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ภาคผนวก

ภาคผนวก ก

ในการสร้างตัวแปรให้มีคุณสมบัติตามต้องการวิธีการหนึ่งที่สามารถทำได้คืออาศัย เทคนิคของการผลิตเลขสุ่มโดยการเขียนโปรแกรม

1. การสร้างตัวเลขสุ่ม (Random Number) โดยการเขียนโปรแกรม

ในการสร้างลักษณะการแจกแจงแบบต่าง ๆ นั้น ต้องใช้ตัวเลขสุ่มเป็นพื้นฐานในการสร้าง สำหรับวิธีการสร้างตัวเลขสุ่มมีอยู่หลายวิธี ในการวิจัยครั้งนี้จะใช้วิธีการสร้างตัวเลขสุ่มตามวิธีของไวท์และชมิดท์ (1975:421) เสนอไว้ ซึ่งจะใช้โปรแกรมย่อย RANDU ผลิตเลขสุ่มที่มีการแจกแจงแบบสม่ำเสมอในพิสัย 0 ถึง 1 โดยใช้คำสั่ง CALL RANDU (IX,IY,RAn) ซึ่งมีพารามิเตอร์ในวงเล็บ IX คือ เลขสุ่มตัวเลขตัวแรกซึ่งจะต้องเป็นจำนวนเต็มบวกที่เป็นเลขคี่และน้อยกว่า 2147483648 ซึ่ง IX นี้จะเป็นค่าเริ่มต้น ที่จะให้โปรแกรมย่อยคำนวณ IY ออกมา IY จึงเป็นค่าที่เป็นเลขสุ่มจำนวนเต็มของโปรแกรมย่อยนี้ และจะใช้เป็นตัวคำนวณ IY ตัวต่อ ๆ ไป สำหรับรายละเอียดในการสร้างโปรแรมย่อยสามารถสแดงได้ดังนี้

```
      SUBROUTINE RANDU (IX,IY,RAN)
      IY = IX*65539
      IF (IY) 5,6,6
5     IY = IY + 2147483647 + 1
6     RAN = IY
      RAN = RAN*0.4656613E-9
      IX = IY
      RETURN
      END
```

2. การสร้างเลขสุ่มที่มีการแจกแจงแบบปกติ

การสร้างตัวแปรสุ่มที่มีการแจกแจงปกติที่มีค่าเฉลี่ย และส่วนเบี่ยงเบนมาตรฐานตามกำหนด จะใช้โปรแกรมย่อย GAUSS ซึ่งจะพิจารณาจากสูตร

$$V = (\Sigma\ RAN_i - k/2)/(k/12)$$

$$; \quad i = 1,2,\ldots,k$$

โดยที่ V เป็นตัวเลขสุ่มที่มีการแจกแจงแบบปกติที่มีค่าเฉลี่ย 0
และความแปรปรวน 1

RAN เป็นตัวเลขสุ่มที่มีการแจกแจงแบบสม่ำเสมอในช่วง (0,1)
จากโปรแกรมย่อย RANDU

k เป็นจำนวนค่าของ RAN_i ที่จะถูกนำมาใช้

โดยปกติตัวเลขสุ่ม V จะมีค่าเข้าใกล้เลขสุ่มที่มีการแจกแจงปกติที่แท้จริงนั้นเมื่อค่าของ k เข้าใกล้ค่าอนันต์ (Infinity) สำหรับโปรแกรมที่ใช้สร้างเลขสุ่มนี้จะเลือก k เป็น 12 เพื่อลดเวลาการคำนวณในเครื่องคอมพิวเตอร์ จากสูตรข้างต้น สามารถเขียนใหม่ได้ดังนี้

$$V = \Sigma\ RAN_i - 6.0 \qquad i = 1,2,\ldots,12$$

และเพื่อให้ตัวเลขสุ่มที่สร้างขึ้นมาแจกแจงเข้าใกล้การแจกแจงปกติ โดยมีค่าเฉลี่ยและส่วนเบี่ยงเบนมาตรฐานตามที่กำหนด ดังนั้นตัวแปรสุ่มดังกล่าวจะเป็น

$$V = AM + V*S^2$$

โดย S เป็นค่าเบี่ยงเบนมาตรฐานตามที่กำหนด

AM เป็นค่าเฉลี่ยตามที่กำหนด

ดังนั้นโปรแกรมย่อย ซึ่งใช้สร้างการแจกแจงแบบปกติ แสดงไว้ดังนี้

```
      SUBROUTINE GAUSS (IX,S,AM,V)
      A = 0.0
      DO 50 I = 1,12
      CALL RANDU (IX,IY,RAN)
      IX = IY
   50 A = A + RAN
      V = (A - 6.)*S + AM
      RETURN
      END
```

3. การสร้างการแจกแจงแบบปกติปลอมปน

การสร้างตัวแปรสุ่ม ที่มีการแจกแจงแบบปกติปลอมปนที่มีค่าเฉลี่ยและส่วนเบี่ยงเบนมาตรฐานตามที่กำหนด จะใช้แนวคิดของ Ramsay (ค.ศ.1977) เสนอไว้ โดยพิจารณาการแจกแจงซึ่งแปลงมาจากการแจกแจงแบบปกติ ที่มีฟังก์ชั่นการแจกแจงอยู่ในรูปของ

$$F(X) = (N - N_1)\, N(0,1) + N_1\, N(0, C^2(1))$$

หมายความว่าตัวแปรสุ่ม X มาจากการแจกแจง N(0,1) ด้วยจำนวนเท่ากับ $N - N_1$ และจากการแจกแจง $N(0, C^2(1))$ ด้วยจำนวนเท่ากับ N_1 โดยที่

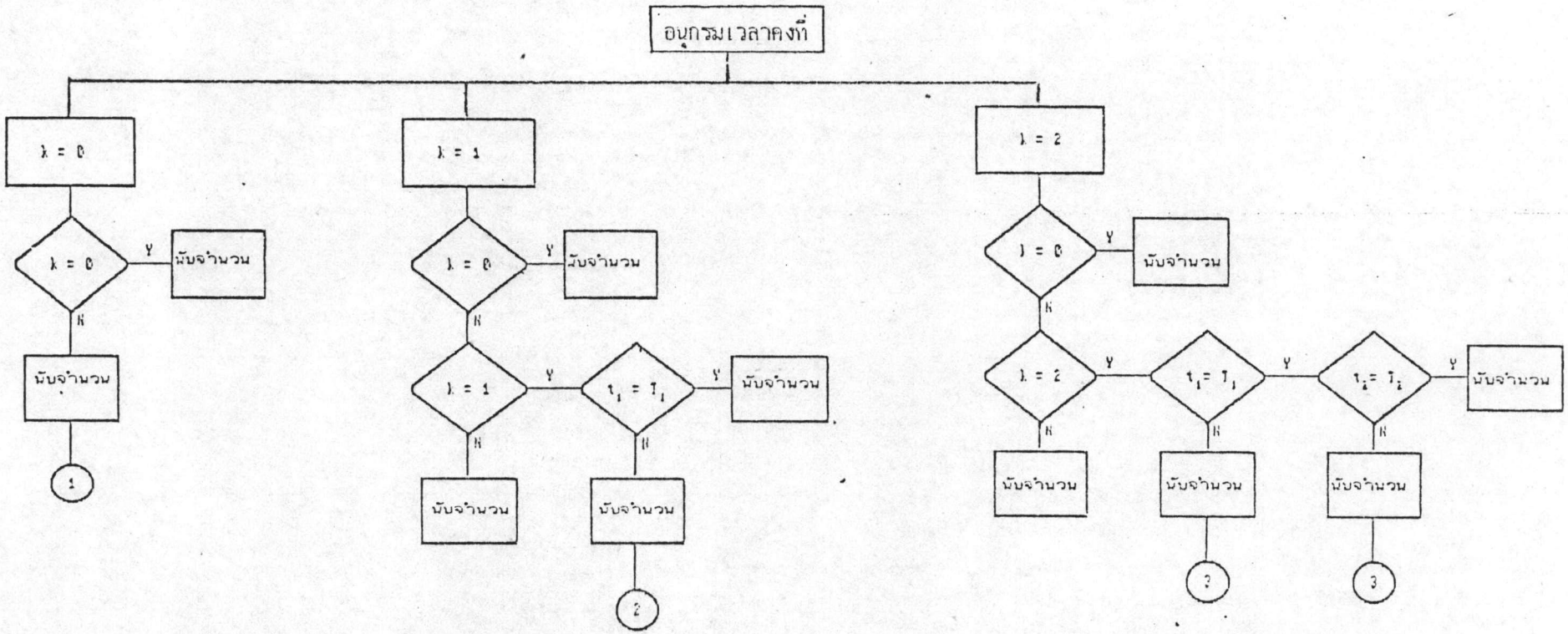
μ และ σ^2 เป็นค่ากำหนดค่าเฉลี่ยและความแปรปรวน

N_1 และ C เป็นค่ากำหนดจำนวนการปลอมปน และสเกลแฟคเตอร์

ดังนั้น คำสั่งในการสร้างข้อมูลให้มีการแจกแจงแบบปกติปลอมปน คือ

```
      IA = 1
      S  = IA
      SA = C*C*S
20    CALL GAUSS (IX,S,AM,X)
      IN = INT(10*X)
      IF ((IN .GE. 2) .AND. (IN .LT. (N-1)) THEN
      DO 15 I=1,N
      IF (I - IN) 12,11,12
11    CALL GAUSS (IX,SA,AM,X)
      R = XMEAN + C*X
      ERR(I) = R
      GOTO 15
12    CALL GAUSS (IX,S,AM,X)
      ERR(I) = X
15    CONTINUE
      ELSE
      GOTO 20
      END IF
```

1. การหาลักส่วนของความผิดพลาดทั้งหมด สามารถแสดงได้ดังแผนผัง



โดยกำหนดให้ N เป็นจำนวนอนุกรมทั้งหมดที่ใช้ทดสอบ

N_1 เป็นจำนวนอนุกรมเวลาทั้งหมดที่ตรวจสอบพบค่าสังเกตที่ผิดปกติ

(1) เป็นจำนวนอนุกรมที่ตรวจสอบพบค่าสังเกตที่ผิดปกติ เมื่ออนุกรมเวลาที่ใช้ทดสอบนั้นไม่มีค่าสังเกตที่ผิดปกติ

(2) เป็นจำนวนอนุกรมเวลาที่ตรวจสอบพบค่าสังเกตที่ผิดปกติและไม่ตรงตำแหน่งคาบเวลาที่มีค่าสังเกตที่ผิดปกติ เมื่ออนุกรมเวลาที่ใช้ทดสอบนั้นมีค่าสังเกตที่ผิดปกติ 1 ค่า

(3) เป็นจำนวนอนุกรมเวลาที่ตรวจสอบพบค่าสังเกตที่ผิดปกติและไม่ตรงตำแหน่งคาบเวลาที่มีค่าสังเกตที่ผิดปกติ เมื่ออนุกรมเวลาที่ใช้ทดสอบนั้นมีค่าสังเกตที่ผิดปกติ 2 ค่า

ดังนั้น

สัดส่วน (1) = สัดส่วนของความผิดพลาดการตรวจสอบพบค่าสังเกตที่ผิดปกติ เมื่ออนุกรมเวลาที่ใช้ทดสอบนั้นไม่มีค่าสังเกตที่ผิดปกติ

= A/N

(2) = สัดส่วนของความผิดพลาดการตรวจสอบไม่พบค่าสังเกตที่ผิดปกติ เมื่ออนุกรมเวลาที่ใช้ทดสอบนั้นมีค่าสังเกตที่ผิดปกติ

= B/N

(3) = สัดส่วนของความผิดพลาดการตรวจสอบพบค่าสังเกตที่ผิดปกติและไม่ตรงตำแหน่งคาบเวลาที่มีค่าสังเกตที่ผิดปกติ เมื่ออนุกรมเวลาที่ใช้ทดสอบนั้นมีค่าสังเกตที่ผิดปกติ

= C/N

2. อำนาจการทดสอบ

อำนาจการทดสอบคือ ความน่าจะเป็นที่จะปฏิเสธสมมติฐาน H_o เมื่อสมมติฐาน H_o ผิด ในการสรุปผลมักจะเกิดความผิดพลาดได้สองแบบ คือ การที่จะปฏิเสธสิ่งที่เป็นจริงและยอมรับสิ่งที่ไม่จริง ซึ่งเราต้องการทำให้ความน่าจะเป็นของเหตุการณ์ของความผิดพลาดเหล่านี้เกิดขึ้นน้อยที่สุดเท่าที่จะเป็นได้ การที่จะปฏิเสธสิ่งที่เป็นจริงเราเรียกว่า ความผิดพลาดแบบที่ I (Type I error) ซึ่งสามารถให้นิยามของความน่าจะเป็นของเหตุการณ์ดังกล่าวได้ดังนี้

$$\alpha = P(\text{ปฏิเสธ } H_o \text{ เมื่อ } H_o \text{ เป็นจริง})$$

ส่วนการยอมรับสิ่งที่ไม่จริงเราเรียกว่าความผิดพลาดแบบที่ II (Type II error) ซึ่งสามารถให้นิยามของความน่าจะเป็นได้ดังนี้

$$\beta = P(\text{ยอมรับ } H_o \text{ เมื่อ } H_1 \text{ เป็นจริง})$$

โดยทั่วไปแล้ว ปัญหาในการทดสอบสมมติฐานจะพยายามควบคุมความน่าจะเป็นของความผิดพลาดแบบที่ I ให้มีค่าน้อย และพยายามทำให้ความน่าจะเป็นของความผิดพลาดแบบที่ II มีค่าน้อยที่สุด เพื่อทำให้อำนาจารทดสอบ

$$1 - \beta = P(\text{ปฏิเสธ } H_o \text{ เมื่อ } H_1 \text{ เป็นจริง})$$

$$= P_{H1}(\text{ปฏิเสธ } H_o)$$

$$= P(\text{ปฏิเสธสิ่งที่ไม่จริง})$$

3. การเปรียบเทียบค่าร้อยละเฉลี่ยความแตกต่างระหว่าง ค่าสังเกตที่ปกติกับค่าสังเกตที่ผิดปกติเมื่อมีการปรับแก้แล้ว

กำหนดให้ N เป็นจำนวนอนุกรมเวลาทั้งหมด

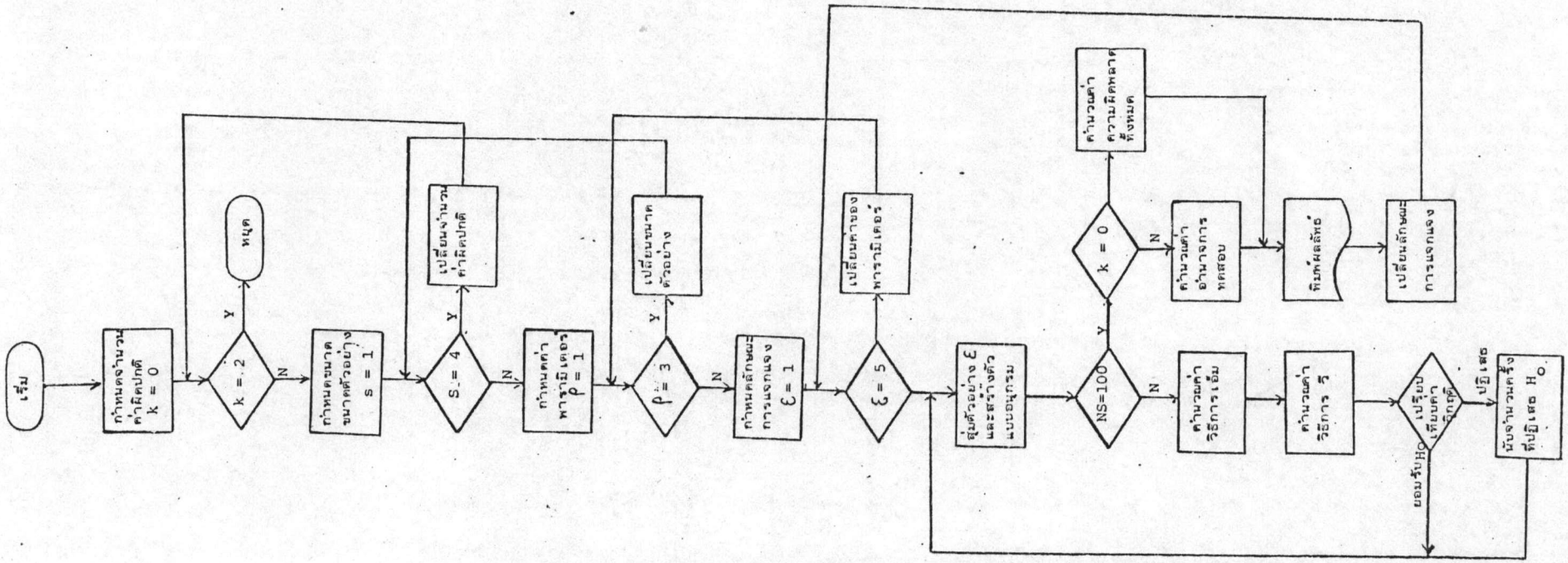
XN เป็นค่าสังเกตที่ปกติ

XD เป็นค่าสังเกตที่ผิดปกติเมื่อมีการปรับแก้แล้ว

C เป็นค่าร้อยละเฉลี่ยความแตกต่างระหว่าง ค่าสังเกตที่ผิดปกติเมื่อมีการปรับแก้แล้กับค่าสังเกตที่ปกติ

ดังนั้น $C = (\Sigma (XD - XN)/N) (100)$

แสดงผังงานสำหรับการหาสัดส่วนฐานนิยมพลาดทั้งหมด อำนาจการทดสอบ
ของตัวสถิติทดสอบ 2 วิธี ในการทดสอบค่าสังเกตที่มีการแจกแจงปกติ



