ภาคผนวก

ผนวก ก

โปรแกรมคอมพิวเตอร์ที่ใช้ในงานวิจัย

การจำลองและการประมวลผลข้อมูลทำได้โดยการใช้โปรแกรมสำเร็จรูป *SAS*® เวอร์ชัน 8.0 ในการจำลองตัวแปรอธิบาย ตัวแปรตาม และคำนวณค่าสัมประสิทธิ์การตัดสินใจ (R^2) และสัมประสิทธิ์การตัดสินใจที่ปรับค่า (R^2_{adj}) พิจารณาโปรแกรมสำหรับประมวลผลได้ดังนี้

โปรแกรมสำหรับจำลองข้อมูล

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 1 ตัว คือ $logit(p_i) = 0.5 - 0.45x_{i1}$ สามารถจำลองตัวแปรอธิบาย และตัวแปรตามโดยการเขียนมาร์กโคร (macro) ได้ดังนี้

```
%macro case_x1(n_sample=,nsim=,p=);

%let loop_num=1;
%do %while (&loop_num<=&nsim);

      data pop;   retain _seed_ 0;
      do _i_ = 1 to &n_sample;

x1=2 + 2* rannor(_seed_);
x1_2=x1*x1;
x3= 20 + 2 * rannor(_seed_);
x5= 8 + 1.732050808 * rannor(_seed_);
x7=0 + 1 * rannor(_seed_);
x9=15 + 1.414213562 * rannor(_seed_);

Uni_x= 0 + (1 - 0) * ranuni(_seed_);
if Uni_x<=0.5 then x2=0;
if Uni_x>0.5 then x2=1;
if Uni_x<0.25 then x4=0;
if(Uni_x<0.5 and Uni_x>=0.25) then x4=1;
if(Uni_x<0.75 and Uni_x>=0.5) then x4=2;
if Uni_x>=0.75 then x4=3;

if Uni_x<(1/3) then x6=0;
if(Uni_x<(2/3) and Uni_x>=(1/3)) then x6=1;
if Uni_x>=(2/3) then x6=2;

if Uni_x<=0.5 then x8=0;
if Uni_x>0.5 then x8=1;

if Uni_x<0.2 then x10=0;
```

```
if(Uni_x<0.4 and Uni_x>=0.2) then x10=1;
if(Uni_x<0.6 and Uni_x>=0.4) then x10=2;
if(Uni_x<0.8 and Uni_x>=0.6) then x10=3;
if Uni_x>=0.8 then x10=4;

      eta_1=0.5-(0.45*x1);
      pi_o= exp(eta_1)/(1 + exp(eta_1));
      Uni_o= 0 + (1 - 0)*ranuni(_seed_);
      pi_oc=pi_o-Uni_o;
      y=ceil(pi_oc);
      output;
end;
drop _seed_ _i_;
run;

/*----------Simple  Random  Sampling----------*/
proc sql;   create view WORK._TMP_0 as select *, RANUNI(0)
as _ran_ from pop order by calculated _ran_;
data sample;
set WORK._TMP_0(obs=&n_sample);
drop _ran_;
run;
```

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 5 ตัว คือ $logit(p_i) = 0.5 - 0.45x_{i1} + 3.525x_{i2} - 0.1x_{i3} - 0.5x_{i4} + 0.2x_{i5}$ การเขียนโปรแกรมจะเหมือนกับตัวแบบที่ประกอบด้วยตัวแปรอธิบาย 1 ตัว แต่จะเปลี่ยนเฉพาะจำนวนตัวแปรอธิบาย $(p = 5)$ และค่าพารามิเตอร์ของตัวแบบ $(b_1, b_2, b_3, b_4, b_5)$ คือ

```
eta_1=0.5-(0.45*x1)+(3.525*x2)-(0.1*x3)-(0.5*x4)+(0.2*x5);
```

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 10 ตัว คือ $logit(p_i) = 0.5 - 0.45x_{i1} + 3.525x_{i2} - 0.1x_{i3} - 0.5x_{i4} + 0.2x_{i5} - 0.4x_{i6} + 0.3x_{i7} - 0.3x_{i8} - 0.05x_{i9} + 0.8x_{i10}$ การเขียนโปรแกรมจะเหมือนกับตัวแบบที่ประกอบด้วยตัวแปรอธิบาย 1 ตัว แต่จะเปลี่ยนเฉพาะจำนวนตัวแปรอธิบาย $(p = 10)$ และค่าพารามิเตอร์ของตัวแบบ $(b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9, b_{10})$ คือ

```
eta_1=0.5-(0.45*x1)+(3.525*x2)-(0.1*x3)-(0.5*x4)+(0.2*x5)
      -(0.4*x6)+(0.3*x7)-(0.3*x8)-(0.05*x9)+(0.8*x10);
```

โปรแกรมสำหรับประมาณค่าสัมประสิทธิ์การถดถอยของตัวแบบโลจีสติก

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 1 ตัว คือ

กรณีตัวแบบ $(M01)$

```
proc logistic data=sample descending noprint;
model y=x1;       output out=re     predicted=pi_h;   run;
proc means        data=sample noprint;    var y;
output out=s_mean css=Sum_S;  run;

proc logistic data=sample_n descending noprint;
model y_n=x1;     output out=re_t   predicted=pi_ht;  run;
proc means        data=re_t noprint;
var y y_n pi_o pi_h pi_ht;
output out=st_mean mean=yb yb_t pi_b pi_bh pi_bht;    run;
```

กรณีตัวแบบ $(M11)$

```
proc logistic data=sample descending noprint;
model y=x1_2;     output out=re_2 predicted=pi_h2;    run;

proc logistic data=sample_n2 descending noprint;
model y_n2=x1_2;  output out=re_t2 predicted=pi_ht2; run;
proc means data=re_t2 noprint; var y y_n2 pi_o pi_h2 pi_ht2;
output out=st_mean2     mean=yb yb_t2 pi_b pi_bh2 pi_bht2; run;
```

กรณีตัวแบบ $(M21)$

```
proc logistic data=sample descending noprint;
model y=x1/link=cloglog; output out=re_4 predicted=pi_h4;   run;

proc logistic data=sample_n4 descending noprint;
model y_n4=x1/link=cloglog; output out=re_t4 predicted=pi_ht4; run;
proc means data=re_t4 noprint; var y y_n4 pi_o pi_h4 pi_ht4;
output out=st_mean4  mean=y_logb yb_t4 pi_b pi_bh4 pi_bht4; run;
```

กรณีตัวแบบ $(M31)$

```
proc logistic data=sample descending noprint;
model y=x1/link=probit; output out=re_3 predicted=pi_h3;    run;

proc logistic data=sample_n3 descending noprint;
model y_n3=x1/link=probit; output out=re_t3 predicted=pi_ht3; run;
proc means data=re_t3 noprint;      var y y_n3 pi_o pi_h3 pi_ht3;
output out=st_mean3 mean=yb yb_t3 pi_b pi_bh3 pi_bht3;      run;
```

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 5 ตัว คือ

กรณีตัวแบบ $(M05)$

```
proc logistic data=sample descending noprint;
model y=x1 x2 x3 x4 x5; output out=re predicted=pi_h; run;

proc logistic data=sample_n descending noprint;
model y_n=x1 x2 x3 x4 x5;     output out=re_t predicted=pi_ht; run;
proc means data=re_t noprint; var y y_n pi_o pi_h pi_ht;
output out=st_mean mean=yb yb_t pi_b pi_bh pi_bht; run;
```

กรณีตัวแบบ $(M15)$

```
proc logistic data=sample descending noprint;
model y=x1_2 x2 x3 x4 x5; output out=re_2 predicted=pi_h2; run;

proc logistic data=sample_n2 descending noprint;
model y_n2=x1_2 x2 x3 x4 x5;  output out=re_t2 predicted=pi_ht2; run;
proc means data=re_t2 noprint;      var y y_n2 pi_o pi_h2 pi_ht2;
output out=st_mean2 mean=yb yb_t2 pi_b pi_bh2 pi_bht2;      run;
```

กรณีตัวแบบ $(M25)$

```
proc logistic data=sample descending noprint;
model y=x1 x2 x3 x4 x5/link=cloglog;
output out=re_4 predicted=pi_h4; run;

proc logistic data=sample_n4 descending noprint;
model y_n4=x1 x2 x3 x4 x5/link=cloglog;
output out=re_t4 predicted=pi_ht4;  run;
proc means data=re_t4 noprint;      var y y_n4 pi_o pi_h4 pi_ht4;
output out=st_mean4 mean=y_logb yb_t4 pi_b pi_bh4 pi_bht4;  run;
```

กรณีตัวแบบ $(M35)$

```
proc logistic data=sample descending noprint;
model y=x1 x2 x3 x4 x5/link=probit;output out=re_3 predicted=pi_h3;
run;

proc logistic data=sample_n3 descending noprint;
model y_n3=x1 x2 x3 x4 x5/link=probit;
output out=re_t3 predicted=pi_ht3;  run;
proc means data=re_t3 noprint;      var y y_n3 pi_o pi_h3 pi_ht3;
output out=st_mean3 mean=yb yb_t3 pi_b pi_bh3 pi_bht3; run;
```

กรณีตัวแบบ $(M45)$

```
proc logistic data=sample descending noprint;
model y=x1 x2 x3 x4;    output out=re_6 predicted=pi_h6; run;

proc logistic data=sample_n6 descending noprint;
model y_n6=x1 x2 x3 x4; output out=re_t6 predicted=pi_ht6;  run;
```

```
proc means data=re_t6 noprint; var y y_n6 pi_o pi_h6 pi_ht6;
output out=st_mean6 mean=yb yb_t6 pi_b pi_bh6 pi_bht6;      run;
```

กรณีตัวแบบ $(M55)$

```
proc logistic data=sample descending noprint;
model y=x1 x3 x4 x5; output out=re_7 predicted=pi_h7; run;

proc logistic data=sample_n7 descending noprint;
model y_n7=x1 x3 x4 x5; output out=re_t7 predicted=pi_ht7; run;
proc means data=re_t7 noprint;      var y y_n7 pi_o pi_h7 pi_ht7;
output out=st_mean7 mean=yb yb_t7 pi_b pi_bh7 pi_bht7; run;
```

กรณีตัวแบบ $(M65)$

```
proc logistic data=sample descending noprint;
model y=x3; output out=re_8 predicted=pi_h8; run;
proc logistic data=sample_n8 descending noprint;
model y_n8=x3;    output out=re_t8 predicted=pi_ht8; run;
proc means data=re_t8 noprint; var y y_n8 pi_o pi_h8 pi_ht8;
output out=st_mean8 mean=yb yb_t8 pi_b pi_bh8 pi_bht8; run;
```

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 10 ตัว คือ

กรณีตัวแบบ $(M010)$

```
proc logistic data=sample descending noprint;
model y=x1 x2 x3 x4 x5 x6 x7 x8 x9 x10;
output out=re predicted=pi_h;                          run;

proc logistic data=sample_n descending noprint;
model y_n=x1 x2 x3 x4 x5 x6 x7 x8 x9 x10;
output out=re_t predicted=pi_ht;                       run;
proc means data=re_t noprint; var y y_n pi_o pi_h pi_ht;
output out=st_mean  mean=yb yb_t pi_b pi_bh pi_bht;   run;
```

กรณีตัวแบบ $(M110)$

```
proc logistic data=sample descending noprint;
model y=x1_2 x2 x3 x4 x5 x6 x7 x8 x9 x10;
output out=re_2 predicted=pi_h2; run;

proc logistic data=sample_n2 descending noprint;
model y_n2=x1_2 x2 x3 x4 x5 x6 x7 x8 x9 x10;
output out=re_t2 predicted=pi_ht2;B                    run;
proc means data=re_t2 noprint;      var y y_n2 pi_o pi_h2 pi_ht2;
output out=st_mean2 mean=yb yb_t2 pi_b pi_bh2 pi_bht2; run;
```

กรณีตัวแบบ $(M210)$

```
proc logistic data=sample descending noprint;
model y=x1 x2 x3 x4 x5 x6 x7 x8 x9 x10/link=cloglog;
output out=re_4 predicted=pi_h4; run;

proc logistic data=sample_n4 descending noprint;
model y_n4=x1 x2 x3 x4 x5 x6 x7 x8 x9 x10/link=cloglog;
output out=re_t4 predicted=pi_ht4;  run;
proc means data=re_t4 noprint; var y y_n4 pi_o pi_h4 pi_ht4;
output out=st_mean4 mean=y_logb yb_t4 pi_b pi_bh4 pi_bht4; run;
```

กรณีตัวแบบ $(M310)$

```
proc logistic data=sample descending noprint;
model y=x1 x2 x3 x4 x5 x6 x7 x8 x9 x10/link=probit;
output out=re_3 predicted=pi_h3; run;

proc logistic data=sample_n3 descending noprint;
model y_n3=x1 x2 x3 x4 x5 x6 x7 x8 x9 x10/link=probit;
output out=re_t3 predicted=pi_ht3; run;
proc means data=re_t3 noprint;      var y y_n3 pi_o pi_h3 pi_ht3;
output out=st_mean3 mean=yb yb_t3 pi_b pi_bh3 pi_bht3; run;
```

