รายการอ้างอิง

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ภาคผนวก

ตารางแสดงลักษณะการทำงานของโปรแกรมทั้งหมดที่ใช้ในการวิจัย

อันดับที่	ชื่อโปรแกรม	การทำงานของโปรแกรม	ชื่อโปรแกรมย่อยที่เรียกใช้
โปรแกรมหลัก	MAIN	- สร้างข้อมูลของตัวแปรอิสระและค่าคลาดเคลื่อน	NORMAL
		- คำนวณค่า MSE ของวิธี BE	BACK
		- คำนวณค่า MSE ของวิธี SW	STEP
		- คำนวณค่า MSE ของวิธี BS	BAYE
โปรแกรมย่อย			
1	NORMAL	- การสร้างเลขสุ่มให้มีการแจกแจงแบบปกติ	RD
2	BACK	- การหาตัวแบบที่เหมาะสมโดยวิธี BE	BETA, MSQE
3	STEP	- การหาตัวแบบที่เหมาะสมโดยวิธี SW	CORR, TF, VERS, BETA, MSQE
4	BAYE	- การหาตัวแบบที่เหมาะสมโดยวิธี BS	FBETA, CALBXTX, CORRX, FINV, NORMAL, BMSQE, FNORMAL, IG, AER2, FINVGAM, CALXTX
5	BETA	- คำนวณค่าสัมประสิทธิ์การถดถอย	INVS
6	FBETA	- คำนวณค่าสัมประสิทธิ์การถดถอย	CALXTX,FINVS
7	MSQE, BMSQE	- คำนวณค่า MSE	
8	CORR, CORRX	- คำนวณหาเมทริกซ์สหสัมพันธ์ของตัวแปรอิสระ	
9	VERS,INVS	- คำนวณอินเวอร์สเมทริกซ์	
10	FINVS	- คำนวณอินเวอร์สเมทริกซ์	
11	CALBXTX	- คำนวณเมทริกซ์ผลคูณ $\beta X'X$	
12	DRXD	- คำนวณเมทริกซ์ผลคูณของ $D^{-1}R^{-1}D^{-1}$	
13	FNORMAL	- คำนวณค่าฟังก์ชันของการแจกแจงปกติ	
14	CALXTX	- คำนวณเมทริกซ์ผลคูณ $X'X$	
15	IG	- สร้างเลขสุ่มให้มีการแจกแจงแบบแกมมาผกผัน	

ตารางแสดงลักษณะการทำงานของโปรแกรมทั้งหมดที่ใช้ในการวิจัย (ต่อ)

อันดับที่	ชื่อโปรแกรม	การทำงานของโปรแกรม	ชื่อโปรแกรมย่อยที่เรียกใช้
ฟังก์ชัน			
16	RD	- สร้างเลขสุ่มที่มีการแจกแจงแบบสม่ำเสมอในช่วง (0,1)	
17	TF	- คำนวณค่าสถิติที	
18	AER2	- คำนวณค่าคลาดเคลื่อนกำลังสอง	

โดยรายละเอียดของโปรแกรมมีดังนี้

```
C*************************************************************
C   MAIN PROGRAM
C   MB  :  ORDER OF INDEPENDENT VAR. TO BUILDING DEPENDENT VAR.
C   MI  :  ORDER OF INDEPENDENT VAR. TO INITIAL MODEL
C*************************************************************
      DOUBLE PRECISION X(110,7),Y(110),E(110),XB(110,28)
      CHARACTER*8 PB(28)
      COMMON/SEED/IX,KK,Z2/TABLE/FTAB(2,100)
      DOUBLE PRECISION AMSE1,AMSE2,AMSE3,SSE1,SSE2,SSE3,
     *AMSEP1,AMSEP2,AMSEP3,XMEAN,ALP(2),XSIGMA,AMINIM,TMIN,
     *RBAC,RSTE,RBAY,POST,TMP11,TMP21,TMP31,TMP12,TMP22,TMP32,
     *VARP11,VARP21,VARP31,VARP12,VARP22,VARP32,SDP12,SDP22,SDP32,
     *ESIGMA(4),CC(2)
      INTEGER N(4),IP(2),IXX,T0,T1,TIME

      N(1)=25
      N(2)=50
      N(3)=75
      N(4)=100
      IP(1)=1
      IP(2)=10
      ESIGMA(1)=5.0
      ESIGMA(2)=10.0
      ESIGMA(3)=20.0
      ESIGMA(4)=25.0
      ALP(1)=0.05
      ALP(2)=0.01
      OPEN(30,FILE='ACC',STATUS='UNKNOWN')
C*************************************************************
C***********      READ STATISTICS VALUE FROM TABLE     *********
C*************************************************************
      OPEN(3,FILE='FVA',STATUS='OLD')
      DO 20 IA=1,2
         DO 11 IDF2=1,30
            READ(3,'(F)') FTAB(IA,IDF2)
11       CONTINUE
         READ(3,'(F)') FTAB4
         DO 12 J=31,40
12          FTAB(IA,J)=FTAB4
         READ(3,'(F)') FTAB45
         DO 13 J=41,45
13          FTAB(IA,J)=FTAB45
         READ(3,'(F)') FTAB5
         DO 14 J=46,50
14          FTAB(IA,J)=FTAB5
         READ(3,'(F)') FTAB6
         DO 15 J=51,60
15          FTAB(IA,J)=FTAB6
         READ(3,'(F)') FTAB7
         DO 16 J=61,70
16          FTAB(IA,J)=FTAB7
         READ(3,'(F)') FTAB8
         DO 17 J=71,80
17          FTAB(IA,J)=FTAB8
         READ(3,'(F)') FTAB9
         DO 18 J=81,90
18          FTAB(IA,J)=FTAB9
         READ(3,'(F)') FTAB1
         DO 19 J=91,100
19          FTAB(IA,J)=FTAB1
20    CONTINUE
```

```
      CLOSE(3)
      KK=0
      IX=173
      IXX=INT(IX)
C*****************************************************************
C***********   GENERATE FIXED INDEPENDENT VARIABLE     ***********
C*****************************************************************
      XMEAN=0.
      XSIGMA=1.
      DO I=1,125
         CALL NORMAL(XMEAN,XSIGMA,X(I,1))
         CALL NORMAL(XMEAN,XSIGMA,X(I,2))
         CALL NORMAL(XMEAN,XSIGMA,X(I,3))
         CALL NORMAL(XMEAN,XSIGMA,X(I,4))
         CALL NORMAL(XMEAN,XSIGMA,X(I,5))
         CALL NORMAL(XMEAN,XSIGMA,X(I,6))
      END DO
C*****************************************************************
      DO ILP=1,2
      DO IN=1,4
      M=10
      NL=200
      IF(ALP(ILP).EQ.0.05) THEN
         IALP=1
      ELSE
         IALP=2
      ENDIF
      DO IE=1,4
      DO MB=1,6
      DO MI=1,6
      IF((IN.EQ.1).AND.(MB.EQ.6)) THEN
        GOTO 999
      ENDIF
C*****************************************************************
C********              GENERATE PREDICTOR                 ********
C*****************************************************************
      DO 22 I=1,N(IN)+M
         XB(I,1)=X(I,1)
         XB(I,2)=X(I,1)**2
         PB(1)='X1'
         PB(2)='X12'
         KB=2
         IF(MB.GT.1) THEN
            XB(I,3)=X(I,2)
            XB(I,4)=X(I,1)*X(I,2)
            XB(I,5)=X(I,2)**2
            PB(3)='X2'
            PB(4)='X1X2'
            PB(5)='X22'
            KB=5
            IF(MB.GT.2) THEN
               XB(I,6)=X(I,3)
               XB(I,7)=X(I,1)*X(I,3)
               XB(I,8)=X(I,2)*X(I,3)
               XB(I,9)=X(I,3)**2
               PB(6)='X3'
               PB(7)='X1X3'
               PB(8)='X2X3'
               PB(9)='X32'
               KB=9
```

```
                IF(MB.GT.3) THEN
                   XB(I,10)=X(I,4)
                   XB(I,11)=X(I,1)*X(I,4)
                   XB(I,12)=X(I,2)*X(I,4)
                   XB(I,13)=X(I,3)*X(I,4)
                   XB(I,14)=X(I,4)**2
                   PB(10)='X4'
                   PB(11)='X1X4'
                   PB(12)='X2X4'
                   PB(13)='X3X4'
                   PB(14)='X42'
                   KB=14
                   IF(MB.GT.4) THEN
                      XB(I,15)=X(I,5)
                      XB(I,16)=X(I,1)*X(I,5)
                      XB(I,17)=X(I,2)*X(I,5)
                      XB(I,18)=X(I,3)*X(I,5)
                      XB(I,19)=X(I,4)*X(I,5)
                      XB(I,20)=X(I,5)**2
                      PB(15)='X5'
                      PB(16)='X1X5'
                      PB(17)='X2X5'
                      PB(18)='X3X5'
                      PB(19)='X4X5'
                      PB(20)='X52'
                      KB=20
                      IF(MB.GT.5) THEN
                         XB(I,21)=X(I,6)
                         XB(I,22)=X(I,1)*X(I,6)
                         XB(I,23)=X(I,2)*X(I,6)
                         XB(I,24)=X(I,3)*X(I,6)
                         XB(I,25)=X(I,4)*X(I,6)
                         XB(I,26)=X(I,5)*X(I,6)
                         XB(I,27)=X(I,6)**2
                         PB(21)='X6'
                         PB(22)='X1X6'
                         PB(23)='X2X6'
                         PB(24)='X3X6'
                         PB(25)='X4X6'
                         PB(26)='X5X6'
                         PB(27)='X62'
                         KB=27
                      ENDIF
                   ENDIF
                ENDIF
             ENDIF
          ENDIF
22     CONTINUE
C*************************************************************
C***********            VARY HYPER PARAMETER          **********
C*************************************************************
       DO IIP=1,2
       IF(IIP.EQ.1) THEN
           CC(1)=5.0
           CC(2)=10.0
       ELSE
           CC(1)=100.0
           CC(2)=500.0
       ENDIF
       DO IC=1,2
```

```
C*****************************************************************
C***********            INITIAL VALUE OF NL LOOP          **********
C*****************************************************************
      IX=282485829
      TM11=0.
