      NR2         =  0
      NR3         =  0
      NR          =  4000
      DO 30 I     =  1,NR
      XSUM        =  0.
      YSUM        =  0.
      XY          =  0.
      SSQY        =  0.
C------------------------------------------------------------------------
C------    SET SAMPLE SIZE BY THE RANDOMING VARIABLES FROM THE     ------
C------    BIVARIATE NORMAL DISTRIBUTION WITH THE CORRELATION      ------
C------          COEFFICIENT BEING EQUAL TO "RHO"                  ------
C------------------------------------------------------------------------
      DO 10 I1    =  1,N
          CALL NORMAL(Y1,Y2)
          YY1     =  10*Y1+500
          YY0     =  500+RHO*(YY1-500)+SQRT(100-100*RHO**2)*Y2
          MX1     =  YY1
          MY1     =  YY0
          MX(I1)  =  2*YY1 - MX1
          MY(I1)  =  2*YY0 - MY1
          IF(I1.EQ.N/2+1) MIS(1) = MX(I1)
          XSUM    =  XSUM + MX(I1)
          YSUM    =  YSUM + MY(I1)
          XY      =  XY   + MX(I1)*MY(I1)
          SSQY    =  SSQY + MY(I1)**2
10    CONTINUE
C------------------------------------------------------------------------
C------      MEAN AND STANDARD DEVIATION OF SAMPLING MEAN          ------
C------------------------------------------------------------------------
      XSUM1       =  XSUM - MIS(1)
      XMEAN       =  XSUM1/(N-1)
      SSD         =  0.
      DO 20 I2    =  1,N
          IF(I2.EQ.N/2+1) GOTO 20
          SSD     =  SSD + (MX(I2) - XMEAN)**2
20    CONTINUE
      SD          =  SQRT(SSD/(N-1))
C------------------------------------------------------------------------
C------              ESTIMATED BY SAMPLING MEAN                  ------
C------------------------------------------------------------------------
      MN1         =  XMEAN
      MEAN        =  2*XMEAN-MN1
      MDX1(I)     =  MIS(1)-MEAN
      MSX1(I)     =  MDX1(I)**2
C------------------------------------------------------------------------
C------              ESTIMATED BY REGRESSION EQUATION            ------
C------------------------------------------------------------------------
      XMEAN2      =  XMEAN
      YMEAN2      =  (YSUM-MY(N/2+1))/(N-1)
      XY2         =  XY-MX(N/2+1)*MY(N/2+1)
      SSQY2       =  SSQY-MY(N/2+1)**2
      D1LS        =  (XY2-(N-1)*YMEAN2*XMEAN2)/(SSQY2-(N-1)*YMEAN2**2)
      D0LS        =  XMEAN2-D1LS*YMEAN2
      XILS1       =  D0LS+D1LS*MY(N/2+1)
```

```
      ILS1        =  XILS1
      LS1         =  2*XILS1-ILS1
      MDX2(I)     =  MIS(1)-LS1
      MSX2(I)     =  MDX2(I)**2
C-----------------------------------------------------------------------
C-----  ESTIMATED BY MEAN OF SAMPLING MEAN AND REGRESSION EQUATION -----
C-----------------------------------------------------------------------
      XMEAN3      =  (XMEAN + XSUM1)/N
      YMEAN3      =  YSUM/N
      XY3         =  XY2+MY(N/2+1)*XMEAN3
      D1LS        =  (XY3-N*YMEAN3*XMEAN3)/(SSQY-N*YMEAN3**2)
      D0LS        =  XMEAN3-D1LS*YMEAN3
      XJLS1       =  D0LS+D1LS*MY(N/2+1)
      XJL         =  (XMEAN+XJLS1)/2.
