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C-----------------------------------------------------------------------
C                REGRESSION ANALYSIS WITH CENSORED DATA
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C                        DESCRIPTION OF VARIABLE
C                T     IS SURVIVAL TIME OR UNCENSORED DATA
C                C     IS CENSORED TIME OR CENSORED DATA
C                Y     IS THE VARIABLE THAT WANT TO OBSERVE
C                      Y     = MIN (T,C)
C                DELTA IS INDICATOR VARIABLES WITH ASSOCIATE Y
C                      DELTA = 1     IF T < C  : (UNCENSORED DATA)
C                            = 0     IF T > C  : (CENSORED DATA)
C                X     IS INDEPENDENT VARIABLE
C                N     NUMBER OF TOTAL OBSERVATION
C                      (UNCENSORED DATA AND CENSORED DATA)
C                KU    IS NUMBER OF UNCENSORED DATA
C                KC    IS NUMBER OF UNCENSORED DATA
C-----------------------------------------------------------------------
C
      DIMENSION X1(200), T(200), C(200), XU(200), YU(200),
     *          XC(200), YC(200), A(3), B(3), AA(3), BB(3), AMSEA(3),
     *          AMSEB(3), TAMSEA(3), TAMSEB(3), V(200), VU(200), VC(200)
      DIMENSION UC(10)
      COMMON    IX, Y(200), X(200), DELTA(200), DEL(200), E(200),
     *          RA(200), P(200), S(200), W(200), WU(200), WC(200)
      DO 111 I=1,10
         READ(5,333) UC(I)
  333    FORMAT(F5.1)
  111 CONTINUE
      IX   =  973253
      AVER = 0.0
      N    = 10
      CEN  = 0.0
      KC   = 0
      KU   = 0
      DO 222 III=1,3
         AA(III) = 0.0
         BB(III) = 0.0
         TAMSEB(III) = 0.0
         TAMSEA(III) = 0.0
  222 CONTINUE
      PRINT *, 'UNIFORM    ', 'N = ' N
      DO 10 J1=1,10
C
C ***** GENERATE INDEPENDENT VARIABLE X FROM RANDOM NUMBER *****
      DO 5 I=1,N
         CALL RANDU (IX,IY,RN)
         X1(I) = RN
    5 CONTINUE
C
         DO 15 J2=1,100
C ***** GENERATE UNCENSORED DATA *****
            DO 20 J3=1,N
               CALL NORMAL(AMEAN,SIGMA,E1)
               T(J3) = ALPHA + BETA * X1(J3) + E1
```

```
   20        CONTINUE
C
C ***** GENERATE CENSORED DATA FROM UNIFORM DISTFIBUTUION *****
            DO 25 J4=1,N
               A1     = BETA * X1(J4)
               B1     = BETA * X1(J4) + UC(J1)
               CALL UNIFOR (A1,B1,C(J4))
   25        CONTINUE
C
C ***** SELECT UNCENSORED DATA AND CENSORED DATA *****
            DO 30 J5=1,N
               IF (C(J5).LT.T(J5)) GOTO 40
               Y(J5)       = T(J5)
               DELTA(J5)   = 1.0
               DEL(J5)     = 1.0
               X(J5)       = X1(J5)
               KU          = KU + 1
               YU(KU)      = T(J5)
               XU(KU)      = X1(J5)
               GOTO 30
   40          Y(J5)       = C(J5)
               DELTA(J5)   = 0.0
               DEL(J5)     = 0.0
               X(J5)       = X1(J5)
               KC          = KC + 1
               YC(KC)      = C(J5)
               XC(KC)      = X1(J5)
   30        CONTINUE
C
C ***** COUNT NUMBER PERCENT OF CENSORED DATA *****
            CEN  = (KC*100.0) / N
            AVER = AVER + CEN
            CEN  = 0.0
C
C ------------------------------------------------------------------------
C *****                    LEAST SQUARE METHOD                      *****