      TM21=0.
      TM31=0.
      VAR11=0.
      VAR21=0.
      VAR31=0.
      VAR12=0.
      VAR22=0.
      VAR32=0.
      TMP11=0.
      TMP21=0.
      TMP31=0.
      VARP11=0.
      VARP21=0.
      VARP31=0.
      VARP12=0.
      VARP22=0.
      VARP32=0.
      DO LOOP=1,NL
      T0=TIME()
C*****************************************************************
C***********                GENERATE ERROR                **********
C*****************************************************************
         DO I=1,N(IN)+M
            CALL NORMAL(DBLE(0.),DBLE(ESIGMA(IE)),E(I))
         END DO
C*****************************************************************
C********       GENERATE PREDICTOR AND DEPENDENT          ********
C*****************************************************************
         DO I=1,N(IN)+M
            Y(I)=E(I)
            Y(I)=Y(I)+XB(I,1)+XB(I,2)
            IF(MB.GT.1) THEN
               Y(I)=Y(I)+XB(I,3)+XB(I,4)+XB(I,5)
            IF(MB.GT.2) THEN
               Y(I)=Y(I)+XB(I,6)+XB(I,7)+XB(I,8)+XB(I,9)
            IF(MB.GT.3) THEN
               Y(I)=Y(I)+XB(I,10)+XB(I,11)+XB(I,12)+XB(I,13)+XB(I,14)
            IF(MB.GT.4) THEN
               Y(I)=Y(I)+XB(I,15)+XB(I,16)+XB(I,17)+XB(I,18)+XB(I,19)
     *              +XB(I,20)
            IF(MB.GT.5) THEN
               Y(I)=Y(I)+XB(I,21)+XB(I,22)+XB(I,23)+XB(I,24)+XB(I,25)
     *              +XB(I,26)+XB(I,27)
            ENDIF
            ENDIF
            ENDIF
            ENDIF
            ENDIF
         END DO
         CALL BAYE(N(IN),M,MB,KB,PB,XB,Y,IALP,AMSE3,AMSEP3,
     *        IP(IIP),CC(IC),POST)
         CALL BACK(N(IN),M,KB,XB,Y,PB,IALP,SSE2,KP1,AMSE1,AMSEP1)
         CALL STEP(N(IN),M,KB,XB,Y,PB,IALP,SSE3,KP2,AMSE2,AMSEP2)
         TM12=TM11+(AMSE1-TM11)/LOOP
         TM22=TM21+(AMSE2-TM21)/LOOP
         TM32=TM31+(AMSE3-TM31)/LOOP
```

```
            TMP12=TMP11+(AMSEP1-TMP11)/LOOP
            TMP22=TMP21+(AMSEP2-TMP21)/LOOP
            TMP32=TMP31+(AMSEP3-TMP31)/LOOP
            IF(LOOP.GT.1) THEN
               VAR12=((1.-1./(LOOP-1))*VAR11)+LOOP*(TM12-TM11)**2
               VAR22=((1.-1./(LOOP-1))*VAR21)+LOOP*(TM22-TM21)**2
               VAR32=((1.-1./(LOOP-1))*VAR31)+LOOP*(TM32-TM31)**2
               VARP12=((1.-1./(LOOP-1))*VARP11)+LOOP*(TMP12-TMP11)**2
               VARP22=((1.-1./(LOOP-1))*VARP21)+LOOP*(TMP22-TMP21)**2
               VARP32=((1.-1./(LOOP-1))*VARP31)+LOOP*(TMP32-TMP31)**2
            ENDIF
            TM11=TM12
            TM21=TM22
            TM31=TM32
            VAR11=VAR12
            VAR21=VAR22
            VAR31=VAR32
            TMP11=TMP12
            TMP21=TMP22
            TMP31=TMP32
            VARP11=VARP12
            VARP21=VARP22
            VARP31=VARP32
         END DO
         T1=TIME()
         TMIN=AMINIM(TMP12,TMP22,TMP32)
         RBAC=((TMP12-TMIN)/TMIN)*100
         RSTE=((TMP22-TMIN)/TMIN)*100
         RBAY=((TMP32-TMIN)/TMIN)*100
         SD12=DSQRT(VAR12)
         SD22=DSQRT(VAR22)
         SD32=DSQRT(VAR32)
         SDP12=DSQRT(VARP12)
         SDP22=DSQRT(VARP22)
         SDP32=DSQRT(VARP32)
C        WRITE(31,1002)
C1002    FORMAT(1X,55('*'))
C        WRITE(31,*)'XMEAN = ',XMEAN,'     XSIGMA = ',XSIGMA
C        WRITE(31,1004)
C1004    FORMAT(1X,55('*'))
C        WRITE(31,1006) MB
C1006    FORMAT(1X,'***** BUILDING DEPENDENT FROM ',I2,' PREDICTORS',
C       *'       *****')
C        WRITE(31,1008) MI
C1008    FORMAT(1X,'***** INITIAL MODEL WITH      ',I2,' PREDICTORS ',
C       *'      *****')
C        WRITE(31,1010) N(IN)
C1010    FORMAT(1X,'***** NUMBER OF OBSERVES IS   ',I3,'             ',
C       *'*****')
C        WRITE(31,1012) NL
C1012    FORMAT(1X,'***** NUMBER OF ITERATION IS  ',I3,'             ',
C       *'    *****')
C        WRITE(31,1014) ALP(ILP)
C1014    FORMAT(1X,'***** SIGNIFINCANT LEVEL IS   ',F3.2,'           ',
C       *'      *****')
C        WRITE(31,1016) ESIGMA(IE)
C1016    FORMAT(1X,'***** S.D OF RANDOM ERROR IS   ',F4.1,'       ',
C       *'        *****')
C        WRITE(31,1018) IXX
C1018    FORMAT(1X,'***** SEED IS                  ',I4,
C       *'               *****')
```

```
C       WRITE(31,1020)
C1020   FORMAT(1X,55('*'))
C       WRITE(31,*) 'SIGMA/TAU     ',IP(IIP),'         C        ',CC(IC)
C       WRITE(31,1021)
C1021   FORMAT(1X,55('*'))
C       WRITE(31,1022)
C1022   FORMAT(1X,'METHOD',6X,' MSE ',6X,'       SD. ')
C       WRITE(31,1024)
C1024   FORMAT(1X,55('*'))
C       WRITE(31,1026)TM12,SD12
C1026   FORMAT(1X,'BACK  ',F12.4,F16.4)
C       WRITE(31,1028)TM22,SD22
C1028   FORMAT(1X,'STEP  ',F12.4,F16.4)
C       WRITE(31,1030)TM32,SD32
C1030   FORMAT(1X,'BAYE  ',F12.4,F16.4)
C       WRITE(31,1032)
C1032   FORMAT(1X,55('*'))
C       WRITE(31,1034)
C1034   FORMAT(1X,'METHOD',6X,'MSE-PRED',5X,'     SD. ')
C       WRITE(31,1052)
C1052   FORMAT(1X,55('*'))
C       WRITE(31,1054)TMP12,SDP12
C1054   FORMAT(1X,'BACK  ',F12.4,F16.4)
C       WRITE(31,1056)TMP22,SDP22
C1056   FORMAT(1X,'STEP  ',F12.4,F16.4)
C       WRITE(31,1058)TMP32,SDP32
C1058   FORMAT(1X,'BAYE  ',F12.4,F16.4)
C       WRITE(31,1060)
C1060   FORMAT(1X,55('*'))
C       WRITE(31,1062)
C1062   FORMAT(1X,'METHOD',6X,' RDAMSE  ')
C       WRITE(31,1068)
C1068   FORMAT(1X,55('*'))
C       WRITE(31,1070)RBAC
C1070   FORMAT(1X,'BACK  ',F12.4)
C       WRITE(31,1072)RSTE
C1072   FORMAT(1X,'STEP  ',F12.4)
C       WRITE(31,1074)RBAY
C1074   FORMAT(1X,'BAYE  ',F12.4)
C       WRITE(31,1076)
C1076   FORMAT(1X,55('*'))