      JLS1        =  XJL
      JLS         =  2*XJL-JLS1
      MDX3(I)     =  MIS(1)-JLS
      MSX3(I)     =  MDX3(I)**2
C-----------------------------------------------------------------------
C----   CLASSIFY THE MISSING DATA INTO THREE DATA REGIONS BY          -----
C----   USING THE FOLLOWING CRITERIONS ,FIRSTLY THE MISSING DATA      -----
C----   IS GREATER THAN THE MEAN PLUS ONE STANDARD DEVIATION          -----
C----   ,SECONDLY IT IS BETWEEN OR EQUAL TO THE MEAN MINUS AND        -----
C----   PLUS ONE STANDARD DEVIATION AND ,LASTLY IT IS LESS THAN       -----
C----   THE MEAN MINUS ONE STANDARD DEVIATION                         -----
C-----------------------------------------------------------------------
      IF(MIS(1).GT.XMEAN+SD)  THEN
            NR1           =  NR1 + 1
            MDX1R1(NR1)   =  MDX1(I)
            MSX1R1(NR1)   =  MSX1(I)
            MDX2R1(NR1)   =  MDX2(I)
            MSX2R1(NR1)   =  MSX2(I)
            MDX3R1(NR1)   =  MDX3(I)
            MSX3R1(NR1)   =  MSX3(I)
      ELSE IF(MIS(1).GE.XMEAN-SD) THEN
            NR2           =  NR2 + 1
            MDX1R2(NR2)   =  MDX1(I)
            MSX1R2(NR2)   =  MSX1(I)
            MDX2R2(NR2)   =  MDX2(I)
            MSX2R2(NR2)   =  MSX2(I)
            MDX3R2(NR2)   =  MDX3(I)
            MSX3R2(NR2)   =  MSX3(I)
      ELSE
            NR3           =  NR3 + 1
            MDX1R3(NR3)   =  MDX1(I)
            MSX1R3(NR3)   =  MSX1(I)
            MDX2R3(NR3)   =  MDX2(I)
            MSX2R3(NR3)   =  MSX2(I)
            MDX3R3(NR3)   =  MDX3(I)
            MSX3R3(NR3)   =  MSX3(I)
      END IF
30    CONTINUE
C-----------------------------------------------------------------------
C----  SET STAND-IN VARIABLES TO BE EQUAL TO ZERO BEFORE SUMMATION  ----
C-----------------------------------------------------------------------
      U1    =  0.
      U11   =  0.
      U12   =  0.
      U13   =  0.
      U2    =  0.
      U21   =  0.
      U22   =  0.
      U23   =  0.
      U3    =  0.
      U31   =  0.
      U32   =  0.
      U33   =  0.
      SU1   =  0.
      SU11  =  0.
      SU12  =  0.
      SU13  =  0.
```

```
      SU2    =  0.
      SU21   =  0.
      SU22   =  0.
      SU23   =  0.
      SU3    =  0.
      SU31   =  0.
      SU32   =  0.
      SU33   =  0.
C-----------------------------------------------------------------------
C-----  SUMMATION THE DIFFERENCE OF MISSING DATA AND VALUE  FROM      ----
C-----  ESTIMATORS AND THERE SQUARE BY CLASSIFYING EACH DATA REGIONS ----
C-----------------------------------------------------------------------
      DO 60 NN    =  1,NK
         U1       =  U1  + MDX1(NN)
         U2       =  U2  + MDX2(NN)
         U3       =  U3  + MDX3(NN)
         SU1      =  SU1 + MSX1(NN)
         SU2      =  SU2 + MSX2(NN)
         SU3      =  SU3 + MSX3(NN)
60    CONTINUE
      DO 61 N1    =  1,NK1
         U11      =  U11  + MDX1R1(N1)
         U12      =  U12  + MDX2R1(N1)
         U13      =  U13  + MDX3R1(N1)
         SU11     =  SU11 + MSX1R1(N1)
         SU12     =  SU12 + MSX2R1(N1)
         SU13     =  SU13 + MSX3R1(N1)
61    CONTINUE
      DO 62 N2    =  1,NK2
         U21      =  U21  + MDX1R2(N2)
