รายการอ้างอิง

ภาษาไทย

ศศิธร พุทไธวัฒน์. วิธีการปรับแก้ค่าประมาณความน่าจะเป็นที่จะเสียชีวิต. วิทยานิพนธ์ปริญญามหาบัณฑิต จุฬาลงกรณ์มหาวิทยาลัย, 2539

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ภาคผนวก

ภาคผนวก ก.

ตาราง ก. แสดงค่า q_x และค่าพารามิเตอร์ที่ใช้ในการจำลองข้อมูลเกี่ยวกับระยะเวลาที่จะมีชีวิตอยู่ต่อไปในอนาคต โดยที่ค่าพารามิเตอร์ k และ n สำหรับการแจกแจงแบบไวบูลล์ ค่าพารามิเตอร์ B และ c สำหรับการแจกแจงแบบกอมเพริตซ์ เมื่อกำหนดให้ $n = 1$ และ $c = 5.5$

x	q_x	k	B
0	0.0222650	0.0412661806	0.0078164935
1	0.0016722	0.0026879483	0.0005091415
2	0.0009873	0.0024488652	0.0004638552
3	0.0014147	0.0022489554	0.0004259890
4	0.0014106	0.0020852229	0.0003949753
5	0.0012949	0.0019549145	0.0003702929
6	0.0011516	0.0018545641	0.0003512849
7	0.0008712	0.0017815419	0.0003374533
8	0.0010579	0.0017327424	0.0003282097
9	0.0010354	0.0017050621	0.0003229666
10	0.0010816	0.0016956362	0.0003211813
11	0.0079830	0.0017014826	0.0003222886
12	0.0010359	0.0017194985	0.0003257012
13	0.0009422	0.0017467020	0.0003308540
14	0.0008964	0.0017803484	0.0003372272
15	0.0009894	0.0018169787	0.0003441656
16	0.0012000	0.0018571890	0.0003517820
17	0.0012914	0.0019012187	0.0003601220
18	0.0010826	0.0019496642	0.0003692983
19	0.0010327	0.0020027650	0.0003793566
20	0.0011777	0.0020607593	0.0003903415
21	0.0009887	0.0021247226	0.0004024573
22	0.0012474	0.0021945355	0.0004156809
23	0.0012713	0.0022712722	0.0004302163

ตาราง ก. (ต่อ) แสดงค่า q_x และค่าพารามิเตอร์ที่ใช้ในการจำลองข้อมูล เกี่ยวกับระยะเวลาที่จะมีชีวิตอยู่ต่อไปในอนาคต โดยที่ค่าพารามิเตอร์ k และ n สำหรับการแจกแจงแบบไวบูลล์ ค่าพารามิเตอร์ B และ c สำหรับการแจกแจงแบบกอมเพริตซ์ เมื่อกำหนดให้ $n = 1$ และ $c = 5.5$

x	q_x	k	B
24	0.0012246	0.0023552929	0.0004461312
25	0.0012725	0.0024674847	0.0004673821
26	0.0014830	0.0025485293	0.0004827334
27	0.0014846	0.0026592999	0.0005037151
28	0.0015752	0.0027808198	0.0005267330
29	0.0014114	0.0029140473	0.0005519683
30	0.0018586	0.0030600582	0.0005796254
31	0.0017439	0.0032202885	0.0006099755
32	0.0016940	0.0033958158	0.0006432233
33	0.0019050	0.0035885563	0.0006797316
34	0.0019045	0.0037995884	0.0007197044
35	0.0024910	0.0040311851	0.0007635732
36	0.0025442	0.0042849146	0.0008116334
37	0.0022632	0.0045632869	0.0008643619
38	0.0032019	0.0048684664	0.0009221674
39	0.0029418	0.0052030943	0.0009855512
40	0.0032727	0.0055700541	0.0010550593
41	0.0033367	0.0059724711	0.0011312845
42	0.0034582	0.0064135976	0.0012148411
43	0.0039501	0.0068971664	0.0013064370
44	0.0041913	0.0074277595	0.0014069395
45	0.0040623	0.0080091208	0.0015170590
46	0.0045610	0.0086467937	0.0016378444
47	0.0050786	0.0093460009	0.0017702859
48	0.0054173	0.0101126507	0.0019155019
49	0.0066352	0.0109533221	0.0020747390

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x	q_x	k	B
50	0.0072757	0.0118749291	0.0022493061
51	0.0067733	0.0128855035	0.0024407257
52	0.0080911	0.0139935836	0.0026506144
53	0.0081861	0.0152085796	0.0028807544
54	0.0097403	0.0165409073	0.0031331198
55	0.0098766	0.0180017427	0.0034098260
56	0.0110187	0.0196032897	0.0037131854
57	0.0132606	0.0213596150	0.0040458590
58	0.0119887	0.0232853517	0.0044106282
59	0.0133964	0.0253966972	0.0048105493
60	0.0151469	0.0277118832	0.0052490830
61	0.0160637	0.0302503631	0.0057299137
62	0.0184887	0.0330338404	0.0062571503
63	0.0206991	0.0360859111	0.0068352632
64	0.0227100	0.0394323543	0.0074691363
65	0.0240755	0.0431016833	0.0081641674
66	0.0273362	0.0471249670	0.0089262426
67	0.0278124	0.0515365005	0.0097618587
68	0.0308903	0.0563734099	0.0106780492
69	0.0346777	0.0616772547	0.0116826855
70	0.0378427	0.0674926639	0.0127842203
71	0.0393142	0.0738690495	0.0139920153
72	0.0447574	0.0808607340	0.0153163522
73	0.0473568	0.0885270238	0.0167684667
74	0.0502673	0.0969330072	0.0183607042

ตาราง ก. (ต่อ) แสดงค่า q_x และค่าพารามิเตอร์ที่ใช้ในการจำลองข้อมูล เกี่ยวกับระยะเวลาที่จะมีชีวิตอยู่ต่อไปในอนาคต โดยที่ค่าพารามิเตอร์ k และ n สำหรับการแจกแจงแบบไวบูลล์ ค่าพารามิเตอร์ B และ c สำหรับการแจกแจงแบบกอมเพิร์ตซ์ เมื่อกำหนดให้ $n = 1$ และ $c = 5.5$

x	q_x	k	B
75	0.0578150	0.1061498520	0.0201065242
76	0.0619347	0.1162558200	0.0220207609
77	0.0678373	0.1273368600	0.0241196938
78	0.0744276	0.1394871470	0.0264211483
79	0.0815311	0.1528097390	0.0289446749
80	0.0869033	0.1674175260	0.0317116305
81	0.0973569	0.1834343670	0.0347454809
82	0.1052148	0.2009967570	0.0380720794
83	0.1116948	0.2202534680	0.0417196192
84	0.1247852	0.2413680550	0.0457190797
85	0.1338742	0.2645196910	0.0501043797
86	0.1471708	0.2899051900	0.0549128056
87	0.1555337	0.3177396060	0.0601851009
88	0.1740715	0.3482594490	0.0659660101
89	0.1873740	0.3817238810	0.0723047256
90	0.2035835	0.4184167390	0.0792549849
91	0.2195275	0.4586498740	0.0868757963
92	0.2346874	0.5027643440	0.0952318311
93	0.2515344	0.5511353020	0.1043940780
94	0.2765228	0.6041724680	0.114402030
95	0.2943558	0.6623269320	0.1254556180
96	0.3158725	0.7260922190	0.1375337840
97	0.3387399	0.7960090640	0.1507771610
98	0.3611554	0.8726714850	0.1652983430
99	0.3858154	0.9567301270	0.1812204120

