```
C
C     THIS PROGRAM PERFORMS QUASI MONTE CARLO SIMULATION
C     OF ACCOUSTIC ANALYSIS OF THE CAB OF A LIGHT-TRUCK
C
C     THE PROBLEM IS TAKEN FROM ABAQUS 6.12 DOCUMENTATION
C     MODEL-1 CABIN-AIR COUPLED ACCOUSTIC ANALYSIS MODEL
C     WITH ONLY DIFFUSE FIELD FOR AIRBORNE LOAD MODELING
C
C     SEE THE ABAQUS DOCUMENTATION FOR DETAILS OF THE PROBLEM
C
C     THE PROBLEM COMPRISE OF 53 RANDOM VARIABLES
C     DEFINING THE RANDOM MATERIAL PROPERTIES OF TOTAL 24 MATERIALS
C
C     THE RANDOM VARIABLES ARE MODELED AS UNIFORMLY DISTRIBUTED
C     WITH COV = 0.2 AND FOLLOWING MEANS
C
C       rho1            = 7.8900E-009
C       rho3            = 7.8900E-009
C       rho4            = 7.8900E-009
C       rho5            = 7.8900E-009
C       rho6            = 7.8900E-009
C       rho7            = 1.2000E-009
C       rho8            = 2.5000E-009
C       rho9            = 1.1000E-009
C       rho10           = 7.8900E-009
C       rho11           = 2.0898E-008
C       rho12           = 6.9110E-009
C       rho13           = 8.0598E-009
C       rho14           = 7.8900E-009
C       rho15           = 2.5270E-010
C       rho16           = 1.4908E-010
C       rho17           = 7.5500E-010
C       rho18           = 2.5000E-009
C       rho19           = 7.8000E-009
C       rho20           = 1.9640E-009
C       rho21           = 3.8980E-009
C       rho22           = 1.8200E-009
C       rho23           = 1.2000E-012
C       ymod1           = 2.1000E+005
C       ymod2           = 2.1000E+005
C       ymod3           = 2.1000E+005
C       ymod4           = 2.1000E+005
C       ymod5           = 2.1000E+005
C       ymod6           = 2.1000E+005
C       ymod7           = 2.8000E+003
C       ymod8           = 7.4000E+004
C       ymod9           = 3.4000E+003
C       ymod10          = 2.1000E+005
C       ymod11          = 2.1000E+005
C       ymod12          = 2.1000E+005
C       ymod13          = 2.4610E+005
C       ymod14          = 2.1000E+005
C       ymod15          = 2.0000E+003
C       ymod16          = 2.6000E+003
C       ymod17          = 2.0000E+003
C       ymod18          = 2.1000E+005
C       ymod19          = 2.0000E+005
C       ymod20          = 2.1000E+005
C       ymod21          = 1.2000E+005
C       ymod22          = 2.1000E+004
C       yield3          = 2.7000E+004
C       yield4          = 2.7000E+004
C       yield5          = 2.7000E+004
C       yield6          = 3.5000E+004
C       yield7          = 4.5000E+003
C       yield8          = 1.1800E+004
C       yield9          = 1.0000E+004
C       bulk1           = 1.1990E-001
C       imped           = 5.0000E+005
C
C     UNITS:
C
C     ALL MASS DENSITIES : KG/MM^3
C     ALL MODULI         : PA
C
C-----------------------------------------------------------------------
C
C     FOLLOWING FILES MUST BE PRESENT IN THE WORKING DIRECTORY:
C
C     1.) response_save.f90          THIS FILE
C     2.) materials_input.inp        ABAQUS INPUT FILE DEFINING 53 RANDOM MATERIAL PROPERTIES
C     3.) acoustic_definition.inp    ABAQUS INPUT FILE DEFINING AIR-MATERIAL AND THE FEA JOB
C
C       4.) tr_cabin_air_w.inp         4.) TO 12.) ARE ABAQUS INPUT FILES...
