```
C       ===============================================================
c       Sensitivity analysis for
C       EXAMPLE 1: a trigonometric-polynomial function
C
C
C
C
C       N = 15
C       Y = a1^T * X + a2^T * sin(X) + a3^T * cos(X) + X^T * M * X
c
C       X(1:15) -> GAUSSIAN DISTRIBUTION
c     a1, a2, and a3, are 15-dimensional constant vectors
c     M is a 15 by 15 constant matrix
c
C
C     -------  command line parameters to run the code   -------------
C     PROGRAM.EXE PROGRAM NBAS NBAS_SM NGAUSS NGAUSS_SM NVAR IID
C     FOR EXAMPLE, UNIVARIATE, M=1 CASE USING THE FOLLOWING COMMAND LINE:
C               PROGRAM.EXE 1 1 2 2 1 1
C
C       NOTE:  ALL CALCULATIONS ARE DONE IN THE STANDARD GAUSSIAN SPACE
C       ALSO, BASED ON HERMITE POLYNOMIAL BASIS AND D-R INTEGRATION
C**************************************************************************************
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        USE RNNOF_INT
        USE RNSET_INT
        USE GQRUL_INT
C        USE GAMMA_INT
        USE UMACH_INT
        USE GAMMA_INT

        USE DFLIB
        INCLUDE "link_fnl_shared.h"

        IMPLICIT REAL*8 (A-H,O-Z)
        REAL*8 IND
        REAL*8 X(20),XMU(20),SIG(20),XX(50),QX(50),QW(50),QXFIX(2),
        1          NMU(20), NSIG(20), SYUI(20), TMPA1(20), TMPA2(20)
      REAL*8 XX_SM(50),QX_SM(50),QW_SM(50),QXFIX_SM(2),X1(20)
        REAL*8 YR1(:,:),YR2(:,:,:,:),YR3(:,:,:,:,:,:),H(:,:,:)
        REAL*8 SMR1(:,:),SMR2(:,:,:,:),SMR3(:,:,:,:,:,:),SMH(:,:,:),
     1      SGR1(:,:),SGR2(:,:,:,:),SGR3(:,:,:,:,:,:),SGH(:,:,:)
        REAL*8 ALFA(:,:),PSIF(:,:),BITA(:,:,:,:),GAMA(:,:,:,:,:,:)
        REAL*8 ALFA_SM(:,:),PSIF_SM(:,:),BITA_SM(:,:,:,:),
        1          GAMA_SM(:,:,:,:,:,:),
     2      ALFA_SG(:,:),PSIF_SG(:,:),BITA_SG(:,:,:,:),
        1          GAMA_SG(:,:,:,:,:,:),
     3      ALFA_SMIID(:,:),ALFA_SGIID(:,:),SCMU(:,:,:),SCSIG(:,:,:),
     4      YPDD(:,:,:), H_GQ(:,:,:)
      ALLOCATABLE YR1,YR2,YR3,H,ALFA,PSIF,BITA,GAMA,SMR1,SMR2,SMR3,SMH,
     1              ALFA_SM,PSIF_SM,BITA_SM,GAMA_SM,
     2      SGR1,SGR2,SGR3,SGH,
     3              ALFA_SG,PSIF_SG,BITA_SG,GAMA_SG,
     4          ALFA_SGIID, ALFA_SMIID,SCMU,SCSIG,YPDD,H_GQ

      REAL*8 SMU_A(200),SSIG_A(200), SMU_A_TMP(200),SSIG_A_TMP(200)
      REAL*8 XXN_SM(30,50), QWN_SM(30,50),QXN_SM(30,50)

      INTEGER N, NVAR
        COMMON /SR02/ XMU,SIG, NMU, NSIG, NYQ, N
        COMMON NGAUSS_GQ,  NBAS

C

        INTEGER(2) n1, n2, n3, n4, n5, n6, n7, n8,N9, status
        CHARACTER(80) buf, FN
        CHARACTER(80) MSG,MSG1
        MSG = 'PROGRAM NBAS NBAS_SM NGAUSS NGAUSS_SM NVAR IID'

        MSG1 = 'IID = 0(INDEPENDENT), 1(IID)'

        n1 = 1
        n2 = 2
        n3 = 3
        n4 = 4
        n5 = 5
        n6 = 6
        n7 = 7
        n8 = 8
        n9 = 9
        n10 = 10

        DO I =1,20
          X1(I)=0.
        ENDDO

        CALL GETARG(n1, buf, status )
        IF (status .EQ. -1) THEN
        PRINT*, 'WRONG NBAS!'
        PRINT*, MSG
        PRINT*, MSG1
        STOP
        ENDIF
        Read( buf, '(i10)' )  NBAS
        PRINT*, 'NBAS = '
        WRITE (*,*) NBAS

        CALL GETARG(n2, buf, status)
        IF (status .EQ. -1) THEN
        PRINT*, 'WRONG NBAS_SM!'
        PRINT*, MSG
        PRINT*, MSG1
        STOP
        ENDIF
        Read( buf, '(i10)' )  NBAS_SM
        PRINT*, 'NBAS_SM = '
        WRITE (*,*) NBAS_SM

        CALL GETARG(n3, buf, status)
        IF (status .EQ. -1) THEN
        PRINT*, 'WRONG NGAUSS!'
        PRINT*, MSG
        PRINT*, MSG1
        STOP
        ENDIF
        Read( buf, '(i10)' )  NGAUSS
        PRINT*, 'NGAUSS = '
        WRITE (*,*) NGAUSS

        CALL GETARG(n4, buf, status)
        IF (status .EQ. -1) THEN
        PRINT*, 'WRONG NGAUSS_SM!'
        PRINT*, MSG
        PRINT*, MSG1
        STOP
        ENDIF
        Read( buf, '(i10)' )  NGAUSS_SM
        PRINT*, 'NGAUSS_SM = '
        WRITE (*,*) NGAUSS_SM

        CALL GETARG(n5, buf, status)
        IF (status .EQ. -1) THEN
        PRINT*, 'WRONG NVAR!'
        PRINT*, MSG
C        PRINT*, MSG1
        STOP
        ENDIF
        Read( buf, '(i10)' )  NVAR
        PRINT*, 'NVAR = '
        WRITE (*,*) NVAR

        CALL GETARG(n6, buf, status )
        IF (status .EQ. -1) THEN
        PRINT*, 'WRONG WHEN READING IID!'
        PRINT*, MSG
        PRINT*, MSG1
        STOP
        ENDIF
        Read( buf, '(i10)' )  IID
        PRINT*, 'IID = '
        WRITE (*,*) IID

        IF (NBAS .GE. 10 .OR. NBAS_SM .GE. 10) THEN
        PRINT*, 'WRONG NBAS OR NBAS_SM (SHOULD BE < 10)!'
        PRINT*, MSG
        WRITE (*,*) NBAS, NBAS_SM
        STOP
        ENDIF

        IF (NGAUSS .GE. 10 .OR. NGAUSS_SM .GE. 10) THEN
        PRINT*, 'WRONG NGAUSS OR NGAUSS_SM (SHOULD BE < 10)!'
        PRINT*, MSG
        WRITE (*,*) NGAUSS, NGAUSS_SM
        STOP
        ENDIF

        IF (NVAR .NE. 1 .AND. NVAR .NE. 2 .AND. NVAR .NE. 3) THEN
        PRINT*, 'WRONG NVAR (SHOULD BE 1,2,3)!'
        PRINT*, MSG
        WRITE (*,*) NVAR
        STOP
        ENDIF

c      OPEN(10, FILE=trim(FN)//'_U.OUT', STATUS='UNKNOWN')
c      OPEN(20, FILE=trim(FN)//'_B.OUT', STATUS='UNKNOWN')
c      OPEN(30, FILE=trim(FN)//'_T.OUT', STATUS='UNKNOWN')
c      OPEN(40, FILE=trim(FN)//'_MCS.OUT', STATUS='UNKNOWN')
C

        N = 15
        PI = 4.*DATAN(1.0D0)
        DO I = 1,N
        XMU(I) = 0.
        SIG(I) = 1.
        ENDDO

      DO I = 1,N
            NMU(I) = 0.
              NSIG(I) = 1.
        ENDDO

        IF (NGAUSS .EQ. 0 .OR. NGAUSS_SM .EQ. 0) STOP
        CALL DGQRUL (NGAUSS,4,0.,0.,0,QXFIX,QX,QW)
        CALL DGQRUL (NGAUSS_SM,4,0.,0.,0,QXFIX_SM,QX_SM,QW_SM)
        DO I = 1,NGAUSS
        XX(I) = QX(I)*DSQRT(2.D0)
        ENDDO
        DO I = 1,NGAUSS_SM
        XX_SM(I)  = QX_SM(I)*DSQRT(2.D0)
        ENDDO
        DO J = 1, N
        DO I =1, NGAUSS_SM
        QXN_SM(J,I) = QX_SM(I)
        QWN_SM(J,I) = QW_SM(I)/DSQRT(PI)
      XXN_SM(J,I)  = QX_SM(I)*DSQRT(2.D0)
        ENDDO
        ENDDO

      NGAUSS_GQ = 10

        ALLOCATE( YR1(N,NGAUSS),YR2(N,N,NGAUSS,NGAUSS),H(N,NBAS,NGAUSS),
     &          ALFA(N,NBAS),PSIF(N,NBAS),BITA(N,N,NBAS,NBAS),
     &          YR3(N,N,N,NGAUSS,NGAUSS,NGAUSS),
     &          GAMA(N,N,N,NBAS,NBAS,NBAS),
     &   SMR1(N,NGAUSS_SM),SMR2(N,N,NGAUSS_SM,NGAUSS_SM),
     &   SMH(N,NBAS_SM,NGAUSS_SM),ALFA_SM(N,NBAS_SM),PSIF_SM(N,NBAS_SM),
     &   BITA_SM(N,N,NBAS_SM,NBAS_SM),
     &          SMR3(N,N,N,NGAUSS_SM,NGAUSS_SM,NGAUSS_SM),
     &          GAMA_SM(N,N,N,NBAS_SM,NBAS_SM,NBAS_SM),
     &   SGR1(N,NGAUSS_SM),SGR2(N,N,NGAUSS_SM,NGAUSS_SM),
     &   SGH(N,NBAS_SM,NGAUSS_SM),ALFA_SG(N,NBAS_SM),PSIF_SG(N,NBAS_SM),
     &   BITA_SG(N,N,NBAS_SM,NBAS_SM),
     &          SGR3(N,N,N,NGAUSS_SM,NGAUSS_SM,NGAUSS_SM),
     &          GAMA_SG(N,N,N,NBAS_SM,NBAS_SM,NBAS_SM),
     &    ALFA_SGIID(N,NBAS_SM),ALFA_SMIID(N,NBAS_SM) )

      ALLOCATE(H_GQ(N,NBAS,NGAUSS_GQ),SCMU(NGAUSS_GQ,
     1  NGAUSS_GQ,NGAUSS_GQ),SCSIG(NGAUSS_GQ,NGAUSS_GQ,NGAUSS_GQ),
     1          YPDD(NGAUSS_GQ,NGAUSS_GQ,NGAUSS_GQ))

C
C       INITIALIZE COEFFICIENTS
C

        Y0 = 0.
        SM0 = 0.
        SG0 = 0.

      NSCORV = N
      IF (IID .EQ. 1) THEN
        IF (IID .EQ. 1 .AND. (NGAUSS .NE. NGAUSS_SM .OR.
     1           NBAS .NE. NBAS_SM)) THEN
        PRINT*,' NGAUSS != NGAUSS_SM  or NBAS != NBAS_SM '
        STOP
        ENDIF
      NSCORV = 1
      ENDIF
      NS = NSCORV

        DO I = 1,N
         DO J = 1,NBAS
         ALFA(I,J) = 0.
         ENDDO
        ENDDO
        DO I = 1,N
         DO J = 1,NBAS_SM
         ALFA_SM(I,J) = 0.
         ALFA_SG(I,J) = 0.
         ENDDO
        ENDDO

        DO I1 = 1,N
         DO I2 = 1,N
          DO J1 = 1,NBAS
           DO J2 = 1,NBAS
           BITA(I1,I2,J1,J2) = 0.
           ENDDO
          ENDDO
         ENDDO
        ENDDO

        DO I1 = 1,N
         DO I2 = 1,N
          DO J1 = 1,NBAS_SM
           DO J2 = 1,NBAS_SM
           BITA_SM(I1,I2,J1,J2) = 0.
           BITA_SG(I1,I2,J1,J2) = 0.
           ENDDO
          ENDDO
         ENDDO
        ENDDO

        DO I1 = 1,N
         DO I2 = 1,N
          DO I3 = 1,N
           DO J1 = 1,NBAS
            DO J2 = 1,NBAS
             DO J3 = 1,NBAS
             GAMA(I1,I2,I3,J1,J2,J3) = 0.
             ENDDO
            ENDDO
           ENDDO
          ENDDO
         ENDDO
        ENDDO

        DO I1 = 1,N
         DO I2 = 1,N
          DO I3 = 1,N
           DO J1 = 1,NBAS_SM
            DO J2 = 1,NBAS_SM
             DO J3 = 1,NBAS_SM
             GAMA_SM(I1,I2,I3,J1,J2,J3) = 0.
             GAMA_SG(I1,I2,I3,J1,J2,J3) = 0.
             ENDDO
            ENDDO
           ENDDO
          ENDDO
         ENDDO
        ENDDO

C
C       CALCULATE/STORE RESPONSE AT MEAN INPUT (YM  SSM)
C
        DO I = 1,N
        X(I) = 0
        ENDDO
        CALL RESPON (X,YM)

C
C       CALCULATE/STORE UNIVARIATE RESPONSES AT GAUSS POINTS (YR1)
C
        DO IX = 1,N
         DO I = 1,N
         X(I) = 0.
         ENDDO
          DO IGAUSS = 1,NGAUSS
          X(IX) = XX(IGAUSS)
          CALL RESPON (X,Y)
          YR1(IX,IGAUSS) = Y
          ENDDO
        ENDDO

C
C       CALCULATE/STORE BIVARIATE RESPONSES AT GAUSS POINTS (YR2)
C
      YR2 = 0.
      IF (NVAR .GE. 2) THEN
        DO IX = 1,N-1
         DO JX = IX+1,N
          DO I = 1,N
          X(I) = 0.
          ENDDO
           DO IGAUSS = 1,NGAUSS
            DO JGAUSS = 1,NGAUSS
            X(IX) = XX(IGAUSS)
            X(JX) = XX(JGAUSS)
            CALL RESPON (X,Y)
            YR2(IX,JX,IGAUSS,JGAUSS) = Y
            ENDDO
           ENDDO
         ENDDO
        ENDDO

        ENDIF

C
C
C       CALCULATE/STORE TRIVARIATE RESPONSES AT GAUSS POINTS (YR3)
C
      YR3 = 0.
      IF (NVAR .EQ. 3) THEN
        DO IX = 1,N-2
         DO JX = IX+1,N-1
          DO KX = JX+1,N
           DO I = 1,N
           X(I) = 0.
           ENDDO
            DO IGAUSS = 1,NGAUSS
             DO JGAUSS = 1,NGAUSS
              DO KGAUSS = 1,NGAUSS
              X(IX) = XX(IGAUSS)
              X(JX) = XX(JGAUSS)
              X(KX) = XX(KGAUSS)
              CALL RESPON (X,Y)
              YR3(IX,JX,KX,IGAUSS,JGAUSS,KGAUSS) = Y
              ENDDO
             ENDDO
            ENDDO
          ENDDO
         ENDDO
        ENDDO

        ENDIF

C
C       CALCULATE/STORE BASIS FUNCTIONS AT GAUSS POINTS (H)
C
        DO I = 1,N
         DO J = 1,NBAS
          DO L = 1,N
          X(L) = 0.
          ENDDO
           DO IGAUSS = 1,NGAUSS
           X(I) = XX(IGAUSS)
           CALL BASIS (X,PSIF,N,NBAS)
         H(I,J,IGAUSS) = PSIF(I,J)
           ENDDO
         ENDDO
        ENDDO

C
C       CALCULATE COEFFICIENT Y0
C

        YU = 0.
        DO IX = 1,N
         DO IGAUSS = 1,NGAUSS
         YU = YU + YR1(IX,IGAUSS)*QW(IGAUSS)/DSQRT(PI)
       ENDDO
        ENDDO

C
        YB = 0.
        DO IX = 1,N-1
         DO JX = IX+1,N
          DO IGAUSS = 1,NGAUSS
           DO JGAUSS = 1,NGAUSS
           YB = YB + YR2(IX,JX,IGAUSS,JGAUSS)*(QW(IGAUSS)/DSQRT(PI))*
     &        (QW(JGAUSS)/DSQRT(PI))
         ENDDO
          ENDDO
         ENDDO
        ENDDO

C
        YT = 0.