C ------------------------------------------------------------------------
      CALL LS(N,Y,X,A(1),B(1))
      AA(1)   =   AA(1) + A(1)
      BB(1)   =   BB(1) + B(1)
      AMSEA(1) = (A(1)-ALPHA)**2
      AMSEB(1) = (B(1)-BETA)**2
      TAMSEA(1) = TAMSEA(1) + AMSEA(1)
      TAMSEB(1) = TAMSEB(1) + AMSEB(1)
C
C
C ------------------------------------------------------------------------
C *****                      MILLER METHOD                          *****
C ------------------------------------------------------------------------
      CALL LS(KU,YU,XU,A(2),B(2))
C
C
      B2 = 0.0
      DO 70 MI=1,15
      JB = 0
         CALL WEIGHT(B(2),N,JB)
         XBARM = 0.0
         SUM1  = 0.0
         SUM2  = 0.0
         DO 75 N1=1,KU
```

```
            XBARM = XBARM + WU(N1)*XU(N1)
 75      CONTINUE
         DO 100 N2=1,KU
            SUM1  = SUM1 + WU(N2)*YU(N2)*(XU(N2)-XBARM)
            SUM2  = SUM2 + WU(N2)*((XU(N2)-XBARM)**2)
100      CONTINUE
            B(2)  = SUM1 / SUM2
            IF (B(2).EQ.B2) GOTO 105
            IF (M1.EQ.15) GOTO 101
            B2 = B(2)
 70   CONTINUE
101   B(2)  = (B(2) + B2) / 2.0
105   XBARM = 0.0
      YBARM = 0.0
      DO 110 N3=1,KU
         XBARM  = XBARM + WU(N3)*XU(N3)
         YBARM  = YBARM + WU(N3)*YU(N3)
110   CONTINUE
      A(2)       = YBARM - B(2)*XBARM
      BB(2)      = BB(2) + B(2)
      AA(2)      = AA(2) + A(2)
      AMSEA(2)   = (A(2)-ALPHA)**2
      AMSEB(2)   = (B(2)-BETA)**2
      TAMSEA(2)  = TAMSEA(2) + AMSEA(2)
      TAMSEB(2)  = TAMSEB(2) + AMSEB(2)
C
C ------------------------------------------------------------------------
C *****                 EUCKLEY & JAMES METHOD                        *****
C ------------------------------------------------------------------------
      CALL LS(KU,YU,XU,A(3),B(3))
C
      B3 = 0.0
      DO 130 M2=1,15
         JB = 0
         CALL WEIGHT(B(3),N,JB)
         XBARB = 0.0
         SUM1  = 0.0
         SUM2  = 0.0
         SUMXX = 0.0
         SUMBW = 0.0
         SUMBU = 0.0
         SUMBC = 0.0
         SUMYU = 0.0
         SUMYC = 0.0
         KKU   = 0
         DO 135 L1=1,N
            V(L1)  = W(L1)
            VC(L1) = WC(L1)
            VU(L1) = WU(L1)
135      CONTINUE
      JB = 1
      CALL WEIGHT (B(3),N,JB)
      DO 140 L2=1,N
         W(L2) = V(L2) / S(L2)
140   CONTINUE
      DO 145 L3=1,N
         IF (DEL(L3).EQ.0.0) GOTO 145
         KKU    = KKU + 1
         SUMBW  = SUMBW + W(L3) * (YU(KKU)-B(3)*XU(KKU))
145   CONTINUE
```

```
      DO 150 L4=1,KC
         YC(L4) = B(3)*XC(L4) + SUMBW
  150 CONTINUE
      DO 155 L5=1,N
         SUMXX = SUMXX + X(L5)
  155 CONTINUE
         XBARB = SUMXX / N
      DO 160 L6=1,KU
         SUMBU = SUMBU + YU(L6)*(XU(L6)-XBARB)
  160 CONTINUE
      DO 170 L7=1,KC
         SUMBC = SUMBC + YC(L7)*(XC(L7)-XBARB)
  170 CONTINUE
         SUM1 = SUMBU + SUMBC
      DO 175 L8=1,N
         SUM2 = SUM2 + ((X(L8)-XBARB)**2)
  175 CONTINUE
         B(3) = SUM1 / SUM2
         IF (B(3).EQ.B3) GOTO 200
         IF (M2.EQ.15) GOTO 205
         B3   = B(3)
  130 CONTINUE
  205 B(3)  = (B(3) + B3) / 2.0
  200 DO 210 L10=1,KU
         SUMYU = SUMYU + YU(L10)
  210 CONTINUE
      DO 215 L11=1,KC
         SUMYC = SUMYC + YC(L11)
  215 CONTINUE
      A(3)       = (SUMYU+SUMYC)/N - B(3)*XBARB
      AA(3)      = AA(3) + A(3)