กรณีตัวแบบ $(M410)$

```
proc logistic data=sample descending noprint;
model y=x1 x2 x4 x5 x6 x8 x9 x10;
output out=re_5 predicted=pi_h5; run;

proc logistic data=sample_n5 descending noprint;
model y_n5=x1 x2 x4 x5 x6 x8 x9 x10;
output out=re_t5 predicted=pi_ht5; run;
proc means data=re_t5 noprint;      var y y_n5 pi_o pi_h5 pi_ht5;
output out=st_mean5 mean=yb yb_t5 pi_b pi_bh5 pi_bht5; run;
```

กรณีตัวแบบ $(M510)$

```
proc logistic data=sample descending noprint;
model y=x1 x2 x3 x4 x5 x6 x7 x9;
output out=re_6 predicted=pi_h6; run;

proc logistic data=sample_n6 descending noprint;
model y_n6=x1 x2 x3 x4 x5 x6 x7 x9;
output out=re_t6 predicted=pi_ht6; run;
proc means data=re_t6 noprint;      var y y_n6 pi_o pi_h6 pi_ht6;
output out=st_mean6 mean=yb yb_t6 pi_b pi_bh6 pi_bht6; run;
```

กรณีตัวแบบ $(M610)$

```
proc logistic data=sample descending noprint;
model y=x2 x4;    output out=re_8 predicted=pi_h8; run;

proc logistic data=sample_n8 descending noprint;
model y_n8=x2 x4;       output out=re_t8 predicted=pi_ht8; run;
proc means data=re_t8 noprint;      var y y_n8 pi_o pi_h8 pi_ht8;
output out=st_mean8 mean=yb yb_t8 pi_b pi_bh8 pi_bht8; run;
```

โปรแกรมสำหรับการคำนวณค่าสัมประสิทธิ์การตัดสินใจ $\left(R^2\right)$ และสัมประสิทธิ์การตัดสินใจที่ปรับค่า $\left(R^2_{adj}\right)$ แบบต่างๆ

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 1 ตัว คือ

กรณีตัวแบบ $(M01)$

```
data fi_ln; set re;
      if pi_h<0.00001 then pi_h=0.00001;
      if pi_h>0.99999 then pi_h=0.99999;
      a=(y-pi_h)**2;    run;
proc means data=fi_ln noprint;      var a;
output out=save_a sum=aa;           run;

data Uni;                     retain _seed_ 0;
do _i_ = 1 to &n_sample;      Uni_t= 0 + (1 - 0) * ranuni(_seed_);
output;     end;              drop _seed_ _i_;  run;
data sample_n;    set re;     set Uni;    pi=pi_h-Uni_t;
y_n=ceil(pi);     run;

data multi;
      set st_mean;            do q=1 to &n_sample;
      y_bm=yb;                yb_tm=yb_t;
      pi_bm=pi_b;             pi_bhm=pi_bh;
      pi_bhtm=pi_bht;         output;     end;  run;

data cal_dn;      set re;     set re_t;   set multi;  run;
data lio;         set cal_dn;
if pi_o<0.00001  then pi_o=0.00001;
if pi_o>0.99999  then pi_o=0.99999;
if pi_bm<0.00001 then pi_bm=0.00001;
if pi_bm>0.99999 then pi_bm=0.99999;
if pi_h<0.00001  then pi_h=0.00001;
if pi_h>0.99999  then pi_h=0.99999;
if y_bm<0.00001  then y_bm=0.00001;
if y_bm>0.99999  then y_bm=0.99999;
if pi_ht<0.00001 then pi_ht=0.00001;
if pi_ht>0.99999 then pi_ht=0.99999;
if yb_tm<0.00001 then yb_tm=0.00001;
if yb_tm>0.99999 then yb_tm=0.99999;
```

```
L_pi=(pi_o*(log(pi_o)))+((1-pi_o)*(log(1-pi_o)));
L_po=(pi_bm*(log(pi_bm)))+((1-pi_bm)*(log(1-pi_bm)));
o_pi=pi_o*(1-pi_o);     o_po=pi_bm*(1-pi_bm);
L5_pi=(pi_h*(log(pi_h)))+((1-pi_h)*(log(1-pi_h)));
L5_po=(y_bm*(log(y_bm)))+((1-y_bm)*(log(1-y_bm)));
o4_pi=pi_h*(1-pi_h);    o4_po=y_bm*(1-y_bm);
L5n_pi=(pi_ht*(log(pi_ht)))+((1-pi_ht)*(log(1-pi_ht)));
L5n_po=(yb_tm*(log(yb_tm)))+((1-yb_tm)*(log(1-yb_tm)));
o4n_pi=pi_ht*(1-pi_ht); o4n_po=yb_tm*(1-yb_tm);
Lo=(y*(log(y_bm)))+((1-y)*(log(1-y_bm)));
LM=(y*(log(pi_h)))+((1-y)*(log(1-pi_h))); run;

proc means data=lio noprint;
var L_pi L_po o_pi o_po L5_pi L5_po o4_pi o4_po L5n_pi L5n_po o4n_pi
o4n_po Lo LM;
output out=ex_p sum=sL_pi sL_po so_pi so_po sL5_pi sL5_po so4_pi
so4_po sL5n_pi sL5n_po so4n_pi so4n_po L_o L_M;  run;

data rr;          set save_a;       set s_mean;       set ex_p;
Ro_true=1-(so_pi/so_po);      Rl_true=1-(sL_pi/sL_po);
Ro=1-(aa/Sum_S);              Rl=1-(-L_M/-L_o);
Ro_MS=1-(((&n_sample-1)*aa)/((&n_sample-&p-1)*Sum_S));
Rl_MS=1-((L_M-((&p+1)/2))/(L_o-0.5));
Ro_LM=1-((aa-so4n_pi+so4_pi)/(Sum_S-so4n_po+so4_po));
Rl_LM=1-((-L_M+sL5n_pi-sL5_pi)/(-L_o+sL5n_po-sL5_po));
Rl_DEV=(1-(exp(-2*(L_M-L_o)/&n_sample)))/(1-(exp(2*L_o/&n_sample)));
Rl_AIC=1-((L_M-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o-1));
```

กรณีตัวแบบ $(M11)$

```
data fi_ln2;      set re_2;
      if pi_h2<0.00001 then pi_h2=0.00001;
      if pi_h2>0.99999 then pi_h2=0.99999;
      a2=(y-pi_h2)**2;  run;
proc means data=fi_ln2 noprint;
var a2;     output out=save_a2 sum=aa2;   run;

data sample_n2;   set re_2;   set Uni;    pi_2=pi_h2-Uni_t;
y_n2=ceil(pi_2);  run;

data multi_2;     set st_mean2;     do q=1 to &n_sample;
y_bm=yb;          yb_tm2=yb_t2;     pi_bm=pi_b;
pi_bhm2=pi_bh2;   pi_bhtm2=pi_bht2; output;     end;  run;

data cal_dn2;     set re_2;   set re_t2;  set multi_2;      run;
data lio_2; set cal_dn2;
if pi_o<0.00001 then pi_o=0.00001;
if pi_o>0.99999 then pi_o=0.99999;
if pi_bm<0.00001 then pi_bm=0.00001;
if pi_bm>0.99999 then pi_bm=0.99999;
if pi_h2<0.00001 then pi_h2=0.00001;
if pi_h2>0.99999 then pi_h2=0.99999;
if y_bm<0.00001 then y_bm=0.00001;
if y_bm>0.99999 then y_bm=0.99999;
if pi_ht2<0.00001 then pi_ht2=0.00001;
if pi_ht2>0.99999 then pi_ht2=0.99999;
```

```
if yb_tm2<0.00001 then yb_tm2=0.00001;
if yb_tm2>0.99999 then yb_tm2=0.99999;
L_pi2=(pi_o*(log(pi_o)))+((1-pi_o)*(log(1-pi_o)));
L_po2=(pi_bm*(log(pi_bm)))+((1-pi_bm)*(log(1-pi_bm)));
o_pi2=pi_o*(1-pi_o);    o_po2=pi_bm*(1-pi_bm);
L5_pi2=(pi_h2*(log(pi_h2)))+((1-pi_h2)*(log(1-pi_h2)));
L5_po2=(y_bm*(log(y_bm)))+((1-y_bm)*(log(1-y_bm)));
o4_pi2=pi_h2*(1-pi_h2); o4_po2=y_bm*(1-y_bm);
L5n_pi2=(pi_ht2*(log(pi_ht2)))+((1-pi_ht2)*(log(1-pi_ht2)));
L5n_po2=(yb_tm2*(log(yb_tm2)))+((1-yb_tm2)*(log(1-yb_tm2)));
o4n_pi2=pi_ht2*(1-pi_ht2);    o4n_po2=yb_tm2*(1-yb_tm2);
Lo_2=(y*(log(y_bm)))+((1-y)*(log(1-y_bm)));
LM_2=(y*(log(pi_h2)))+((1-y)*(log(1-pi_h2)));   run;

proc means data=lio_2 noprint;
var   L_pi2 L_po2 o_pi2 o_po2 L5_pi2 L5_po2 o4_pi2 o4_po2  L5n_pi2
      L5n_po2 o4n_pi2 o4n_po2 Lo_2 LM_2;
Output out=ex_p2 sum=sL_pi2 sL_po2 so_pi2 so_po2 sL5_pi2 sL5_po2
so4_pi2 so4_po2 sL5n_pi2 sL5n_po2 so4n_pi2 so4n_po2 L_o2 L_M2; run;

data rr;          set s_mean;       set save_a2;      set ex_p2;
Ro_true2=1-(so_pi2/so_po2);   Rl_true2=1-(sL_pi2/sL_po2);
Ro_2=1-(aa2/Sum_S);           Rl_2=1-(-L_M2/-L_o2);
Ro_MS2=1-(((&n_sample-1)*aa2)/((&n_sample-&p-1)*Sum_S));
Rl_MS2=1-((L_M2-((&p+1)/2))/(L_o2-0.5));
Ro_LM2=1-((aa2-so4n_pi2+so4_pi2)/(Sum_S-so4n_po2+so4_po2));
Rl_LM2=1-((-L_M2+sL5n_pi2-sL5_pi2)/(-L_o2+sL5n_po2-sL5_po2));
Rl_DEV2=(1-(exp(-2*(L_M2-L_o2)/&n_sample)))/(1-
(exp(2*L_o2/&n_sample)));
Rl_AIC2=1-((L_M2-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o2-1));
```

กรณีตัวแบบ $(M21)$

```
data fi_ln4;      set re_4;
      if pi_h4<0.00001 then pi_h4=0.00001;
      if pi_h4>0.99999 then pi_h4=0.99999;
a4=(y-pi_h4)**2;  run;
proc means data=fi_ln4 noprint;     var a4;
      output out=save_a4 sum=aa4;   run;

data sample_n4;   set re_4;         set Uni;
pi_4=pi_h4-Uni_t; y_n4=ceil(pi_4);  run;

data multi_4;     set st_mean4;     do q=1 to &n_sample;
y_bm4=y_logb;     yb_tm4=yb_t4;     pi_bm=pi_b;
pi_bhm4=pi_bh4;   pi_bhtm4=pi_bht4; output;     end;  run;

data cal_dn4;     set re_4;   set re_t4;  set multi_4;      run;
data lio_4; set cal_dn4;
if pi_o<0.00001 then pi_o=0.00001;
if pi_o>0.99999 then pi_o=0.99999;
if pi_bm<0.00001 then pi_bm=0.00001;
if pi_bm>0.99999 then pi_bm=0.99999;
if pi_h4<0.00001 then pi_h4=0.00001;
if pi_h4>0.99999 then pi_h4=0.99999;
if y_bm4<0.00001 then y_bm4=0.00001;
```

```
if y_bm4>0.99999 then y_bm4=0.99999;
if pi_ht4<0.00001 then pi_ht4=0.00001;
if pi_ht4>0.99999 then pi_ht4=0.99999;
if yb_tm4<0.00001 then yb_tm4=0.00001;
if yb_tm4>0.99999 then yb_tm4=0.99999;
L_pi4=(pi_o*(log(pi_o)))+((1-pi_o)*(log(1-pi_o)));
L_po4=(pi_bm*(log(pi_bm)))+((1-pi_bm)*(log(1-pi_bm)));
o_pi4=pi_o*(1-pi_o);    o_po4=pi_bm*(1-pi_bm);
L5_pi4=(pi_h4*(log(pi_h4)))+((1-pi_h4)*(log(1-pi_h4)));
L5_po4=(y_bm4*(log(y_bm4)))+((1-y_bm4)*(log(1-y_bm4)));
o4_pi4=pi_h4*(1-pi_h4); o4_po4=y_bm4*(1-y_bm4);
L5n_pi4=(pi_ht4*(log(pi_ht4)))+((1-pi_ht4)*(log(1-pi_ht4)));
L5n_po4=(yb_tm4*(log(yb_tm4)))+((1-yb_tm4)*(log(1-yb_tm4)));
o4n_pi4=pi_ht4*(1-pi_ht4);    o4n_po4=yb_tm4*(1-yb_tm4);
Lo_4=(y*(log(y_bm4)))+((1-y)*(log(1-y_bm4)));
LM_4=(y*(log(pi_h4)))+((1-y)*(log(1-pi_h4)));   run;

proc means data=lio_4 noprint;
      var L_pi4 L_po4 o_pi4 o_po4 L5_pi4 L5_po4 o4_pi4 o4_po4
L5n_pi4 L5n_po4 o4n_pi4 o4n_po4 Lo_4 LM_4;
output out=ex_p4 sum=sL_pi4 sL_po4 so_pi4 so_po4 sL5_pi4 sL5_po4
so4_pi4 so4_po4 sL5n_pi4 sL5n_po4 so4n_pi4 so4n_po4 L_o4 L_M4; run;

data rr;          set s_mean;       set save_a4;      set ex_p4;
Ro_true4=1-(so_pi4/so_po4);   Rl_true4=1-(sL_pi4/sL_po4);
Ro_4=1-(aa4/Sum_S);           Rl_4=1-(-L_M4/-L_o4);
Ro_MS4=1-(((&n_sample-1)*aa4)/((&n_sample-&p-1)*Sum_S));
Rl_MS4=1-((L_M4-((&p+1)/2))/(L_o4-0.5));
Ro_LM4=1-((aa4-so4n_pi4+so4_pi4)/(Sum_S-so4n_po4+so4_po4));
Rl_LM4=1-((-L_M4+sL5n_pi4-sL5_pi4)/(-L_o4+sL5n_po4-sL5_po4));
Rl_DEV4=(1-(exp(-2*(L_M4-L_o4)/&n_sample)))/(1-
      (exp(2*L_o4/&n_sample)));
Rl_AIC4=1-((L_M4-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o4-1));
```