        DO IX = 1,N-2
         DO JX = IX+1,N-1
          DO KX = JX+1,N
           DO IGAUSS = 1,NGAUSS
            DO JGAUSS = 1,NGAUSS
             DO KGAUSS = 1,NGAUSS
             YT = YT + YR3(IX,JX,KX,IGAUSS,JGAUSS,KGAUSS)*
     &          (QW(IGAUSS)/DSQRT(PI))*(QW(JGAUSS)/DSQRT(PI))*
     &          (QW(KGAUSS)/DSQRT(PI))
           ENDDO
            ENDDO
           ENDDO
          ENDDO
         ENDDO
        ENDDO

C
C
      NT = N
      IF (NVAR .EQ. 3) THEN
        Y0 = YT - DFLOAT(NT-3)*YB + DFLOAT((NT-2)*(NT-3))*YU/2.
     &     - DFLOAT((NT-1)*(NT-2)*(NT-3))*YM/6.
      ELSE IF (NVAR .EQ. 2) THEN
      Y0 =  YB
     &     - DFLOAT((NT-2))*YU + DFLOAT((NT-2)*(NT-1))*YM/2.
      ELSE IF (NVAR .EQ. 1) THEN
      Y0 =  YU
     &     - DFLOAT((NT-1))*YM
      ENDIF

C     DOUBLE CHECK SM0 Y0 'S FORMULAR FROM PAPER ??
C     DUE TO IN IID CASE, SM0 AND SG0 ARE ONE VARIABLES FUNCTION, SO THE EXPRESSION CAN BE
C     SM0 = SMU - (N-1)*SMM
C     SG0 = SGU - (N-1)*SGM

      NS = NSCORV

      SM0 = SMU - (N-1.)*SMM
      SG0 = SGU - (N-1.)*SGM

C   SM0 = SMT - DFLOAT(N-3)*SMB + DFLOAT((N-2)*(N-3))*SMU/2.
C     &     - DFLOAT((N-1)*(N-2)*(N-3))*SMM/6.
C   SG0 = SGT - DFLOAT(N-3)*SGB + DFLOAT((N-2)*(N-3))*SGU/2.
C     &     - DFLOAT((N-1)*(N-2)*(N-3))*SGM/6.
C

C
C       CALCULATE COEFFICIENTS ALFA(I,J)
C
        DO I = 1,N
         DO J = 1,NBAS
C
         YYU = 0.
          DO IGAUSS = 1,NGAUSS
          YYU = YYU + YR1(I,IGAUSS)*H(I,J,IGAUSS)*QW(IGAUSS)/DSQRT(PI)
        ENDDO
C
          YYB = 0.
           DO 10 IX = 1,N-1
           DO 10 JX = IX+1,N
           IF (IX .NE. I .AND. JX .NE. I) GO TO 10
            DO IGAUSS = 1,NGAUSS
             DO JGAUSS = 1,NGAUSS
             IF (IX .EQ. I) KGAUSS = IGAUSS
             IF (JX .EQ. I) KGAUSS = JGAUSS
             YYB = YYB + YR2(IX,JX,IGAUSS,JGAUSS)*H(I,J,KGAUSS)*
     &           (QW(IGAUSS)/DSQRT(PI))*(QW(JGAUSS)/DSQRT(PI))
             ENDDO
            ENDDO
10         CONTINUE
C
C
          YYT = 0.
           DO 20 IX = 1,N-2
           DO 20 JX = IX+1,N-1
           DO 20 KX = JX+1,N
           IF (IX .NE. I .AND. JX .NE. I .AND. KX .NE. I) GO TO 20
            DO IGAUSS = 1,NGAUSS
             DO JGAUSS = 1,NGAUSS
              DO KGAUSS = 1,NGAUSS
              IF (IX .EQ. I) MGAUSS = IGAUSS
              IF (JX .EQ. I) MGAUSS = JGAUSS
              IF (KX .EQ. I) MGAUSS = KGAUSS
              YYT = YYT + YR3(IX,JX,KX,IGAUSS,JGAUSS,KGAUSS)*H(I,J,MGAUSS)
     &           *(QW(IGAUSS)/DSQRT(PI))*(QW(JGAUSS)/DSQRT(PI))*
     &           (QW(KGAUSS)/DSQRT(PI))
                  ENDDO
             ENDDO
            ENDDO
20         CONTINUE
C
C   --------------  IJNME PDD EQ.(26) (23)
      NT = N
      IF (NVAR .EQ. 3) THEN
      ALFA(I,J) = YYT - DFLOAT(NT-3)*YYB + DFLOAT((NT-2)*(NT-3))*YYU/2.

      ELSE IF (NVAR .EQ. 2) THEN
      ALFA(I,J) =  YYB
     &     - DFLOAT((NT-2))*YYU
      ELSE IF (NVAR .EQ. 1) THEN
      ALFA(I,J) =  YYU
      ENDIF
C
         ENDDO
        ENDDO

C
C       CALCULATE COEFFICIENTS BITA(I1,I2,J1,J2)
C
        DO I1 = 1,N-1
         DO I2 = I1+1,N
          DO J1 = 1,NBAS
           DO J2 = 1,NBAS
C
          YYYB = 0.
            DO IGAUSS = 1,NGAUSS
             DO JGAUSS = 1,NGAUSS
             YYYB = YYYB +
     &     YR2(I1,I2,IGAUSS,JGAUSS)*H(I1,J1,IGAUSS)*H(I2,J2,JGAUSS)*
     &     (QW(IGAUSS)/DSQRT(PI))*(QW(JGAUSS)/DSQRT(PI))
             ENDDO
            ENDDO
C
          YYYT = 0.
           DO 30 IIX = 1,N-2
           DO 30 JJX = IIX+1,N-1
           DO 30 KKX = JJX+1,N
           IF (IIX .NE. I1 .AND. IIX .NE. I2 .AND.
     &       JJX .NE. I1 .AND. JJX .NE. I2 .AND.
     &       KKX .NE. I1 .AND. KKX .NE. I2) GO TO 30
           IF (IIX .EQ. I1 .AND. (JJX .EQ. I2 .OR. KKX .EQ. I2)) GO TO 31
           IF (JJX .EQ. I1 .AND. (IIX .EQ. I2 .OR. KKX .EQ. I2)) GO TO 31
           IF (KKX .EQ. I1 .AND. (IIX .EQ. I2 .OR. JJX .EQ. I2)) GO TO 31
           GO TO 30
31        DO IGAUSS = 1,NGAUSS
             DO JGAUSS = 1,NGAUSS
              DO KGAUSS = 1,NGAUSS
              IF (IIX .EQ. I1) MGAUSS1 = IGAUSS
              IF (JJX .EQ. I1) MGAUSS1 = JGAUSS
              IF (KKX .EQ. I1) MGAUSS1 = KGAUSS
              IF (IIX .EQ. I2) MGAUSS2 = IGAUSS
              IF (JJX .EQ. I2) MGAUSS2 = JGAUSS
              IF (KKX .EQ. I2) MGAUSS2 = KGAUSS
              YYYT = YYYT + YR3(IIX,JJX,KKX,IGAUSS,JGAUSS,KGAUSS)*
     &      H(I1,J1,MGAUSS1)*H(I2,J2,MGAUSS2)*(QW(IGAUSS)/DSQRT(PI))*
     &      (QW(JGAUSS)/DSQRT(PI))*(QW(KGAUSS)/DSQRT(PI))
                  ENDDO
             ENDDO
            ENDDO
30         CONTINUE
C
      NT = N
      IF (NVAR .EQ. 3) THEN
      BITA(I1,I2,J1,J2) = YYYT - DFLOAT(NT-3)*YYYB

      ELSE IF (NVAR .EQ. 2) THEN
      BITA(I1,I2,J1,J2) =  YYYB
      ELSE IF (NVAR .EQ. 1) THEN
      BITA(I1,I2,J1,J2) =  0.
      ENDIF

C       WRITE(*,*) I1, I2, J1, J2,   BITA(I1,I2,J1,J2)
C
           ENDDO
          ENDDO
         ENDDO
        ENDDO

C
C
C       CALCULATE COEFFICIENTS GAMA(I1,I2,I3,J1,J2,J3)
C
        DO I1 = 1,N-2
         DO I2 = I1+1,N-1
          DO I3 = I2+1,N
           DO J1 = 1,NBAS
            DO J2 = 1,NBAS
             DO J3 = 1,NBAS
C
             GAMA(I1,I2,I3,J1,J2,J3) = 0.
            DO IGAUSS = 1,NGAUSS
               DO JGAUSS = 1,NGAUSS
                DO KGAUSS = 1,NGAUSS
              GAMA(I1,I2,I3,J1,J2,J3) = GAMA(I1,I2,I3,J1,J2,J3) +
     &              YR3(I1,I2,I3,IGAUSS,JGAUSS,KGAUSS)*
     &        H(I1,J1,IGAUSS)*H(I2,J2,JGAUSS)*H(I3,J3,KGAUSS)*
     &       (QW(IGAUSS)/DSQRT(PI))*
     &       (QW(JGAUSS)/DSQRT(PI))*(QW(KGAUSS)/DSQRT(PI))
                    ENDDO
               ENDDO
              ENDDO
C
             ENDDO
            ENDDO
           ENDDO
          ENDDO
         ENDDO
        ENDDO

C     =============================================
C       NOW CALCULATE THE Q-TH (Q up to 3rd) MOMENT BY ANALYTICAL EXPRESSION using direct pdd of response function
C     =============================================

        PRINT*, 'q-th (Q up to 3rd) MOMENT  OF Y BY ANALYTICAL EXPRESSION
     1    USING DIRECT pdd to response function y  IS  ....'
C

C     ==================
C     MOMENT OF ANALYTICAL
C     ==================

C     ----    1ST MOMENT
      RM1 = Y0
      PRINT*,  '---------------------------------------------'
      WRITE(*,*) 'RM1 = ', RM1

C     ----    2ND MOMENT

          RM2 = Y0**2

          DO I = 1,N
              DO J = 1,NBAS
                RM2 = RM2 + ALFA(I,J)**2
              ENDDO
          ENDDO
          PRINT*,  '---------------------------------------------'
          WRITE(*,*) 'RM2 (UNIVARITE) = ', RM2
          RM2U = RM2

          DO I1 = 1,N-1
          DO I2 = I1+1,N
              DO J1 = 1,NBAS
              DO J2 = 1,NBAS
                RM2 = RM2 + BITA(I1,I2,J1,J2)**2
              ENDDO
              ENDDO
          ENDDO
          ENDDO

          PRINT*,  '---------------------------------------------'
          WRITE(*,*) 'RM2 (BIVARITE) = ', RM2
          RM2B = RM2

          DO I1 = 1,N-2
          DO I2 = I1+1,N-1
          DO I3 = I2+1,N
              DO J1 = 1,NBAS
              DO J2 = 1,NBAS
              DO J3 = 1,NBAS
                RM2 = RM2 + GAMA(I1,I2,I3,J1,J2,J3)**2
              ENDDO
              ENDDO
              ENDDO
          ENDDO
          ENDDO
          ENDDO

          PRINT*,  '---------------------------------------------'
          WRITE(*,*) 'RM2 (TRIVARITE) = ', RM2
          RM2T = RM2

C     ----    3RD MOMENT

      RM3 = Y0**3 + 3*Y0*(RM2-Y0**2)

C     U*U*U

      DO I1=1,N
      DO K1=1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO L1=1,NBAS
          DO N1=1,NBAS

          IF (I1 .EQ. K1 .AND. K1 .EQ. M1) THEN
            IS = (J1+L1+N1)/2
            IF(MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS ) THEN
                RM3 = RM3 + ALFA(I1,J1)*ALFA(K1,L1)*ALFA(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))*
     2     GAMMA(1.0+DFLOAT(N1)))/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)))
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO

          PRINT*,  '---------------------------------------------'
          WRITE(*,*) 'RM3 (UNIVARITE) = ', RM3
          RM3U = RM3

C     B*U*U

      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO N1=1,NBAS

          IF (I1 .EQ. K1 .AND. I2 .EQ. M1 ) THEN
            IF (J1 .EQ. L1 .AND. J2 .EQ. N1) THEN
            RM3 =  RM3 + BITA(I1,I2,J1,J2)*ALFA(K1,L1)*ALFA(M1,N1)
            ENDIF
          ENDIF
          IF (I2 .EQ. K1 .AND. I1 .EQ. M1 ) THEN
            IF (J2 .EQ. L1 .AND. J1 .EQ. N1) THEN
            RM3 =  RM3 + BITA(I1,I2,J1,J2)*ALFA(K1,L1)*ALFA(M1,N1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     U*B*U

      DO I1=1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS

          IF (K1 .EQ. I1 .AND. K2 .EQ. M1 ) THEN
            IF (L1 .EQ. J1 .AND. L2 .EQ. N1) THEN
            RM3 =  RM3 + BITA(K1,K2,L1,L2)*ALFA(I1,J1)*ALFA(M1,N1)
            ENDIF
          ENDIF
          IF (K2 .EQ. I1 .AND. K1 .EQ. M1 ) THEN
            IF (L2 .EQ. J1 .AND. L1 .EQ. N1) THEN
            RM3 =  RM3 + BITA(K1,K2,L1,L2)*ALFA(I1,J1)*ALFA(M1,N1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     U*U*B

      DO I1=1,N
      DO K1=1,N
      DO M1=1,N-1
      DO M2=M1+1,N
          DO J1=1,NBAS
          DO L1=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS

          IF (M1 .EQ. I1 .AND. M2 .EQ. K1 ) THEN
            IF (N1 .EQ. J1 .AND. N2 .EQ. L1) THEN
            RM3 =  RM3 + BITA(M1,M2,N1,N2)*ALFA(I1,J1)*ALFA(K1,L1)
            ENDIF
          ENDIF
          IF (M2 .EQ. I1 .AND. M1 .EQ. K1 ) THEN
            IF (N2 .EQ. J1 .AND. N1 .EQ. L1) THEN
            RM3 =  RM3 + BITA(M1,M2,N1,N2)*ALFA(I1,J1)*ALFA(K1,L1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
C     B*B*U
      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS

          IF (I1 .EQ. K1 .AND. I1 .EQ. M1 ) THEN
           IS = (J1+L1+N1)/2
            IF(MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS ) THEN
            IF (I2 .EQ. K2 .AND. J2 .EQ. L2) THEN
             RM3 = RM3 + BITA(I1,I2,J1,J2)*BITA(K1,K2,L1,L2)
     1          *ALFA(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))*
     2     GAMMA(1.0+DFLOAT(N1)))/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)))

            ENDIF
            ENDIF
          ENDIF

          IF (I2 .EQ. K2 .AND. I2 .EQ. M1 ) THEN
           IS = (J2+L2+N1)/2
            IF(MOD(J2+L2+N1, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N1 .LE. IS ) THEN
            IF (I1 .EQ. K1 .AND. J1 .EQ. L1) THEN
             RM3 = RM3 + BITA(I1,I2,J1,J2)*BITA(K1,K2,L1,L2)
     1          *ALFA(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))*
     2     GAMMA(1.0+DFLOAT(N1)))/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N1)))

            ENDIF
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     B*U*B
      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N
      DO M1=1,N-1
      DO M2=M1+1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS

          IF (I1 .EQ. K1 .AND. I1 .EQ. M1 ) THEN
           IS = (J1+L1+N1)/2
            IF(MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
            IF(MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS ) THEN
            IF (I2 .EQ. M2 .AND. J2 .EQ. N2) THEN
             RM3 = RM3 + BITA(I1,I2,J1,J2)*BITA(M1,M2,N1,N2)
     1          *ALFA(K1,L1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))*
     2     GAMMA(1.0+DFLOAT(N1)))/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)))

            ENDIF
            ENDIF
          ENDIF

          IF (I2 .EQ. K1 .AND. I2 .EQ. M2 ) THEN
           IS = (J2+L1+N2)/2
            IF(MOD(J2+L1+N2, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N2 .LE. IS ) THEN
            IF (I1 .EQ. M1 .AND. J1 .EQ. N1) THEN
             RM3 = RM3 + BITA(I1,I2,J1,J2)*BITA(M1,M2,N1,N2)
     1          *ALFA(K1,L1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L1))*
     2     GAMMA(1.0+DFLOAT(N2)))/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N2)))

            ENDIF
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     U*B*B
      DO I1=1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N-1
      DO M2=M1+1,N
          DO J1=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS

          IF (I1 .EQ. K1 .AND. I1 .EQ. M1 ) THEN
           IS = (J1+L1+N1)/2
            IF(MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS ) THEN
            IF (K2 .EQ. M2 .AND. L2 .EQ. N2) THEN
             RM3 = RM3 + BITA(K1,K2,L1,L2)*BITA(M1,M2,N1,N2)
     1          *ALFA(I1,J1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))*
     2     GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)))

            ENDIF
            ENDIF
          ENDIF

          IF (I1 .EQ. K2 .AND. I1 .EQ. M2 ) THEN
           IS = (J1+L2+N2)/2
            IF(MOD(J1+L2+N2, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N2 .LE. IS ) THEN
            IF (K1 .EQ. M1 .AND. L1 .EQ. N1) THEN
             RM3 = RM3 + BITA(K1,K2,L1,L2)*BITA(M1,M2,N1,N2)
     1          *ALFA(I1,J1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L2))*
     2     GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N2)))

            ENDIF
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     B*B*B
C     B*B*B
      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N-1
      DO M2=M1+1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS

          IF ( (I1 .EQ. K1 .AND. I2 .EQ. K2 .AND. I3 .EQ. K3) .AND.