ภาคผนวก ค

โปรแกรมที่ 1 โปรแกรมสำหรับสร้างอนุกรมเวลาคงที่ตัวแบบ AR(1) มีค่าสังเกตที่ผิดปกติ k = 0 , k = 1 , k = 2

```
C*****THIS PROGRAM FOR GENERATING TIME SERIES
C*****WITH FIRST AUTOREGRESSIVE MODEL AR(1)
      DIMENSION ERR(120),Y(120),AERR(120),BERR(120),CERR(120),C(8)
     +,YA(120),YB(120),YA2(120),YB2(120),ASCAL(120),SS(8)
     +,IK(2),IO(120),BSCAL(120),KM1(120),KM2(120),DERR(120)
     +,YC(120),YC2(120),YD(120),YD2(120),CSCAL(120)
     +,DSCAL(120),HERR(120),HSCAL(120),YH(120),YH2(120),YT(120)
     +,YT2(120),YX(120),YX2(120),YY(120),YY2(120),IERR(120),XERR(120)
     +,YERR(120),TSCAL(120),XSCAL(120),YSCAL(120)
      DOUBLE PRECISION IX
      OPEN (1,FILE='2A3.PRN')
      OPEN (2,FILE='2A4.PRN')
      OPEN (3,FILE='2A5.PRN')
      OPEN (4,FILE='2A6.PRN')
      OPEN (9,FILE='A22.PRN')
      IX = 65479
      N = 50
      C(1) = 3.
      C(2) = 4.
      C(3) = 5.
      C(4) = 6.
      C(5) = 7.
      C(6) = 8.
      C(7) = 9.
      C(8) = 10.
      AM = 0.
      XMU = 10.
      IA = 1
      K = 2
C     DO 20 XRHO = 0.1,1.0,4
      XRHO = 0.1
      XFRE = XRHO
      DO 30 IM = 1,100
      S = IA
      XMEAN = XMU/(1 - XFRE)
      DO 11 J=1,8
      SS(J) = C(J)*C(J)*S
11    CONTINUE
```

```
C*****GENERATE INTITIAL DATA FOR AR(1)
      CALL GAUSS (IX,S,AM,U)
     Y(0) = XMEAN
C*****GENERATE AUTOREGRESSIVE FIRST ORDER
C*****GENERATE ERROR NORMAL DISTRIBUTION (0,1)
      DO 40 I = 1,N
      CALL GAUSS(IX,S,AM,V)
      ERR(I) = V
      Y(I) = XFRE*Y(I-1) + ERR(I)
40    CONTINUE
C*****GENERATE ERROR SCALE - CONTAMINATE NORMAL DISTRIBUTION (0,1)
C*****GENERATE OUTLIERS  2 TIME
65    CALL GAUSS (IX,S,AM,V)
      IN = N*V
      IF ((IN .GT. 2) .AND. (IN .LT. (N-1))) THEN
      N1 = IN
      ELSE
      GOTO 65
      ENDIF
64    CALL GAUSS (IX,S,AM,V)
      JN = N*V/2
      IF ((JN .GT. 2) .AND. (JN .LT. (N-1))) THEN
      N2 = JN
      ELSE
      GOTO 64
      ENDIF
      IF (N1 .EQ. N2) GOTO 64
      DO 1200 I=1,2
      IF (N1 .LE. N2) GOTO 1200
       M = N1
       N1 = N2
       N2 = M
1200  CONTINUE
      DO 60 J=1,4
      DO 50 I=1,N
      IF (I - N1)  8,9,11
8     YA2(I) = Y(I)
      GOTO 50


9     SA = C(J)*C(J)*S
      CALL GAUSS (IX,SA,AM,V)
      ASCAL (N1) = SA*ERR(N1)
      YA2(N1) = XFRE*YA2(N1-1) + ASCAL(N1)
      GOTO 50
11    IF (I - N2) 8,12,8
12    SB = C(J)*C(J)*S
      CALL GAUSS (IX,SB,AM,V)
      ASCAL (N2) = SB*ERR(N2)
      YA2(N2) = XFRE*YA2(N2-1) + ASCAL(N2)
50    CONTINUE
```

```
C*****STATIONARY TIME SERES NO OBSERVATION OUTLIER
C*****AND 2 OUTLIERS
      DO 90 I=1,N
      WRITE (3,101) Y(I),YA2(I)
101   FORMAT (2F10.2)
90    CONTINUE
60    CONTINUE
      WRITE (9,109) N1,N2
109   FORMAT (2I5)
30    CONTINUE
20    CONTINUE
      STOP
      END
*****THIS SUBROUTINE IS TO GENERATE RANDOM NUMBER
2       SUBROUTINE RANDU (IX,IY,RAN)
      DOUBLE PRECISION IX
      IY = IX*65539
      IF (IY) 5,6,6
    5 IY = IY + 2147483647 + 1
    6 RAN = IY
      RAN = RAN*0.4656613E-9
      RETURN
      END
C*****THIS SUBROUTINE IS TO GENERATE NORMAL DISTRIBUTION
      SUBROUTINE GAUSS (IX,S,AM,V)
      DOUBLE PRECISION IX
      A = 0.
      DO 50 I = 1,12
      CALL RANDU (IX,IY,RAN)
      IX=IY
50    A = A + RAN
      V = (A - 6.0)*S + AM
      RETURN
      END
```

โปรแกรมที่ 2 โปรแกรมสำหรับสร้างอนุกรมเวลาคงที่ตัวแบบ MA(1) มีค่าสังเกตที่ผิดปกติ k = 0 , k = 1 , k = 2

```
C*****THIS PROGRAM FOR GENERATING STATIONARY TIME SERIES MA(1)
C*****WITH MOVING-AVERAGE FIRST ORDER MODEL MA(1)
      DIMENSION ERR(120),Y(120),IC(2),IK(2),E(120),YA1(120),YB2(120)
      DIMENSION YA2(120),YB1(120),AERR(120),BERR(120),ASCAL(120)
      DIMENSION BSCAL(120),IO(100),KM1(100),KM2(100)
      DOUBLE PRECISION IX
      OPEN (5,FILE='MA1.OUT')
      OPEN (6,FILE='MA2.OUT')
      IX = 987352
      N = 50
      IC(1) = 3
      IC(2) = 10
      AM = 0.
      BETA = 10.
      IA = 1
      K = 2
      DO 20 XRHO = 0.1,0.6,0.4
      DO 30 IM = 1,100
      FB = SQRT(1-(4*XRHO*XRHO))
      AL = (-1+FB)/(2*XRHO)
      AL1 = (-1-FB)/(2*XRHO)
      CETA = ABS(MAX(AL,AL1))
      S = IA
      XMEAN = BETA
      SA = IC(1)*IC(1)*S + XMEAN
      SB = IC(2)*IC(2)*S + XMEAN
C*****GENERATE ERROR NORMAL DISTRIBUTION (0,1)
      DO 50 I = 1,N
```

```
      CALL GAUSS(IX,S,AM,X)
      ERR(I) = X
      AERR(I) = ERR(I)
      BERR(I) = ERR(I)
50    CONTINUE
C*****GENERATE ERROR SCALE - CONTAMINATE NORMAL DISTRIBUTION
      DO 60 J=1,N
      CALL ASCALE (IX,SA,AM,X)
      ASCAL(J) = X+10*XMEAN
      CALL BSCALE (IX,SB,AM,V)
      BSCAL(J) = V+10*XMEAN



60    CONTINUE
C*****GENERATE INTITIAL DATA FOR MOVING-AVERAGE
      CALL GAUSS (IX,S,AM,X)
      ERR(0) = X
      AERR(0) = ERR(0)
      BERR(0) = ERR(0)
      DO 70 I = 1,N
      E(I) = ERR(I) - CETA*ERR(I-1)
      Y(I)  = BETA + E(I)
      YA1(I) = Y(I)
      YB1(I) = Y(I)
      YA2(I) = Y(I)
      YB2(I) = Y(I)
70    CONTINUE
C*****GENERATE OUTLIERS 1 AND 2 TIME
      DO 80 I = 1,K
75    CALL GAUSS (IX,S,AM,V)
      NN = ABS(INT(15*V))
      IF ((NN .GT. 2) .AND. (NN .LT. (N-1))) THEN
```

```
      IO(IM) = NN
      AERR(IO(IM)) = ABS(ASCAL(IO(IM)) + XMEAN)
      YA1(IO(IM)) = BETA + AERR(IO(IM)) - CETA*AERR(IO(IM)-1)
      BERR(IO(IM)) = ABS(BSCAL(IO(IM))+ XMEAN)
      YB1(IO(IM)) = BETA + BERR(IO(IM)) - CETA*BERR(IO(IM)-1)
      ELSE
      GOTO 75
      ENDIF
 65   CALL GAUSS (IX,S,AM,V)
      IN = ABS(INT(15*V))
      JN = ABS(INT(30*V))
      IF ((IN .GT. 2) .AND. (IN .LT. (N-1))) THEN
      IK(1) = IN
      IK(2) = JN
      KM1(IM) = IK(1)
      KM2(IM) = IK(2)
      ELSE
      GOTO 65
      ENDIF
      AERR(KM1(IM)) = ABS(ASCAL(KM1(IM)) + XMEAN)
      AERR(KM2(IM)) = ABS(ASCAL(KM2(IM)) + XMEAN)
      YA2(KM1(IM)) = BETA + AERR(KM1(IM)) - CETA*AERR(KM1(IM)-1)
      YA2(KM2(IM)) = BETA + AERR(KM2(IM)) - CETA*AERR(KM2(IM)-1)
      BERR(KM1(IM)) = ABS(BSCAL(KM1(IM))+ XMEAN)
      BERR(KM2(IM)) = ABS(BSCAL(KM2(IM))+ XMEAN)
      YB2(KM1(IM)) = BETA + BERR(KM1(IM)) - CETA*BERR(KM1(IM)-1)
      YB2(KM2(IM)) = BETA + BERR(KM2(IM)) - CETA*BERR(KM2(IM)-1)
 80   CONTINUE
C*****GENERRATE STATIONARY TIME SERIES DATA MODEL MA(1)
C*****NO OBSERVATION OUTLIER AND 1 OR 2 OUTLIERS
      DO 100 I = 1,N
      WRITE (5,110) Y(I),YA1(I),YB1(I),YA2(I),YB2(I)
110   FORMAT (5F10.4)
```

```
100   CONTINUE
      WRITE (6,120) IM,IO(IM),KM1(IM),KM2(IM)
120   FORMAT (4I6)
30    CONTINUE
20    CONTINUE
      STOP
      END
C*****THIS SUBROUTINE IS TO GENERATE RANDOM NUMBER
      SUBROUTINE RANDU (IX,IY,RAN)
      DOUBLE PRECISION IX
      IY = IX*65539
      IF (IY) 5,6,6
    5 IY = IY + 2147433647 + 1
    6 RAN= IY
      RAN=RAN*0.4656613E-9
      RETURN
      END
C*****THIS SUBROUTINE IS TO GENERATE NORMAL DISTRIBUTION
      SUBROUTINE GAUSS (IX,S,AM,V)
      DOUBLE PRECISION IX
      A = 0.0
      DO 50 I = 1,12
      CALL RANDU (IX,IY,Y)
      IX = IY
      A = A + Y
   50 CONTINUE

      V = (A - 6.0)*S + AM
      RETURN
      END
C*****THIS SUBROUTINE IS TO GENERATE SCALE-CONTAMINATE
C*****NORMAL DISTRIBUTION IC = 3
      SUBROUTINE ASCALE (IX,SA,AM,V)
      DOUBLE PRECISION IX
      A = 0.0
```

```
      DO 50 I = 1,12
      CALL RANDU (IX,IY,Y)
      IX = IY
      A = A + Y
   50 CONTINUE
      V = (A - 6.0)*SA + AM
      RETURN
      END
C*****THIS SUBROUTINE IS TO GENERATE SCALE-CONTAMINATE
C*****NORMAL DISTRIBUTION IC = 10
      SUBROUTINE BSCALE (IX,SB,AM,V)
      DOUBLE PRECISION IX
      A = 0.0
      DO 50 I = 1,12
      CALL RANDU (IX,IY,Y)
      IX = IY
      A = A + Y
   50 CONTINUE
      V = (A - 6.0)*SB + AM
      RETURN
      END
```

โปรแกรมที่ 3 โปรแกรมสำหรับสร้างอนุกรมเวลาคงที่ตัวแบบ ARMA(1,1) มีค่าสังเกตที่ผิดปกติ k = 0 , k = 1 , k = 2

```
C*****THIS PROGRAM FOR GENERATING STATIONARY TIME SERIES ARMA(1,1)
C*****WITH MIXED AUTOREGRESSIVE-MOVING AVERAGE FIRST ORDER MODEL
      DIMENSION ER(120),IK(2)
      DIMENSION ERR(120),Y(120),AERR(120),BERR(120),IC(2)
      DIMENSION YA(120),YB(120),ASCAL(120),BSCAL(120)
      REAL*8 AA,BB,CC,DD
      DOUBLE PRECISION IX
      OPEN (5,FILE='ARMA.OUT')
      IX = 987352
      N = 50
      AM = 0.
      XMU = 10.
      IA = 1
      K = 2
      IC(1) = 3
      IC(2) = 10
      DO 20 XRHO = 0.1,1,0.4
      DO 25 XCETA = 0.1,0.5,0.3
      DO 30 I = 1,100
      AA = XCETA
      BB = -(1+2*XRHO*XCETA+XCETA**2)
      CC = XRHO+XCETA+XRHO*XCETA**2
      DD = SQRT(BB**2-4*AA*CC)
      AS = (-BB+DD)/2*AA
      BS = (-BB-DD)/2*AA
      XFRE = ABS(MIN(AS,BS))
      XMEAN = XMU/(1-XFRE)
```

```
      S = IA
      SA = IC(1)*IC(1)*S + XMEAN
      SB = IC(2)*IC(2)*S + XMEAN
C*****GENERATE ERROR SCALE-CONTAMINATE NORMAL DISTRIBUTION
      CALL RANDU (IX,IY,RAN)
      Y(0) = 100*RAN
      YA(0) = Y(0)
      YB(0)  =Y(0)
C*****GENERATE ERROR NORMAL DISTRIBUTION (0,1)
      DO 50 I = 1,N
      CALL GAUSS(IX,S,AM,X)
      ERR(I) = X
      AERR(I) = ERR(I)
      BERR(I) = ERR(I)
50    CONTINUE
C*****GENERATE ERROR SCALE - CONTAMINATE NORMAL DISTRIBUTION (0,σ2)
      DO 60 J = 1,N
      CALL ASCALE (IX,SA,AM,X)
      ASCAL(J) = X + 10*XMEAN
      CALL BSCALE (IX,SB,AM,U)
      BSCAL(J) = U + 10*XMEAN
60    CONTINUE
C*****GENERATE INTITIAL DATA FOR MOVING-AVERAGE
      CALL GAUSS (IX,S,AM,X)
      ERR(0) = X
      AERR(0) = ERR(0)
      BERR(0) = ERR(0)
      DO 70 I = 1,N
      Y(I) =  XMU + XFRE*Y(I-1) - XCETA*ERR(I-1) + ERR(I)
      YA(I) = Y(I)
      YB(I) = Y(I)
70    CONTINUE
C*****GENERATING TWO OUTLIERS
```

```
      DO 80 I = 1,K
75    CALL GAUSS (IX,S,AM,V)
      IN = INT(10*V)
      IF ((IN .GT. 2) .AND. (IN .LT. (N-1)) THEN
      IK(I) = IN
      AERR(IK(I)) = ABS(ASCAL(IK(I)) + XMEAN)
      YA(IK(I)) = XMU+XFRE*YA(IK(I)-1)-XCETA(IK(I)-1)+AERR(IK(I))
      BERR(IK(I)) = ABS(BSCAL(IK(I)) + XMEAN)
      YB(IK(I)) = XMU+XFRE*YB(IK(I)-1)-XCETA(IK(I)-1)+BERR(IK(I))
      ELSE
      GOTO 75
      ENDIF
80    CONTINUE
C*****GENERATE STATIONARY TIME SERIES DATA  MODEL ARMA(1,1)
C*****NO OBSERVATION OUTLIER AND 1 OR 2 OUTLIERS
      DO 90 I = 1,N
      WRITE (5,100) Y(I),YA(I),YB(I)
100   FORMAT(3F10.4)
90    CONTINUE
30    CONTINUE
25    CONTINUE
20    CONTINUE
      STOP
      END
C*****THIS SUBROUTINE IS TO GENERATE RANDOM NUMBER
      SUBROUTINE RANDU (IX,IY,RAN)
      DOUBLE PRECISION IX
      IY = IX*65539
      IF (IY) 5,6,6
    5 IY = IY + 2147433647 + 1
    6 RAN= IY
      RAN=RAN*0.4656613E-9
      RETURN
      END
```

```
C*****THIS SUBROUTINE IS TO GENERATE NORMAL DISTRIBUTION
      SUBROUTINE GAUSS (IX,S,AM,V)
      DOUBLE PRECISION IX
      A = 0.0
      DO 50 I = 1,12
      CALL RANDU (IX,IY,Y)
      IX = IY
      A = A + Y
   50 CONTINUE
      V = (A - 6.0)*S + AM
      RETURN
      END
C*****THIS SUBROUTINE IS TO GENERATE SCALE-CONTAMINATE NORMAL
C*****DISTRIBUTION IC = 3
      SUBROUTINE ASCALE (IX,SA,AM,V)
      DOUBLE PRECISION IX
      A = 0.0
      DO 50 I = 1,12
      CALL RANDU (IX,IY,Y)
      IX = IY
      A = A + Y
   50 CONTINUE
      V = (A - 6.0)*SA + AM



      RETURN
      END
C*****THIS SUBROUTINE IS TO GENERATE SCALE-CONTAMINATE NORMAL
C*****DISTRIBUTION IC = 10
      SUBROUTINE BSCALE (IX,SB,AM,V)
      DOUBLE PRECISION IX
      A = 0.0
      DO 50 I = 1,12
      CALL RANDU (IX,IY,Y)
```

```
      IX = IY
      A = A + Y
   50 CONTINUE
      V = (A - 6.0)*SB + AM
      RETURN
      END
```

โปรแกรมที่ 4 โปรแกรมสำหรับสร้างอนุกรมเวลาคงที่ตัวแบบ AR(1) มีค่าสังเกตที่ผิดปกติเป็นร้อยละ (p) 5 15 25

```
C*****THIS PROGRAM FOR GENERATING TIME SERIES
C*****WITH FIRST AUTOREGRESSIVE MODEL AR(1)
      DIMENSION ERR(120),Y(120),AERR(120),BERR(120),CERR(120),C(8)
     +,YA(120),YB(120),YA1(120),YB1(120),ASCAL(120)
     +,IK(2),IO(120),BSCAL(120),KM1(120),KM2(120),DERR(120)
     +,YC(120),YC1(120),YD(120),YD1(120),CSCAL(120)
     +,DSCAL(120),HERR(120),HSCAL(120),YH(120),YH1(120),YT(120)
     +,YT1(120),YX(120),YX1(120),YY(120),YY1(120),TERR(120),XERR(120)
     +,YERR(120),TSCAL(120),XSCAL(120),YSCAL(120),SS(4)
      DIMENSION IB5(120),IB15(120),IB25(120)
      DOUBLE PRECISION IX
      OPEN (1,FILE='AP3')
      OPEN (2,FILE='AP4')
      OPEN (3,FILE='AP5')
      OPEN (4,FILE='AP6')
C      OPEN (9,FILE='AP.prn')
      IX = 65479
      N = 120
      C(1) = 3.
      C(2) = 4.
      C(3) = 5.
      C(4) = 6.
      AM = 0.
      XMU = 1.
      IA = 1
      K = 2
C      DO 20 XRHO = 0.1,1,0.4
      XRHO = 0.9
      XFRE = XRHO
      XA = .05
      XB = .15
      XC = .25
      MB = INT(XA*N)
      MD = INT(XB*N)
      ME = INT(XC*N)
      S = 1.
      do 22 j=1,4
      SS(j) = C(j)*C(j)*S
22    continue
      XMEAN = XMU/(1. - XFRE)
      DO 30 K = 1,100
```

```
C*****GENERATE ERROR NORMAL DISTRIBUTION (0,1)
      DO 40 I = 1,N
      CALL GAUSS(IX,S,AM,X)
      ERR(I) = X
40    CONTINUE
C      DO 50 J = 1,N
C      CALL ASCALE (IX,SA,AM,U)
C      ASCAL(J) = U + 10*XMEAN
C      BSCAL(J) = U + 10*XMEAN
C50    CONTINUE
      DO 60 I = 1,N
      Y(I) = XMEAN + XFRE*Y(I-1) + ERR(I)
      YA(I) = Y(I)
C      YB(I) = Y(I)
C      YC(I) = Y(I)
60    CONTINUE
      do 61 ij=1,4
      DO 70 J = 1,MB
75    CALL GAUSS (IX,S,AM,V)
      IN =  INT(N*V)
      IF ((IN .GT. 2) .AND. (IN .LT. (N-1))) THEN
      IB5(J) = IN
C*****CHANGE VARIANCE IS 3, 4, 5, 6
      AERR(IB5(J)) =  SS(ij)* ERR(IB5(J))
      YA(IB5(J)) = XMEAN + XFRE*YA(IB5(J)-1) + AERR(IB5(J))
      ELSE
      GOTO 75
      ENDIF
70    CONTINUE
c61    continue
C      DO 80 J = 1,MD
C85     CALL GAUSS (IX,S,AM,V)
c       NN =  INT(N*V)
C      IF ((NN .GT. 2) .AND. (NN .LT. (N-1))) THEN
C      IB15(J) = NN
C      BERR(IB15(J)) = SS(1)*ERR(IB15(J))
C      YB(IB15(J)) = XMEAN + XFRE*YB(IB15(J)-1) + BERR(IB15(J))
C      ELSE
C      GOTO 85
C      ENDIF
C80    CONTINUE
C      DO 90 J = 1,ME
C95     CALL GAUSS (IX,S,AM,V)
C      KN =  INT(N*V)
C      IF ((KN .GT. 2) .AND. (KN .LT. (N-1))) THEN
C      IB25(J) = KN
C      CERR(IB25(J)) = SS(1)*ERR(IB25(J))
C      YC(IB25(J)) = XMEAN + XFRE*YC(IB25(J)-1) + CERR(IB25(J))
C      ELSE
C      GOTO 95
C      ENDIF
C90    CONTINUE
```

```
      DO 100 I=1,N
      WRITE (ij,140) Y(I),YA(I)
140   FORMAT (2F10.2)
100    CONTINUE
61    continue
30    CONTINUE
20    CONTINUE
      STOP
      END
C*****THIS SUBROUTINE IS TO GENERATE RANDOM NUMBER
      SUBROUTINE RANDU (IX,IY,RAN)
      DOUBLE PRECISION IX
      IY = IX*65539
      IF (IY) 5,6,6
    5 IY = IY + 2147433647 + 1
    6 RAN = IY
      RAN = RAN*0.4656613E-9
      RETURN
      END
C*****THIS SUBROUTINE IS TO GENERATE NORMAL DISTRIBUTION
      SUBROUTINE GAUSS (IX,S,AM,V)
      DOUBLE PRECISION IX
      A = 0.
      DO 50 I = 1,12
      CALL RANDU (IX,IY,Y)
      IX=IY
   50 A = A + Y
      V = (A - 6.0)*S + AM
      RETURN
      END
C*****THIS SUBROUTINE IS TO GENERATE SCAL-CONTAMINATE NORMAL
C*****DISTRIBUTION
      SUBROUTINE ASCALE (IX,SA,AM,U)
      DOUBLE PRECISION IX
      A = 0.
      DO 50 I = 1,12
      CALL RANDU (IX,IY,Y)
      IX=IY
   50 A = A + Y
      U = (A - 6.0)*SA + AM
      RETURN
      END
```

