

บรรณานุกรม

ภาษาไทย

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โรงพิมพ์อานพิมพ์ 2526.

_____. การวิเคราะห์ปัญหามัลติโคลิเนียร์ตี้น้ล้การถดถอยพหุคูณเมื่อมีค่าล้ง เกิดล้ล้หาย :
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2528.

ภาษาต่างประเทศ

Afifi, A.A. and Elashoff, R.M. . "Missing Observations in Multivariate
Statistics II Point Estimation of Simple Linear Regression."
Journal of the American Statistical Association 62(1967):
10-29.

Chan, L.S., Gilman, J.A. and Dunn, O.J. "Alternative approaches to
missing values in discriminant analysis" Journal of the
American Statistical Association 71(1976):842-844

Gibbons, D.G. "A Simulation Study of some Ridge Estimators" Journal
of the American Statistical Association 76(1981): 131-139.

Hoerl, A.E. and Kennard, R.W. "Ridge Regression : Biased
Estimation for Nonorthogonal Problems" Technometrics 12(1970)
:55-67.

Kebjian, H.H. "Missing Observations in Multivariate Regression" Journal
of the American Statistical Association 1969:1609-1616.

บรรณานุกรม (ต่อ)

McDonald, G.C. and Galarneau, D.I. . "A Monte Carlo Evaluation of
Some Ridge Type Estimators" Journal of the American
Statistical Association 70(1975): 407-416.

Wichern, E.W. and Churchill, G.A. "A Comparison of Ridge Estimators"
Technometrics 20(1978): 301-311

ภาคผนวก



ภาคผนวก ก

การผลิตเลขสุ่มปกติโดยวิธี Log-and-Trig

วิธี Log-and-Trig เป็นผลงานของมุลเลอร์ (Muller) ซึ่งใช้ผลิตเลขสุ่มปกติจากเลขสุ่มแจกแจงสม่ำเสมอเท่านั้น

ให้ $U_1 \sim N(0, \sigma^2)$ และ $U_2 \sim N(0, \sigma^2)$ โดยที่ U_1 เป็นอิสระกับ U_2 การแจกแจงร่วมของตัวแปร U_1 และ U_2 จึงเขียนได้เป็น

$$\begin{aligned} f_{U_1, U_2}(U_1, U_2) &= \frac{1}{\sigma\sqrt{2\pi}} e^{-U_1^2/2\sigma^2} \cdot \frac{1}{\sigma\sqrt{2\pi}} e^{-U_2^2/2\sigma^2} \\ &= \frac{1}{2\pi\sigma^2} e^{-(U_1^2+U_2^2)/2\sigma^2} \quad ; \quad -\infty < U_1 < \infty, \quad -\infty < U_2 < \infty \end{aligned}$$

ค่าคู่หนึ่งของตัวแปรสุ่ม U_1 และ U_2 จะกำหนดจุด ๆ หนึ่งขึ้นในยุคลิเดียนที่สมมติเท่ากับ 2 จุดสุ่มนี้อาจเขียนแสดงได้ด้วยแกนโพลาร์ (polar coordinate) (R, θ)

$$U_1 = R \cos \theta$$

และ

$$U_2 = R \sin \theta$$

จะพบว่า การแจกแจงร่วมของ R และ θ คือ

$$g_{R, \theta}(r, \theta) = \frac{1}{2\pi\sigma^2} e^{-r^2/2\sigma^2} \cdot J^+$$

$$\text{โดยที่ } J^+ = \begin{vmatrix} \frac{\partial U_1}{\partial r} & \frac{\partial U_1}{\partial \theta} \\ \frac{\partial U_2}{\partial r} & \frac{\partial U_2}{\partial \theta} \end{vmatrix} = \begin{vmatrix} \cos \theta & -r \sin \theta \\ \sin \theta & r \cos \theta \end{vmatrix} = r$$

$$g_{R,\theta}(r,\theta) = \frac{r}{2\pi\sigma^2} e^{-r^2/2\sigma^2} \quad ; \quad 0 \leq r < \infty, 0 \leq \theta < 2\pi$$

$$g_R(r) = \int_0^{2\pi} \frac{r}{2\pi\sigma^2} e^{-r^2/2\sigma^2} d\theta$$

$$= \frac{r}{\sigma^2} e^{-r^2/2\sigma^2} \quad ; \quad 0 \leq r < \infty$$

$$g_\theta(\theta) = \int_0^\infty \frac{r}{2\pi\sigma^2} e^{-r^2/2\sigma^2} dr$$

$$= \frac{1}{2\pi} \quad ; \quad 0 \leq \theta < 2\pi$$

แสดงว่า $\theta \sim \text{Uniform}(0, 2\pi)$ และ $R \sim \text{Rayleigh}(\beta = \sigma^2)$ และ θ เป็นอิสระ

กับ R ทั้งนี้เพราะ $f_R(r) f_\theta(\theta) = f_{R,\theta}(r,\theta)$

จาก $f_\theta(\theta) = \frac{1}{2\pi} \quad ; \quad 0 \leq \theta < 2\pi$ กำหนดให้ $X_{1i} = (\sigma^2/2\pi)\theta_i$

$$\therefore M_{X_{1i}}(t) = \frac{e^{2\pi(\sigma^2 t/2\pi)} - e^{0(\sigma^2 t/2\pi)}}{(\sigma^2 t/2\pi)(2\pi - 0)}$$

$$= \frac{e^{\sigma^2 t} - e^{0t}}{t(\sigma^2 - 0)}$$

แสดงว่า $X_{1i} \sim \text{Uniform}(0, \sigma^2)$

จาก $f_R(r) = \frac{r}{\sigma^2} e^{-r^2/2\sigma^2} \quad ; \quad 0 \leq r < \infty$ กำหนดให้ $X_{2i} = \sigma^2 e^{-R_i^2/2\sigma^2}$

$$r_i = [2\sigma^2 \ln(\sigma^2/x_{2i})]^{1/2}$$

$$J^+ = |dr/dx_{2i}| = \frac{1}{2} (2\sigma^2/x_{2i}) [2\sigma^2 \ln(\sigma^2/x_{2i})]^{-1/2}$$

$$f_{X_{2i}}(x_{2i}) = [2\sigma^2 \ln(\sigma^2/x_{2i})]^{1/2} (1/\sigma^2)(x_{2i}/\sigma^2)^{1/2} [(2\sigma^2/x_{2i}) 2\sigma^2 \ln(\sigma^2/x_{2i})]^{-1/2}$$

$$= \frac{1}{\sigma^2} ; 0 \leq x_{2i} \leq \sigma^2$$

แสดงว่า $X_{1i} \sim \text{Uniform}(0, \sigma^2)$ และ $X_{2i} \sim \text{Uniform}(0, \sigma^2)$ โดยที่

$$X_{1i} = \frac{\sigma^2}{2\pi} \theta_i \quad \text{และ} \quad X_{2i} = \sigma^2 e^{-R_i^2/2\sigma^2}$$

เราจึงนำความรู้เกี่ยวกับ X_{1i} และ X_{2i} ไปใช้ในการสร้างเลขสุ่มที่มีการแจกแจงแบบ $N(0, \sigma^2)$ ได้ดังนี้

เนื่องจาก $U_1 \sim N(0, \sigma^2)$ และ $U_2 \sim N(0, \sigma^2)$ โดยที่ U_1 เป็นอิสระกับ U_2 และเนื่องจาก $R \sim \text{Rayleigh}(\sigma^2)$ และ $\theta \sim \text{Uniform}(0, 2\pi)$ โดยที่ R และ θ เป็นอิสระต่อกัน

ดังนั้น $U_1 = R \cos \theta$ และ $U_2 = R \sin \theta$ จึงเป็นอิสระต่อกันและ U_1 และ U_2 ยังคงมีการแจกแจงแบบ $N(0, \sigma^2)$

$$\text{กำหนดให้ } X_{1i} = \frac{\sigma^2}{2\pi} \theta_i \quad \text{และ} \quad X_{2i} = \sigma^2 e^{-R_i^2/2\pi}$$

เราได้พิสูจน์มาแล้วว่า X_{1i} และ X_{2i} ต่างก็มีการแจกแจงแบบ $\text{Uniform}(0, \sigma^2)$

ดังนั้น เมื่อแทนที่ R และ θ ซึ่งเป็นฟังก์ชันของ X_{1i} และ X_{2i} ลงในสมการ $U_1 = R \cos \theta$ และ $U_2 = R \sin \theta$ จึงพบว่า

$$U_1 = [2\sigma^2 \ln(\sigma^2/X_{2i})]^{1/2} \cos [(2\pi/\sigma^2)X_{1i}] \sim N(0, \sigma^2)$$

$$U_2 = [2\sigma^2 \ln(\sigma^2/X_{2i})]^{1/2} \sin [(2\pi/\sigma^2)X_{1i}] \sim N(0, \sigma^2)$$

คือสมการสำหรับสร้างเลขสุ่มปกติ $N(0, \sigma^2)$ สองกลุ่มที่เป็นอิสระต่อกัน ทั้งนี้นักวิจัยจะต้องกำหนดค่าของ X_{1i} และ X_{2i} ขึ้นก่อนจึงจะทราบค่าของ U_1 และ U_2 ตามต้องการ โดยที่

$$0 \leq X_{1i} \leq \sigma^2, \quad 0 \leq X_{2i} \leq \sigma^2$$

หมายเหตุ ถ้ากำหนดให้ $\sigma^2=1$ จะพบว่า X_{1i} และ X_{2i} มีการแจกแจงแบบ Uniform (0,1) และพบว่า U_1 และ U_2 มีการแจกแจงแบบ $N(0,1)$ โดยที่