     1         (I1 .EQ. M1 .AND. I2 .EQ. M2 .AND. I3 .EQ. M3)
     1        ) THEN
           IS1 = (J1+L1+N1)/2
           IS2 = (J2+L2+N2)/2
            IF(MOD(IS1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS ) THEN
            IF(MOD(IS2, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N2 .LE. IS ) THEN
             RM3 = RM3 + BITA(K1,K2,L1,L2)*BITA(M1,M2,N1,N2)
     1          *BITA(I1,I2,J1,J2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))*
     2     GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)))*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))*
     2     GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N2)))

            ENDIF
            ENDIF
          ENDIF

          IF (( (I1 .EQ. K1 .AND. I2 .EQ. M2 .AND. K2 .EQ. M1) .AND.
     1          (J1 .EQ. L1 .AND. J2 .EQ. N2 .AND. L2 .EQ. N1) ) .OR.
     1         ((I1 .EQ. M1 .AND. I2 .EQ. K2 .AND. K1 .EQ. M2) .AND.
     1          (J1 .EQ. N1 .AND. J2 .EQ. L2 .AND. L1 .EQ. N2) ) .OR.
     1         ((K1 .EQ. M1 .AND. K2 .EQ. I2 .AND. I1 .EQ. M2) .AND.
     1          (L1 .EQ. N1 .AND. L2 .EQ. J2 .AND. J1 .EQ. N2) ) .OR.
     1         ((K1 .EQ. I1 .AND. K2 .EQ. M2 .AND. I2 .EQ. M1) .AND.
     1          (L1 .EQ. J1 .AND. L2 .EQ. N2 .AND. J2 .EQ. N1) ) .OR.
     1         ((M1 .EQ. I1 .AND. M2 .EQ. K2 .AND. I2 .EQ. K1) .AND.
     1          (N1 .EQ. J1 .AND. N2 .EQ. L2 .AND. J2 .EQ. L1) ) .OR.
     1         ((M1 .EQ. K1 .AND. M2 .EQ. I2 .AND. I1 .EQ. K2) .AND.
     1          (N1 .EQ. L1 .AND. N2 .EQ. J2 .AND. J1 .EQ. L2) )
     1                 ) THEN
             RM3 = RM3 + BITA(K1,K2,L1,L2)*BITA(M1,M2,N1,N2)
     1          *BITA(I1,I2,J1,J2)

          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
          PRINT*,  '---------------------------------------------'
          WRITE(*,*) 'RM3 (BIVARITE) = ', RM3
          RM3B = RM3

      IF (NVAR .EQ. 3) THEN

C     T*U*U, UTU, UUT are zero

C     T*B*U
      DO I1=1,N-2
      DO I2=I1+1,N-1
      DO I3=I2+1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO J3=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS

          IF (I1 .EQ. K1 .AND. I2 .EQ. K2 .AND. I3 .EQ. M1 ) THEN
            IF (J1 .EQ. L1 .AND. J2 .EQ. L2 .AND. J3 .EQ. N1) THEN
            RM3 =  RM3 + GAMA(I1,I2,I3,J1,J2,J3)*BITA(K1,K2,L1,L2)
     1              *ALFA(M1,N1)
            ENDIF
          ENDIF
          IF (I1 .EQ. K1 .AND. I2 .EQ. M1 .AND. I3 .EQ. K2 ) THEN
            IF (J1 .EQ. L1 .AND. J2 .EQ. N1 .AND. J3 .EQ. L2) THEN
            RM3 =  RM3 + GAMA(I1,I2,I3,J1,J2,J3)*BITA(K1,K2,L1,L2)
     1              *ALFA(M1,N1)
            ENDIF
          ENDIF

          IF (I1 .EQ. M1 .AND. I2 .EQ. K1 .AND. I3 .EQ. K2 ) THEN
            IF (J1 .EQ. N1 .AND. J2 .EQ. L1 .AND. J3 .EQ. L2) THEN
            RM3 =  RM3 + GAMA(I1,I2,I3,J1,J2,J3)*BITA(K1,K2,L1,L2)
     1              *ALFA(M1,N1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
C     T*U*B
      DO I1=1,N-2
      DO I2=I1+1,N-1
      DO I3=I2+1,N
      DO K1=1,N
      DO M1=1,N-1
      DO M2=M1+1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO J3=1,NBAS
          DO L1=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS

          IF (I1 .EQ. K1 .AND. I2 .EQ. M1 .AND. I3 .EQ. M2 ) THEN
            IF (J1 .EQ. L1 .AND. J2 .EQ. N1 .AND. J3 .EQ. N2) THEN
            RM3 =  RM3 + GAMA(I1,I2,I3,J1,J2,J3)*BITA(M1,M2,N1,N2)
     1              *ALFA(K1,L1)
            ENDIF
          ENDIF

          IF (I1 .EQ. M1 .AND. I2 .EQ. M2 .AND. I3 .EQ. K1 ) THEN
            IF (J1 .EQ. N1 .AND. J2 .EQ. N2 .AND. J3 .EQ. L1) THEN
            RM3 =  RM3 + GAMA(I1,I2,I3,J1,J2,J3)*BITA(M1,M2,N1,N2)
     1              *ALFA(K1,L1)
            ENDIF
          ENDIF
          IF (I1 .EQ. M1 .AND. I2 .EQ. K1 .AND. I3 .EQ. M2 ) THEN
            IF (J1 .EQ. N1 .AND. J2 .EQ. L1 .AND. J3 .EQ. N2) THEN
            RM3 =  RM3 + GAMA(I1,I2,I3,J1,J2,J3)*BITA(M1,M2,N1,N2)
     1              *ALFA(K1,L1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     B*T*U
      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N-2
      DO K2=K1+1,N-1
      DO K3=K2+1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO L3=1,NBAS
          DO N1=1,NBAS

          IF (K1 .EQ. I1 .AND. K2 .EQ. I2 .AND. K3 .EQ. M1 ) THEN
            IF (L1 .EQ. J1 .AND. L2 .EQ. J2 .AND. L3 .EQ. N1) THEN
            RM3 =  RM3 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(I1,I2,J1,J2)
     1              *ALFA(M1,N1)
            ENDIF
          ENDIF
          IF (K1 .EQ. I1 .AND. K2 .EQ. M1 .AND. K3 .EQ. I2 ) THEN
            IF (L1 .EQ. J1 .AND. L2 .EQ. N1 .AND. L3 .EQ. J2) THEN
            RM3 =  RM3 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(I1,I2,J1,J2)
     1              *ALFA(M1,N1)
            ENDIF
          ENDIF

          IF (K1 .EQ. M1 .AND. K2 .EQ. I1 .AND. K3 .EQ. I2 ) THEN
            IF (L1 .EQ. N1 .AND. L2 .EQ. J1 .AND. L3 .EQ. J2) THEN
            RM3 =  RM3 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(I1,I2,J1,J2)
     1              *ALFA(M1,N1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     U*T*B
      DO I1=1,N
      DO K1=1,N-2
      DO K2=K1+1,N-1
      DO K3=K2+1,N
      DO M1=1,N-1
      DO M2=M1+1,N
          DO J1=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO L3=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS

          IF (K1 .EQ. I1 .AND. K2 .EQ. M1 .AND. K3 .EQ. M2 ) THEN
            IF (L1 .EQ. J1 .AND. L2 .EQ. N1 .AND. L3 .EQ. N2) THEN
            RM3 =  RM3 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(M1,M2,N1,N2)
     1              *ALFA(I1,J1)
            ENDIF
          ENDIF

          IF (K1 .EQ. M1 .AND. K2 .EQ. M2 .AND. K3 .EQ. I1 ) THEN
            IF (L1 .EQ. N1 .AND. L2 .EQ. N2 .AND. L3 .EQ. J1) THEN
            RM3 =  RM3 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(M1,M2,N1,N2)
     1              *ALFA(I1,J1)
            ENDIF
          ENDIF
          IF (K1 .EQ. M1 .AND. K2 .EQ. I1 .AND. K3 .EQ. M2 ) THEN
            IF (L1 .EQ. N1 .AND. L2 .EQ. J1 .AND. L3 .EQ. N2) THEN
            RM3 =  RM3 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(M1,M2,N1,N2)
     1              *ALFA(I1,J1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     U*B*T
      DO I1=1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N-2
      DO M2=M1+1,N-1
      DO M3=M2+1,N
          DO J1=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS
          DO N3=1,NBAS

          IF (M1 .EQ. I1 .AND. M2 .EQ. K1 .AND. M3 .EQ. K2 ) THEN
            IF (N1 .EQ. J1 .AND. N2 .EQ. L1 .AND. N3 .EQ. L2) THEN
            RM3 =  RM3 + GAMA(M1,M2,M3,N1,N2,N3)*BITA(K1,K2,L1,L2)
     1              *ALFA(I1,J1)
            ENDIF
          ENDIF

          IF (M1 .EQ. K1 .AND. M2 .EQ. K2 .AND. M3 .EQ. I1 ) THEN
            IF (N1 .EQ. L1 .AND. N2 .EQ. L2 .AND. N3 .EQ. J1) THEN
            RM3 =  RM3 + GAMA(M1,M2,M3,N1,N2,N3)*BITA(K1,K2,L1,L2)
     1              *ALFA(I1,J1)
            ENDIF
          ENDIF
          IF (M1 .EQ. K1 .AND. M2 .EQ. I1 .AND. M3 .EQ. K2 ) THEN
            IF (N1 .EQ. L1 .AND. N2 .EQ. J1 .AND. N3 .EQ. L2) THEN
            RM3 =  RM3 + GAMA(M1,M2,M3,N1,N2,N3)*BITA(K1,K2,L1,L2)
     1              *ALFA(I1,J1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     B*U*T
      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N
      DO M1=1,N-2
      DO M2=M1+1,N-1
      DO M3=M2+1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS
          DO N3=1,NBAS

          IF (M1 .EQ. I1 .AND. M2 .EQ. I2 .AND. M3 .EQ. K1 ) THEN
            IF (N1 .EQ. J1 .AND. N2 .EQ. J2 .AND. N3 .EQ. L1) THEN
            RM3 =  RM3 + GAMA(M1,M2,M3,N1,N2,N3)*BITA(I1,I2,J1,J2)
     1              *ALFA(K1,L1)
            ENDIF
          ENDIF
          IF (M1 .EQ. I1 .AND. M2 .EQ. K1 .AND. M3 .EQ. I2 ) THEN
            IF (N1 .EQ. J1 .AND. N2 .EQ. L1 .AND. N3 .EQ. J2) THEN
            RM3 =  RM3 + GAMA(M1,M2,M3,N1,N2,N3)*BITA(I1,I2,J1,J2)
     1              *ALFA(K1,L1)
            ENDIF
          ENDIF

          IF (M1 .EQ. K1 .AND. M2 .EQ. I1 .AND. M3 .EQ. I2 ) THEN
            IF (N1 .EQ. L1 .AND. N2 .EQ. J1 .AND. N3 .EQ. J2) THEN
            RM3 =  RM3 + GAMA(M1,M2,M3,N1,N2,N3)*BITA(I1,I2,J1,J2)
     1              *ALFA(K1,L1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
c     TBB, BTB,BBT

C     T*B*B
      DO I1=1,N-2
      DO I2=I1+1,N-1
      DO I3=I2+1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N-1
      DO M2=M1+1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO J3=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS

          IF (I1 .EQ. K1 .AND. I1 .EQ. M1 ) THEN

            IS = (J1+L1+N1)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( I2 .EQ. K2 .AND. I3 .EQ. M2 ) THEN
            IF( J2 .EQ. L2 .AND. J3 .EQ. N2)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          BITA(K1,K2,L1,L2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF
            IF( I2 .EQ. M2 .AND. I3 .EQ. K2 ) THEN
            IF( J2 .EQ. N2 .AND. J3 .EQ. L2)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          BITA(K1,K2,L1,L2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

        IF (I2 .EQ. K1 .AND. I2 .EQ. M2 ) THEN

            IS = (J2+L1+N2)/2

            IF( ( MOD(J2+L1+N2, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N2 .LE. IS)) THEN

            IF( I1 .EQ. M1 .AND. I3 .EQ. K2 ) THEN
            IF( J1 .EQ. N1 .AND. J3 .EQ. L2)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          BITA(K1,K2,L1,L2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N2)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

        IF (I2 .EQ. M1 .AND. I2 .EQ. K2 ) THEN

            IS = (J2+L2+N1)/2

            IF( ( MOD(J2+L2+N1, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( I1 .EQ. K1 .AND. I3 .EQ. M2 ) THEN
            IF( J1 .EQ. L1 .AND. J3 .EQ. N2)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          BITA(K1,K2,L1,L2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

        IF (I3 .EQ. M2 .AND. I3 .EQ. K2 ) THEN

            IS = (J3+L2+N2)/2

            IF( ( MOD(J3+L2+N2, 2) .EQ. 0 .AND. J3 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N2 .LE. IS)) THEN

            IF( I1 .EQ. K1 .AND. I2 .EQ. M1 ) THEN
            IF( J1 .EQ. L1 .AND. J2 .EQ. N1)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          BITA(K1,K2,L1,L2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT( GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS-J3))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N2)) )

            ENDIF
            ENDIF

            IF( I1 .EQ. M1 .AND. I2 .EQ. K1 ) THEN
            IF( J1 .EQ. N1 .AND. J2 .EQ. L1)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          BITA(K1,K2,L1,L2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT( GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS-J3))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N2)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     B*T*B
      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N-2
      DO K2=K1+1,N-1
      DO K3=K2+1,N
      DO M1=1,N-1
      DO M2=M1+1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO L3=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS

          IF (K1 .EQ. I1 .AND. K1 .EQ. M1 ) THEN

            IS = (J1+L1+N1)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( K2 .EQ. I2 .AND. K3 .EQ. M2 ) THEN
            IF( L2 .EQ. J2 .AND. L3 .EQ. N2)  THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT( GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF
            IF( K2 .EQ. M2 .AND. K3 .EQ. I2 ) THEN
            IF( L2 .EQ. N2 .AND. L3 .EQ. J2)  THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT( GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

        IF (K2 .EQ. I1 .AND. K2 .EQ. M2 ) THEN

            IS = (J1+L2+N2)/2

            IF( ( MOD(J1+L2+N2, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N2 .LE. IS)) THEN

            IF( K1 .EQ. M1 .AND. K3 .EQ. I2 ) THEN
            IF( L1 .EQ. N1 .AND. L3 .EQ. J2)  THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT( GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N2)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

        IF (K2 .EQ. M1 .AND. K2 .EQ. I2 ) THEN

            IS = (J2+L2+N1)/2

            IF( ( MOD(J2+L2+N1, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( K1 .EQ. I1 .AND. K3 .EQ. M2 ) THEN
            IF( L1 .EQ. J1 .AND. L3 .EQ. N2)  THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT( GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

        IF (K3 .EQ. M2 .AND. K3 .EQ. I2 ) THEN

            IS = (J2+L3+N2)/2

            IF( ( MOD(J2+L3+N2, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L3 .LE. IS  .AND. N2 .LE. IS)) THEN

            IF( K1 .EQ. I1 .AND. K2 .EQ. M1 ) THEN
            IF( L1 .EQ. J1 .AND. L2 .EQ. N1)  THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT( GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L3))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L3))*GAMMA(1.0+DFLOAT(IS-N2)) )

            ENDIF
            ENDIF

            IF( K1 .EQ. M1 .AND. K2 .EQ. I1 ) THEN
            IF( L1 .EQ. N1 .AND. L2 .EQ. J1)  THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L3))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L3))*GAMMA(1.0+DFLOAT(IS-N2)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     B*B*T
      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N-2
      DO M2=M1+1,N-1
      DO M3=M2+1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS
          DO N3=1,NBAS

          IF (M1 .EQ. I1 .AND. M1 .EQ. K1 ) THEN

            IS = (J1+L1+N1)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( M2 .EQ. I2 .AND. M3 .EQ. K2 ) THEN
            IF( N2 .EQ. J2 .AND. N3 .EQ. L2)  THEN
             RM3 = RM3 + GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(K1,K2,L1,L2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF
            IF( M2 .EQ. K2 .AND. M3 .EQ. I2 ) THEN
            IF( N2 .EQ. L2 .AND. N3 .EQ. J2)  THEN
             RM3 = RM3 + GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(K1,K2,L1,L2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

        IF (M2 .EQ. I1 .AND. M2 .EQ. K2 ) THEN

            IS = (J1+L2+N2)/2

            IF( ( MOD(J1+L2+N2, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N2 .LE. IS)) THEN

            IF( M1 .EQ. K1 .AND. M3 .EQ. I2 ) THEN
            IF( N1 .EQ. L1 .AND. N3 .EQ. J2)  THEN
             RM3 = RM3 + GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(K1,K2,L1,L2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N2)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

        IF (M2 .EQ. K1 .AND. M2 .EQ. I2 ) THEN