         U22      =  U22  + MDX2R2(N2)
         U23      =  U23  + MDX3R2(N2)
         SU21     =  SU21 + MSX1R2(N2)
         SU22     =  SU22 + MSX2R2(N2)
         SU23     =  SU23 + MSX3R2(N2)
62    CONTINUE
      DO 63 N3    =  1,NK3
         U31      =  U31  + MDX1R3(N3)
         U32      =  U32  + MDX2R3(N3)
         U33      =  U33  + MDX3R3(N3)
         SU31     =  SU31 + MSX1R3(N3)
         SU32     =  SU32 + MSX2R3(N3)
         SU33     =  SU33 + MSX3R3(N3)
63    CONTINUE
C-----------------------------------------------------------------------
C-----      SUBSTITUTE THE VALUE OF STAND-IN VARIABLES TO BE          ------
C-----      NEW VARIABLES FOR RECALLING THE OTHER COMMANDS            ------
C-----------------------------------------------------------------------
      SUM(1)   =  U1
      SUM1(1)  =  U11
      SUM1(2)  =  U12
      SUM1(3)  =  U13
      SUM(2)   =  U2
      SUM2(1)  =  U21
      SUM2(2)  =  U22
      SUM2(3)  =  U23
      SUM(3)   =  U3
      SU13(1)  =  U31
      SUM3(2)  =  U32
      SUM3(3)  =  U33
      SSQ(1)   =  SU1
      SSQ1(1)  =  SU11
      SSQ1(2)  =  SU12
      SSQ1(3)  =  SU13
      SSQ(2)   =  SU2
      SSQ2(1)  =  SU21
      SSQ2(2)  =  SU22
      SSQ2(3)  =  SU23
      SSQ(3)   =  SU3
      SSQ3(1)  =  SU31
      SSQ3(2)  =  SU32
      SSQ3(3)  =  SU33
```

```
      WRITE(6,70)
      WRITE(6,71) N,RHO
70    FORMAT(//2X,40('**-'))
71    FORMAT(//T40,'***  MIS = 1 ;  N = ',I2,' ;  RHO = ',F4.1,' ***'/
     *       T40,13('---')//)
C-----------------------------------------------------------------------
C-----    GET THE AVERAGE OF THE SUMMATION OF DIFFERENCE DATA AND    -----
C-----    THERE SQUARE BY DIVIDING THE NUMBERS OF MISSING DATA       -----
C-----                 IN EACH DATA REGIONS AND PRINT                -----
C-----------------------------------------------------------------------
      DO 80 K   =  1,3
      WRITE(6,81)
      AVERS     =  SUM(K)/NR
      AVERS1    =  SUM1(K)/NR1
      AVERS2    =  SUM2(K)/NR2
      AVERS3    =  SUM3(K)/NR3
      AVERQ     =  SSQ(K)/NR
      AVERQ1    =  SSQ1(K)/NR1
      AVERQ2    =  SSQ2(K)/NR2
      AVERQ3    =  SSQ3(K)/NR3
      WRITE(6,82) K,AVERS1,AVERQ1,AVERS2,AVERQ2
      WRITE(6,83)
      WRITE(6,84) AVERS3,AVERQ3,AVERS,AVERQ
80    CONTINUE
C-----------------------------------------------------------------------
C-----      PRINT NUMBERS OF MISSING DATA IN EACH DATA REGIONS      ------
C-----------------------------------------------------------------------
      WRITE(6,85) NR1,NR2,NR3,NR
81    FORMAT(1/12X,'EST.NO.',T32,'MDD.REG1',T53,'MDS.REG1',T74,'MDD.REG2'
     *      ,T95,'MDS.REG2')
82    FORMAT(15X,I1,2X,4(3X,F18.4)/)
83    FORMAT(T32,'MDD.REG3',T53,'MDS.REG3',T74,'MDD.TOT',T95,'MDS.TOT')
84    FORMAT(18X,4(3X,F18.4)/2X,40('---')//)
85    FORMAT(/T32,'REGION1 N =',I4,T53,'REGION2 N =',I4,T74,'REGION3 N =
     *'     ,I4,T95,'TOTAL  =',I5//2X,40('**-')/2X,40('**-')//)
100   CONTINUE
      STOP
      END

C------------------------- SUBROUTINE NORMAL ----------------------------
      SUBROUTINE NORMAL (RNN1,RNN2)
      COMMON IA
10    CALL RANDUM (IA,IY,RN)
      V1    =  2.*RN-1.
      CALL RANDUM (IA,IY,RN)
      V2    =  2.*RN-1.