ภาคผนวก ข.

```
C=====================================================================
C              MAIN PROGRAM
C=====================================================================
      DIMENSION SUMQX(100),IAGE(100),WWITH(100),DDEATH(100),EENDER(100)
      COMMON/VAR1/TABQX(100),NUM,PK(100),PB(100),IFIRST,ILAST,INTAGE
      COMMON/VAR2/GRADQX(100),RTE1(100),RTE2(100),VMQX(100)
      COMMON/VAR3/K,SUMTW,DEATH,WITH,ENDER,VMRTE1,VMRTE2
      COMMON/VAR4/PC,PN,U,ALP,BETA,NW
C#####################################################################
C       ADD   DATA
C#####################################################################
      NUM       = 100
      IROUND    = 100
      ISEED     = 167
      NW        = INT(0.3*NUM)
      PN        = 1.0
      PC        = 5.5
      U         = 2.
      ALP       = 1.5
      BETA      = 1.0
      IGEN      = 1
      IFIRST    = 10
      ILAST     = 89
      INTAGE    = ILAST-IFIRST+1
      Z         = 0.
      XN        = 2.
      ICALL     = 1
      KNOT      = 4
```

```
      MAT       = KNOT+4
      VK1       = 23.0
      VK2       = 50.0
      VK3       = 70.0
      VK4       = 80.0
      IAGE(1) = 0
      DO 5 I = 2,100
      IAGE(I) = IAGE(I-1)+1
5     CONTINUE
      WRITE(6,6)
6     FORMAT(65('='))
      IF (IGEN.EQ.1) THEN
      WRITE(6,7)
7     FORMAT(15X,'###### WEIBULL-UNIFORM  DISTRIBUTION ######')
      WRITE(6,8)
8     FORMAT(65('-'))
      WRITE(6,9)PN,U
9     FORMAT(5X,'WITH PN = ',F5.2,7X,'U = ',F5.2)
      ELSE   IF  (IGEN.EQ.2)  THEN
      WRITE(6,10)
10    FORMAT(15X,'###### GOMPERTZ-UNIFORM DISTRIBUTION ######')
      WRITE(6,11)
11    FORMAT(65('-'))
      WRITE(6,12)PC,U
12    FORMAT(5X,'WITH PC = ',F5.2,7X,'U = ',F5.2)
      ELSE   IF  (IGEN.EQ.3)  THEN
      WRITE(6,13)
13    FORMAT(15X,'###### WEIBULL-GAMMA DISTRIBUTION ######')
      WRITE(6,14)
14    FORMAT(65('-'))
```

```
      WRITE(6,15)PN,ALP,BETA
15    FORMAT(5X,'WITH PN = ',F5.2,5X,'ALP = ',F5.2,5X,'BETA = ',F5.2)
3     ELSE   IF  (IGEN.EQ.4)  THEN
      WRITE(6,16)
16    FORMAT(15X,'###### GOMPERTZ-GAMMA DISTRIBUTION ######')
      WRITE(6,17)
17    FORMAT(65('-'))
      WRITE(6,18)PC,ALP,BETA
18    FORMAT(5X,'WITH PC = ',F5.2,5X,'ALP = ',F5.2,5X,'BETA = ',F5.2)
      ENDIF
      WRITE(6,19)ISEED,NUM,IROUND
19    FORMAT(5X,'SEED = ',I5,7X,'SAMPLE SIZE = ',I5,5X,'ROUND = ',I4)
      WRITE(6,20)
20    FORMAT(65('='))
      IF (IGEN.EQ.1.OR.IGEN.EQ.3)  THEN
      WRITE(6,25)
25    FORMAT(1X,'AGE',3X,'ESTIMATE QX',5X,
     *'PARAMETER K',5X,'DEATH',5X,'WITH',5X,'ENDER')
      ELSE  IF (IGEN.EQ.2.OR.IGEN.EQ.4)  THEN
      WRITE(6,26)
26    FORMAT(1X,'AGE',3X,'ESTIMATE QX',5X,
     *'PARAMETER B',5X,'DEATH',5X,'WITH',5X,'ENDER')
      ENDIF
      WRITE(6,30)
30    FORMAT(65('='))
      CALL TQX
      DO 35 J= 1,100
      SUMQX(J) = 0.0
35    CONTINUE
      SUMWW  =  0.0
```

```
SUMDD  = 0.0
SUMEE  =  0.0
DO 40 K = 1,100
      IF (IGEN.EQ.1.OR.IGEN.EQ.3)  THEN
         PK(K) =  -(ALOG(1.0-TABQX(K))*(PN+1.))
      ELSE  IF (IGEN.EQ.2.OR.IGEN.EQ.4)  THEN
         PB(K) =  -(ALOG(1.0-TABQX(K))*ALOG(PC)/(PC-1.))
      ENDIF
SUMD = 0.0
SUMW = 0.0
SUME = 0.0
DO 45 I =1,IROUND
    DEATH = 0.0
    WITH  = 0.0
    ENDER = 0.0
    SUMTW = 0.0
  IF (IGEN.EQ.1) THEN
  CALL GENWU(ISEED)
  ELSE IF (IGEN.EQ.2) THEN
  CALL GENGU(ISEED)
  ELSE IF (IGEN.EQ.3) THEN
  CALL GENWG(ISEED)
  ELSE IF (IGEN.EQ.4) THEN
  CALL GENGG(ISEED)
  ENDIF
ESQX  = DEATH/(FLOAT(NUM)-SUMTW)
SUMQX(K) = SUMQX(K)+ESQX
SUMD   =  SUMD+DEATH
SUMW   =  SUMW+WITH
SUME   =  SUME+ENDER
```

```
45   CONTINUE
     VMQX(K)   = SUMQX(K)/IROUND
     WWITH(K)  = SUMW/IROUND/NUM*100.
     DDEATH(K) = SUMD/IROUND/NUM*100.
     EENDER(K) = SUME/IROUND/NUM*100.
     IF (IGEN.EQ.1.OR.IGEN.EQ.3) THEN
     WRITE(6,50)IAGE(K),VMQX(K),PK(K),DDEATH(K),
    *WWITH(K),EENDER(K)
50   FORMAT(1X,I3,3X,F10.7,5X,F13.10,3X,F5.2,3X,F5.2,3X,F5.2)
     ELSE IF(IGEN.EQ.2.OR.IGEN.EQ.4)  THEN
     WRITE(6,51)IAGE(K),VMQX(K),PB(K),DDEATH(K),
    *WWITH(K),EENDER(K)
51   FORMAT(1X,I3,3X,F10.7,5X,F13.10,3X,F5.2,3X,F5.2,3X,F5.2)
     ENDIF
40   CONTINUE
     DO 1 I = IFIRST+1,ILAST+1
      SUMWW  = SUMWW+WWITH(I)
      SUMDD  = SUMDD+DDEATH(I)
      SUMEE  = SUMEE+EENDER(I)
1    CONTINUE
     VMWITH  = SUMWW/FLOAT(INTAGE)
     VMDEA   = SUMDD/FLOAT(INTAGE)
     VMEND   = SUMEE/FLOAT(INTAGE)
     WRITE(6,59)
59   FORMAT(65('='))
     WRITE(6,60)IFIRST,ILAST,VMDEA,VMWITH,VMEND
60   FORMAT(1X,'MEAN AGE(',I2,'-',I2,') ==>',
    *18X,F5.2,3X,F5.2,3X,F5.2)
     WRITE(6,78)
78   FORMAT(65('='))
```

```
C-------------------------------------------------------------
C       MOVING  WEIGHTED  AVERAGE
C-------------------------------------------------------------
      WRITE(6,79)
79    FORMAT(10X,'MOVING WEIGHTED AVERAGE GRADUATION')
      WRITE(6,80)Z,XN
80    FORMAT(15X,'WITH Z = ',F3.1,5X,'N = ',F5.1)
      CALL  MWA(Z,XN)
C-------------------------------------------------------------