            IS = (J2+L1+N2)/2

            IF( ( MOD(J2+L1+N2, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N2 .LE. IS)) THEN

            IF( M1 .EQ. I1 .AND. M3 .EQ. K2 ) THEN
            IF( N1 .EQ. J1 .AND. N3 .EQ. L2)  THEN
             RM3 = RM3 + GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(K1,K2,L1,L2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N2)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

        IF (M3 .EQ. K2 .AND. M3 .EQ. I2 ) THEN

            IS = (J2+L2+N3)/2

            IF( ( MOD(J2+L2+N3, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N3 .LE. IS)) THEN

            IF( M1 .EQ. I1 .AND. M2 .EQ. K1 ) THEN
            IF( N1 .EQ. J1 .AND. N2 .EQ. L1)  THEN
             RM3 = RM3 + GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(K1,K2,L1,L2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N3)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N3)) )

            ENDIF
            ENDIF

            IF( M1 .EQ. K1 .AND. M2 .EQ. I1 ) THEN
            IF( N1 .EQ. L1 .AND. N2 .EQ. J1)  THEN
             RM3 = RM3 + GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(I1,I2,J1,J2)*
     1          BITA(K1,K2,L1,L2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N3)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N3)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     T*T*U, TUT, UTT
C     T*T*U
      DO I1=1,N-2
      DO I2=I1+1,N-1
      DO I3=I2+1,N
      DO K1=1,N-2
      DO K2=K1+1,N-1
      DO K3=K2+1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO J3=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO L3=1,NBAS
          DO N1=1,NBAS

          IF (M1 .EQ. I1 .AND. M1 .EQ. K1 ) THEN

            IS = (J1+L1+N1)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( I2 .EQ. K2 .AND. I3 .EQ. K3 ) THEN
            IF( J2 .EQ. L2 .AND. J3 .EQ. L3)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          ALFA(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )
```

```
            ENDIF
            ENDIF

            ENDIF
          ENDIF

          IF (M1 .EQ. I2 .AND. M1 .EQ. K2 ) THEN

            IS = (J2+L2+N1)/2

            IF( ( MOD(IS, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( I1 .EQ. K1 .AND. I3 .EQ. K3 ) THEN
            IF( J1 .EQ. L1 .AND. J3 .EQ. L3)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          ALFA(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          IF (M1 .EQ. I3 .AND. M1 .EQ. K3 ) THEN

            IS = (J3+L3+N1)/2

            IF( ( MOD(IS, 2) .EQ. 0 .AND. J3 .LE. IS
     1       .AND. L3 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( I1 .EQ. K1 .AND. I2 .EQ. K2 ) THEN
            IF( J1 .EQ. L1 .AND. J2 .EQ. L2)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          ALFA(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L3))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J3))
     2     *GAMMA(1.0+DFLOAT(IS-L3))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     T*U*T
      DO I1=1,N-2
      DO I2=I1+1,N-1
      DO I3=I2+1,N
      DO K1=1,N
      DO M1=1,N-2
      DO M2=M1+1,N-1
      DO M3=M2+1,N

          DO J1=1,NBAS
          DO J2=1,NBAS
          DO J3=1,NBAS
          DO L1=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS
          DO N3=1,NBAS

          IF (K1 .EQ. I1 .AND. K1 .EQ. M1 ) THEN

            IS = (J1+L1+N1)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( I2 .EQ. M2 .AND. I3 .EQ. M3 ) THEN
            IF( J2 .EQ. N2 .AND. J3 .EQ. N3)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          ALFA(K1,L1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          IF (K1 .EQ. I2 .AND. K1 .EQ. M2 ) THEN

            IS = (J2+N2+L1)/2

            IF( ( MOD(IS, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N2 .LE. IS)) THEN

            IF( I1 .EQ. M1 .AND. I3 .EQ. M3 ) THEN
            IF( J1 .EQ. N1 .AND. J3 .EQ. N3)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          ALFA(K1,L1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(N2))
     2          *GAMMA(1.0+DFLOAT(L1)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-N2))*GAMMA(1.0+DFLOAT(IS-L1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          IF (K1 .EQ. I3 .AND. K1 .EQ. M3 ) THEN

            IS = (J3+L1+N3)/2

            IF( ( MOD(IS, 2) .EQ. 0 .AND. J3 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N3 .LE. IS)) THEN

            IF( I1 .EQ. M1 .AND. I2 .EQ. M2 ) THEN
            IF( J1 .EQ. N1 .AND. J2 .EQ. N2)  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          ALFA(K1,L1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N3)) )/(GAMMA(1.0+DFLOAT(IS-J3))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N3)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     U*T*T
      DO I1=1,N
      DO K1=1,N-2
      DO K2=K1+1,N-1
      DO K3=K2+1,N
      DO M1=1,N-2
      DO M2=M1+1,N-1
      DO M3=M2+1,N

          DO J1=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO L3=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS
          DO N3=1,NBAS

          IF (I1 .EQ. K1 .AND. I1 .EQ. M1 ) THEN

            IS = (J1+L1+N1)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( K2 .EQ. M2 .AND. K3 .EQ. M3 ) THEN
            IF( L2 .EQ. N2 .AND. L3 .EQ. N3)  THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          ALFA(I1,J1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          IF (I1 .EQ. K2 .AND. I1 .EQ. M2 ) THEN

            IS = (J1+N2+L2)/2

            IF( ( MOD(IS, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N2 .LE. IS)) THEN

            IF( K1 .EQ. M1 .AND. K3 .EQ. M3 ) THEN
            IF( L1 .EQ. N1 .AND. L3 .EQ. N3)  THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          ALFA(I1,J1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(N2))
     2          *GAMMA(1.0+DFLOAT(L2)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-N2))*GAMMA(1.0+DFLOAT(IS-L2)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          IF (I1 .EQ. K3 .AND. I1 .EQ. M3 ) THEN

            IS = (J1+L3+N3)/2

            IF( ( MOD(IS, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L3 .LE. IS  .AND. N3 .LE. IS)) THEN

            IF( K1 .EQ. M1 .AND. K2 .EQ. M2 ) THEN
            IF( L1 .EQ. N1 .AND. L2 .EQ. N2)  THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          ALFA(I1,J1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L3))
     2          *GAMMA(1.0+DFLOAT(N3)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L3))*GAMMA(1.0+DFLOAT(IS-N3)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     T*T*B, TBT, BTT
      TMP3 = 0.
C     T*T*B
      DO I1=1,N-2
      DO I2=I1+1,N-1
      DO I3=I2+1,N
      DO K1=1,N-2
      DO K2=K1+1,N-1
      DO K3=K2+1,N
      DO M1=1,N-1
      DO M2=M1+1,N

          DO J1=1,NBAS
          DO J2=1,NBAS
          DO J3=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO L3=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS

          IF ( (I1 .EQ. K1 .AND. I1 .EQ. M1) .AND.
     1         (I2 .EQ. K2 .AND. I2 .EQ. M2) .AND.
     1         (I3 .EQ. K3 .AND. J3 .EQ. L3)
     1           ) THEN
            IS1 = (J1+L1+N1)/2
            IS2 = (J2+L2+N2)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS1
     1       .AND. L1 .LE. IS1  .AND. N1 .LE. IS1) .AND.
     2      ( MOD(J2+L2+N2, 2) .EQ. 0 .AND. J2 .LE. IS2
     1       .AND. L2 .LE. IS2  .AND. N2 .LE. IS2)
     1           ) THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS1-J1))
     2     *GAMMA(1.0+DFLOAT(IS1-L1))*GAMMA(1.0+DFLOAT(IS1-N1)) )*
     2     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS2-J2))
     2     *GAMMA(1.0+DFLOAT(IS2-L2))*GAMMA(1.0+DFLOAT(IS2-N2)) )

C            RM3 = RM3 + TMP3

            ENDIF
          ENDIF

          IF ( (I1 .EQ. K1 .AND. I1 .EQ. M1) .AND.
     1         (I3 .EQ. K3 .AND. I3 .EQ. M2) .AND.
     1         (I2 .EQ. K2 .AND. J2 .EQ. L2)
     1           ) THEN
            IS1 = (J1+L1+N1)/2
            IS2 = (J3+L3+N2)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS1
     1       .AND. L1 .LE. IS1  .AND. N1 .LE. IS1) .AND.
     2      ( MOD(J3+L3+N2, 2) .EQ. 0 .AND. J3 .LE. IS2
     1       .AND. L3 .LE. IS2  .AND. N2 .LE. IS2)
     1           ) THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS1-J1))
     2     *GAMMA(1.0+DFLOAT(IS1-L1))*GAMMA(1.0+DFLOAT(IS1-N1)) )*
     2     DSQRT(GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L3))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS2-J3))
     2     *GAMMA(1.0+DFLOAT(IS2-L3))*GAMMA(1.0+DFLOAT(IS2-N2)) )
C          RM3 = RM3 + TMP3
            ENDIF
          ENDIF

          IF ( (I2 .EQ. K2 .AND. I2 .EQ. M1) .AND.
     1         (I3 .EQ. K3 .AND. I3 .EQ. M2) .AND.
     1         (I1 .EQ. K1 .AND. J1 .EQ. L1)
     1           ) THEN
            IS1 = (J2+L2+N1)/2
            IS2 = (J3+L3+N2)/2

            IF( ( MOD(IS1, 2) .EQ. 0 .AND. J2 .LE. IS1
     1       .AND. L2 .LE. IS1  .AND. N1 .LE. IS1) .AND.
     2      ( MOD(IS2, 2) .EQ. 0 .AND. J3 .LE. IS2
     1       .AND. L3 .LE. IS2  .AND. N2 .LE. IS2)
     1           ) THEN
             RM3 = RM3+ GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          BITA(M1,M2,N1,N2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS1-J2))
     2     *GAMMA(1.0+DFLOAT(IS1-L2))*GAMMA(1.0+DFLOAT(IS1-N1)) )*
     2     DSQRT(GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L3))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS2-J3))
     2     *GAMMA(1.0+DFLOAT(IS2-L3))*GAMMA(1.0+DFLOAT(IS2-N2)) )
C          RM3 = RM3 + TMP3
            ENDIF
          ENDIF

          IF ( ((M1 .EQ. I1 .AND. M2 .EQ. K1) .AND.
     1          (N1 .EQ. J1 .AND. N2 .EQ. L1) .AND.
     1          (I2 .EQ. K2 .AND. I3 .EQ. K3) .AND.
     1          (J2 .EQ. L2 .AND. J3 .EQ. L3) ) .OR.
     2         ((M2 .EQ. I1 .AND. M1 .EQ. K1) .AND.
     1          (N2 .EQ. J1 .AND. N1 .EQ. L1) .AND.
     1          (I2 .EQ. K2 .AND. I3 .EQ. K3) .AND.
     1          (J2 .EQ. L2 .AND. J3 .EQ. L3) ) .OR.
     3         ((M1 .EQ. I2 .AND. M2 .EQ. K2) .AND.
     1          (N1 .EQ. J2 .AND. N2 .EQ. L2) .AND.
     1          (I1 .EQ. K1 .AND. I3 .EQ. K3) .AND.
     1          (J1 .EQ. L1 .AND. J3 .EQ. L3) ) .OR.
     3         ((M2 .EQ. I2 .AND. M1 .EQ. K2) .AND.
     1          (N2 .EQ. J2 .AND. N1 .EQ. L2) .AND.
     1          (I1 .EQ. K1 .AND. I3 .EQ. K3) .AND.
     1          (J1 .EQ. L1 .AND. J3 .EQ. L3) ) .OR.
     3         ((M1 .EQ. I3 .AND. M2 .EQ. K3) .AND.
     1          (N1 .EQ. J3 .AND. N2 .EQ. L3) .AND.
     1          (I1 .EQ. K1 .AND. I2 .EQ. K2) .AND.
     1          (J1 .EQ. L1 .AND. J2 .EQ. L2) ) .OR.
     3         ((M2 .EQ. I3 .AND. M1 .EQ. K3) .AND.
     1          (N2 .EQ. J3 .AND. N1 .EQ. L3) .AND.
     1          (I1 .EQ. K1 .AND. I2 .EQ. K2) .AND.
     1          (J1 .EQ. L1 .AND. J2 .EQ. L2) ) .OR.
     3         ((M1 .EQ. I1 .AND. M2 .EQ. K2) .AND.
     1          (N1 .EQ. J1 .AND. N2 .EQ. L2) .AND.
     1          (I2 .EQ. K1 .AND. I3 .EQ. K3) .AND.
     1          (J2 .EQ. L1 .AND. J3 .EQ. L3) ) .OR.
     3         ((M1 .EQ. K1 .AND. M2 .EQ. I2) .AND.
     1          (N1 .EQ. L1 .AND. N2 .EQ. J2) .AND.
     1          (I1 .EQ. K2 .AND. I3 .EQ. K3) .AND.
     1          (J1 .EQ. L2 .AND. J3 .EQ. L3) ) .OR.
     3         ((M1 .EQ. I1 .AND. M2 .EQ. K3) .AND.
     1          (N1 .EQ. J1 .AND. N2 .EQ. L3) .AND.
     1          (I2 .EQ. K1 .AND. I3 .EQ. K2) .AND.
     1          (J2 .EQ. L1 .AND. J3 .EQ. L2) ) .OR.
     3         ((M1 .EQ. K1 .AND. M2 .EQ. I3) .AND.
     1          (N1 .EQ. L1 .AND. N2 .EQ. J3) .AND.
     1          (I1 .EQ. K2 .AND. I2 .EQ. K3) .AND.
     1          (J1 .EQ. L2 .AND. J2 .EQ. L3) ) .OR.
     3         ((M1 .EQ. I2 .AND. M2 .EQ. K3) .AND.
     1          (N1 .EQ. J2 .AND. N2 .EQ. L3) .AND.
     1          (I1 .EQ. K1 .AND. I3 .EQ. K2) .AND.
     1          (J1 .EQ. L1 .AND. J3 .EQ. L2) ) .OR.
     3         ((M1 .EQ. K2 .AND. M2 .EQ. I3) .AND.
     1          (N1 .EQ. L2 .AND. N2 .EQ. J3) .AND.
     1          (I1 .EQ. K1 .AND. I2 .EQ. K3) .AND.
     1          (J1 .EQ. L1 .AND. J2 .EQ. L3) )
     1           ) THEN

             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          BITA(M1,M2,N1,N2)
C            RM3 = RM3 + TMP3
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO

      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
C      WRITE (*,*) TMP3

C     T*B*T
      DO I1=1,N-2
      DO I2=I1+1,N-1
      DO I3=I2+1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N-2
      DO M2=M1+1,N-1
      DO M3=M2+1,N

          DO J1=1,NBAS
          DO J2=1,NBAS
          DO J3=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS
          DO N3=1,NBAS

          IF ( (I1 .EQ. K1 .AND. I1 .EQ. M1) .AND.
     1         (I2 .EQ. K2 .AND. I2 .EQ. M2) .AND.
     1         (I3 .EQ. M3 .AND. J3 .EQ. N3)
     1           ) THEN
            IS1 = (J1+L1+N1)/2
            IS2 = (J2+L2+N2)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS1
     1       .AND. L1 .LE. IS1  .AND. N1 .LE. IS1) .AND.
     2      ( MOD(J2+L2+N2, 2) .EQ. 0 .AND. J2 .LE. IS2
     1       .AND. L2 .LE. IS2  .AND. N2 .LE. IS2)
     1           ) THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(K1,K2,L1,L2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS1-J1))
     2     *GAMMA(1.0+DFLOAT(IS1-L1))*GAMMA(1.0+DFLOAT(IS1-N1)) )*
     2     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS2-J2))
     2     *GAMMA(1.0+DFLOAT(IS2-L2))*GAMMA(1.0+DFLOAT(IS2-N2)) )

            ENDIF
          ENDIF

          IF ( (I1 .EQ. K1 .AND. I1 .EQ. M1) .AND.
     1         (I3 .EQ. M3 .AND. I3 .EQ. K2) .AND.
     1         (I2 .EQ. M2 .AND. J2 .EQ. N2)
     1           ) THEN
            IS1 = (J1+L1+N1)/2
            IS2 = (J3+L2+N3)/2

            IF( ( MOD(IS1, 2) .EQ. 0 .AND. J1 .LE. IS1
     1       .AND. L1 .LE. IS1  .AND. N1 .LE. IS1) .AND.
     2      ( MOD(IS2, 2) .EQ. 0 .AND. J3 .LE. IS2
     1       .AND. L2 .LE. IS2  .AND. N3 .LE. IS2)
     1           ) THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(K1,K2,L1,L2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS1-J1))
     2     *GAMMA(1.0+DFLOAT(IS1-L1))*GAMMA(1.0+DFLOAT(IS1-N1)) )*
     2     DSQRT(GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N3)) )/(GAMMA(1.0+DFLOAT(IS2-J3))
     2     *GAMMA(1.0+DFLOAT(IS2-L2))*GAMMA(1.0+DFLOAT(IS2-N3)) )

            ENDIF
          ENDIF

          IF ( (I2 .EQ. M2 .AND. I2 .EQ. K1) .AND.
     1         (I3 .EQ. M3 .AND. I3 .EQ. K2) .AND.
     1         (I1 .EQ. M1 .AND. J1 .EQ. N1)
     1           ) THEN
            IS1 = (J2+N2+L1)/2
            IS2 = (J3+N3+L2)/2

            IF( ( MOD(IS1, 2) .EQ. 0 .AND. J2 .LE. IS1
     1       .AND. N2 .LE. IS1  .AND. L1 .LE. IS1) .AND.