กรณีตัวแบบ $(M31)$

```
data fi_ln3;      set re_3;
if pi_h3<0.00001 then pi_h3=0.00001;
if pi_h3>0.99999 then pi_h3=0.99999;      a3=(y-pi_h3)**2;  run;
proc means data=fi_ln3 noprint;     var a3;
output out=save_a3 sum=aa3;         run;

data sample_n3;   set re_3;   set Uni;    pi_3=pi_h3-Uni_t;
                  y_n3=ceil(pi_3);        run;

data multi_3;     set st_mean3;     do q=1 to &n_sample;
y_bm=yb;          yb_tm3=yb_t3;     pi_bm=pi_b;
pi_bhm3=pi_bh3;   pi_bhtm3=pi_bht3; output;     end;  run;
data cal_dn3;     set re_3;   set re_t3;  set multi_3;      run;
data lio_3;       set cal_dn3;
if pi_o<0.00001 then pi_o=0.00001;
if pi_o>0.99999 then pi_o=0.99999;
if pi_bm<0.00001 then pi_bm=0.00001;
if pi_bm>0.99999 then pi_bm=0.99999;
if pi_h3<0.00001 then pi_h3=0.00001;
if pi_h3>0.99999 then pi_h3=0.99999;
```

```
if y_bm<0.00001 then y_bm=0.00001;
if y_bm>0.99999 then y_bm=0.99999;
if pi_ht3<0.00001 then pi_ht3=0.00001;
if pi_ht3>0.99999 then pi_ht3=0.99999;
if yb_tm3<0.00001 then yb_tm3=0.00001;
if yb_tm3>0.99999 then yb_tm3=0.99999;
L_pi3=(pi_o*(log(pi_o)))+((1-pi_o)*(log(1-pi_o)));
L_po3=(pi_bm*(log(pi_bm)))+((1-pi_bm)*(log(1-pi_bm)));
o_pi3=pi_o*(1-pi_o);    o_po3=pi_bm*(1-pi_bm);
L5_pi3=(pi_h3*(log(pi_h3)))+((1-pi_h3)*(log(1-pi_h3)));
L5_po3=(y_bm*(log(y_bm)))+((1-y_bm)*(log(1-y_bm)));
o4_pi3=pi_h3*(1-pi_h3); o4_po3=y_bm*(1-y_bm);
L5n_pi3=(pi_ht3*(log(pi_ht3)))+((1-pi_ht3)*(log(1-pi_ht3)));
L5n_po3=(yb_tm3*(log(yb_tm3)))+((1-yb_tm3)*(log(1-yb_tm3)));
o4n_pi3=pi_ht3*(1-pi_ht3);    o4n_po3=yb_tm3*(1-yb_tm3);
Lo_3=(y*(log(y_bm)))+((1-y)*(log(1-y_bm)));
LM_3=(y*(log(pi_h3)))+((1-y)*(log(1-pi_h3)));   run;

proc means data=lio_3 noprint;
var L_pi3 L_po3 o_pi3 o_po3 L5_pi3 L5_po3 o4_pi3 o4_po3
L5n_pi3 L5n_po3 o4n_pi3 o4n_po3 Lo_3 LM_3;
output out=ex_p3 sum=sL_pi3 sL_po3 so_pi3 so_po3 sL5_pi3 sL5_po3
so4_pi3 so4_po3  sL5n_pi3 sL5n_po3 so4n_pi3 so4n_po3 L_o3 L_M3;run;

data rr;          set s_mean;       set save_a3;      set ex_p3;
Ro_true3=1-(so_pi3/so_po3);   Rl_true3=1-(sL_pi3/sL_po3);
Ro_3=1-(aa3/Sum_S);           Rl_3=1-(-L_M3/-L_o3);
Ro_MS3=1-(((&n_sample-1)*aa3)/((&n_sample-&p-1)*Sum_S));
Rl_MS3=1-((L_M3-((&p+1)/2))/(L_o3-0.5));
Ro_LM3=1-((aa3-so4n_pi3+so4_pi3)/(Sum_S-so4n_po3+so4_po3));
Rl_LM3=1-((-L_M3+sL5n_pi3-sL5_pi3)/(-L_o3+sL5n_po3-sL5_po3));
Rl_DEV3=(1-(exp(-2*(L_M3-L_o3)/&n_sample)))/(1-
      (exp(2*L_o3/&n_sample)));
Rl_AIC3=1-((L_M3-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o3-1));
```

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 5 ตัว คือ

กรณีตัวแบบ $(M05)$ เหมือนกับตัวแบบ $(M01)$ เปลี่ยนแค่การเขียน

```
data rr;          set save_a;       set s_mean;       set ex_p;
Ro_true=1-(so_pi/so_po);            Rl_true=1-(sL_pi/sL_po);
Ro=1-(aa/Sum_S);                    Rl=1-(-L_M/-L_o);
Ro_MS=1-(((&n_sample-1)*aa)/((&n_sample-&p-1)*Sum_S));
Rl_MS=1-((L_M-((&p+1)/2))/(L_o-0.5));
Ro_LM=1-((aa-so4n_pi+so4_pi)/(Sum_S-so4n_po+so4_po));
Rl_LM=1-((-L_M+sL5n_pi-sL5_pi)/(-L_o+sL5n_po-sL5_po));
Rl_DEV=(1-(exp(-2*(L_M-L_o)/&n_sample)))/(1-(exp(2*L_o/&n_sample)));
Rl_AIC=1-((L_M-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o-1));
```

กรณีตัวแบบ $(M15)$ เหมือนกับตัวแบบ $(M11)$ เปลี่ยนแค่การเขียน

```
data rr;          set s_mean;       set save_a2;      set ex_p2;
Ro_true2=1-(so_pi2/so_po2);         Rl_true2=1-(sL_pi2/sL_po2);
Ro_2=1-(aa2/Sum_S);                 Rl_2=1-(-L_M2/-L_o2);
```

```
Ro_MS2=1-(((&n_sample-1)*aa2)/((&n_sample-&p-1)*Sum_S));
Rl_MS2=1-((L_M2-((&p+1)/2))/(L_o2-0.5));
Ro_LM2=1-((aa2-so4n_pi2+so4_pi2)/(Sum_S-so4n_po2+so4_po2));
Rl_LM2=1-((-L_M2+sL5n_pi2-sL5_pi2)/(-L_o2+sL5n_po2-sL5_po2));
Rl_DEV2=(1-(exp(-2*(L_M2-L_o2)/&n_sample)))/(1-
(exp(2*L_o2/&n_sample)));
Rl_AIC2=1-((L_M2-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o2-1));
```

กรณีตัวแบบ $(M25)$ เหมือนกับตัวแบบ $(M21)$ เปลี่ยนแค่การเขียน

```
data rr;          set s_mean;       set save_a4;      set ex_p4;
Ro_true4=1-(so_pi4/so_po4);         Rl_true4=1-(sL_pi4/sL_po4);
Ro_4=1-(aa4/Sum_S);                 Rl_4=1-(-L_M4/-L_o4);
Ro_MS4=1-(((&n_sample-1)*aa4)/((&n_sample-&p-1)*Sum_S));
Rl_MS4=1-((L_M4-((&p+1)/2))/(L_o4-0.5));
Ro_LM4=1-((aa4-so4n_pi4+so4_pi4)/(Sum_S-so4n_po4+so4_po4));
Rl_LM4=1-((-L_M4+sL5n_pi4-sL5_pi4)/(-L_o4+sL5n_po4-sL5_po4));
Rl_DEV4=(1-(exp(-2*(L_M4-L_o4)/&n_sample)))/(1-
(exp(2*L_o4/&n_sample)));
Rl_AIC4=1-((L_M4-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o4-1));
```

กรณีตัวแบบ $(M35)$ เหมือนกับตัวแบบ $(M31)$ เปลี่ยนแค่การเขียน

```
data rr;          set s_mean;       set save_a3;      set ex_p3;
Ro_true3=1-(so_pi3/so_po3);         Rl_true3=1-(sL_pi3/sL_po3);
Ro_3=1-(aa3/Sum_S);                 Rl_3=1-(-L_M3/-L_o3);
Ro_MS3=1-(((&n_sample-1)*aa3)/((&n_sample-&p-1)*Sum_S));
Rl_MS3=1-((L_M3-((&p+1)/2))/(L_o3-0.5));
Ro_LM3=1-((aa3-so4n_pi3+so4_pi3)/(Sum_S-so4n_po3+so4_po3));
Rl_LM3=1-((-L_M3+sL5n_pi3-sL5_pi3)/(-L_o3+sL5n_po3-sL5_po3));
Rl_DEV3=(1-(exp(-2*(L_M3-L_o3)/&n_sample)))/(1-
(exp(2*L_o3/&n_sample)));
Rl_AIC3=1-((L_M3-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o3-1));
```

กรณีตัวแบบ $(M45)$

```
data fi_ln6;            set re_6;
      if pi_h6<0.00001 then pi_h6=0.00001;
      if pi_h6>0.99999 then pi_h6=0.99999;
      a6=(y-pi_h6)**2;  run;
proc means data=fi_ln6 noprint;     var a6;
      output out=save_a6 sum=aa6;   run;

data sample_n6;         set re_6;         set Uni;
pi_6=pi_h6-Uni_t;       y_n6=ceil(pi_6);  run;

data multi_6;           set st_mean6;           do q=1 to &n_sample;
y_bm=yb;                yb_tm6=yb_t6;           pi_bm=pi_b;
pi_bhm6=pi_bh6;         pi_bhtm6=pi_bht6;       output; end; run;

data cal_dn6;     set re_6;   set re_t6;  set multi_6; run;
data lio_6;       set cal_dn6;
if pi_o<0.00001 then pi_o=0.00001;
```

```
if pi_o>0.99999 then pi_o=0.99999;
if pi_bm<0.00001 then pi_bm=0.00001;
if pi_bm>0.99999 then pi_bm=0.99999;
if pi_h6<0.00001 then pi_h6=0.00001;
if pi_h6>0.99999 then pi_h6=0.99999;
if y_bm<0.00001 then y_bm=0.00001;
if y_bm>0.99999 then y_bm=0.99999;
if pi_ht6<0.00001 then pi_ht6=0.00001;
if pi_ht6>0.99999 then pi_ht6=0.99999;
if yb_tm6<0.00001 then yb_tm6=0.00001;
if yb_tm6>0.99999 then yb_tm6=0.99999;
L_pi6=(pi_o*(log(pi_o)))+((1-pi_o)*(log(1-pi_o)));
L_po6=(pi_bm*(log(pi_bm)))+((1-pi_bm)*(log(1-pi_bm)));
o_pi6=pi_o*(1-pi_o);          o_po6=pi_bm*(1-pi_bm);
L5_pi6=(pi_h6*(log(pi_h6)))+((1-pi_h6)*(log(1-pi_h6)));
L5_po6=(y_bm*(log(y_bm)))+((1-y_bm)*(log(1-y_bm)));
o4_pi6=pi_h6*(1-pi_h6);       o4_po6=y_bm*(1-y_bm);
L5n_pi6=(pi_ht6*(log(pi_ht6)))+((1-pi_ht6)*(log(1-pi_ht6)));
L5n_po6=(yb_tm6*(log(yb_tm6)))+((1-yb_tm6)*(log(1-yb_tm6)));
o4n_pi6=pi_ht6*(1-pi_ht6);    o4n_po6=yb_tm6*(1-yb_tm6);
Lo_6=(y*(log(y_bm)))+((1-y)*(log(1-y_bm)));
LM_6=(y*(log(pi_h6)))+((1-y)*(log(1-pi_h6))); run;

proc means data=lio_6 noprint;
var L_pi6 L_po6 o_pi6 o_po6 L5_pi6 L5_po6 o4_pi6 o4_po6 L5n_pi6
L5n_po6 o4n_pi6 o4n_po6 Lo_6 LM_6;
output out=ex_p6 sum=sL_pi6 sL_po6 so_pi6 so_po6 sL5_pi6 sL5_po6
so4_pi6 so4_po6 sL5n_pi6 sL5n_po6 so4n_pi6 so4n_po6 L_o6 L_M6; run;

data rr;          set s_mean;       set save_a6;      set ex_p6;
Ro_true6=1-(so_pi6/so_po6);         Rl_true6=1-(sL_pi6/sL_po6);
Ro_6=1-(aa6/Sum_S);                 Rl_6=1-(-L_M6/-L_o6);
Ro_MS6=1-(((&n_sample-1)*aa6)/((&n_sample-4-1)*Sum_S));
Rl_MS6=1-((L_M6-((4+1)/2))/(L_o6-0.5));
Ro_LM6=1-((aa6-so4n_pi6+so4_pi6)/(Sum_S-so4n_po6+so4_po6));
Rl_LM6=1-((-L_M6+sL5n_pi6-sL5_pi6)/(-L_o6+sL5n_po6-sL5_po6));
Rl_DEV6=(1-(exp(-2*(L_M6-L_o6)/&n_sample)))/(1-
(exp(2*L_o6/&n_sample)));
Rl_AIC6=1-((L_M6-((4+1)*(&n_sample-1)/(&n_sample-4-1)))/(L_o6-1));
```

