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C       ============================================================
c       Sensitivity analysis for
C       EXAMPLE 5: a six-bay, twenty-one-bar truss (Lognormally distributed)
C       METHOD: PDD-MCS
c           MAIN CODE
C
C
C
C
C       N = 21
c
C     X(I) ~ , Lognormally distributed,  mu1 ... mu4 = 120, mu5 = 50, mu6 = 40, COV = c \in [0.1, 0.7]    STIELTJES PROCEDURE
C     GAUSS QUADRATURE RULE BY STIELTJES PROCEDURE
c
C
C     -------  command line parameters to run the code   -------------
C     PROGRAM.EXE NVAR  NBAS_R
C
C*****************************************************************************
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      IMPLICIT REAL*8 (A-H,O-Z)




        DOUBLE PRECISION X(200),G(200),MOMSEN_OUT(10,2),XMU_IN(200),
     1   OBJ(200), XSIG_IN(200),X0(200),XL01(200),XU01(200)

        REAL*8 XMU(200),SIG(200),NMU(200),NSIG(200)
        COMMON /SR02/ NMU, NSIG, NYQ, N
        INTEGER NBAS(20), NGAUSS(20),NGAUSS_SM(20),NBAS_SM(20), IFLAG_Y,
     1       I_EVAL, NVAR, I_Y, NBAS_R

        COMMON /XR01/ N_F, N_GF, N_GC, N_EF,N_EC, N_EF1, N_EC1,
     1    N_EF2, N_EC2
         COMMON /XR04/ NBAS_R, NGAUSS_R, NVAR

         COMMON /XR09/ I_EVAL
         CHARACTER(80) FN
       COMMON /XR10/ FN
         COMMON /XR11/ XL01, XU01
         COMMON /XR20/ C1_SCAL, I_RECIPROCAL
      INTEGER IITER, IITER1, N_PREFEA, N_FEA, IITER_TOTAL, I_SQP
      COMMON /XR05/ IITER, IITER1, N_PREFEA, N_FEA, IITER_TOTAL, I_SQP

      REAL*8 PF, PF_MCS, PF_SEN(10,10), PF_SEN_MCS(10,10), TS_OUT,
     1    Y0, YU(10,10), WU(10,10)


        DOUBLE PRECISION  pf_sen_out_pdd(200,2), pf_sen_out_crude(200,2),
     1   pf_sen_out_crude_fd(200,2)

      INTEGER NBAS_SPA, NGAUSS_SPA ,status

      COMMON /SPA01/ Y0, YU,WU, NBAS_SPA, NGAUSS_SPA
       CHARACTER(80) MSG,MSG1
       CHARACTER(320) buf
       INTEGER IW1
       COMMON /XR07/ IW1
        n1 = 1
        n2 = 2
        n3 = 3
        n4 = 4
        n5 = 5
        n6 = 6
        n7 = 7
        n8 = 8

        IW1 = 0

        MSG = 'PROGRAM NVAR  NBAS_R'


        CALL GETARG(n1, buf, status)
        IF (status .EQ. -1) THEN
        PRINT*, 'WRONG NVAR!'
        PRINT*, MSG
C        PRINT*, MSG1
        STOP
        ENDIF


        Read( buf, '(i)' )  NVAR
        PRINT*, 'NVAR = '
        WRITE (*,*) NVAR


        CALL GETARG(n2, buf, status)
        IF (status .EQ. -1) THEN
        PRINT*, 'WRONG NVAR!'
        PRINT*, MSG
        STOP
        ENDIF

        Read( buf, '(i)' )  NBAS_R
        PRINT*, 'NBAS_R = '
        WRITE (*,*) NBAS_R




!        NVAR =2


!        NBAS_R = 3

        I_Y = 0


      NBAS_SPA = 1
c       NGAUSS_SPA = 3

        c0 = 1.0

       IFLAG_AIJK  = 0
       N = 21
!       N = 5
       IMCS = 0
c       NVAR = 1


        X0(1) = 2
        X0(2) = 2
        X0(3) = 2
        X0(4) = 2
        X0(5) = 2
        X0(6) = 2

        X0(7) = 10
        X0(8) = 10
        X0(9) = 10
        X0(10) = 10
        X0(11) = 10
        X0(12) = 10

        X0(13) = 3
        X0(14) = 3
        X0(15) = 3
        X0(16) = 3
        X0(17) = 3

        X0(18) = 1
        X0(19) = 1
        X0(20) = 1
        X0(21) = 1



        NSAMP = 10**7
        IID = 0

        cov = 0.1

        DO I = 1, N
        XMU_IN(I) = X0(I)
c        XSIG_IN(I) = 0.1 *XMU_IN(I)
        XSIG_IN(i) = cov * XMU_in(i)
        ENDDO

!        XMU_IN = 1.0
!        XSIG_IN = 0.2



        NBAS = NBAS_R
        NBAS_SM = NBAS_R
        NGAUSS = 2*NBAS_R-1
        NGAUSS_SM = 2
        NGAUSS_GQ = 2


c       -- modify main
      dcov =  0.02
      ncov  = (0.7-0.1)/dcov
      ncum  = 5
      ng_cum = 10
      ng_cum_sen = 10
      ntheta = 2

      n_comp = 2

      do i = 1,n_comp
       call PDD(XMU_IN, XSIG_IN, nvar, NBAS_R, i)

       enddo

       call MCS_PDD2_sys (XMU_IN, XSIG_IN, nvar, NBAS_R,  Nsamp,
     1   n_comp,pf_sen_out_pdd, pf_sen_out_crude, pf_sen_out_crude_fd)

       OPEN(200,FILE='PDD_MCS_cdf.DAT',STATUS='UNKNOWN')


       WRITE(200,'(F20.10)'), pf_sen_out_pdd(1,1)
       WRITE(200,'(<21>F20.10)'), pf_sen_out_pdd(2:22,1)
       WRITE(200,'(<21>F20.10)'), pf_sen_out_pdd(2:22,2)


!        call MCS_crude_sys (XMU_IN, XSIG_IN,   Nsamp,
!     1   n_comp, pf_sen_out)

       OPEN(201,FILE='crude_MCS_cdf.DAT',STATUS='UNKNOWN')

       WRITE(201,'(F20.10)'), pf_sen_out_crude(1,1)
       WRITE(201,'(<21>F20.10)'), pf_sen_out_crude(2:22,1)
       WRITE(201,'(<21>F20.10)'), pf_sen_out_crude(2:22,2)

       OPEN(202,FILE='crude_MCS_cdf_fd.DAT',STATUS='UNKNOWN')

       WRITE(202,'(F20.10)'), pf_sen_out_crude_fd(1,1)
       WRITE(202,'(<21>F20.10)'), pf_sen_out_crude_fd(2:22,1)
       WRITE(202,'(<21>F20.10)'), pf_sen_out_crude_fd(2:22,2)


      close(200)
      close(201)
      close(202)

      END
```