โปรแกรมที่ 5 โปรแกรมสำหรับสร้างอนุกรมเวลาคงที่ตัวแบบ MA(1) มีค่าสังเกตที่ผิดปกติเป็นร้อยละ (p) 5 15 25

```
C*****THIS PROGRAM FOR GENERATING STATIONARY TIME SERIES MA(1)
C*****WITH MOVING-AVERAGE FIRST ORDER MODEL MA(1)
      DIMENSION ERR(120),Y(120),C(8),IK(2),E(120),YA1(120),YB2(120)
     +,YA2(120),YB1(120),AERR(120),BERR(120),ASCAL(120),YA(120),YB(120)
     +,BSCAL(120),IO(120),KM1(120),KM2(120),YC(120),YH(120),YT(120)
     +,YX(120),YY(120),CERR(120),DERR(120),HERR(120),TERR(120),XERR(120)
     +,YERR(120),CSCAL(120),DSCAL(120),HSCAL(120),XSCAL(120),YSCAL(120)
     +,YD(120),YD1(120),YH1(120),YD2(120),YH2(120),TSCAL(120),YC1(120)
     +,YC2(120),YX1(120),YY1(120),YT1(120),YT2(120),YX2(120)
     +,YY2(120),SS(120),IB5(120),IB15(120),IB25(120)
      DOUBLE PRECISION IX
      OPEN (1,FILE='AP3')
      OPEN (2,FILE='AP4')
      OPEN (3,FILE='AP5')
      OPEN (4,FILE='AP6')
      IX = 65479
      N = 50
      C(1) = 3.
      C(2) = 4.
      C(3) = 5.
      C(4) = 6.
      AM = 0.
      BETA = 10.
      IA = 1
      K = 2
      xrho = 0.1
      XMEAN = BETA
      XA = .05
      XB = .15
      XC = .25
      MB = INT(XA*N)
      MD = INT(XB*N)
      ME = INT(XC*N)
      S = 1.
      do 22 j=1,4
      SS(j) = C(j)*C(j)*S
22    continue
c      DO 20 XRHO = 0.1,0.5,0.3
C      DO 30 IM = 1,100
      FB = SQRT(1-(4*XRHO*XRHO))
      AL = (-1+FB)/(2*XRHO)
      AL1 = (-1-FB)/(2*XRHO)
```

```
      CETA = AL
C*****GENERATE ERROR NORMAL DISTRIBUTION (0,1)
      DO 40 I = 1,N
      CALL GAUSS(IX,S,AM,X)
      ERR(I) = X
40    CONTINUE
C*****GENERATE ERROR SCALE - CONTAMINATE NORMAL DISTRIBUTION
C*****GENERATE INTITIAL DATA FOR MOVING-AVERAGE
      DO 60 I = 1,N
      Y(I) = ERR(I) - CETA*ERR(I-1)
      YA(I) = Y(I)
C      YB(I) = Y(I)
C      YC(I) = Y(I)
60    CONTINUE
C*****GENERATE OUTLIERS 1 AND 2 TIME
      do 61 ij=1,4
      DO 70 J = 1,MB
75    CALL GAUSS (IX,S,AM,V)
      IN =  INT(N*V)
      IF ((IN .GT. 2) .AND. (IN .LT. (N-1))) THEN
      IB5(J) = IN
C*****CHANGE VARIANCE IS 3, 4, 5, 6
      AERR(IB5(J)) =  SS(ij)* ERR(IB5(J))
      YA(IB5(J)) = CETA*YA(IB5(J)-1) + AERR(IB5(J))
      ELSE
      GOTO 75
      ENDIF
70    CONTINUE
C      DO 80 J = 1,MD
C85     CALL GAUSS (IX,S,AM,V)
c       NN =  INT(N*V)
C      IF ((NN .GT. 2) .AND. (NN .LT. (N-1))) THEN
C      IB15(J) = NN
C      BERR(IB15(J)) = SS(1)*ERR(IB15(J))
C      YB(IB15(J)) = XMEAN + XFRE*YB(IB15(J)-1) + BERR(IB15(J))
C      ELSE
C      GOTO 85
C      ENDIF
C80    CONTINUE
C      DO 90 J = 1,ME
C95     CALL GAUSS (IX,S,AM,V)
C      KN =  INT(N*V)
C      IF ((KN .GT. 2) .AND. (KN .LT. (N-1))) THEN
C      IB25(J) = KN
C      CERR(IB25(J)) = SS(1)*ERR(IB25(J))
C      YC(IB25(J)) = XMEAN + XFRE*YC(IB25(J)-1) + CERR(IB25(J))
C      ELSE
C      GOTO 95
C      ENDIF
C90    CONTINUE
```

```
      DO 100 I=1,N
      WRITE (ij,140) Y(I),YA(I)
140   FORMAT (2F10.2)
100    CONTINUE
61    continue
30    CONTINUE
20    CONTINUE
      STOP
      END
C*****THIS SUBROUTINE IS TO GENERATE RANDOM NUMBER
      SUBROUTINE RANDU (IX,IY,RAN)
      DOUBLE PRECISION IX
      IY = IX*65539
      IF (IY) 5,6,6
    5 IY = IY + 2147433647 + 1
    6 RAN= IY
      RAN=RAN*0.4656613E-9
      RETURN
      END
C*****THIS SUBROUTINE IS TO GENERATE NORMAL DISTRIBUTION
      SUBROUTINE GAUSS (IX,S,AM,V)
      DOUBLE PRECISION IX
      A = 0.0
      DO 50 I = 1,12
      CALL RANDU (IX,IY,RAN)
      IX = IY
      A = A + RAN
      V = (A - 6.0)*S + AM
   50 CONTINUE
      RETURN
      END
```

โปรแกรมที่ 6 โปรแกรมสำหรับสร้างอนุกรมเวลาคงที่ตัวแบบ ARMA(1,1) มีค่า

สังเกตที่ผิดปกติร้อยละ (p) 5 15 25

```
C*****THIS PROGRAM FOR GENERATING STATIONARY TIME SERIES ARMA(1,1)
C*****WITH MIXED AUTOREGRESSIVE-MOVING AVERAGE FIRST ORDER MODEL
      DIMENSION ER(500),CERR(500)
      DIMENSION ERR(500),Y(500),AERR(500),BERR(500),IC(2)
      DIMENSION YA(500),YB(500),ASCAL(500),BSCAL(500),YC(500)
      DIMENSION IB5(120),IB15(120),IB25(120)
      REAL*8 AA,BB,CC,DD
      DOUBLE PRECISION IX
      OPEN (5,FILE='ARMAP.OUT')
      IX = 987352
      N = 50
      AM = 0.
      XMU = 10.
      IA = 1
      XA = .05
      XB = .15
      XC = .25
      MB = INT(XA*N)
      MD = INT(XB*N)
      ME = INT(XC*N)
      IC(1) = 3
      IC(2) = 10
      DO 20 XRHO = 0.1,1,0.4
      DO 25 XCETA = 0.1,0.6,0.4
      DO 30 K = 1,100
      AA = XCETA
      BB = -(1+2*XRHO*XCETA+XCETA**2)
      CC = XRHO+XCETA+XRHO*XCETA**2
```

```
      DD = SQRT(BB**2-4*AA*CC)
      AS = (-BB+DD)/2*AA
      BS = (-BB-DD)/2*AA
      XFRE = AS
      XMEAN = XMU/(1-XFRE)
      S = IA
C      SA = IC(1)*IC(1)*S + XMEAN
      SB = IC(2)*IC(2)*S + XMEAN
C*****GENERATE ERROR SCALE-CONTAMINATE NORMAL DISTRIBUTION
      CALL RANDU (IX,IY,RAN)
      Y(0)  = 100*RAN
      YA(0) = Y(0)
      YB(0) = Y(0)
      YB(0) = Y(0)
C*****GENERATE ERROR NORMAL DISTRIBUTION (0,1)
      DO 50 I = 1,N
      CALL GAUSS(IX,S,AM,X)
      ERR(I) = X
      AERR(I) = ERR(I)
      BERR(I) = ERR(I)
      CERR(I) = ERR(I)
50    CONTINUE
C*****GENERATE ERROR SCALE - CONTAMINATE NORMAL DISTRIBUTION (0, 2)
      DO 60 J = 1,N
      CALL ASCALE (IX,SA,AM,X)
      ASCAL(J) = X + 10*XMEAN
60    CONTINUE
      DO 70 J = 1,N
      CALL BSCALE (IX,SB,AM,X)
      BSCAL(J) = X + 10*XMEAN
70    CONTINUE
C*****GENERATE INTITIAL DATA FOR MOVING-AVERAGE
      CALL GAUSS (IX,S,AM,X)
      ERR(0) = X
```

```
      DO 80 I = 1,N
      Y(I) =  XMU + XFRE*Y(I-1) - XCETA*ERR(I-1) + ERR(I)
      YA(I) = Y(I)
      YB(I) = Y(I)
      YC(I) = Y(I)
80    CONTINUE
      DO 90 J = 1,MB
95    CALL GAUSS (IX,S,AM,V)
      IN =  INT(10*V)
      IF ((IN .GT. 2) .AND. (IN .LT. (N-1))) THEN
      IB5(J) = IN
      AERR(IB5(J)) = ABS(XMEAN + BSCAL(IB5(J)))
      YA(IB5(J)) = XMU + XFRE*YA(IB5(J)-1) + AERR(IB5(J))
      ELSE
      GOTO 95
      ENDIF

90    CONTINUE
      DO 100 J = 1,MD
105   CALL GAUSS (IX,S,AM,V)
      NN =  INT(10*V)
      IF ((NN .GT. 2) .AND. (NN .LT. (N-1))) THEN
      IB15(J) = NN
      BERR(IB15(J)) = ABS(XMEAN + BSCAL(IB15(J)))
      YB(IB15(J)) = XMU + XFRE*YB(IB15(J)-1) + BERR(IB15(J))
      ELSE
      GOTO 105
      ENDIF
100    CONTINUE
      DO 110 J = 1,ME
115   CALL GAUSS (IX,S,AM,V)
      KN = INT(10*V)
      IF ((KN .GT. 2) .AND. (KN .LT. (N-1))) THEN
      IB25(J) = KN
      CERR(IB25(J)) = ABS(XMEAN + BSCAL(IB25(J)))
      YC(IB25(J)) = XMU + XFRE*YC(IB25(J)-1) + CERR(IB25(J))
```

```
      ELSE
      GOTO 115
      ENDIF
110   CONTINUE
      DO 120 I=1,N
      WRITE (5,140) Y(I),YA(I),YB(I),YC(I)
140   FORMAT (4F10.4)
120   CONTINUE
30    CONTINUE
25    CONTINUE
20    CONTINUE
      STOP
      END
C*****THIS SUBROUTINE IS TO GENERATE RANDOM NUMBER
      SUBROUTINE RANDU (IX,IY,RAN)
      DOUBLE PRECISION IX
      IY = IX*65539
      IF (IY) 5,6,6
    5 IY = IY + 2147433647 + 1
    6 RAN = IY

      RAN = RAN*0.4656613E-9
      RETURN
      END
C*****THIS SUBROUTINE IS TO GENERATE NORMAL DISTRIBUTION
      SUBROUTINE GAUSS (IX,S,AM,V)
      DOUBLE PRECISION IX
      A = 0.
      DO 50 I = 1,12
      CALL RANDU (IX,IY,Y)
      IX=IY
   50 A = A + Y
      V = (A - 6.0)*S + AM
      RETURN
      END
```

```
C*****THIS SUBROUTINE IS TO GENERATE SCAL-CONTAMINATE NORMAL
C*****DISTRIBUTION
      SUBROUTINE BSCALE (IX,SB,AM,U)
      DOUBLE PRECISION IX
      A = 0.
      DO 50 I = 1,12
      CALL RANDU (IX,IY,Y)
      IX=IY
   50 A = A + Y
      U = (A - 6.0)*SB + AM
      RETURN
      END
```

โปรแกรมที่ 7 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ ตัวแบบ AR(1) วิธีการแบบเอ็ม

```
C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....WITH PROCEDUSE M
      DIMENSION P(120),Q(120),Q1(120),Q2(120),ERR1(120),P1(120),P2(120)
     +,YO1(20),YFOR1(120),ER1(120),ELLA1(120),YO2(120),JM(2)
     +,ERR2(120),ELDAT1(120),WAT1(120),ELAMA1(120),ELLA2(120)
     +,YO(120),YFOR(120),ER(120),ERR(120),WAT(120),ELAMA(120)
     +,ELLA(120),IM(120),J1(120),J2(120),YHAT(120),XHAT(120)
     +,YADJ(120),XADJ(120),IT(120),JT(120),IQ3(120),KRE05(2),ELAMA2(120)
     +,MT1(120),IQ4(120),IT1(120),IT2(120),YHAT1(120),MT2(120)
     +,YHAT2(120),YADJ1(120),YADJ2(120),XADJ1(120),XADJ2(120)
     +,XHAT1(120),XHAT2(120),II(120),JJ(120),KK(120),K(120),WAT2(120)
     +,L(120),EP1(120),EP2(120),EP3(120),M2(120),BE05(3),IP(120)
     +,M(120),AH05(2),BE01(3),M1(120),MI2(120),KI(120),AH01(2)
     +,XAD(120)
      REAL*8 IB105,JR105,IB205,JR205,IRE05,JAC05,JRE05,IAC05,IB01
     +,IB201,JR201,IRE01,JAC01,JRE01,IAC01,JJ05,JJ01,JR101
      OPEN (1,FILE = '2A3.PRN')
      OPEN (2,FILE = '2A4.PRN')
      OPEN (3,FILE = '2A5.PRN')
      OPEN (4,FILE = '2A6.PRN')
C      OPEN (5,FILE = '2A7.PRN')
C      OPEN (6,FILE = '2A8.PRN')
C      OPEN (7,FILE = '2A9.PRN')
C      OPEN (8,FILE = '2A10.PRN')
      OPEN (9,FILE = 'A22.PRN')
      OPEN (10,FILE = '2A122.PRN')
      N = 50
      Z01 = 2.575
      Z05 = 1.96
      ZP01 = 4.0
      ZP05 = 3.5
      READ (9,15,END=300) (IQ3(I),IQ4(I),I=1,100)
15    FORMAT (2I5)
      DO 2 I=1,100
      MT1(I) = IQ3(I)
      MT2(I) = IQ4(I)
2     CONTINUE
300   CLOSE (300)
      DO 999 JD = 1,4
      IK = 0
      AM = 0
      MX = 0
```

```
      XZ = 0
      PX = 0
      PZ = 0
      BW05 = 0
      BW01 = 0
      AW053 = 0
      AW05 = 0
      AR05 = 0
      ACC05 = 0
      ACB05 = 0
      JR105 = 0
      IB205 = 0
      JR205 = 0
      IRE05 = 0
      AJJ05 = 0
      YSU1 = 0
      YSU2 = 0
      REJ05 = 0
      IAC05 = 0
      AW01 = 0
      AR01 = 0
      ACC01 = 0
      ACB01 = 0
      JR101 = 0
      IB201 = 0
      JR201 = 0
      IRE01 = 0
      AJJ01 = 0
      REJ01 = 0
      IAC01 = 0
      YSV1 = 0
      YSV2 = 0
1     READ (ID,10,END=200) (Q(I),Q1(I),I=1,N)
      IK=IK+1
      AM = IK
10    FORMAT (2F10.2)
      IT1(IK) = MT1(IK)
      IT2(IK) = MT2(IK)
      DO 30 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
30    CONTINUE
C.... FIND AUTOCORRELATION
      Y = 0
      Y1 = 0
      Y2 = 0
      DO 40 I = 1,N
      YO(I) = P1(I)
      Y = Y + YO(I)
40    CONTINUE
      YBAR = Y/N
```

```
      XX = 0
      X11 = 0
      XY11 = 0
      DO 50 I = 1,N-1
      X = (YO(I) - YBAR)*(YO(I+1) - YBAR)
      XX = XX + X
50    CONTINUE
      YY = 0
      X22 = 0
      XY22 = 0
      DO 60 I = 1,N
      X1 = (YO(I) - YBAR)**2
      YY = YY + X1
60    CONTINUE
      XRHO = XX/YY
C.....FIND PARAMETER ESTIMATE
      XFRE  = XRHO
      B00 = YBAR*(1 - XFRE)
      XPHI = XFRE
C.....FIND FORECASTING FOR AR(1) MODEL
      SSE = 0
      SSE1 = 0
      SSE2 = 0
      KB = 0
      DO 70 I = 1,N
C.....FIND ERROR
      YFOR(I) = B00 + XFRE*YO(I-1)
      ERR(I) = YO(I) - YFOR(I)
      ER(I) = ERR(I)**2
      SSE = SSE + ER(I)
70    CONTINUE
      STD = SQRT(SSE/N)
C.....FIND PARAMETER WAT AND LAMDA FOR DETECTION AND ADJUSTMENT
      DO 80 I = 2,N-1
      WAT(1) = 0
      ELAMA(1) = 0
      WAT(I) = (ERR(I) - (XPHI*ERR(I+1)))/(1+XPHI**2)
      ELAM = SQRT(1+XPHI**2)
      ELLA(I) = WAT(I)*ELAM/STD
      ELAMA(I) = ABS(ELLA(I))
80    CONTINUE
      EP1(IK) = ELAMA(1)
      DO 110 I=1,N
      IF (EP1(IK) .GE. ELAMA(I)) GOTO 110
      II(IK) = I
      EP1(IK) = ELAMA(I)
110   CONTINUE
      EP2(IK) = ELAMA(1)
      DO 120 I=1,N
      IF (II(IK) .EQ. I) GOTO 120
      IF (EP2(IK) .GE. ELAMA(I)) GOTO 120
      JJ(IK) = I
```

```
      EP2(IK) = ELAMA(I)
120   CONTINUE
      EP3(IK) = ELAMA(1)
      DO 130 I=1,N
      IF ((IT(IK) .EQ. I) .OR. (JJ(IK) .EQ. I)) GOTO 130
      IF (EP3(IK) .GE. ELAMA(I)) GOTO 130
      KK(IK) = I

      EP3(IK) = ELAMA(I)
130   CONTINUE

      IF (EP1(IK) .LE. ZP05) THEN
       BW05 = BW05 + 1.0
      ELSE
      END IF

      WAT1(IT1(IK))=(ERR(IT1(IK))-(XPHI*ERR(IT1(IK)+1)))/(1+XPHI**2)
      ELAM1 = SQRT(1+XPHI**2)
      ELLA1(IT1(IK)) = WAT1(IT1(IK))*ELAM1/STD
      ELAMA1(IT1(IK)) = ABS(ELLA1(IT1(IK)))
      IF (ELAMA1(IT1(IK)) .GT. Z05) THEN
       ACC05 = ACC05 + 1.0
       FYY =  P1(IT1(IK)) - P(IT1(IK))
       FX = FX + FYY
       YHAT1(IT1(IK)) = P1(IT1(IK)) - WAT1(IT1(IK))
       YAD01(IT1(IK)) = (YHAT1(IT1(IK)) - P(IT1(IK)))
C     +/YHAT1(IT1(IK))
        YSU1 = YSU1+YAD01(IT1(IK))
      ELSE
      END IF

      WAT2(IT2(IK))=(ERR(IT2(IK))-(XPHI*ERR(IT2(IK)+1)))/(1+XPHI**2)
      ELAM2 = SQRT(1+XPHI**2)
      ELLA2(IT2(IK)) = WAT2(IT2(IK))*ELAM2/STD
      ELAMA2(IT2(IK)) = ABS(ELLA2(IT2(IK)))
      IF (ELAMA2(IT2(IK)) .GT.  Z05) THEN
       ACB05 = ACB05 + 1.0
       FYX =  P1(IT1(IK)) - P(IT1(IK))
       FZ = FZ + FYX

       YHAT2(IT2(IK)) = P1(IT2(IK)) - WAT2(IT2(IK))
       YAD02(IT2(IK)) = (YHAT2(IT2(IK)) - P(IT2(IK)))
C     +/YHAT2(IT2(IK))
        YSU2 = YSU2+YAD02(IT2(IK))

      ELSE
C       REC05 = REC05 + 1.0
      END IF
C      ELSE
C      END IF
C     DETEC K = 2
```

```
      IF ((EP1(IK) .GT. ZO5) .AND. (EP2(IK) .GT. ZO5)
     + .AND. (EP3(IK) .LE. ZO5)) THEN
       AWO5 = AWO5 + 1.0
      ELSE
      END IF
       IF ((II(IK) .EQ. IT1(IK)) .OR. (II(IK)
     + .EQ. IT2(IK)) .AND. (JJ(IK) .EQ. IT1(IK))
     + .OR. (JJ(IK) .EQ. IT2(IK))) THEN
C     POSITION t = T
       AJJO5 = AJJO5 + 1.0
      ELSE
      END IF

      IF (EP1(IK) .LE. ZPO1)  THEN
       BWO1 = BWO1 + 1.0
      ELSE
      END IF

      IF (ELAMA1(IT1(IK)) .GT. ZO1) THEN
       ACCO1 = ACCO1 + 1.0
       HYY =  P1(IT1(IK)) - P(IT1(IK))
       HX = HX + HYY
       XHAT1(IT1(IK)) = P1(IT1(IK)) - WAT1(IT1(IK))
       XADJ1(IT1(IK)) = (XHAT1(IT1(IK)) - P(IT1(IK)))
C     +/XHAT1(IT1(IK))
       XSU1 = XSU1+XADJ1(IT1(IK))
      ELSE
      END IF

      IF (ELAMA2(IT2(IK)) .GT.  ZO1) THEN
       ACBO1 = ACBO1 + 1.0
       HYX =  P1(IT2(IK)) - P(IT2(IK))


      HZ = HZ + HYX
      XHAT2(IT2(IK)) = P1(IT2(IK)) - WAT2(IT2(IK))
      XADJ2(IT2(IK)) = (XHAT2(IT2(IK)) - P(IT2(IK)))
C     +/XHAT2(IT2(IK))
      XSU2 = XSU2+XADJ2(IT2(IK))

      ELSE
C       RECO1 = RECO1 + 1.0
      END IF
C     DETEC K = 2
      IF((EP1(IK) .GT. ZO1) .AND. (EP2(IK) .GT. ZO1)
     + .AND. (EP3(IK) .LE. ZO1)) THEN
      AWO1 = AWO1 + 1.0
      ELSE
      END IF
       IF ((II(IK) .EQ. IT1(IK)) .OR. (II(IK)
     + .EQ. IT2(IK)) .AND. (JJ(IK) .EQ. IT1(IK))
```

```
     + .OR. (JJ(IK) .EQ. IT2(IK))) THEN
C      POSITION t = T
         AJJ01 = AJJ01 + 1.0
       ELSE
       END IF
       DO 170 I=1,N
170    Q1(I) = 0
       PW05 = 1.0 -  BW05/AM
       AHL05 = ((ACC05+ACB05)/2.)/100.
       YT1 = FX/ACC05
       YM1 = YSU1/ACC05
       YT2 = FZ/ACB05
       YM2 = YSU2/ACB05
       PW01 = 1.0 - BW01/AM
       AHL01 = ((ACC01+ACB01)/2.0)/100.
       XT1 = HX/ACC01
       YA1 = XSU1/ACC01
       XT2 = HZ/ACB01
       YA2 = XSU2/ACB01
       GOTO 1
C200    WRITE (*,220) IK,PW05,AHL05,YM1,YM2,PW01,AHL01,YA1,YA2
200    WRITE (*,220) IK,YT1,YM1,YT2,YM2,XT1,YA1,XT2,YA2
C       WRITE (*,220) IK,IT1(IK),IT2(IK),ELAMA1(IT1(IK)),ELAMA2(IT2(IK))
C       FORMAT (I5,8F8.3)
220    FORMAT (I5,8F10.3)
C200     WRITE (*,333) IK,IRE05,JAC05,JRE05,IRE01,JAC01,JRE01
C333    FORMAT (I5,6F8.3)
C       DO 170 I=1,N
C170    Q1(I) = 0
C       GOTO 7
999    CONTINUE
       STOP
       END
```