C       CLOSE(31)
        WRITE(30,2000) ALP(IALP),ESIGMA(IE),N(IN),MB,MI,IP(IIP),CC(IC),
     *TMP12,SDP12,RBAC,TMP22,SDP22,RSTE,TMP32,SDP32,RBAY,T1-T0
2000    FORMAT(2F6.2,I5,3I4,F6.1,9F14.4,I5)
        WRITE(6,2002) ALP(IALP),ESIGMA(IE),N(IN),MB,MI,IP(IIP),CC(IC),
     *TMP22,SDP22,RBAC,TMP32,SDP32,RSTE,TMP42,SDP42,RBAY,T1-T0
2002    FORMAT(I5,2F6.2,I5,3I4,F6.1,9F14.4,I5)
        END DO
        END DO
        END DO
999     END DO
        END DO
        END DO
        END DO
        CLOSE(30)
        END
C
C       ------------------------------------------------------
C
```

```
C*****************************************************************
C***********      ORDINARY LEAST SQUARE SUBROUTINE     **********
C*****************************************************************
      SUBROUTINE OLS(N,M,KE1,XE,Y,PR,SSE,AMSE,AMSEP)
      DOUBLE PRECISION XE(110,28),Y(110),B(28)
      CHARACTER*8 PR(13)
      DOUBLE PRECISION AMSE,SSE,AMSEP

      CALL BETA(N,KE1,XE,Y,B)
      CALL MSQE(N,M,KE1,XE,Y,B,SSE,AMSE,AMSEP)
C      WRITE(6,100)
C100   FORMAT(1X,' ********** ORDINARY LEAST SQUARE ********** ')
C      DO 10 I=1,KE1
C         WRITE(6,1002) PR(I),B(I)
C1002     FORMAT(1X,'COEFFICIENT CORR. OF ',A,F)
C10    CONTINUE
C      WRITE(6,1004) AMSE
C1004  FORMAT(1X,'MEAN SQUARE ERROR FOR INITIAL SET ',F)
C      WRITE(6,1006) AMSEP
C1006  FORMAT(1X,'MEAN SQUARE ERROR FOR TEST SET ',F)
      RETURN
      END
C*****************************************************************
C***********      BACKWARD ELIMINATION SUBROUNTINE     **********
C*****************************************************************
      SUBROUTINE BACK(N,M,KE1,XE,Y,PR,IALP,SSE,KP,AMSE,AMSEP)
      DOUBLE PRECISION XE(110,28),Y(110),B(28),XT(28,100),XTY(28),
     *F(28),FMIN(28),XO(110,28),XA(110,28),XOTY(28),XOT(28,100)
      CHARACTER*8 PR(28),PRO(28)
      COMMON/TABLE/FTAB(2,100)
      DOUBLE PRECISION YTY,S1,S2,SSR,SSE,RF,AMSE,AMSEP

C      WRITE(6,1000)
C1000  FORMAT(1X,' ********** BACKWARD ELIMINATION  ********** ')
      KA1=KE1
      DO 12 J=1,KA1
         DO 10 I=1,N+M
            XA(I,J)=XE(I,J)
10       CONTINUE
         PRO(J)=PR(J)
12    CONTINUE
      YTY=0.
      DO 14 I=1,N
         YTY=YTY+(Y(I)*Y(I))
14    CONTINUE
100   CALL BETA(N,KA1,XA,Y,B)
      DO 18 I=1,N
         DO 16 J=1,KA1
            XT(J,I)=XA(I,J)
16       CONTINUE
18    CONTINUE
      DO 22 I=1,KA1
         XTY(I)=0.
         DO 20 J=1,N
            XTY(I)=XTY(I)+(XT(I,J)*Y(J))
20       CONTINUE
22    CONTINUE
      S1=0.
      DO 24 I=1,KA1
         S1=S1+(B(I)*XTY(I))
24    CONTINUE
```

```
      II=0
      IO=2
200   JJ=1
      DO 28 J=1,KA1
         DO 26 I=1,N+M
            XO(I,J)=XA(I,J)
26       CONTINUE
28    CONTINUE
      DO 32 J=1,KA1
         DO 30 I=1,N
            IF(XA(I,J).NE.XA(I,IO)) THEN
               XO(I,JJ)=XA(I,J)
               IF(I.EQ.N) THEN
                  JJ=JJ+1
                ENDIF
            ENDIF
30       CONTINUE
32    CONTINUE
      KA1=KA1-1
      CALL BETA(N,KA1,XO,Y,B)
      DO 36 I=1,N
         DO 34 J=1,KA1
            XOT(J,I)=XO(I,J)
34       CONTINUE
36    CONTINUE
      DO 40 I=1,KA1
         XOTY(I)=0.
         DO 38 J=1,N
            XOTY(I)=XOTY(I)+(XOT(I,J)*Y(J))
38       CONTINUE
40    CONTINUE
      S2=0.
      DO 42 I=1,KA1
         S2=S2+(B(I)*XOTY(I))
42    CONTINUE
      SSR=S1-S2
      SSE=(YTY-S1)/(N-KA1-1)
      RF=SSR/SSE
      II=II+1
      F(II)=RF
      IO=IO+1
      KA1=KA1+1
      IF(IO.LE.KA1) GOTO 200
      IM=2
      RMIN=F(1)
      DO 44 I=1,II
         IF(RMIN.GT.F(I)) THEN
            RMIN=F(I)
            IM=I+1
         ENDIF
44    CONTINUE
      FMIN(IM)=RMIN
      IF(FMIN(IM).GE.FTAB(IALP,N-KA1)) GOTO 300
C      WRITE(6,1001)PRO(IM)
C1001  FORMAT(5X,'VARIABLE REMOVE ',A)
      JJ=1
```

```
      DO 48 J=1,KA1
         DO 46 I=1,N+M
            IF(XO(I,J).NE.XO(I,IM)) THEN
               XO(I,JJ)=XO(I,J)
               PRO(JJ)=PRO(J)
               IF(I.EQ.N+M) THEN
                  JJ=JJ+1
               ENDIF
            ENDIF
46       CONTINUE
48    CONTINUE
      DO 52 I=1,N+M
         DO 50 J=1,JJ
            XA(I,J)=XO(I,J)
50       CONTINUE
52    CONTINUE
      KA1=KA1-1
      IF(KA1.GT.2) GOTO 100
300   CALL BETA(N,KA1,XA,Y,B)
      CALL MSQE(N,M,KA1,XA,Y,B,SSE,AMSE,AMSEP)
      KP=KA1
C      WRITE(6,*)
C      DO 54 I=1,KA1
C         WRITE(6,1002) PRO(I),B(I)
C1002     FORMAT(5X,'COEFFICIENT OF REG. ',A,F)
C54    CONTINUE
C      WRITE(6,1004) AMSE
C1004  FORMAT(1X,'MEAN SQUARE ERROR FOR INITIAL SET ',F)
C      WRITE(6,1006) AMSEP
C1006  FORMAT(1X,'MEAN SQUARE ERROR FOR TEST SET ',F)
      RETURN
      END
C*************************************************************
C***********       STEPWISE REGRESSION ROUTINE         **********
C*************************************************************
      SUBROUTINE STEP(N,M,KE1,XE,Y,PR,IALP,SSE,KP,AMSE,AMSEP)
      DOUBLE PRECISION XE(110,28),Y(110),R(28,28),RR(28,28),
     *XO(110,28),A(28,28),CO(28,28),PAR(28),XC(110,28),XOT(28,100),
     *XOTY(28),XR(110,28),XRT(28,100),XRTY(28),F(28),FMIN(28),B(28),
     *XA(110,28)
      CHARACTER*8 PR(28),PRO(28),PRC(28)
      COMMON/TABLE/FTAB(2,100)
      DOUBLE PRECISION YTY,S1,S2,SSR,SSE,RF,AMSE,AMSEP
      DOUBLE PRECISION TF,T,RRMAX,PMAX

C      WRITE(6,1000)
C1000  FORMAT(1X,' ***********  STEPWISE REGRESSION  *********** ')
      NIN=1
      NOUT=1
      KA1=KE1
      KA2=KA1+1
      YTY=0.
      PRO(1)='CONST.'