      S     =  V1*V1+V2*V2
      IF (S.GE.1.) GOTO 10
      RNN1  =  V1*SQRT ((-2.*ALOG(S))/S)
      RNN2  =  V2*SQRT ((-2.*ALOG(S))/S)
      RETURN
      END

C------------------------ SUBROUTINE RANDUM ---------------------------
      SUBROUTINE RANDUM(IX,IY,RN)
      COMMON IA
      IY    =  IX*65539
      IF (IY) 10,20,20
10    IY    =  IY+2147483647+1
20    RN    =  IY
      RN    =  RN*.4656613E-9
      IX    =  IY
      IA    =  IX
      RETURN
      END
```

```
C-------------------------------------------------------------------
C------   NUMBER OF MISSING DATA = 2,N=10 AND RHO=0.2,0.4 & 0.6   ------
C-------------------------------------------------------------------

      DIMENSION MDX1(8000),MDX2(8000),MDX3(8000),MSX1(8000),MSX2(8000),
     *          MSX3(8000),MDX1R1(2300),MDX1R2(4200),MDX1R3(2300),
     *          MDX2R1(2300),MDX2R2(4200),MDX2R3(2300),MDX3R1(2300),
     *          MDX3R2(4200),MDX3R3(2300),MSX1R1(2300),MSX1R2(4200),
     *          MSX1R3(2300),MSX2R1(2300),MSX2R2(4200),MSX2R3(2300),
     *          MSX3R1(2300),MSX3R2(4200),MSX3R3(2300),MX(15),MY(15),
     *          SUM(3),SUM1(3),SUM2(3),SUM3(3),MIS(2)
      DOUBLE PRECISION SSQ(3),SSQ1(3),SSQ2(3),SSQ3(3)
      COMMON IA
      N          =  10
      DO 100 RHO =  0.2,0.6,0.2
      IA         =  65539
      NR1        =  0
      NR2        =  0
      NR3        =  0
      NR         =  4000
      NR0        =  8000
      DO 30 I    =  1,NR
      XSUM       =  0.
      YSUM       =  0.
      XY         =  0.
      SSQY       =  0.
C-------------------------------------------------------------------
C-----    SET SAMPLE SIZE BY THE RANDOMING VARIABLES FROM THE     ------
C-----    BIVARIATE NORMAL DISTRIBUTION WITH THE CORRELATION      ------
C-----          COEFFICIENT BEING EQUAL TO "RHO"                  ------
C-------------------------------------------------------------------
      DO 10 I1   =  1,N
         CALL NORMAL(Y1,Y2)
         YY1     =  10*Y1+500
         YY0     =  500+RHO*(YY1-500)+SQRT(100-100*RHO**2)*Y2
         MX1     =  YY1
         MY1     =  YY0
         MX(I1)  =  2*YY1 - MX1
         MY(I1)  =  2*YY0 - MY1
         IF(I1.EQ.N/2+1) MIS(1) = MX(I1)
         IF(I1.EQ.N)     MIS(2) = MX(I1)
         XSUM    =  XSUM + MX(I1)
         YSUM    =  YSUM + MY(I1)
         XY      =  XY   + MX(I1)*MY(I1)
         SSQY    =  SSQY + MY(I1)**2
10    CONTINUE
C-------------------------------------------------------------------
C------      MEAN AND STANDARD DEVIATION OF SAMPLING MEAN         ------
C-------------------------------------------------------------------
      XSUM2      =  XSUM - MIS(1)-MIS(2)
      XMEAN      =  XSUM2/(N-2)
      SSD        =  0.