โปรแกรมที่ 8 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ ตัวแบบ MA(1) วิธีการแบบเอ็ม

```
C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....WITH PROCEDUSE M
      REAL MAP,MAPE,MAPE2
      DIMENSION Q(120),Q1(120),Q2(120),Q3(120),ERR1(120),P(120)
     +,YO1(120),YFOR1(120),ER1(120),ELLA1(120),XER(120),P1(120)
     +,ELDAT1(120),WAT1(120),ELAMA1(120),ELLA2(120),P2(120)
     +,MAP(120),YO2(120),YFOR2(120),XER1(120),MAP2(120)
     +,XAPE1(120),XAPE2(120),YO3(120),YFOR3(120),ERR(120)
     +,ER2(120),ER3(120),WAT2(120),WAT3(120),ELAMA2(120)
     +,ELLA3(120),XER3(120),MAP3(120),ELAMA3(120)
     +,P3(120),ELAMA(120),ERR3(120),ERR2(120),K1(120),K2(120)
     +,K3(120),XAPE3(120),YFOR(120)
      OPEN (1,FILE = 'AP3')
      OPEN (2,FILE = 'AP4')
      OPEN (3,FILE = 'AP5')
      OPEN (4,FILE = 'AP6')
      N = 50
      DO 200 ID = 1,4
      Z05 = 1.96
      Z01 = 2.33
      XYPE1 = 0
      IK = 0
      M = 5
1     READ (ID,10,END = 300) (Q(I),Q1(I),I=1,N)
      IK=IK+1
      AM = IK
10    FORMAT(2F10.2)
      DO 30 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
30    CONTINUE
C.....FIND AUTOCORRELATION
      DO 40 I = 1,N-M
      YO1(I) = P1(I)
40    CONTINUE
3     Y1 = 0
      DO 82 I = 1,N-M
      Y1 = Y1 + YO1(I)
82    CONTINUE
      YBAR1 = Y1/(N-M)
      X11 = 0
      DO 50 I = 1,(N-M)-1
```

```
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      X11 = X11 + X1
50    CONTINUE
      X22 = 0
      DO 60 I = 1,(N-M)
      X2 = (YO1(I) - YBAR1)**2
      X22 = X22 + X2
60    CONTINUE
      XRHO = X11/X22
C.....FIND PARAMETER ESTIMATE
C      IF (XRHO .GT. 0.5) GOTO 8
      XR = 1-(4*XRHO*XRHO)
      FB = SQRT(XR)
      AL = (-1+FB)/(2*XRHO)
      XCETA = AL
      B0 = YBAR1
      XPHI = - XCETA
C.....FIND FORECASTING FOR MA(1) MODEL
      SSE = 0
      ERR(0) = 0
C.....FIND ERROR
      DO 65 I = 1,N-M
      YFOR1(I) = B0 - XCETA*ERR(I-1)
      ERR(I) = YO1(I)- YFOR1(I)
      ER1(I) = ERR(I)**2
      SSE = SSE + ER1(I)
65    CONTINUE
      STD = SQRT(SSE/(N-M))
C.....FIND PARAMETER WAT AND LAMDA FOR DETECTION AND ADJUSTMENT
66    J1 = 0
      DO 70 I = 2,(N-M)-1
      WAT1(1) = 0
      ELAMA1(1) = 0
      WAT1(I) = (ERR(I) - (XPHI*ERR(I+1)))/(1+XPHI**2)
      ELAM1 = SQRT(1+XPHI**2)
      ELLA1(I) = WAT1(I)*ELAM1/STD
      ELAMA1(I) = ABS(ELLA1(I))
      IF(ELAMA1(I) .GT. Z05) THEN
      J1 = J1 + 1
      K1(J1) = I
      YO1(K1(J1)) = YO1(K1(J1)) - WAT1(K1(J1))
      ELSE
      END IF
70    CONTINUE
      EP1 = ELAMA1(1)
      DO 90 I=2,(N-M)-1
      IF (EP1 .GE. ELAMA1(I) ) GOTO 90
      EP1 = ELAMA1(I)
90    CONTINUE
      IF (EP1 .GT. Z05) THEN
      Y1 = 0
      DO 85 I = 1,N-M
```

```
      Y1 = Y1 + YO1(I)
85    CONTINUE
      YBAR1 = Y1/(N-M)
      X11 = 0
      DO 55 I = 1,(N-M)-1
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      X11 = X11 + X1
55    CONTINUE
      X22 = 0
      DO 160 I = 1,(N-M)
      X2 = (YO1(I) - YBAR1)**2
      X22 = X22 + X2
160    CONTINUE
      XRHO = X11/X22
C.....FIND PARAMETER ESTIMATE
C      IF (XRHO .GT. 0.5) GOTO 8
      XR = 1-(4*XRHO*XRHO)
      FB = SQRT(XR)
      AL = (-1+FB)/(2*XRHO)
      XCETA = AL
      B0 = YBAR1
      XPHI = - XCETA
      ELSE
      END IF
500   APE1 = 0
      DO 95 I = 1,N-(N-M)
      YFOR(N-M+I) = B0 - XCETA*ERR((N-M)+(I-1))
C*****FIND ERROR
      XER(I) = YFOR(N-M+I) - P(N-M+I)
C*****FIND SUM
      MAP(I) = ABS(XER(I)/YFOR(N-M+I))
      APE1 = APE1 + MAP(I)
95    CONTINUE
      DO 150 I=1,N
150   Q(I) = 0
      XAPE1(IK) =APE1/(N-(N-M))
      XYPE1 = XYPE1 + XAPE1(IK)
      XMAPE1 = XYPE1/AM
8     GOTO 1
300   WRITE (*,77) IK,XMAPE1
77    FORMAT (I5,F10.2)
200   CONTINUE
      STOP
      END
```

โปรแกรมที่ 9 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ตัวแบบ DARMA(1,1) วิธีการแบบเอ็ม

```
C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....WITH PROCEDUSE M
      DIMENSION P(120),Q(120),Q1(120),Q2(120),ERR1(120),P1(120),P2(120)
      DIMENSION YO1(120),YFOR1(120),ER1(120),ELLA1(120),YO2(120),JM(2)
      DIMENSION ERR2(120),ELDAT1(120),WAT1(120),ELAMA1(120),ELLA2(120)
      DIMENSION WAT2(120),ELDAT2(120),ELAMA2(120),ER2(120),YFOR2(120)
      DIMENSION AX(120),AX2(120),BX(120),BX2(120),CX(120),CX2(120)
      DIMENSION XCETA1(500),XCETA2(500),XFRE1(500),XFRE2(500),XER2(120)
      DIMENSION EMC1(120),EMC2(120),XRR1(120),XER1(120),XRR2(120)
      OPEN (4,FILE = 'ARMA.OUT')
      N = 50
      IK = 0
1     READ (4,10,END = 200) (Q(I),Q1(I),Q2(I),I=1,N)
      IK=IK+1
10    FORMAT (3F10.4)
      DO 30 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
      P2(I) = Q2(I)
30    CONTINUE
C.....FIND AUTOCORRELATION
      Y1 = 0
      Y2 = 0
      DO 40 I = 1,N
      YO1(I) = P1(I)
      YO2(I) = P2(I)
      Y1 = Y1 + YO1(I)
      Y2 = Y2 + YO2(I)
40    CONTINUE
      YBAR1 = Y1/N
      YBAR2 = Y2/N
      X11 = 0
      AX11 = 0
      XY11 = 0
      BXY11 = 0
      DO 50 I = 1,N-1
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      AX1 = (YO1(I) - YBAR1)*(YO1(I+2) - YBAR1)
      XY1 = (YO2(I) - YBAR2)*(YO2(I+1) - YBAR2)
      BXY1 = (YO2(I) - YBAR2)*(YO2(I+2) - YBAR2)
      X11 = X11 + X1
      AX11 = AX11 + AX1
```

```
      XY11 = XY11 + XY1
      BXY11 = BXY11 + BXY1
50    CONTINUE
      X22 = 0
      XY22 = 0
      DO 60 I = 1,N
      X2 = (YO1(I) - YBAR1)**2
      XY2 = (YO2(I) - YBAR2)**2
      X22 = X22 + X2
      XY22 = XY22 + XY2
60    CONTINUE
      XRHO1 = X11/X22
      AXRHO2 = AX11/X22
      XRHO2 = XY11/XY22
      BXRHO2 = BXY11/XY22
C.....FIND PARAMETER ESTIMATE XFRE
      XFRE1 = AXRHO2/XRHO1
      XFRE2 = BXRHO2/XRHO2
C.....FIND PARAMETER ESTIMATE XCETA1
      DO 61 J = 1,2
      A1 = XRHO1 - XFRE1
      A2 = 1 + (XFRE1*XFRE1) - (2*RHO1*XFRE1)
      A3 = A1
      A4 = SQRT((A2**2)-(4*A1*A3))
      XCETA1(1) = (-A2+A4)/(2*A1)
      XCETA1(2)= (-A2-A4)/(2*A1)
      B1 = XCETA1(J)
      B01 = YBAR1*(1-XFRE1)
C.....FIND MINIMUM SUMSQUARE ERROR
      SSE1 = 0
      SE1 = 0
      ERR1(0) = 0
      XRR1(0) = 0
      XER1(0) = 0
      DO 70 I = 1,N
      YFOR1(I) = B01+XFRE1*YO1(I-1)-XCETA1(J)*ERR1(I-1)
      ERR1(I) = YO1(I) - YFOR1(I)
      ER1(I) = ERR1(I)**2
      SSE1 = SSE1 + ER1(I)
70    CONTINUE
      EMC1(J) = SSE1
61    CONTINUE
C.....FIND PARAMETER ESTIMATE XCETA2
      DO 62 J=1,2
      D1 = XRHO2 - XFRE2
      D2 = 1 + (XFRE2*XFRE2) - (XRHO2*XFRE2)
      D3 = D1
      D4 = SQRT((D2*D2)-(4*D1*D3))
      XCETA2(1) = (-D2+D4)/(2*D1)
      XCETA2(2)= (-D2-D42)/(2*D1)
      B2 = XCETA2(J)
      B02 = YBAR2*(1-XFRE2)
```

```
C.....FIND MINIMUM SUMSQUARE ERROR
      SSE2 = 0
      SE2 = 0
      ERR2(0) = 0
      XRR2(0) = 0
      XER2(0) = 0
      DO 71 I = 1,N
      YFOR2(I) = B02+XFRE2(J)*YO1(I-1)-XCETA2(J)*ERR2(I-1)
      ERR2(I) = YO2(I) - YFOR2(I)
      ER2(I) = ERR2(I)**2
      SSE2 = SSE2 + ER2(I)
71    CONTINUE
      EMC2(J) = SSE2
62    CONTINUE
      EMP1 = EMC1(1)
      DO 81 I=1,2
      IF (EMP1 .LE. EMC1(I) ) GOTO 81
      EMP1 = EMC1(I)
      LM = I
81    CONTINUE
      EMP2 = EMC2(1)
      DO 82 J=1,2
      IF (EMP2 .LE. EMC2(J) ) GOTO 82
      EMP2 = EMC2(J)
      LN = J
82    CONTINUE
      FRE1 = XFRE1
      CETA1 = XCETA1(LM)
      FRE2 = XFRE2
      CETA2 = XCETA2(LN)
      XPH11 = FRE1-CETA1
      XPH12 = FRE2-CETA2
C.....FIND ERROR FOR FORCASTING ARMA(1,1) MODEL
      DO 1150 I = 1,N
      YFOR1(I) = B01+FRE1*YO1(I-1)-CETA1*XRR1(I-1)
      XRR1(I) = YO1(I) - YFOR1(I)
      XER1(I) = XRR1(I)**2
      SE1 = SE1 + XER1(I)
      YFOR2(I) = B02+FRE2*YO1(I-1)-CETA2*XRR2(I-1)
      XRR2(I) = YO2(I) - YFOR2(I)
      XER2(I) = XRR2(I)**2
      SE2 = SE2 + XER2(I)
1150  CONTINUE
      KB = 0
      XSE1 = 0
      XSE2 = 0
      STX1 = SQRT(SE1/N)
      STX2 = SQRT(SE2/N)
C.....FIND PARAMETER WAT AND LAMDA FOR DETECTION AND ADJUSTMENT
66    DO 80 I = 1,N-1
      WAT1(1) = 0
      ELAMA1(1) = 0
```

```
      WAT1(I) = (XRR1(I) - (XPHI1*XRR1(I+1)))/(1+XPHI1**2)
      ELAM1 = SQRT(1+XPHI1**2)
      ELLA1(I) = WAT1(I)*ELAM1/STX1
      ELAMA1(I) = ABS(ELLA1(I))
      IF(ELAMA1(I) .GT. 1.65) THEN
      IM = I
      RR1 = XRR1(I)-(WAT1(I)*XPHI1)
      XER1(I) = RR1**2
      ELSE
      END IF
60    CONTINUE
      DO 85 I=1,N
      XSE1 = XSE1 + XER1(I)
85    CONTINUE
      KB = KB + 1
      ST1 = SQRT(XSE1/N)
      STX1 = ST1
      EP1 = ELAMA1(1)
      DO 86 I=1,N
      IF (EP1 .GE. ELAMA1(I) ) GOTO 86
      EP1 = ELAMA1(I)
86    CONTINUE
      IF ( EP1 .GT. 1.65) GOTO 66
      SUM1 = 0
      SUM2 = 0
      SUM3 = 0
      P1(IM) = YO1(IM) - WAT1(IM)
      AX(IK) = 100*((YO1(IM) - P(IM))/P(IM))
      EX(IK) = 100*((YO1(IM) - P1(IM))/P1(IM))
      CX(IK) = 100*((P1(Im) - P(Im))/P(IM))
      AB = 0
      KK = 0
67    DO 83 I = 2,N-1
      WAT2(1) = 0
      ELAMA2(1) = 0
      WAT2(I) = (XRR2(I) - (XPHI2*XRR2(I+1)))/(1+XPHI2**2)
      ELAM2 = SQRT(1+XPHI2**2)
      ELLA2(I) = WAT2(I)*ELAM2/STX2
      ELAMA2(I) = ABS(ELLA2(I))
      IF (ELAMA2(I) .GT. 1.65) THEN
      AB = AB + 1
      IF (AB .EQ. 1) THEN
      JM(1) = I
      ELSE
      JM(2) = I
      END IF
      XR2 = XRR2(I)-(WAT2(I)*XPHI2)
      XER2(I) = XR2**2
      ELSE
      END IF
83    CONTINUE
```

```
      DO 84 I=1,N
      XSE2 = XSE2 + XER2(I)
84    CONTINUE
      KK = KK + 1
      SX2 = SQRT(XSE2/N)
      STX2 = SX2
      EP2 = ELAMA2(1)
      DO 89 I=1,N
      IF (EP2 .GE. ELAMA2(I) ) GOTO 89
      EP2 = ELAMA2(I)
89    CONTINUE
      IF ( EP2 .GT. 1.65) GOTO 67
      SUM12 = 0
      SUM22 = 0
      SUM32 = 0
      DO 87 I=1,2
      P2(JM(I)) = YO2(JM(I)) - WAT2(JM(I))
87    CONTINUE
      RB1 = 100*(YO2(JM(1)) - P(JM(1)))/P(JM(1))
      RB2 = 100*(YO2(JM(2)) - P(JM(2)))/P(JM(2))
      AX2(IK) = (RB1 + RB2)/2
      RB12 = 100*(YO2(JM(1)) - P2(JM(1)))/P2(JM(1))
      RB22 = 100*(YO2(JM(2)) - P2(JM(2)))/P2(JM(2))
      BX2(IK) = (RB12 + RB22)/2
      RB13 = 100*(P2(JM(1)) - P(JM(1)))/P(JM(1))
      RB23 = 100*(P2(JM(2)) - P(JM(2)))/P(JM(2))
      CX2(IK) = (RB13 + RB23)/2
C     DO 100 I = 1,N
C      WRITE (7,110) I,Q(I),P(I)
C      WRITE (8,120) I,Q(I),Q1(I),P1(I),WAT1(I)
C      WRITE (9,130) I,Q(I),Q2(I),P2(I)
110   FORMAT (I3,2F10.4)
120   FORMAT (I3,4F10.4)
130   FORMAT (I3,3F10.4)
100   CONTINUE
      DO 1000 I = 1,IK
      SUM1 = SUM1 + AX(I)
      SUM2 = SUM2 + BX(I)
      SUM3 = SUM3 + CX(I)
1000  CONTINUE
      A = SUM1/IK
      B = SUM2/IK
      C = SUM3/IK
      DO 1100 I = 1,IK
      SUM12 = SUM12 + AX2(I)
      SUM22 = SUM22 + BX2(I)
      SUM32 = SUM32 + CX2(I)
1100  CONTINUE
      A2 = SUM12/IK
      B2 = SUM22/IK
      C2 = SUM32/IK
      WRITE (*,77) IK,A,B,C,A2,B2,C2
77    FORMAT (I3,6F10.4)
      DO 150 I=1,N
150   Q(I) = 0
      GOTO 1
200   STOP
```