      BB(3)      = BB(3) + B(3)
      AMSEA(3)   = (A(3)-ALPHA)**2
      AMSEB(3)   = (B(3)-BETA)**2
      TAMSEA(3)  = TAMSEA(3) + AMSEA(3)
      TAMSEB(3)  = TAMSEB(3) + AMSEB(3)
C
      KU    = 0
      KC    = 0
   15 CONTINUE
C
C **** AVERAGE NUMBER PERCENT OF CENSORED DATA FROM 100 LOOP ****
C **** AVERAGE ALPHA,BETA AND MEAN SQUARE ERROR FROM 100 LOOP ****
      AVER = AVER / 100.0
      DO 1 III=1,3
         AA(III)      = AA(III)/100.0
         BB(III)      = BB(III)/100.0
         TAMSEB(III) = TAMSEB(III)/100.0
         TAMSEA(III) = TAMSEA(III)/100.0
    1 CONTINUE
      WRITE (6,2000)AVER, AA(1), BB(1), TAMSEA(1), TAMSEB(1),
     *                    AA(2), BB(2), TAMSEA(2), TAMSEB(2),
     *                    AA(3), BB(3), TAMSEA(3), TAMSEB(3)
 2000 FORMAT(/2X,'AVERAGE % CEN ' ,F8.3/
     *       'A1',F15.3,'B1',F15.3,'AMSEA1',F15.3,'AMSEB1',F15.3/
     *       'A2',F15.3,'B2',F15.3,'AMSEA2',F15.3,'AMSEB2',F15.3/
     *       'A3',F15.3,'B3',F15.3,'AMSEA3',F15.3,'AMSEB3',F15.3)
      AVER = 0.0
      DO 123 III=1,3
         AA(III)      = 0.0
```

```
          BB(III)      = 0.0
          TAMSEB(III) = 0.0
          TAMSEA(III) = 0.0
          AMSEA(III)   = 0.0
          AMSEB(III)   = 0.0
  123 CONTINUE
   10 CONTINUE
      STOP
      END
C
C ------------------------------------------------------------------------
C *****              SUBROUTINE LEAST SQUARE                        *****
C ------------------------------------------------------------------------
      SUBROUTINE LS(N,T,X,A,B)
      DIMENSION  T(N),X(N)
      SUM1   =   0.0
      SUM2   =   0.0
      SUMXX  = 0.0
      SUMTT  = 0.0
      DO 50 L=1,N
         SUMXX = SUMXX + X(L)
         SUMTT = SUMTT + T(L)
   50 CONTINUE
      XBAR   =   SUMXX / N
      TBAR   =   SUMTT / N
      DO 60 K=1,N
         SUM1   =   SUM1 + T(K)*(X(K)-XBAR)
         SUM2   =   SUM2 + (X(K)-XBAR)**2
   60 CONTINUE
      B = SUM1 / SUM2
      A = TBAR - B*XBAR
      RETURN
      END
C
C ------------------------------------------------------------------------
C *****                    SUEROTUINE WEIGHT                        *****
C ------------------------------------------------------------------------
C **** THIS SUEROUTINE COMPUTE PRODUCT LIMIT ESTIMATOR AND WEIGHT ****
C
      SUBROUTINE WEIGHT(BETA,NO,JB)
      COMMON     IX, Y(200), X(200), DELTA(200), DEL(200), E(200),
     *           RA(200), P(200),S(200), W(200), WU(200), WC(200)
      SUMW = 0.0
C
C ***** COMPUTE ERROR *****
      DO 10 I=1,NO
      E(I)   = T(I) - BETA*X(I)
      DEL(I) = DELTA(I)
   10 CONTINUE
C
C ***** COMPUTE RANK OF ERROR *****
      II = NO - 1
      DO 20 I=1,II
      KK = NO - I
         DO 30 K=1,KK
            IF (E(K).LT.E(K+1)) GO TO 30
            SE          =  E(K)
            E(K)        =  E(K+1)
            E(K+1)      =  SE
            SK          =  DEL(K)
```

```
            DEL(K)     =  DEL(K+1)
            DEL(K+1)   =  SK
   30     CONTINUE
   20  CONTINUE
       IF (JB.EQ.1) GOTO 1000
       DO 40 I=1,NO
          IF (DEL(I).EQ.0.0) GOTO 45
          AAA = NO-I
          BBB = NO-I+1
          RA(I) = AAA / BBB
          GO TO 40
   45     PPP = NO
          QQQ = NO+1
          RA(I) = PPP / QQQ
   40  CONTINUE
       GOTO 2000
 1000  DO 41 I=1,NO
          IF (DEL(I).EQ.1.0) GOTO 43