C     5.) tr_cabin_elements.inp        WELL DEFINED IN THE ABAQUS DOCUMENTATION
C     6.) tr_cabin_elsets.inp          AND USED HERE THE WAY THEY WERE, EXCEPT FOR THE FOLLOWING
C     7.) tr_cabin_nodes.inp           CHANGES:
C     8.) tr_cabin_nsets.inp             (i) NODE NUMBER FOR THE NODE NEAR DRIVER'S EAR IS CHANGED TO
C     9.) tr_cabin_sections.inp        2165 IN THE FILE tr_cabin_nsets.inp AS PER THE SPECIFICATIONS
C    10.) tr_materials_acous.inp       OF MEASURING SOUND PRESSURE LEVELS IN ISO-5128
C    11.) tr_parameters.inp            (ii) THE 53 MATERIAL PROPERTIES DEFINED AS RANDOM VARIABLES
C    12.) tr_parameters_inphase.inp    ARE CHANGED FROM NUMBERS TO THEIR VARIABLE NAMES IN THE FILE
C                                      tr_materials_acous.inp. THEIR VALUES ARE READ FROM THE FILE
C                                      materials_input.inp
C
C    13.) run_acoustics.py          PYTHON FILE THAT RUNS FEA IN ABAQUS AND SAVES OUTPUT
C    14.) run_abaqus.bat            CALLED BY THIS CODE TO RUN acoustic.py
C    15.) SOBOL_POINTS.DAT          53-DIMENSIONAL SOBOL POINTS
C    16.) abaqus_v6.env             ABAQUS ENVIRONMENT FILE FOR CALLING RESEARCH LICENSE
C
C-----------------------------------------------------------------------
C
C     THIS PROGRAM PERFORMS THE FOLLOWING PROCESS:
C
C     1.) READS THE RANDOM INPUT VARIABLE, 53 DIMENSIONAL VECTOR
C         GENERATED AS SOBOL SEQUENCE FROM MATLAB
C
C     2.) TRANSFORMS THESE U[0 1] POINTS TO THE RESPECTIVE DISTRIBUTIONS
C         TO GET VALUES OF 53 RANDOM MATERIAL PROPERTIES
C
C     3.) EDITS THE FILE materials_input.inp WITH NEW VALUES OF MATERIAL
C         PROPERTIES
C
C     4.) RUNS ABAQUS FEA WITH NEW MATERIAL PROPERTIES, WAITS FOR COMPLETION
C         OF THE JOB, AND THEN CREATES UPDATED OUTPUT FILES
C
C     NOTE THAT THIS PROGRAM EDITS ONLY ONE FILE (materials_input.inp) IN EACH
C     SIMULATION, AND THEN UPDATES ALL THE OUTPUT FILES
C
C-----------------------------------------------------------------------
C
C     COMPILING THIS PROGRAM ON WINDOWS, USING ifort COMPILER
C     GIVE THE FOLLOWING COMMANDS:
C
C     1.) ifort -o QMCS response_save.f90 %LINK_FXL%
C
C     2.) QMCS
C
C-----------------------------------------------------------------------
C
      MODULE COMMONVARS
            IMPLICIT NONE
            REAL*8, PUBLIC :: A(53),B(53),ABDIFF(53)
      END MODULE COMMONVARS
C
C-----------------------------------------------------------------------
C
      USE COMMONVARS
      IMPLICIT REAL*8(A-B,O-Z)
      REAL*8 X(53),XNU(53)
      REAL*8 YPOR(200),YMODE1(14021),YMODE2(14021)
        CHARACTER*100 STRING1
C
      XMU(1)  = 7.8900E-009
      XMU(2)  = 7.8900E-009
      XMU(3)  = 7.8900E-009
      XMU(4)  = 7.8900E-009
      XMU(5)  = 7.8900E-009
      XMU(6)  = 1.2000E-009
      XMU(7)  = 2.5000E-009
      XMU(8)  = 1.1000E-009
      XMU(9)  = 7.8900E-009
      XMU(10) = 2.0898E-008
      XMU(11) = 6.9110E-009
      XMU(12) = 8.0598E-009
      XMU(13) = 7.8900E-009
      XMU(14) = 2.5270E-010
      XMU(15) = 1.4908E-010
      XMU(16) = 7.5500E-010
      XMU(17) = 2.5000E-009
      XMU(18) = 7.8000E-009
      XMU(19) = 1.9640E-009
      XMU(20) = 3.8980E-009
      XMU(21) = 1.8200E-009
      XMU(22) = 1.2000E-012
      XMU(23) = 2.1000E+005