      DO 12 I=1,N+M
         DO 10 J=1,KA1
            XA(I,J)=XE(I,J)
10       CONTINUE
12     CONTINUE
      DO 14 I=1,N
           YTY=YTY+(Y(I)*Y(I))
14    CONTINUE
```

```
      CALL CORR(N,KA1,XA,Y,R)
      DO 16 I=2,KA1
         IF(R(I,KA2).GE.0) THEN
            RR(I,KA2)=R(I,KA2)
         ELSE
            RR(I,KA2)=-R(I,KA2)
         ENDIF
16    CONTINUE
      IO=2
      RMAX=RR(IO,KA2)
      DO 18 I=3,KA1
         IF(RR(I,KA2).GT.RMAX) THEN
            RMAX=RR(I,KA2)
            IO=I
         ENDIF
18    CONTINUE
      RRMAX=RMAX**2
      DO 20 I=1,N+M
         XO(I,1)=1.
20    CONTINUE
      TF=T(N,2,RRMAX)**2
      IF(TF.LT.FTAB(IALP,N-2)) THEN
         KA1=1
C         WRITE(6,1002)
C1002     FORMAT(5X,'NO VARIABLE IN EQUATION')
         GOTO 400
      ENDIF
      DO 22 J=1,KA1
         PRC(J)=PR(J)
22    CONTINUE
      NIN=1
      IL=2
      DO 24 I=1,N+M
         XO(I,IL)=XA(I,IO)
24    CONTINUE
      PRO(IL)=PRC(IO)
C      WRITE(6,1004)PRO(IL)
C1004  FORMAT(2X,'VARIABLE ENTER IS ',A)
      DO 28 I=1,N+M
         DO 26 J=1,KA1
            XC(I,J)=XA(I,J)
26       CONTINUE
28    CONTINUE
      JJ=1
      DO 32 J=1,KA1
         DO 30 I=1,N+M
            IF(XA(I,J).NE.XA(I,IO)) THEN
               XC(I,JJ)=XA(I,J)
               PRC(JJ)=PRC(J)
               IF(I.EQ.N+M) THEN
                  JJ=JJ+1
               ENDIF
            ENDIF
30       CONTINUE
32    CONTINUE
      KA1=KA1-1
      IP=KA1
100   DO 42 IR=2,KA1
         IL=IL+1
         DO 36 J=1,KA1
            DO 34 I=1,N
```

```
                IF(XC(I,J).EQ.XC(I,IR)) THEN
                   XO(I,IL)=XC(I,J)
                ENDIF
34           CONTINUE
36        CONTINUE
          CALL CORR(N,IL,XO,Y,CO)
          M1=IL+1
          DO 40 I=2,M1
             DO 38 J=2,M1
                A(I,J)=CO(I,J)
38           CONTINUE
40        CONTINUE
          CALL VERS(M1,A)
          PAR(IR)=(-A(IL,M1)/(A(IL,IL)*A(M1,M1))**.5)**2
          IL=IL-1
42     CONTINUE
       PMAX=PAR(2)
       DO 44 I=2,KA1
          IF(PMAX.LE.PAR(I)) THEN
             PMAX=PAR(I)
             MR=I
          ENDIF
44     CONTINUE
200    TF=T(N,IL+1,PMAX)**2
       IF(TF.LT.FTAB(IALP,N-IL-1)) THEN
          NIN=0
          KA1=IL
          IF(NIN+NOUT.NE.0) GOTO 300
          GOTO 400
       ENDIF
       IL=IL+1
       DO 46 I=1,N+M
          XO(I,IL)=XC(I,MR)
46     CONTINUE
       PRO(IL)=PRC(MR)
       NIN=1
C       WRITE(6,1006)PRO(IL)
C1006   FORMAT(2X,'VARIABLE ENTER IS ',A)
       JJ=1
       DO 50 J=1,KA1
          DO 48 I=1,N+M
             IF(XC(I,J).NE.XC(I,MR)) THEN
                XC(I,JJ)=XC(I,J)
                PRC(JJ)=PRC(J)
                IF(I.EQ.N+M) THEN
                   JJ=JJ+1
                ENDIF
             ENDIF
48        CONTINUE
50     CONTINUE
       IP=IP-1
       KA1=IL
300    IF(KA1.LE.2) GOTO 400
       CALL BETA(N,KA1,XO,Y,B)
       DO 54 I=1,N
          DO 52 J=1,KA1
             XOT(J,I)=XO(I,J)
52        CONTINUE
54     CONTINUE
       DO 58 I=1,KA1
          XOTY(I)=0.
```

```
         DO 56 J=1,N
            XOTY(I)=XOTY(I)+(XOT(I,J)*Y(J))
56       CONTINUE
58    CONTINUE
      S1=0.
      DO 60 I=1,KA1
         S1=S1+(B(I)*XOTY(I))
60    CONTINUE
      II=0
      DO 80 IZ=2,IL
         JR=1
         DO 64 I=1,N
            DO 62 J=1,KA1
               XR(I,J)=XO(I,J)
62          CONTINUE
64       CONTINUE
         DO 68 J=1,KA1
            DO 66 I=1,N
               IF(XO(I,J).NE.XO(I,IZ)) THEN
                  XR(I,JR)=XO(I,J)
                  IF(I.EQ.N) THEN
                     JR=JR+1
                  ENDIF
               ENDIF
66          CONTINUE
68       CONTINUE
         KA1=KA1-1
         CALL BETA(N,KA1,XR,Y,B)
         DO 72 I=1,N
            DO 70 J=1,KA1
               XRT(J,I)=XR(I,J)
70          CONTINUE
72       CONTINUE
         DO 76 I=1,KA1
            XRTY(I)=0.
            DO 74 J=1,N
               XRTY(I)=XRTY(I)+(XRT(I,J)*Y(J))
74          CONTINUE
76       CONTINUE
         S2=0.
         DO 78 I=1,KA1
            S2=S2+(B(I)*XRTY(I))
78       CONTINUE
         SSR=S1-S2
         SSE=(YTY-S1)/(N-KA1-1)
         RF=SSR/SSE
         II=II+1
         F(II)=RF
         KA1=KA1+1
80    CONTINUE
      MM=2
      RMIN=F(1)
      DO 82 I=1,II
         IF(RMIN.GT.F(I)) THEN
            RMIN=F(I)
            MM=I+1
         ENDIF
82    CONTINUE
      FMIN(MM)=RMIN
      IF(FMIN(MM).GE.FTAB(IALP,N-KA1)) THEN
         NOUT=0
```

```
            IF(NOUT+NIN.NE.0.AND.KA1.LT.KE1) THEN
               KA1=IP
               GOTO 100
            ELSE
               KA1=IL
               GOTO 400
            ENDIF
         ENDIF
         IP=IP+1
         DO 84 I=1,N+M
            XC(I,IP)=XO(I,MM)
            PRC(IP)=PRO(MM)
84       CONTINUE
         NOUT=1
C         WRITE(6,1008) PRC(IP)
C1008    FORMAT(2X,'VARIABLE REMOVED IS ',A)
         JJ=1
         DO 88 J=1,KA1
            DO 86 I=1,N+M
               IF(XO(I,J).NE.XO(I,MM)) THEN
                  XO(I,JJ)=XO(I,J)
                  PRO(JJ)=PRO(J)
                  IF(I.EQ.N+M) THEN
                     JJ=JJ+1
                  ENDIF
               ENDIF
86          CONTINUE
88       CONTINUE
         KA1=IP
         IL=IL-1
         DO 98 IR=2,KA1
            IL=IL+1
            DO 92 J=1,KA1
               DO 90 I=1,N
                  IF(XC(I,J).EQ.XC(I,IR)) THEN
                     XO(I,IL)=XC(I,J)
                  ENDIF
90             CONTINUE
92          CONTINUE
            CALL CORR(N,IL,XO,Y,CO)
            M1=IL+1
            DO 96 I=2,M1
               DO 94 J=2,M1
                  A(I,J)=CO(I,J)
94             CONTINUE
96          CONTINUE
            CALL VERS(M1,A)
            PAR(IR)=(-A(IL,M1)/(A(IL,IL)*A(M1,M1))**.5)**2
            IL=IL-1
98       CONTINUE
         PMAX=PAR(2)

         DO 102 I=2,KA1
            IF(PMAX.LE.PAR(I)) THEN
               PMAX=PAR(I)
               MR=I
            ENDIF
102      CONTINUE
         IF(MR.EQ.IP) THEN
            KA1=IL
            GOTO 400
```

```
      ELSE
         GOTO 200
      ENDIF
400   CALL BETA(N,KA1,XO,Y,B)
      CALL MSQE(N,M,KA1,XO,Y,B,SSE,AMSE,AMSEP)
      KP=KA1
C      DO 104 I=1,KA1
C         WRITE(6,1010) PRO(I),B(I)
C1010     FORMAT(5X,'COEFFICIENT CORR. OF ',A,F)
C104   CONTINUE
C      WRITE(6,1012) AMSE
C1012  FORMAT(1X,'MEAN SQUARE ERROR FOR INITIAL SET ',F)
C      WRITE(6,1014) AMSEP
C1014  FORMAT(1X,'MEAN SQUARE ERROR FOR TEST SET ',F)
      RETURN
      END
C*****************************************************************
C     BAYESIAN STOCHASTIC PROCESS FOR VARIABLE SELECTION
C*****************************************************************