C           FUNCTIONAL FORMS GRADUATION
C-------------------------------------------------------------
      WRITE(6,80)
80    FORMAT(5X,'####### FUNCTIONAL FORMS GRADUATION #######')
      IF  (ICALL.EQ.1) THEN
        CALL FORMW
        WRITE(6,81)
81      FORMAT(15X,'WEIBULL FORM')
        WRITE(6,82)PPK,PPN
82      FORMAT(5X,'WITH K = ',F15.12,5X,'N = ',F10.7)
C       WRITE(6,83)
C83     FORMAT(64('='))
      ELSE
        CALL FORMG
        WRITE(6,84)
84      FORMAT(15X,'GOMPERTZ FORM')
        WRITE(6,85)PPB,PPC
85      FORMAT(5X,'WITH B = ',F15.12,5X,'C = ',F10.7)
        WRITE(6,86)
86      FORMAT(64('='))
      ENDIF
```

```
C-------------------------------------------------------------
C          CUBIC SPLINES GRADUATION
C-------------------------------------------------------------
      WRITE(6,80)
80    FORMAT(5X,'######## CUBIC SPLINES GRADUATION ########')
      CALL SPLINE
      WRITE(6,81)KNOT
81    FORMAT(5X,'WITH KNOT = ',I2)
      WRITE(6,82)VK1,VK2,VK3,VK4
82    FORMAT(5X,'K1 = ',F5.2,3X,'K2 = ',F5.2,3X,'K3 = ',F5.2,3X,'K4 = ',
     *F5.2)
      WRITE(6,83)
83    FORMAT(65('='))
      WRITE(6,87)
87    FORMAT(1X,'AGE',5X,'TABQX',6X,'MEANQX',8X,'GRADQX',
     * 8X,'RTE1',8X,'RTE2')
      SURTE1 = 0.0
      SURTE2 = 0.0
      DO 90 K = 1,100
      RTE1(K) = ABS(TABQX(K)-GRADQX(K))/TABQX(K)*100.
      RTE2(K) = ABS(TABQX(K)-VMQX(K))/TABQX(K)*100.
      SURTE1 = SURTE1+RTE1(K)
      SURTE2 = SURTE2+RTE2(K)
      WRITE(6,95)IAGE(K),TABQX(K),VMQX(K),GRADQX(K),RTE1(K),RTE2(K)
95    FORMAT(1X,I3,3X,F10.7,3X,F10.7,3X,F10.7,3X,F8.5,3X,F8.5)
90    CONTINUE
      VMRTE3 = SURTE1/100.
      VMRTE4 = SURTE2/100.
      WRITE(6,91)
91    FORMAT(65('='))
```

```
      WRITE(6,100)VMRTE1,VMRTE2
100   FORMAT(1X,'MEAN RELATIVE ERROR (10-89) = ',18X,F8.5,3X,F8.5)
      WRITE(6,101)VMRTE3,VMRTE4
101   FORMAT(1X,'MEAN RELATIVE ERROR (0-99) = ',18X,F8.5,3X,F8.5)
      WRITE(6,102)
102   FORMAT(65('='))
      STOP
      END
C=============================================================
C                    SUBROUTINE
C       GENERATED FUTURE LIFETIME AND WITHDRAWAL TIME
C            (WEIBULL-UNIFORM DISTRIBUTION)
C=============================================================
      SUBROUTINE  GENWU(ISEED)
      COMMON/VAR1/TABQX(100),NUM,PK(100),PB(100),IFIRST,ILAST,INTAGE
      COMMON/VAR2/GRADQX(100),RTE1(100),RTE2(100),VMQX(100)
      COMMON/VAR3/K,SUMTW,DEATH,WITH,ENDER,VMRTE1,VMRTE2
      COMMON/VAR4/PC,PN,U,ALP,BETA,NW
      DO 5 I = 1,NUM
15      WUNI1 =  RAN(ISEED)
        IF (WUNI1.LE.0.0) GOTO 15
        WUNI  = U*WUNI1
10      TWEI1  =  RAN(ISEED)
        IF (TWEI1.LE.0.0) GOTO 10
          TWEI2 = ALOG(1.-TWEI1)
          TWEI3 = (PN+1)/PK(K)
          TWEI4 = 1/(PN+1)
          TWEI  = (-TWEI3*TWEI2)**TWEI4
        IF  (TWEI.LE.WUNI) THEN
          IF (TWEI.LE.1.0)  THEN
```

```
            DEATH  = DEATH+1.
          ELSE
            ENDER  = ENDER+1.
          ENDIF
        ELSE
          IF (WUNI.LE.1.) THEN
            IF (WITH.LT.NW)  THEN
              WITH   = WITH+1.0
              SUMTW1 = 1.-WUNI
              SUMTW  = SUMTW+SUMTW1
            ELSE
              GOTO 15
            ENDIF
          ELSE
              ENDER  =  ENDER+1.
          ENDIF
        ENDIF
5       CONTINUE
        RETURN
        END
C=============================================================
C                    SUBROUTINE
C        GENERATED FUTURE LIFETIME AND WITHDRAWAL TIME
C           (GOMPERTZ-UNIFORM DISTRIBUTION)
C=============================================================
      SUBROUTINE  GENGU(ISEED)
      COMMON/VAR1/TABQX(100),NUM,PK(100),PB(100),IFIRST,ILAST,INTAGE
      COMMON/VAR2/GRADQX(100),RTE1(100),RTE2(100),VMQX(100)
      COMMON/VAR3/K,SUMTW,DEATH,WITH,ENDER,VMRTE1,VMRTE2
      COMMON/VAR4/PC,PN,U,ALP,BETA,NW
```

```
      DO 5 I = 1,NUM
15       WUNI1  = RAN(ISEED)
         IF (WUNI1.LE.0.0) GOTO 15
         WUNI   = U*WUNI1
10       TGOM1  = RAN(ISEED)
         IF (TGOM1.LE.0.0) GOTO 10
            TGOM2 = ALOG(1.-TGOM1)
            TGOM3 = ALOG(PC)
            TGOM4 = TGOM3*TGOM2/PB(K)
            TGOM5 =  1.0-TGOM4
            TGOM6 = ALOG(TGOM5)
            TGOM  = TGOM6/TGOM3
         IF  (TGOM.LE.WUNI) THEN
            IF (TGOM.LE.1.0)  THEN
               DEATH  = DEATH+1.
            ELSE
               ENDER  = ENDER+1.
            ENDIF
         ELSE
            IF (WUNI.LE.1.) THEN
               IF (WITH.LT.NW)  THEN
                  WITH   = WITH+1.0
                  SUMTW1 = 1.-WUNI
                  SUMTW  = SUMTW+SUMTW1
               ELSE
                  GOTO 15
               ENDIF
            ELSE
                  ENDER =  ENDER+1.
            ENDIF
```

```
      ENDIF
5     CONTINUE
      RETURN
      END
C=====================================================================
C                    SUBROUTINE
C       GENERATED FUTURE LIFETIME AND WITHDRAWAL TIME
C             (WEIBULL-GAMMA DISTRIBUTION)