      XMU(24) = 2.1000E+005
      XMU(25) = 2.1000E+005
      XMU(26) = 2.1000E+005
      XMU(27) = 2.1000E+005
      XMU(28) = 2.1000E+005
      XMU(29) = 2.8000E+003
      XMU(30) = 7.4000E+004
      XMU(31) = 3.4000E+003
      XMU(32) = 2.1000E+005
      XMU(33) = 2.1000E+005
      XMU(34) = 2.1000E+005
      XMU(35) = 2.4610E+005
      XMU(36) = 2.1000E+005
      XMU(37) = 2.0000E+003
      XMU(38) = 2.6000E+003
      XMU(39) = 2.0000E+003
      XMU(40) = 2.1000E+005
      XMU(41) = 2.0000E+005
      XMU(42) = 2.1000E+005
      XMU(43) = 1.2000E+005
      XMU(44) = 2.1000E+004
      XMU(45) = 2.7000E+004
      XMU(46) = 2.7000E+004
      XMU(47) = 2.7000E+004
      XMU(48) = 3.5000E+004
      XMU(49) = 4.5000E+003
      XMU(50) = 1.3800E+004
      XMU(51) = 1.0000E+004
      XMU(52) = 1.3990E-001
      XMU(53) = 5.0000E+005
C
      COV = 0.2
      ACOEFF = 1.D0 - COV*DSQRT(3.D0)
      BCOEFF = 1.D0 + COV*DSQRT(3.D0)
C
      DO I = 1,53
      A(I) = XMU(I)*ACOEFF
      B(I) = XMU(I)*BCOEFF
      ABDIFF(I) = B(I)-A(I)
      ENDDO
C
        OPEN(1000,FILE='SOBOL_POINTS.DAT', STATUS='OLD', &
             ACCESS='SEQUENTIAL', FORM='FORMATTED')
C
      OPEN(10,FILE='RESPONSE_POR.DAT', STATUS='UNKNOWN', &
             ACCESS='SEQUENTIAL', FORM='FORMATTED')
      OPEN(20,FILE='RESPONSE_MODE_35.DAT', STATUS='UNKNOWN', &
             ACCESS='SEQUENTIAL', FORM='FORMATTED')
      OPEN(30,FILE='RESPONSE_MODE_44.DAT', STATUS='UNKNOWN', &
             ACCESS='SEQUENTIAL', FORM='FORMATTED')
C
      PRINT*,'ENTER THE SAMPLE SIZE'
      READ*,NSAMP
C
       DO I = 1,53
       X(I) = 0.500
       X(I) = 0.D0
       X(I) = 1.D0
       ENDDO
C
       DO ISAMP = 1, NSAMP
C
        READ(1000,'(5JE25.15E3)') ( X(I), I = 1,53 )
C
       IF(ISAMP.LT.290) GOTO 100
        CALL RESPON(X)
C
        OPEN(500,FILE='POR_2165.DAT', STATUS='OLD', &
             ACCESS='SEQUENTIAL', FORM='FORMATTED')
       DO IREAD = 1,2
        READ(500,'(A100)')STRING1
       ENDDO
       DO IREAD = 1,200
        READ(500,'(A34,6G25.9)') STRING1,YPOR(IREAD)
       ENDDO
       CLOSE(500)
       WRITE(10,'(200G20.9)') ( YPOR(J),J=1,200 )
C
       OPEN(510,FILE='MODE_35.DAT', STATUS='OLD', &
            ACCESS='SEQUENTIAL', FORM='FORMATTED')
       OPEN(520,FILE='MODE_44.DAT', STATUS='OLD', &
            ACCESS='SEQUENTIAL', FORM='FORMATTED')
       DO IREAD = 1,28
        READ(510,'(A100)')STRING1
        READ(520,'(A100)')STRING1
       ENDDO
       DO IREAD = 1, 14021
        READ(510,'(I19,3G20.9)') INODE,YMODE1(IREAD)
        READ(520,'(I19,3G20.9)') INODE,YMODE2(IREAD)
       ENDDO
       CLOSE(510)
       CLOSE(520)
C
        WRITE(20,'(14021G20.9)') ( YMODE1(J),J=1,14021 )
        WRITE(30,'(14021G20.9)') ( YMODE2(J),J=1,14021 )
C
        WRITE(*,*)
        WRITE(*,'(15,A5,15,A10)') ISAMP,'OF',NSAMP,'SAMPLES'
        WRITE(*,*)
C
100   CONTINUE
      ENDDO
C
      CLOSE(10)
      CLOSE(20)
      CLOSE(30)
C
      STOP
      END
C
C-----------------------------------------------------------------------
C
        SUBROUTINE RESPON (X)
C
      USE COMMONVARS
      IMPLICIT REAL*8(A-B,O-Z)
      REAL*8 X(53),Z(53)
        CHARACTER*50 CFILE
C
      DO I = 1,53
      Z(I) = ABDIFF(I)*X(I) + A(I)
      ENDDO
C
        OPEN(100,FILE='materials_input.inp', STATUS='UNKNOWN', &