กรณีตัวแบบ $(M55)$

```
data fi_ln7;            set re_7;
      if pi_h7<0.00001 then pi_h7=0.00001;
      if pi_h7>0.99999 then pi_h7=0.99999;
      a7=(y-pi_h7)**2;  run;
proc means data=fi_ln7 noprint;          var a7;
      output out=save_a7 sum=aa7;        run;

data sample_n7;         set re_7;        set Uni;
pi_7=pi_h7-Uni_t;       y_n7=ceil(pi_7); run;

data multi_7;           set st_mean7;          do q=1 to &n_sample;
y_bm=yb;                yb_tm7=yb_t7;          pi_bm=pi_b;
pi_bhm7=pi_bh7;         pi_bhtm7=pi_bht7;      output; end; run;
```

```
data cal_dn7;     set re_7;   set re_t7;  set multi_7;      run;
data lio_7;       set cal_dn7;
if pi_o<0.00001 then pi_o=0.00001;
if pi_o>0.99999 then pi_o=0.99999;
if pi_bm<0.00001 then pi_bm=0.00001;
if pi_bm>0.99999 then pi_bm=0.99999;
if pi_h7<0.00001 then pi_h7=0.00001;
if pi_h7>0.99999 then pi_h7=0.99999;
if y_bm<0.00001 then y_bm=0.00001;
if y_bm>0.99999 then y_bm=0.99999;
if pi_ht7<0.00001 then pi_ht7=0.00001;
if pi_ht7>0.99999 then pi_ht7=0.99999;
if yb_tm7<0.00001 then yb_tm7=0.00001;
if yb_tm7>0.99999 then yb_tm7=0.99999;

L_pi7=(pi_o*(log(pi_o)))+((1-pi_o)*(log(1-pi_o)));
L_po7=(pi_bm*(log(pi_bm)))+((1-pi_bm)*(log(1-pi_bm)));
o_pi7=pi_o*(1-pi_o);          o_po7=pi_bm*(1-pi_bm);
L5_pi7=(pi_h7*(log(pi_h7)))+((1-pi_h7)*(log(1-pi_h7)));
L5_po7=(y_bm*(log(y_bm)))+((1-y_bm)*(log(1-y_bm)));
o4_pi7=pi_h7*(1-pi_h7);       o4_po7=y_bm*(1-y_bm);
L5n_pi7=(pi_ht7*(log(pi_ht7)))+((1-pi_ht7)*(log(1-pi_ht7)));
L5n_po7=(yb_tm7*(log(yb_tm7)))+((1-yb_tm7)*(log(1-yb_tm7)));
o4n_pi7=pi_ht7*(1-pi_ht7);    o4n_po7=yb_tm7*(1-yb_tm7);
Lo_7=(y*(log(y_bm)))+((1-y)*(log(1-y_bm)));
LM_7=(y*(log(pi_h7)))+((1-y)*(log(1-pi_h7))); run;

proc means data=lio_7 noprint;
      var L_pi7 L_po7 o_pi7 o_po7 L5_pi7 L5_po7 o4_pi7 o4_po7
L5n_pi7 L5n_po7 o4n_pi7 o4n_po7 Lo_7 LM_7;
output out=ex_p7 sum=sL_pi7 sL_po7 so_pi7 so_po7 sL5_pi7 sL5_po7
so4_pi7 so4_po7 sL5n_pi7 sL5n_po7 so4n_pi7 so4n_po7 L_o7 L_M7; run;

data rr;          set s_mean;       set save_a7;      set ex_p7;
Ro_true7=1-(so_pi7/so_po7);         Rl_true7=1-(sL_pi7/sL_po7);
Ro_7=1-(aa7/Sum_S);                 Rl_7=1-(-L_M7/-L_o7);
Ro_MS7=1-(((&n_sample-1)*aa7)/((&n_sample-4-1)*Sum_S));
Rl_MS7=1-((L_M7-((4+1)/2))/(L_o7-0.5));
Ro_LM7=1-((aa7-so4n_pi7+so4_pi7)/(Sum_S-so4n_po7+so4_po7));
Rl_LM7=1-((-L_M7+sL5n_pi7-sL5_pi7)/(-L_o7+sL5n_po7-sL5_po7));
Rl_DEV7=(1-(exp(-2*(L_M7-L_o7)/&n_sample)))/(1-
(exp(2*L_o7/&n_sample)));
Rl_AIC7=1-((L_M7-((4+1)*(&n_sample-1)/(&n_sample-4-1)))/(L_o7-1));
```

กรณีตัวแบบ $(M65)$

```
data fi_ln8;      set re_8;
      if pi_h8<0.00001 then pi_h8=0.00001;
      if pi_h8>0.99999 then pi_h8=0.99999;
      a8=(y-pi_h8)**2; run;
proc means data=fi_ln8 noprint;     var a8;
      output out=save_a8 sum=aa8;   run;

data sample_n8;   set re_8;   set Uni;    pi_8=pi_h8-Uni_t;
y_n8=ceil(pi_8);  run;
```

```
data multi_8;          set st_mean8;          do q=1 to &n_sample;
y_bm=yb;               yb_tm8=yb_t8;          pi_bm=pi_b;
pi_bhm8=pi_bh8;        pi_bhtm8=pi_bht8;      output; end; run;

data cal_dn8;     set re_8;   set re_t8;  set multi_8; run;
data lio_8;       set cal_dn8;
if pi_o<0.00001 then pi_o=0.00001;
if pi_o>0.99999 then pi_o=0.99999;
if pi_bm<0.00001 then pi_bm=0.00001;
if pi_bm>0.99999 then pi_bm=0.99999;
if pi_h8<0.00001 then pi_h8=0.00001;
if pi_h8>0.99999 then pi_h8=0.99999;
if y_bm<0.00001 then y_bm=0.00001;
if y_bm>0.99999 then y_bm=0.99999;
if pi_ht8<0.00001 then pi_ht8=0.00001;
if pi_ht8>0.99999 then pi_ht8=0.99999;
if yb_tm8<0.00001 then yb_tm8=0.00001;
if yb_tm8>0.99999 then yb_tm8=0.99999;

L_pi8=(pi_o*(log(pi_o)))+((1-pi_o)*(log(1-pi_o)));
L_po8=(pi_bm*(log(pi_bm)))+((1-pi_bm)*(log(1-pi_bm)));
o_pi8=pi_o*(1-pi_o);    o_po8=pi_bm*(1-pi_bm);
L5_pi8=(pi_h8*(log(pi_h8)))+((1-pi_h8)*(log(1-pi_h8)));
L5_po8=(y_bm*(log(y_bm)))+((1-y_bm)*(log(1-y_bm)));
o4_pi8=pi_h8*(1-pi_h8); o4_po8=y_bm*(1-y_bm);
L5n_pi8=(pi_ht8*(log(pi_ht8)))+((1-pi_ht8)*(log(1-pi_ht8)));
L5n_po8=(yb_tm8*(log(yb_tm8)))+((1-yb_tm8)*(log(1-yb_tm8)));
o4n_pi8=pi_ht8*(1-pi_ht8);    o4n_po8=yb_tm8*(1-yb_tm8);
Lo_8=(y*(log(y_bm)))+((1-y)*(log(1-y_bm)));
LM_8=(y*(log(pi_h8)))+((1-y)*(log(1-pi_h8))); run;

proc means data=lio_8 noprint;
      var L_pi8 L_po8 o_pi8 o_po8 L5_pi8 L5_po8 o4_pi8 o4_po8
L5n_pi8 L5n_po8 o4n_pi8 o4n_po8 Lo_8 LM_8;
output out=ex_p8 sum=sL_pi8 sL_po8 so_pi8 so_po8 sL5_pi8 sL5_po8
so4_pi8 so4_po8 sL5n_pi8 sL5n_po8 so4n_pi8 so4n_po8 L_o8 L_M8; run;

data rr;          set s_mean;       set save_a9;      set ex_p9;
Ro_true8=1-(so_pi8/so_po8);         Rl_true8=1-(sL_pi8/sL_po8);
Ro_8=1-(aa8/Sum_S);                 Rl_8=1-(-L_M8/-L_o8);
Ro_MS8=1-(((&n_sample-1)*aa8)/((&n_sample-1-1)*Sum_S));
Rl_MS8=1-((L_M8-((1+1)/2))/(L_o8-0.5));
Ro_LM8=1-((aa8-so4n_pi8+so4_pi8)/(Sum_S-so4n_po8+so4_po8));
Rl_LM8=1-((-L_M8+sL5n_pi8-sL5_pi8)/(-L_o8+sL5n_po8-sL5_po8));
Rl_DEV8=(1-(exp(-2*(L_M8-L_o8)/&n_sample)))/(1-
(exp(2*L_o8/&n_sample)));
Rl_AIC8=1-((L_M8-((1+1)*(&n_sample-1)/(&n_sample-1-1)))/(L_o8-1));
```

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 10 ตัว คือ กรณีตัวแบบ $(M010)$ เหมือนกับตัวแบบ $(M01)$ เปลี่ยนแค่การเขียน

```
data rr;          set save_a;       set s_mean;       set ex_p;
Ro_true=1-(so_pi/so_po);            Rl_true=1-(sL_pi/sL_po);
Ro=1-(aa/Sum_S);                    Rl=1-(-L_M/-L_o);
Ro_MS=1-(((&n_sample-1)*aa)/((&n_sample-&p-1)*Sum_S));
```

```
Rl_MS=1-((L_M-((&p+1)/2))/(L_o-0.5));
Ro_LM=1-((aa-so4n_pi+so4_pi)/(Sum_S-so4n_po+so4_po));
Rl_LM=1-((-L_M+sL5n_pi-sL5_pi)/(-L_o+sL5n_po-sL5_po));
Rl_DEV=(1-(exp(-2*(L_M-L_o)/&n_sample)))/(1-(exp(2*L_o/&n_sample)));
Rl_AIC=1-((L_M-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o-1));
```

กรณีตัวแบบ $(M110)$ เหมือนกับตัวแบบ $(M11)$ เปลี่ยนแค่การเขียน

```
data rr;          set s_mean;       set save_a2;      set ex_p2;
Ro_true2=1-(so_pi2/so_po2);         Rl_true2=1-(sL_pi2/sL_po2);
Ro_2=1-(aa2/Sum_S);                 Rl_2=1-(-L_M2/-L_o2);
Ro_MS2=1-(((&n_sample-1)*aa2)/((&n_sample-&p-1)*Sum_S));
Rl_MS2=1-((L_M2-((&p+1)/2))/(L_o2-0.5));
Ro_LM2=1-((aa2-so4n_pi2+so4_pi2)/(Sum_S-so4n_po2+so4_po2));
Rl_LM2=1-((-L_M2+sL5n_pi2-sL5_pi2)/(-L_o2+sL5n_po2-sL5_po2));
Rl_DEV2=(1-(exp(-2*(L_M2-L_o2)/&n_sample)))/(1-
(exp(2*L_o2/&n_sample)));
Rl_AIC2=1-((L_M2-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o2-1));
```

กรณีตัวแบบ $(M210)$ เหมือนกับตัวแบบ $(M21)$ เปลี่ยนแค่การเขียน

```
data rr;          set s_mean;       set save_a4;      set ex_p4;
Ro_true4=1-(so_pi4/so_po4);         Rl_true4=1-(sL_pi4/sL_po4);
Ro_4=1-(aa4/Sum_S);                 Rl_4=1-(-L_M4/-L_o4);
Ro_MS4=1-(((&n_sample-1)*aa4)/((&n_sample-&p-1)*Sum_S));
Rl_MS4=1-((L_M4-((&p+1)/2))/(L_o4-0.5));
Ro_LM4=1-((aa4-so4n_pi4+so4_pi4)/(Sum_S-so4n_po4+so4_po4));
Rl_LM4=1-((-L_M4+sL5n_pi4-sL5_pi4)/(-L_o4+sL5n_po4-sL5_po4));
Rl_DEV4=(1-(exp(-2*(L_M4-L_o4)/&n_sample)))/(1-
(exp(2*L_o4/&n_sample)));
Rl_AIC4=1-((L_M4-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o4-1));
```