          AAA = NO-I
          BBB = NO-I+1
          RA(I) = AAA / BBB
          GO TO 41
   43     PPP = NO
          QQQ = NO+1
          RA(I) = PPP / QQQ
   41  CONTINUE
 2000     S(1) = RA(1)
       DO 50 I=2,NO
          S(I) = S(I-1) * RA(I)
   50  CONTINUE
       DO 75 I=1,NO
          P(I) = 1.0 - S(I)
   75  CONTINUE
   60  IF (JB.EQ.1) GOTO 3000
          W(1) = P(1)
       DO 80 I=2,NO
          W(I) = P(I) - P(I-1)
   80  CONTINUE
       IF (DEL(NO).EQ.1.0) GOTO 101
       DO 102 I=1,NO
       IF (DEL(I).EQ.0.0) GOTO 102
       KKU  = KKU + 1
       SUMW = SUMW + W(I)
  102  CONTINUE
       DO 103 I=1,NO
          W(I) = W(I) / SUMW
  103  CONTINUE
  101  DO 85 I=1,NO
          IF (DEL(I).EQ.1.0) GOTO 100
          IC = IC + 1
          WC(IC) = W(I)
          GOTO 85
  100     IU = IU + 1
          WU(IU) = W(I)
   85  CONTINUE
       IC = 0
       IU = 0
 3000  RETURN
       END
C
```

```
C
C ------------------------------------------------------------------------
C *****                        RANDOM NUMBER                          *****
C ------------------------------------------------------------------------
      SUBROUTINE RANDU(IX, IY, RN)
      IY  =  IX * 262147
      IF (IY) 5,6,6
    5 IY  =  IY + 34359738367 + 1
    6 RN  =  IY
      RN  =  RN/34359738367
      IX  = IY
      RETURN
      END
C
C ------------------------------------------------------------------------
C *****                   NORMAL DISTRIBUTUION                        ****
C ------------------------------------------------------------------------
      SUBROUTINE NORMAL(AMEAN,SIGMA,XN)
      COMMON     IX, Y(200), X(200), DELTA(200), DEL(200), E(200),
     *           RA(200), P(200), S(200), W(200), WU(200), WC(200)
      A = 0.
      DO 13 I = 1,12
      CALL RANDU(IX,IY,RN)
      A = A + RN
   13 CONTINUE
      XN = (A-6.) * SIGMA + AMEAN
      RETURN
      END
C
C ------------------------------------------------------------------------
C *****                   UNIFORM DISTRIBUTUION                       *****
C ------------------------------------------------------------------------
      SUBROUTINE UNIFOR(A,B,XU)
      COMMON     IX, Y(200), X(200), DELTA(200), DEL(200), E(200),
     *           RA(200), P(200), S(200), W(200), WU(200), WC(200)
      CALL RANDU(IX,IY,RN)
      XU = A + (B - A) * RN
      RETURN
      END
C
C ------------------------------------------------------------------------
C *****                   GAMMA DISTRIBUTUION                         *****
C ------------------------------------------------------------------------
      SUBROUTINE GAMMA(ALPHAG,BETAG,XG)
      COMMON     IX, Y(200), X(200), DELTA(200), DEL(200), E(200),
     *           RA(200), P(200), S(200), W(200), WU(200), WC(200)
      XG = 0.0
      V  = 1.0
    5 CALL RANDU(IX,IY,RN)
      V = V * RN
      IF (BETAG.EQ.1.0) GOTO 10
      BETAG = BETAG - 1.0
      GOTO 5
   10 XG = - ALPHAG* ALOG (V)
      RETURN
      END
```

ประวัติผู้เขียน

นางสาวอัมพร ชาตบุษยมาส เกิดที่จังหวัดกรุงเทพมหานคร จบการศึกษาจากมหาวิทยาลัยรามคำแหง เมื่อปี 2524 ได้เข้าศึกษาในภาควิชาสถิติ สาขาสถิติ คณะพาณิชยศาสตร์และการบัญชี จุฬาลงกรณ์มหาวิทยาลัย เมื่อปีการศึกษา 2526 ปัจจุบันรับราชการตำแหน่ง นักวิชาการขนส่ง 4 ฝ่ายระบบข้อสนเทศ กองเศรษฐกิจการขนส่งและคมนาคม สำนักงานปลัดกระทรวงคมนาคม