C=====================================================================
      SUBROUTINE  GENWG(ISEED)
      COMMON/VAR1/TABQX(100),NUM,PK(100),PB(100),IFIRST,ILAST,INTAGE
      COMMON/VAR2/GRADQX(100),RTE1(100),RTE2(100),VMQX(100)
      COMMON/VAR3/K,SUMTW,DEATH,WITH,ENDER,VMRTE1,VMRTE2
      COMMON/VAR4/PC,PN,U,ALP,BETA,NW
      DO 5 I = 1,NUM
16      IF (ALP.GT.1.) THEN
      A = 1./(2.*ALP-1.)**(1./2.)
      B = ALP-ALOG(4.)
      Q = ALP+1./A
      C = 4.5
      D = 1.+ALOG(C)
2       U1 = RAN(ISEED)
        U2 = RAN(ISEED)
        V  = A*ALOG(U1/(1.-U1))
        Y  = ALP*EXP(V)
        Z  = (U1**2.)*U2
        Z1 = ALOG(Z)
        W  = B+(Q*V)-Y
        WDZ = W+D-(C*Z)
        IF (WDZ.GE.0.) THEN
```

```
          X  = Y
        ELSE
          IF (W.GE.Z1)  THEN
             X  = Y
          ELSE
             GOTO 2
          ENDIF
        ENDIF
           WGAM  = X*BETA
        ENDIF
C-------------------------------------------------------
        IF (ALP.EQ.0.) THEN
           U = RAN(ISEED)
           WGAM = -BETA*ALOG(U)
        ENDIF
C-------------------------------------------------------
10       TWEI1  =  RAN(ISEED)
        IF (TWEI1.LE.0.0) GOTO 10
           TWEI2 = ALOG(1.-TWEI1)
           TWEI3 = (PN+1)/PK(K)
           TWEI4 = 1/(PN+1)
           TWEI  = (-TWEI3*TWEI2)**TWEI4
        IF  (TWEI.LE.WGAM) THEN
           IF (TWEI.LE.1.0)  THEN
              DEATH  = DEATH+1.
           ELSE
              ENDER  = ENDER+1.
           ENDIF
        ELSE
           IF (WGAM.LE.1.) THEN
```

```
      IF (WITH.LT.NW)  THEN
            WITH   = WITH+1.0
            SUMTW1 = 1.-WGAM
            SUMTW  = SUMTW+SUMTW1
          ELSE
            GOTO 16
          ENDIF
        ELSE
            ENDER  =  ENDER+1.
        ENDIF
      ENDIF
5     CONTINUE
      RETURN
      END
C=====================================================================
C                    SUBROUTINE
C      GENERATED FUTURE LIFETIME AND WITHDRAWAL TIME
C             (GOMPERTZ-GAMMA DISTRIBUTION)
C=====================================================================
      SUBROUTINE  GENGG(ISEED)
      COMMON/VAR1/TABQX(100),NUM,PK(100),PB(100),IFIRST,ILAST,INTAGE
      COMMON/VAR2/GRADQX(100),RTE1(100),RTE2(100),VMQX(100)
      COMMON/VAR3/K,SUMTW,DEATH,WITH,ENDER,VMRTE1,VMRTE2
      COMMON/VAR4/PC,PN,U,ALP,BETA,NW
      DO 5 I = 1,NUM
16    IF ((ALP.GT.0.).AND.(ALP.LT.1.)) THEN
        E = EXP(1.)
        B = (E+ALP)/E
1       U1 = RAN(ISEED)
        P = B*U1
```

```
      IF (P.GT.1.)  THEN
         Y = -ALOG((B-P)/ALP)
         U2 = RAN(ISEED)
         IF (U2.LE.(Y**(ALP-1.))) THEN
              X = Y
         ELSE
              GOTO 1
         ENDIF
       ELSE
         Y = P**(1./ALP)
         U2 = RAN(ISEED)
         IF (U2.LE.EXP(-Y)) THEN
              X = Y
         ELSE
              GOTO 1
         ENDIF
       ENDIF
            WGAM  = X*BETA
     ENDIF
C-----------------------------------------------------
      IF (ALP.GT.1.) THEN
      A = 1./(2.*ALP-1.)**(1./2.)
      B = ALP-ALOG(4.)
      Q = ALP+1./A
      C = 4.5
      D = 1.+ALOG(C)
2       U1 = RAN(ISEED)
        U2 = RAN(ISEED)
        V  = A*ALOG(U1/(1.-U1))
        Y  = ALP*EXP(V)
```

```
      Z  = (U1**2.)*U2
      Z1 = ALOG(Z)
       W  = B+(Q*V)-Y
       WDZ = W+D-(C*Z)
       IF (WDZ.GE.0.) THEN
          X  = Y
       ELSE
         IF (W.GE.Z1)  THEN
            X  = Y
         ELSE
           GOTO 2
         ENDIF
       ENDIF
          WGAM  = X*BETA
       ENDIF
C-------------------------------------------------------------
       IF (ALP.EQ.0.) THEN
          U = RAN(ISEED)
          WGAM = -BETA*ALOG(U)
       ENDIF
C-------------------------------------------------------------
10      TGOM1  =  RAN(ISEED)
       IF (TGOM1.LE.0.0) GOTO 10
          TGOM2 = ALOG(1.-TGOM1)
          TGOM3 = ALOG(PC)
          TGOM4 = TGOM3*TGOM2/PB(K)
          TGOM5 =  1.0-TGOM4
          TGOM6 = ALOG(TGOM5)
          TGOM  = TGOM6/TGOM3
       IF  (TGOM.LE.WGAM) THEN
```

```
      IF (TGOM.LE.1.0)  THEN
            DEATH  = DEATH+1.
         ELSE
            ENDER  = ENDER+1.
         ENDIF
       ELSE
         IF (WGAM.LE.1.) THEN
            IF (WITH.LT.NW)  THEN
               WITH = WITH+1.0
               SUMTW1 = 1.-WGAM
               SUMTW = SUMTW+SUMTW1
            ELSE
               GOTO 16
            ENDIF
         ELSE
               ENDER =  ENDER+1.
         ENDIF
      ENDIF
5     CONTINUE
      RETURN
      END
C=============================================================
C                    SUBROUTINE
C                 TABLE OF MORTALITY
C=============================================================
      SUBROUTINE  TQX
      COMMON/VAR1/TABQX(100),NUM,PK(100),PB(100),IFIRST,ILAST,INTAGE
      COMMON/VAR2/GRADQX(100),RTE1(100),RTE2(100),VMQX(100)
      COMMON/VAR3/K,SUMTW,DEATH,WITH,ENDED,VMRTE1,VMRTE2
      COMMON/VAR4/PC,PN,U,ALP,BETA,NW
```