กรณีตัวแบบ $(M310)$ เหมือนกับตัวแบบ $(M31)$ เปลี่ยนแค่การเขียน

```
data rr;          set s_mean;       set save_a3;      set ex_p3;
Ro_true3=1-(so_pi3/so_po3);         Rl_true3=1-(sL_pi3/sL_po3);
Ro_3=1-(aa3/Sum_S);                 Rl_3=1-(-L_M3/-L_o3);
Ro_MS3=1-(((&n_sample-1)*aa3)/((&n_sample-&p-1)*Sum_S));
Rl_MS3=1-((L_M3-((&p+1)/2))/(L_o3-0.5));
Ro_LM3=1-((aa3-so4n_pi3+so4_pi3)/(Sum_S-so4n_po3+so4_po3));
Rl_LM3=1-((-L_M3+sL5n_pi3-sL5_pi3)/(-L_o3+sL5n_po3-sL5_po3));
Rl_DEV3=(1-(exp(-2*(L_M3-L_o3)/&n_sample)))/(1-
(exp(2*L_o3/&n_sample)));
Rl_AIC3=1-((L_M3-((&p+1)*(&n_sample-1)/(&n_sample-&p-1)))/(L_o3-1));
```

กรณีตัวแบบ $(M410)$

```
data fi_ln5;            set re_5;
      if pi_h5<0.00001 then pi_h5=0.00001;
      if pi_h5>0.99999 then pi_h5=0.99999;
      a5=(y-pi_h5)**2;  run;
```

```
proc means data=fi_ln5 noprint;     var a5;
      output out=save_a5 sum=aa5;   run;

data sample_n5;         set re_5;         set Uni;
pi_5=pi_h5-Uni_t;       y_n5=ceil(pi_5);  run;

data multi_5;           set st_mean5;           do q=1 to &n_sample;
y_bm=yb;                yb_tm5=yb_t5;           pi_bm=pi_b;
pi_bhm5=pi_bh5;         pi_bhtm5=pi_bht5;       output; end; run;

data cal_dn5;     set re_5;   set re_t5;  set multi_5;      run;
data lio_5;       set cal_dn5;
if pi_o<0.00001 then pi_o=0.00001;
if pi_o>0.99999 then pi_o=0.99999;
if pi_bm<0.00001 then pi_bm=0.00001;
if pi_bm>0.99999 then pi_bm=0.99999;
if pi_h5<0.00001 then pi_h5=0.00001;
if pi_h5>0.99999 then pi_h5=0.99999;
if y_bm<0.00001 then y_bm=0.00001;
if y_bm>0.99999 then y_bm=0.99999;
if pi_ht5<0.00001 then pi_ht5=0.00001;
if pi_ht5>0.99999 then pi_ht5=0.99999;
if yb_tm5<0.00001 then yb_tm5=0.00001;
if yb_tm5>0.99999 then yb_tm5=0.99999;
L_pi5=(pi_o*(log(pi_o)))+((1-pi_o)*(log(1-pi_o)));
L_po5=(pi_bm*(log(pi_bm)))+((1-pi_bm)*(log(1-pi_bm)));
o_pi5=pi_o*(1-pi_o);          o_po5=pi_bm*(1-pi_bm);
L5_pi5=(pi_h5*(log(pi_h5)))+((1-pi_h5)*(log(1-pi_h5)));
L5_po5=(y_bm*(log(y_bm)))+((1-y_bm)*(log(1-y_bm)));
o4_pi5=pi_h5*(1-pi_h5);       o4_po5=y_bm*(1-y_bm);
L5n_pi5=(pi_ht5*(log(pi_ht5)))+((1-pi_ht5)*(log(1-pi_ht5)));
L5n_po5=(yb_tm5*(log(yb_tm5)))+((1-yb_tm5)*(log(1-yb_tm5)));
o4n_pi5=pi_ht5*(1-pi_ht5);    o4n_po5=yb_tm5*(1-yb_tm5);
Lo_5=(y*(log(y_bm)))+((1-y)*(log(1-y_bm)));
LM_5=(y*(log(pi_h5)))+((1-y)*(log(1-pi_h5))); run;

proc means data=lio_5 noprint;
      var   L_pi5 L_po5 o_pi5 o_po5 L5_pi5 L5_po5 o4_pi5 o4_po5
            L5n_pi5 L5n_po5 o4n_pi5 o4n_po5 Lo_5 LM_5;
output out=ex_p5 sum=sL_pi5 sL_po5 so_pi5 so_po5 sL5_pi5 sL5_po5
so4_pi5 so4_po5 sL5n_pi5 sL5n_po5 so4n_pi5 so4n_po5 L_o5 L_M5; run;

data rr;          set s_mean;       set save_a5;      set ex_p5;
Ro_true5=1-(so_pi5/so_po5);         Rl_true5=1-(sL_pi5/sL_po5);
Ro_5=1-(aa5/Sum_S);                 Rl_5=1-(-L_M5/-L_o5);
Ro_MS5=1-(((&n_sample-1)*aa5)/((&n_sample-8-1)*Sum_S));
Rl_MS5=1-((L_M5-((8+1)/2))/(L_o5-0.5));
Ro_LM5=1-((aa5-so4n_pi5+so4_pi5)/(Sum_S-so4n_po5+so4_po5));
Rl_LM5=1-((-L_M5+sL5n_pi5-sL5_pi5)/(-L_o5+sL5n_po5-sL5_po5));
Rl_DEV5=(1-(exp(-2*(L_M5-L_o5)/&n_sample)))/(1-
(exp(2*L_o5/&n_sample)));
Rl_AIC5=1-((L_M5-((8+1)*(&n_sample-1)/(&n_sample-8-1)))/(L_o5-1));
```

กรณีตัวแบบ $(M510)$ เหมือนกับตัวแบบ $(M45)$ เปลี่ยนแค่การเขียน

```
data rr;          set s_mean;       set save_a6;      set ex_p6;
Ro_true6=1-(so_pi6/so_po6);         Rl_true6=1-(sL_pi6/sL_po6);
```

```
Ro_6=1-(aa6/Sum_S);                Rl_6=1-(-L_M6/-L_o6);
Ro_MS6=1-(((&n_sample-1)*aa6)/((&n_sample-8-1)*Sum_S));
Rl_MS6=1-((L_M6-((8+1)/2))/(L_o6-0.5));
Ro_LM6=1-((aa6-so4n_pi6+so4_pi6)/(Sum_S-so4n_po6+so4_po6));
Rl_LM6=1-((-L_M6+sL5n_pi6-sL5_pi6)/(-L_o6+sL5n_po6-sL5_po6));
Rl_DEV6=(1-(exp(-2*(L_M6-L_o6)/&n_sample)))/(1-
(exp(2*L_o6/&n_sample)));
Rl_AIC6=1-((L_M6-((8+1)*(&n_sample-1)/(&n_sample-8-1)))/(L_o6-1));
```

กรณีตัวแบบ $(M610)$ เหมือนกับตัวแบบ $(M65)$ เปลี่ยนแค่การเขียน

```
data rr;          set s_mean;      set save_a8;      set ex_p8;
Ro_true8=1-(so_pi8/so_po8);              Rl_true8=1-(sL_pi8/sL_po8);
Ro_8=1-(aa8/Sum_S);                      Rl_8=1-(-L_M8/-L_o8);
Ro_MS8=1-(((&n_sample-1)*aa8)/((&n_sample-2-1)*Sum_S));
Rl_MS8=1-((L_M8-((2+1)/2))/(L_o8-0.5));
Ro_LM8=1-((aa8-so4n_pi8+so4_pi8)/(Sum_S-so4n_po8+so4_po8));
Rl_LM8=1-((-L_M8+sL5n_pi8-sL5_pi8)/(-L_o8+sL5n_po8-sL5_po8));
Rl_DEV8=(1-(exp(-2*(L_M8-L_o8)/&n_sample)))/(1-
(exp(2*L_o8/&n_sample)));
Rl_AIC8=1-((L_M8-((2+1)*(&n_sample-1)/(&n_sample-2-1)))/(L_o8-1));
```

โปรแกรมสำหรับการคำนวณค่าสถิติได้แก่ R^2 , bias, relative bias, RMSE และ out of range(%) ของค่าสัมประสิทธิ์การตัดสินใจ (R^2) และสัมประสิทธิ์การตัดสินใจที่ปรับค่า (R^2_{adj}) แบบต่างๆ

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 1 ตัว คือ กรณีตัวแบบ $(M01)$

```
/*----------Find RMSE----------*/
data RMSE;  set rr;
ERo=(Ro_true-Ro)**2;               ERl=(Rl_true-Rl)**2;
ERo_MS=(Ro_true-Ro_MS)**2;         ERl_MS=(Rl_true-Rl_MS)**2;
ERo_LM=(Ro_true-Ro_LM)**2;         ERl_LM=(Rl_true-Rl_LM)**2;
ERl_DEV=(Rl_true-Rl_DEV)**2;       ERl_AIC=(Rl_true-Rl_AIC)**2;

data RootM;                  set ROOT;
rRo=sqrt(mRo);               rRl=sqrt(mRl);
rRo_MS=sqrt(mRo_MS);         rRl_MS=sqrt(mRl_MS);
rRo_LM=sqrt(mRo_LM);         rRl_LM=sqrt(mRl_LM);
rRl_DEV=sqrt(mRl_DEV);       rRl_AIC=sqrt(mRl_AIC);

data out;                    set summary;
if Ro_true=. then delete;    if Ro_true2=. then delete;
if Ro_true3=. then delete;   if Ro_true4=. then delete;
i=_N_;                       if i>&nsim then delete;
if(Ro>0 and Ro<1) then Ro=bb; if(Rl>0 and Rl<1) then Rl=cc;
if(Ro_MS>0 and Ro_MS<1) then Ro_MS=dd;
if(Rl_MS>0 and Rl_MS<1) then Rl_MS=ee;
```

```
if(Ro_LM>0 and Ro_LM<1) then Ro_LM=ff;
if(Rl_LM>0 and Rl_LM<1) then Rl_LM=gg;
if(Rl_DEV>0 and Rl_DEV<1) then Rl_DEV=hh;
if(Rl_AIC>0 and Rl_AIC<1) then Rl_AIC=ii; run;

data count_p;                          set count;
pRo=nRo*100/nRo_true;                  pRl=nRl*100/nRo_true;
pRo_MS=nRo_MS*100/nRo_true;            pRl_MS=nRl_MS*100/nRo_true;
pRo_LM=nRo_LM*100/nRo_true;            pRl_LM=nRl_LM*100/nRo_true;
pRl_DEV=nRl_DEV*100/nRo_true;          pRl_AIC=nRl_AIC*100/nRo_true;
run;

proc means data=RootM mean;
title 'Root Mean Square Error for True Models';
var rRo rRl rRo_MS rRl_MS rRo_LM rRl_LM rRl_DEV rRl_AIC; run;
proc means data=count_p mean;
      title 'Percent of R2 out. for True Models';
var pRo pRl pRo_MS pRl_MS pRo_LM pRl_LM pRl_DEV pRl_AIC; run;
proc means data=summary n mean median std min max;
      title 'Summary statistics of 1,000 values for True Models';
var Ro_true Rl_true Ro Rl Ro_MS Rl_MS Ro_LM Rl_LM Rl_DEV Rl_AIC; run;
```

กรณีตัวแบบ $(M11)$

```
/*----------Find RMSE----------*/
data RMSE;                             set rr;
ERo_2=(Ro_true2-Ro_2)**2;              ERl_2=(Rl_true2-Rl_2)**2;
ERo_MS2=(Ro_true2-Ro_MS2)**2;          ERl_MS2=(Rl_true2-Rl_MS2)**2;
ERo_LM2=(Ro_true2-Ro_LM2)**2;          ERl_LM2=(Rl_true2-Rl_LM2)**2;
ERl_DEV2=(Rl_true2-Rl_DEV2)**2;        ERl_AIC2=(Rl_true2-Rl_AIC2)**2;

data RootM;                        set ROOT;
rRo_2=sqrt(mRo_2);                 rRl_2=sqrt(mRl_2);
rRo_MS2=sqrt(mRo_MS2);             rRl_MS2=sqrt(mRl_MS2);
rRo_LM2=sqrt(mRo_LM2);             rRl_LM2=sqrt(mRl_LM2);
rRl_DEV2=sqrt(mRl_DEV2);           rRl_AIC2=sqrt(mRl_AIC2);

data out;                          set summary;
if Ro_true=. then delete;          if Ro_true2=. then delete;
if Ro_true3=. then delete;         if Ro_true4=. then delete;
i=_N_;                             if i>&nsim then delete;
if(Ro_2>0 and Ro_2<1) then Ro_2=bbb;
if(Rl_2>0 and Rl_2<1) then Rl_2=ccc;
if(Ro_MS2>0 and Ro_MS2<1) then Ro_MS2=ddd;
if(Rl_MS2>0 and Rl_MS2<1) then Rl_MS2=eee;
if(Ro_LM2>0 and Ro_LM2<1) then Ro_LM2=fff;
if(Rl_LM2>0 and Rl_LM2<1) then Rl_LM2=ggg;
if(Rl_DEV2>0 and Rl_DEV2<1) then Rl_DEV2=hhh;
if(Rl_AIC2>0 and Rl_AIC2<1) then Rl_AIC2=iii; run;

data count_p;                          set count;
pRo_2=nRo_2*100/nRo_tru2;              pRl_2=nRl_2*100/nRo_tru2;
pRo_MS2=nRo_MS2*100/nRo_tru2;          pRl_MS2=nRl_MS2*100/nRo_tru2;
pRo_LM2=nRo_LM2*100/nRo_tru2;          pRl_LM2=nRl_LM2*100/nRo_tru2;
pRl_DEV2=nRl_DEV2*100/nRo_tru2;        pRl_AIC2=nRl_AIC2*100/nRo_tru2;
run;
```

```
proc means data=RootM mean;
      title 'Root Mean Square Error for X1**2 Models';
var rRo_2 rRl_2 rRo_MS2 rRl_MS2 rRo_LM2 rRl_LM2 rRl_DEV2 rRl_AIC2;
run;
proc means data=count_p mean;
      title 'Percent of R2 out. for X1**2 Models';
var pRo_2 pRl_2 pRo_MS2 pRl_MS2 pRo_LM2 pRl_LM2 pRl_DEV2 pRl_AIC2;
run;
proc means data=summary n mean median std min max;
      title 'Summary statistics of 1,000 values for X1**2 Models';
var Ro_true2 Rl_true2 Ro_2 Rl_2 Ro_MS2 Rl_MS2 Ro_LM2 Rl_LM2 Rl_DEV2
Rl_AIC2; run;
```