      DO 20 I2   =  1,N
         IF(I2.EQ.N/2+1) GOTO 20
         IF(I2.EQ.N/2)   GOTO 20
         SSD     =  SSD + (MX(I2) - XMEAN)**2
20    CONTINUE
      SD         =  SQRT(SSD/(N-2))
C-------------------------------------------------------------------
C------              ESTIMATED BY SAMPLING MEAN                   ------
C-------------------------------------------------------------------
      MN1        =  XMEAN
      MEAN       =  2*XMEAN-MN1
      MDX1(I)    =  MIS(1)-MEAN
      MDX1(NR+I) =  MIS(2)-MEAN
      MSX1(I)    =  MDX1(I)**2
      MSX1(NR+I) =  MDX1(NR+I)**2
C-------------------------------------------------------------------
C------              ESTIMATED BY REGRESSION EQUATION             ------
C-------------------------------------------------------------------
      XMEAN2     =  XMEAN
      YMEAN2     =  (YSUM-MY(N/2+1)-MY(N))/(N-2)
```

```
      XY2          =  XY-MX(N/2+1)*MY(N/2+1)-MX(N)*MY(N)
      SSQY2        =  SSQY-MY(N/2+1)**2-MY(N)**2
      VARD1        =  XY2-(N-2)*YMEAN2*XMEAN2
      VARD2        =  SSQY2-(N-2)*YMEAN2**2
      D1LS         =  VARD1/VARD2
      D0LS         =  XMEAN2-D1LS*YMEAN2
      XILS1        =  D0LS+D1LS*MY(N/2+1)
      XILS2        =  D0LS+D1LS*MY(N)
      ILS1         =  XILS1
      ILS2         =  XILS2
      LS1          =  2*XILS1-ILS1
      LS2          =  2*XILS2-ILS2
      MDX2(I)      =  MIS(1)-LS1
      MSX2(I)      =  MDX2(I)**2
      MDX2(NR+I)   =  MIS(2)-LS2
      MSX2(NR+I)   =  MDX2(NR+I)**2
C-------------------------------------------------------------------
C-----  ESTIMATED BY MEAN OF SAMPLING MEAN AND REGRESSION EQUATION -----
C-------------------------------------------------------------------
      XMEAN3       =  (XSUM2+2*XMEAN)/N
      YMEAN3       =  YSUM/N
      XY3          =  XY2+XMEAN*(MY(N/2+1)+MY(N))
      D1LS         =  (XY3-N*YMEAN3*XMEAN3)/(SSQY-N*YMEAN3**2)
      D0LS         =  XMEAN3-D1LS*YMEAN3
      XJLS1        =  D0LS+D1LS*MY(N/2+1)
      XJLS2        =  D0LS+D1LS*MY(N)
      JLS1         =  (XMEAN+XJLS1)/2.
      JLS2         =  (XMEAN+XJLS2)/2.
      MSR1         =  (XMEAN+XJLS1)-JLS1
      MSR2         =  (XMEAN+XJLS2)-JLS2
      MDX3(I)      =  MIS(1)-MSR1
      MSX3(I)      =  MDX3(I)**2
      MDX3(NR+I)   =  MIS(2)-MSR2
      MSX3(NR+I)   =  MDX3(NR+I)**2
C-------------------------------------------------------------------
C----    CLASSIFY THE MISSING DATA INTO THREE DATA REGIONS BY      -----
C----    USING THE FOLLOWING CRITERIONS ,FIRSTLY THE MISSING DATA  -----
C----    IS GREATER THAN THE MEAN PLUS ONE STANDARD DEVIATION      -----
C----    ,SECONDLY IT IS BETWEEN OR EQUAL TO THE MEAN MINUS AND    -----
C----    PLUS ONE STANDARD DEVIATION AND ,LASTLY IT IS LESS THAN   -----
C----    THE MEAN MINUS ONE STANDARD DEVIATION                     -----
C-------------------------------------------------------------------
      IF(MIS(1).GT.XMEAN+SD)  THEN
            NR1            =  NR1 + 1
            MDX1R1(NR1)    =  MDX1(I)
            MSX1R1(NR1)    =  MSX1(I)
            MDX2R1(NR1)    =  MDX2(I)
            MSX2R1(NR1)    =  MSX2(I)
            MDX3R1(NR1)    =  MDX3(I)
            MSX3R1(NR1)    =  MSX3(I)
      ELSE IF(MIS(1).GE.XMEAN-SD) THEN