      SUBROUTINE BAYE(N,M,MB,KB1,PR,XB,Y,IALP,AMSE,AMSEP,IP,CC,
     *PPROB)
C
      DOUBLE PRECISION XB(110,28),Y(110),PRIOR(28),TAU(28),
     *HYVAR(2,28),RX(28,28),XTX(28,28),B1(28),B2(28),B3(28),
     *TB2(28),DIAG(28,28),DRD(28,28),TDRD(28,28),BVAR(28,28),
     *TVAR(28,28),FB1(28),FB2(28),POST(28),PPOST(100),XTY(28)
      DOUBLE PRECISION SSE4,AMSE,TEMP,DUE,IALFA,IA1,IBETA,LAMBDA,
     *SIGMA1,SIGMA2,AERR2,FS1,FS2,FACT,SSE1,RATIO,TMP,TBETA,AMSEP,
     *CC,PPROB
      INTEGER ITER,DELTA1(28),DELTA2(28),DELTA3(28),FLAG(28),IP
      CHARACTER*8 PR(28)

      DOUBLE PRECISION FACTORIAL,FNORMAL,AER2,FINVGAM

C
C     SET PRIOR FOR PREDICTOR WITH STRONG HEREDITY
C     PR(DA=1)=0.50
C     PR(DA^2=1|DA)=(0,0.5)
C     PR(DAB=1|DA,DB)=(0,0,0,0.25)
C
      PRIOR(1)=0.5
      PRIOR(2)=0.5
      IF(MB.GT.1) THEN
      PRIOR(3)=0.5
      PRIOR(4)=0.25
      PRIOR(5)=0.5
        IF(MB.GT.2) THEN
         PRIOR(6)=0.5
         PRIOR(7)=0.25
         PRIOR(8)=0.25
         PRIOR(9)=0.5
           IF(MB.GT.3) THEN
            PRIOR(10)=0.5
            PRIOR(11)=0.25
            PRIOR(12)=0.25
            PRIOR(13)=0.25
            PRIOR(14)=0.5
              IF(MB.GT.4) THEN
               PRIOR(15)=0.5
               PRIOR(16)=0.25
               PRIOR(17)=0.25
```

```
                PRIOR(18)=0.25
                PRIOR(19)=0.25
                PRIOR(20)=0.5
                  IF(MB.GT.5) THEN
                   PRIOR(21)=0.5
                   PRIOR(22)=0.25
                   PRIOR(23)=0.25
                   PRIOR(24)=0.25
                   PRIOR(25)=0.25
                   PRIOR(26)=0.25
                   PRIOR(27)=0.5
                  ENDIF
               ENDIF
            ENDIF
          ENDIF
        ENDIF
        DO I=1,KB1
         FLAG(I)=1
        END DO
C
C       SIGMA(BETA[I])/TAU(I) = IP
C
        CALL FBETA(N,KB1,XB,Y,FLAG,XTX,B1)
        CALL MSQE(N,M,KB1,XB,Y,B1,SSE,SIGMA1,AMSEP)
        DO I=1,KB1
           TEMP=SIGMA1/XTX(I,I)
           TAU(I)=DSQRT(TEMP)/DBLE(IP)
        END DO
C
C       CALCULATE VARIANCE OF HYPERPARAMETER BETA
C
        DO I=1,KB1
           HYVAR(1,I)=1/TAU(I)
           HYVAR(2,I)=1/(CC*TAU(I))
        END DO
C       ------------------------------------------------------------------
C       CALCULATE VARIABLE WHICH CONSTANT IN ALL ITERATION
C
        ITER=100
C
C       SET DUE=0 BECAUSE IT MAKE ESTIMATED PARAMETER NOT DIVERGE
C
        DUE=1.99
C
C       CALCULATE ALFA FOR INVERSE GAMMA (DEPEND ON DUE)
C
        IALFA = (N+DUE)/2
        IA1=IALFA
        FACT=FACTORIAL(IA1)
C       ------------------------------------------------------------------
C       SETTING PARAMETER FOR INITIAL ITERATION
C       TO BEGINING
C          DELTA1 : DELTA VECTOR OF  ZEROTH ITER
C          DELTA2 : DELTA VECTOR OF  FIRST ITER
C          B1 : BETA VECTOR OF ZEROTH ITER <LS ESTIMATE>
C          B2 : BETA VECTOR OF FIRST  ITER <GIBBS SAMPLING ESTIMATE>
C          SIGMA1 : SIGMA^2 OF ZEROTH ITER <LS ESTIMATE>
C          SIGMA2 : SIGMA^2 OF FIRST ITER <GIBBS SAMPLING ESTIMATE>
C          LAMBDA =  VARIANCE OF SATURATE MODEL BY LS METHOD
C
```

```
      DO I=1,KB1
         DELTA1(I)=1
      END DO
      CALL BMSQE(N,M,KB1,XB,Y,DELTA1,B1,SSE1,LAMBDA,AMSEP)
      PPOST(1)=1.
      DO I=1,KB1
         PPOST(1)=PPOST(1)*PRIOR(I)
      END DO
C
C     SET DIAGONAL MATRIX OF BETA VARIANCE DEPEND ON DELTA1 VECTOR
C     BY EQUATION 4
C
      DO I=1,KB1
         DO J=1,KB1
            IF(I.EQ.J) THEN
               DIAG(I,I)=HYVAR(2,I)
            ELSE
               DIAG(I,J)=0.
            ENDIF
         END DO
      END DO
C
C     CALCULATE VECTOR : BETA(LS,I)*XTX(J,I) = XTY(I)
C
C      CALL CALBXTX(KB1,B1,XTX,FLAG,BXTX)
      DO I=1,KB1
         XTY(I)=0.
         DO J=1,N
            XTY(I)=XTY(I)+XB(J,I)*Y(J)
         END DO
      END DO
C     ---------------------------------------------------------
C                       BEGIN GIBBS
C     ---------------------------------------------------------
C     LET : ORDER OF ITERATION FOR GIBBS SAMPLING
C     GENERATE PARAMETER BY EQUATION 12
C
      DO LET=2,ITER
C
C        CALCULATE CORRELATION MATRIX AND ITS INVERSE
C
          CALL CORRX(N,KB1,XB,FLAG,RX)
          CALL FINVS(KB1,RX,FLAG)
C         WRITE(6,*) 'ITERATION ',LET
C
C        CALCULATE PRODUCT OF DIAG*RX*DIAG MATRIX
C
         CALL DRXD(DIAG,RX,KB1,FLAG,DRD)
C
C        CALCULATE VARIANCE METRIX OF BETA VECTOR BY EQUTION 13(A)
C
         DO I=1,KB1
            IF(FLAG(I).EQ.1) THEN
               DO J=1,KB1
                  BVAR(I,J)=0.
                  IF(FLAG(J).EQ.1) THEN
                     BVAR(I,J)=(XTX(I,J)/SIGMA1)+DRD(I,J)
                  ENDIF
               END DO
            ENDIF
         END DO
```

```
      CALL FINVS(KB1,BVAR,FLAG)
C
C     CALCULATE B3 : MEAN OF BETA ESTIMATE VECTOR
C
      DO I=1,KB1
         B3(I)=0.
         IF(FLAG(I).EQ.1) THEN
            DO J=1,KB1
               IF(FLAG(J).EQ.1) THEN
                  B3(I)=B3(I)+BVAR(I,J)*XTY(J)
               ENDIF
            END DO
            B3(I)=B3(I)/SIGMA1
         ENDIF
      END DO
C
C     GENERATE BETA VECTOR OF FIRST ITERATION BY EQUATION 13
C
      DO I=1,KB1
         B2(I)=0.
         IF(FLAG(I).EQ.1) THEN
            CALL NORMAL(B3(I),BVAR(I,I),B2(I))
            IF(DELTA1(I).EQ.1) THEN
               FB2(I)=FNORMAL(B2(I),B3(I),BVAR(I,I))
            ELSE
               FB1(I)=FNORMAL(B2(I),B3(I),BVAR(I,I))
            ENDIF
         ENDIF
      END DO
C
C     CALCULATE ABSOLTE ERROR OF ESTIMATION WITH BETA
C
      AERR2=AER2(Y,XB,B2,DELTA1,KB1,N)
C
C     CAL PARAMETER OF INVERSE GAMMA (IALFA,IBETA)
C
      IBETA=(AERR2+(DUE*LAMBDA))/2
C
C     GENERATE SIGMA2 OF FIRST ITERATION BY EQUATION 14
C
      CALL IG(IALFA,IBETA,SIGMA2)
C
C     INTIAL SOME PARAMETER BEFORE FIND DELTA2 VECTOR
C
      DO I=1,KB1
         DELTA3(I)=DELTA1(I)
         TB2(I)=B2(I)
      END DO
C     ------------------------------------------------------------
C     FINDING DELTA2 VECTOR COMPONENTWISE BY SAMPLING CONSECUTIVELY
C     ------------------------------------------------------------
C     L : ORDER OF DELTA2(L) TO FIND NEW VALUE
C
      DO L=1,KB1
         IF(FLAG(L).EQ.1) THEN
            DELTA3(L)=1-DELTA1(L)
            IF(DELTA3(L).EQ.1) THEN
               DIAG(L,L)=HYVAR(2,L)
            ELSE
               DIAG(L,L)=HYVAR(1,L)
            ENDIF
```

```
                CALL DRXD(DIAG,RX,KB1,FLAG,TDRD)
                DO I=1,KB1
                   IF(FLAG(I).EQ.1) THEN
                      DO J=1,KB1
                         TVAR(I,J)=0.