$$U_1 = [-2 \ln x_{2i}]^{1/2} \cos (2\pi x_{1i}) \sim N(0,1)$$

$$U_2 = [-2 \ln x_{2i}]^{1/2} \sin (2\pi x_{1i}) \sim N(0,1)$$

ภาคผนวก ข

โปรแกรม 1

โปรแกรมการสร้างตัวแปรอิสระและตัวแปรตาม ตามเงื่อนไขที่กำหนดรวมทั้งการ
กำหนดค่าสุ่มโดยสุ่มให้แก่ตัวแปรอิสระ

```

10 PRINT "WORK.BAS"
15 CLEAR
16 DEFSNG A-Z
20 INPUT "SAMPLE SIZE " ; N
30 CCC = CCC + 1
50 DIM X(N,5),X0(5),XBAR(5),S0(5),S2(5),TMSSEL(10),TMSSES(10),X1(N),X2(N),U1(N),U2
(N),AA(N,5),IP(N),PB(N,5),IC(5),IB(N,5),KOUNT(5),MX(5),N1(5),Q(5),Q1(5),R(5,5),Y
(N,5),S1(5,5),A$(N),B$(25),S(5)
60 COMMON N,R0,R1,NN,M,BL,BS,X(),TMSSEL(),TMSSES(),IP(),PB(),AA(),IC(),Y(),CCC,DD,
N6
70 INPUT "POPULATION CORRELATION" ; R1,R0
80 FOR II = 1 TO 5
90 GOSUB 940
100 IF II = 4 OR II = 5 THEN 150
110 FOR J = 1 TO N
120 X(J,II) = SQR((1 - R1 ^ 2)) * U1(J) + R1 * U2(J)
130 NEXT J
140 GOTO 180
150 FOR J = 1 TO N
160 X(J,II) = SQR((1 - R0 ^ 2)) * U1(J) + R0 * U2(J)
170 NEXT J
180 X0(II) = 0!
190 FOR J = 1 TO N
200 X0(II) = X0(II) + X(J,II)
210 NEXT J
220 XBAR(II) = (1!/N) * X0(II)
230 S0(II) = 0!
240 FOR J = 1 TO N
250 S0(II) = S0(II) + (X(J,II) - XBAR(II))^2
260 NEXT J
270 S2(II) = (1!/(N-1)) * S0(II)
280 S(II) = SQR(S2(II))
290 FOR J = 1 TO N
300 X(J,II) = (X(J,II) - XBAR(II))/S(II)
310 NEXT J
320 NEXT II
330 ERASE X0,XBAR,S0,S2,S
480 REM ....CREATE CORRELATION Ri : i = 1(1)5

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500 R(2,1) = R1^2:R(3,1) = R1^2:R(3,2) = R1^2:R(4,1) = R1*R0:R(4,2) = R1*R0:R(4,
3) = R1*R0
510 R(5,1) = R1*R0:R(5,2) = R1*R0:R(5,3) = R1*R0:R(5,4) = R0^2
520 FOR I = 1 TO 5
530 FOR J = 1 TO 5
540 R(I,J) = R(J,I)
550 NEXT J
551 R(I,I) = 1
560 NEXT I
570 NN = 5
580 GOSUB 1180
590 INPUT "MAX. OF RANDOM DATA" : M
600 REM ....M IS SIGMA-SQUARE....
610 GOSUB 2090
620 ERASE X1.X2
650 K1 = BL
660 GOSUB 850
670 K1 = BS
680 GOSUB 850
690 ERASE U1,U2
710 LPRINT "NO. OF REPLICATION = " ; CCC,
720 LPRINT "N = " ; N; " ";
730 LPRINT "RHO = " ; R1; " ";
740 LPRINT "RHO* = " ; R0; " ";
750 LPRINT "SIGMA = " ; M; " ";
780 GOSUB 2320
831 ERASE R,S1
840 CHAIN "SUB17.BAS"
850 REM ....GENERATE Yi,i = 1(1)N....
860 FOR I = 1 TO N
870 Y(I,K1) = 0!
880 FOR J = 1 TO NN
890 Y(I,K1) = Y(I,K1) + S1(J,K1) * X(I,J)
900 NEXT J
910 Y(I,K1) = Y(I,K1) + U2(I)
920 NEXT I
922 PRINT TAB(20); " DEPENDENT VARIABLE Y(i,j)"
923 FOR I = 1 TO N
924 PRINT TAB(20); "Y(" ; I ; "," ; K1 ; ") = " ; Y(I,K1)
925 NEXT I
930 RETURN
940 REM ....SUB1 Random Normal Deviate N(0,1)....
950 RANDOMIZE
970 FOR I = 1 TO N
980 Q = RND
990 X1(I) = Q
1000 IF I = 1 THEN 1040
1010 FOR J = 1 TO I - 1
1020 IF X1(J) = X1(I) THEN 980
1030 NEXT J
1040 NEXT I

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1050 FOR I = 1 TO N
1060 Q1 = RND
1070 X2(I) = Q1
1080 IF I = 1 THEN 1120
1090 FOR J = 1 TO I-1
1100 IF X2(J) = X2(I) THEN 1060
1110 NEXT J
1120 NEXT I
1130 FOR I = 1 TO N
1140 U1(I) = SQR((-2!)*LOG(X2(I)))*COS(44!*X1(I)/7!)
1150 U2(I) = SQR((-2!)*LOG(X2(I)))*SIN(44!*X1(I)/7!)
1160 NEXT I
1170 RETURN
1180 REM ....SUB3 Eigen Value and Eigen Vector....
1190 R = .00001
1210 FOR I = 1 TO NN
1220 S1(I,I) = 1!
1230 NEXT I
1240 FOR I = 2 TO NN
1250 FOR J = 1 TO I-1
1260 I1 = I1 + 2! * R(I,J)^2
1270 NEXT J
1280 NEXT I
1290 N11 = SQR(I1): N22 = (R/NN)*N11: T = N11
1300 T = T/NN
1310 FOR M1 = 2 TO NN
1320 FOR M2 = 1 TO M1-1
1330 IF ABS(R(M2,M1)) <= T THEN 1520
1340 I2 = 1!
1350 V1 = R(M2,M2): V2 = R(M2,M1): V3 = R(M1,M1)
1360 M = (V1 - V3)*.5
1370 IF M <> 0! THEN 1400
1380 W = -1!
1390 GOTO 1410
1400 W = -SGN(M)*V2/SQR(V2^2 + M^2)
1410 T1 = W/SQR(2!*(1!+SQR(1! - W/2!)))
1420 T2 = T1^2
1430 C1 = SQR(1! - T2): C2 = C1^2: T3 = T1*C1
1440 FOR I = 1 TO NN
1450 I1 = R(I,M2)*C1 - R(I,M1)*T1:R(I,M1) = R(I,M2)*T1 + R(I,M1)*C1:R(I,M2)=I1
1460 I1 = S1(I,M2)*C1-S1(I,M1)*T1:S1(I,M1) = S1(I,M2)*T1+S1(I,M1)*C1
1461 S1(I,M2) = I1
1470 NEXT I
1480 FOR I = 1 TO NN
1490 R(M2,I) = R(I,M2): R(M1,I) = R(I,M1)
1500 NEXT I
1510 R(M2,M2) = V1*C2+V3*T2-2*V2*T3:R(M1,M1) = V1*T2+V3*C2+2*V2*T3
1520 R(M2,M1) = (V1 - V3)*T3+V2*(C2-T2):R(M1,M2) = R(M2,M1)
1530 NEXT M2
1540 NEXT M1
1550 IF I2 <> 1! THEN 1580
1560 I2 = 0!

```

```
1570 GOTO 1310
1580 IF T > N22 THEN 1300
1590 REM ....SORT MATRIX R.S (R1>R2>...>R5)....
1600 FOR I = 1 TO NN
1610 FOR J = 1 TO NN-1
1620 IF R(J,J) > R(J+1,J+1) THEN 1670
1630 B = R(J,J):R(J,J) = R(J+1,J+1): R(J+1,J+1) = B
1640 FOR K = 1 TO NN
1650 B = S1(K,J): S1(K,J) = S1(K,J+1):S1(K,J+1) = B
1660 NEXT K
1670 NEXT J
1680 NEXT I
1810 REM ....SAVE Eigen Value....
1820 OPEN "R",#1,"C:F30",4*NN
1830 FIELD#1,4 AS A$(1)
1840 FOR I = 2 TO NN
1850 FIELD#1,4*(I-1) AS AA$,4 AS A$(I)
1860 NEXT I
1870 FOR I = 1 TO NN
1880 LSET A$(I) = MKS$(R(I,I))
1890 NEXT I
1900 PUT#1,1
1910 CLOSE#1
1920 REM ....SAVE Eigen Vector....
1930 OPEN "R",#3,"C:F31",4*NN*NN
1940 FIELD#3,4 AS B$(1)
1950 FOR I = 2 TO NN*NN
1960 FIELD#3,4*(I-1) AS BB$,4 AS B$(I)
1970 NEXT I
1980 K = 0
1990 FOR I = 1 TO NN
2000 FOR J = 1 TO NN
2010 K = K + 1
2020 LSET B$(K) = MKS$(S1(J,I))
2030 NEXT J
2040 NEXT I
2050 PUT#3,1
2060 CLOSE#3
2070 BL = 1: BS = NN
2080 RETURN
2090 REM ....SUB2 Random Normal Deviate N(0,a^2)
2100 RANDOMIZE
2110 FOR I = 1 TO N
2120 Q = RND
2130 R = (Q*M): X1(I) = R
2140 IF I = 1 THEN 2180
2150 FOR J = 1 TO I-1
2160 IF X1(J) = X1(I) THEN 2120
2170 NEXT J
2180 NEXT I
2190 FOR I = 1 TO N
2200 Q1 = RND
```

```
2210 R = (Q1*M): X2(I) = R
2220 IF I = 1 THEN 2260
2230 FOR J = 1 TO I-1
2240 IF X2(J) = X2(I) THEN 2200
2250 NEXT J
2260 NEXT I
2270 FOR I = 1 TO N
2280 U1(I) = SQR((2!*M*LOG(M/X2(I))))*COS(44!*X1(I)/(7!*M))
2290 U2(I) = SQR((2!*M*LOG(M/X2(I))))*SIN(44!*X1(I)/(7!*M))
2300 NEXT I
2310 RETURN
2320 REM ....SUB4 MISS....
2330 DIM N3(5)
2350 FOR K = 1 TO 5
2360 IC(K) = 0
2370 NEXT K
2380 FOR I = 1 TO 5
2390 RANDOMIZE
2410 MX(I) = INT(RND*100)/100
2420 IF MX(I) < .05 OR MX(I) > .15 THEN 2390
2430 N1(I) = CINT(MX(I)*N)
2440 NEXT I
2450 FOR I = 1 TO 5
2460 FOR J = 1 TO N1(I)
2470 RANDOMIZE
2480 Q(I) = INT(RND*N)
2490 IF Q(I) > N OR Q(I) <= 0 THEN 2470
2500 IB(J,I) = Q(I)
2510 NEXT J
2520 N3(I) = N1(I)-1
2530 FOR L4 = 1 TO N3(I)
2540 L3 = L4 + 1
2550 FOR L2 = L3 TO N1(I)
2560 IF IB(L4,I) <= IB(L2,I) THEN 2600
2570 IP = IB(L4,I)
2580 IB(L4,I) = IB(L2,I)
2590 IB(L2,I) = IP
2600 NEXT L2
2610 NEXT L4
2615 KOUNT(I) = 0
2620 FOR L1 = 1 TO N1(I)
2630 SS = 1
2640 LL1 = L1 + SS
2650 IF LL1 > N1(I) THEN 2760
2660 IF IB(L1,I) > IB(LL1,I) THEN 2760
2670 IF IB(L1,I) < IB(LL1,I) THEN 2760
2680 RANDOMIZE
2690 Q1(I) = INT(RND*N)
2700 IF Q1(I) > N OR Q1(I) <= 0 THEN 2640
2710 IB(LL1,I) = Q1(I)
2730 KOUNT(I) = KOUNT(I) + 1
```

```
2740 SS = SS + 1
2750 GOTO 2640
2760 NEXT L1
2770 IF KOUNT(I) > 0 THEN 2520
2780 FOR J = 1 TO N
2790 PB(J,I) = 0!
2800 NEXT J
2810 FOR J = 1 TO N1(I)
2820 PB(IB(J,I),I) = 1!
2830 NEXT J
2840 NEXT I
2890 FOR I = 1 TO N
2900 TT = 0
2910 FOR J = 1 TO 5
2920 IF PB(I,J) = 1! THEN TT = TT+1
2950 NEXT J
2960 IP(I) = TT
2970 IC(TT+1) = IC(TT+1)+1
2980 NEXT I
2981 FOR T = 1 TO N
2982 FOR S = 1 TO 5
2983 IF PB(T,S) = 1! THEN X(T,S) = 0!
2984 NEXT S
2985 NEXT T
2991 N4 = 0
3000 FOR I = 1 TO N
3010 IF IP(I) <> 0 THEN 3055
3020 N4 = N4 + 1
3030 FOR J = 1 TO 5
3040 AA(N4,J) = X(I,J)
3050 NEXT J
3055 NEXT I
3056 N6 = 0
3057 FOR I = 1 TO N
3058 IF IP(I) = 5 THEN 3060
3059 N6 = N6 + 1
3060 NEXT I
3200 RETURN
```



โปรแกรม 2

โปรแกรมการประมาณค่าสังเกตที่สูญหาย โดยวิธี Mean Substitution

```
10 REM ....SUB17 MEAN....
15 PRINT "SUB17.BAS"
16 DEFSNG A - Z
20 DIM W(N,5),E$(N),SUM(5),AV(5)
30 COMMON N,R0,R1,NN,M,BL,BS,X(),TMSL(),TMSL(),IP(),PB(),AA(),IC(),Y(),CCC,DD,
N6
100 FOR I = 1 TO 5
110 SUM(I) = 0
120 JJ = 0
130 FOR J = 1 TO N
140 IF IP(J) = 5 THEN GOTO 180
150 IF PB(J,I) = 1! THEN GOTO 180
160 SUM(I) = SUM(I) + X(J,I)
170 JJ = JJ + 1
180 NEXT J
200 AV(I) = SUM(I) / JJ
210 NEXT I
220 IQQ = 0
270 FOR I = 1 TO N
275 IF IP(I) = 5 THEN 320
276 IQQ = IQQ + 1
280 FOR J = 1 TO 5
290 W(IQQ,J) = X(I,J)
300 IF PB(IQQ,J) = 1! THEN W(IQQ,J) = AV(J)
310 NEXT J
320 NEXT I
340 FOR I = 1 TO 5
345 OPEN "R",#1,"C:F1750",4*N6
350 FIELD#1,4 AS E$(1)
360 FOR J = 2 TO N6
370 FIELD#1,4*(J-1) AS EE$,4 AS E$(J)
380 NEXT J
390 FOR J = 1 TO N6
400 LSET E$(J) = MKS$(W(J,I))
410 NEXT J
420 PUT#1,I
430 CLOSE#1
440 NEXT I
450 CHAIN "SUB6.BAS"
```