กรณีตัวแบบ $(M21)$

```
/*----------Find RMSE----------*/
data RMSE;                          set rr;
ERo_4=(Ro_true4-Ro_4)**2;           ERl_4=(Rl_true4-Rl_4)**2;
ERo_MS4=(Ro_true4-Ro_MS4)**2;       ERl_MS4=(Rl_true4-Rl_MS4)**2;
ERo_LM4=(Ro_true4-Ro_LM4)**2;       ERl_LM4=(Rl_true4-Rl_LM4)**2;
ERl_DEV4=(Rl_true4-Rl_DEV4)**2;     ERl_AIC4=(Rl_true4-Rl_AIC4)**2;

data RootM;                     set ROOT;
rRo_4=sqrt(mRo_4);              rRl_4=sqrt(mRl_4);
rRo_MS4=sqrt(mRo_MS4);          rRl_MS4=sqrt(mRl_MS4);
rRo_LM4=sqrt(mRo_LM4);          rRl_LM4=sqrt(mRl_LM4);
rRl_DEV4=sqrt(mRl_DEV4);        rRl_AIC4=sqrt(mRl_AIC4);

data out;                       set summary;
if Ro_true=. then delete;       if Ro_true2=. then delete;
if Ro_true3=. then delete;      if Ro_true4=. then delete;
i=_N_;                          if i>&nsim then delete;
if(Ro_4>0 and Ro_4<1) then Ro_4=bbbb;
if(Rl_4>0 and Rl_4<1) then Rl_4=cccc;
if(Ro_MS4>0 and Ro_MS4<1) then Ro_MS4=dddd;
if(Rl_MS4>0 and Rl_MS4<1) then Rl_MS4=eeee;
if(Ro_LM4>0 and Ro_LM4<1) then Ro_LM4=ffff;
if(Rl_LM4>0 and Rl_LM4<1) then Rl_LM4=gggg;
if(Rl_DEV4>0 and Rl_DEV4<1) then Rl_DEV4=hhhh;
if(Rl_AIC4>0 and Rl_AIC4<1) then Rl_AIC4=iiii; run;

data count_p;                       set count;
pRo_4=nRo_4*100/nRo_tru4;           pRl_4=nRl_4*100/nRo_tru4;
pRo_MS4=nRo_MS4*100/nRo_tru4;       pRl_MS4=nRl_MS4*100/nRo_tru4;
pRo_LM4=nRo_LM4*100/nRo_tru4;       pRl_LM4=nRl_LM4*100/nRo_tru4;
pRl_DEV4=nRl_DEV4*100/nRo_tru4;     pRl_AIC4=nRl_AIC4*100/nRo_tru4;
run;

proc means data=RootM mean;
      title 'Root Mean Square Error for Comple-log-log Models';
var rRo_4 rRl_4 rRo_MS4 rRl_MS4 rRo_LM4 rRl_LM4 rRl_DEV4 rRl_AIC4;
run;
proc means data=count_p mean;
      title 'Percent of R2 out. for Comple-log-log Models';
var pRo_4 pRl_4 pRo_MS4 pRl_MS4 pRo_LM4 pRl_LM4 pRl_DEV4 pRl_AIC4;
```

```
run;
proc means data=summary n mean median std min max;
title 'Summary statistics of 1,000 values for Comple-log-log Models';
var Ro_true4 Rl_true4 Ro_4 Rl_4 Ro_MS4 Rl_MS4 Ro_LM4 Rl_LM4 Rl_DEV4
Rl_AIC4; run;
```

กรณีตัวแบบ $(M31)$

```
/*----------Find RMSE----------*/
data RMSE;                          set rr;
ERo_3=(Ro_true3-Ro_3)**2;           ERl_3=(Rl_true3-Rl_3)**2;
ERo_MS3=(Ro_true3-Ro_MS3)**2;       ERl_MS3=(Rl_true3-Rl_MS3)**2;
ERo_LM3=(Ro_true3-Ro_LM3)**2;       ERl_LM3=(Rl_true3-Rl_LM3)**2;
ERl_DEV3=(Rl_true3-Rl_DEV3)**2;     ERl_AIC3=(Rl_true3-Rl_AIC3)**2;

data RootM;                     set ROOT;
rRo_3=sqrt(mRo_3);              rRl_3=sqrt(mRl_3);
rRo_MS3=sqrt(mRo_MS3);          rRl_MS3=sqrt(mRl_MS3);
rRo_LM3=sqrt(mRo_LM3);          rRl_LM3=sqrt(mRl_LM3);
rRl_DEV3=sqrt(mRl_DEV3);        rRl_AIC3=sqrt(mRl_AIC3);

data out;                       set summary;
if Ro_true=. then delete;       if Ro_true2=. then delete;
if Ro_true3=. then delete;      if Ro_true4=. then delete;
i=_N_;                          if i>&nsim then delete;
if(Ro_3>0 and Ro_3<1) then Ro_3=bbbb;
if(Rl_3>0 and Rl_3<1) then Rl_3=cccc;
if(Ro_MS3>0 and Ro_MS3<1) then Ro_MS3=dddd;
if(Rl_MS3>0 and Rl_MS3<1) then Rl_MS3=eeee;
if(Ro_LM3>0 and Ro_LM3<1) then Ro_LM3=ffff;
if(Rl_LM3>0 and Rl_LM3<1) then Rl_LM3=gggg;
if(Rl_DEV3>0 and Rl_DEV3<1) then Rl_DEV3=hhhh;
if(Rl_AIC3>0 and Rl_AIC3<1) then Rl_AIC3=iiii; run;

data count_p;                       set count;
pRo_3=nRo_3*100/nRo_tru3;           pRl_3=nRl_3*100/nRo_tru3;
pRo_MS3=nRo_MS3*100/nRo_tru3;       pRl_MS3=nRl_MS3*100/nRo_tru3;
pRo_LM3=nRo_LM3*100/nRo_tru3;       pRl_LM3=nRl_LM3*100/nRo_tru3;
pRl_DEV3=nRl_DEV3*100/nRo_tru3;     pRl_AIC3=nRl_AIC3*100/nRo_tru3;
run;

proc means data=RootM mean;
      title 'Root Mean Square Error for Probit Models';
var rRo_3 rRl_3 rRo_MS3 rRl_MS3 rRo_LM3 rRl_LM3 rRl_DEV3 rRl_AIC3;
run;
proc means data=count_p mean;
      title 'Percent of R2 out. for Probit Models';
var pRo_3 pRl_3 pRo_MS3 pRl_MS3 pRo_LM3 pRl_LM3 pRl_DEV3 pRl_AIC3;
run;
proc means data=summary n mean median std min max;
      title 'Summary statistics of 1,000 values for Probit Models';
var Ro_true3 Rl_true3 Ro_3 Rl_3 Ro_MS3 Rl_MS3 Ro_LM3 Rl_LM3 Rl_DEV3
Rl_AIC3; run;
```

โปรแกรมแสดงการสรุปผลจาก 1,000 ครั้งของตัวแบบการถดถอยโลจีสติกที่ประกอบด้วยตัวแปรอธิบาย 1 ตัว $\left[(M01),(M11),(M31),(M21)\right]$ คือ

```
data summary;                  set summary RMSE;
if ERo<0 then delete;          if ERo_2<0 then delete;
if ERo_3<0 then delete;        if ERo_4<0 then delete; run;

data summary;     set summary rr;
if Ro_true=. then delete;      if Ro_true2=. then delete;
if Ro_true3=. then delete;     if Ro_true4=. then delete;
i=_N_;      if i>&nsim then delete; run;

%let loop_num=%eval(&loop_num+1);
%end;

proc freq data=summary noprint;     run;
proc means data=summary noprint;
var ERo ERl ERo_MS ERl_MS ERo_LM ERl_LM ERl_DEV ERl_AIC
    ERo_2 ERl_2 ERo_MS2 ERl_MS2 ERo_LM2 ERl_LM2 ERl_DEV2 ERl_AIC2
    ERo_3 ERl_3 ERo_MS3 ERl_MS3 ERo_LM3 ERl_LM3 ERl_DEV3 ERl_AIC3
    ERo_4 ERl_4 ERo_MS4 ERl_MS4 ERo_LM4 ERl_LM4 ERl_DEV4 ERl_AIC4;
      output  out=ROOT mean=
mRo mRl mRo_MS mRl_MS mRo_LM mRl_LM mRl_DEV mRl_AIC
mRo_2 mRl_2 mRo_MS2 mRl_MS2 mRo_LM2 mRl_LM2 mRl_DEV2 mRl_AIC2
mRo_3 mRl_3 mRo_MS3 mRl_MS3 mRo_LM3 mRl_LM3 mRl_DEV3 mRl_AIC3
mRo_4 mRl_4 mRo_MS4 mRl_MS4 mRo_LM4 mRl_LM4 mRl_DEV4 mRl_AIC4;
run;

proc means data=out noprint;
var   Ro_true  Ro   Rl   Ro_MS  Rl_MS  Ro_LM  Rl_LM  Rl_DEV  Rl_AIC
      Ro_true2 Ro_2 Rl_2 Ro_MS2 Rl_MS2 Ro_LM2 Rl_LM2 Rl_DEV2 Rl_AIC2
      Ro_true3 Ro_3 Rl_3 Ro_MS3 Rl_MS3 Ro_LM3 Rl_LM3 Rl_DEV3 Rl_AIC3
      Ro_true4 Ro_4 Rl_4 Ro_MS4 Rl_MS4 Ro_LM4 Rl_LM4 Rl_DEV4 Rl_AIC4;
output out=count n=
nRo_true nRo   nRl   nRo_MS  nRl_MS  nRo_LM  nRl_LM  nRl_DEV  nRl_AIC
nRo_tru2 nRo_2 nRl_2 nRo_MS2 nRl_MS2 nRo_LM2 nRl_LM2 nRl_DEV2 Rl_AIC2
nRo_tru3 nRo_3 nRl_3 nRo_MS3 nRl_MS3 nRo_LM3 nRl_LM3 nRl_DEV3 Rl_AIC3
nRo_tru4 nRo_4 nRl_4 nRo_MS4 nRl_MS4 nRo_LM4 nRl_LM4 nRl_DEV4 Rl_AIC4
; run;

%mend case_x1;
```

เรียกใช้มาร์กโคร (macro) ตามขนาดตัวอย่างต่างๆ ได้ดังนี้

```
%case_x1(n_sample=50,   nsim=1000,p=1);
%case_x1(n_sample=100,  nsim=1000,p=1);
%case_x1(n_sample=1000, nsim=1000,p=1);
%case_x1(n_sample=2000, nsim=1000,p=1);
```

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 5 ตัว คือ

กรณีตัวแบบ $(M05)$ การเขียนโปรแกรมเหมือนกับตัวแบบ $(M01)$

กรณีตัวแบบ $(M15)$ การเขียนโปรแกรมเหมือนกับตัวแบบ $(M11)$

กรณีตัวแบบ $(M25)$ การเขียนโปรแกรมเหมือนกับตัวแบบ $(M21)$

กรณีตัวแบบ $(M35)$ การเขียนโปรแกรมเหมือนกับตัวแบบ $(M31)$

กรณีตัวแบบ $(M45)$

```
/*----------Find RMSE----------*/
data RMSE;                          set rr;
ERo_6=(Ro_true6-Ro_6)**2;           ERl_6=(Rl_true6-Rl_6)**2;
ERo_MS6=(Ro_true6-Ro_MS6)**2;       ERl_MS6=(Rl_true6-Rl_MS6)**2;
ERo_LM6=(Ro_true6-Ro_LM6)**2;       ERl_LM6=(Rl_true6-Rl_LM6)**2;
ERl_DEV6=(Rl_true6-Rl_DEV6)**2;     ERl_AIC6=(Rl_true6-Rl_AIC6)**2;

data RootM;                    set ROOT;
rRo_6=sqrt(mRo_6);             rRl_6=sqrt(mRl_6);
rRo_MS6=sqrt(mRo_MS6);         rRl_MS6=sqrt(mRl_MS6);
rRo_LM6=sqrt(mRo_LM6);         rRl_LM6=sqrt(mRl_LM6);
rRl_DEV6=sqrt(mRl_DEV6);       rRl_AIC6=sqrt(mRl_AIC6);

data out;                      set summary;
if Ro_true=. then delete;      if Ro_true2=. then delete;
if Ro_true3=. then delete;     if Ro_true4=. then delete;
if Ro_true5=. then delete;     i=_N_;
if i>&nsim then delete;        if(Ro>0 and Ro<1) then Ro=bb;
if(Ro_6>0 and Ro_6<1) then Ro_6=bb_6;
if(Rl_6>0 and Rl_6<1) then Rl_6=cc_6;
if(Ro_MS6>0 and Ro_MS6<1) then Ro_MS6=dd_6;
if(Rl_MS6>0 and Rl_MS6<1) then Rl_MS6=ee_6;
if(Ro_LM6>0 and Ro_LM6<1) then Ro_LM6=ff_6;
if(Rl_LM6>0 and Rl_LM6<1) then Rl_LM6=gg_6;
if(Rl_DEV6>0 and Rl_DEV6<1) then Rl_DEV6=hh_6;
if(Rl_AIC6>0 and Rl_AIC6<1) then Rl_AIC6=ii_6;

data count_p;                       set count;
pRo_6=nRo_6*100/nRo_tru6;           pRl_6=nRl_6*100/nRo_tru6;
pRo_MS6=nRo_MS6*100/nRo_tru6;       pRl_MS6=nRl_MS6*100/nRo_tru6;
pRo_LM6=nRo_LM6*100/nRo_tru6;       pRl_LM6=nRl_LM6*100/nRo_tru6;
pRl_DEV6=nRl_DEV6*100/nRo_tru6;     pRl_AIC6=nRl_AIC6*100/nRo_tru6;

proc means data=RootM mean;
      title 'Root Mean Square Error for Miss X5 Models';
var rRo_6 rRl_6 rRo_MS6 rRl_MS6 rRo_LM6 rRl_LM6 rRl_DEV6 rRl_AIC6;
run;
proc means data=count_p mean;
      title 'Percent of R2 out. for Add Miss X5 Models';
var pRo_6 pRl_6 pRo_MS6 pRl_MS6 pRo_LM6 pRl_LM6 pRl_DEV6 pRl_AIC6;
run;
proc means data=summary n mean median std min max;
      title 'Summary statistics of 1,000 values for Miss X5 Models';
var Ro_true6 Rl_true6 Ro_6 Rl_6 Ro_MS6 Rl_MS6 Ro_LM6 Rl_LM6 Rl_DEV6
Rl_AIC6; run;
```