โปรแกรมที่ 10 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ ตัวแบบ AP(1) วิธีการแบบเอ็ม

```
C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....WITH PROCEDUSE M
      REAL MAP,MAPE,MAPE2
      DIMENSION Q(120),Q1(120),Q2(120),Q3(120),KM(50),ERR1(120),P(120)
      DIMENSION YO1(120),YFOR1(120),ER1(120),ELLA1(120),XER(120),P1(120)
      DIMENSION ELDAT1(120),WAT1(120),ELAMA1(120),ELLA2(120),P2(120)
      DIMENSION MAP(120),YO2(120),YFOR2(120),XER2(120),MAP2(120)
      DIMENSION XAPE1(120),XAPE2(120),YO3(120),YFOR(120)
      DIMENSION ER2(120),ER3(120),WAT2(120),WAT3(120),ELAMA2(120)
      DIMENSION ELLA3(120),XER3(120),MAP3(120),ELAMA3(120)
      DIMENSION P3(120),ELAMA(120),ERR3(120),ERR2(120),K1(120),K2(120)
      DIMENSION K3(120),XAPE3(120)
      OPEN (1,FILE = 'AP3')
      OPEN (2,FILE = 'AP4')
      OPEN (3,FILE = 'AP5')
      OPEN (4,FILE = 'AP6')
      N = 120
      DO 200 ID = 1,4
      Z05 = 1.96
      Z01 = 2.33
      XYPE1 = 0
      IK = 0
      M = 5
1     READ (ID,10,END = 300) (Q(I),Q1(I),I=1,N)
      IK=IK+1
      AM = IK
10    FORMAT(2F10.2)
      DO 30 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
30    CONTINUE
C.....FIND AUTOCORRELATION
      DO 40 I = 1,(N-M)
      YO1(I) = P1(I)
40    CONTINUE
3     Y1 = 0
      DO 82 I = 1,N-M
      Y1 = Y1 + YO1(I)
82    CONTINUE
      YBAR1 = Y1/(N-M)
      X11 = 0
      DO 50 I = 1,((N-M)-1)
```

```
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      X11 = X11 + X1
50    CONTINUE
      X22 = 0
      DO 60 I = 1,(N-M)
      X2 = (YO1(I) - YBAR1)**2
      X22 = X22 + X2
60    CONTINUE
      XRHO1 = X11/X22
C.....FIND PARAMETER ESTIMATE
      XFRE1 = XRHO1
      B01 = YBAR1*(1 - XFRE1)
      XPHI1 = XFRE1
C.....FIND FORECASTING FOR AR(1) MODEL
      SSE1 = 0
      DO 70 I = 1,(N-M)
C.....FIND ERROR
      YFOR1(I) = B01 + XFRE1*YO1(I-1)
      ERR1(I) = YO1(I) - YFOR1(I)
      ER1(I) = ERR1(I)**2
      SSE1 = SSE1 + ER1(I)
70    CONTINUE
      KB = 0
      SE1 = 0
      STD1 = SQRT(SSE1/(N-M))
C.....FIND PARAMETER WAT AND LAMDA FOR DETECTION AND ADJUSTMENT
66    J1 = 0
      SU1 = 0
      DO 80 I = 2,(N-M)-1
      WAT1(1) = 0
      ELAMA1(1) = 0
      WAT1(I) = (ERR1(I) - (XPHI1*ERR1(I+1)))/(1+XPHI1**2)
      ELAM1 = SQRT(1+XPHI1**2)
      ELLA1(I) = WAT1(I)*ELAM1/STD1
     ELAMA1(I) = ABS(ELLA1(I))
     IF(ELAMA1(I) .GT. Z05) THEN
     J1 = J1 + 1
     K1(J1) = I
     YO1(K1(J1)) = YO1(K1(J1)) - WAT1(K1(J1))
     ELSE
     END IF
80    CONTINUE
      EP1 = ELAMA1(1)
      DO 88 I=1,(N-M)-1
      IF (EP1 .GT. ELAMA1(I) ) GOTO 88
      EP1 = ELAMA1(I)
88    CONTINUE
      IF (EP1 .GT. Z05) GOTO 3
C*****FIND FORECASETING MODEL
500   APE1 = 0
      DO 90 I = 1,N-(N-M)
     YFOR(N-M+I) = B01 + XFRE1*P1((N-M)+(I-1))
C*****FIND ERROR
      XER(I) = YFOR(N-M+I) - P(N-M+I)
```

```
C*****FIND SUM
      MAP(I) = ABS(XER(I)/YFOR(N-M+I))
      APE1 = APE1 + MAP(I)
90    CONTINUE
      DO 150 I=1,N
150   Q(I) = 0
      XAPE1(IK) =APE1/(N-(N-M))
      XYPE1 = XYPE1 + XAPE1(IK)
      XMAPE1 = XYPE1/AM
      GOTO 1
300   WRITE (*,77) IK,XMAPE1
77    FORMAT (I5,F10.2)
200   CONTINUE
      STOP
      END
```

โปรแกรมที่ 11 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ตัวแบบ MP(1) วิธีการแบบเอ็ม

```
C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....PROCEDUES V
      DIMENSION P(120),Q(120),Q1(120),ERR1(120),P1(120)
     +,YO1(120),YFOR1(120),ER1(120),ELLA1(120),YFOR(120)
     +,ELDAT1(120),WAT1(120),ELAMA1(120),S1(120),S2(120)
     +,F01(40,40),F05(40,40),K1(120),XD1(120),XD2(120)
     +,XR1(120),XR2(120),XRD(120),XRD1(120),XRD12(120)
     +,XX22(120),XX12(120),MAP(120),XAPE1(120),XXD(120)
     +,XX2(120),XX1(120),XER(120),LM(120),LN(120)
      REAL*8 XFRE1,XXD,MAP
C     KM=COLUM
C     KN=ROW
      KM=18
      KN=33
      OPEN (1,FILE = 'AP3')
      OPEN (2,FILE = 'AP4')
      OPEN (3,FILE = 'AP5')
      OPEN (4,FILE = 'AP6')
C      OPEN (6,FILE = 'F01')
C      OPEN (7,FILE = 'F05')
C      READ (6,40) ((F01(I,J),J=1,KM),I=1,KN)
C      READ (7,50) ((F05(I,J),J=1,KM),I=1,KN)
40    FORMAT(18F4.2)
50    FORMAT(18F4.2)
      N = 120
      Z05 = 1.96
      Z01 = 2.33
      M = 5
      DO 1500 ID = 1,4
      XYPE1 = 0
      IK = 0
1     READ (ID,10,END=1000) (Q(I),Q1(I),I=1,N)
      IK=IK+1
      AM = IK
10    FORMAT (2F10.2)
      DO 70 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
70    CONTINUE
C.....FIND AUTOCORRELATION
3      Y1 = 0
      DO 80 I = 1,N-M
```

```
      YO1(I) = P1(I)
      Y1 = Y1 + YO1(I)
60    CONTINUE
      YBAR1 = Y1/(N-M)
      X11 = 0
      DO 90 I = 1,(N-M-1)
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      X11 = X11 + X1
90    CONTINUE
      X22 = 0
      DO 100 I = 1,N-M
      X2 = (YO1(I) - YBAR1)**2
      X22 = X22 + X2
100   CONTINUE
      XRHO1 = X11/X22
C.....FIND PARAMETER ESTIMATE
      XFRE1 = XRHO1
      XPHY1 = XFRE1
      BO1 = YBAR1*(1 - XFRE1)
C.....FIND FORECASTING FOR AR(1) MODEL
      SSE1 = 0
C.....FIND ERROR
      DO 120 I = 1,N-M
      YFOR1(I) = BO1 + XFRE1*YO1(I-1)
      ERR1(I) = YO1(I) - YFOR1(I)
      ER1(I) = ERR1(I)**2
      SSE1 = SSE1 + ER1(I)
120   CONTINUE
      STD1 = SQRT(SSE1/(N-M))
C.....FIND PARAMETER
      SUM1 = 0.
      SUM2 = 0.
      SUM3 = 0.
66    J = 0.

      AA = 0.
      AB = 0.
      DO 130 I = 2,(N-M-1)
      WAT1(1) = 0
      ELAMA1(1) = 0
      WAT1(I) = (ERR1(I) - (XPHI1*ERR1(I+1)))/(1+XPHI1**2)
      ELAM1 = SQRT(1+XPHI1**2)
      ELLA1(I) = WAT1(I)*ELAM1/STD1
      ELAMA1(I) = ABS(ELLA1(I))
      IF(ELAMA1(I) .GT. ZO1) THEN
      DO 140 L = I,N-M
      AA = AA + ER1(L)
140   CONTINUE
      XD1(I) = AA
      XR1(I) = (I-1)*XD1(I)
      DO 150 K = 1,I-1
      AB = AB + ER1(K)
150   CONTINUE
```

```
      XD2(I) = AB
      XR2(I) = (N-M-I+1)*XD2(I)
      S2(I) = XD2(I)*(N-M-I+1)
      S1(I) = XD1(I)*(I-1)
      XXD(I) = S1(I)/S2(I)
      YO1(I) = YBAR1 + (YO1(I)-YBAR1)/SQRT(XXD(I))
      ELSE
      END IF
130   CONTINUE
      EP1 = ELAMA1(1)
      DO 160 I = 1,N-M-1
      IF (EP1 .GE. ELAMA1(I)) GOTO 160
      EP1 = ELAMA1(I)
160   CONTINUE
       DO 135 I = 1,J
       DO 140 L = K1(I),(N-M)
       AA = AA + ER1(L)
 140   CONTINUE
       XD1(I) = AA
       XR1(K1(I)) = (K1(I)-1)*XD1(I)
 135   CONTINUE
       DO 145 I = 1,J
       DO 150 K = 1,K1(I)-1
       AB = AB + ER1(K)
 150   CONTINUE
       XD2(I) = AB
       XR2(K1(I)) = ((N-M)-K1(I)+1)*XD2(I)
 145   CONTINUE
       DO 155 I = 1,J
       XRD(K1(I)) = XR1(K1(I))/XR2(K1(I))
       S2(I) = XD2(I)*((N-M)-K1(I)+1)
       S1(I) = XD1(I)*(K1(I)-1)
       XXD(I) = S1(I)/S2(I)
       LM(I) = K1(I)-1
       LN(I) = (N-M)-K1(I)+1
       IF ((LM(I) .GT. 10) .AND. (LM(I) .LE. 12)) THEN
        MM = 11
        ELSE
         IF ((LM(I) .GT. 12) .AND. (LM(I) .LE. 15)) THEN
          MM = 12
          ELSE
           IF ((LM(I) .GT. 15) .AND. (LM(I) .LE. 20)) THEN
            MM = 13
            ELSE
             IF ((LM(I) .GT. 20) .AND. (LM(I) .LE. 24)) THEN
             MM = 14
              ELSE
               IF ((LM(I) .GT. 24) .AND. (LM(I) .LE. 30)) THEN
                MM = 15
                ELSE
                 IF ((LM(I) .GT. 30) .AND. (LM(I) .LE. 40)) THEN
                  MM = 16
                  ELSE
                   IF ((LM(I) .GT. 40) .AND. (LM(I) .LE. 60)) THEN
                    MM = 17
                    ELSE
                     IF ((LM(I) .GT. 60) .AND. (LM(I) .LE. 120)) THEN
                      MM = 18
```

```
                    ELSE
                   ENDIF
                  ENDIF
                 ENDIF
                ENDIF
               ENDIF
              ENDIF
             ENDIF
            ENDIF
           ENDIF
          IF ((LN(I) .GT. 30) .AND. (LN(I) .LE. 40)) THEN
           NN = 31
           ELSE
            IF ((LN(I) .GT. 40) .AND. (LN(I) .LE. 60)) THEN
             NN = 32
             ELSE
              IF ((LN(I) .GT. 60) .AND. (LN(I) .LE. 120)) THEN
               NN = 33
               ELSE
              ENDIF
            ENDIF
          ENDIF
          IF (XXD(I) .GT. F05(NN,MM)) THEN
          P1(K1(I)) = YBAR1 + (YO1(K1(I))-YBAR1)/SQRT(XXD(I))
          ELSE
          END IF
 155      CONTINUE
          GOTO 3
         IF (EP1 .GT. Z01) THEN
         Y1 = 0
         DO 600 I = 1,N-M
         Y1 = Y1 + YO1(I)
600       CONTINUE
         YBAR1 = Y1/(N-M)
         X11 = 0
         DO 900 I = 1,(N-M-1)
         X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
         X11 = X11 + X1
900       CONTINUE
         X22 = 0
         DO 1050 I = 1,N-M
         X2 = (YO1(I) - YBAR1)**2
         X22 = X22 + X2
1050      CONTINUE
         XRHO1 = X11/X22
C.....FIND PARAMETER ESTIMATE
         XFRE1 = XRHO1
         B01 = YBAR1*(1 - XFRE1)
         ELSE
         END IF
500      APE1 = 0.
         DO 170 I = 1,N-(N-M)
         YFOR(N-M+I) = B01 + XFRE1*P1((N-M)+(I-1))
```

```
C*****FIND ERROR
      XER(I) = YFOR(N-M+I) - P(N-M+I)
      MAP(I) = ABS(XER(I)/YFOR(N-M+I))
      APE1 = APE1 + MAP(I)
170   CONTINUE
      DO 230 I=1,N
230   Q(I) = 0
      XAPE1(IK) = 100*APE1/(N-(N-M))
      XYPE1 = XYPE1 + XAPE1(IK)
      XMAPE1 = XYPE1/AM
      GOTO 1
1000  WRITE (*,77) IK,XMAPE1
77    FORMAT (I5,F10.2)
C      GOTO 1
1500  CONTINUE
      STOP
      END
```

โปรแกรมที่ 12 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ตัวแบบ ARMAP(1,1) วิธีการแบบเอ็ม

```
      C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....FOR ARMA(1,1) MODEL WITH PROCEDUSE M
      REAL*8 MAP,MAPE,MAPE2
      DIMENSION Q(120),Q1(120),KM(50),ERR1(120),P(120)
      DIMENSION YO1(120),ER1(120),ELLA1(120),XER(120),P1(120)
      DIMENSION ELDAT1(120),WAT1(120),ELAMA1(120),K1(120),ELAMDA(120)
      DIMENSION MAP(120),MAP2(120),WAT(120),XER1(120)
      DIMENSION XAPE1(120),XCETA1(120),XFRE1(120),ERR(120),YFOR(120)
      DIMENSION EMC(120),XERR(120),YFOR1(120)
      DIMENSION XERR1(120)
      OPEN (5,FILE = 'ARMAP.OUT')
      N = 120
      IK = 0
      M = 5
1     READ (5,10,END = 300) (Q(I),Q1(I),I=1,N)
      IK=IK+1
10    FORMAT (2F10.4)
      DO 30 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
30    CONTINUE
C.....FIND AUTOCORRELATION
3     Y1 = 0
      DO 40 I = 1,(N-M)
      YO1(I) = P1(I)
      Y1 = Y1 + YO1(I)
40    CONTINUE
      YBAR1 = Y1/(N-M)
      X11 = 0
      AX11 = 0
      DO 50 I = 1,((N-M)-1)
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      AX1 = (YO1(I) - YBAR1)*(YO1(I+2) - YBAR1)
      X11 = X11 + X1
      AX11 = AX11 + AX1
50    CONTINUE
      X22 = 0
      DO 60 I = 1,(N-M)
      X2 = (YO1(I) - YBAR1)**2
      X22 = X22 + X2
60    CONTINUE
```

```
      R1 = X11/X22
      R2 = AX11/X22
C.....FIND PARAMETER ESTIMATE XCETA
      XRHO1 = R1
      XRHO2 = R2
      XRFE1 = XRHO2/XRHO1
      DO 60 J = 1,2
      A1 = XRHO1 - XFRE1
      A2 = 1 + (XFRE*XFRE1) - (2*XRHO1*XFRE1)
      A3 = A1
      IF ((A2*A2)-(4*A1*A3) .LT. 0) GOTO 7
      A4 = SQRT((A2*A2)-(4*A1*A3))
      XCETA1(1) = (-A2 + A4)/(2*A1)
      XCETA1(2) = (-A2 - A4)/(2*A1)
      B1 = XCETA1(J)
      B0 = YBAR*(1-B1)
C.....FIND FORECASTING FOR ARMA(1,1) MODEL
      SSE = 0.
      ERR(0) = 0
      DO 90 I=1,(N-M)
C.....FIND ERROR
      YFOR(I) = B0+XFRE1*YO1(I-1)-XCETA1(J)*ERR(I-1)
      ERR(I) = YO1(I) - YFOR(I)
      ER1(I) = ERR(I)**2
      SSE = SSE + ER1(I)
90    CONTINUE
      EMC (J) = SSE/(N-M)
60    CONTINUE
      EM = EMC(1)
      DO 100 I=1,2
      IF (EM .LE. EMC(I)) GOTO 100
      EM = EMC(I)
      NJ = I
100    CONTINUE
      B11 = XFRE1
      B22 = XCETA1(NJ)
      IZ = IZ + 1
      IF (IZ .EQ. 3) GOTO 8
      B00 = YBAR*(1-B11)
      XPHI = B11-B22
C.....FIND PARAMETER WAT AND LAMDA FOR DETECTION AND ADJUSTMENT
      DO 110 I = 1,(N-M)
C.....FIND ERROR FOR MINIMUM SUMSQUARE
      YFOR1(I) = B00 + B11*YO1(I-1) - B22*XERR(I-1)
      XERR(I) = YO1(I) - YFOR1(I)
      XER1(I) = XERR(I)**2
      XSSE = XSSE + XER1(I)
110    CONTINUE
      STD = SQRT(XSSE/(N-M))
      XAMP = 0
      WAT1(1) = 0.
      ELAMDA(1) = 0.
```

```
66    J1 = 0
      DO 120 I = 2,(N-M)-1
      WAT1(1) = 0
      ELAMA1(1) = 0
      WAT1(I) = (XERR(I) - (XPHI*XERR(I+1)))/(1+XPHI**2)
      ELAM1 = SQRT(1+XPHI**2)
      ELLA1(I) = WAT1(I)*ELAM1/STD
      ELAMA1(I) = ABS(ELLA1(I))
      IF(ELAMA1(I) .GT. 1.65) THEN
      J1 = J1 + 1
      K1(J1) = I
      R1 = ERR1(K1(J1)) - (WAT1(K1(J1))*XPHI)
      ER1(K1(J1)) = R1**2
      ELSE
      END IF
120   CONTINUE
      DO 130 I=1,(N-M)
      SE1 = SE1 + ER1(I)
130   CONTINUE
      APE1 = 0
      MAPE1 = 0
      STX1 = SQRT(SE1/(N-M))
      STD = STX1
      EP1 = ELAMA1(1)
      DO 140 I=2,(N-M)-1
      IF (EP1 .GE. ELAMA1(I) ) GOTO 140
      EP1 = ELAMA1(I)
140   CONTINUE
      IF (EP1 .GE. 1.65) GOTO 66
      DO 150 I = 1,J1
      P1(K1(I)) = YO1(K1(I)) - WAT1(K1(I))
150   CONTINUE
      IF (EP1 .GT. 1.65) GOTO 3
C*****FIND FORECASETING MODEL
8     DO 160 I = 1,N-(N-M)
      YFOR1(N-M+I) = B00 + B11*YO1((N-M)+(I-1)) - B22*XERR((N-M)-(I-1))
C*****FIND ERROR
      XER(I) = P(N-M+I) - YFOR1(N-M+I)
C*****FIND SUM
      MAP(I) = ABS(XER(I)/P(N-M+I))*100
      APE1 = APE1 + MAP(I)
160   CONTINUE
      XAPE1(IK) = APE1/(N-(N-M))
      DO 170 I=1,IK
      XYPE1 = MAPE1 + XAPE1(I)
170   CONTINUE
      XMAPE1 = XYPE1/IK
      WRITE (*,77) IK.XMAPE1
77    FORMAT (I4,F10.2)
199   CONTINUE
      DO 180 I=1,N
180   Q(I) = 0
7     GOTO 1
300   STOP
      END
```