โปรแกรม 3

โปรแกรมการประมาณค่าพารามิเตอร์ตามวิธี Mean-Hoerl, Kennard and Baldwin (Mean-HKB) รวมทั้งคำนวณค่า Total Mean Square Error (TMSE)

```

10 REM ....SUB6 MEAN-HKB....
11 PRINT "SUB6.BAS"
16 DEFSNG A - Z
20 DIM W(N,NN),E$(N),P2(NN,N),YL(NN,N),YS(NN,N),P3(NN,NN),P5(NN,NN),P6(NN,NN)
21 DIM FL(NN,NN),FS(NN,NN),FLT(NN,NN),FST(NN,NN),IDEN(NN,NN),KIL(NN,NN)
22 DIM KIS(NN,NN),HL(NN,NN),HS(NN,NN),B$(NN*NN),P33(NN,NN)
23 DIM Q1(NN,1),Q2(NN,1),Q3(NN,1),Q4(NN,1),YZ(N,NN),C1(NN,1),C2(NN,1)
30 COMMON N,R0,R1,NN,M,BL,BS,X(),TMSEL(),TMSSES(),IP(),PB(),AA(),IC(),Y(),CCC,DD,
N6
50 FOR I = 1 TO NN
55 OPEN "R",#1,"C:F1750",4*N6
60 FIELD#1,4 AS E$(1)
70 FOR J = 2 TO N6
80 FIELD#1,4*(J-1) AS EE$,4 AS E$(J)
90 NEXT J
100 GET#1,I
110 FOR J = 1 TO N6
120 W(J,I) = CVS(E$(J))
130 NEXT J
135 CLOSE#1
140 NEXT I
160 FOR I = 1 TO NN
170 FOR J = 1 TO N6
180 P2(I,J) = W(J,I)
190 NEXT J
200 NEXT I
201 N4 = 0
202 FOR I = 1 TO N
203 IF IP(I) = 5 THEN 207
204 N4 = N4 + 1
205 YZ(N4,BL) = Y(I,BL)
206 YZ(N4,BS) = Y(I,BS)
207 NEXT I
210 FOR I = 1 TO N6
220 YL(BL,I) = YZ(I,BL)
230 YS(BS,I) = YZ(I,BS)
240 NEXT I
241 PRINT TAB(10);"P3(I,J)"

```

```

250 FOR I = 1 TO NN
260 FOR J = 1 TO NN
270 P3(I,J) = 0!
280 FOR K = 1 TO N6
290 P3(I,J) = P3(I,J) + P2(I,K)*W(K,J)
300 NEXT K
301 PRINT P3(I,J);"      ":
310 NEXT J
311 PRINT
320 NEXT I
323 FOR I = 1 TO NN:FOR J = 1 TO NN:P33(I,J) = P3(I,J):NEXT J
324 NEXT I
330 FOR I = 1 TO NN
340 FOR J = 1 TO NN
350 P3(I,J) = INT(P3(I,J)*100)/100
360 NEXT J: NEXT I
370 FOR K = 1 TO NN
380 FOR J = 1 TO NN
390 IF J = K THEN 410
400 P3(K,J) = P3(K,J)/P3(K,K)
410 NEXT J
420 P3(K,K) = 1/P3(K,K)
430 FOR I = 1 TO NN
440 IF I = K THEN 490
450 FOR J = 1 TO NN
460 IF J = K THEN 480
470 P3(I,J) = P3(I,J)-P3(K,J)*P3(I,K)
480 NEXT J
490 NEXT I
500 FOR I = 1 TO NN
505 IF I = K THEN 520
510 P3(I,K) = -P3(I,K)*P3(K,K)
520 NEXT I
530 NEXT K
601 PRINT TAB(10);"P4(I,J)"
602 FOR I = 1 TO NN:FOR J = 1 TO NN:PRINT P3(I,J);"      ":NEXT J:PRINT:NEXT I
610 FOR I = 1 TO NN
620 P5(I,BL) = 0!: P6(I,BS) = 0!
630 FOR J = 1 TO N6
640 P5(I,BL) = P5(I,BL) + P2(I,J)*YZ(J,BL)
650 P6(I,BS) = P6(I,BS) + P2(I,J)*YZ(J,BS)
660 NEXT J
670 NEXT I
680 FOR I = 1 TO NN
690 FL(I,BL) = 0!: FS(I,BS) = 0!
700 FOR J = 1 TO NN
710 FL(I,BL) = FL(I,BL) + P3(I,J)*P5(J,BL)
720 FS(I,BS) = FS(I,BS) + P3(I,J)*P6(J,BS)
730 NEXT J
740 NEXT I

```




```

760 Y0 = 0!: Y1 = 0!
770 FOR I = 1 TO N6
780 Y0 = Y0 + YL(BL,I)*YZ(I,BL)
790 Y1 = Y1 + YS(BS,I)*YZ(I,BS)
800 NEXT I
820 FOR I = 1 TO NN
830 FLT(BL,I) = FL(I,BL)
840 FST(BS,I) = FS(I,BS)
850 NEXT I
860 S11 = 0!: S12 = 0!
870 FOR I = 1 TO NN
880 S11 = S11 + FLT(BL,I)*P5(I,BL)
890 S12 = S12 + FST(BS,I)*P6(I,BS)
900 NEXT I
910 SL = (1/(N6-NN))*(Y0-S11)
920 SS = (1/(N6-NN))*(Y1-S12)
930 FFL = 0!: FFS = 0!: KL = 0!: KS = 0!
940 FOR I = 1 TO NN
950 FFL = FFL + FLT(BL,I)*FL(I,BL)
960 FFS = FFS + FST(BS,I)*FS(I,BS)
970 NEXT I
980 KL = (NN*SL)/FFL: KS = (NN*SS)/FFS
990 FOR I = 1 TO NN
1000 FOR J = 1 TO NN
1010 IF I = J THEN IDEN(I,J) = 1! ELSE IDEN(I,J) = 0!
1020 NEXT J
1030 NEXT I
1040 FOR I = 1 TO NN
1050 FOR J = 1 TO NN
1060 KIL(I,J) = KL*IDEN(I,J): KIS(I,J) = KS*IDEN(I,J)
1070 NEXT J
1080 NEXT I
1100 FOR I = 1 TO NN
1110 FOR J = 1 TO NN
1111 HL(I,J) = 0!: HS(I,J) = 0!
1120 HL(I,J) = P33(I,J) + KIL(I,J): HS(I,J) = P33(I,J) + KIS(I,J)
1130 NEXT J
1140 NEXT I
1141 PRINT TAB(10);"HL(I,J)"
1142 FOR I = 1 TO NN:FOR J = 1 TO NN:PRINT HL(I,J);" ";NEXT J:PRINT:NEXT I
1143 PRINT TAB(10);"HS(I,J)"
1144 FOR I = 1 TO NN:FOR J = 1 TO NN:PRINT HS(I,J);" ";NEXT J:PRINT:NEXT I
1145 FOR I = 1 TO NN: FOR J = 1 TO NN
1146 HL(I,J) = INT(HL(I,J)*100)/100: HS(I,J) = INT(HS(I,J)*100)/100
1147 NEXT J: NEXT I
1160 FOR K = 1 TO NN
1170 FOR J = 1 TO NN
1180 IF J = K THEN 1200
1190 HL(K,J) = HL(K,J)/HL(K,K)
1200 NEXT J
1210 HL(K,K) = 1/HL(K,K)

```

```

1220 FOR I = 1 TO NN
1230 IF I = K THEN 1280
1240 FOR J = 1 TO NN
1250 IF J = K THEN 1270
1260 HL(I,J) = HL(I,J) - HL(K,J)*HL(I,K)
1270 NEXT J
1280 NEXT I
1290 FOR I = 1 TO NN
1300 IF I = K THEN 1320
1310 HL(I,K) = -HL(I,K)*HL(K,K)
1320 NEXT I
1330 NEXT K
1340 FOR K = 1 TO NN
1350 FOR J = 1 TO NN
1360 IF J = K THEN 1370
1365 HS(K,J) = HS(K,J)/HS(K,K)
1370 NEXT J
1380 HS(K,K) = 1/HS(K,K)
1390 FOR I = 1 TO NN
1400 IF I = K THEN 1450
1410 FOR J = 1 TO NN
1420 IF J = K THEN 1440
1430 HS(I,J) = HS(I,J) - HS(K,J)*HS(I,K)
1440 NEXT J
1450 NEXT I
1460 FOR I = 1 TO NN
1470 IF I = K THEN 1490
1480 HS(I,K) = -HS(I,K)*HS(K,K)
1490 NEXT I
1500 NEXT K
1691 PRINT TAB(10);"HLI(I,J)"
1692 FOR I = 1 TO NN:FOR J = 1 TO NN:PRINT HL(I,J);"      ";;NEXT J:PRINT:NEXT I
1693 PRINT TAB(10);"HSI(I,J)"
1694 FOR I = 1 TO NN:FOR J = 1 TO NN:PRINT HS(I,J);"      ";;NEXT J:PRINT:NEXT I
1700 FOR I = 1 TO NN
1710 C1(I,1) = 0!: C2(I,1) = 0!
1720 FOR K = 1 TO NN
1730 C1(I,1) = C1(I,1) + HL(I,K)*P5(K,BL)
1740 C2(I,1) = C2(I,1) + HS(I,K)*P6(K,BS)
1750 NEXT K
1760 NEXT I
1770 OPEN "R",#3,"C:F31",4*NN*NN
1780 FIELD#3,4 AS B$(1)
1790 FOR I = 2 TO NN*NN
1800 FIELD#3,4*(I-1) AS BB$,4 AS B$(I)
1810 NEXT I
1820 GET#3,1
1830 FOR I = 1 TO NN
1840 Q1(I,1) = CVS(B$(I))
1850 Q2(I,1) = CVS(B$(I+4*NN))
1860 NEXT I
1870 CLOSE#3

```

```
1880 FOR I = 1 TO NN
1890 Q3(I,1) = C1(I,1) - Q1(I,1)
1900 Q4(I,1) = C2(I,1) - Q2(I,1)
1910 NEXT I
1920 Q5 = 0: Q6 = 0
1930 FOR I = 1 TO NN
1940 Q5 = Q5 + Q3(I,1)^2
1950 Q6 = Q6 + Q4(I,1)^2
1960 NEXT I
1970 TMSSEL(1) = TMSSEL(1) + Q5
1980 TMSSES(1) = TMSSES(1) + Q6
1981 LPRINT "TMSSEL(1) = "; TMSSEL(1), "TMSSES(1) = "; TMSSES(1)
2031 ERASE W,P2,YL,YS,P3,P5,P6,FL,FS,FLT,FST,IDEN,KIL,KIS,HL,HS,P33,C1,C2,Q1,Q2
2032 ERASE Q3,Q4
2040 CHAIN "SUB7.BAS"
```

โปรแกรม 4

โปรแกรมการประมาณค่าพารามิเตอร์ตามวิธี Mean-Lawless and Wang
(Mean-LW) รวมทั้งคำนวณค่า Total Mean Square Error (TMSE)

```

10 REM ....SUB7 MEAN-LW....
11 PRINT "SUB7.BAS"
20 DIM W(N,NN),E$(N),P2(NN,N),YL(NN,N),P3(NN,NN),P33(NN,NN),P34(NN,NN),P4(NN,NN),
),P5(NN,NN),P6(NN,NN),FL(NN,NN),FS(NN,NN),FLT(NN,NN),FST(NN,NN),YS(NN,N)
23 DIM P(NN,NN),L(NN,NN),LI(NN,NN),L1(NN,NN),L2(NN,NN),L3(NN,1),L30(NN,1)
24 DIM ML(NN,1),MS(NN,1),MLT(1,NN)
30 DIM MST(1,NN),GTL(1,NN),GTS(1,NN),IDEN(NN,NN),KIL(NN,NN),KIS(NN,NN)
31 DIM HL(NN,NN),HS(NN,NN),HLI(NN,NN),HS1(NN,NN),C1(NN,1),C2(NN,1),B$(NN*NN)
32 DIM Q1(NN,1),Q2(NN,1),Q3(NN,1),Q4(NN,1),YZ(N,NN)
40 COMMON N,R0,R1,NN,M,BL,BS,X(),TMSEL(),TMSES(),IP(),PB(),AA(),IC(),Y(),CCC,DD,
N6
60 FOR I = 1 TO NN
65 OPEN "R",#1,"C:F1750",4*N6
70 FIELD#1,4 AS E$(1)
80 FOR J = 2 TO N6
90 FIELD#1,4*(J-1) AS E$(J)
100 NEXT J
110 GET#1,I
120 FOR J = 1 TO N6
130 W(J,I) = CVS(E$(J))
140 NEXT J
145 CLOSE#1
150 NEXT I
170 FOR I = 1 TO NN
180 FOR J = 1 TO N6
190 P2(I,J) = W(J,I)
200 NEXT J
210 NEXT I
211 N4 = 0
212 FOR I = 1 TO N
213 IF IP(I) = 5 THEN 217
214 N4 = N4 + 1
215 YZ(N4,BL) = Y(I,BL)
216 YZ(N4,BS) = Y(I,BS)
217 NEXT I
220 FOR I = 1 TO N6
230 YL(BL,I) = YZ(I,BL)
240 YS(BS,I) = YZ(I,BS)
250 NEXT I