กรณีตัวแบบ $(M55)$

```
/*----------Find RMSE----------*/
data RMSE;                          set rr;
ERo_7=(Ro_true7-Ro_7)**2;           ERl_7=(Rl_true7-Rl_7)**2;
ERo_MS7=(Ro_true7-Ro_MS7)**2;       ERl_MS7=(Rl_true7-Rl_MS7)**2;
ERo_LM7=(Ro_true7-Ro_LM7)**2;       ERl_LM7=(Rl_true7-Rl_LM7)**2;
ERl_DEV7=(Rl_true7-Rl_DEV7)**2;     ERl_AIC7=(Rl_true7-Rl_AIC7)**2;

data RootM;                     set ROOT;
rRo_7=sqrt(mRo_7);              rRl_7=sqrt(mRl_7);
rRo_MS7=sqrt(mRo_MS7);          rRl_MS7=sqrt(mRl_MS7);
rRo_LM7=sqrt(mRo_LM7);          rRl_LM7=sqrt(mRl_LM7);
rRl_DEV7=sqrt(mRl_DEV7);        rRl_AIC7=sqrt(mRl_AIC7);

data out;                       set summary;
if Ro_true=. then delete;       if Ro_true2=. then delete;
if Ro_true3=. then delete;      if Ro_true4=. then delete;
if Ro_true5=. then delete;      i=_N_;
if i>&nsim then delete;         if(Ro>0 and Ro<1) then Ro=bb;
if(Ro_7>0 and Ro_7<1) then Ro_7=bb_7;
if(Rl_7>0 and Rl_7<1) then Rl_7=cc_7;
if(Ro_MS7>0 and Ro_MS7<1) then Ro_MS7=dd_7;
if(Rl_MS7>0 and Rl_MS7<1) then Rl_MS7=ee_7;
if(Ro_LM7>0 and Ro_LM7<1) then Ro_LM7=ff_7;
if(Rl_LM7>0 and Rl_LM7<1) then Rl_LM7=gg_7;
if(Rl_DEV7>0 and Rl_DEV7<1) then Rl_DEV7=hh_7;
if(Rl_AIC7>0 and Rl_AIC7<1) then Rl_AIC7=ii_7;

data count_p;                       set count;
pRo_7=nRo_7*100/nRo_tru7;           pRl_7=nRl_7*100/nRo_tru7;
pRo_MS7=nRo_MS7*100/nRo_tru7;       pRl_MS7=nRl_MS7*100/nRo_tru7;
pRo_LM7=nRo_LM7*100/nRo_tru7;       pRl_LM7=nRl_LM7*100/nRo_tru7;
pRl_DEV7=nRl_DEV7*100/nRo_tru7;     pRl_AIC7=nRl_AIC7*100/nRo_tru7;

proc means data=RootM mean;
      title 'Root Mean Square Error for Miss X2 Models';
var rRo_7 rRl_7 rRo_MS7 rRl_MS7 rRo_LM7 rRl_LM7 rRl_DEV7 rRl_AIC7;
run;
proc means data=count_p mean;
      title 'Percent of R2 out. for Add Miss X2 Models';
var pRo_7 pRl_7 pRo_MS7 pRl_MS7 pRo_LM7 pRl_LM7 pRl_DEV7 pRl_AIC7;
run;
proc means data=summary n mean median std min max;
      title 'Summary statistics of 1,000 values for Miss X2 Models';
var Ro_true7 Rl_true7 Ro_7 Rl_7 Ro_MS7 Rl_MS7 Ro_LM7 Rl_LM7 Rl_DEV7
Rl_AIC7;  run;
```

กรณีตัวแบบ $(M65)$

```
/*----------Find RMSE----------*/
data RMSE;                          set rr;
ERo_8=(Ro_true8-Ro_8)**2;           ERl_8=(Rl_true8-Rl_8)**2;
ERo_MS8=(Ro_true8-Ro_MS8)**2;       ERl_MS8=(Rl_true8-Rl_MS8)**2;
ERo_LM8=(Ro_true8-Ro_LM8)**2;       ERl_LM8=(Rl_true8-Rl_LM8)**2;
```

```
ERl_DEV8=(Rl_true8-Rl_DEV8)**2;     ERl_AIC8=(Rl_true8-Rl_AIC8)**2;

data RootM;                    set ROOT;
rRo_8=sqrt(mRo_8);             rRl_8=sqrt(mRl_8);
rRo_MS8=sqrt(mRo_MS8);         rRl_MS8=sqrt(mRl_MS8);
rRo_LM8=sqrt(mRo_LM8);         rRl_LM8=sqrt(mRl_LM8);
rRl_DEV8=sqrt(mRl_DEV8);       rRl_AIC8=sqrt(mRl_AIC8);

data out;                      set summary;
if Ro_true=. then delete;      if Ro_true2=. then delete;
if Ro_true3=. then delete;     if Ro_true4=. then delete;
if Ro_true5=. then delete;     i=_N_;
if i>&nsim then delete;        if(Ro>0 and Ro<1) then Ro=bb;
if(Ro_8>0 and Ro_8<1) then Ro_8=bb_8;
if(Rl_8>0 and Rl_8<1) then Rl_8=cc_8;
if(Ro_MS8>0 and Ro_MS8<1) then Ro_MS8=dd_8;
if(Rl_MS8>0 and Rl_MS8<1) then Rl_MS8=ee_8;
if(Ro_LM8>0 and Ro_LM8<1) then Ro_LM8=ff_8;
if(Rl_LM8>0 and Rl_LM8<1) then Rl_LM8=gg_8;
if(Rl_DEV8>0 and Rl_DEV8<1) then Rl_DEV8=hh_8;
if(Rl_AIC8>0 and Rl_AIC8<1) then Rl_AIC8=ii_8; run;

data count_p;                          set count;
pRo_8=nRo_8*100/nRo_tru8;              pRl_8=nRl_8*100/nRo_tru8;
pRo_MS8=nRo_MS8*100/nRo_tru8;          pRl_MS8=nRl_MS8*100/nRo_tru8;
pRo_LM8=nRo_LM8*100/nRo_tru8;          pRl_LM8=nRl_LM8*100/nRo_tru8;
pRl_DEV8=nRl_DEV8*100/nRo_tru8;        pRl_AIC8=nRl_AIC8*100/nRo_tru8;
run;

proc means data=RootM mean;
      title 'Root Mean Square Error for have X3 Models';
var rRo_8 rRl_8 rRo_MS8 rRl_MS8 rRo_LM8 rRl_LM8 rRl_DEV8 rRl_AIC8;
run;
proc means data=count_p mean;
      title 'Percent of R2 out. for Add have X3 Models';
var pRo_8 pRl_8 pRo_MS8 pRl_MS8 pRo_LM8 pRl_LM8 pRl_DEV8 pRl_AIC8;
run;
proc means data=summary n mean median std min max;
      title 'Summary statistics of 1,000 values for have X3 Models';
var Ro_true8 Rl_true8 Ro_8 Rl_8 Ro_MS8 Rl_MS8 Ro_LM8 Rl_LM8 Rl_DEV8
Rl_AIC8; run;
```

โปรแกรมแสดงการสรุปผลจาก 1,000 ครั้งของตัวแบบการถดถอยโลจีสติกที่ประกอบด้วยตัวแปรอธิบาย 5 ตัว $\left[(M05),(M15),(M35),(M25),(M45),(M55),(M65)\right.$ คือ

```
data summary;                          set summary RMSE;
if ERo<0 then delete;                  if ERo_2<0 then delete;
if ERo_3<0 then delete;                if ERo_4<0 then delete;
if ERo_5<0 then delete;                if ERo_6<0 then delete;
if ERo_7<0 then delete;                if ERo_8<0 then delete; run;

data summary;                          set summary rr;
if Ro_true=. then delete;              if Ro_true2=. then delete;
if Ro_true3=. then delete;             if Ro_true4=. then delete;
```

```
if Ro_true6=. then delete;          if Ro_true7=. then delete;
if Ro_true8=. then delete;          i=_N_; if i>&nsim then delete;
run;

%let loop_num=%eval(&loop_num+1);
%end;

proc freq data=summary noprint;     run;
proc means data=summary noprint;
var   ERo ERl ERo_MS ERl_MS ERo_LM ERl_LM ERl_DEV ERl_AIC
      ERo_2 ERl_2 ERo_MS2 ERl_MS2 ERo_LM2 ERl_LM2 ERl_DEV2 ERl_AIC2
      ERo_3 ERl_3 ERo_MS3 ERl_MS3 ERo_LM3 ERl_LM3 ERl_DEV3 ERl_AIC3
      ERo_4 ERl_4 ERo_MS4 ERl_MS4 ERo_LM4 ERl_LM4 ERl_DEV4 ERl_AIC4
      ERo_6 ERl_6 ERo_MS6 ERl_MS6 ERo_LM6 ERl_LM6 ERl_DEV6 ERl_AIC6
      ERo_7 ERl_7 ERo_MS7 ERl_MS7 ERo_LM7 ERl_LM7 ERl_DEV7 ERl_AIC7
      ERo_8 ERl_8 ERo_MS8 ERl_MS8 ERo_LM8 ERl_LM8 ERl_DEV8 ERl_AIC8;
      output  out=ROOT mean=
mRo   mRl   mRo_MS  mRl_MS  mRo_LM  mRl_LM  mRl_DEV  mRl_AIC
mRo_2 mRl_2 mRo_MS2 mRl_MS2 mRo_LM2 mRl_LM2 mRl_DEV2 mRl_AIC2
mRo_3 mRl_3 mRo_MS3 mRl_MS3 mRo_LM3 mRl_LM3 mRl_DEV3 mRl_AIC3
mRo_4 mRl_4 mRo_MS4 mRl_MS4 mRo_LM4 mRl_LM4 mRl_DEV4 mRl_AIC4
mRo_6 mRl_6 mRo_MS6 mRl_MS6 mRo_LM6 mRl_LM6 mRl_DEV6 mRl_AIC6
mRo_7 mRl_7 mRo_MS7 mRl_MS7 mRo_LM7 mRl_LM7 mRl_DEV7 mRl_AIC7
mRo_8 mRl_8 mRo_MS8 mRl_MS8 mRo_LM8 mRl_LM8 mRl_DEV8 mRl_AIC8
; run;

proc means data=out noprint;
var   Ro_true  Ro   Rl   Ro_MS  Rl_MS  Ro_LM  Rl_LM  Rl_DEV  Rl_AIC
      Ro_true2 Ro_2 Rl_2 Ro_MS2 Rl_MS2 Ro_LM2 Rl_LM2 Rl_DEV2 Rl_AIC2
      Ro_true3 Ro_3 Rl_3 Ro_MS3 Rl_MS3 Ro_LM3 Rl_LM3 Rl_DEV3 Rl_AIC3
      Ro_true4 Ro_4 Rl_4 Ro_MS4 Rl_MS4 Ro_LM4 Rl_LM4 Rl_DEV4 Rl_AIC4
      Ro_true6 Ro_6 Rl_6 Ro_MS6 Rl_MS6 Ro_LM6 Rl_LM6 Rl_DEV6 Rl_AIC6
      Ro_true7 Ro_7 Rl_7 Ro_MS7 Rl_MS7 Ro_LM7 Rl_LM7 Rl_DEV7 Rl_AIC7
      Ro_true8 Ro_8 Rl_8 Ro_MS8 Rl_MS8 Ro_LM8 Rl_LM8 Rl_DEV8 Rl_AIC8;
output out=count n=
nRo_true nRo   nRl   nRo_MS  nRl_MS  nRo_LM  nRl_LM  nRl_DEV  nRl_AIC
nRo_tru2 nRo_2 nRl_2 nRo_MS2 nRl_MS2 nRo_LM2 nRl_LM2 nRl_DEV2 Rl_AIC2
nRo_tru3 nRo_3 nRl_3 nRo_MS3 nRl_MS3 nRo_LM3 nRl_LM3 nRl_DEV3 Rl_AIC3
nRo_tru4 nRo_4 nRl_4 nRo_MS4 nRl_MS4 nRo_LM4 nRl_LM4 nRl_DEV4 Rl_AIC4
nRo_tru6 nRo_6 nRl_6 nRo_MS6 nRl_MS6 nRo_LM6 nRl_LM6 nRl_DEV6 Rl_AIC6
nRo_tru7 nRo_7 nRl_7 nRo_MS7 nRl_MS7 nRo_LM7 nRl_LM7 nRl_DEV7 Rl_AIC7
nRo_tru8 nRo_8 nRl_8 nRo_MS8 nRl_MS8 nRo_LM8 nRl_LM8 nRl_DEV8 Rl_AIC8
; run;

%mend case_x5;
```