     2      ( MOD(IS2, 2) .EQ. 0 .AND. J3 .LE. IS2
     1       .AND. N3 .LE. IS2  .AND. L2 .LE. IS2)
     1           ) THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(K1,K2,L1,L2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(N2))
     2          *GAMMA(1.0+DFLOAT(L1)) )/(GAMMA(1.0+DFLOAT(IS1-J2))
     2     *GAMMA(1.0+DFLOAT(IS1-N2))*GAMMA(1.0+DFLOAT(IS1-L1)) )*
     2     DSQRT(GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(N3))
     2          *GAMMA(1.0+DFLOAT(L2)) )/(GAMMA(1.0+DFLOAT(IS2-J3))
     2     *GAMMA(1.0+DFLOAT(IS2-N3))*GAMMA(1.0+DFLOAT(IS2-L2)) )

            ENDIF
          ENDIF

          IF ( ((K1 .EQ. I1 .AND. K2 .EQ. M1) .AND.
     1          (L1 .EQ. J1 .AND. L2 .EQ. N1) .AND.
     1          (I2 .EQ. M2 .AND. I3 .EQ. M3) .AND.
     1          (J2 .EQ. N2 .AND. J3 .EQ. N3) ) .OR.
     2         ((K2 .EQ. I1 .AND. K1 .EQ. M1) .AND.
     1          (L2 .EQ. J1 .AND. L1 .EQ. N1) .AND.
     1          (I2 .EQ. M2 .AND. I3 .EQ. M3) .AND.
     1          (J2 .EQ. N2 .AND. J3 .EQ. N3) ) .OR.
     3         ((K1 .EQ. I2 .AND. K2 .EQ. M2) .AND.
     1          (L1 .EQ. J2 .AND. L2 .EQ. N2) .AND.
     1          (I1 .EQ. M1 .AND. I3 .EQ. M3) .AND.
     1          (J1 .EQ. N1 .AND. J3 .EQ. N3) ) .OR.
     3         ((K2 .EQ. I2 .AND. K1 .EQ. M2) .AND.
     1          (L2 .EQ. J2 .AND. L1 .EQ. N2) .AND.
     1          (I1 .EQ. M1 .AND. I3 .EQ. M3) .AND.
     1          (J1 .EQ. N1 .AND. J3 .EQ. N3) ) .OR.
     3         ((K1 .EQ. I3 .AND. K2 .EQ. M3) .AND.
     1          (L1 .EQ. J3 .AND. L2 .EQ. N3) .AND.
     1          (I1 .EQ. M1 .AND. I2 .EQ. M2) .AND.
     1          (J1 .EQ. N1 .AND. J2 .EQ. N2) ) .OR.
     3         ((K2 .EQ. I3 .AND. K1 .EQ. M3) .AND.
     1          (L2 .EQ. J3 .AND. L1 .EQ. N3) .AND.
     1          (I1 .EQ. M1 .AND. I2 .EQ. M2) .AND.
     1          (J1 .EQ. N1 .AND. J2 .EQ. N2) ) .OR.
     3         ((K1 .EQ. I1 .AND. K2 .EQ. M2) .AND.
     1          (L1 .EQ. J1 .AND. L2 .EQ. N2) .AND.
     1          (I2 .EQ. M1 .AND. I3 .EQ. M3) .AND.
     1          (J2 .EQ. N1 .AND. J3 .EQ. N3) ) .OR.
     3         ((K1 .EQ. M1 .AND. K2 .EQ. I2) .AND.
     1          (L1 .EQ. N1 .AND. L2 .EQ. J2) .AND.
     1          (I1 .EQ. M2 .AND. I3 .EQ. M3) .AND.
     1          (J1 .EQ. N2 .AND. J3 .EQ. N3) ) .OR.
     3         ((K1 .EQ. I1 .AND. K2 .EQ. M3) .AND.
     1          (L1 .EQ. J1 .AND. L2 .EQ. N3) .AND.
     1          (I2 .EQ. M1 .AND. I3 .EQ. M2) .AND.
     1          (J2 .EQ. N1 .AND. J3 .EQ. N2) ) .OR.
     3         ((K1 .EQ. M1 .AND. K2 .EQ. I3) .AND.
     1          (L1 .EQ. N1 .AND. L2 .EQ. J3) .AND.
     1          (I1 .EQ. M2 .AND. I2 .EQ. M3) .AND.
     1          (J1 .EQ. N2 .AND. J2 .EQ. N3) ) .OR.
     3         ((K1 .EQ. I2 .AND. K2 .EQ. M3) .AND.
     1          (L1 .EQ. J2 .AND. L2 .EQ. N3) .AND.
     1          (I1 .EQ. M1 .AND. I3 .EQ. M2) .AND.
     1          (J1 .EQ. N1 .AND. J3 .EQ. N2) ) .OR.
     3         ((K1 .EQ. M2 .AND. K2 .EQ. I3) .AND.
     1          (L1 .EQ. N2 .AND. L2 .EQ. J3) .AND.
     1          (I1 .EQ. M1 .AND. I2 .EQ. M3) .AND.
     1          (J1 .EQ. N1 .AND. J2 .EQ. N3) )
     1           ) THEN

             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(K1,K2,L1,L2)
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO

      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     B*T*T
      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N-2
      DO K2=K1+1,N-1
      DO K3=K2+1,N
      DO M1=1,N-2
      DO M2=M1+1,N-1
      DO M3=M2+1,N

          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO L3=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS
          DO N3=1,NBAS

          IF ( (I1 .EQ. K1 .AND. I1 .EQ. M1) .AND.
     1         (I2 .EQ. K2 .AND. I2 .EQ. M2) .AND.
     1         (K3 .EQ. M3 .AND. L3 .EQ. N3)
     1           ) THEN
            IS1 = (J1+L1+N1)/2
            IS2 = (J2+L2+N2)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS1
     1       .AND. L1 .LE. IS1  .AND. N1 .LE. IS1) .AND.
     2      ( MOD(J2+L2+N2, 2) .EQ. 0 .AND. J2 .LE. IS2
     1       .AND. L2 .LE. IS2  .AND. N2 .LE. IS2)
     1           ) THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(I1,I2,J1,J2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS1-J1))
     2     *GAMMA(1.0+DFLOAT(IS1-L1))*GAMMA(1.0+DFLOAT(IS1-N1)) )*
     2     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS2-J2))
     2     *GAMMA(1.0+DFLOAT(IS2-L2))*GAMMA(1.0+DFLOAT(IS2-N2)) )

            ENDIF
          ENDIF

          IF ( (I1 .EQ. K1 .AND. I1 .EQ. M1) .AND.
     1         (K3 .EQ. M3 .AND. K3 .EQ. I2) .AND.
     1         (K2 .EQ. M2 .AND. L2 .EQ. N2)
     1           ) THEN
            IS1 = (J1+L1+N1)/2
            IS2 = (L3+J2+N3)/2

            IF( ( MOD(IS1, 2) .EQ. 0 .AND. J1 .LE. IS1
     1       .AND. L1 .LE. IS1  .AND. N1 .LE. IS1) .AND.
     2      ( MOD(IS2, 2) .EQ. 0 .AND. L3 .LE. IS2
     1       .AND. J2 .LE. IS2  .AND. N3 .LE. IS2)
     1           ) THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(I1,I2,J1,J2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS1-J1))
     2     *GAMMA(1.0+DFLOAT(IS1-L1))*GAMMA(1.0+DFLOAT(IS1-N1)) )*
     2     DSQRT(GAMMA(1.0+DFLOAT(L3))*GAMMA(1.0+DFLOAT(J2))
     2          *GAMMA(1.0+DFLOAT(N3)) )/(GAMMA(1.0+DFLOAT(IS2-L3))
     2     *GAMMA(1.0+DFLOAT(IS2-J2))*GAMMA(1.0+DFLOAT(IS2-N3)) )

            ENDIF
          ENDIF

          IF ( (K2 .EQ. M2 .AND. K2 .EQ. I1) .AND.
     1         (K3 .EQ. M3 .AND. K3 .EQ. I2) .AND.
     1         (K1 .EQ. M1 .AND. L1 .EQ. N1)
     1           ) THEN
            IS1 = (L2+N2+J1)/2
            IS2 = (L3+N3+J2)/2

            IF( ( MOD(IS1, 2) .EQ. 0 .AND. L2 .LE. IS1
     1       .AND. N2 .LE. IS1  .AND. J1 .LE. IS1) .AND.
     2      ( MOD(IS2, 2) .EQ. 0 .AND. L3 .LE. IS2
     1       .AND. N3 .LE. IS2  .AND. J2 .LE. IS2)
     1           ) THEN
             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(I1,I2,J1,J2)*
     1     DSQRT(GAMMA(1.0+DFLOAT(L2))*GAMMA(1.0+DFLOAT(N2))
     2          *GAMMA(1.0+DFLOAT(J1)) )/(GAMMA(1.0+DFLOAT(IS1-L2))
     2     *GAMMA(1.0+DFLOAT(IS1-N2))*GAMMA(1.0+DFLOAT(IS1-J1)) )*
     2     DSQRT(GAMMA(1.0+DFLOAT(L3))*GAMMA(1.0+DFLOAT(N3))
     2          *GAMMA(1.0+DFLOAT(J2)) )/(GAMMA(1.0+DFLOAT(IS2-L3))
     2     *GAMMA(1.0+DFLOAT(IS2-N3))*GAMMA(1.0+DFLOAT(IS2-J2)) )

            ENDIF
          ENDIF

          IF ( ((I1 .EQ. K1 .AND. I2 .EQ. M1) .AND.
     1          (J1 .EQ. L1 .AND. J2 .EQ. N1) .AND.
     1          (K2 .EQ. M2 .AND. K3 .EQ. M3) .AND.
     1          (L2 .EQ. N2 .AND. L3 .EQ. N3) ) .OR.
     2         ((I2 .EQ. K1 .AND. I1 .EQ. M1) .AND.
     1          (J2 .EQ. L1 .AND. J1 .EQ. N1) .AND.
     1          (K2 .EQ. M2 .AND. K3 .EQ. M3) .AND.
     1          (L2 .EQ. N2 .AND. L3 .EQ. N3) ) .OR.
     3         ((I1 .EQ. K2 .AND. I2 .EQ. M2) .AND.
     1          (J1 .EQ. L2 .AND. J2 .EQ. N2) .AND.
     1          (K1 .EQ. M1 .AND. K3 .EQ. M3) .AND.
     1          (L1 .EQ. N1 .AND. L3 .EQ. N3) ) .OR.
     3         ((I2 .EQ. K2 .AND. I1 .EQ. M2) .AND.
     1          (J2 .EQ. L2 .AND. J1 .EQ. N2) .AND.
     1          (K1 .EQ. M1 .AND. K3 .EQ. M3) .AND.
     1          (L1 .EQ. N1 .AND. L3 .EQ. N3) ) .OR.
     3         ((I1 .EQ. K3 .AND. I2 .EQ. M3) .AND.
     1          (J1 .EQ. L3 .AND. J2 .EQ. N3) .AND.
     1          (K1 .EQ. M1 .AND. K2 .EQ. M2) .AND.
     1          (L1 .EQ. N1 .AND. L2 .EQ. N2) ) .OR.
     3         ((I2 .EQ. K3 .AND. I1 .EQ. M3) .AND.
     1          (J2 .EQ. L3 .AND. J1 .EQ. N3) .AND.
     1          (K1 .EQ. M1 .AND. K2 .EQ. M2) .AND.
     1          (L1 .EQ. N1 .AND. L2 .EQ. N2) ) .OR.
     3         ((I1 .EQ. K1 .AND. I2 .EQ. M2) .AND.
     1          (J1 .EQ. L1 .AND. J2 .EQ. N2) .AND.
     1          (K2 .EQ. M1 .AND. K3 .EQ. M3) .AND.
     1          (L2 .EQ. N1 .AND. L3 .EQ. N3) ) .OR.
     3         ((I1 .EQ. M1 .AND. I2 .EQ. K2) .AND.
     1          (J1 .EQ. N1 .AND. J2 .EQ. L2) .AND.
     1          (K1 .EQ. M2 .AND. K3 .EQ. M3) .AND.
     1          (L1 .EQ. N2 .AND. L3 .EQ. N3) ) .OR.
     3         ((I1 .EQ. K1 .AND. I2 .EQ. M3) .AND.
     1          (J1 .EQ. L1 .AND. J2 .EQ. N3) .AND.
     1          (K2 .EQ. M1 .AND. K3 .EQ. M2) .AND.
     1          (L2 .EQ. N1 .AND. L3 .EQ. N2) ) .OR.
     3         ((I1 .EQ. M1 .AND. I2 .EQ. K3) .AND.
     1          (J1 .EQ. N1 .AND. J2 .EQ. L3) .AND.
     1          (K1 .EQ. M2 .AND. K2 .EQ. M3) .AND.
     1          (L1 .EQ. N2 .AND. L2 .EQ. N3) ) .OR.
     3         ((I1 .EQ. K2 .AND. I2 .EQ. M3) .AND.
     1          (J1 .EQ. L2 .AND. J2 .EQ. N3) .AND.
     1          (K1 .EQ. M1 .AND. K3 .EQ. M2) .AND.
     1          (L1 .EQ. N1 .AND. L3 .EQ. N2) ) .OR.
     3         ((I1 .EQ. M2 .AND. I2 .EQ. K3) .AND.
     1          (J1 .EQ. N2 .AND. J2 .EQ. L3) .AND.
     1          (K1 .EQ. M1 .AND. K2 .EQ. M3) .AND.
     1          (L1 .EQ. N1 .AND. L2 .EQ. N3) )
     1           ) THEN

             RM3 = RM3 + GAMA(K1,K2,K3,L1,L2,L3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1          BITA(I1,I2,J1,J2)
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO

      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     T*T*T
      DO I1=1,N-2
      DO I2=I1+1,N-1
      DO I3=I2+1,N
      DO K1=1,N-2
      DO K2=K1+1,N-1
      DO K3=K2+1,N
      DO M1=1,N-2
      DO M2=M1+1,N-1
      DO M3=M2+1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO J3=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO L3=1,NBAS
          DO N1=1,NBAS
          DO N2=1,NBAS
          DO N3=1,NBAS

          IF ( (I1 .EQ. K1 .AND. I2 .EQ. K2 .AND. I3 .EQ. K3)) THEN
          IF ( (I1 .EQ. M1 .AND. I2 .EQ. M2 .AND. I3 .EQ. M3)) THEN

            IS1 = (J1+L1+N1)/2
            IS2 = (J2+L2+N2)/2
            IS3 = (J3+L3+N3)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS1
     1       .AND. L1 .LE. IS1  .AND. N1 .LE. IS1) .AND.
     2      ( MOD(J2+L2+N2, 2) .EQ. 0 .AND. J2 .LE. IS2
     1       .AND. L2 .LE. IS2  .AND. N2 .LE. IS2) .AND.
     2      ( MOD(J3+L3+N3, 2) .EQ. 0 .AND. J3 .LE. IS3
     1       .AND. L3 .LE. IS3  .AND. N3 .LE. IS3)  ) THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS1-J1))
     2     *GAMMA(1.0+DFLOAT(IS1-L1))*GAMMA(1.0+DFLOAT(IS1-N1)) )*
     2     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N2)) )/(GAMMA(1.0+DFLOAT(IS2-J2))
     2     *GAMMA(1.0+DFLOAT(IS2-L2))*GAMMA(1.0+DFLOAT(IS2-N2)) )*
     3     DSQRT(GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L3))
     3          *GAMMA(1.0+DFLOAT(N3)) )/(GAMMA(1.0+DFLOAT(IS3-J3))
     3     *GAMMA(1.0+DFLOAT(IS3-L3))*GAMMA(1.0+DFLOAT(IS3-N3)) )

          ENDIF

            ENDIF
          ENDIF

          IF ( (I1 .EQ. M1 .AND. I1 .EQ. K1 ) ) THEN
            IS = (J1+L1+N1)/2
            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS)) THEN

C       SIX COMBINATION OF POSSIBLILTY
            IF((I2 .EQ. K2 .AND. I3 .EQ. M2 .AND. K3 .EQ. M3) .OR.
     1         (I2 .EQ. K2 .AND. I3 .EQ. M3 .AND. K3 .EQ. M2) .OR.
     2         (I2 .EQ. K3 .AND. I3 .EQ. M2 .AND. K2 .EQ. M3) .OR.
     2         (I2 .EQ. K3 .AND. I3 .EQ. M3 .AND. K2 .EQ. M2) .OR.
     2         (I2 .EQ. M2 .AND. I3 .EQ. K2 .AND. K3 .EQ. M3) .OR.
     2         (I2 .EQ. M2 .AND. I3 .EQ. K3 .AND. K2 .EQ. M3) .OR.
     2         (I2 .EQ. M3 .AND. I3 .EQ. K2 .AND. K3 .EQ. M2) .OR.
     2         (I2 .EQ. M3 .AND. I3 .EQ. K3 .AND. K2 .EQ. M2)
     2          )  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS1-J1))
     2     *GAMMA(1.0+DFLOAT(IS1-L1))*GAMMA(1.0+DFLOAT(IS1-N1)) )

            ENDIF
            ENDIF

          ENDIF

          IF ( (I3 .EQ. M3 .AND. I3 .EQ. K3 ) ) THEN
            IS = (J3+L3+N3)/2
            IF( ( MOD(J3+L3+N3, 2) .EQ. 0 .AND. J3 .LE. IS
     1       .AND. L3 .LE. IS  .AND. N3 .LE. IS)) THEN

C       SIX COMBINATION OF POSSIBLILTY
            IF((I1 .EQ. K1 .AND. I2 .EQ. M1 .AND. K2 .EQ. M2) .OR.