```



```

260 FOR I = 1 TO NN
270 FOR J = 1 TO NN
280 P3(I,J) = 0
290 FOR K = 1 TO N6
300 P3(I,J) = P3(I,J) + P2(I,K)*W(K,J)
310 NEXT K
320 NEXT J
330 NEXT I
333 FOR I = 1 TO NN:FOR J = 1 TO NN:P33(I,J) = P3(I,J):P34(I,J) = P3(I,J)
334 NEXT J:NEXT I
340 FOR I = 1 TO NN
350 FOR J = 1 TO NN
360 IF I = J THEN P4(I,J) = 1 ELSE P4(I,J) = 0
370 NEXT J
380 NEXT I
390 FOR I = 1 TO NN
400 FOR J = 1 TO NN
410 IF P3(J,I) <> 0 THEN 440
420 NEXT J
430 GOTO 610
440 FOR K = 1 TO NN
450 B = P3(I,K):P3(I,K) = P3(J,K):P3(J,K) = B
460 B = P4(I,K):P4(I,K) = P4(J,K):P4(J,K) = B
470 NEXT K
480 C = 1/P3(I,I)
490 FOR K = 1 TO NN
500 P3(I,K) = C*P3(I,K)
510 P4(I,K) = C*P4(I,K)
520 NEXT K
530 FOR J = 1 TO NN
540 IF J = I THEN 600
550 C = -P3(J,I)
560 FOR K = 1 TO NN
570 P3(J,K) = P3(J,K) + C*P3(I,K)
580 P4(J,K) = P4(J,K) + C*P4(I,K)
590 NEXT K
600 NEXT J
610 NEXT I
620 FOR I = 1 TO NN
630 P5(I,BL) = 0: P6(I,BS) = 0
640 FOR J = 1 TO N6
650 P5(I,BL) = P5(I,BL) + P2(I,J)*Z(J,BL)
660 P6(I,BS) = P6(I,BS) + P2(I,J)*YZ(J,BS)
670 NEXT J
680 NEXT I

```

```

690 FOR I = 1 TO NN
700 FL(I,BL) = 0: FS(I,BS) = 0
710 FOR J = 1 TO NN
720 FL(I,BL) = FL(I,BL) + P4(I,J)*P5(J,BL)
730 FS(I,BS) = FS(I,BS) + P4(I,J)*P6(J,BS)
740 NEXT J
750 NEXT I
760 Y0 = 0: Y1 = 0
770 FOR I = 1 TO N6
780 Y0 = Y0 + YL(BL,I)*YZ(I,BL)
790 Y1 = Y1 + YS(BS,I)*YZ(I,BS)
800 NEXT I
810 FOR I = 1 TO NN
820 FLT(BL,I) = FL(I,BL)
830 FST(BS,I) = FS(I,BS)
840 NEXT I
850 S11 = 0: S12 = 0
860 FOR I = 1 TO NN
870 S11 = S11 + FLT(BL,I)*P5(I,BL)
880 S12 = S12 + FST(BS,I)*P6(I,BS)
890 NEXT I
900 SL = (1/(N6-NN))*(Y0-S11)
910 SS = (1/(N6-NN))*(Y1-S12)
911 PRINT "SL = ";SL,"SS = ";SS
920 REM ....SUB3 Eigen Value and Eigen Vector....
930 R = .00001
950 FOR I = 1 TO NN
960 P(I,I) = 1
970 NEXT I
980 FOR I = 2 TO NN
990 FOR J = 1 TO I-1
1000 I1 = I1 + 2*P33(I,J)^2
1010 NEXT J
1020 NEXT I
1030 N11 = SQR(I1):N21 = (R/NN)*N11:T = N11
1040 T = T/NN
1050 FOR M1 = 2 TO NN
1060 FOR M2 = 1 TO M1-1
1070 IF ABS(P33(M2,M1)) <= T THEN 1260
1080 I2 = 1
1090 V1 = P33(M2,M2):V2 = P33(M2,M1):V3 = P33(M1,M1)
1100 M = (V1 - V3)*.5
1110 IF M <> 0 THEN 1130
1120 W = -1:GOTO 1140
1130 W = -SGN(M)*V2/SQR(V2^2 + M^2)
1140 T1 = W/SQR(2*(1 + SQR(1-W/2)))
1150 T2 = T1^2
1160 C1 = SQR(1-T2):C2 = C1^2:T3 = T1*C1

```

```

1170 FOR I = 1 TO NN
1180 I1 = P33(I,M2)*C1-P33(I,M1)*T1:P33(I,M1) = P33(I,M2)*T1+P33(I,M1)*C1
1181 P33(I,M2) = I1
1190 I1 = P(I,M2)*C1-P(I,M1)*T1:P(I,M1) = P(I,M2)*T1+P(I,M1)*C1:P(I,M2) = I1
1200 NEXT I
1210 FOR I = 1 TO NN
1220 P33(M2,I) = P33(I,M2):P33(M1,I) = P33(I,M1)
1230 NEXT I
1240 P33(M2,M2) = V1*C2+V3*T2-2*V2*T3:P33(M1,M1) = V1*T2+V3*C2+2*V2*T3
1250 P33(M2,M1) = (V1 - V3)*T3+V2*(C2-T2):P33(M1,M2) = P33(M2,M1)
1260 NEXT M2
1270 NEXT M1
1280 IF I2 <> 1 THEN 1310
1290 I2 = 0
1300 GOTO 1050
1310 IF T > N21 THEN 1040
1320 RM . . . . SORT MATRIX P33.(P1>P2> . . . . >P5) . . . .
1330 FOR I = 1 TO NN
1340 FOR J = 1 TO NN-1
1350 IF P33(J,J) > P33(J+1,J+1) THEN 1400
1360 B = P33(J,J):P33(J,J) = P33(J+1,J+1):P33(J+1,J+1) = B
1370 FOR K = 1 TO NN
1380 B = P(K,J):P(K,J) = P(K,J+1):P(K,J+1) = B
1390 NEXT K
1400 NEXT J
1410 NEXT I
1420 FOR I = 1 TO NN
1430 FOR J = 1 TO NN
1440 IF I = J THEN L(I,J) = P33(I,J) ELSE L(I,J) = 0
1450 NEXT J
1460 NEXT I
1470 FOR I = 1 TO NN
1480 FOR J = 1 TO NN
1490 IF I = J THEN LI(I,J) = 1/L(I,J) ELSE LI(I,J) = 0
1500 NEXT J
1510 NEXT I
1700 FOR I = 1 TO NN
1710 FOR J = 1 TO NN
1720 LI(I,J) = 0
1730 FOR K = 1 TO NN
1740 LI(I,J) = LI(I,J) + W(I,K)*P(K,J)
1750 NEXT K
1760 NEXT J
1770 NEXT I
1780 FOR I = 1 TO NN
1790 FOR J = 1 TO NN
1800 L2(I,J) = LI(J,I)
1810 NEXT J
1820 NEXT I

```

```
1830 FOR I = 1 TO NN
1840 L3(I,1) = 0:L30(I,1) = 0
1850 FOR K = 1 TO NN
1860 L3(I,1) = L3(I,1) + L2(I,K)*YZ(K,BL)
1870 L30(I,1) = L30(I,1) + L2(I,K)*YZ(K,BS)
1880 NEXT K
1890 NEXT I
1950 FOR I = 1 TO NN
1960 ML(I,1) = 0:MS(I,1) = 0
1970 FOR K = 1 TO NN
1980 ML(I,1) = ML(I,1) + LI(I,K)*L3(K,1)
1990 MS(I,1) = MS(I,1) + LI(I,K)*L30(K,1)
2000 NEXT K
2010 NEXT I
2020 FOR I = 1 TO NN
2030 MLT(1,I) = ML(I,1):MST(1,I) = MS(I,1)
2040 NEXT I
2050 FOR J = 1 TO NN
2060 GTL(1,J) = 0:GTS(1,J) = 0
2070 FOR K = 1 TO NN
2080 GTL(1,J) = GTL(1,J) + MLT(1,K)*L(K,J)
2085 GTS(1,J) = GTS(1,J) + MST(1,K)*L(K,J)
2090 NEXT K
2100 NEXT J
2110 GML = 0:GMS = 0
2120 FOR I = 1 TO NN
2130 GML = GML + GTL(1,I)*ML(I,1)
2140 GMS = GMS + GTS(1,I)*MS(I,1)
2150 NEXT I
2160 KL = NN*SL/GML
2170 KS = NN*SS/GMS
2410 FOR I = 1 TO NN
2420 FOR J = 1 TO NN
2430 IF I = J THEN IDEN(I,J) = 1 ELSE IDEN(I,J) = 0
2440 NEXT J
2450 NEXT I
2460 FOR I = 1 TO NN
2470 FOR J = 1 TO NN
2480 KIL(I,J) = KL*IDEN(I,J):KIS(I,J) = KS*IDEN(I,J)
2490 NEXT J
2500 NEXT I
2510 FOR I = 1 TO NN
2520 FOR J = 1 TO NN
2530 HL(I,J) = P34(I,J) + KIL(I,J):HS(I,J) = P34(I,J) + KIS(I,J)
2540 NEXT J
2550 NEXT I
2560 FOR I = 1 TO NN
2570 FOR J = 1 TO NN
2580 IF I = J THEN 2590 ELSE 2610
2590 HLI(I,J) = 1:HSI(I,J) = 1
2600 GOTO 2620
```



```

2610 HLI(I,J) = 0:HSI(I,J) = 0
2620 NEXT J
2630 NEXT I
2640 FOR I = 1 TO NN
2650 FOR J = 1 TO NN
2660 IF HL(J,I) <> 0 THEN 2690
2670 NEXT J
2680 GOTO 2870
2690 FOR K = 1 TO NN
2700 B = HL(I,K):HL(I,K) = HL(J,K):HL(J,K) = B
2710 B = HLI(I,K):HLI(I,K) = HLI(J,K):HLI(J,K) = B
2720 NEXT K
2730 C = 1/HL(I,I)
2740 FOR K = 1 TO NN
2750 HL(I,K) = C*HL(I,K)
2760 HLI(I,K) = C*HLI(I,K)
2770 NEXT K
2780 FOR J = 1 TO NN
2790 IF J = I THEN 2850
2800 C = -HL(J,I)
2810 FOR K = 1 TO NN
2820 HL(J,K) = HL(J,K) + C*HL(I,K)
2830 HLI(J,K) = HLI(J,K) + C*HLI(I,K)
2840 NEXT K
2850 NEXT J
2860 NEXT I
2870 FOR I = 1 TO NN
2880 FOR J = 1 TO NN
2890 IF HS(J,I) <> 0 THEN 2920
2900 NEXT J
2910 GOTO 3100
2920 FOR K = 1 TO NN
2930 B = HS(I,K):HS(I,K) = HS(J,K):HS(J,K) = B
2940 B = HSI(I,K):HSI(I,K) = HSI(J,K):HSI(J,K) = B
2950 NEXT K
2960 C = 1/HS(I,I)
2970 FOR K = 1 TO NN
2980 HS(I,K) = C*HS(I,K)
2990 HSI(I,K) = C*HSI(I,K)
3000 NEXT K
3010 FOR J = 1 TO NN
3020 IF J = I THEN 3080
3030 C = -HS(J,I)
3040 FOR K = 1 TO NN
3050 HS(J,K) = HS(J,K) + C*HS(I,K)
3060 HSI(J,K) = HSI(J,K) + C*HSI(I,K)
3070 NEXT K
3080 NEXT J
3090 NEXT I