TABQX(1) = 0.0204217

TABQX(2) = 0.0013431

TABQX(3) = 0.0012237

TABQX(4) = 0.0011239

TABQX(5) = 0.0010421

TABQX(6) = 0.0009770

TABQX(7) = 0.0009269

TABQX(8) = 0.0008904

TABQX(9) = 0.0008660

TABQX(10) = 0.0008522

TABQX(11) = 0.0008475

TABQX(12) = 0.0008504

TABQX(13) = 0.0008594

TABQX(14) = 0.0008730

TABQX(15) = 0.0008898

TABQX(16) = 0.0009081

TABQX(17) = 0.0009282

TABQX(18) = 0.0009502

TABQX(19) = 0.0009744

TABQX(20) = 0.0010009

TABQX(21) = 0.0010299

TABQX(22) = 0.0010618

TABQX(23) = 0.0010967

TABQX(24) = 0.0011350

TABQX(25) = 0.0011770

TABQX(26) = 0.0012330

TABQX(27) = 0.0012735

TABQX(28) = 0.0013288

TABQX(29) = 0.0013895

TABQX(30) = 0.0014560

TABQX(31) = 0.0015289

TABQX(32) = 0.0016089

TABQX(33) = 0.0016965

TABQX(34) = 0.0017927

TABQX(35) = 0.0018980

TABQX(36) = 0.0020136

TABQX(37) = 0.0021402

TABQX(38) = 0.0022791

TABQX(39) = 0.0024313

TABQX(40) = 0.0025982

TABQX(41) = 0.0027812

TABQX(42) = 0.0029818

TABQX(43) = 0.0032017

TABQX(44) = 0.0034427

TABQX(45) = 0.0037070

TABQX(46) = 0.0039966

TABQX(47) = 0.0043141

TABQX(48) = 0.0046621

TABQX(49) = 0.0050436

TABQX(50) = 0.0054617

TABQX(51) = 0.0059199

TABQX(52) = 0.0064221

TABQX(53) = 0.0069724

TABQX(54) = 0.0075755

TABQX(55) = 0.0082364

TABQX(56) = 0.0089605

TABQX(57) = 0.0097538

TABQX(58) = 0.0106230

TABQX(59) = 0.0115752

TABQX(60) = 0.0126181

TABQX(61) = 0.0137604

TABQX(62) = 0.0150114

TABQX(63) = 0.0163813

TABQX(64) = 0.0178812

TABQX(65) = 0.0195231

TABQX(66) = 0.0213203

TABQX(67) = 0.0232871

TABQX(68) = 0.0254391

TABQX(69) = 0.0277932

TABQX(70) = 0.0303680

TABQX(71) = 0.0331833

TABQX(72) = 0.0362608

TABQX(73) = 0.0396240

TABQX(74) = 0.0432982

TABQX(75) = 0.0473108

TABQX(76) = 0.0516911

TABQX(77) = 0.0564708

TABQX(78) = 0.0616840

TABQX(79) = 0.0673671

TABQX(80) = 0.0735589

TABQX(81) = 0.0803009

TABQX(82) = 0.0876369

TABQX(83) = 0.0956134

TABQX(84) = 0.1042794

TABQX(85) = 0.1136860

TABQX(86) = 0.1238867

TABQX(87) = 0.1349367

TABQX(88) = 0.1468926

TABQX(89) = 0.1598121

TABQX(90) = 0.1737533

```
      TABQX(91) = 0.1887738
      TABQX(92) = 0.2049298
      TABQX(93) = 0.2222749
      TABQX(94) = 0.2408589
      TABQX(95) = 0.2607257
      TABQX(96) = 0.2819122
      TABQX(97) = 0.3044456
      TABQX(98) = 0.3283410
      TABQX(99) = 0.3535993
      TABQX(100) = 0.3802041
      RETURN
      END
C=============================================================
C                  FUNCTION RANDOM(0,1)
C=============================================================
      FUNCTION RAN(ISEED)
      ISEED = ISEED*16807
      IF (ISEED.LT.0) ISEED = ISEED+2147483647+1
         RAN = ISEED
         RAN = RAN*0.465661E-9
      RETURN
      END
C=============================================================
C                  SUBROUTINE
C      MOVING  WEIGHTED AVERAGE  GRADUTION
C=============================================================
    SUBROUTINE  MWA(Z,XN)
    COMMON/VAR1/TABQX(100),NUM,PK(100),PB(100),IFIRST,ILAST,INTAGE
    COMMON/VAR2/GRADQX(100),RTE1(100),RTE2(100),VMQX(100)
    COMMON/VAR3/K,SUMTW,DEATH,WITH,ENDER,VMRTE1,VMRTE2
```

```
      COMMON/VAR4/PC,PN,U,ALP,BETA,NW
      REAL*8 FACT1,FACT2,FACT3,FACT4,FACT5,FACT6,FACT7,FACT8,FACT9,
     *FACT0,S1,S2,S3,S4,H,VK,AR,AR1,AR2,AR3,AR4,HK1,HK2,AR11,AR12,AR13,
     *AR14,AR0,QX1,QX2,QX
      F = Z
      FACT1 = FACT(F)
      F = 2.*XN+2.*Z+1.
      FACT2 = FACT(F)
      F = 2.*Z+1.
      FACT3 = FACT(F)
      F =2.*XN
      FACT4 = FACT(F)
      F = Z+2.
      FACT5 = FACT(F)
      F = 2.*XN+2.*Z+3.
      FACT6 = FACT(F)
      F = 2.*Z+5.
      FACT7 = FACT(F)
      F = 2.*XN-2.
      FACT8 = FACT(F)
      F = Z+1.
      FACT9 = FACT(F)
      F = Z*2.+3.
      FACT0 = FACT(F)
      S1 = (FACT1**2*FACT2)/(FACT3*FACT4)
      S2 = (FACT5**2*FACT6)/(FACT7*FACT8)
      S3 = (FACT9**2*FACT6)/(FACT0*FACT4)
      S4 = (FACT9**2*FACT2)/(FACT0*FACT8)
      H  = (S2-((XN+Z+1.)**2*S4))/(S1*S2-S3*S4)
      VK = ((XN+Z+1.)**2*S1-S3)/(S1*S2-S3*S4)
```

```
      SURTE1 = 0.0
      SURTE2 = 0.0
      DO 10 J = IFIRST+1,ILAST+1
        QX = 0.0
        N  = INT(XN)
          DO 20 I = 1,N