                         IF(FLAG(J).EQ.1) THEN
                            TVAR(I,J)=(XTX(I,J)/SIGMA1)+TDRD(I,J)
                         ENDIF
                      END DO
                   ENDIF
                END DO
                CALL FINVS(KB1,TVAR,FLAG)
                TB2(L)=0.
                DO J=1,KB1
                   IF(FLAG(J).EQ.1) THEN
                      TB2(L)=TB2(L)+TVAR(L,J)*XTY(J)
                   ENDIF
                END DO
                TB2(L)=TB2(L)/SIGMA1
C
C          GENERATE BETA VECTOR OF SECOND ITERATION BY EQUATION 13
C
                IF(DELTA3(L).EQ.1) THEN
                   FB2(L)=FNORMAL(B2(L),TB2(L),TVAR(L,L))
                ELSE
                   FB1(L)=FNORMAL(B2(L),TB2(L),TVAR(L,L))
                ENDIF
C
C          CALCULATE ABSOLTE ERROR OF ESTIMATION WITH BETA
C
                AERR2=AER2(Y,XB,TB2,DELTA3,KB1,N)
C
C            CALCULATE PARAMETER OF INVERSE GAMMA (IALFA,IBETA)
C
                TBETA=(AERR2+(DUE*LAMBDA))/2
C
C            GENERATE SIGMA2 OF SECOND ITERATION BY EQUATION 14
C
                IF(DELTA3(L).EQ.1) THEN
                   FS1=FINVGAM(SIGMA2,IALFA,IBETA,FACT)
                   FS2=FINVGAM(SIGMA2,IALFA,TBETA,FACT)
                ELSE
                   FS2=FINVGAM(SIGMA2,IALFA,IBETA,FACT)
                   FS1=FINVGAM(SIGMA2,IALFA,TBETA,FACT)
                ENDIF
                TMP=1.0
                IF(LET.EQ.2) THEN
                   DO I=1,KB1
                      IF(I.NE.L) THEN
                         IF(DELTA3(I).EQ.1) THEN
                            TMP=TMP*FB2(I)
                         ELSE
                            TMP=TMP*FB1(I)
                         ENDIF
                      ENDIF
                   END DO
                ELSE
                   DO I=1,KB1
                      IF(I.NE.L) THEN
                         IF(DELTA3(I).EQ.1) THEN
                            TMP=TMP*FB2(I)
```

```
                ELSE
                   TMP=TMP*FB1(I)
                ENDIF
             ENDIF
          END DO
       ENDIF
       RATIO=(FS1*TMP*(1-PRIOR(L))*FB1(L))+
     *       (FS2*TMP*PRIOR(L)*FB2(L))
       RATIO=FS2*TMP*PRIOR(L)*FB2(L)/RATIO
       RPOST(L)=RATIO
       IF((L.EQ.1).OR.(L.EQ.3).OR.(L.EQ.6).OR.(L.EQ.10).OR.
     *  (L.EQ.15).OR.(L.EQ.21)) THEN
          IF(RATIO.GE.(1-PRIOR(L))) THEN
             DELTA2(L)=1
          ELSE
             DELTA2(L)=0
          ENDIF
       ELSE IF(L.EQ.2) THEN
          IF((RATIO.GE.(1-PRIOR(L))).AND.(DELTA2(1).EQ.1))
     *    THEN
              DELTA2(L)=1
          ELSE
             DELTA2(L)=0
          ENDIF
       ELSE IF(L.EQ.5) THEN
          IF((RATIO.GE.(1-PRIOR(L))).AND.(DELTA2(3).EQ.1))
     *    THEN
             DELTA2(L)=1
          ELSE
             DELTA2(L)=0
          ENDIF
       ELSE IF(L.EQ.9) THEN
          IF((RATIO.GE.(1-PRIOR(L))).AND.(DELTA2(6).EQ.1))
     *    THEN
             DELTA2(L)=1
          ELSE
             DELTA2(L)=0
          ENDIF
       ELSE IF(L.EQ.14) THEN
          IF((RATIO.GE.(1-PRIOR(L))).AND.(DELTA2(10).EQ.1))
     *    THEN
                DELTA2(L)=1
          ELSE
             DELTA2(L)=0
          ENDIF
       ELSE IF(L.EQ.20) THEN
          IF((RATIO.GE.(1-PRIOR(L))).AND.(DELTA2(15).EQ.1))
     *    THEN
             DELTA2(L)=1
          ELSE
             DELTA2(L)=0
          ENDIF
       ELSE IF(L.EQ.27) THEN
          IF((RATIO.GE.(1-PRIOR(L))).AND.(DELTA2(21).EQ.1))
     *    THEN
                DELTA2(L)=1
          ELSE
             DELTA2(L)=0
          ENDIF
       ELSE IF(L.EQ.4) THEN
```

```
            IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(1).EQ.1).
     *      AND.(DELTA2(3).EQ.1))) THEN
               DELTA2(L)=1
            ELSE
               DELTA2(L)=0
            ENDIF
         ELSE IF(L.EQ.7) THEN
            IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(1).EQ.1).
     *      AND.(DELTA2(6).EQ.1))) THEN
               DELTA2(L)=1
            ELSE
               DELTA2(L)=0
            ENDIF
         ELSE IF(L.EQ.8) THEN
            IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(3).EQ.1).
     *      AND.(DELTA2(6).EQ.1))) THEN
               DELTA2(L)=1
            ELSE
               DELTA2(L)=0
            ENDIF
         ELSE IF(L.EQ.11) THEN
            IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(1).EQ.1).
     *      AND.(DELTA2(10).EQ.1))) THEN
               DELTA2(L)=1
            ELSE
               DELTA2(L)=0
            ENDIF
         ELSE IF(L.EQ.12) THEN
            IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(3).EQ.1).
     *      AND.(DELTA2(10).EQ.1))) THEN
               DELTA2(L)=1
            ELSE
               DELTA2(L)=0
            ENDIF
         ELSE IF(L.EQ.13) THEN
            IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(6).EQ.1).
     *      AND.(DELTA2(10).EQ.1))) THEN
               DELTA2(L)=1
            ELSE
               DELTA2(L)=0
            ENDIF
         ELSE IF(L.EQ.16) THEN
            IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(1).EQ.1).
     *      AND.(DELTA2(15).EQ.1))) THEN
               DELTA2(L)=1
            ELSE
               DELTA2(L)=0
            ENDIF
         ELSE IF(L.EQ.17) THEN
            IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(3).EQ.1).
     *      AND.(DELTA2(15).EQ.1))) THEN
               DELTA2(L)=1
            ELSE
               DELTA2(L)=0
            ENDIF
         ELSE IF(L.EQ.18) THEN
            IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(6).EQ.1).
     *      AND.(DELTA2(15).EQ.1))) THEN
               DELTA2(L)=1
            ELSE
               DELTA2(L)=0
```

```
                ENDIF
             ELSE IF(L.EQ.19) THEN
                IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(10).EQ.1).
     *          AND.(DELTA2(15).EQ.1))) THEN
                   DELTA2(L)=1
                ELSE
                   DELTA2(L)=0
                ENDIF
             ELSE IF(L.EQ.22) THEN
                IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(1).EQ.1).
     *          AND.(DELTA2(21).EQ.1))) THEN
                   DELTA2(L)=1
                ELSE
                   DELTA2(L)=0
                ENDIF
             ELSE IF(L.EQ.23) THEN
                IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(3).EQ.1).
     *          AND.(DELTA2(21).EQ.1))) THEN
                   DELTA2(L)=1
                ELSE
                   DELTA2(L)=0
                ENDIF
             ELSE IF(L.EQ.24) THEN
                IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(6).EQ.1).
     *          AND.(DELTA2(21).EQ.1))) THEN
                   DELTA2(L)=1
                ELSE
                   DELTA2(L)=0
                ENDIF
             ELSE IF(L.EQ.25) THEN
                IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA2(10).EQ.1).