     1         (I1 .EQ. K1 .AND. I2 .EQ. M2 .AND. K2 .EQ. M1) .OR.
     2         (I1 .EQ. K2 .AND. I2 .EQ. M1 .AND. K1 .EQ. M2) .OR.
     2         (I1 .EQ. K2 .AND. I2 .EQ. M2 .AND. K1 .EQ. M1) .OR.
     2         (I1 .EQ. M1 .AND. I2 .EQ. K1 .AND. K2 .EQ. M2) .OR.
     2         (I1 .EQ. M1 .AND. I2 .EQ. K2 .AND. K1 .EQ. M2) .OR.
     2         (I1 .EQ. M2 .AND. I2 .EQ. K1 .AND. K2 .EQ. M1) .OR.
     2         (I1 .EQ. M2 .AND. I2 .EQ. K2 .AND. K1 .EQ. M1)
     2          )  THEN
             RM3 = RM3 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          GAMA(M1,M2,M3,N1,N2,N3)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L3))
     2          *GAMMA(1.0+DFLOAT(N3)) )/(GAMMA(1.0+DFLOAT(IS1-J3))
     2     *GAMMA(1.0+DFLOAT(IS1-L3))*GAMMA(1.0+DFLOAT(IS1-N3)) )

            ENDIF
            ENDIF

          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

          PRINT*,  '--------------------------------------------'
          WRITE(*,*) 'RM3 (TRIVARITE) = ', RM3
          RM3T = RM3

      ENDIF

C   ======================
C   SENSITIVITY OF ANALYTICAL
C   =====================
      itmp = N
      if (IID .EQ. 1) itmp = 1

      DO IMU = 1,itmp
      PRINT *, 'IMU = ', IMU

        SM0 = 0.
        SC0 = 0
        SG0 = 0.
C
        DO I = 1,N
         DO J = 1,NBAS_SM
         ALFA_SM(I,J) = 0.
         ALFA_SG(I,J) = 0.
         ENDDO
        ENDDO

        DO I1 = 1,N
         DO I2 = 1,N
          DO J1 = 1,NBAS_SM
           DO J2 = 1,NBAS_SM
           BITA_SM(I1,I2,J1,J2) = 0.
           BITA_SG(I1,I2,J1,J2) = 0.
           ENDDO
          ENDDO
         ENDDO
        ENDDO

        DO I1 = 1,N
         DO I2 = 1,N
          DO I3 = 1,N
           DO J1 = 1,NBAS_SM
            DO J2 = 1,NBAS_SM
             DO J3 = 1,NBAS_SM
             GAMA_SM(I1,I2,I3,J1,J2,J3) = 0.
             GAMA_SG(I1,I2,I3,J1,J2,J3) = 0.
             ENDDO
            ENDDO
           ENDDO
          ENDDO
         ENDDO
        ENDDO
        ALFA_SM = 0.
        BITA_SM = 0.
        GAMA_SM = 0.
      ALFA_SG = 0.
        BITA_SG = 0.
        GAMA_SG = 0.
        ALFA_SMIID = 0.
        ALFA_SGIID = 0.

C
C
C       CALCULATE/STORE CONSTANT TERM OF SCORE FUNCTION AT GAUSS POINTS
C

        DO I = 1,N
        X(I) = 0.0
        ENDDO
        CALL SCOR (X,SMU_A,SSIG_A)
        SMM = SMU_A(IMU)
        SGM = SSIG_A(IMU)

C
C
C       CALCULATE/STORE UNIVARIATE SCORE FUNCTION AT GAUSS POINTS
C

        DO IX = 1,N
         DO I = 1,N
         X(I) = 0.0
         ENDDO
          DO IGAUSS = 1,NGAUSS_SM
          X(IMU) = XXN_SM(IMU,IGAUSS)
C         X1 = X(IX)
          CALL SCOR (X,SMU_A, SSIG_A)
          S_MU = SMU_A(IMU)
          S_SIG = SSIG_A(IMU)
          SMR1(IX,IGAUSS) = S_MU
          SGR1(IX,IGAUSS) = S_SIG
          ENDDO
        ENDDO

C
C
C       CALCULATE/STORE BIVARIATE SCORE FUNCTION AT GAUSS POINTS
C

        DO IX = 1,N-1
         DO JX = IX+1,N
          DO I = 1,N
          X(I) = 0.0
          ENDDO
           DO IGAUSS = 1,NGAUSS_SM
            DO JGAUSS = 1,NGAUSS_SM
            X(IMU) = XXN_SM(IMU,IGAUSS)
            X(IMU) = XXN_SM(IMU,JGAUSS)
C           X1 = X(IX)
          CALL SCOR (X,SMU_A, SSIG_A)
          S_MU = SMU_A(IMU)
          S_SIG = SSIG_A(IMU)
            SMR2(IX,JX,IGAUSS,JGAUSS) = S_MU
            SGR2(IX,JX,IGAUSS,JGAUSS) = S_SIG
            ENDDO
           ENDDO
         ENDDO
        ENDDO

        SMR2 = 0.

C
C
C       CALCULATE/STORE TRIVARIATE SCORE FUNCTION AT GAUSS POINTS
C

        DO IX = 1,N-2
         DO JX = IX+1,N-1
          DO KX = JX+1,N
           DO I = 1,N
           X(I) = 0.0
           ENDDO
            DO IGAUSS = 1,NGAUSS_SM
             DO JGAUSS = 1,NGAUSS_SM
              DO KGAUSS = 1,NGAUSS_SM
              X(IMU) = XXN_SM(IMU,IGAUSS)
              X(IMU) = XXN_SM(IMU,JGAUSS)
              X(IMU) = XXN_SM(IMU,KGAUSS)
C           X1 = X(IX)
            CALL SCOR (X,SMU_A, SSIG_A)
              S_MU = SMU_A(IMU)
              S_SIG = SSIG_A(IMU)
              SMR3(IX,JX,KX,IGAUSS,JGAUSS,KGAUSS) = S_MU
              SGR3(IX,JX,KX,IGAUSS,JGAUSS,KGAUSS) = S_SIG
              ENDDO
             ENDDO
            ENDDO
          ENDDO
         ENDDO
        ENDDO
        SMR3 = 0.

C
C       CALCULATE/STORE BASIS FUNCTIONS AT GAUSS POINTS (H)
C
        DO I = 1,N
         DO J = 1,NBAS_SM
          DO L = 1,N
          X(L) = 0.0
          ENDDO
           DO IGAUSS = 1,NGAUSS_SM
           X(IMU) = XXN_SM(IMU,IGAUSS)
           CALL BASIS (X,PSIF_SM,N,NBAS_SM)
           CALL BASIS (X,PSIF_SG,N,NBAS_SM)
         SMH(I,J,IGAUSS) = PSIF_SM(IMU,J)
         SGH(I,J,IGAUSS) = PSIF_SG(IMU,J)
           ENDDO
         ENDDO
        ENDDO

C
C       CALCULATE COEFFICIENT Y0
C

        SMU = 0.
        SGU = 0.
        DO IX = 1,N
         DO IGAUSS = 1,NGAUSS_SM
         SMU = SMU + SMR1(IX,IGAUSS)*QWN_SM(IMU,IGAUSS)
         SGU = SGU + SGR1(IX,IGAUSS)*QWN_SM(IMU,IGAUSS)
       ENDDO
        ENDDO

        SMB = 0.
        SGB = 0.
        DO IX = 1,N-1
         DO JX = IX+1,N
          DO IGAUSS = 1,NGAUSS_SM
           DO JGAUSS = 1,NGAUSS_SM
           SMB = SMB + SMR2(IX,JX,IGAUSS,JGAUSS)*(QWN_SM(IMU,IGAUSS))*
     &         (QWN_SM(IMU,JGAUSS))
           SGB = SGB + SGR2(IX,JX,IGAUSS,JGAUSS)*(QWN_SM(IMU,IGAUSS))*
     &         (QWN_SM(IMU,JGAUSS))

         ENDDO
          ENDDO
         ENDDO
        ENDDO

        SMT = 0.
        SGT = 0.
        DO IX = 1,N-2
         DO JX = IX+1,N-1
          DO KX = JX+1,N
           DO IGAUSS = 1,NGAUSS_SM
            DO JGAUSS = 1,NGAUSS_SM
             DO KGAUSS = 1,NGAUSS_SM
             SMT = SMT + SMR3(IX,JX,KX,IGAUSS,JGAUSS,KGAUSS)*
     &           (QWN_SM(IMU,IGAUSS))*(QWN_SM(IMU,JGAUSS))*
     &           (QWN_SM(IMU,KGAUSS))
             SGT = SGT + SGR3(IX,JX,KX,IGAUSS,JGAUSS,KGAUSS)*
     &           (QWN_SM(IMU,IGAUSS))*(QWN_SM(IMU,JGAUSS))*
     &           (QWN_SM(IMU,KGAUSS))

           ENDDO
            ENDDO
           ENDDO
          ENDDO
         ENDDO
        ENDDO

C     DOUBLE CHECK SM0 Y0 'S FORMULAR FROM PAPER ??
C     DUE TO IN IID CASE, SM0 AND SG0 ARE ONE VARIABLES FUNCTION, SO THE EXPRESSION CAN BE
C     SM0 = SMU - (N-1)*SMM
C     SG0 = SGU - (N-1)*SGM

      NT = 1
      SM0 = (SMU - (NT-1.)*SMM)/DFLOAT(N)
      SG0 = (SGU - (NT-1.)*SGM)/DFLOAT(N)

C      SG0 = (SGU - (N-1.)*SGM)

C   SM0 = SMT - DFLOAT(N-3)*SMB + DFLOAT((N-2)*(N-3))*SMU/2.
C     &      - DFLOAT((N-1)*(N-2)*(N-3))*SMM/6.
       ttttt = SGT - DFLOAT(NT-3)*SGB + DFLOAT((NT-2)*(NT-3))*SGU/2.
     &      - DFLOAT((NT-1)*(NT-2)*(NT-3))*SGM/6.
C

C
C       CALCULATE COEFFICIENTS ALFA(I,J)
C

C
C       CALCULATE COEFFICIENTS ALFA_SM(I,J), ALFA_SG(I,J)
C
C     CHECK SSMU, COZ SHOULD BE  = 18.XX
        DO I = IMU,IMU
         DO J = 1,NBAS_SM
C
         SSMU = 0.
         SSGU = 0.
          DO IGAUSS = 1,NGAUSS_SM
          SSMU = SSMU + SMR1(IMU,IGAUSS)*SMH(IMU,J,IGAUSS)*QWN_SM(IMU,IGAUSS)
          SSGU = SSGU + SGR1(IMU,IGAUSS)*SGH(IMU,J,IGAUSS)*QWN_SM(IMU,IGAUSS)
        ENDDO
C
          SSMB = 0.
          SSGB = 0.
           DO 110 IX = 1,N-1
           DO 110 JX = IX+1,N
           IF (IX .NE. I .AND. JX .NE. I) GO TO 110
            DO IGAUSS = 1,NGAUSS_SM
             DO JGAUSS = 1,NGAUSS_SM
             IF (IX .EQ. I) KGAUSS = IGAUSS
             IF (JX .EQ. I) KGAUSS = JGAUSS
             SSMB = SSMB + SMR2(IMU,IMU,IGAUSS,JGAUSS)*SMH(IMU,J,KGAUSS)*
     &            (QWN_SM(IMU,IGAUSS))*(QWN_SM(IMU,JGAUSS))
             SSGB = SSGB + SGR2(IMU,IMU,IGAUSS,JGAUSS)*SGH(IMU,J,KGAUSS)*
     &            (QWN_SM(IMU,IGAUSS))*(QWN_SM(IMU,JGAUSS))

             ENDDO
            ENDDO
110        CONTINUE
C
C
C     ALFA_SM EVERY DIMENSION NOT EQUAL   DOUBLE CHECK HERE
          SSMT = 0.
          SSGT = 0.
           DO 120 IX = 1,N-2
           DO 120 JX = IX+1,N-1
           DO 120 KX = JX+1,N
           IF (IX .NE. I .AND. JX .NE. I .AND. KX .NE. I) GO TO 120
            DO IGAUSS = 1,NGAUSS_SM
             DO JGAUSS = 1,NGAUSS_SM
              DO KGAUSS = 1,NGAUSS_SM
              IF (IX .EQ. I) MGAUSS = IGAUSS
              IF (JX .EQ. I) MGAUSS = JGAUSS
              IF (KX .EQ. I) MGAUSS = KGAUSS
              SSMT = SSMT + SMR3(IMU,IMU,IMU,IGAUSS,JGAUSS,KGAUSS)*
     1       SMH(IMU,J,MGAUSS)
     &            *(QWN_SM(IMU,IGAUSS))*(QWN_SM(IMU,JGAUSS))*
     &            (QWN_SM(IMU,KGAUSS))
              SSGT = SSGT + SGR3(IMU,IMU,IMU,IGAUSS,JGAUSS,KGAUSS)*
     1        SGH(IMU,J,MGAUSS)
     &            *(QWN_SM(IMU,IGAUSS))*(QWN_SM(IMU,JGAUSS))*
     &            (QWN_SM(IMU,KGAUSS))
                  ENDDO
             ENDDO
            ENDDO
120        CONTINUE

C       ------ REMARK AND PAUSE HERE, IT'S RIGHT OF THE FOLLOWING
           ALFA_SM(I,J) = SSMU
           ALFA_SG(I,J) = SSGU
C
         ENDDO
        ENDDO

C  ----------   FORMULA 14   OF LR.PDF   ----------

            DO I = 1,N
             DO J = 1,NBAS_SM
               IF (IID .EQ. 1) THEN
               ALFA_SMIID(I,J) = ALFA_SM(1,J)
               ALFA_SGIID(I,J) = ALFA_SG(1,J)
               ELSE IF (IID .EQ. 0) THEN
               ALFA_SMIID(I,J) = ALFA_SM(I,J)
               ALFA_SGIID(I,J) = ALFA_SG(I,J)
               END IF
             ENDDO
            ENDDO

C
C       CALCULATE COEFFICIENTS BITA_SM(I1,I2,J1,J2), BITA_SG(I1,I2,J1,J2)
C
        DO I1 = 1,N-1
         DO I2 = I1+1,N
          DO J1 = 1,NBAS_SM
           DO J2 = 1,NBAS_SM
C
          SSSMB = 0.
          SSSGB = 0.
            DO IGAUSS = 1,NGAUSS_SM
             DO JGAUSS = 1,NGAUSS_SM
             SSSMB = SSSMB +
     &     SMR2(I1,I2,IGAUSS,JGAUSS)*SMH(IMU,J1,IGAUSS)*
     &      SMH(IMU,J2,JGAUSS)*
     &     (QWN_SM(IMU,IGAUSS))*(QWN_SM(IMU,JGAUSS))
             SSSGB = SSSGB +
     &     SGR2(I1,I2,IGAUSS,JGAUSS)*SGH(IMU,J1,IGAUSS)*
     &      SGH(IMU,J2,JGAUSS)*
     &     (QWN_SM(IMU,IGAUSS))*(QWN_SM(IMU,JGAUSS))

             ENDDO
            ENDDO
C
           SSSMT = 0.
           SSSGT = 0.
           DO 130 JJX = IIX+1,N-1
           DO 130 KKX = JJX+1,N
           IF (IIX .NE. I1 .AND. IIX .NE. I2 .AND.
     &       JJX .NE. I1 .AND. JJX .NE. I2 .AND.