            HK1 = (XN**2-FLOAT(I)**2)*VK+H
            AR1 = ((XN+1.)**2)-(FLOAT(I)**2)
            AR2 = ((XN+2.)**2)-(FLOAT(I)**2)
            AR3 = ((XN+3.)**2)-(FLOAT(I)**2)
            AR4 = ((XN+4.)**2)-(FLOAT(I)**2)
            IF (Z.EQ.0.)   THEN
                AR = HK1
            ELSE IF (Z.EQ.1.) THEN
               AR = AR1*HK1
            ELSE IF (Z.EQ.2.) THEN
               AR = AR1*AR2*HK1
            ELSE IF (Z.EQ.3.) THEN
               AR = AR1*AR2*AR3*HK1
            ELSE IF (Z.EQ.4.) THEN
               AR = AR1*AR2*AR3*AR4*HK1
            ENDIF
      QX1 = AR*VMQX(J+I)
      QX2 = AR*VMQX(J-I)
      QX  = QX+QX1+QX2
   20 CONTINUE
      HK2  = XN**2*VK+H
      AR11 = (XN+1.)**2
      AR12 = (XN+2.)**2
      AR13 = (XN+3.)**2
```

```
      AR14 = (XN+4.)**2
      IF (Z.EQ.0.) THEN
        AR0 = HK2
      ELSE IF (Z.EQ.1.) THEN
        AR0 = AR11*HK2
      ELSE IF (Z.EQ.2.) THEN
        AR0 = AR11*AR12*HK2
      ELSE IF (Z.EQ.3.) THEN
        AR0 = AR11*AR12*AR13*HK2
      ELSE IF (Z.EQ.4.) THEN
        AR0 = AR11*AR12*AR13*AR14*HK2
      ENDIF
      QX0       = AR0*VMQX(J)
      GRADQX(J) =  QX+QX0
      RTE1(J)   =  ABS(TABQX(J)-GRADQX(J))/TABQX(J)*100.
      RTE2(J)   =  ABS(TABQX(J)-VMQX(J))/TABQX(J)*100.
      SURTE1    =  SURTE1+RTE1(J)
      SURTE2    =  SURTE2+RTE2(J)
10    CONTINUE
      VMRTE1    =  SURTE1/FLOAT(INTAGE)
      VMRTE2    =  SURTE2/FLOAT(INTAGE)
      RETURN
      END
C=======================================================================
C                  FUNCTION FACTORIAL
C=======================================================================
      FUNCTION FACT(F)
      IF (F.EQ.0.)  THEN
        FACT = 1.
        GOTO 1
```

```
      ENDIF
      FACT  = 1.
        M  = INT(F)
      DO 10 L = 1,M
       FACT = FACT*FLOAT(L)
10    CONTINUE
1     RETURN
      END
C=============================================================
C                    SUBROUTINE
C              FUNCTIONAL FORMS GRADUATION
C                 (WEIBULL 'S FORM)
C=============================================================
      SUBROUTINE  FORMW
      DIMENSION   TX(2,100),TXW(2,100),TXWX(2,2),TXWQX(2),
     *X(100,2),W(100,100),QX(100)
      COMMON/VAR1/TABQX(100),NUM,PK(100),PB(100),IFIRST,ILAST,INTAGE
      COMMON/VAR2/GRADQX(100),RTE1(100),RTE2(100),VMQX(100)
      COMMON/VAR3/K,SUMTW,DEATH,WITH,ENDED,VMRTE1,VMRTE2
      COMMON/VAR4/PPK,PPN,PPB,PPC,PN,PC,U,ALP,BETA,NW
C       DO 10 I = 1,INTAGE
C            X1  = FLOAT(I+IFIRST-1)
C            X2  = FLOAT(I+IFIRST)
        DO 10 I=1,60
           X1 = FLOAT(I)
           X2 = FLOAT(I+1)
          X(I,1)  = 1.
          X(I,2)  = ALOG10(X1)
          TX(1,I) = 1.
          TX(2,I) = ALOG10(X1)
```

```
        QX(I)   = ALOG10(VMQX(X2))
C        DO 10 J = 1,INTAGE
        DO 10 J = 1,99
         IF (I.EQ.J) THEN
          W(I,J) = FLOAT(NUM)/(VMQX(X2)*(1.-VMQX(X2)))
         ELSE
          W(I,J)  = 0.0
         ENDIF
10    CONTINUE
      DO 20 I = 1,2
        TXWX(I,1)   =  0.0
        TXWX(I,2)   = 0.0
        TXWQX(I)    =  0.0
C        DO 20 J = 1,INTAGE
        DO 20 J = 1,99
         TXW(I,J)  = 0.0
C          DO 15 K =1,INTAGE
          DO 15 K= 1,99
           TXW(I,J)  = TXW(I,J)+TX(I,K)*W(K,J)
15         CONTINUE
      TXWX(I,1)  = TXWX(I,1)+TXW(I,J)*X(J,1)
      TXWX(I,2)  = TXWX(I,2)+TXW(I,J)*X(J,2)
      TXWQX(I)   = TXWQX(I)+TXW(I,J)*QX(J)
20    CONTINUE
      AB     = TXWX(1,1)*TXWX(2,2)-TXWX(2,1)*TXWX(1,2)
      A1     = TXWQX(1)*TXWX(2,2)-TXWQX(2)*TXWX(1,2)
      B1     = TXWX(1,1)*TXWQX(2)-TXWX(2,1)*TXWQX(1)
      A      = A1/AB
      B      = B1/AB
      PPK    = 10.**A
```

```
      PPN    = B
      SURTE1 = 0.0
      SURTE2 = 0.0
      DO 30 J = IFIRST+1,ILAST+1
      GRADQX(J) = 1.-(EXP(((J**(PPN+1.))-((J-1.)**(PPN+1.)))*
     * (-PPK)/(PPN+1.)))
      RTE1(J)   = ABS(TABQX(J)-GRADQX(J))/TABQX(J)*100.
      RTE2(J)   = ABS(TABQX(J)-VMQX(J))/TABQX(J)*100.
      SURTE1    = SURTE1+RTE1(J)
      SURTE2    = SURTE2+RTE2(J)
30    CONTINUE
      VMRTE1    = SURTE1/FLOAT(INTAGE)
      VMRTE2    = SURTE2/FLOAT(INTAGE)
      RETURN
      END