     *          AND.(DELTA2(21).EQ.1))) THEN
                   DELTA2(L)=1
                ELSE
                   DELTA2(L)=0
                ENDIF
             ELSE IF(L.EQ.26) THEN
                IF((RATIO.GE.(1-PRIOR(L))).AND.((DELTA215).EQ.1)
     *           .AND.(DELTA2(21).EQ.1))) THEN
                   DELTA2(L)=1
                ELSE
                   DELTA2(L)=0
                ENDIF
             ENDIF
C
C          ASSIGN POSTERIOR PROB TO DELTA2 VECTOR
C
             DELTA3(L)=DELTA2(L)
             IF(DELTA2(L).EQ.1) THEN
                POST(L)=RATIO
                DIAG(L,L)=HYVAR(2,L)
             ELSE
                POST(L)=1.0-RATIO
                DIAG(L,L)=HYVAR(1,L)
                FLAG(L)=0
             ENDIF
          ENDIF
       END DO
       PPOST(LET)=1.0
```

```
            DO I=1,KB1
               PPOST(LET)=POST(I)*PPOST(LET)
               B1(I)=B2(I)
               DELTA1(I)=DELTA2(I)
            END DO
            PPROB=PPOST(LET)
            SIGMA1=SIGMA2
C
C           CALCULATE XTX MATRIX FOR NEXT LOOP
C
            CALL CALXTX(XB,N,KB1,FLAG,XTX)

            CALL BMSQE(N,M,KB1,XB,Y,DELTA1,B1,SSE1,TMP,AMSEP)
         END DO
         CALL BMSQE(N,M,KB1,XB,Y,DELTA1,B1,SSE1,AMSE,AMSEP)
C         WRITE(6,*)  ' '
C         WRITE(6,*) 'FINAL MODEL     BETA                    POST.PROB '
C         TMP=0
C         DO I=1,KB1
C            IF(DELTA1(I).EQ.1) THEN
C               TMP=TMP+1
C               WRITE(6,*) PR(I), B1(I), RPOST(I)
C            ENDIF
C         END DO
C         WRITE(6,*) AMSE,AMSEP
         RETURN
         END
C*************************************************************************
C*                       CALCULTE XTX MATRIX                             *
C*************************************************************************
         SUBROUTINE CALXTX(X,N,K,FLAG,R)
         DOUBLE PRECISION X(110,28),R(28,28)
         INTEGER FLAG(28)
         DO I=1,K
            DO J=1,K
               R(I,J)=0.0
               IF((FLAG(I).EQ.1).AND.(FLAG(J).EQ.1)) THEN
                  DO L=1,N
                     R(I,J)=R(I,J)+X(L,I)*X(L,J)
                  END DO
               ENDIF
            END DO
         END DO
         RETURN
         END
C*************************************************************************
C*                  CALCULATE PRODUCT D_INV_D*RX_D_INV_D                 *
C*************************************************************************
         SUBROUTINE DRXD(D,R,K,FLAG,RDR)
         DOUBLE PRECISION R(28,28),RDR(28,28),D(28,28),R1(28,28)
         INTEGER FLAG(28)
         DO I=1,K
          DO J=1,K
             R1(I,J)=0.
             IF((FLAG(I).EQ.1).AND.(FLAG(J).EQ.1)) THEN
                DO L=1,K
                   IF(FLAG(L).EQ.1) THEN
                    R1(I,J)=R1(I,J)+D(I,L)*R(L,J)
                  ENDIF
                END DO
             ENDIF
```

```
        END DO
       END DO
       DO I=1,K
        DO J=1,K
           RDR(I,J)=0.
           IF((FLAG(I).EQ.1).AND.(FLAG(J).EQ.1)) THEN
              DO L=1,K
                 IF(FLAG(L).EQ.1) THEN
                  RDR(I,J)=RDR(I,J)+R1(I,L)*D(L,J)
                ENDIF
              END DO
           ENDIF
        END DO
       END DO

       RETURN
       END
C*****************************************************************
C***********       FLAG INVERSE MATRIX SUBROUTINE        **********
C*****************************************************************
       SUBROUTINE FINVS(KE1,A,FLAG)
       DOUBLE PRECISION A(28,28),B(28,28)
       INTEGER FLAG(28)
       DO I=1,KE1
          DO J=1,KE1
             B(I,J)=A(I,J)
          END DO
       END DO
       DO L=1,KE1
        IF(FLAG(L).EQ.1) THEN
           B(L,L)=-1.0D0/B(L,L)
           DO I=1,KE1
                IF((FLAG(I).EQ.1).AND.((I-L).NE.0)) THEN
                   B(I,L)=-B(I,L)*B(L,L)
              ENDIF
           END DO
           DO I=1,KE1
              IF(FLAG(I).EQ.1) THEN
               DO J=1,KE1
                    IF((FLAG(J).EQ.1).AND.(((I-L)*(J-L)).NE.0)) THEN
                       B(I,J)=B(I,J)-B(I,L)*B(L,J)
                    ENDIF
               END DO
              ENDIF
           END DO
           DO J=1,KE1
                IF((FLAG(J).EQ.1).AND.((J-L).NE.0)) THEN
                   B(L,J)=-B(L,J)*B(L,L)
                ENDIF
           END DO
        ENDIF
       END DO
       DO I=1,KE1
          DO J=1,KE1
             IF((FLAG(I).EQ.1).AND.(FLAG(J).EQ.1)) THEN
                A(I,J)=-B(I,J)
             ENDIF
          END DO
       END DO
       RETURN
       END
```

```
C*****************************************************************
C***********    COEFFICIENT OF REGRESSION ROUTINE      **********
C*****************************************************************
      SUBROUTINE FBETA(N,KE1,XE,Y,FLAG,XX,B)
      DOUBLE PRECISION XE(110,28),Y(110),B(28),XTY(28),A(28,28),
*     XX(28,28)
      INTEGER FLAG(28)

      DO I=1,KE1
       IF(FLAG(I).EQ.1) THEN
            XTY(I)=0.
          DO J=1,N
               XTY(I)=XTY(I)+(XE(J,I)*Y(J))
          END DO
       ENDIF
      END DO
      CALL CALXTX(XE,N,KE1,FLAG,XX)
      DO I=1,KE1
         DO J=1,KE1
            A(I,J)=XX(I,J)
         END DO
      END DO
      CALL FINVS(KE1,A,FLAG)
      DO I=1,KE1
       IF(FLAG(I).EQ.1) THEN
          B(I)=0.
          DO J=1,KE1
             IF(FLAG(J).EQ.1) THEN
              B(I)=B(I)+(A(I,J)*XTY(J))
             ENDIF
          END DO
       ENDIF
      END DO
      RETURN
      END
C*****************************************************************
C***********    COEFFICIENT OF REGRESSION ROUTINE      **********
C*****************************************************************
      SUBROUTINE BETA(N,KE1,XE,Y,B)
      DOUBLE PRECISION XE(110,28),Y(110),B(28),XTY(28),A(28,28)
      DO I=1,KE1
         XTY(I)=0.
         DO J=1,N
            XTY(I)=XTY(I)+(XE(J,I)*Y(J))
         END DO
      END DO
      DO I=1,KE1
         DO L=1,KE1
            A(I,L)=0.
            DO J=1,N
                A(I,L)=A(I,L)+(XE(J,I)*XE(J,L))
            END DO
         END DO
      END DO
      CALL INVS(KE1,A)
      DO I=1,KE1
         B(I)=0.
         DO J=1,KE1
            B(I)=B(I)+(A(I,J)*XTY(J))
         END DO
      END DO
```

```
      RETURN
      END
C*****************************************************************
C***********         CORRELATION  SUBROUTINE           **********
C*****************************************************************
      SUBROUTINE CORR(N,KE1,XL,YL,RL)
      DOUBLE PRECISION XL(110,28),YL(110),RL(28,28),XMEAN(28)
      DOUBLE PRECISION SQ,SSQ,RSUM,SSQR,SQR

      KE2=KE1+1
      DO I=1,N
         XL(I,KE2)=YL(I)
      END DO
      DO J=2,KE2
         SUM=0.
         DO I=1,N
            SUM=SUM+XL(I,J)
         END DO
         XMEAN(J)=SUM/N
      END DO
      DO J=2,KE2
         DO IM=2,KE2
            RSUM=0.
            SQ=0.
            SSQ=0.