     &       KKX .NE. I1 .AND. KKX .NE. I2) GO TO 130
           IF (IIX .EQ. I1 .AND. (JJX .EQ. I2 .OR. KKX .EQ. I2)) GO TO 131
           IF (JJX .EQ. I1 .AND. (IIX .EQ. I2 .OR. KKX .EQ. I2)) GO TO 131
           IF (KKX .EQ. I1 .AND. (IIX .EQ. I2 .OR. JJX .EQ. I2)) GO TO 131
           GO TO 130
131        DO IGAUSS = 1,NGAUSS_SM
             DO JGAUSS = 1,NGAUSS_SM
              DO KGAUSS = 1,NGAUSS_SM
              IF (IIX .EQ. I1) MGAUSS1 = IGAUSS
              IF (JJX .EQ. I1) MGAUSS1 = JGAUSS
              IF (KKX .EQ. I1) MGAUSS1 = KGAUSS
              IF (IIX .EQ. I2) MGAUSS2 = IGAUSS
              IF (JJX .EQ. I2) MGAUSS2 = JGAUSS
              IF (KKX .EQ. I2) MGAUSS2 = KGAUSS
              SSSMT = SSSMT + SMR3(IIX,JJX,KKX,IGAUSS,JGAUSS,KGAUSS)*
     &      SMH(IMU,J1,MGAUSS1)*SMH(IMU,J2,MGAUSS2)*
     &      (QWN_SM(IMU,IGAUSS))*
     &      (QWN_SM(IMU,JGAUSS))*(QWN_SM(IMU,KGAUSS))

              SSSGT = SSSGT + SGR3(IIX,JJX,KKX,IGAUSS,JGAUSS,KGAUSS)*
     &      SGH(IMU,J1,MGAUSS1)*SGH(IMU,J2,MGAUSS2)*
     &      (QWN_SM(IMU,IGAUSS))*
     &      (QWN_SM(IMU,JGAUSS))*(QWN_SM(IMU,KGAUSS))

                  ENDDO
             ENDDO
            ENDDO
130        CONTINUE
C
           BITA_SM(I1,I2,J1,J2) = SSSMT - DFLOAT(N-3)*SSSMB
           BITA_SG(I1,I2,J1,J2) = SSSGT - DFLOAT(N-3)*SSSGB

C       WRITE(*,*) I1, I2, J1, J2,   BITA(I1,I2,J1,J2)
C
           ENDDO
          ENDDO
         ENDDO
        ENDDO

C
C
C       CALCULATE COEFFICIENTS GAMA_SM(I1,I2,I3,J1,J2,J3), GAMA_SG(I1,I2,I3,J1,J2,J3)
C
        DO I1 = 1,N-2
         DO I2 = I1+1,N-1
          DO I3 = I2+1,N
           DO J1 = 1,NBAS_SM
            DO J2 = 1,NBAS_SM
             DO J3 = 1,NBAS_SM
C
             GAMA_SM(I1,I2,I3,J1,J2,J3) = 0.
             GAMA_SG(I1,I2,I3,J1,J2,J3) = 0.
            DO IGAUSS = 1,NGAUSS_SM
               DO JGAUSS = 1,NGAUSS_SM
                DO KGAUSS = 1,NGAUSS_SM
              GAMA_SM(I1,I2,I3,J1,J2,J3) = GAMA_SM(I1,I2,I3,J1,J2,J3) +
     &              SMR3(I1,I2,I3,IGAUSS,JGAUSS,KGAUSS)*
     &        SMH(IMU,J1,IGAUSS)*SMH(IMU,J2,JGAUSS)*SMH(IMU,J3,KGAUSS)*
     &       (QWN_SM(IMU,IGAUSS))*
     &       (QWN_SM(IMU,JGAUSS))*(QWN_SM(IMU,KGAUSS))

              GAMA_SG(I1,I2,I3,J1,J2,J3) = GAMA_SG(I1,I2,I3,J1,J2,J3) +
     &              SGR3(I1,I2,I3,IGAUSS,JGAUSS,KGAUSS)*
     &        SGH(IMU,J1,IGAUSS)*SGH(IMU,J2,JGAUSS)*SGH(IMU,J3,KGAUSS)*
     &       (QWN_SM(IMU,IGAUSS))*
     &       (QWN_SM(IMU,JGAUSS))*(QWN_SM(IMU,KGAUSS))

                    ENDDO
               ENDDO
              ENDDO
C
             ENDDO
            ENDDO
           ENDDO
          ENDDO
         ENDDO
        ENDDO

      IF (IID .EQ. 1) THEN
C          PRINT*,  'INDEPENDENT IDENTICAL DISTRIBUTION ...'
C          NBAS_SEN = MIN(NBAS, NBAS_SM)
C          SENSM = N* SM0
C          SENSG = N*SG0
C          DO I = 1,N
C              DO J = 1,NBAS_SEN
C                SENSM =  SENSM + ALFA(I,J)*ALFA_SMIID(I,J)
C                SENSG =  SENSG + ALFA(I,J)*ALFA_SGIID(I,J)
C              ENDDO
C          ENDDO
C
C          WRITE(*,*) 'SENSM = ', SENSM
C          WRITE(*,*) 'SENSG = ', SENSG
      ELSE IF (IID .EQ. 0) THEN
          PRINT*,  'INDEPENDENT BUT NOT INDENTICAL DISTRIBUTION
     1              '
C          NBAS_SEN = MIN(NBAS, NBAS_SM)
C          SENSM = N* SM0
C          SENSG = N*SG0
C          DO I = 1,N
C              DO J = 1,NBAS_SEN
C                SENSM =  SENSM + ALFA(I,J)*ALFA_SM(I,J)
C                SENSG =  SENSG + ALFA(I,J)*ALFA_SG(I,J)
C              ENDDO
C          ENDDO
C
      ELSE IF (IID .EQ. 2) THEN
          PRINT*,  'DEPENDENT DISTRIBUTION
     1              NOT READY YET ... '
C          NBAS_SEN = MIN(NBAS, NBAS_SM)
C          SENSM = N* SM0
C          SENSG = N*SG0
C          DO I = 1,N
C              DO J = 1,NBAS_SEN
C                SENSM =  SENSM + ALFA(I,J)*ALFA_SM(I,J)
C                SENSG =  SENSG + ALFA(I,J)*ALFA_SG(I,J)
C              ENDDO
C          ENDDO
C
      END IF

C     ==============================================
C       NOW CALCULATE THE SENSIVITY OF Q-TH (Q up to 2nd)  MOMENT BY ANALYTICAL EXPRESSION using direct pdd of response function
C     ==============================================

        PRINT*, 'the sensitivity q-th (Q up to 2nd) MOMENT  OF Y BY ANALYTICAL
     1   EXPRESSION  USING DIRECT pdd to response function y  IS  ....'
C

C     ===================
C     MOMENT OF ANALYTICAL
C     ===================

C     ----    1ST MOMENT
          PRINT*,  'INDEPENDENT IDENTICAL DISTRIBUTION ...'
        NBAS_SEN = MIN(NBAS, NBAS_SM)
        SENSM1 = N*SM0*Y0
        SENSG1 = N*SG0*Y0
        DO I = 1,N
            DO J = 1,NBAS_SEN
              SENSM1 =  SENSM1 + ALFA(I,J)*ALFA_SMIID(I,J)
              SENSG1 =  SENSG1 + ALFA(I,J)*ALFA_SGIID(I,J)
            ENDDO
        ENDDO
        PRINT*,  '---------(sensitivity of 1st moment)-------------'
        WRITE(*,*) 'SENSM1  = ', SENSM1
        WRITE(*,*) 'SENSG1 = ', SENSG1

C     ----    SENSITIVITY OF 2ND MOMENT

          SENSM2 = Y0**2*SM0 + SM0*(RM2-Y0**2) +
     1              2*Y0*(SENSM1 - N*SM0*Y0)
          SENSG2 = Y0**2*SG0 + SG0*(RM2-Y0**2) +
     1              2*Y0*(SENSG1 - N*SG0*Y0)

C     U*U*U

      DO I1=1,N
      DO K1=1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO L1=1,NBAS
          DO N1=1,NBAS

          IF (I1 .EQ. K1 .AND. K1 .EQ. M1) THEN
            IS = (J1+L1+N1)/2
            IF(MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS ) THEN
        SENSM2 = SENSM2 + ALFA(I1,J1)*ALFA(K1,L1)*ALFA_SMIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))*
     2     GAMMA(1.0+DFLOAT(N1)))/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)))

        SENSG2 = SENSG2 + ALFA(I1,J1)*ALFA(K1,L1)*ALFA_SGIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))*
     2     GAMMA(1.0+DFLOAT(N1)))/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)))
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO

          PRINT*,  '----------(sensitivity of 2ND moment)------------'
          WRITE(*,*) 'SENSM2 (UNIVARITE) = ', SENSM2
          WRITE(*,*) 'SENSG2 (UNIVARITE) = ', SENSG2
          SENSM2U = SENSM2
          SENSG2U = SENSG2

C     B*U*U

      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO N1=1,NBAS

          IF (I1 .EQ. K1 .AND. I2 .EQ. M1 ) THEN
            IF (J1 .EQ. L1 .AND. J2 .EQ. N1) THEN
            SENSM2 =  SENSM2 + BITA(I1,I2,J1,J2)*ALFA(K1,L1)*
     1                  ALFA_SMIID(M1,N1)
            SENSG2 =  SENSG2 + BITA(I1,I2,J1,J2)*ALFA(K1,L1)*
     1                  ALFA_SGIID(M1,N1)
            ENDIF
          ENDIF
          IF (I2 .EQ. K1 .AND. I1 .EQ. M1 ) THEN
            IF (J2 .EQ. L1 .AND. J1 .EQ. N1) THEN
            SENSM2 =  SENSM2 + BITA(I1,I2,J1,J2)*ALFA(K1,L1)*
     1                  ALFA_SMIID(M1,N1)
            SENSG2 =  SENSG2 + BITA(I1,I2,J1,J2)*ALFA(K1,L1)*
     1                  ALFA_SGIID(M1,N1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     U*B*U

      DO I1=1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS

          IF (K1 .EQ. I1 .AND. K2 .EQ. M1 ) THEN
            IF (L1 .EQ. J1 .AND. L2 .EQ. N1) THEN
            SENSM2 =  SENSM2 + BITA(K1,K2,L1,L2)*ALFA(I1,J1)*
     1                  ALFA_SMIID(M1,N1)
            SENSG2 =  SENSG2 + BITA(K1,K2,L1,L2)*ALFA(I1,J1)*
     1                  ALFA_SGIID(M1,N1)
            ENDIF
          ENDIF
          IF (K2 .EQ. I1 .AND. K1 .EQ. M1 ) THEN
            IF (L2 .EQ. J1 .AND. L1 .EQ. N1) THEN
            SENSM2 =  SENSM2 + BITA(K1,K2,L1,L2)*ALFA(I1,J1)*
     1                  ALFA_SMIID(M1,N1)
            SENSG2 =  SENSG2 + BITA(K1,K2,L1,L2)*ALFA(I1,J1)*
     1                  ALFA_SGIID(M1,N1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     B*B*U
      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS

          IF (I1 .EQ. K1 .AND. I1 .EQ. M1 ) THEN
           IS = (J1+L1+N1)/2
            IF(MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS ) THEN
            IF (I2 .EQ. K2 .AND. J2 .EQ. L2) THEN
             SENSM2 = SENSM2 + BITA(I1,I2,J1,J2)*BITA(K1,K2,L1,L2)
     1          *ALFA_SMIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))*
     2     GAMMA(1.0+DFLOAT(N1)))/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)))

             SENSG2 = SENSG2 + BITA(I1,I2,J1,J2)*BITA(K1,K2,L1,L2)
     1          *ALFA_SGIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))*
     2     GAMMA(1.0+DFLOAT(N1)))/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)))

            ENDIF
            ENDIF
          ENDIF

          IF (I2 .EQ. K2 .AND. I2 .EQ. M1 ) THEN
           IS = (J2+L2+N1)/2
            IF(MOD(J2+L2+N1, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N1 .LE. IS ) THEN
            IF (I1 .EQ. K1 .AND. J1 .EQ. L1) THEN
             SENSM2 = SENSM2 + BITA(I1,I2,J1,J2)*BITA(K1,K2,L1,L2)
     1          *ALFA_SMIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))*
     2     GAMMA(1.0+DFLOAT(N1)))/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N1)))

             SENSG2 = SENSG2 + BITA(I1,I2,J1,J2)*BITA(K1,K2,L1,L2)
     1          *ALFA_SGIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))*
     2     GAMMA(1.0+DFLOAT(N1)))/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N1)))

            ENDIF
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

          PRINT*,  '----------------------------------------'
          WRITE(*,*) 'SENSM2 (BIVARITE) = ', SENSM2
          WRITE(*,*) 'SENSG2 (BIVARITE) = ', SENSG2
      SENSM2B = SENSM2
      SENSG2B = SENSG2

      IF (NVAR .EQ. 3) THEN

C     T*U*U, UTU, UUT are zero

C     T*B*U
      DO I1=1,N-2
      DO I2=I1+1,N-1
      DO I3=I2+1,N
      DO K1=1,N-1
      DO K2=K1+1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO J3=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO N1=1,NBAS

          IF (I1 .EQ. K1 .AND. I2 .EQ. K2 .AND. I3 .EQ. M1 ) THEN
            IF (J1 .EQ. L1 .AND. J2 .EQ. L2 .AND. J3 .EQ. N1) THEN
            SENSM2  =  SENSM2  + GAMA(I1,I2,I3,J1,J2,J3)*
     1              BITA(K1,K2,L1,L2)*ALFA_SMIID(M1,N1)

            SENSG2  =  SENSG2  + GAMA(I1,I2,I3,J1,J2,J3)*
     1              BITA(K1,K2,L1,L2)*ALFA_SGIID(M1,N1)
            ENDIF
          ENDIF
          IF (I1 .EQ. K1 .AND. I2 .EQ. M1 .AND. I3 .EQ. K2 ) THEN
            IF (J1 .EQ. L1 .AND. J2 .EQ. N1 .AND. J3 .EQ. L2) THEN
            SENSM2  =  SENSM2  + GAMA(I1,I2,I3,J1,J2,J3)*
     1              BITA(K1,K2,L1,L2)*ALFA_SMIID(M1,N1)

            SENSG2  =  SENSG2  + GAMA(I1,I2,I3,J1,J2,J3)*
     1              BITA(K1,K2,L1,L2)*ALFA_SGIID(M1,N1)
            ENDIF
          ENDIF

          IF (I1 .EQ. M1 .AND. I2 .EQ. K1 .AND. I3 .EQ. K2 ) THEN
            IF (J1 .EQ. N1 .AND. J2 .EQ. L1 .AND. J3 .EQ. L2) THEN
            SENSM2  =  SENSM2  + GAMA(I1,I2,I3,J1,J2,J3)*
     1              BITA(K1,K2,L1,L2)*ALFA_SMIID(M1,N1)

            SENSG2  =  SENSG2  + GAMA(I1,I2,I3,J1,J2,J3)*
     1              BITA(K1,K2,L1,L2)*ALFA_SGIID(M1,N1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     B*T*U
      DO I1=1,N-1
      DO I2=I1+1,N
      DO K1=1,N-2
      DO K2=K1+1,N-1
      DO K3=K2+1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO L3=1,NBAS
          DO N1=1,NBAS

          IF (K1 .EQ. I1 .AND. K2 .EQ. I2 .AND. K3 .EQ. M1 ) THEN
            IF (L1 .EQ. J1 .AND. L2 .EQ. J2 .AND. L3 .EQ. N1) THEN
            SENSM2 =  SENSM2 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(I1,I2,J1,J2)
     1              *ALFA_SMIID(M1,N1)

            SENSG2 =  SENSG2 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(I1,I2,J1,J2)
     1              *ALFA_SGIID(M1,N1)
            ENDIF
          ENDIF
          IF (K1 .EQ. I1 .AND. K2 .EQ. M1 .AND. K3 .EQ. I2 ) THEN
            IF (L1 .EQ. J1 .AND. L2 .EQ. N1 .AND. L3 .EQ. J2) THEN
            SENSM2 =  SENSM2 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(I1,I2,J1,J2)
     1              *ALFA_SMIID(M1,N1)

            SENSG2 =  SENSG2 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(I1,I2,J1,J2)
     1              *ALFA_SGIID(M1,N1)
            ENDIF
          ENDIF

          IF (K1 .EQ. M1 .AND. K2 .EQ. I1 .AND. K3 .EQ. I2 ) THEN
            IF (L1 .EQ. N1 .AND. L2 .EQ. J1 .AND. L3 .EQ. J2) THEN
            SENSM2 =  SENSM2 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(I1,I2,J1,J2)
     1              *ALFA_SMIID(M1,N1)

            SENSG2 =  SENSG2 + GAMA(K1,K2,K3,L1,L2,L3)*BITA(I1,I2,J1,J2)
     1              *ALFA_SGIID(M1,N1)
            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

C     T*T*U
      DO I1=1,N-2
      DO I2=I1+1,N-1
      DO I3=I2+1,N
      DO K1=1,N-2
      DO K2=K1+1,N-1
      DO K3=K2+1,N
      DO M1=1,N
          DO J1=1,NBAS
          DO J2=1,NBAS
          DO J3=1,NBAS
          DO L1=1,NBAS
          DO L2=1,NBAS
          DO L3=1,NBAS
          DO N1=1,NBAS

          IF (M1 .EQ. I1 .AND. M1 .EQ. K1 ) THEN

            IS = (J1+L1+N1)/2

            IF( ( MOD(J1+L1+N1, 2) .EQ. 0 .AND. J1 .LE. IS