โปรแกรมที่ 13 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ ตัวแบบ VAR(1) วิธีการแบบวี

```
C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....PROCEDUES V
      DIMENSION P(120),Q(120),Q1(120),Q2(120),ERR1(120),P1(120),P2(120)
     +,YO1(120),YFOR1(120),ER1(120),ELLA1(120),YO2(120),JM(2),YR2(120)
     +,ERR2(120),ELDAT1(120),WAT1(120),ELAMA1(120),ELLA2(120),YD(120)
     +,WAT2(120),ELDAT2(120),ELAMA2(120),ER2(120),YFOR2(120),YR1(120)
     +,AX(120),AX2(120),BX(120),BX2(120),CX(120),CX2(120),IP(120)
     +,F01(40,40),F05(40,40),YFOR(120),ERR(120),ER(120),IT1(120)
     +,XR1(120),XR2(120),XRD(120),XRD1(120),XRD12(120),YHAT1(120)
     +,XX22(120),XX12(120),WAT(120),ELAMA(120),ELLA(120),YADJ1(120)
     +,XX2(120),XX1(120),XR(120),RR1(120),RR2(120),RD(120),EX(120)
     +,JM1(120),JM2(120),XHAT1(120),XADJ1(120),MT1(120),IQ3(120)
     +,MO(120),IP2(120),EX2(120),YYR1(120),YYR2(120),YYD(120)
     +,MO2(120),YHAT2(120),YXR1(120),YXR2(120),YXD(120),RF1(120)
     +,RF2(120),RD2(120),YADJ2(120),XHAT2(120),XADJ2(120),IT2(120)
     +,MT2(120),IQ4(120),EX3(120),IP3(120)
      REAL*8 J05,J01,JJ05,JJ01,JR05,JR01,BE05,BE01
C     KM=COLUM
C     KN=ROW
      KM=16
      KN=33
      OPEN (1,FILE = '2A3.PRN')
      OPEN (2,FILE = '2A4.PRN')
      OPEN (3,FILE = '2A5.PRN')
      OPEN (4,FILE = '2A6.PRN')
      OPEN (6,FILE = 'F01')
      OPEN (7,FILE = 'F05')
      OPEN (9,FILE = 'V21.PRN')
      OPEN (10,FILE = '2V121.PRN')
      N = 120
      IK = 0
      READ (6,40) ((F01(I,J),J=1,KM),I=1,KN)
      READ (7,50) ((F05(I,J),J=1,KM),I=1,KN)
40    FORMAT(16F4.2)
50    FORMAT(16F4.2)
      READ (9,15,END=300) (IQ3(I),IQ4(I),I=1,100)
15    FORMAT (2I5)
      DO 2 I=1,100
      MT1(I) = IQ3(I)
      MT2(I) = IQ4(I)
2     CONTINUE
300   CLOSE (9)
```

```
      DO 999 ID = 1,4
      IK = 0.
      AM = 0.
      ALP05 = 0.
      ALPHO1 = 0.
      ASUM = 0.
      BSUM = 0.
      CSUM = 0.
      DSUM = 0.
      XSX = 0.
      BCC01 =0.
      BCC05 = 0.
      YD1 = 0.
      YD2 = 0.
      ACC05 = 0.
      REC05 = 0.
      AC05 = 0.
      AW05 = 0.
      YYD1 = 0.
      YYD2 = 0.
      BW05 = 0.
      YXD2 = 0.
      YXD1 = 0.
      DA1 = 0.
      DA2 = 0.
      YSU = 0.
      ACC01 = 0.
      REC01 = 0.
      DD1 = 0.
      DD2 = 0.
      AC01 = 0.
      AW01 = 0.
      BW01 = 0.

      J01 = 0.
      JJ01 = 0.
      XSU = 0.
      QW = 0.
      YSX = 0.
1     READ (ID,10,END=200) (Q(I),Q1(I),I=1,N)
      IK=IK+1
      AM = IK
10    FORMAT (2F10.2)
      IT1(IK) = MT1(IK)
      IT2(IK) = MT2(IK)
      DO 30 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
30    CONTINUE

C.....FIND AUTOCORRELATION
```

```
      Y1 = 0
      Y2 = 0
      DO 80 I = 1,N
      YO1(I) = P1(I)
      Y1 = Y1 + YO1(I)
 80   CONTINUE
      YBAR1 = Y1/N
      X = 0
      X11 = 0
      XY11 = 0
      DO 90 I = 1,N-1
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      X11 = X11 + X1
 90   CONTINUE
      X22 = 0
      DO 100 I = 1,N
      X2 = (YO1(I) - YBAR1)**2
      X22 = X22 + X2
100   CONTINUE
      RHO1 = X11/X22
C.....FIND PARAMETER ESTIMATE
      XFRE = RHO1
      BO0 = YBAR*(1 - XFRE)
C.....FIND FORECASTING FOR AR(1) MODEL
      SSE = 0.
C.....FIND ERROR

      DO 120 I = 1,N
      YFOR1(I) = BO1 + XFRE*YO1(I-1)
      ERR(I) = YO1(I) - YFOR1(I)
      ER(I) = ERR(I)**2
      SSE1 = SSE1 + ER(I)
120   CONTINUE
      STD1 = SQRT(SSE1/N)
      EX(IK) = ER(1)
      DO 125 I=1,N
      IF (EX(IK) .GE. ER(I)) GOTO 125
      IP(IK) = I
      EX(IK) = ER(I)
125   CONTINUE
      EX2(IK) = ER(1)
      DO 126 I=1,N
      IF (IP(IK) .EQ. I) GOTO 126
      IF (EX2(IK) .GE. ER(I)) GOTO 126
      IP2(IK) = I
      EX2(IK) = ER(I)
126   CONTINUE

      EX3(IK) = ER(1)
      DO 135 I=1,N
      IF ((IP(IK) .EQ. I) .OR. (IP2(IK) .EQ. I)) GOTO 135
      IF (EX3(IK) .GE. ER(I)) GOTO 135
```

```
      IP3(IK) = I
      EX3(IK) = ER(I)
135   CONTINUE

      DO 142 L = IP(IK),N
      YD1 = YD1 + ER(L)

142   CONTINUE
      YR1(IP(IK)) = (IP(IK)-1)*YD1
      DO 152 K = 1,IP(IK)-1
      YD2 = YD2 + ER(K)
152   CONTINUE
      YR2(IP(IK)) = (N-IP(IK)+1)*YD2
      YD(IP(IK)) = YR1(IP(IK))/YR2(IP(IK))
      SY = YD2*(N-IP(IK)+1)
      SV = YD1*(IP(IK)-1)
      XYD = SV/SY
      IMM = IP(IK)-1
      INN = N-IP(IK)+1
      CALL FSTAT (IMM,INN,IJJ,JJO)
      MM=IJJ
      NN=JJO

      DO 142 L = IP2(IK),N
      YYD1 = YYD1 + ER(L)
143   CONTINUE
      YYR1(IP2(IK)) = (IP2(IK)-1)*YYD1
      DO 153 K = 1,IP2(IK)-1
      YYD2 = YYD2 + ER(K)
153   CONTINUE
      YYR2(IP2(IK)) = (N-IP2(IK)+1)*YYD2
      YYD(IP2(IK)) = YYR1(IP2(IK))/YYR2(IP2(IK))
      SYY = YYD2*(N-IP2(IK)+1)
      SVV = YYD1*(IP2(IK)-1)
      XYX = SVV/SYY
      IM2 = IP2(IK)-1
      IN2 = N-IP2(IK)+1
      CALL FSTAT (IM2,IN2,IJJ,JJO)
      MM2=IJJ
      NN2=JJO

      DO 144 L = IP3(IK),N
      YXD1 = YXD1 + ER(L)
144   CONTINUE
      YXR1(IP3(IK)) = (IP3(IK)-1)*YXD1
      DO 157 K = 1,IP3(IK)-1
      YXD2 = YXD2 + ER(K)
157   CONTINUE
      YXR2(IP3(IK)) = (N-IP3(IK)+1)*YXD2
```

```
      YXD(IP3(IK)) = YXR1(IP3(IK))/YXR2(IP3(IK))
      SYX = YXD2*(N-IP3(IK)+1)
      SVX = YXD1*(IP3(IK)-1)
      XXX = SVX/SYX
      IM3 = IP3(IK)-1
      IN3 = N-IP3(IK)+1
      CALL FSTAT (IM3,IN3,IJJ,JJO)
      MM3=IJJ
      NN3=JJO

C*****POWER OF TEST  TYPE II
      IF(XYD .LE. F05(NN,MM)) THEN
       BW05 = BW05 + 1.0
      ELSE
      END IF
C*****TYPE I ERROR
      IF ((XYD .LE. F05(NN,MM)) .AND. (XYX .LE. F05(NN2,MM2))
     + .AND. (XXX .LE. F05(NN3,MM3))) THEN
        ALP05 = ALP05 + 1.0
      ELSE
      END IF
C*****POWER OF TEST  TYPE II
      IF(XYD .LE. F01(NN,MM)) THEN
       BW01 = BW01 + 1.0
      ELSE
      END IF
C*****TYPE I ERROR
      IF ((XYD .LE. F01(NN,MM)) .AND. (XYX .LE. F01(NN2,MM2))
     + .AND. (XXX .LE. F01(NN3,MM3))) THEN
        ALPH01 = ALPH01 + 1.0
      ELSE
      END IF

      MO(IK) = IT1(IK)

      DO 140 L = MO(IK),N
      DD1 = DD1 + ER(L)
140   CONTINUE
      RR1(MO(IK)) = (MO(IK)-1)*DD1
      DO 150 K = 1,MO(IK)-1
      DD2 = DD2 + ER(K)
150   CONTINUE
      RR2(MO(IK)) = (N-MO(IK)+1)*DD2
      RD(MO(IK)) = RR1(MO(IK))/RR2(MO(IK))
      S2 = DD2*(N-MO(IK)+1)
      S1 = DD1*(MO(IK)-1)
      XDD = S1/S2
      IMO = MO()K)-1
      INO = N-MO(IK)+1
      CALL FSTAT (INO,IMO,IJO,JNO)
      MMO=IJO
      NNO=JNO
      IF (XDD .GT. F05(NNO,MMO)) THEN
```

```
      ACC05 = ACC05 + 1.0
      YHAT1(IT1(IK)) = YBAR1 + (YO1(MO(IK))-YBAR1)/SQRT(XDD)
      YADJ1(IT1(IK)) = (YHAT1(IT1(IK)) - P(IT1(IK)))
     +/YHAT1(IT1(IK))
       YSU = YSU+YADJ1(IT1(IK))
       A = (P1(IT1(IK)) - P(IT1(IK)))/P(IT1(IK))
       ASUM =ASUM + A
      ELSE
C      REC05 = REC05 + 1.0
      END IF

      MO2(IK) = IT2(IK)
      DO 146 L = MO2(IK),N
      DA1 = DA1 + ER(L)
146   CONTINUE
      RF1(MO2(IK)) = (MO2(IK)-1)*DA1
      DO 156 K = 1,MO2(IK)-1
      DA2 = DA2 + ER(K)
156   CONTINUE
      RF2(MO2(IK)) = (N-MO2(IK)+1)*DA2
      RD2(MO2(IK)) = RF1(MO2(IK))/RF2(MO2(IK))
      SS2 = DA2*(N-MO2(IK)+1)
      SS1 = DA1*(MO2(IK)-1)
      XDY = SS1/SS2
      IMO2 = MO2(IK)-1
      INO2 = N-MO2(IK)+1
      CALL FSTAT (INO2,IMO2,IJO,JNO)
      MMO2=IJO
      NNO2=JNO
      IF (XDY .GT. F05(NNO2,MMO2)) THEN
       BCC05 = BCC05 + 1.0
       YHAT2(IT2(IK)) = YBAR1 + (YO1(MO2(IK))-YBAR1)/SQRT(XDY)
       YADJ2(IT2(IK)) = (YHAT2(IT2(IK)) - P(IT2(IK)))
      +/YHAT2(IT2(IK))
       YSX = YSX+YADJ2(IT2(IK))
       A2= (P1(IT2(IK)) - P(IT2(IK)))/P(IT2(IK))
       BSUM =BSUM + A2
      ELSE
C      REC05 = REC05 + 1.0
      END IF

      IF (XDD .GT. F01(NNO,MMO)) THEN
       ACC01 = ACC01 + 1.0
       XHAT1(IT1(IK)) = YBAR1 + (YO1(MO(IK))-YBAR1)/SQRT(XDD)
       XADJ1(IT1(IK)) = (XHAT1(IT1(IK)) - P(IT1(IK)))
      +/XHAT1(IT1(IK))
       XSU = XSU+XADJ1(IT1(IK))
       B = (P1(IT1(IK)) - P(IT1(IK)))/P(IT1(IK))
       CSUM =CSUM + B
      ELSE
C      REC01 = REC01 + 1.0
      END IF
```

```
      IF (XDY .GT. F01(NNO2,MMO2)) THEN
       BCC01 = BCC01 + 1.0
       YHAT2(IT2(IK)) = YBAR1 + (YD1(MD2(IK))-YBAR1)/SQRT(XDY)
       XADJ2(IT2(IK)) = (XHAT2(IT2(IK)) - P(IT2(IK)))
     +/XHAT2(IT2(IK))
        XSX = XSX+XADJ2(IT2(IK))
        B2 = (P1(IT2(IK)) - P(IT2(IK)))/P(IT2(IK))
        DSUM =DSUM + B2
      ELSE
       REC01 = REC01 + 1.0
      END IF

      DO 170 I=1,N
  170 Q(I) = 0
      AHL05 = 1.0 - (AM-BW05+ALP05)/AM
      AHL01 = 1.0 - (AM-BW01+ALPH01)/AM
      PW05 = 1.0 - (BW05/AM)
      PW01 = 1.0 - (BW01/AM)
      YA05 = ASUM/ACC05
      YB05 = YSU/ACC05
      YC05 = ASUM/ACC05
      YD05 = YSX/BCC05
      XA01 = CSUM/ACC01
      XB01 = XSU/ACC01
      XC01 = DSUM/BCC01
      XD01 = XSX/BCC01
      GOTO 1
  200 WRITE (10,220) IK,PW05,AHL05,YA05,YB05,YC05,YD05
     +,PW01,AHL01,XA01,XB01,XC01,XD01
c200  WRITE (*,220) IK,B05,JA05,JRE05,EP1(IK),EP2(IK)
  220 FORMAT (I5,12F8.3)
C      DO 170 I=1,N
C170   Q(I) = 0
C      GOTO 1
  999 CONTINUE
      STOP
      END
C*****SUBROUTINE TABLE F-STAT
      SUBROUTINE  FSTAT (IMO,INO,MMO,NNO)
      LMO = IMO
      LNO = INO
      IF ((LMO .GT. 10) .AND. (LMO .LE. 12)) THEN
       MMO = 11
       ELSE
        IF ((LMO .GT. 12) .AND. (LMO .LE. 15)) THEN
         MMO = 12
         ELSE
          IF ((LMO .GT. 15) .AND. (LMO .LE. 20)) THEN
           MMO = 13
           ELSE
            IF ((LMO .GT. 20) .AND. (LMO .LE. 24)) THEN
             MMO = 14
             ELSE
```

```
          IF ((LMO .GT. 24) .AND. (LMO .LE. 30)) THEN
           MMO = 15
           ELSE
            IF ((LMO .GT. 30) .AND. (LMO .LE. 40)) THEN
             MMO = 16
             ELSE
              IF ((LMO .GT. 40) .AND. (LMO .LE. 60)) THEN
               MMO = 17
               ELSE
                IF ((LMO .GT. 60) .AND. (LMO .LE. 120)) THEN
                 MMO = 18
                 ELSE
                ENDIF
               ENDIF
              ENDIF
             ENDIF
            ENDIF
           ENDIF
          ENDIF
         ENDIF
        ENDIF
       IF ((LNO .GT. 30) .AND. (LNO .LE. 40)) THEN
        NNO = 31
        ELSE
         IF ((LNO .GT. 40) .AND. (LNO .LE. 60)) THEN
          NNO = 32
          ELSE
           IF ((LNO .GT. 60) .AND. (LNO .LE. 120)) THEN

            ELSE
           ENDIF
         ENDIF
       ENDIF
       RETURN
       END
```