C=====================================================================
C                    SUBROUTINE
C             FUNCTIONAL FORMS GRADUATION
C                 (GOMPERTZ 'S FORM)
C=====================================================================
      SUBROUTINE  FORMG
      DIMENSION   TX(2,100),TXW(2,100),TXWX(2,2),TXWQX(2),
     * X(100,2),W(100,100),QX(100)
      COMMON/VAR1/TABQX(100),NUM,PK(100),PB(100),IFIRST,ILAST,INTAGE
      COMMON/VAR2/GRADQX(100),RTE1(100),RTE2(100),VMQX(100)
      COMMON/VAR3/K,SUMTW,DEATH,WITH,ENDED,VMRTE1,VMRTE2
      COMMON/VAR4/PPK,PPN,PPB,PPC,PN,PC,U,ALP,BETA,NW
C     DO 10 I = 1,INTAGE
C        X1  = FLOAT(I+IFIRST-1)
C        X2  = FLOAT(I+IFIRST)
```

```
      MAX = 90
     DO 10 I = 1,MAX
       X1 = FLOAT(I+9)
       X2 = FLOAT(I+10)
       X(I,1)  = 1.
       X(I,2)  =  X1
       TX(1,I) = 1.
       TX(2,I) = X1
       QX(I)   = ALOG10(VMQX(X2))
C       DO 10 J = 1,INTAGE
       DO 10 J = 1,MAX
         IF (I.EQ.J) THEN
           W(I,J) = FLOAT(NUM)/(VMQX(X2)*(1.-VMQX(X2)))
         ELSE
           W(I,J)  = 0.0
         ENDIF
10    CONTINUE
     DO 20 I = 1,2
        TXWX(I,1)   =  0.0
        TXWX(I,2)   =  0.0
        TXWQX(I)    =  0.0
C         DO 20 J = 1,INTAGE
        DO 20 J = 1,MAX
          TXW(I,J)  = 0.0
C           DO 15 K =1,INTAGE
          DO 15 K =1,MAX
            TXW(I,J)  = TXW(I,J)+TX(I,K)*W(K,J)
15    CONTINUE
     TXWX(I,1)  = TXWX(I,1)+TXW(I,J)*X(J,1)
     TXWX(I,2)  = TXWX(I,2)+TXW(I,J)*X(J,2)
```

```
      TXWQX(I)   = TXWQX(I)+TXW(I,J)*QX(J)
20    CONTINUE
      AB     = TXWX(1,1)*TXWX(2,2)-TXWX(2,1)*TXWX(1,2)
      A1     = TXWQX(1)*TXWX(2,2)-TXWQX(2)*TXWX(1,2)
      B1     = TXWX(1,1)*TXWQX(2)-TXWX(2,1)*TXWQX(1)
      A      = A1/AB
      B      = B1/AB
      PPB    = 10.**A
      PPC    = 10.**B
      SURTE1 = 0.0
      SURTE2 = 0.0
      DO 30 J = IFIRST+1,ILAST+1
C     DO 30 J = 11,51
      GRADQX(J) = 1.-(EXP(PPC**(J-1.)*(PPC-1.)*(-PPB)/ALOG(PPC)))
      RTE1(J)   = ABS(TABQX(J)-GRADQX(J))/TABQX(J)*100.
      RTE2(J)   = ABS(TABQX(J)-VMQX(J))/TABQX(J)*100.
      SURTE1    = SURTE1+RTE1(J)
      SURTE2    = SURTE2+RTE2(J)
30    CONTINUE
      VMRTE1    = SURTE1/FLOAT(INTAGE)
      VMRTE2    = SURTE2/FLOAT(INTAGE)
      RETURN
      END
C=======================================================================
C                    SUBROUTINE
C              CUBIC SPLINES GRADUATION
C=======================================================================
      SUBROUTINE  SPLINE
      DIMENSION   TX(15,100),TXW(15,100),TXWX(15,15),TXWQX(15),
     *X(100,15),W(100,100),QX(100),C(15),A(15,15)
```

```
COMMON/VAR1/TABQX(100),NUM,PK(100),PB(100),IFIRST,ILAST,INTAGE
COMMON/VAR2/GRADQX(100),RTE1(100),RTE2(100),VMQX(100)
COMMON/VAR3/K,SUMTW,DEATH,WITH,ENDED,VMRTE1,VMRTE2
COMMON/VAR4/VK1,VK2,VK3,VK4,KNOT,MAT,PN,PC,U,ALP,BETA,NW
 MIN = 0
 MAX = 99
 MM = MAX-MIN+1
DO 10 I = 1,MM
    X1   = FLOAT(I+MIN-1)
   QX(I) = VMQX(I+MIN)
   DO 10 J = 1,MAT
     IF (I.EQ.1.AND.MIN.EQ.0) THEN
       IF (I.EQ.J) THEN
          X(I,J) = 1.0
       ELSE
          X(I,J) = X1
       ENDIF
   ELSE IF (J.EQ.5) THEN
       IF (X1.GE.VK1)  THEN
         X(I,J) = (X1-VK1)**3
       ELSE
         X(I,J) = 0.0
       ENDIF
     ELSE IF (J.EQ.6) THEN
       IF (X1.GE.VK2)  THEN
         X(I,J) = (X1-VK2)**3
       ELSE
         X(I,J) = 0.0
       ENDIF
     ELSE IF (J.EQ.7) THEN
```

```
      IF (X1.GE.VK3)  THEN
        X(I,J) = (X1-VK3)**3
      ELSE
        X(I,J) = 0.0
      ENDIF
    ELSE IF (J.EQ.8) THEN
      IF (X1.GE.VK4) THEN
        X(I,J) = (X1-VK4)**3
      ELSE
        X(I,J) = 0.0
      ENDIF
    ELSE IF (J.EQ.9) THEN
      IF (X1.GE.VK5) THEN
        X(I,J) = (X1-VK5)**3
      ELSE
        X(I,J) = 0.0
      ENDIF
    ELSE  IF (J.EQ.5) THEN
      IF (X1.GE.VK1)  THEN
        X(I,J) = (X1-VK1)**3
      ELSE
        X(I,J) = 0.0
      ENDIF
    ELSE IF (J.EQ.6) THEN
      IF (X1.GE.VK2)  THEN
        X(I,J) = (X1-VK2)**3
      ELSE
        X(I,J) = 0.0
      ENDIF
    ELSE IF (J.EQ.7) THEN
```

```
            IF (X1.GE.VK3)  THEN
              X(I,J) = (X1-VK3)**3
            ELSE
              X(I,J) = 0.0
            ENDIF