     1       .AND. L1 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( I2 .EQ. K2 .AND. I3 .EQ. K3 ) THEN
            IF( J2 .EQ. L2 .AND. J3 .EQ. L3)  THEN
             SENSM2 = SENSM2 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          ALFA_SMIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )

             SENSG2 = SENSG2 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          ALFA_SGIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J1))*GAMMA(1.0+DFLOAT(L1))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J1))
     2     *GAMMA(1.0+DFLOAT(IS-L1))*GAMMA(1.0+DFLOAT(IS-N1)) )
            ENDIF
            ENDIF

            ENDIF
          ENDIF

          IF (M1 .EQ. I2 .AND. M1 .EQ. K2 ) THEN

            IS = (J2+L2+N1)/2

            IF( ( MOD(IS, 2) .EQ. 0 .AND. J2 .LE. IS
     1       .AND. L2 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( I1 .EQ. K1 .AND. I3 .EQ. K3 ) THEN
            IF( J1 .EQ. L1 .AND. J3 .EQ. L3)  THEN
             SENSM2 = SENSM2 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          ALFA_SMIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N1)) )

             SENSG2 = SENSG2 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          ALFA_SGIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J2))*GAMMA(1.0+DFLOAT(L2))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J2))
     2     *GAMMA(1.0+DFLOAT(IS-L2))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          IF (M1 .EQ. I3 .AND. M1 .EQ. K3 ) THEN

            IS = (J3+L3+N1)/2

            IF( ( MOD(IS, 2) .EQ. 0 .AND. J3 .LE. IS
     1       .AND. L3 .LE. IS  .AND. N1 .LE. IS)) THEN

            IF( I1 .EQ. K1 .AND. I2 .EQ. K2 ) THEN
            IF( J1 .EQ. L1 .AND. J2 .EQ. L2)  THEN
             SENSM2 = SENSM2 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          ALFA_SMIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L3))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J3))
     2     *GAMMA(1.0+DFLOAT(IS-L3))*GAMMA(1.0+DFLOAT(IS-N1)) )

             SENSG2 = SENSG2 + GAMA(I1,I2,I3,J1,J2,J3)*
     1          GAMA(K1,K2,K3,L1,L2,L3)*
     1          ALFA_SGIID(M1,N1)*
     1     DSQRT(GAMMA(1.0+DFLOAT(J3))*GAMMA(1.0+DFLOAT(L3))
     2          *GAMMA(1.0+DFLOAT(N1)) )/(GAMMA(1.0+DFLOAT(IS-J3))
     2     *GAMMA(1.0+DFLOAT(IS-L3))*GAMMA(1.0+DFLOAT(IS-N1)) )

            ENDIF
            ENDIF

            ENDIF
          ENDIF

          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
          ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO
      ENDDO

          PRINT*,  '----------------------------------------'
          WRITE(*,*) 'SENSM2 (TRIVARITE) = ', SENSM2
          WRITE(*,*) 'SENSG2 (TRIVARITE) = ', SENSG2
      SENSM2T = SENSM2
      SENSG2T = SENSG2

      ENDIF
```

```fortran
C     ----------- ENDDO OF DO I=1,IMU   ----------
      ENDDO




      STOP
      END
C
C       -----------------------------------------------------------
        SUBROUTINE RESPON(X,Y)
C
C       CALCULATES Y FOR A SAMPLE OF X
C
      IMPLICIT REAL*8 (A-H,O-Z)
        REAL*8 X(20),Z(20),XMU(20),SIG(20), NMU(20),NSIG(20)
      REAL*8 Y, M(15,15), A1(15),A2(15),A3(15), test3(3,3)
      INTEGER NYQ, N
        COMMON /SR02/ XMU,SIG, NMU, NSIG, NYQ, N

      data A1/0.0118, 0.0456, 0.2297, 0.0393, 0.1177, 0.3865, 0.3897,
     1 0.6061, 0.6159, 0.4005, 1.0741, 1.1474, 0.7880, 1.1242, 1.1982/
      data A2/0.4341, 0.0887, 0.0512, 0.3233, 0.1489, 1.0360, 0.9892,
     1 0.9672, 0.8977, 0.8083, 1.8426, 2.4712, 2.3946, 2.0045, 2.2621/
      data A3/0.1044, 0.2057, 0.0774, 0.2730, 0.1253, 0.7526, 0.8570,
     1 1.0331, 0.8388, 0.7970, 2.2145, 2.0382, 2.4004, 2.0541, 1.9845/

C
C   DO I = 1,4
C   Z(I) = X(I)
C   ENDDO
      DO I = 1, 15
        Z(I) = NMU(I) + NSIG(I)*X(I)

      ENDDO
C      Z(1) = NMU(1) + NSIG(1)*X(1)
C       Z(2) = NMU(2) + NSIG(2)*X(2)
C       Z(3) = NMU(3)+ NSIG(3)*X(3)

c       test3 = reshape((/ 1, 2, 3, 4, 5, 6, 7, 8, 9 /), shape(test3))
      M = reshape((/  -2.2482886e-002, -1.8501666e-001,  1.3418263e-001,
     1  3.6867264e-001,  1.7172785e-001,  1.3651143e-001,
     1  -4.4034404e-001, -8.1422854e-002,  7.1321025e-001,
     1  -4.4361072e-001,  5.0383394e-001, -2.4101458e-002,
     1  -4.5939684e-002,  2.1666181e-001,  5.5887417e-002,
     1   2.5659630e-001,  5.3792287e-002,  2.5800381e-001,
     1   2.3795905e-001, -5.9125756e-001, -8.1627077e-002,
     1  -2.8749073e-001,  4.1581639e-001,  4.9752241e-001,
     1   8.3893165e-002, -1.1056683e-001,  3.3222351e-002,
     1  -1.3979497e-001, -3.1020556e-002, -2.2318721e-001,
     1  -5.5999811e-002,  1.9542252e-001,  9.5529005e-002,
     1  -2.8626530e-001, -1.4441303e-001,  2.2369356e-001,
     1   1.4527412e-001,  2.8998481e-001,  2.3105010e-001,
     1  -3.1929879e-001, -2.9039128e-001, -2.0956898e-001,
     1   4.3139047e-001,  2.4429152e-002,  4.4904409e-002,
     1   6.6448103e-001,  4.3069872e-001,  2.9924645e-001,
     1  -1.6202441e-001, -3.1479544e-001, -3.9026802e-001,
     1   1.7679822e-001,  5.7952663e-002,  1.7230342e-001,
     1   1.3466011e-001, -3.5275240e-001,  2.5146896e-001,
     1  -1.8810529e-002,  3.6482392e-001, -3.2504618e-001,
     1  -1.2127800e-001,  1.2463327e-001,  1.0656519e-001,
     1   4.6562296e-002, -2.1678617e-001,  1.9492172e-001,
     1  -6.5521126e-002,  2.4404669e-002, -9.6828860e-002,
     1   1.9366196e-001,  3.3354757e-001,  3.1295994e-001,
     1  -8.3615456e-002, -2.5342082e-001,  3.7325717e-001,
     1  -2.8376230e-001, -3.2820154e-001, -1.0496068e-001,
     1  -2.2073452e-001, -1.3708154e-001, -1.4426375e-001,
     1  -1.1503319e-001,  2.2424151e-001, -3.0395022e-002,
     1  -5.1505615e-001,  1.7254978e-002,  3.8957118e-002,
     1   3.6069184e-001,  3.0902452e-001,  5.0030193e-002,
     1  -7.7875893e-002,  3.7456560e-003,  8.8685604e-001,
     1  -2.6590028e-001, -7.9325357e-002, -4.2734919e-002,
     1  -1.8653782e-001, -3.5604718e-001, -1.7497421e-001,
     1   8.8699956e-002,  4.0025886e-001, -5.5979693e-002,
     1   1.3724479e-001,  2.1485613e-001, -1.1265799e-002,
     1  -9.2294730e-002,  5.9209563e-001,  3.1338285e-002,
     1  -3.3080861e-002, -2.4308858e-001, -9.9798547e-002,
     1   3.4460195e-002,  9.5119813e-002, -3.3801620e-001,
     1   6.3860024e-003, -6.1207299e-001,  8.1325416e-002,
     1   8.8683114e-001,  1.4254905e-001,  1.4776204e-001,
     1  -1.3189434e-001,  5.2878496e-001,  1.2652391e-001,
     1   4.5113625e-002,  5.8373514e-001,  3.7291503e-001,
     1   1.1395325e-001, -2.9479222e-001, -5.7014085e-001,
     1   4.6291592e-001, -9.4050179e-002,  1.3959097e-001,
     1  -3.8607402e-001, -4.4897060e-001, -1.4602419e-001,
     1   5.8107658e-002, -3.2289338e-001,  9.3139162e-002,
     1   7.2427234e-002, -5.6919401e-001,  5.2554237e-001,
     1   2.3656926e-001, -1.1782016e-002,  7.1820601e-002,
     1   7.8277291e-002, -1.3355752e-001,  2.2722721e-001,
     1   1.4369455e-001, -4.5198935e-001, -5.5574794e-001,
     1   6.6145875e-001,  3.4633299e-001,  1.4098019e-001,
     1   5.1882591e-001, -2.8019898e-001, -1.6032260e-001,
     1  -6.8413337e-002, -2.0428242e-001,  6.9672173e-002,
     1   2.3112577e-001, -4.4368579e-002, -1.6455425e-001,
     1   2.1620977e-001,  4.2702105e-003, -8.7399014e-002,
     1   3.1599556e-001, -2.7551859e-002,  1.3434254e-001,
     1   1.3497371e-001,  5.4005680e-002, -1.7374789e-001,
     1   1.7525393e-001,  6.0258929e-002, -1.7914162e-001,
     1  -3.1056619e-001, -2.5358691e-001,  2.5847535e-002,
     1  -4.3006001e-001, -6.2266361e-001, -3.3996882e-002,
     1  -2.9038151e-001,  3.4101270e-002,  3.4903413e-002,
     1  -1.2121764e-001,  2.6030714e-002, -3.3546274e-001,
     1  -4.1424111e-001,  5.3248380e-002, -2.7099455e-001,
     1  -2.6251302e-002,  4.1024137e-001,  2.6636349e-001,
     1   1.5582891e-001, -1.8666254e-001,  1.9895831e-002,
     1  -2.4388652e-001, -4.4098852e-001,  1.2618825e-002,
     1   2.4945112e-001,  7.1101888e-002,  2.4623792e-001,
     1   1.7484502e-001,  8.5286769e-003,  2.5147070e-001,
     1  -1.4659862e-001, -8.4625150e-002,  3.6931333e-001,
     1  -2.9955293e-001,  1.1044360e-001, -7.5690139e-001,
     1   4.1494323e-002, -2.5980564e-001,  4.6402128e-001,
     1  -3.6112127e-001, -9.4980789e-001, -1.6504063e-001,
     1   3.0943325e-003,  5.2792942e-002,  2.2523648e-001,
     1   3.8390366e-001,  4.5562427e-001, -1.8631744e-001,
     1   8.2333995e-003,  1.6670803e-001,  1.6045688e-001/
     2  ), shape(M))

        Y = 0.0
        DO I = 1,15
         Y = Y + A1(I)*Z(I) + A2(I)*SIN(Z(I)) + A3(I)*COS(Z(I))
        ENDDO
        DO I = 1,15
        DO J = 1,15
            Y = Y + Z(I)*M(J,I)*Z(J)
        ENDDO
        ENDDO

c        Y = (Z(1)**2 + Z(2)**2 + Z(3)**2 + Z(1)*Z(2)
c     1     + 2*Z(2)*Z(3) + 4*Z(3)*Z(1))**NYQ
c        Y = (4.0*Z(1)**4.0*Z(2)**4.0*Z(3)**4.0)**NYQ

C
        RETURN
        END

C
C--------------------------------------------------------------
        SUBROUTINE SCOR(X,S_MU, S_SIG)
C
C       CALCULATES SCORE FUNCTION FOR A SAMPLE OF X
C
      IMPLICIT REAL*8 (A-H,O-Z)
        REAL*8 X(20),Z(20),XMU(20),SIG(20), NMU(20),NSIG(20)
      REAL*8 S_MU(200), S_SIG(200)
        INTEGER NYQ, N
        COMMON /SR02/ XMU,SIG, NMU, NSIG, NYQ, N

C     ONLY FIRST TWO VARIABLES ARE DESIGN VARIABLES, FROM 3-5 VARIABLES, NEED ADD NEW SCORE FUNCTION FOR THIS PROBLEM
      DO I=1,N
      Z(I) = NMU(I) + NSIG(I)*X(I)
      S_MU(I) =  1./NSIG(I) * ((Z(I)-NMU(I))/NSIG(I))
      S_SIG(I) =  1./NSIG(I) * (((Z(I)-NMU(I))/NSIG(I))**2.0  - 1.0)
      ENDDO

        RETURN
        END



C
C--------------------------------------------------------------
        SUBROUTINE SCOR1(X,S_MU, S_SIG)
C
C       CALCULATES SCORE FUNCTION FOR A SAMPLE OF X
C
      IMPLICIT REAL*8 (A-H,O-Z)
        REAL*8 X(20),Z(20),XMU(20),SIG(20), NMU(20),NSIG(20)
      REAL*8 S_MU, S_SIG
        INTEGER NYQ, N
        COMMON /SR02/ XMU,SIG, NMU, NSIG, NYQ, N
C
C   DO I = 1,4
C   Z(I) = X(I)
C   ENDDO
      Z(1) = NMU(1) + NSIG(1)*X(1)
C   Z(2) = NMU(2) + NSIG(2)*X(2)
C   Z(3) = NMU(3) + NSIG(3)*X(3)
C
      S_MU =  1./NSIG(1) * ((Z(1)-NMU(1))/NSIG(1))
C     1       + 1/NSIG(2) * ((Z(2)-NMU(2))/NSIG(2))
C     2       + 1/NSIG(3) * ((Z(3)-NMU(3))/NSIG(3))
      S_SIG =  1./NSIG(1) * (((Z(1)-NMU(1))/NSIG(1))**2  - 1)
C     1        + 1/NSIG(2) * (((Z(2)-NMU(2))/NSIG(2))**2  - 1)
C     2        + 1/NSIG(3) * (((Z(3)-NMU(3))/NSIG(3))**2  - 1)
C

        RETURN
        END

C
C--------------------------------------------------------------
        SUBROUTINE SCOR2(X,S_MU, S_SIG)
C
C       CALCULATES SCORE FUNCTION FOR A SAMPLE OF X
C
      IMPLICIT REAL*8 (A-H,O-Z)
        REAL*8 X(20),Z(20),XMU(20),SIG(20), NMU(20),NSIG(20)
      REAL*8 S_MU, S_SIG
        INTEGER NYQ, N
        COMMON /SR02/ XMU,SIG, NMU, NSIG, NYQ, N
C

      S_MU =0.
      S_SIG =0.
      DO I =1,N
        Z(I) = NMU(I) + NSIG(I)*X(I)
        S_MU = S_MU + 1./NSIG(I) * ((Z(I)-NMU(I))/NSIG(I))
        S_SIG = S_SIG + 1./NSIG(I) * (((Z(I)-NMU(I))/NSIG(I))**2  - 1)
      ENDDO

        RETURN
        END



C
C--------------------------------------------------------------
        SUBROUTINE PDF_IID(X, Y)
C
C       CALCULATES PDF VALUE FOR A SAMPLE OF X
C
      IMPLICIT REAL*8 (A-H,O-Z)
        REAL*8 X(20),Z(20),XMU(20),SIG(20), NMU(20),NSIG(20)
      REAL*8 S_MU, S_SIG
      INTEGER NYQ, N
        COMMON /SR02/ XMU,SIG, NMU, NSIG, NYQ, N

      Y = 1.
      DO I = 1,N
        Z(I) = NMU(I) + NSIG(I)*X(I)
        Y = Y * 1./(NSIG(I)*DSQRT(2*PI)) * EXP(-0.5*
     1      ((Z(I)-NMU(I))/NSIG(I))**2)

      ENDDO

        RETURN
        END




C
C       ------------------------------------------------------------
        SUBROUTINE BASIS(X,PSIF,N,NBAS)
C
C       DEFINES HERMITE POLYNOMIALS - NORMALIZED W.R.T. N(0,1) PDF
C       DO NOT INCLUDE THE 0-ORDER, BECAUSE THE 0-ORDER GIVES MEAN
C     ALREADY INCLUDED IN Y0
C
      IMPLICIT REAL*8 (A-H,O-Z)
        REAL*8 X(N),PSIF(N,NBAS)
C
        DO I = 1,N
        IF (1 .LE. NBAS) PSIF(I,1) = X(I)
        IF (2 .LE. NBAS) PSIF(I,2) = (X(I)**2 - 1.)/DSQRT(2.D0)
        IF (3 .LE. NBAS) PSIF(I,3) = (X(I)**3 - 3.*X(I))/
     &                               DSQRT(6.D0)
        IF (4 .LE. NBAS) PSIF(I,4) = (X(I)**4 - 6.*X(I)**2 + 3.)/
     &                               DSQRT(24.D0)
        IF (5 .LE. NBAS) PSIF(I,5) = (X(I)**5 - 10.*X(I)**3 + 15.*X(I))/
     &                               DSQRT(120.D0)
        IF (6 .LE. NBAS) PSIF(I,6) = (X(I)**6 - 15.*X(I)**4 + 45.*X(I)**2
     &                              -15.)/DSQRT(720.D0)
        IF (7 .LE. NBAS) PSIF(I,7) = (X(I)**7 - 21.*X(I)**5 + 105.*X(I)**3
     &                              -105.*X(I))/DSQRT(5040.D0)
        IF (8 .LE. NBAS) PSIF(I,8) = (X(I)**8 - 28.*X(I)**6 + 210.*X(I)**4
     &                              -420.*X(I)**2 + 105.)/DSQRT(40320.D0)
        IF (9 .LE. NBAS) PSIF(I,9) = (X(I)**9 - 36.*X(I)**7 + 378.*X(I)**5
     &              -1260.*X(I)**3 + 945.*X(I))/DSQRT(362880.D0)
        ENDDO
C
        RETURN
        END
```