```



```
3100 FOR I = 1 TO NN
3110 C1(I,1) = 0:C2(I,1) = 0
3120 FOR K = 1 TO NN
3130 C1(I,1) = C1(I,1) + HLI(I,K)*P5(K,BL)
3140 C2(I,1) = C2(I,1) + HSI(I,K)*P6(K,BS)
3150 NEXT K
3160 NEXT I
3170 OPEN "R",#3,"C:F31",4*NN*NN
3180 FIELD#3,4 AS BS(1)
3190 FOR I = 2 TO NN*NN
3200 FIELD#3,4*(I-1) AS BBS,4 AS BS(I)
3210 NEXT I
3220 GET#3,1
3230 FOR I = 1 TO NN
3240 Q1(I,1) = CVS(BS(I))
3250 Q2(I,1) = CVS(BS(I+4*NN))
3260 NEXT I
3270 CLOSE#3
3280 FOR I = 1 TO NN
3290 Q3(I,1) = C1(I,1) - Q1(I,1)
3300 Q4(I,1) = C2(I,1) - Q2(I,1)
3310 NEXT I
3320 Q5 = 0:Q6 = 0
3330 FOR I = 1 TO NN
3340 Q5 = Q5 + Q3(I,1)^2
3350 Q6 = Q6 + Q4(I,1)^2
3360 NEXT I
3370 TMSEL(2) = TMSEL(2) + Q5
3380 TMSSES(2) = TMSSES(2) + Q6
3381 LPRINT "TMSEL(2) = ";TMSEL(2),"TMSSES(2) = ";TMSSES(2)
3440 CHAIN "SUB18.BAS"
```

โปรแกรม 5

โปรแกรมการประมาณค่าสังเกตุที่สูญหาย โดยวิธี Regression

```

10 REM ....SUB18 REGRESSION....
15 PRINT "SUB18.BAS"
20 DEFSNG A-Z
30 DIM SM1(N,5),SM2(N,5),MIS(N,5),IS1(5,5),AMS(1,5),Z(N,5),BB(5,5),B(15),ANS(1),
T(15),XB(5),R(15),D(10),RX(N*N),RY(N),STD(10),F$(N),IS(5)
40 COMMON N,RO,R1,NN,M,BL,BS,X(),TMSEL(),TMSSES(),IP(),PB(),AA(),IC(),Y(),CCC,DD,
N6
80 JC = 0
90 JK = 0
95 K = 4
100 N3 = IC(1)
110 FOR I = 1 TO N3
120 FOR J = 1 TO 5
130 SM1(I,J) = AA(I,J)
140 NEXT J
150 NEXT I
160 FOR A = 1 TO 4
180 III = 0
190 GOSUB 1000
200 III = III + 1
210 IF III > 50 THEN 730
220 IF JK <> 0 THEN 420
230 IIP = 0
240 JJJ = 0
250 FOR J = 1 TO N
260 IF IP(J) >= 5 THEN 400
270 IF IP(J) <= A-1 THEN 350
280 IF IP(J) <> A THEN 400
290 IIP = IIP + 1
300 FOR ISS = 1 TO 5
310 SM1(IIP,ISS) = X(J,ISS)
320 NEXT ISS
340 GOTO 400
350 JJJ = JJJ + 1
360 IIP = IIP + 1
370 FOR IR = 1 TO 5
380 SM1(IIP,IR) = SM2(JJJ,IR)
390 NEXT IR
400 NEXT J

```

```

410 N3 = IIP
420 IIP = 0
430 FOR J = 1 TO N
440 I1 = 0
450 IF IP(J) >= 5 THEN 680
460 IF IP(J) > A THEN 680
470 IIP = IIP + 1
480 IF IP(J) <> A THEN 680
490 FOR J2 = 1 TO 5
500 IF PB(J,J2) = 0! THEN 530
510 I1 = I1 + 1
520 MIS(IIP,I1) = J2
530 NEXT J2
540 FOR I2 = 1 TO A
550 FOR J2 = 1 TO 5
560 IF IS1(5,J2) = MIS(IIP,I2) THEN JII = J2
570 NEXT J2
580 SUM = AMS(1,JII)
590 FOR JJ = 1 TO 4
600 L = IS1(JJ,JII)
610 SUM = SUM + SM1(IIP,L)*BB(JJ,JII)
620 NEXT JJ
630 SUB = ABS(SUM-SM1(IIP,IS1(5,JII)))
640 SM1(IIP,IS1(5,JII)) = SUM
650 IF SUB > .1 THEN JC=JC+1
670 NEXT I2
680 NEXT J
690 JK = JC
700 IF JC = 0 THEN 730
710 JC = 0
720 GOTO 190
730 NEXT A
740 FOR I = 1 TO 5
750 OPEN "R",#1,"C:F1800",4*N6
760 FIELD#1,4 AS F$(1)
770 FOR J = 2 TO N6
780 FIELD#1,4*(J-1) AS FF$,4 AS F$(J)
790 NEXT J
800 FOR J = 1 TO N6
810 Z(J,I) = SM1(J,I)
820 LSET F$(J) = MKS$(Z(J,I))
830 NEXT J
840 PUT#1,I
850 CLOSE#1
860 NEXT I
890 CHAIN "SUB9.BAS"
1000 REM ....SUB19 REGRESS....
1030 FOR J = 1 TO N3
1040 FOR I = 1 TO 5
1050 SM2(J,I) = SM1(J,I)
1060 NEXT I
1070 NEXT J

```



```
1080 N33 = N3
1090 GOSUB 1400
1100 FOR JP = 1 TO 5
1110 IS(JP) = JP
1120 NEXT JP
1130 FOR I = 1 TO 5
1140 IF I = 1 THEN 1210
1150 IEE = IS(1)
1160 FOR IE = 1 TO 4
1170 IS(IE) = IS(IE+1)
1180 NEXT IE
1200 IS(5) = IEE
1210 GOSUB 2400
1220 GOSUB 2610
1230 GOSUB 4000
1240 FOR JJ = 1 TO 5
1250 BB(JJ,I) = B(JJ)
1260 IS1(JJ,I) = IS(JJ)
1270 NEXT JJ
1290 AMS(1,I) = ANS(1)
1310 NEXT I
1320 RETURN
1400 REM ....SUB20 CORR....
1410 FOR J12 = 1 TO 5
1420 D(J12) = 0!
1430 T(J12) = 0!
1440 NEXT J12
1450 KKKK = 15
1460 FOR I = 1 TO KKKK
1470 R(I) = 0!
1480 NEXT I
1485 GN = N33
1490 L1 = 0
1510 IF N33 > 5 THEN 1540
1520 KK = N33
1530 GOTO 1550
1540 KK = 5
1550 FOR I = 1 TO KK
1560 FOR J = 1 TO 5
1570 B(J) = SM1(I,J)
1580 NEXT J
1590 FOR J = 1 TO 5
1600 T(J) = T(J) + B(J)
1610 L1 = L1 + 1
1620 RX(L1) = B(J)
1630 NEXT J
1631 NEXT I
1640 PKK = KK
1650 IPKK = PKK
1660 FOR J = 1 TO 5
1670 XB(J) = T(J)
1680 T(J) = T(J) / PKK
1690 NEXT J
```

```
1700 L1 = 0
1710 FOR I = 1 TO KK
1720 JK1 = 0
1730 FOR J = 1 TO 5
1740 L1 = L1 + 1
1750 B(J) = RX(L1) - T(J)
1760 NEXT J
1770 FOR J = 1 TO 5
1780 D(J) = D(J) + B(J)
1790 FOR K1 = 1 TO J
1800 JK1 = JK1 + 1
1810 R(JK1) = R(JK1)+B(J)*B(K1)
1820 NEXT K1
1830 NEXT J
1840 NEXT I
1850 IF N33 <= KK THEN 2040
1860 KK = N33-KK
1870 FOR I = 1 TO KK
1880 JK1 = 0
1890 FOR J = 1 TO 5
1900 B(J) = SM1(I+IPKK,J)
1910 NEXT J
1920 FOR J = 1 TO 5
1930 XB(J) = XB(J)+B(J)
1940 B(J) = B(J) - T(J)
1950 D(J) = D(J) + B(J)
1960 NEXT J
1970 FOR J = 1 TO 5
1980 FOR K1 = 1 TO J
1990 JK1 = JK1 + 1
2000 R(JK1) = R(JK1)+B(J)*B(K1)
2010 NEXT K1
2020 NEXT J
2030 NEXT I
2040 JK1 = 0
2050 FOR J = 1 TO 5
2060 XB(J) = XB(J)/GN
2070 FOR K1 = 1 TO J
2080 JK1 = JK1 + 1
2090 R(JK1) = R(JK1)-D(J)*D(K1)/GN
2100 NEXT K1
2110 NEXT J
2120 JK1 = 0
2130 FOR J = 1 TO 5
2140 JK1 = JK1 + J
2150 STD(J) = SQR(ABS(R(JK1)))
2160 NEXT J
2170 FOR J = 1 TO 5
2180 FOR K1 = J TO 5
2190 JK1 = J+(K1*K1-K1)/2
2200 L1 = 5*(J-1)+K1
```

```
2210 RX(L1) = R(JK1)
2220 L1 = 5*(K1-1)+J
2230 RX(L1) = R(JK1)
2231 S = STD(J)*STD(K1)
2240 IF S <> 0 THEN 2270
2250 R(JK1) = 0!
2260 GOTO 2280
2270 R(JK1) = R(JK1)/S
2280 NEXT K1
2290 NEXT J
2300 N4 = SQR(GN-1!)
2310 FOR J = 1 TO 5
2320 STD(J) = STD(J)/N4
2330 NEXT J
2340 L1 = -5
2350 FOR I = 1 TO 5
2360 L1 = L1 + 6
2370 D(I) = RX(L1)
2380 NEXT I
2390 RETURN
2400 REM ....SUB21 .....
2410 MM = 0
2415 ND = IS(5)
2420 FOR J1 = 1 TO 4
2440 L2 = IS(J1)
2450 IF ND >= L2 THEN 2480
2460 L3 = ND+(L2*L2-L2)/2
2470 GOTO 2490
2480 L3 = L2+(ND*ND-ND)/2
2490 RY(J1) = R(L3)
2500 FOR I3 = 1 TO 4
2510 L4 = IS(I3)
2520 IF L4 >= L2 THEN 2550
2530 L3 = L4+(L2*L2-L2)/2
2540 GOTO 2560
2550 L3 = L2+(L4*L4-L4)/2
2560 MM = MM + 1
2570 RX(MM) = R(L3)
2580 NEXT I3
2590 NEXT J1
2600 RETURN
2610 REM ....SUB22 .....
2620 DET = 1!
2625 NK = -K
2630 FOR K2 = 1 TO 4
2650 NK = NK + K
2660 B(K2) = K2
2670 T(K2) = K2
2680 KKK = NK + K2
2690 BI = RX(KKK)
```

```
2700 FOR J4 = K2 TO 4
2710 IZ = 4*(J4-1)
2720 FOR I4 = K2 TO 4
2730 IJ = IZ + I4
2740 IF ABS(BI) >= ABS(RX(IJ)) THEN 2780
2750 BI = RX(IJ)
2760 B(K2) = I4
2770 T(K2) = J4
2780 NEXT I4
2790 NEXT J4
2800 J4 = B(K2)
2810 IF J4 <= K2 THEN 2910
2820 KI = K2-4
2830 FOR I4 = 1 TO 4
2840 KI = KI + 4
2850 HO = -RX(KI)
2860 JI = KI-K2+J4
2870 RX(KI) = RX(JI)
2890 RX(JI) = HO
2900 NEXT I4
2910 I4 = T(K2)
2920 IF I4 <= K2 THEN 3010
2930 JP = 4*(I4-1)
2940 FOR J4 = 1 TO 4
2950 JK2 = NK + J4
2960 JI = JP+J4
2970 HO = -RX(JK2)
2980 RX(JK2) = RX(JI)
2990 RX(JI) = HO
3000 NEXT J4
3010 IF BI <> 0 THEN 3040
3020 DET = 0!
3030 RETURN
3040 FOR I4 = 1 TO 4
3050 IF I4 = K2 THEN 3090
3060 IK = NK + I4
3070 PP = -RX(IK)/BI
3080 RX(IK) = PP
3090 NEXT I4
3100 FOR I4 = 1 TO 4
3110 IK = NK + I4
3120 HO = RX(IK)
3130 IJ = I4-4
3140 FOR J4 = 1 TO 4
3150 IJ = IJ+4
3160 IF I4 = K2 THEN 3200
3170 IF J4 = K2 THEN 3200
3180 KJ = IJ-I4+K2
3190 RX(IJ) = HO*RX(KJ)+RX(IJ)
3200 NEXT J4
3210 NEXT I4
```




```
3220 KJ = K2-4
3230 FOR J4 = 1 TO 4
3240 KJ = KJ+4
3250 IF J4 = K2 THEN 3270
3260 RX(KJ) = RX(KJ)/BI
3270 NEXT J4
3280 DET = DET*B1
3290 RX(KKK) = 1!/BI
3300 NEXT K2
3310 K2 = 4
3320 K2 = K2-1
3330 IF K2 <= 0 THEN 3550
3340 I4 = B(K2)
3350 IF I4 <= K2 THEN 3450
3360 JQ = 4*(K2-1)
3370 JR = 4*(I4-1)
3380 FOR J4 = 1 TO 4
3390 JK2 = JQ + J4
3400 HO = RX(JK2)
3410 JI = JR + J4
3420 RX(JK2) = -RX(JI)
3430 RX(JI) = HO
3440 NEXT J4
3450 J4 = T(K2)
3460 IF J4 <= K2 THEN 3320
3470 KI = K2-4
3480 FOR I4 = 1 TO 4
3490 KI = KI+4
3500 HO = RX(KI)
3510 JI = KI-K2+J4
3520 RX(KI) = -RX(JI)
3530 RX(JI) = HO
3535 NEXT I4
3540 GOTO 3320
3550 RETURN
4000 REM ...SUB23 ....
4010 FOR J5 = 1 TO 4
4030 B(J5) = 0!
4040 NEXT J5
4050 FOR J5 = 1 TO 4
4060 L6 = 4*(J5-1)
4070 FOR I5 = 1 TO 4
4080 L5 = L6 + I5
4090 B(J5) = B(J5)+RY(I5)*RX(L5)
4095 NEXT I5
4100 NEXT J5
4110 B0 = 0!
4120 L6 = IS(5)
```

```
4130 FOR I5 = 1 TO 4
4150 L5 = IS(I5)
4160 B(I5) = B(I5)*(STD(L6)/STD(L5))
4170 B0 = B0+B(I5)*XB(L5)
4180 NEXT I5
4190 B0 = XB(L6)-B0
4200 ANS(1) = B0
4210 RETURN
```