โปรแกรมที่ 14 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ตัวแบบ VMA(1) วิธีการแบบวี

```
C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....PROCEDUES V
      DIMENSION P(120),Q(120),Q1(120),ERR1(120),P1(120)
     +,YO1(120),YFOR1(120),ER1(120),ELLA1(120),YFOR(120)
     +,ELDAT1(120),WAT1(120),ELAMA1(120),S1(120),S2(120)
     +,F01(40,40),F05(40,40),K1(120),XD1(120),XD2(120)
     +,XR1(120),XR2(120),XRD(120),XRD1(120),XRD12(120)
     +,XX22(120),XX12(120),MAP(120),XAPE1(120),XXD(120)
     +,XX2(120),XX1(120),XER(120),LM(120),LN(120)
      REAL*8 XFRE1,XXD,MAP
C     KM=COLUM
C     KN=ROW
      KM=18
      KN=33
      OPEN (1,FILE = 'AP3')
      OPEN (2,FILE = 'AP4')
      OPEN (3,FILE = 'AP5')
      OPEN (4,FILE = 'AP6')
      N = 50
      Z05 = 1.96
      Z01 = 2.33
      M = 5
      DO 1500 ID = 1,4
      XYPE1 = 0
      IK = 0
1     READ (ID,10,END=1000) (Q(I),Q1(I),I=1,N)
      IK=IK+1
      AM = IK
10    FORMAT (2F10.2)
      DO 70 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
      YO1(I) = P1(I)
70    CONTINUE
C.....FIND AUTOCORRELATION
3      Y1 = 0
      DO 80 I = 1,N-M
      Y1 = Y1 + YO1(I)
80    CONTINUE
      YBAR = Y1/(N-M)
      X11 = 0
      DO 90 I = 1,(N-M-1)
```

```
      X1 = (YO1(I) - YBAR)*(YO1(I+1) - YBAR)
      X11 = X11 + X1
90    CONTINUE
      X22 = 0
      DO 100 I = 1,N-M
      X2 = (YO1(I) - YBAR)**2
      X22 = X22 + X2
100   CONTINUE
      XRHO = X11/X22
      IF (XRHO .GE. 0.5) THEN
      XRHO = 0.4
      ELSE
      ENDIF
C.....FIND PARAMETER ESTIMATE
      XR = 1-(4*XRHO*XRHO)
      FB = SQRT(XR)
      AL = (-1+FB)/(2*XRHO)
      XCETA = AL
      B0 = YBAR
      XPHI1 = - XCETA
C.....FIND FORECASTING FOR MA(1) MODEL
      DO 120 I = 1,N-M
      YFOR1(I) = B0 - XCETA*ERR1(I-1)
      ERR1(I) = YO1(I) - YFOR1(I)
      ER1(I) = ERR1(I)**2
      SSE1 = SSE1 + ER1(I)
120   CONTINUE
      STD1 = SQRT(SSE1/(N-M))
C.....FIND PARAMETER
      SUM1 = 0.
      SUM2 = 0.
      SUM3 = 0.
66    J = 0.
      AA = 0.
      AB = 0.
      DO 130 I = 2,(N-M-1)
      WAT1(1) = 0
      ELAMA1(1) = 0
      WAT1(I) = (ERR1(I) - (XPHI1*ERR1(I+1)))/(1+XPHI1**2)
      ELAM1 = SQRT(1+XPHI1**2)
      ELLA1(I) = WAT1(I)*ELAM1/STD1
      ELAMA1(I) = ABS(ELLA1(I))
      IF(ELAMA1(I) .GT. Z05) THEN
      DO 140 L = I,N-M
      AA = AA + ER1(L)
140   CONTINUE
      XD1(I) = AA
      XR1(I) = (I-1)*XD1(I)
      DO 150 K = 1,I-1
      AB = AB + ER1(K)
150   CONTINUE
      XD2(I) = AB
      XR2(I) = (N-M-I+1)*XD2(I)
      S2(I) = XD2(I)*(N-M-I+1)
      S1(I) = XD1(I)*(I-1)
```

```
      XXD(I) = S1(I)/S2(I)
      YO1(I) = YBAR1 + (YO1(I)-YBAR1)/SQRT(XXD(I))
      ELSE
      END IF
130   CONTINUE
      EP1 = ELAMA1(1)
      DO 160 I = 1,N-M-1
      IF (EP1 .GE. ELAMA1(I)) GOTO 160
      EP1 = ELAMA1(I)
160   CONTINUE
      IF (EP1 .GT. ZO5) THEN
      Y1 = 0
      DO 85 I = 1,N-M
      Y1 = Y1 + YO1(I)
85    CONTINUE
      YBAR1 = Y1/(N-M)
      X11 = 0
      DO 95 I = 1,(N-M-1)
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      X11 = X11 + X1
95    CONTINUE
      X22 = 0
      DO 105 I = 1,N-M
      X2 = (YO1(I) - YBAR1)**2
      X22 = X22 + X2
105   CONTINUE
      XRHO = X11/X22
      IF (XRHO .GE. 0.5) THEN
      XRHO = 0.4
      ELSE
      ENDIF
C.....FIND PARAMETER ESTIMATE
      XR = 1-(4*XRHO*XRHO)
      FB = SQRT(XR)
      AL = (-1+FB)/(2*XRHO)
      XCETA = AL
      BO = YBAR1
      ELSE
      END IF
500   APE1 = 0.
      DO 170 I = 1,N-(N-M)
      YFOR(N-M+I) = BO - XCETA*ERR1((N-M)+(I-1))
C*****FIND ERROR
      XER(I) = YFOR(N-M+I) - P(N-M+I)
      MAP(I) = ABS(XER(I)/YFOR(N-M+I))
      APE1 = APE1 + MAP(I)
170   CONTINUE
      DO 230 I=1,N
230   Q(I) = 0
      XAPE1(IK) = 100*APE1/(N-(N-M))
      XYPE1 = XYPE1 + XAPE1(IK)
      XMAPE1 = XYPE1/AM
      GOTO 1
1000  WRITE (*,77) IK,XMAPE1
77    FORMAT (I5,F10.2)
```

โปรแกรมที่ 15 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ ตัวแบบ VARMA(1,1) วิธีการแบบวี

```
      ENDC.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....WITH PROCEDUSE V
      DIMENSION P(120),Q(120),Q1(120),Q2(120),ERR1(120),P1(120),P2(120)
      DIMENSION YO1(120),YFOR1(120),ER1(120),ELLA1(120),YO2(120),JM(2)
      DIMENSION ERR2(120),WAT1(120),ELAMA1(120),ELLA2(120)
      DIMENSION WAT2(120),ELAMA2(120),ER2(120),YFOR2(120)
      DIMENSION AX(120),AX2(120),BX(120),BX2(120),CX(120),CX2(120)
      DIMENSION F01(40,40),F05(40,40),XCETA1(500),XCETA2(500)
      DIMENSION XR1(120),XR2(120),XRD(120),XRD1(120),XRD12(120)
      DIMENSION XX22(120),XX12(120),XFRE1(500),XFRE2(500),XER2(120)
      DIMENSION XX2(120),XX1(120),XRR1(120),XRR2(120),XER1(120)
      DIMENSION EMC1(300),EMC2(300)
C     KM=COLUM
C     KN=ROW
      KM=18
      KN=33
      OPEN (5,FILE = 'ARMA.OUT')
      OPEN (6,FILE = 'F01')
      OPEN (7,FILE = 'F05')
      READ (6,40) ((F01(I,J),J=1,KM),I=1,KN)
      READ (7,50) ((F05(I,J),J=1,KM),I=1,KN)
40    FORMAT(18F4.2)
50    FORMAT(18F4.2)
      N = 50
      IK = 0
1     READ (5,10,END=1000) (Q(I),Q1(I),Q2(I),I=1,N)
      IK=IK+1
10    FORMAT (3F10.4)
      DO 60 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
      P2(I) = Q2(I)
60    CONTINUE
C.....FIND AUTOCORRELATION
      Y1 = 0
      Y2 = 0
      DO 70 I = 1,N
      YO1(I) = P1(I)
      YO2(I) = P2(I)
      Y1 = Y1 + YO1(I)
      Y2 = Y2 + YO2(I)
70    CONTINUE
```

```
      YBAR1 = Y1/N
      YBAR2 = Y2/N
      X11 = 0
      AX11 = 0
      XY11 = 0
      BXY11 = 0
      DO 80 I = 1,N-1
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      AX1 = (YO1(I) - YBAR1)*(YO1(I+2) - YBAR1)
      XY1 = (YO2(I) - YBAR2)*(YO2(I+1) - YBAR2)
      BXY1 = (YO2(I) - YBAR2)*(YO2(I+2) - YBAR2)
      X11 = X11 + X1
      AX11 = AX11 + AX1
      XY11 = XY11 + XY1
      BXY11 = BXY11 + BXY1
80    CONTINUE
      X22 = 0
      XY22 = 0
      DO 90 I = 1,N
      X2 = (YO1(I) - YBAR1)**2
      XY2 = (YO2(I) - YBAR2)**2
      X22 = X22 + X2
      XY22 = XY22 + XY2
90    CONTINUE
      XRHO1 = X11/X22
      AXRHO2 = AX11/X22
      XRHO2 = XY11/XY22
      BXRHO2 = BXY11/XY22
C.....FIND PARAMETER ESTIMATE XFRE
      XFRE1 = AXRHO2/XRHO1
      XFRE2 = BXRHO2/XRHO2
C.....FIND PARAMETER ESTIMATE XCETA1
      DO 61 J = 1,2
      A1 = XRHO1 - XFRE1
      A2 = 1 + (XFRE1*XFRE1) - (2XRHO1*XFRE1)
      A3 = A1
      A4 = SQRT((A2**2)-(4*A1*A3))
      XCETA1(1) = (-A2+A4)/(2*A1)
      XCETA1(2)= (-A2-A4)/(2*A1)
      B1 = XCETA1(J)
      B01 = YBAR1*(1-XFRE1)
C.....FIND MINIMUM SUMSQUARE ERROR
      SSE1 = 0
      SE1 = 0
      ERR1(0) = 0
      XRR1(0) = 0
      XER1(0) = 0
      DO 100 I = 1,N
      YFOR1(I) = B01+XFRE1*YO1(I-1)-XCETA1(J)*ERR1(I-1)
      ERR1(I) = YO1(I) - YFOR1(I)
      ER1(I) = ERR1(I)**2
```

```
      SSE1 = SSE1 + ER1(I)
100   CONTINUE
      EMC1(J) = SSE1
61    CONTINUE
C.....FIND PARAMETER ESTIMATE XCETA2
      DO 62 J=1,2
      D1 = XRHO2 - XFRE2
      D2 = 1 + (XFRE2*XFRE2) - (XRHO2*XFRE2)
      D3 = D1
      D4 = SQRT((D2*D2)-(4*D1*D3))
      XCETA2(1) = (-D2+D4)/(2*D1)
      XCETA2(2)= (-D2-D42)/(2*D1)
      B2 = XCETA2(J)
      B02 = YBAR2*(1-XFRE2)
C.....FIND MINIMUM SUMSQUARE ERROR
      SSE2 = 0
      SE2 = 0
      ERR2(0) = 0
      XRR2(0) = 0
      XER2(0) = 0
      DO 71 I = 1,N
      YFOR2(I) = B02+XFRE2(J)*YO1(I-1)-XCETA2(J)*ERR2(I-1)
      ERR2(I) = YO2(I) - YFOR2(I)
      ER2(I) = ERR2(I)**2
      SSE2 = SSE2 + ER2(I)
71    CONTINUE
      EMC2(J) = SSE2
62    CONTINUE
      EMP1 = EMC1(1)
      DO 81 I=1,2
      IF (EMP1 .LE. EMC1(I) ) GOTO 81
      EMP1 = EMC1(I)
      LM = I
81    CONTINUE
      EMP2 = EMC2(1)
      DO 82 J=1,2
      IF (EMP2 .LE. EMC2(J) ) GOTO 82
      EMP2 = EMC2(J)
      LN = J
82    CONTINUE
      FRE1 = XFRE1
      CETA1 = XCETA1(LM)
      FRE2 = XFRE2
      CETA2 = XCETA2(LN)
      XPHI1 = FRE1-CETA1
      XPHI2 = FRE2-CETA2
C.....FIND ERROR FOR FORCASTING ARMA(1,1) MODEL
      DO 180 I = 1,N
      YFOR1(I) = B01+FRE1*YO1(I-1)-CETA1*XRR1(I-1)
      XRR1(I) = YO1(I) - YFOR1(I)
      XER1(I) = XRR1(I)**2
      SE1 = SE1 + XER1(I)
```

```
      YFOR2(I) = BO2+FRE2*YO2(I-1)-CETA2*XRR2(I-1)
      XRR2(I) = YO2(I) - YFOR2(I)
      XER2(I) = XRR2(I)**2
      SE2 = SE2 + XER2(I)
180   CONTINUE
      KB = 0
      XSE1 = 0
      XSE2 = 0
      STX1 = SQRT(SE1/N)
      STX2 = SQRT(SE2/N)
C.....FIND PARAMETER WAT AND LAMDA FOR DETECTION AND ADJUSTMENT
      XD1 = 0
      XD2 = 0
      XY1 = 0
      XY12 = 0
      DO 190 I = 2,N-1
      WAT1(1) = 0
      ELAMA1(1) = 0
      WAT1(I) = (XRR1(I) - (XPHI1*XRR1(I+1)))/(1+XPHI1**2)
      ELAM1 = SQRT(1+XPHI1**2)
      ELLA1(I) = WAT1(I)*ELAM1/STX1
      ELAMA1(I) = ABS(ELLA1(I))
      IF(ELAMA1(I) .GT. 1.65) THEN
      IM = I
      ELSE
      END IF
190   CONTINUE
      SUM1 = 0.
      SUM2 = 0.
      SUM3 = 0.
      DO 200 L = IM,N
      XD1 = XD1 + XER1(L)
200   CONTINUE
      XR1(IM) = (IM-1)*XD1
      DO 210 K = 1,IM-1
      XD2 = XD2 + XER1(K)
210   CONTINUE
      XR2(IM) = (N-1M+1)*XD2
      XRD(IM) = XR1(IM)/XR2(IM)
      S2 = XD2*(N-IM+1)
      S1 = XD1*(IM-1)
      XXD = S1/S2
      LXM = IM-1
      MM = LXM
      LYN = N-IM+1
      NN = LYN
      IF ((LXM .GT. 10) .AND. (LXM .LE. 12)) THEN
       MM = 11
       ELSE
        IF ((LXM .GT. 12) .AND. (LXM .LE. 15)) THEN
         MM = 12
         ELSE
          IF ((LXM .GT. 15) .AND. (LXM .LE. 20)) THEN
```

```
          MM = 13
          ELSE
           IF ((LXM .GT. 20) .AND. (LXM .LE. 24)) THEN
            MM = 14
            ELSE
             IF ((LXM .GT. 24) .AND. (LXM .LE. 30)) THEN
              MM = 15
              ELSE
               IF ((LXM .GT. 30) .AND. (LXM .LE. 40)) THEN
                MM = 16
               ELSE
                IF ((LXM .GT. 40) .AND. (LXM .LE. 60)) THEN
                  MM = 17
                  ELSE
                   IF ((LXM .GT. 60) .AND. (LXM .LE. 120)) THEN
                    MM = 18
                    ELSE
                   ENDIF
                  ENDIF
                 ENDIF
                ENDIF
               ENDIF
              ENDIF
             ENDIF
            ENDIF
           ENDIF
          IF ((LYN .GT. 30) .AND. (LYN .LE. 40)) THEN
           NN = 31
           ELSE
            IF ((LYN .GT. 40) .AND. (LYN .LE. 60)) THEN
             NN = 32
             ELSE
              IF ((LYN .GT. 60) .AND. (LYN .LE. 120)) THEN
               NN = 33
               ELSE
              ENDIF
             ENDIF
            ENDIF
          IF (XXD .GT. FO1(NN,MM)) THEN
           P1(IM) = YBAR1 + (YO1(IM)-YBAR1)/SQRT(XXD)
          ELSE
          END IF
          AX(IK) = 100*(YO1(IM) - P(IM))/P(IM)
          BX(IK) = 100*(YO1(IM) - P1(IM))/P1(IM)
          CX(IK) = 100*(P1(IM) - P(IM))/P(IM)
          DO 220 I = 1,IK
          SUM1 = SUM1 + AX(I)
          SUM2 = SUM2 + BX(I)
          SUM3 = SUM3 + CX(I)
220       CONTINUE
          A = SUM1/IK
          B = SUM2/IK
          C = SUM3/IK
          AB = 0
          DO 230 I = 2,N-1
          WAT2(1) = 0
```

```
240   CONTINUE
      XX1(JM(1)) = (JM(1)-1)*XY1
      DO 250 K = 1,JM(1)-1
      XY2 = XY2 + XER2(K)
250   CONTINUE
      XX2(JM(1)) = (N-JM(1)+1)*XY2
      XRD1(JM(1)) = XX1(JM(1))/XX2(JM(1))
      DO 260 L = JM(2),N
      XY12 = XY12 + XER2(L)
260   CONTINUE
      XX12(JM(2)) = (JM(2)-1)*XY12
      DO 270 K = 1,JM(2)-1
      XY22 = XY22 + XER2(K)
270   CONTINUE
      XX22(JM(2)) = (N-JM(2)+1)*XY22
      XRD12(JM(2)) = XX12(JM(2))/XX22(JM(2))
      NX  = JM(1)-1
      MZ = NX
      NY  = N-JM(1)+1
      NZ = NY
      MX  = JM(2)-1
      MA = MX
      MY  = N-JM(2)+1
      NA = MY
      IF (XRD1(JM(1)) .GT. F01(NZ,MZ)) THEN
        P2(JM(1)) = YBAR1 + (YO1(JM(1))-YBAR1)/SQRT(XRD1(JM(1)))
       ELSE
       IF (XRD12(JM(2)) .GT. F01(NA,MA)) THEN
        P2(JM(2)) = YBAR2 + (YO2(JM(2))-YBAR2)/SQRT(XRD12(JM(2)))
        ELSE
       ENDIF
      ENDIF
      RB1 = 100*(YO2(JM(1)) - P(JM(1)))/P(JM(1))
      RB2 = 100*(YO2(JM(2)) - P(JM(2)))/P(JM(2))
      AX2(IK) = (RB1 + RB2)/2
      RB12 = 100*(YO2(JM(1)) - P2(JM(1)))/P2(JM(1))
      RB22 = 100*(YO2(JM(2)) - P2(JM(2)))/P2(JM(2))
      BX2(IK) = (RB12 + RB22)/2
      RB13 = 100*(P2(JM(1)) - P(JM(1)))/P(JM(1))
      RB23 = 100*(P2(JM(2)) - P(JM(2)))/P(JM(2))
      CX2(IK) = (RB13 + RB23)/2
      DO 280 J=1,IK
      SUM12 = SUM12 + AX2(J)
      SUM22 = SUM22 + BX2(J)
      SUM32 = SUM32 + CX2(J)
280   CONTINUE
      A2 = SUM12/IK
      B2 = SUM22/IK
      C2 = SUM32/IK
      WRITE (*,77) IK,A,B,C,A2,B2,C2
77    FORMAT (I3,6F10.2)
      DO 290 I=1,N
290   Q(I) = 0
      GOTO 1
1000  STOP
      END
```