          ELSE IF (J.EQ.8) THEN
            IF (X1.GE.VK4) THEN
              X(I,J) = (X1-VK4)**3
            ELSE
              X(I,J) = 0.0
            ENDIF
          ELSE IF (J.EQ.9) THEN
            IF (X1.GE.VK5) THEN
              X(I,J) = (X1-VK5)**3
            ELSE
              X(I,J) = 0.0
            ENDIF
          ELSE  IF (J.EQ.10) THEN
            IF (X1.GE.VK6)  THEN
              X(I,J) = (X1-VK6)**3
            ELSE
              X(I,J) = 0.0
            ENDIF
              X(I,J) = X1**(J-1)
10    CONTINUE
C-------------------------------------------------------------
      DO 20 J = 1,MAT
        DO 20 I = 1,MM
          TX(J,I) = X(I,J)
20    CONTINUE
```

```
      DO 30 I = 1,MM
C       X1 = FLOAT(I+IFIRST)
        DO 30 J = 1,MM
          IF (I.EQ.J) THEN
            W(I,J) = FLOAT(NUM)/QX(I)*(1.-QX(I))
          ELSE
            W(I,J)  = 0.0
          ENDIF
30    CONTINUE
C-------------------------------------------------------
C      END FIND MATRIX : X,TX,W,QX
C-------------------------------------------------------
      DO 1 I = 1,MAT
        DO 1 J = 1,MAT
          TXWX(I,J) = 0.0
1     CONTINUE
      DO 40 I = 1,MAT
        TXWQX(I) = 0.0
        DO 40 L = 1,MM
          TXW(I,L)  = 0.0
          DO 15 K =1,MM
            TXW(I,L)  = TXW(I,L)+TX(I,K)*W(K,L)
15          CONTINUE
            TXWQX(I)  =  TXWQX(I)+TXW(I,L)*QX(L)
            DO 40 J = 1,MAT
              TXWX(I,J)  =  TXWX(I,J)+TXW(I,L)*X(L,J)
40    CONTINUE
C-------------------------------------------------
C      END FIND MATRIX : TXWQX,TXWX
C-------------------------------------------------
```

```
      DO 31 I = 1,MAT-1
        DO 31 J = I+1,MAT
          A(J,I)   =  TXWX(J,I)/TXWX(I,I)
          TXWQX(J) =  TXWQX(J)-A(J,I)*TXWQX(I)
          DO 31 L =1,MAT
            TXWX(J,L) = TXWX(J,L)-A(J,I)*TXWX(I,L)
31    CONTINUE
      C(MAT)  = TXWQX(MAT)/TXWX(MAT,MAT)
        DO 50 I = MAT-1,1,-1
          SUM = 0.0
          DO 41 J = MAT,I+1,-1
            SUM = SUM+C(J)*TXWX(I,J)
41    CONTINUE
        C(I)  =  (TXWQX(I)-SUM)/TXWX(I,I)
50    CONTINUE
C-------------------------------------------------------
C     END FIND VALUE OF C
C-------------------------------------------------------
      SURTE1 = 0.0
      SURTE2= 0.0
      IA = IFIRST-MIN+1
      IB = ILAST-MIN+1
      DO 60 I = 1,100
        X1  = FLOAT(I+MIN-1)
        IF (X1.EQ.0.) THEN
          SUMP = C(1)
          GRADQX(1) = SUMP
          GOTO 60
        ENDIF
        SUMP = 0.0
```

```
      DO 51 J = 1,MAT
        IF (J.EQ.5) THEN
          IF (X1.GE.VK1) THEN
            SUMP = SUMP+C(J)*(X1-VK1)**3
          ENDIF
        ELSE IF (J.EQ.6) THEN
          IF (X1.GE.VK2) THEN
            SUMP = SUMP+C(J)*(X1-VK2)**3
          ENDIF
        ELSE IF (J.EQ.7) THEN
          IF (X1.GE.VK3) THEN
            SUMP = SUMP+C(J)*(X1-VK3)**3
          ENDIF
        ELSE IF (J.EQ.8) THEN
          IF (X1.GE.VK4) THEN
            SUMP = SUMP+C(J)*(X1-VK4)**3
          ENDIF
        ELSE IF (J.EQ.9) THEN
          IF (X1.GE.VK5) THEN
            SUMP = SUMP+C(J)*(X1-VK5)**3
          ENDIF
        ELSE IF (J.EQ.10) THEN
          IF (X1.GE.VK6) THEN
            SUMP = SUMP+C(J)*(X1-VK6)**3
          ENDIF
      ENDIF
        ELSE
          SUMP = SUMP+C(J)*(X1**(J-1))
        ENDIF
51    CONTINUE
```

```
          GRADQX(I+MIN)  = SUMP
60     CONTINUE
       DO 61 K = IFIRST+1,ILAST+1
       RTE1(K) = ABS(TABQX(K)-GRADQX(K))/TABQX(K)*100.
       RTE2(K) = ABS(TABQX(K)-VMQX(K))/TABQX(K)*100.
       SURTE1 = SURTE1+RTE1(K)
       SURTE2 = SURTE2+RTE2(K)
61     CONTINUE
       VMRTE1 = SURTE1/FLOAT(INTAGE)
       VMRTE2 = SURTE2/FLOAT(INTAGE)
       RETURN
       END
C=============================================================================
```

ประวัติผู้เขียน

นางสาว สมใจ สุภัควิริยะกุล เกิดวันที่ 9 ธันวาคม พ.ศ. 2513 สำเร็จการศึกษาปริญญาตรีวิทยาศาสตรบัณฑิต สาขาวิชาคณิตศาสตร์ประยุกต์ ภาควิชาคณิตศาสตร์ คณะวิทยาศาสตร์ สถาบันเทคโนโลยีพระจอมเกล้าเจ้าคุณทหารลาดกระบัง ในปีการศึกษา 2536 และเข้าศึกษาต่อในหลักสูตรวิทยาศาสตรมหาบัณฑิต สาขาการประกันภัย ภาควิชาสถิติ คณะพาณิชยศาสตร์และการบัญชี จุฬาลงกรณ์มหาวิทยาลัย ในปีพ.ศ. 2537