            NR2            =  NR2 + 1
            MDX1R2(NR2)    =  MDX1(I)
            MSX1R2(NR2)    =  MSX1(I)
            MDX2R2(NR2)    =  MDX2(I)
            MSX2R2(NR2)    =  MSX2(I)
            MDX3R2(NR2)    =  MDX3(I)
            MSX3R2(NR2)    =  MSX3(I)
      ELSE
            NR3            =  NR3 + 1
            MDX1R3(NR3)    =  MDX1(I)
            MSX1R3(NR3)    =  MSX1(I)
            MDX2R3(NR3)    =  MDX2(I)
            MSX2R3(NR3)    =  MSX2(I)
            MDX3R3(NR3)    =  MDX3(I)
            MSX3R3(NR3)    =  MSX3(I)
      END IF
      IF(MIS(2).GT.XMEAN+SD)  THEN
            NR1            =  NR1 + 1
            MDX1R1(NR1)    =  MDX1(I+NR)
            MSX1R1(NR1)    =  MSX1(I+NR)
            MDX2R1(NR1)    =  MDX2(I+NR)
            MSX2R1(NR1)    =  MSX2(I+NR)
            MDX3R1(NR1)    =  MDX3(I+NR)
            MSX3R1(NR1)    =  MSX3(I+NR)
```

```
      ELSE IF(MIS(2).GE.XMEAN-SD) THEN
            NR2          =  NR2 + 1
            MDX1R2(NR2)  =  MDX1(I+NR)
            MSX1R2(NR2)  =  MSX1(I+NR)
            MDX2R2(NR2)  =  MDX2(I+NR)
            MSX2R2(NR2)  =  MSX2(I+NR)
            MDX3R2(NR2)  =  MDX3(I+NR)
            MSX3R2(NR2)  =  MSX3(I+NR)
      ELSE
            NR3          =  NR3 + 1
            MDX1R3(NR3)  =  MDX1(I+NR)
            MSX1R3(NR3)  =  MSX1(I+NR)
            MDX2R3(NR3)  =  MDX2(I+NR)
            MSX2R3(NR3)  =  MSX2(I+NR)
            MDX3R3(NR3)  =  MDX3(I+NR)
            MSX3R3(NR3)  =  MSX3(I+NR)
      END IF
30    CONTINUE
C-----------------------------------------------------------------------
C----  SET STAND-IN VARIABLES TO BE EQUAL TO ZERO BEFORE SUMMATION  ----
C-----------------------------------------------------------------------
      U1     =  0.
      U11    =  0.
      U12    =  0.
      U13    =  0.
      U2     =  0.
      U21    =  0.
      U22    =  0.
      U23    =  0.
      U3     =  0.
      U31    =  0.
      U32    =  0.
      U33    =  0.
      SU1    =  0.
      SU11   =  0.
      SU12   =  0.
      SU13   =  0.
      SU2    =  0.
      SU21   =  0.
      SU22   =  0.
      SU23   =  0.
      SU3    =  0.
      SU31   =  0.
      SU32   =  0.
      SU33   =  0.
C-----------------------------------------------------------------------
C----  SUMMATION THE DIFFERENCE OF MISSING DATA AND VALUE  FROM      ----
C----  ESTIMATORS AND THERE SQUARE BY CLASSIFYING EACH DATA REGIONS  ----
C-----------------------------------------------------------------------
      DO 60 N0   =  1,NR0
         U1      =  U1  + MDX1(N0)
         U2      =  U2  + MDX2(N0)
         U3      =  U3  + MDX3(N0)
         SU1     =  SU1 + MSX1(N0)
         SU2     =  SU2 + MSX2(N0)
         SU3     =  SU3 + MSX3(N0)
60    CONTINUE
      DO 61 N1   =  1,NR1
         U11     =  U11  + MDX1R1(N1)
         U12     =  U12  + MDX2R1(N1)
         U13     =  U13  + MDX3R1(N1)
         SU11    =  SU11 + MSX1R1(N1)
         SU12    =  SU12 + MSX2R1(N1)
         SU13    =  SU13 + MSX3R1(N1)
61    CONTINUE
      DO 62 N2   =  1,NR2
         U21     =  U21  + MDX1R2(N2)
         U22     =  U22  + MDX2R2(N2)
         U23     =  U23  + MDX3R2(N2)
         SU21    =  SU21 + MSX1R2(N2)
         SU22    =  SU22 + MSX2R2(N2)