โปรแกรม 6

โปรแกรมการประมาณค่าพารามิเตอร์ตามวิธี Regression-Hoerl, Kennard and Baldwin (Regression-HKB) รวมทั้งคำนวณค่า Total Mean Square Error (TMSE)

```

10 REM ....SUB9 REGRESSION-HKB....
11 PRINT "SUB9.BAS"
12 DEFSNG A - Z
13 DIM W(N,NN),F$(N),P2(NN,N),YL(NN,N),YS(NN,N),P3(NN,NN),P5(NN,NN),P6(NN,NN)
14 DIM FL(NN,NN),FS(NN,NN),FLT(NN,NN),FST(NN,NN),IDEN(NN,NN),KIL(NN,NN)
15 DIM KIS(NN,NN),HL(NN,NN),HS(NN,NN),BS(NN*NN),P33(NN,NN)
16 DIM Q1(NN,1),Q2(NN,1),Q3(NN,1),Q4(NN,1),YZ(N,NN),C1(NN,1),C2(NN,1)
17 COMMON N,R0,R1,NN,M,BL,BS,X(),TMSEL(),TMSES(),IP(),PB(),AA(),IC(),Y(),CCC,DD,
18 N6
19 FOR I = 1 TO NN
20 OPEN "R",#1,"C:F1800",4*N6
21 FIELD#1,4 AS F$(1)
22 FOR J = 2 TO N6
23 FIELD#1,4*(J-1) AS FF$,4 AS F$(J)
24 NEXT J
25 GET#1,I
26 FOR J = 1 TO N6
27 W(J,I) = CVS(F$(J))
28 NEXT J
29 CLOSE#1
30 NEXT I
31 FOR I = 1 TO NN
32 FOR J = 1 TO N6
33 P2(I,J) = W(J,I)
34 NEXT J
35 NEXT I
36 N4 = 0
37 FOR I = 1 TO N
38 IF IP(I) = 5 THEN 207
39 N4 = N4 + 1
40 YZ(N4,BL) = Y(I,BL)
41 YZ(N4,BS) = Y(I,BS)
42 NEXT I
43 FOR I = 1 TO N6
44 YL(BL,1) = YZ(I,BL)
45 YS(BS,1) = YZ(I,BS)
46 NEXT I
47 PRINT TAB(10);"P3(I,J)"

```

```

250 FOR I = 1 TO NN
260 FOR J = 1 TO NN
270 P3(I,J) = 0!
280 FOR K = 1 TO N6
290 P3(I,J) = P3(I,J) + P2(I,K)*W(K,J)
300 NEXT K
301 PRINT P3(I,J);" ";
310 NEXT J
311 PRINT
320 NEXT I
323 FOR I = 1 TO NN:FOR J = 1 TO NN:P33(I,J) = P3(I,J):NEXT J
324 NEXT I
330 FOR I = 1 TO NN
340 FOR J = 1 TO NN
350 P3(I,J) = INT(P3(I,J)*100)/100
360 NEXT J: NEXT I
370 FOR K = 1 TO NN
380 FOR J = 1 TO NN
390 IF J = K THEN 410
400 P3(K,J) = P3(K,J)/P3(K,K)
410 NEXT J
420 P3(K,K) = 1/P3(K,K)
430 FOR I = 1 TO NN
440 IF I = K THEN 490
450 FOR J = 1 TO NN
460 IF J = K THEN 480
470 P3(I,J) = P3(I,J)-P3(K,J)*P3(I,K)
480 NEXT J
490 NEXT I
500 FOR I = 1 TO NN
505 IF I = K THEN 520
510 P3(I,K) = -P3(I,K)*P3(K,K)
520 NEXT I
530 NEXT K
601 PRINT TAB(10);"P4(I,J)"
602 FOR I = 1 TO NN:FOR J = 1 TO NN:PRINT P3(I,J);" ";:NEXT J:PRINT:NEXT I
610 FOR I = 1 TO NN
620 P5(I,BL) = 0!: P6(I,BS) = 0!
630 FOR J = 1 TO N6
640 P5(I,BL) = P5(I,BL) + P2(I,J)*YZ(J,BL)
650 P6(I,BS) = P6(I,BS) + P2(I,J)*YZ(J,BS)
660 NEXT J
670 NEXT I
680 FOR I = 1 TO NN
690 FL(I,BL) = 0!: FS(I,BS) = 0!
700 FOR J = 1 TO NN
710 FL(I,BL) = FL(I,BL) + P3(I,J)*P5(J,BL)
720 FS(I,BS) = FS(I,BS) + P3(I,J)*P6(J,BS)
730 NEXT J
740 NEXT I

```

```

760 Y0 = 0!: Y1 = 0!
770 FOR I = 1 TO N6
780 Y0 = Y0 + YL(BL,I)*YZ(I,BL)
790 Y1 = Y1 + YS(BS,I)*YZ(I,BS)
800 NEXT I
820 FOR I = 1 TO NN
830 FLT(BL,I) = FL(I,BL)
840 FST(BS,I) = FS(I,BS)
850 NEXT I
860 S11 = 0!: S12 = 0!
870 FOR I = 1 TO NN
880 S11 = S11 + FLT(BL,I)*P5(I,BL)
890 S12 = S12 + FST(BS,I)*P6(I,BS)
900 NEXT I
910 SL = (1/(N6-NN))*(Y0-S11)
920 SS = (1/(N6-NN))*(Y1-S12)
930 FFL = 0!: FFS = 0!: KL = 0!: KS = 0!
940 FOR I = 1 TO NN
950 FFL = FFL + FLT(BL,I)*FL(I,BL)
960 FFS = FFS + FST(BS,I)*FS(I,BS)
970 NEXT I
980 KL = (NN*SL)/FFL: KS = (NN*SS)/FFS
990 FOR I = 1 TO NN
1000 FOR J = 1 TO NN~
1010 IF I = J THEN IDEN(I,J) = 1! ELSE IDEN(I,J) = 0!
1020 NEXT J
1030 NEXT I
1040 FOR I = 1 TO NN
1050 FOR J = 1 TO NN
1060 KIL(I,J) = KL*IDEN(I,J): KIS(I,J) = KS*IDEN(I,J)
1070 NEXT J
1080 NEXT I
1100 FOR I = 1 TO NN
1110 FOR J = 1 TO NN
1111 HL(I,J) = 0!: HS(I,J) = 0!
1120 HL(I,J) = P33(I,J) + KIL(I,J): HS(I,J) = P33(I,J) + KIS(I,J)
1130 NEXT J
1140 NEXT I
1141 PRINT TAB(10);"HL(I,J)"
1142 FOR I = 1 TO NN:FOR J = 1 TO NN:PRINT HL(I,J);" ";:NEXT J:PRINT:NEXT I
1143 PRINT TAB(10);"HS(I,J)"
1144 FOR I = 1 TO NN:FOR J = 1 TO NN:PRINT HS(I,J);" ";:NEXT J:PRINT:NEXT I
1145 FOR I = 1 TO NN: FOR J = 1 TO NN
1146 HL(I,J) = INT(HL(I,J)*100)/100: HS(I,J) = INT(HS(I,J)*100)/100
1147 NEXT J: NEXT I
1160 FOR K = 1 TO NN
1170 FOR J = 1 TO NN
1180 IF J = K THEN 1200
1190 HL(K,J) = HL(K,J)/HL(K,K)
1200 NEXT J
1210 HL(K,K) = 1/HL(K,K)

```

```

1220 FOR I = 1 TO NN
1230 IF I = K THEN 1280
1240 FOR J = 1 TO NN
1250 IF J = K THEN 1270
1260 HL(I,J) = HL(I,J) - HL(K,J)*HL(I,K)
1270 NEXT J
1280 NEXT I
1290 FOR I = 1 TO NN
1300 IF I = K THEN 1320
1310 HL(I,K) = -HL(I,K)*HL(K,K)
1320 NEXT I
1330 NEXT K
1340 FOR K = 1 TO NN
1350 FOR J = 1 TO NN
1360 IF J = K THEN 1370
1365 HS(K,J) = HS(K,J)/HS(K,K)
1370 NEXT J
1380 HS(K,K) = 1/HS(K,K)
1390 FOR I = 1 TO NN
1400 IF I = K THEN 1450
1410 FOR J = 1 TO NN
1420 IF J = K THEN 1440
1430 HS(I,J) = HS(I,J) - HS(K,J)*HS(I,K)
1440 NEXT J
1450 NEXT I
1460 FOR I = 1 TO NN
1470 IF I = K THEN 1490
1480 HS(I,K) = -HS(I,K)*HS(K,K)
1490 NEXT I
1500 NEXT K
1691 PRINT TAB(10);"HLI(I,J)"
1692 FOR I = 1 TO NN:FOR J = 1 TO NN:PRINT HL(I,J);"      ";NEXT J:PRINT:NEXT I
1693 PRINT TAB(10);"HSI(I,J)"
1694 FOR I = 1 TO NN:FOR J = 1 TO NN:PRINT HS(I,J);"      ":"::NEXT J:PRINT:NEXT I
1700 FOR I = 1 TO NN
1710 C1(I,1) = 0!: C2(I,1) = 0!
1720 FOR K = 1 TO NN
1730 C1(I,1) = C1(I,1) + HL(I,K)*P5(K,BL)
1740 C2(I,1) = C2(I,1) + HS(I,K)*P6(K,BS)
1750 NEXT K
1760 NEXT I
1770 OPEN "R",#3,"C:F31",4*NN*NN
1780 FIELD#3,4 AS B$(1)
1790 FOR I = 2 TO NN*NN
1800 FIELD#3,4*(I-1) AS BB$,4 AS B$(I)
1810 NEXT I
1820 GET#3,1
1830 FOR I = 1 TO NN