            DO I=1,N
               RSUM=RSUM+((XL(I,J)-XMEAN(J))*(XL(I,IM)-XMEAN(IM)))
               SQ=SQ+(XL(I,J)-XMEAN(J))**2
               SSQ=SSQ+(XL(I,IM)-XMEAN(IM))**2
            END DO
            SSQR=SSQ**.5
            SQR=SQ**.5
            RL(J,IM)=RSUM/(SSQR*SQR)
         END DO
      END DO
      RETURN
      END
C*****************************************************************
C***********       INVERSE MATRIX SUBROUTINE           **********
C*****************************************************************
      SUBROUTINE INVS(KE1,A)
      DOUBLE PRECISION A(28,28),B(28,28)

      DO I=1,KE1
         DO J=1,KE1
            B(I,J)=A(I,J)
         END DO
      END DO
      DO L=1,KE1
         B(L,L)=-1.0D0/B(L,L)
         DO I=1,KE1
            IF((I-L).NE.0) THEN
               B(I,L)=-B(I,L)*B(L,L)
            ENDIF
         END DO
         DO I=1,KE1
            DO J=1,KE1
               IF(((I-L)*(J-L)).NE.0) THEN
                  B(I,J)=B(I,J)-B(I,L)*B(L,J)
               ENDIF
            END DO
```

```
            END DO
            DO J=1,KE1
               IF((J-L).NE.0) THEN
                  B(L,J)=-B(L,J)*B(L,L)
               ENDIF
            END DO
         END DO
         DO I=1,KE1
            DO J=1,KE1
               A(I,J)=-B(I,J)
            END DO
         END DO
         RETURN
         END
C*****************************************************************
C**********          VERSE MATRIX SUBROUTINE           **********
C*****************************************************************
         SUBROUTINE VERS(KE2,A)
         DOUBLE PRECISION A(28,28),B(28,28)

         DO I=2,KE2
            DO J=2,KE2
               B(I,J)=A(I,J)
            END DO
         END DO
         DO L=2,KE2
            B(L,L)=-1.0D0/B(L,L)
            DO I=2,KE2
               IF((I-L).NE.0) THEN
                  B(I,L)=-B(I,L)*B(L,L)
               ENDIF
            END DO
            DO I=2,KE2
               DO J=2,KE2
                  IF((I-L)*(J-L).NE.0) THEN
                     B(I,J)=B(I,J)-B(I,L)*B(L,J)
                  ENDIF
               END DO
            END DO
            DO J=2,KE2
               IF((J-L).NE.0) THEN
                  B(L,J)=-B(L,J)*B(L,L)
               ENDIF
            END DO
         END DO
         DO I=2,KE2
            DO J=2,KE2
               B(I,J)=-B(I,J)
            END DO
         END DO
         DO I=1,KE2
            DO J=1,KE2
               A(I,J)=B(I,J)
            END DO
         END DO
         RETURN
         END
```

```
C*****************************************************************
C***********       MEAN SQUARE EROR SUBROUTINE          **********
C*****************************************************************
      SUBROUTINE MSQE(N,M,KE1,XE,Y,B,SSE,AMSE,AMSEP)
      DOUBLE PRECISION XE(110,28),Y(110),YP(110),B(28)
      DOUBLE PRECISION SSE,AMSE,AMSEP,SSEP
      INTEGER N,M,KE1

      DO I=1,N+M
         YP(I)=0.
         DO J=1,KE1
            YP(I)=YP(I)+(B(J)*XE(I,J))
         END DO
      END DO
      SSE=0.
      DO I=1,N
         SSE=SSE+(Y(I)-YP(I))**2
      END DO
      AMSE=SSE/DBLE(N-KE1)
      SSEP=0.
      DO I=N+1,N+M
         SSEP=SSEP+(Y(I)-YP(I))**2
      END DO
      AMSEP=SSEP/DBLE(M)
      RETURN
      END
C*****************************************************************
C***********    MEAN SQUARE EROR FOR BAYE SUBROUTINE    *********
C*****************************************************************
      SUBROUTINE BMSQE(N,M,KE1,XE,Y,DELTA,B,SSE,AMSE,AMSEP)
      DOUBLE PRECISION XE(110,28),Y(110),YP(110),B(28),AMSEP
      INTEGER DELTA(28),IK
      DOUBLE PRECISION SSE,AMSE,AMSEP

      IK=0
      DO I=1,KE1
         IF(DELTA(I).NE.0) THEN
            IK=IK+1
         ENDIF
      END DO
      DO I=1,N+M
         YP(I)=0.
         DO J=1,KE1
            YP(I)=YP(I)+(B(J)*XE(I,J)*DELTA(J))
         END DO
      END DO
      SSE=0.
      DO I=1,N
         SSE=SSE+(Y(I)-YP(I))**2
      END DO
      AMSE=SSE/DBLE(N-IK)
      SSEP=0.
      DO I=N+1,N+M
         SSEP=SSEP+(Y(I)-YP(I))**2
      END DO
      AMSEP=SSEP/DBLE(M)
      RETURN
      END
```

```
C*****************************************************************
C***********  GENERATE NORMAL DISTRIBUTION SUBROUTINE  **********
C*****************************************************************
      SUBROUTINE NORMAL(DMEAN,SIGMA,X)
      COMMON/SEED/IX,KK,Z2
      DOUBLE PRECISION Z1,X,R1,R2,RD,DMEAN,SIGMA,DLOG,DSQRT,DCOS,DSIN

      PI=3.1415926
      IF(KK.NE.1) THEN
         R1=RD(IX)
         R2=RD(IX)
         Z1=DSQRT(-2*DLOG(R1))*DCOS(2*PI*R2)
         Z2=DSQRT(-2*DLOG(R1))*DSIN(2*PI*R2)
         X=Z1*SIGMA+DMEAN
         KK=1
      ELSE
         X=Z2*SIGMA+DMEAN
         KK=0
      ENDIF
      RETURN
      END
C*****************************************************************
C***********      GENERATE RANDOM NUMBER FUNCTION      **********
C*****************************************************************
      DOUBLE PRECISION FUNCTION RD(IX)
      DOUBLE PRECISION RD
      INTEGER IX,IY
      IY=IX*65539
      IF(IY.LT.0) THEN
         IY=IY+2147483647+1
      ENDIF
      RD=IY
      RD=RD*.4556613E-9
      IX=IY
      RETURN
      END
C*****************************************************************
C***********         T STATISTIC FUNCTION              **********
C*****************************************************************
      DOUBLE PRECISION FUNCTION T(N,KA1,PMAX)
      DOUBLE PRECISION T,PMAX
      INTEGER KA1

      T=DSQRT(PMAX)*DSQRT((N-KA1)/(1.-PMAX))
      RETURN
      END
C*****************************************************************
C***********            MINIMUM  FUNCTION              **********
C*****************************************************************
      FUNCTION AMINIM(A1,A2,A3)
      DOUBLE PRECISION A1,A2,A3,AMINIM

      AMINIM=A1
      IF(A2.LT.AMINIM) THEN
         AMINIM=A2
      ENDIF
      IF(A3.LT.AMINIM) THEN
         AMINIM=A3
      ENDIF
      RETURN
      END
```

```
C*********************************************************************
C*               CALCULATE ABSOUTE ERROR POWER 2                     *
C*********************************************************************
      DOUBLE PRECISION FUNCTION AER2(Y,X,BETA,DELTA,K,N)
      DOUBLE PRECISION Y(110),X(110,28),BETA(28),AER2,YP
      INTEGER DELTA(28)
      AER2=0.
      DO I=1,N
         YP=0.
       DO J=1,K
            YP=YP+X(I,J)*BETA(J)*DBLE(DELTA(J))
       END DO
         AER2=AER2+(Y(I)-YP)**2
      END DO
      RETURN
      END
C*********************************************************************
C*                           FACTORIAL OF X                          *
C*********************************************************************
      DOUBLE PRECISION  FUNCTION FACTORIAL(X)
      DOUBLE PRECISION X,FACTORIAL
      X=X-1
      FACTORIAL = DSQRT(2*22/7*X)*(X**X/DEXP(X))
      RETURN
      END
C*********************************************************************
C*           CALCULATE PDF AT X POINT OF NORMAL DISTRIBUTION         *
C*********************************************************************
      DOUBLE PRECISION FUNCTION FNORMAL(X,MEAN,VAR)
      DOUBLE PRECISION MEAN,VAR,X,FNORMAL
      FNORMAL=0.
      FNORMAL=DEXP(-((X-MEAN)**2)/(2.0*VAR))/DSQRT(2.0*22.0/7.0)*VAR)
      RETURN
      END
C*********************************************************************
C*       CALCULATE PDF AT X POINT OF INVERSE GAMMA DISTRIBUTION      *
C*********************************************************************
      DOUBLE PRECISION FUNCTION FINVGAM(X,GALFA,GBETA,FACT)
      DOUBLE PRECISION GALFA,GBETA,X,FINVGAM,FACT
      FINVGAM=0.
      FINVGAM=(GBETA**GALFA)*DEXP(-GBETA/X)/(FACT*X**(GALFA+1))
      RETURN
      END
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ประวัติผู้วิจัย

นางสาวนุชรินทร์ ทิพยวรรณากร เกิดวันที่ 1 เมษายน พ.ศ. 2515 จังหวัดกรุงเทพมหานคร สำเร็จการศึกษาปริญญาตรีวิทยาศาสตร์บัณฑิต สาขาสถิติประยุกต์ ภาควิชาคณิตศาสตร์และวิทยาการคอมพิวเตอร์ สถาบันเทคโนโลยีพระจอมเกล้าพระนครเหนือ ในปีการศึกษา 2536 และเข้าศึกษาต่อในหลักสูตรสถิติศาสตรมหาบัณฑิต สาขาสถิติ ภาควิชาสถิติ ที่จุฬาลงกรณ์มหาวิทยาลัย เมื่อ พ.ศ. 2537