เรียกใช้มาร์กโคร (macro) ตามขนาดตัวอย่างต่างๆ ได้ดังนี้

```
%case_x5(n_sample=50,   nsim=1000,p=5);
%case_x5(n_sample=100,  nsim=1000,p=5);
%case_x5(n_sample=1000, nsim=1000,p=5);
%case_x5(n_sample=2000, nsim=1000,p=5);
```

กรณีที่ตัวแบบการถดถอยโลจีสติกประกอบด้วยตัวแปรอธิบาย 10 ตัว คือ กรณีตัวแบบ $(M010)$ การเขียนโปรแกรมเหมือนกับตัวแบบ $(M01)$

กรณีตัวแบบ $(M110)$ การเขียนโปรแกรมเหมือนกับตัวแบบ $(M11)$

กรณีตัวแบบ $(M210)$ การเขียนโปรแกรมเหมือนกับตัวแบบ $(M21)$

กรณีตัวแบบ $(M310)$ การเขียนโปรแกรมเหมือนกับตัวแบบ $(M31)$

กรณีตัวแบบ $(M410)$

```
/*----------Find RMSE----------*/
data RMSE;                          set rr;
ERo_5=(Ro_true5-Ro_5)**2;           ERl_5=(Rl_true5-Rl_5)**2;
ERo_MS5=(Ro_true5-Ro_MS5)**2;       ERl_MS5=(Rl_true5-Rl_MS5)**2;
ERo_LM5=(Ro_true5-Ro_LM5)**2;       ERl_LM5=(Rl_true5-Rl_LM5)**2;
ERl_DEV5=(Rl_true5-Rl_DEV5)**2;     ERl_AIC5=(Rl_true5-Rl_AIC5)**2;

data RootM;                     set ROOT;
rRo_5=sqrt(mRo_5);              rRl_5=sqrt(mRl_5);
rRo_MS5=sqrt(mRo_MS5);          rRl_MS5=sqrt(mRl_MS5);
rRo_LM5=sqrt(mRo_LM5);          rRl_LM5=sqrt(mRl_LM5);
rRl_DEV5=sqrt(mRl_DEV5);        rRl_AIC5=sqrt(mRl_AIC5);

data out;                       set summary;
if Ro_true=. then delete;       if Ro_true2=. then delete;
if Ro_true3=. then delete;      if Ro_true4=. then delete;
if Ro_true5=. then delete;      i=_N_;
if i>&nsim then delete;         if(Ro>0 and Ro<1) then Ro=bb;
if(Ro_5>0 and Ro_5<1) then Ro_5=bb_5;
if(Rl_5>0 and Rl_5<1) then Rl_5=cc_5;
if(Ro_MS5>0 and Ro_MS5<1) then Ro_MS5=dd_5;
if(Rl_MS5>0 and Rl_MS5<1) then Rl_MS5=ee_5;
if(Ro_LM5>0 and Ro_LM5<1) then Ro_LM5=ff_5;
if(Rl_LM5>0 and Rl_LM5<1) then Rl_LM5=gg_5;
if(Rl_DEV5>0 and Rl_DEV5<1) then Rl_DEV5=hh_5;
if(Rl_AIC5>0 and Rl_AIC5<1) then Rl_AIC5=ii_5;

data count_p;                       set count;
pRo_5=nRo_5*100/nRo_tru5;           pRl_5=nRl_5*100/nRo_tru5;
pRo_MS5=nRo_MS5*100/nRo_tru5;       pRl_MS5=nRl_MS5*100/nRo_tru5;
pRo_LM5=nRo_LM5*100/nRo_tru5;       pRl_LM5=nRl_LM5*100/nRo_tru5;
pRl_DEV5=nRl_DEV5*100/nRo_tru5;     pRl_AIC5=nRl_AIC5*100/nRo_tru5;

proc means data=RootM mean;
      title 'Root Mean Square Error for Miss X3 X7 Models';
var rRo_5 rRl_5 rRo_MS5 rRl_MS5 rRo_LM5 rRl_LM5 rRl_DEV5 rRl_AIC5;
run;
proc means data=count_p mean;
      title 'Percent of R2 out. for Miss X3 X7 Models';
var pRo_5 pRl_5 pRo_MS5 pRl_MS5 pRo_LM5 pRl_LM5 pRl_DEV5 pRl_AIC5;
run;
proc means data=summary n mean median std min max;
title 'Summary statistics of 1,000 values for Miss X3 X7 Models';
var Ro_true5 Rl_true5 Ro_5 Rl_5 Ro_MS5 Rl_MS5 Ro_LM5 Rl_LM5 Rl_DEV5
Rl_AIC5; run;
```

กรณีตัวแบบ $(M510)$ การเขียนโปรแกรมเหมือนกับตัวแบบ $(M55)$ เปลี่ยนแค่การเขียน

```
proc means data=RootM mean;
      title 'Root Mean Square Error for Miss X8 X10 Models';
var rRo_6 rRl_6 rRo_MS6 rRl_MS6 rRo_LM6 rRl_LM6 rRl_DEV6 rRl_AIC6;
run;
proc means data=count_p mean;
      title 'Percent of R2 out. for Add Miss X8 X10 Models';
var pRo_6 pRl_6 pRo_MS6 pRl_MS6 pRo_LM6 pRl_LM6 pRl_DEV6 pRl_AIC6;
run;
proc means data=summary n mean median std min max;
title 'Summary statistics of 1,000 values for Miss X8 X10 Models';
var Ro_true6 Rl_true6 Ro_6 Rl_6 Ro_MS6 Rl_MS6 Ro_LM6 Rl_LM6 Rl_DEV6
Rl_AIC6; run;
```

กรณีตัวแบบ $(M610)$ การเขียนโปรแกรมเหมือนกับตัวแบบ $(M65)$ เปลี่ยนแค่การเขียน

```
proc means data=RootM mean;
      title 'Root Mean Square Error for have X2 X4 Models';
var rRo_8 rRl_8 rRo_MS8 rRl_MS8 rRo_LM8 rRl_LM8 rRl_DEV8 rRl_AIC8;
run;
proc means data=count_p mean;
      title 'Percent of R2 out. for Add have X2 X4 Models';
var pRo_8 pRl_8 pRo_MS8 pRl_MS8 pRo_LM8 pRl_LM8 pRl_DEV8 pRl_AIC8;
run;
proc means data=summary n mean median std min max;
title 'Summary statistics of 1,000 values for have X2 X4 Models';
var Ro_true8 Rl_true8 Ro_8 Rl_8 Ro_MS8 Rl_MS8 Ro_LM8 Rl_LM8 Rl_DEV8
Rl_AIC8; run;
```

โปรแกรมการสรุปผลจาก 1,000 ครั้งของตัวแบบการถดถอยโลจีสติกที่ประกอบด้วยตัวแปรอธิบาย 10 ตัว $[(M010),(M110),(M310),(M210),(M410),(M510),(M610)$ คือ

```
data summary;                          set summary RMSE;
if ERo<0 then delete;                  if ERo_2<0 then delete;
if ERo_3<0 then delete;                if ERo_4<0 then delete; run;

data summary;                          set summary rr;
if Ro_true=. then delete;              if Ro_true2=. then delete;
if Ro_true3=. then delete;             if Ro_true4=. then delete;
i=_N_;      if i>&nsim then delete; run;

%let loop_num=%eval(&loop_num+1);
%end;

proc freq data=summary noprint;     run;
proc means data=summary noprint;
var   ERo ERl ERo_MS ERl_MS ERo_LM ERl_LM ERl_DEV ERl_AIC
      ERo_2 ERl_2 ERo_MS2 ERl_MS2 ERo_LM2 ERl_LM2 ERl_DEV2 ERl_AIC2
      ERo_3 ERl_3 ERo_MS3 ERl_MS3 ERo_LM3 ERl_LM3 ERl_DEV3 ERl_AIC3
```

```
      ERo_4 ERl_4 ERo_MS4 ERl_MS4 ERo_LM4 ERl_LM4 ERl_DEV4 ERl_AIC4
      ERo_5 ERl_5 ERo_MS5 ERl_MS5 ERo_LM5 ERl_LM5 ERl_DEV5 ERl_AIC5
      ERo_6 ERl_6 ERo_MS6 ERl_MS6 ERo_LM6 ERl_LM6 ERl_DEV6 ERl_AIC6
      ERo_8 ERl_8 ERo_MS8 ERl_MS8 ERo_LM8 ERl_LM8 ERl_DEV8 ERl_AIC8;
output  out=ROOT mean=
mRo mRl mRo_MS mRl_MS mRo_LM mRl_LM mRl_DEV mRl_AIC
mRo_2 mRl_2 mRo_MS2 mRl_MS2 mRo_LM2 mRl_LM2 mRl_DEV2 mRl_AIC2
mRo_3 mRl_3 mRo_MS3 mRl_MS3 mRo_LM3 mRl_LM3 mRl_DEV3 mRl_AIC3
mRo_4 mRl_4 mRo_MS4 mRl_MS4 mRo_LM4 mRl_LM4 mRl_DEV4 mRl_AIC4
mRo_5 mRl_5 mRo_MS5 mRl_MS5 mRo_LM5 mRl_LM5 mRl_DEV5 mRl_AIC5
mRo_6 mRl_6 mRo_MS6 mRl_MS6 mRo_LM6 mRl_LM6 mRl_DEV6 mRl_AIC6
mRo_8 mRl_8 mRo_MS8 mRl_MS8 mRo_LM8 mRl_LM8 mRl_DEV8 mRl_AIC8; run;

proc means data=out noprint;
var   Ro_true  Ro   Rl   Ro_MS  Rl_MS  Ro_LM  Rl_LM  Rl_DEV  Rl_AIC
      Ro_true2 Ro_2 Rl_2 Ro_MS2 Rl_MS2 Ro_LM2 Rl_LM2 Rl_DEV2 Rl_AIC2
      Ro_true3 Ro_3 Rl_3 Ro_MS3 Rl_MS3 Ro_LM3 Rl_LM3 Rl_DEV3 Rl_AIC3
      Ro_true4 Ro_4 Rl_4 Ro_MS4 Rl_MS4 Ro_LM4 Rl_LM4 Rl_DEV4 Rl_AIC4
      Ro_true5 Ro_5 Rl_5 Ro_MS5 Rl_MS5 Ro_LM5 Rl_LM5 Rl_DEV5 Rl_AIC5
      Ro_true6 Ro_6 Rl_6 Ro_MS6 Rl_MS6 Ro_LM6 Rl_LM6 Rl_DEV6 Rl_AIC6
      Ro_true8 Ro_8 Rl_8 Ro_MS8 Rl_MS8 Ro_LM8 Rl_LM8 Rl_DEV8 Rl_AIC8;

output out=count n=
nRo_true nRo   nRl   nRo_MS  nRl_MS  nRo_LM  nRl_LM  nRl_DEV  nRl_AIC
nRo_tru2 nRo_2 nRl_2 nRo_MS2 nRl_MS2 nRo_LM2 nRl_LM2 nRl_DEV2 Rl_AIC2
nRo_tru3 nRo_3 nRl_3 nRo_MS3 nRl_MS3 nRo_LM3 nRl_LM3 nRl_DEV3 Rl_AIC3
nRo_tru4 nRo_4 nRl_4 nRo_MS4 nRl_MS4 nRo_LM4 nRl_LM4 nRl_DEV4 Rl_AIC4
nRo_tru5 nRo_5 nRl_5 nRo_MS5 nRl_MS5 nRo_LM5 nRl_LM5 nRl_DEV5 Rl_AIC5
nRo_tru6 nRo_6 nRl_6 nRo_MS6 nRl_MS6 nRo_LM6 nRl_LM6 nRl_DEV6 Rl_AIC6
nRo_tru8 nRo_8 nRl_8 nRo_MS8 nRl_MS8 nRo_LM8 nRl_LM8 nRl_DEV8 Rl_AIC8
;run;

%mend case_x10;
```

เรียกใช้มาร์กโคร (macro) ตามขนาดตัวอย่างต่างๆ ได้ดังนี้

```
%case_x10(n_sample=50,   nsim=1000,p=10);
%case_x10(n_sample=100,  nsim=1000,p=10);
%case_x10(n_sample=1000, nsim=1000,p=10);
%case_x10(n_sample=2000, nsim=1000,p=10);
```