```

```
1840 Q1(I,1) = CVS(B$(I))
1850 Q2(I,1) = CVS(B$(I+4*NN))
1860 NEXT I
1870 CLOSE#3
1880 FOR I = 1 TO NN
1890 Q3(I,1) = C1(I,1) - Q1(I,1)
1900 Q4(I,1) = C2(I,1) - Q2(I,1)
1910 NEXT I
1920 Q5 = 0: Q6 = 0
1930 FOR I = 1 TO NN
1940 Q5 = Q5 + Q3(I,1)^2
1950 Q6 = Q6 + Q4(I,1)^2
1960 NEXT I
1970 TMSSEL(3) = TMSSEL(3) + Q5
1980 TMSSES(3) = TMSSES(3) + Q6
1981 LPRINT "TMSSEL(3) = "; TMSSEL(3), "TMSSES(3) = "; TMSSES(3)
2031 ERASE W,P2,YL,YS,P3,P5,P6,FL,FS,FLT,FST,IDEN,KIL,KIS,HL,HS,P33,C1,C2,Q1,Q2
2032 ERASE Q3,Q4
2040 CHAIN "SUB10.BAS"
```

โปรแกรม 7

โปรแกรมการประมาณค่าพารามิเตอร์ตามวิธี Regression-Lawless and Wang
(Regression-LW) รวมทั้งคำนวณค่า Total Mean Square Error (TMSE)

```

10 REM ....SUB10 REGRESSION-LW....
11 PRINT "SUB10.BAS"
20 DIM W(N,NN),F$(N),P2(NN,N),YL(NN,N),P3(NN,NN),P33(NN,NN),P34(NN,NN),P4(NN,NN),
P5(NN,NN),P6(NN,NN),FL(NN,NN),FS(NN,NN),FLT(NN,NN),FST(NN,NN)
23 DIM P(NN,NN),L(NN,NN),LI(NN,NN),LI(NN,NN),L2(NN,NN),L3(NN,1),L30(NN,1)
24 DIM ML(NN,1),MS(NN,1),MLT(1,NN)
30 DIM MST(1,NN),GTL(1,NN),GTS(1,NN),IDEN(NN,NN),KIL(NN,NN),KIS(NN,NN)
31 DIM HL(NN,NN),HS(NN,NN),HLI(NN,NN),HSI(NN,NN),C1(NN,1),C2(NN,1),BS(NN*NN)
32 DIM Q1(NN,1),Q2(NN,1),Q3(NN,1),Q4(NN,1),YS(NN,N),YZ(N,NN)
40 COMMON N,R0,R1,NN,M,BL,BS,X(),TMSEL(),TMSES(),IP(),PB(),AA(),IC(),Y(),CCC,DD,
N6
50 FOR I = 1 TO NN
60 OPEN "R",#1,"C:F1800",4*N6
70 FIELD#1,4 AS F$(1)
80 FOR J = 2 TO N6
90 FIELD#1,4*(J-1) AS FFS,4 AS F$(J)
100 NEXT J
110 GET#1,I
120 FOR J = 1 TO N6
130 W(J,I) = CVS(F$(J))
140 NEXT J
150 CLOSE#1
160 NEXT I
170 FOR I = 1 TO NN
180 FOR J = 1 TO N6
190 P2(I,J) = W(J,I)
200 NEXT J
210 NEXT I
211 N4 = 0
212 FOR I = 1 TO N
213 IF IP(I) = 5 THEN 217
214 N4 = N4 + 1
215 YZ(N4,BL) = Y(I,BL)
216 YZ(N4,BS) = Y(I,BS)
217 NEXT I
220 FOR I = 1 TO N6
230 YL(BL,I) = YZ(I,BL)
240 YS(BS,I) = YZ(I,BS)
250 NEXT I

```



```

260 FOR I = 1 TO NN
270 FOR J = 1 TO NN
280 P3(I,J) = 0
290 FOR K = 1 TO N6
300 P3(I,J) = P3(I,J) + P2(I,K)*W(K,J)
310 NEXT K
320 NEXT J
330 NEXT I
333 FOR I = 1 TO NN:FOR J = 1 TO NN:P33(I,J) = P3(I,J):P34(I,J) = P3(I,J)
334 NEXT J:NEXT I
340 FOR I = 1 TO NN
350 FOR J = 1 TO NN
360 IF I = J THEN P4(I,J) = 1 ELSE P4(I,J) = 0
370 NEXT J
380 NEXT I
390 FOR I = 1 TO NN
400 FOR J = I TO NN
410 IF P3(J,I) <> 0 THEN 440
420 NEXT J
430 GOTO 610
440 FOR K = 1 TO NN
450 B = P3(I,K):P3(I,K) = P3(J,K):P3(J,K) = B
460 B = P4(I,K):P4(I,K) = P4(J,K):P4(J,K) = B
470 NEXT K
480 C = 1/P3(I,I)
490 FOR K = 1 TO NN
500 P3(I,K) = C*P3(I,K)
510 P4(I,K) = C*P4(I,K)
520 NEXT K
530 FOR J = 1 TO NN
540 IF J = I THEN 600
550 C = -P3(J,I)
560 FOR K = 1 TO NN
570 P3(J,K) = P3(J,K) + C*P3(I,K)
580 P4(J,K) = P4(J,K) + C*P4(I,K)
590 NEXT K
600 NEXT J
610 NEXT I
622 FOR I = 1 TO NN
630 P5(I,BL) = 0: P6(I,BS) = 0
640 FOR J = 1 TO N6
650 P5(I,BL) = P5(I,BL) + P2(I,J)*YZ(J,BL)
660 P6(I,BS) = P6(I,BS) + P2(I,J)*YZ(J,BS)
670 NEXT J
680 NEXT I
690 FOR I = 1 TO NN
700 FL(I,BL) = 0: FS(I,BS) = 0
710 FOR J = 1 TO NN
720 FL(I,BL) = FL(I,BL) + P4(I,J)*P5(J,BL)
730 FS(I,BS) = FS(I,BS) + P4(I,J)*P6(J,BS)
740 NEXT J
750 NEXT I

```

```

760 Y0 = 0: Y1 = 0
770 FOR I = 1 TO N6
780 Y0 = Y0 + YL(BL,I)*YZ(I,BL)
790 Y1 = Y1 + YS(BS,I)*YZ(I,BS)
800 NEXT I
810 FOR I = 1 TO NN
820 FLT(BL,I) = FL(I,BL)
830 FST(BS,I) = FS(I,BS)
840 NEXT I
850 S11 = 0: S12 = 0
860 FOR I = 1 TO NN
870 S11 = S11 + FLT(BL,I)*P5(I,BL)
880 S12 = S12 + FST(BS,I)*P6(I,BS)
890 NEXT I
900 SL = (1/(N6-NN))*(Y0-S11)
910 SS = (1/(N6-NN))*(Y1-S12)
911 PRINT "SL = ";SL,"SS = ";SS
920 REM ....SUB3 Eigen Value and Eigen Vector....
930 R = .00001
950 FOR I = 1 TO NN
960 P(I,I) = 1
970 NEXT I
980 FOR I = 2 TO NN
990 FOR J = 1 TO I-1
1000 I1 = I1 + 2*P33(I,J)^2
1010 NEXT J
1020 NEXT I
1030 N11 = SQR(I1):N21 = (R/NN)*N11:T = N11
1040 T = T/NN
1050 FOR M1 = 2 TO NN
1060 FOR M2 = 1 TO M1-1
1070 IF ABS(P33(M2,M1)) <= T THEN 1260
1080 I2 = 1
1090 V1 = P33(M2,M2):V2 = P33(M2,M1):V3 = P33(M1,M1)
1100 M = (V1 - V3)*.5
1110 IF M <> 0 THEN 1130
1120 W = -1:GOTO 1140
1130 W = -SGN(M)*V2/SQR(V2^2 + M^2)
1140 T1 = W/SQR(2*(1 + SQR(1-W/2)))
1150 T2 = T1^2
1160 C1 = SQR(1-T2):C2 = C1^2:T3 = T1*C1
1170 FOR I = 1 TO NN
1180 I1 = P33(I,M2)*C1-P33(I,M1)*T1:P33(I,M1) = P33(I,M2)*T1+P33(I,M1)*C1
1181 P33(I,M2) = I1
1190 I1 = P(I,M2)*C1-P(I,M1)*T1:P(I,M1) = P(I,M2)*T1+P(I,M1)*C1:P(I,M2) = I1
1200 NEXT I
1210 FOR I = 1 TO NN
1220 P33(M2,I) = P33(I,M2):P33(M1,I) = P33(I,M1)
1230 NEXT I

```



```
1240 P33(M2,M2) = V1*C2+V3*T2-2*V2*T3:P33(M1,M1) = V1*T2+V3*C2+2*V2*T3
1250 P33(M2,M1) = (V1 - V3)*T3+V2*(C2-T2):P33(M1,M2) = P33(M2,M1)
1260 NEXT M2
1270 NEXT M1
1280 IF I2 <> 1 THEN 1310
1290 I2 = 0
1300 GOTO 1050
1310 IF T > N21 THEN 1040
1320 REM ....SORT MATRIX P33.P(P1>P2>....>P5)....
1330 FOR I = 1 TO NN
1340 FOR J = 1 TO NN-1
1350 IF P33(J,J) > P33(J+1,J+1) THEN 1400
1360 B = P33(J,J):P33(J,J) = P33(J+1,J+1):P33(J+1,J+1) = B
1370 FOR K = 1 TO NN
1380 B = P(K,J):P(K,J) = P(K,J+1):P(K,J+1) = B
1390 NEXT K
1400 NEXT J
1410 NEXT I
1420 FOR I = 1 TO NN
1430 FOR J = 1 TO NN
1440 IF I = J THEN L(I,J) = P33(I,J) ELSE L(I,J) = 0
1450 NEXT J
1460 NEXT I
1470 FOR I = 1 TO NN
1480 FOR J = 1 TO NN
1490 IF I = J THEN LI(I,J) = 1/L(I,J) ELSE LI(I,J) = 0
1500 NEXT J
1510 NEXT I
1700 FOR I = 1 TO NN
1710 FOR J = 1 TO NN
1720 L1(I,J) = 0
1730 FOR K = 1 TO NN
1740 L1(I,J) = L1(I,J) + W(I,K)*P(K,J)
1750 NEXT K
1760 NEXT J
1770 NEXT I
1780 FOR I = 1 TO NN
1790 FOR J = 1 TO NN
1800 L2(I,J) = L1(J,I)
1810 NEXT J
1820 NEXT I
1830 FOR I = 1 TO NN
1840 L3(I,1) = 0:L30(I,1) = 0
1850 FOR K = 1 TO NN
1860 L3(I,1) = L3(I,1) + L2(I,K)*YZ(K,BL)
1870 L30(I,1) = L30(I,1) + L2(I,K)*YZ(K,BS)
1880 NEXT K
1890 NEXT I
```

```

1950 FOR I = 1 TO NN
1960 ML(I,1) = 0:MS(I,1) = 0
1970 FOR K = 1 TO NN
1980 ML(I,1) = ML(I,1) + LI(I,K)*L3(K,1)
1990 MS(I,1) = MS(I,1) + LI(I,K)*L30(K,1)
2000 NEXT K
2010 NEXT I
2020 FOR I = 1 TO NN
2030 MLT(1,I) = ML(I,1):MST(1,I) = MS(I,1)
2040 NEXT I
2050 FOR J = 1 TO NN
2060 GTL(1,J) = 0:GTS(1,J) = 0
2070 FOR K = 1 TO NN
2080 GTL(1,J) = GTL(1,J) + MLT(1,K)*L(K,J)
2085 GTS(1,J) = GTS(1,J) + MST(1,K)*L(K,J)
2090 NEXT K
2100 NEXT J
2110 GML = 0:GMS = 0
2120 FOR I = 1 TO NN
2130 GML = GML + GTL(1,I)*ML(I,1)
2140 GMS = GMS + GTS(1,I)*MS(I,1)
2150 NEXT I
2160 KL = NN*SL/GML
2170 KS = NN*SS/GMS
2410 FOR I = 1 TO NN
2420 FOR J = 1 TO NN
2430 IF I = J THEN IDEN(I,J) = 1 ELSE IDEN(I,J) = 0
2440 NEXT J
2450 NEXT I
2460 FOR I = 1 TO NN
2470 FOR J = 1 TO NN
2480 KIL(I,J) = KL*IDEN(I,J):KIS(I,J) = KS*IDEN(I,J)
2490 NEXT J
2500 NEXT I
2510 FOR I = 1 TO NN
2520 FOR J = 1 TO NN
2530 HL(I,J) = P34(I,J) + KIL(I,J):HS(I,J) = P34(I,J) + KIS(I,J)
2540 NEXT J
2550 NEXT I
2560 FOR I = 1 TO NN
2570 FOR J = 1 TO NN
2580 IF I = J THEN 2590 ELSE 2610
2590 HLI(I,J) = 1:HSI(I,J) = 1
2600 GOTO 2620
2610 HLI(I,J) = 0:HSI(I,J) = 0
2620 NEXT J
2630 NEXT I
2640 FOR I = 1 TO NN
2650 FOR J = 1 TO NN
2660 IF HL(J,I) <> 0 THEN 2690
2670 NEXT J