โปรแกรมที่ 16 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ ตัวแบบ VAP(1) วิธีการแบบวี

```
C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....PROCEDUES V
      REAL*8 MAP,MAPE,MAPE2,XMAPE1,YBAR1,SSE1,SE1
      DIMENSION P(120),Q(120),Q1(120),ERR1(120),P1(120),YO11(120)
      DIMENSION YO1(120),YFOR1(120),ER1(120),ELLA1(120)
      DIMENSION ELDAT1(120),WAT1(120),ELAMA1(120),S1(120),S2(120)
      DIMENSION F01(40,40),F05(40,40),K1(120),XD1(120),XD2(120)
      DIMENSION XR1(120),XR2(120),XRD(120),XRD1(120),XRD12(120)
      DIMENSION XX22(120),XX12(120),MAP(120),XAPE1(120),XXD(120)
      DIMENSION XX2(120),XX1(120),XER(120),LM(120),LN(120)
C     KM=COLUM
C     KN=ROW
      KM=18
      KN=33
      OPEN (5,FILE = 'AP.OUT')
      OPEN (6,FILE = 'F01')
      OPEN (7,FILE = 'F05')
      READ (6,40) ((F01(I,J),J=1,KM),I=1,KN)
      READ (7,50) ((F05(I,J),J=1,KM),I=1,KN)
40    FORMAT(18F4.2)
50    FORMAT(18F4.2)
      M = 5
      N = 50
      IK = 0
1     READ (5,10,END=1000) (Q(I),Q1(I),I=1,N)
      IK=IK+1
10    FORMAT (2F10.4)
      DO 70 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
70    CONTINUE
C.....FIND AUTOCORRELATION
3     Y1 = 0
      DO 80 I = 1,N-M
      YO1(I) = P1(I)
      Y1 = Y1 + YO1(I)
80    CONTINUE
      YBAR1 = Y1/(N-M)
      X11 = 0
      DO 90 I = 1,((N-M)-1)
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      X11 = X11 + X1
90    CONTINUE
      X22 = 0
```

```
      DO 100 I = 1,(N-M)
      X2 = (YO1(I) - YBAR1)**2
      X22 = X22 + X2
100   CONTINUE
      XRHO1 = X11/X22
C.....FIND PARAMETER ESTIMATE
      XFRE1 = XRHO1
      LY = 0
      K = 0
c     K = K + 1
c     IF (K .EQ. 2) goto 88
      XPHY1 = XFRE1
      B01 = YBAR1*(1 - XFRE1)
C.....FIND FORECASTING FOR AR(1) MODEL
      SSE1 = 0
      SSE2 = 0
C.....FIND ERROR
      DO 120 I = 1,(N-M)
      YFOR1(I) = B01 + XFRE1*YO1(I-1)
      ERR1(I) = YO1(I) - YFOR1(I)
      ER1(I) = ERR1(I)**2
      SSE1 = SSE1 + ER1(I)
120   CONTINUE
      STD1 = SQRT(SSE1/(N-M))
C.....FIND PARAMETER
      SUM1 = 0.
      SUM2 = 0.
      SUM3 = 0.
      J = 0.
66    DO 130 I = 2,((N-M)-1)
      WAT1(1) = 0
      ELAMA1(1) = 0
      WAT1(I) = (ERR1(I) - (XPHI1*ERR1(I+1)))/(1+XPHI1**2)
      ELAM1 = SQRT(1+XPHI1**2)
      ELLA1(I) = WAT1(I)*ELAM1/STD1
      ELAMA1(I) = ABS(ELLA1(I))
      IF(ELAMA1(I) .GT. 1.65) THEN
      J = J + 1
      K1(J) = I
      ELSE
      END IF
130   CONTINUE
      DO 135 I = 1,J
      DO 140 L = K1(I),(N-M)
      XD1(I) = XD1(I) + ER1(L)
140   CONTINUE
      XR1(K1(I)) = (K1(I)-1)*XD1(I)
135   CONTINUE
      DO 145 I = 1,J
      DO 150 K = 1,K1(I)-1
      XD2(I) = XD2(I) + ER1(K)
150   CONTINUE
      XR2(K1(I)) = ((N-M)-K1(I)+1)*XD2(I)
145   CONTINUE
      DO 155 I = 1,J
C     XRD(K1(I)) = XR1(K1(I))/XR2(K1(I))
```

```
      S2(I) = XD2(I)*((N-M)-K1(I)+1)
      S1(I) = XD1(I)*(K1(I)-1)
      XXD(I) = S1(I)/S2(I)
      LM(I) = K1(I)-1
      LN(I) = (N-M)-K1(I)+1
      IF (XXD(I) .GE. F01(NN,MM)) THEN
      P1(K1(I)) = YBAR1 + (YO1(K1(I))-YBAR1)/SQRT(XXD(I))
      ELSE
      END IF
155   CONTINUE
      EP1 = ELAMA1(1)
      DO 160 I = 2,((N-M)-1)
      IF (EP1 .GE. ELAMA1(I)) GOTO 160
      EP1 = ELAMA1(I)
160   CONTINUE
      IF (EP1 .GT. 1.65) GOTO 3
88    DO 170 I = 1,(N-(N-M))
      YFOR1(N-M+I) = B01 + XFRE1*YFOR1((N-M)+(I+1))
C*****FIND ERROR
      XER(I) = P(N-M+I) - YFOR1(N-M+I)
      MAP(I) = ABS(XER(I)/P(N-M+I))*100
      APE1 = APE1 + MAP(I)
170   CONTINUE
      XAPE1(IK) = APE1/(N-(N-M))
      DO 180 I =1,IK
      XYPE1 = MAPE1 + XAPE1(I)
180   CONTINUE
      XMAPE1 = XYPE1/IK
      WRITE (*,77) IK,XMAPE1
77    FORMAT (I4,F10.2)
      DO 230 I=1,N
230   Q(I) = 0
      GOTO 1
1000  STOP
      END
```

โปรแกรมที่ 17 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ ตัวแบบ VMP(1) วิธีการแบบวี

```
C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....PROCEDUES V
      REAL*8 MAP,MAPE,MAPE2,XMAPE1,YBAR1,SSE1,SE1
      DIMENSION P(120),Q(120),Q1(120),ERR(120),P1(120),YQ11(120)
      DIMENSION YO1(120),YFOR1(120),ER1(120),ELLA1(120)
      DIMENSION ELDAT1(120),WAT1(120),ELAMA1(120),S1(120),S2(120)
      DIMENSION F01(40,40),F05(40,40),K1(120),XD1(120),XD2(120)
      DIMENSION XR1(120),XR2(120),XRD(120),XRD1(120),XRD12(120)
      DIMENSION XX22(120),XX12(120),MAP(120),XAPE1(120),XXD(120)
      DIMENSION XX2(120),XX1(120),XER(120),LM(120),LN(120)
C     KM=COLUM
C     KN=ROW
      KM=18
      KN=33
      OPEN (5,FILE = 'MP.OUT')
      OPEN (6,FILE = 'F01')
      OPEN (7,FILE = 'F05')
      READ (6,40) ((F01(I,J),J=1,KM),I=1,KN)
      READ (7,50) ((F05(I,J),J=1,KM),I=1,KN)
40    FORMAT(18F4.2)
50    FORMAT(18F4.2)
      M = 5
      N = 50
      IK = 0
1     READ (5,10,END=1000) (Q(I),Q1(I),I=1,N)
      IK=IK+1
10    FORMAT (2F10.4)
      DO 20 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
20    CONTINUE
C.....FIND AUTOCORRELATION
3     Y1 = 0
      DO 60 I = 1,N-M
      YO1(I) = P1(I)
      Y1 = Y1 + YO1(I)
60    CONTINUE
      YBAR1 = Y1/(N-M)
      X11 = 0
      DO 70 I = 1,((N-M)-1)
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      X11 = X11 + X1
70    CONTINUE
      X22 = 0
```

```
      IZ = 0
      DO 80 I = 1,(N-M)
      X2 = (YO1(I) - YBAR1)**2
      X22 = X22 + X2
 80   CONTINUE
      XRHO1 = X11/X22
 C.....FIND PARAMETER ESTIMATE
      XR = 1-(4*XRHO1*XRHO1)
      IF (XR .LT. 0) THEN
      XR = 0.
      ELSE
      ENDIF
      FB = SQRT(XR)
      AL = (-1+FB)/(2*XRHO1)
      XCETA = AL
      B01 = YBAR1 .
 C     IZ = IZ + 1
 C     IF (IZ .EQ. 2) GOTO 88
      XPHI = - XCETA
 C.....FIND FORECASTING FOR MA(1) MODEL
      SSE = 0
      ERR(0) = 0
 C.....FIND ERROR
      DO 90 I = 1,N-M
      YFOR1(I) = B01 - XCETA*ERR(I-1)
      ERR(I) = YO1(I)- YFOR1(I)
      ER1(I) = ERR(I)**2
      SSE = SSE + ER1(I)
 90   CONTINUE
      STD = SQRT(SSE/(N-M))
 C.....FIND PARAMETER WAT AND LAMDA FOR DETECTION AND ADJUSTMENT
 66   J1 = 0
      DO 100 I = 2,(N-M)-1
      WAT1(1) = 0
      ELAMA1(1) = 0
      WAT1(I) = (ERR(I) - (XPHI*ERR(I+1)))/(1+XPHI**2)
      ELAM1 = SQRT(1+XPHI**2)
      ELLA1(I) = WAT1(I)*ELAM1/STD
      ELAMA1(I) = ABS(ELLA1(I))
      IF(ELAMA1(I) .GT. 1.65) THEN
      J1 = J1 + 1
      K1(J1) = I
      ELSE
      END IF
 100  CONTINUE
      DO 85 I = 1,J1
      DO 110 L = K1(I),(N-M)
      XD1(I) = XD1(I) + ER1(L)
 110  CONTINUE
      XR1(K1(I)) = (K1(I)-1)*XD1(I)
 85   CONTINUE
      DO 95 I = 1,J1
      DO 120 K = 1,K1(I)-1
      XD2(I) = XD2(I) + ER1(K)
 120  CONTINUE
      XR2(K1(I)) = ((N-M)-K1(I)+1)*XD2(I)
 95   CONTINUE
```

```
      DO 130 I = 1,J1
C       XRD(K1(I)) = XR1(K1(I))/XR2(K1(I))
      S2(I) = XD2(I)*((N-M)-K1(I)+1)
      S1(I) = XD1(I)*(K1(I)-1)
      XXD(I) = S1(I)/S2(I)
      LM(I) = K1(I)-1
      LN(I) = (N-M)-K1(I)+1
      IF (XXD(I) .GT. F05(NN,MM)) THEN
      P1(K1(I)) = YBAR1 + (YO1(K1(I))-YBAR1)/SQRT(XXD(I))

      ELSE
      END IF
130   CONTINUE
      APE1 = 0
      MAPE1 = 0
      EP1 = ELAMA1(1)
      DO 140 I = 2,((N-M)-1)
      IF (EP1 .GE. ELAMA1(I)) GOTO 140
      EP1 = ELAMA1(I)
140   CONTINUE
C     IF (EP1 .GT. 1.65) GOTO 3
88    DO 150 I = 1,(N-(N-M))
      YFOR1(N-M+I) = B01 + XFRE1*YFOR1((N-M)+(I+1))
C*****FIND ERROR
      XER(I) = P(N-M+I) - YFOR1(N-M+I)
      MAP(I) = ABS(XER(I)/P(N-M+I))*100
      APE1 = APE1 + MAP(I)
150   CONTINUE
      XAPE1(IK) = APE1/(N-(N-M))
      DO 160 I =1,IK
      XYPE1 = MAPE1 + XAPE1(I)
160   CONTINUE
      XMAPE1 = XYPE1/IK
      WRITE (*,77) IK,XMAPE1
77    FORMAT (I4,F10.2)
      DO 230 I=1,N
230   Q(I) = 0
8     GOTO 1
1000  STOP
      END
```

โปรแกรมที่ 18 โปรแกรมสำหรับตรวจหาค่าสังเกตที่ผิดปกติ สำหรับอนุกรมเวลาคงที่ ตัวแบบ VARMAP(1,1) วิธีการแบบวี

```
C.....THIS PROGRAM FOR DETECTION OUTLIER TIME SERIES
C.....PROCEDUES V
      REAL*8 MAP,MAPE,MAPE2,XMAPE1,YBAR1,SSE1,SE1
      DIMENSION Q(120),Q1(120),ERR1(120),P(120),XRR1(120)
      DIMENSION YO1(120),ER1(120),ELLA1(120),XER(120),P1(120)
      DIMENSION ELDAT1(120),WAT1(120),ELAMA1(120),K1(120),ELAMDA(120)
      DIMENSION MAP(120),MAP2(120),WAT(120),XER1(120),XXD(120),LM(120)
      DIMENSION XAPE1(120),XCETA1(500),XFRE1(500),ERR(120),YFOR(120)
      DIMENSION EMC1(120),XERR(120),YFOR1(120),XR1(120),XR2(120)
      DIMENSION XERR1(120),XD1(120),XD2(120),S1(120),S2(120),LM(120)
      DIMENSION FO1(40,40),FO5(40,40),YO11(120),XFRE12(500)
      DIMENSION XRD(500)
C     KM=COLUM
C     KN=ROW
      KM = 18
      KN = 33
      OPEN (5,FILE = 'ARMAP.OUT')
      OPEN (6,FILE = 'FO1')
      OPEN (7,FILE = 'FO5')
      READ (6,40) ((FO1(I,J),J=1,KM),I=1,KN)
      READ (7,50) ((FO5(I,J),J=1,KM),I=1,KN)
40    FORMAT (18F4.2)
50    FORMAT (18F4.2)
      M = 5
      N = 50
      IK = 0
1     READ (5,10,END=1000) (Q(I),Q1(I),I=1,N)
      IK=IK+1
10    FORMAT (2F10.4)
      DO 70 I=1,N
      P(I) = Q(I)
      P1(I) = Q1(I)
70    CONTINUE
C.....FIND AUTOCORRELATION
3     Y1 = 0.
      DO 60 I = 1,(N-M)
      YO1(I) = P1(I)
      Y1 = Y1 + YO1(I)
60    CONTINUE
      YBAR1 = Y1/(N-M)
      X11 = 0
      AX11 = 0
      DO 50 I = 1,((N-M)-1)
```

```
      X1 = (YO1(I) - YBAR1)*(YO1(I+1) - YBAR1)
      AX1 = (YO1(I) - YBAR1)*(YO1(I+2) - YBAR1)
      X11 = X11 + X1
      AX11 = AX11 + AX1
   0  CONTINUE
      X22 = 0
      DO 60 I = 1,(N-M)
      X2 = (YO1(I) - YBAR1)**2
      X22 = X22 + X2
   0  CONTINUE
      R1 = X11/X22
      R2 = AX11/X22
     .....FIND PARAMETER ESTIMATE XCETA
      XRHO1 = R1
      XRHO2 = R2
      XRFE1 = XRHO2/XRHO1
      DO 80 J = 1,2
      A1 = XRHO1 - XFRE1
      A2 = 1 + (XFRE*XFRE1) - (2*XRHO1*XFRE1)
      A3 = A1
      IF ((A2*A2)-(4*A1*A3) .LT. 0) GOTO 7
      A4 = SQRT((A2*A2)-(4*A1*A3))
      XCETA1(1) = (-A2 + A4)/(2*A1)
      XCETA1(2) = (-A2 - A4)/(2*A1)
      B1 = XCETA1(J)
      B0 = YBAR*(1-B1)
     .....FIND FORECASTING FOR ARMA(1,1) MODEL
      SSE = 0.
      ERR(0) = 0
      DO 90 I=1,(N-M)
     .....FIND ERROR
      YFOR(I) = B0+XFRE1*YO1(I-1)-XCETA1(J)*ERR(I-1)
      ERR(I) = YO1(I) - YFOR(I)
      ER1(I) = ERR(I)**2
      SSE = SSE + ER1(I)
   0  CONTINUE
      EMC (J) = SSE/(N-M)
  00  CONTINUE
      EM = EMC(1)
      DO 100 I=1,2
      IF (EM .LE. EMC(I)) GOTO 100
      EM = EMC(I)
      MX = I
  00   CONTINUE
      FRE1 = XFRE1
      CETA1 = XCETA1(MX)
      XPHI1 = FRE1-CETA1
     .....FIND ERROR FOR FORCASTING ARMA(1,1) MODEL
      DO 190 I = 1,N-M
      YFOR1(I) = B01+FRE1*YO1(I-1)-CETA1*ERR1(I-1)
      XRR1(I) = YO1(I) - YFOR1(I)
      XER1(I) = XRR1(I)**2
      SE1 = SE1 + XER1(I)
 190  CONTINUE
```

```
      KB = 0
      XSE1 = 0
      IF (SE1 .EQ. 0) GOTO 4
      STX1 = SQRT(SE1/(N-M))
C.....FIND PARAMETER WAT AND LAMDA FOR DETECTION AND ADJUSTMENT
      SUM1 = 0.
      SUM2 = 0.
      SUM3 = 0.
      J = 0
66    DO 200 I = 2,((N-M)-1)
      WAT1(1) = 0
      ELAMA1(1) = 0
      WAT1(I) = (XRR1(I) - (XPHI1*XRR1(I+1)))/(1+XPHI1**2)
      ELAM1 = SQRT(1+XPHI1**2)
      ELLA1(I) = WAT1(I)*ELAM1/STX1
      ELAMA1(I) = ABS(ELLA1(I))
      IF(ELAMA1(I) .GT. 1.65) THEN
      J = J + 1
      K1(J) = I
      ELSE
      END IF
200   CONTINUE
      DO 210 I = 1,J
      DO 220 L = K1(I),(N-M)
      XD1(I) = XD1(I) + ER1(L)
220   CONTINUE
      XR1(K1(I)) = (K1(I)-1)*XD1(I)
210   CONTINUE
      DO 230 I = 1,J
      DO 240 K = 1,K1(I)-1
      XD2(I) = XD2(I) + ER1(K)
240   CONTINUE
      XR2(K1(I)) = ((N-M)-K1(I)+1)*XD2(I)
230   CONTINUE
      DO 250 I = 1,J
      XRD(K1(I)) = XR1(K1(I))/XR2(K1(I))
      S2(I) = XD2(I)*((N-M)-K1(I)+1)
      S1(I) = XD1(I)*(K1(I)-1)
      XXD(I) = S1(I)/S2(I)
C     LM(I) = K1(I)-1
C     LN(I) = (N-M)-K1(I)+1
      IF ((LM(I) .GT. 10) .AND. (LM(I) .LE. 12)) THEN
      MM = 11
      ELSE
       IF ((LM(I) .GT. 12) .AND. (LM(I) .LE. 15)) THEN
        MM = 12
        ELSE
         IF ((LM(I) .GT. 15) .AND. (LM(I) .LE. 20)) THEN
          MM = 13
          ELSE
           IF ((LM(I) .GT. 20) .AND. (LM(I) .LE. 24)) THEN
            MM = 14
            ELSE
             IF ((LM(I) .GT. 24) .AND. (LM(I) .LE. 30)) THEN
```

```
                MM = 15
                ELSE
                 IF ((LM(I) .GT. 30) .AND. (LM(I) .LE. 40)) THEN
                 MM = 16
                  ELSE
                   IF ((LM(I) .GT. 40) .AND. (LM(I) .LE. 60)) THEN
                    MM = 17
                    ELSE
                     IF ((LM(I) .GT. 60) .AND. (LM(I) .LE. 120)) THEN
                      MM = 18
                      ELSE
                     ENDIF
                    ENDIF
                   ENDIF
                  ENDIF
                 ENDIF
                ENDIF
               ENDIF
              IF ((LN(I) .GT. 30) .AND. (LN(I) .LE. 40)) THEN
               NN = 31
               ELSE
                IF ((LN(I) .GT. 40) .AND. (LN(I) .LE. 60)) THEN
                 NN = 32
                 ELSE
                  IF ((LN(I) .GT. 60) .AND. (LN(I) .LE. 120)) THEN
                   NN = 33
                   ELSE
                  ENDIF
                 ENDIF
               ENDIF
              IF (XXD(I) .GE. FO1(NN,MM)) THEN
              P1(K1(I)) = YBAR1 + (YO1(K1(I))-YBAR1)/SQRT(XXD(I))
              ELSE
              END IF
50    CONTINUE
      EP1 = ELAMA1(1)
      DO 290 I = 2,((N-M)-1)
      IF (EP1 .GE. ELAMA1(I)) GOTO 290
      EP1 = ELAMA1(I)
90    CONTINUE
      IF (EP1 .GT. 1.65) GOTO 3
      DO 300 I = 1,(N-(N-M))
      YFOR1(N-M+I)=BO1+FPE1*YFOR1((N-M)+(I+1))-CETA1*ERR1((N-M)-(I+1))
*****FIND ERROR
      XER(I) = P(N-M+I) - YFOR1(N-M+I)
      MAP(I) = ABS(XER(I)/P(N-M+I))*100
      APE1 = APE1 + MAP(I)
300   CONTINUE
      XAPE1(IK) = APE1/(N-(N-M))
      DO 310 I =1,IK
      XYPE1 = MAPE1 + XAPE1(I)
10    CONTINUE
      XMAPE1 = XYPE1/IK
      WRITE (*,77) IK,XMAPE1
7     FORMAT (I4,F20.2)
```

ประวัติผู้เขียน

นายเฉลิมสิน สิงห์สนอง เกิดเมื่อวันที่ 10 สิงหาคม 2502 จังหวัดกรุงเทพมหานครฯ ได้รับปริญญาการศึกษาบัณฑิต คณะศึกษาศาสตร์ จากมหาวิทยาลัยศรีนครินทรวิโรฒ เมื่อปีการศึกษา 2525 และเข้าศึกษาต่อในสาขาสถิติ ภาควิชา สถิติ บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย เมื่อปีการศึกษา 2532 ปัจจุบันเป็นอาจารย์ประจำที่ มหาวิทยาลัยธุรกิจบัณฑิตย์