             ACCESS='SEQUENTIAL', FORM='FORMATTED')
C
        WRITE(100,'(A10)')'*parameter'
        WRITE(100,'(A12,E24.14E3)')'rho1       = ',Z(1)
        WRITE(100,'(A12,E24.14E3)')'rho3       = ',Z(2)
        WRITE(100,'(A12,E24.14E3)')'rho4       = ',Z(3)
        WRITE(100,'(A12,E24.14E3)')'rho5       = ',Z(4)
        WRITE(100,'(A12,E24.14E3)')'rho6       = ',Z(5)
        WRITE(100,'(A12,E24.14E3)')'rho7       = ',Z(6)
        WRITE(100,'(A12,E24.14E3)')'rho8       = ',Z(7)
        WRITE(100,'(A12,E24.14E3)')'rho9       = ',Z(8)
        WRITE(100,'(A12,E24.14E3)')'rho10      = ',Z(9)
        WRITE(100,'(A12,E24.14E3)')'rho11      = ',Z(10)
        WRITE(100,'(A12,E24.14E3)')'rho12      = ',Z(11)
        WRITE(100,'(A12,E24.14E3)')'rho13      = ',Z(12)
        WRITE(100,'(A12,E24.14E3)')'rho14      = ',Z(13)
        WRITE(100,'(A12,E24.14E3)')'rho15      = ',Z(14)
        WRITE(100,'(A12,E24.14E3)')'rho16      = ',Z(15)
        WRITE(100,'(A12,E24.14E3)')'rho17      = ',Z(16)
        WRITE(100,'(A12,E24.14E3)')'rho18      = ',Z(17)
        WRITE(100,'(A12,E24.14E3)')'rho19      = ',Z(18)
        WRITE(100,'(A12,E24.14E3)')'rho20      = ',Z(19)
        WRITE(100,'(A12,E24.14E3)')'rho21      = ',Z(20)
        WRITE(100,'(A12,E24.14E3)')'rho22      = ',Z(21)
        WRITE(100,'(A12,E24.14E3)')'rho23      = ',Z(22)
        WRITE(100,'(A12,E24.14E3)')'ymod1      = ',Z(23)
        WRITE(100,'(A12,E24.14E3)')'ymod2      = ',Z(24)
        WRITE(100,'(A12,E24.14E3)')'ymod3      = ',Z(25)
        WRITE(100,'(A12,E24.14E3)')'ymod4      = ',Z(26)
        WRITE(100,'(A12,E24.14E3)')'ymod5      = ',Z(27)
        WRITE(100,'(A12,E24.14E3)')'ymod6      = ',Z(28)
        WRITE(100,'(A12,E24.14E3)')'ymod7      = ',Z(29)
        WRITE(100,'(A12,E24.14E3)')'ymod8      = ',Z(30)
        WRITE(100,'(A12,E24.14E3)')'ymod9      = ',Z(31)
        WRITE(100,'(A12,E24.14E3)')'ymod10     = ',Z(32)
        WRITE(100,'(A12,E24.14E3)')'ymod11     = ',Z(33)
        WRITE(100,'(A12,E24.14E3)')'ymod12     = ',Z(34)
        WRITE(100,'(A12,E24.14E3)')'ymod13     = ',Z(35)
        WRITE(100,'(A12,E24.14E3)')'ymod14     = ',Z(36)
        WRITE(100,'(A12,E24.14E3)')'ymod15     = ',Z(37)
        WRITE(100,'(A12,E24.14E3)')'ymod16     = ',Z(38)
        WRITE(100,'(A12,E24.14E3)')'ymod17     = ',Z(39)
        WRITE(100,'(A12,E24.14E3)')'ymod18     = ',Z(40)
        WRITE(100,'(A12,E24.14E3)')'ymod19     = ',Z(41)
        WRITE(100,'(A12,E24.14E3)')'ymod20     = ',Z(42)
        WRITE(100,'(A12,E24.14E3)')'ymod21     = ',Z(43)
        WRITE(100,'(A12,E24.14E3)')'ymod22     = ',Z(44)
        WRITE(100,'(A12,E24.14E3)')'yield3     = ',Z(45)
        WRITE(100,'(A12,E24.14E3)')'yield4     = ',Z(46)
        WRITE(100,'(A12,E24.14E3)')'yield5     = ',Z(47)
        WRITE(100,'(A12,E24.14E3)')'yield6     = ',Z(48)
        WRITE(100,'(A12,E24.14E3)')'yield7     = ',Z(49)
        WRITE(100,'(A12,E24.14E3)')'yield8     = ',Z(50)
        WRITE(100,'(A12,E24.14E3)')'yield9     = ',Z(51)
        WRITE(100,'(A12,E24.14E3)')'bulk1      = ',Z(52)
        WRITE(100,'(A12,E24.14E3)')'imped      = ',Z(53)
C
        CLOSE(100)
C
          WRITE (CFILE, '(A50)') 'run-abaqus run_acoustics'
          CALL SYSTEM (CFILE)
C
        RETURN
        END
```