         SU23    =  SU23 + MSX3R2(N2)
62    CONTINUE
```

```
      DO 63 N3    =  1,NR3
         U31      =  U31  + MDX1R3(N3)
         U32      =  U32  + MDX2R3(N3)
         U33      =  U33  + MDX3R3(N3)
         SU31     =  SU31 + MSX1R3(N3)
         SU32     =  SU32 + MSX2R3(N3)
         SU33     =  SU33 + MSX3R3(N3)
63    CONTINUE
C-------------------------------------------------------------------
C-----     SUBSTITUTE THE VALUE OF STAND-IN VARIABLES TO BE       ------
C-----     NEW VARIABLES FOR RECALLING THE OTHER COMMANDS         ------
C-------------------------------------------------------------------
      SUM(1)      =  U1
      SUM1(1)     =  U11
      SUM1(2)     =  U12
      SUM1(3)     =  U13
      SUM(2)      =  U2
      SUM2(1)     =  U21
      SUM2(2)     =  U22
      SUM2(3)     =  U23
      SUM(3)      =  U3
      SUM3(1)     =  U31
      SUM3(2)     =  U32
      SUM3(3)     =  U33
      SSQ(1)      =  SU1
      SSQ1(1)     =  SU11
      SSQ1(2)     =  SU12
      SSQ1(3)     =  SU13
      SSQ(2)      =  SU2
      SSQ2(1)     =  SU21
      SSQ2(2)     =  SU22
      SSQ2(3)     =  SU23
      SSQ(3)      =  SU3
      SSQ3(1)     =  SU31
      SSQ3(2)     =  SU32
      SSQ3(3)     =  SU33
      WRITE(6,70)
      WRITE(6,71) N,RHO
70    FORMAT(/2X,40('**-'))
71    FORMAT(//T40,'***  MIS = 2 ;  N = ',I2,' ;  RHO = ',F4.1,' ***'/
     *       T40,13('---')//)
C-------------------------------------------------------------------
C-----    GET THE AVERAGE OF THE SUMMATION OF DIFFERENCE DATA AND  -----
C-----    THERE SQUARE BY DIVIDING THE NUMBERS OF MISSING DATA     -----
C-----              IN EACH DATA REGIONS AND PRINT                 -----
C-------------------------------------------------------------------
      DO 80 K   =  1,3
      WRITE(6,81)
      AVERS     =  SUM(K)/NR0
      AVERS1    =  SUM1(K)/NR1
      AVERS2    =  SUM2(K)/NR2
      AVERS3    =  SUM3(K)/NR3
      AVERQ     =  SSQ(K)/NR0
      AVERQ1    =  SSQ1(K)/NR1
      AVERQ2    =  SSQ2(K)/NR2
      AVERQ3    =  SSQ3(K)/NR3
      WRITE(6,82) K,AVERS1,AVERQ1,AVERS2,AVERQ2
      WRITE(6,83)
      WRITE(6,84) AVERS3,AVERQ3,AVERS,AVERQ
80    CONTINUE
C-------------------------------------------------------------------
C-----     PRINT NUMBERS OF MISSING DATA IN EACH DATA REGIONS      ------
C-------------------------------------------------------------------
      WRITE(6,85) NR1,NR2,NR3,NR0
81    FORMAT(/12X,'EST.NO.',T32,'MDD.REG1',T53,'MDS.REG1',T74,'MDD.REG2'
     *       ,T95,'MDS.REG2')
82    FORMAT(15X,I1,2X,4(3X,F18.4)/)
83    FORMAT(T32,'MDD.REG3',T53,'MDS.REG3',T74,'MDD.TOT',T95,'MDS.TOT')
84    FORMAT(18X,4(3X,F18.4)/2X,40('---')//)
85    FORMAT(/T32,'REGION1 N =',I4,T53,'REGION2 N =',I4,T74,'REGION3 N =
     *'      ,I4,T95,'TOTAL  =',I5//2X,40('**-')/2X,40('**-')//)
100   CONTINUE
      STOP
      END
```

ประวัติผู้เขียน

ว่าที่ร้อยโท ถวัลย์ จันทร์เพ็ง สำเร็จการศึกษาระดับปริญญาการศึกษาบัณฑิต วิชาเอก คณิตศาสตร์ วิชาโทเคมี จากมหาวิทยาลัยศรีนครินทรวิโรฒ วิทยาเขตบางเขน ปีการศึกษา 2524 เข้าศึกษาต่อในสาขาวิชาสถิติการศึกษา ภาควิชาวิจัยการศึกษา บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย ปีการศึกษา 2528 ปัจจุบันรับราชการ ตำแหน่งอาจารย์ 1 ระดับ 4 กรมสามัญศึกษา กระทรวงศึกษาธิการ