```



```
2680 GOTO 2870
2690 FOR K = 1 TO NN
2700 B = HL(I,K):HL(I,K) = HL(J,K):HL(J,K) = B
2710 B = HLI(I,K):HLI(I,K) = HLI(J,K):HLI(J,K) = B
2720 NEXT K
2730 C = 1/HL(I,I)
2740 FOR K = 1 TO NN
2750 HL(I,K) = C*HL(I,K)
2760 HLI(I,K) = C*HLI(I,K)
2770 NEXT K
2780 FOR J = 1 TO NN
2790 IF J = I THEN 2850
2800 C = -HL(J,I)
2810 FOR K = 1 TO NN
2820 HL(J,K) = HL(J,K) + C*HL(I,K)
2830 HLI(J,K) = HLI(J,K) + C*HLI(I,K)
2840 NEXT K
2850 NEXT J
2860 NEXT I
2870 FOR I = 1 TO NN
2880 FOR J = I TO NN
2890 IF HS(J,I) <> 0 THEN 2920
2900 NEXT J
2910 GOTO 3100
2920 FOR K = 1 TO NN
2930 B = HS(I,K):HS(I,K) = HS(J,K):HS(J,K) = B
2940 B = HSI(I,K):HSI(I,K) = HSI(J,K):HSI(J,K) = B
2950 NEXT K
2960 C = 1/HS(I,I)
2970 FOR K = 1 TO NN
2980 HS(I,K) = C*HS(I,K)
2990 HSI(I,K) = C*HSI(I,K)
3000 NEXT K
3010 FOR J = 1 TO NN
3020 IF J = I THEN 3080
3030 C = -HS(J,I)
3040 FOR K = 1 TO NN
3050 HS(J,K) = HS(J,K) + C*HS(I,K)
3060 HSI(J,K) = HSI(J,K) + C*HSI(I,K)
3070 NEXT K
3080 NEXT J
3090 NEXT I
3100 FOR I = 1 TO NN
3110 C1(I,1) = 0:C2(I,1) = 0
3120 FOR K = 1 TO NN
3130 C1(I,1) = C1(I,1) + HLI(I,K)*P5(K,BL)
3140 C2(I,1) = C2(I,1) + HSI(I,K)*P6(K,BS)
3150 NEXT K
3160 NEXT I
```

```
3170 OPEN "R",#3,"C:F31",4*NN*NN
3180 FIELD#3,4 AS B$(1)
3190 FOR I = 2 TO NN*NN
3200 FIELD#3,4*(I-1) AS BBS,4 AS B$(I)
3210 NEXT I
3220 GET#3,1
3230 FOR I = 1 TO NN
3240 Q1(I,1) = CVS(B$(I))
3250 Q2(I,1) = CVS(B$(I+4*NN))
3260 NEXT I
3270 CLOSE#3
3280 FOR I = 1 TO NN
3290 Q3(I,1) = C1(I,1) - Q1(I,1)
3300 Q4(I,1) = C2(I,1) - Q2(I,1)
3310 NEXT I
3320 Q5 = 0:Q6 = 0
3330 FOR I = 1 TO NN
3340 Q5 = Q5 + Q3(I,1)^2
3350 Q6 = Q6 + Q4(I,1)^2
3360 NEXT I
3370 TMSSEL(4) = TMSSEL(4) + Q5
3380 TMSSES(4) = TMSSES(4) + Q6
3381 LPRINT "TMSSEL(4) = ";TMSSEL(4),"TMSSES(4) = ";TMSSES(4)
3440 CHAIN "SUB20.BAS"
```

โปรแกรม 8

โปรแกรมการประมาณค่าพารามิเตอร์ตามวิธี Ordinary Least Square

(OLS)

```

10 REM ....SUB20 OLS-MISS....
11 PRINT "SUB20.BAS"
16 DEFSNG A-Z
20 N3 = IC(1)
30 DIM Y1(N3,NN),P1(N3,NN),P2(NN,N3),YL(NN,N3),YS(NN,N3),P3(NN,NN),P5(NN,NN),P6(
NN,NN),FL(NN,NN),FS(NN,NN),FLT(NN,NN),FLS(NN,NN),CS(NN+1),DS(N),AS(N3),YY(N3,NN)
40 COMMON N,R0,R1,NN,M,BL,BS,X(),TMSEL(),TMSSES(),IP(),PB(),AA(),IC(),Y(),CCC,DD,
N6
41 N4 = 0
42 FOR I = 1 TO N
43 IF IP(I) <> 0 THEN 47
44 N4 = N4+1
45 YY(N4,BL) = Y(I,BL)
46 YY(N4,BS) = Y(I,BS)
47 NEXT I
50 FOR I = 1 TO N3
60 FOR J = 1 TO NN
70 P1(I,J) = AA(I,J)
80 NEXT J
90 NEXT I
100 FOR I = 1 TO N3
110 Y1(I,BL) = YY(I,BL)
120 Y1(I,BS) = YY(I,BS)
130 NEXT I
140 FOR I = 1 TO NN
150 FOR J = 1 TO N3
160 P2(I,J) = P1(J,I)
170 NEXT J
180 NEXT I
190 FOR I = 1 TO N3
200 YL(BL,I) = Y1(I,BL)
210 YS(BS,I) = Y1(I,BS)
220 NEXT I
230 FOR I = 1 TO NN
240 FOR J = 1 TO NN
250 P3(I,J) = 0!
260 FOR K = 1 TO N3
270 P3(I,J) = P3(I,J) + P2(I,K)*P1(K,J)
280 NEXT K

```

```
290 PRINT P3(I,J);" ";
300 NEXT J
310 PRINT
320 NEXT I
330 FOR I = 1 TO NN
340 FOR J = 1 TO NN
350 P3(I,J) = INT(P3(I,J)*100)/100
360 NEXT J
370 NEXT I
380 FOR K = 1 TO NN
390 FOR J = 1 TO NN
400 IF J = K THEN 420
410 P3(K,J) = P3(K,J)/P3(K,K)
420 NEXT J
430 P3(K,K) = 1/P3(K,K)
440 FOR I = 1 TO NN
450 IF I = K THEN 500
460 FOR J = 1 TO NN
470 IF J = K THEN 490
480 P3(I,J) = P3(I,J) - P3(K,J)*P3(I,K)
490 NEXT J
500 NEXT I
510 FOR I = 1 TO NN
520 IF I = K THEN 540
530 P3(I,K) = -P3(I,K)*P3(K,K)
540 NEXT I
550 NEXT K
560 PRINT TAB(10);"P4(I,J)"
570 FOR I = 1 TO NN
580 FOR J = 1 TO NN
590 PRINT P3(I,J);" ";
600 NEXT J
610 PRINT
620 NEXT I
630 FOR I = 1 TO NN
640 P5(I,BL) = 0!
650 P6(I,BS) = 0!
660 FOR J = 1 TO N3
670 P5(I,BL) = P5(I,BL) + P2(I,J)*Y1(J,BL)
680 P6(I,BS) = P6(I,BS) + P2(I,J)*Y1(J,BS)
690 NEXT J
700 NEXT I
710 FOR I = 1 TO NN
720 FL(I,BL) = 0!
730 FS(I,BS) = 0!
740 FOR J = 1 TO NN
750 FL(I,BL) = FL(I,BL) + P3(I,J)*P5(J,BL)
760 FS(I,BS) = FS(I,BS) + P3(I,J)*P6(J,BS)
770 NEXT J
780 NEXT I
```



```

790 Y0 = 0!
800 Y1 = 0!
810 FOR I = 1 TO N3
820 Y0 = Y0 + YL(BL,I)*Y1(I,BL)
830 Y1 = Y1 + YS(BS,I)*Y1(I,BS)
840 NEXT I
850 FOR I = 1 TO NN
860 FLT(BL,I) = FL(I,BL)
870 FST(BS,I) = FS(I,BS)
880 NEXT I
890 S11 = 0!
900 S12 = 0!
910 FOR I = 1 TO NN
920 S11 = S11 + FLT(BL,I)*P5(I,BL)
930 S12 = S12 + FST(BS,I)*P6(I,BS)
940 NEXT I
950 SL = (1/(N3-NN))*(Y0-S11)
960 SS = (1/(N3-NN))*(Y1-S12)
970 OPEN "R",#1,"C:F50",4*(NN+1)
980 FIELD#1,4 AS C$(1)
990 FOR I = 2 TO NN+1
1000 FIELD#1,4*(I-1) AS CC$(4) AS C$(I)
1010 NEXT I
1020 FOR I = 1 TO NN
1030 LSET C$(I) = MKS$(FL(I,BL))
1040 NEXT I
1050 LSET C$(NN+1) = MKS$(SL)
1060 PUT#1,1
1070 FOR I = 1 TO NN
1080 LSET C$(I) = MKS$(FS(I,BS))
1090 NEXT I
1100 LSET C$(NN+1) = MKS$(SS)
1110 PUT#1,2
1120 CLOSE#1
1130 ERASE Y1,P1,P2,YL,YS,P3,P5,P6,FL,FS,FLT,FST
1140 CHAIN "SUB14.BAS"

```



โปรแกรม 9

โปรแกรมการคำนวณค่า Total Mean Square Error (TMSE) ของวิธีประมาณ
ค่าพารามิเตอร์แบบ Ordinary Least Square (OLS)

```

10 REM ....SUB14 TMSE(m)....
11 PRINT "SUB14.BAS"
16 DEFNG A - Z
20 DIM B$(NN*NN),Q1(NN,1),Q2(NN,1),C$(NN+1),C1(NN,1),C2(NN,1),Q3(NN,1),Q4(NN,1)
,D$(N)
30 COMMON N,R0,R1,NN,M,BL,BS,X(),TMSEL(),TMSES(),IP(),PB(),AA(),IC(),Y(),CCC,DD,
N6
40 OPEN "R",#3,"C:F31",4*NN*NN
50 FIELD#3,4 AS B$(1)
60 FOR I = 2 TO NN*NN
70 FIELD#3,4*(I-1) AS B$(I)
80 NEXT I
90 GET#3,1
100 FOR I = 1 TO NN
110 Q1(I,1) = CVS(B$(I))
120 Q2(I,1) = CVS(B$(I+4*NN))
130 NEXT I
140 CLOSE#3
150 OPEN "R",#1,"C:F50",4*(NN+1)
160 FIELD#1,4 AS C$(1)
170 FOR I = 2 TO NN+1
180 FIELD#1,4*(I-1) AS C$(I)
190 NEXT I
200 GET#1,1
210 FOR I = 1 TO NN
220 C1(I,1) = CVS(C$(I))
230 NEXT I
240 GET#1,2
250 FOR I = 1 TO NN
260 C2(I,1) = CVS(C$(I))
270 NEXT I
280 CLOSE#1
290 FOR I = 1 TO NN
300 Q3(I,1) = C1(I,1) - Q1(I,1)
310 Q4(I,1) = C2(I,1) - Q2(I,1)
320 NEXT I

```

```
330 Q5 = 0 : Q6 = 0
340 FOR I = 1 TO NN
350 Q5 = Q5+Q3(I,1)^2
360 Q6 = Q6+Q4(I,1)^2
370 NEXT I
380 ERASE C1,C2,Q1,Q2,Q3,Q4
390 TMSSEL(5) = TMSSEL(5)+Q5
400 TMSSES(5) = TMSSES(5)+Q6
401 LPRINT "TMSSEL(5) = "; TMSSEL(5),"TMSSES(5) = "; TMSSES(5)
680 CHAIN "WORK.BAS"
```



ประวัติผู้เขียน

นายวิวัฒน์ สกลลั่นศรีเศรษฐ์ เกิดเมื่อวันที่ 14 มกราคม 2507 ที่กรุงเทพมหานคร
สำเร็จการศึกษาปริญญาวิทยาศาสตรบัณฑิต (สถิติศาสตร์) คณะวิทยาศาสตร์ มหาวิทยาลัยรามคำแหง
ปีการศึกษา 2528 และเข้าศึกษาต่อในภาควิชาสถิติ บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
เมื่อปีการศึกษา 2529