```
@==========================================================================@
@                                                                          @
@   -------------------------   PROGRAM NOTES   -----------------------   @
@                                                                          @
@       THIS PROGRAM IS LCMTV GAUSSPRG DPR2.PRG                           @
@                                                                          @
@                                                                          @
@     THIS PROGRAM PRODUCES OLS ESTIMATES OF THE FIXED-EFFECTS MODEL       @
@                                                                          @
@          TABLE 4:  RAILROAD EFFECTS WITH A TIME TREND.                   @
@          TABLE 5:  RAILROAD EFFECTS WITH NO TIME TREND.                  @
@          TABLE 6:  RAILROAD EFFECTS AND TIME EFFECTS.                    @
@                                                                          @
@                                                                          @
@       BREUSCH-PAGAN TESTS FOR HETEROSKEDASTICITY AND                     @
@       RESET TESTS ARE REPORTED.                                          @
@                                                                          @
@==========================================================================@

@==========================================================================@
@                                                                          @
@   >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>   DATA   <<<<<<<<<<<<<<<<<<<<<<<<<<<<   @
@                                                                          @
@==========================================================================@

OUTPUT FILE = LPT1 ON;
FORMAT /M1 /RD 12,4;

@   NUMBER OF RAILROADS   @   N = 15;
@   NUMBER OF YEARS       @   T = 9;

NT       =  N*T;

NAMES    =  GETNAME("C:\\LCMTV\\DATA\\NDPR.DAT");
OPEN D1  =  C:\LCMTV\DATA\NDPR.DAT   VARINDXI;
D        =  READR(D1,NT);
F1       =  CLOSE(D1);

YI       =  IGENADMN;
X1I      =  ITPK;
X2I      =  IGTM;
RRI      =  IRRID;
YEARI    =  IYEAR;

R        =  D[.,RRI];
RR       =  R[SEQA(1,T,N),.];

Y        =  D[.,YI];
X1       =  D[.,X1I];
X2       =  D[.,X2I];

YEAR     =  D[.,YEARI];
YEARD    =  YEAR - 1983;

DUMR     =  DUMMY(R,RR);
DUMR     =  DUMR[.,1:15];
```

```
DUMT     =  DUMMY(YEAR,SEQA(1979,1,9));

DUMT     =  DUMT[.,2:9];

X        =  X1 ~ X2 ~ YEARD ~ DUMR;

K1       =  COLS(X);
NT       =  ROWS(X);

@=============================================================================@
@                                                                             @
@    >>>>>>>>>>>   MODEL WITH RAILROAD EFFECTS AND TIME TREND   <<<<<<<<<<<   @
@                                                                             @
@=============================================================================@

B        =  INV(X'X)*X'Y;
E        =  Y - X*B;
S1       =  E'E;
S        =  INV(NT - K1)*S1;
COV      =  INV(X'X)*S;
TSTAT    =  B ./ SQRT(DIAG(COV));
RSQ      =  1 - S1/((NT - 1)*STDC(Y)^2);

SEL1     =  (YEAR .EQ 1979);
SEL2     =  (YEAR .EQ 1987);

CLEAR D;

E1       =  DELIF(E,SEL1);
E2       =  DELIF(E,SEL2);
DE       =  E1 - E2;

RHO      =  INV(E2'E2)*E1'E2;
DW       =  2*(1 - RHO);

SH       =  INV(NT)*S1;
U        =  E^2;
BU       =  INV(X'X)*X'U;
UH       =  X*BU;
BP       =  (NT - 1)*(STDC(UH)^2)/(2*SH^2);    DFBP = K1 - 1;

Q1       =  (X*B)^2;
Q2       =  (X*B)^3;
Q3       =  (X*B)^4;
XR       =  X ~ Q1 ~ Q2 ~ Q3;
KR       =  COLS(XR);
BR       =  INV(XR'XR)*XR'Y;
ER       =  Y - XR*BR;
SR       =  ER'ER;
RESET    =  ((S1 - SR)/3)/(SR/(NT - KR));     DFR = NT - KR;

"                                                                             ";
"                                                                    DPR2.PRG";
">>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>    TABLE  4    <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<";
"                                                                             ";
FORMAT 1,8;
"                                    ";;  $NAMES[YI,.];;  " ACCOUNT           ";
FORMAT /M1 /RD 12,4;
"                                                                             ";
"                                                                             ";
```

```
"                                                                                ";
"          OLS REGRESSION MODEL WITH RAILROAD EFFECTS AND TIME TREND              ";
"                                                                                ";
"                                                                                ";
"                                                                                ";
"                       COEFFICIENT  ESTIMATE      T-RATIO                       ";
"                                                                                ";
FORMAT 1,8;
"                              ";; $NAMES[X1I,.];; FORMAT /M1 /RD 12,4;
                                      B[1,.];;     TSTAT[1,.];
FORMAT 1,8;
"                              ";; $NAMES[X2I,.];; FORMAT /M1 /RD 12,4;
                                      B[2,.];;     TSTAT[2,.];
"                              TIME";; B[3,.];;     TSTAT[3,.];
"                                                                               ";
"                              F5  ";; B[4,.];;     TSTAT[4,.];
"                              F8  ";; B[5,.];;     TSTAT[5,.];
"                              F10 ";; B[6,.];;     TSTAT[6,.];
"                              F18 ";; B[7,.];;     TSTAT[7,.];
"                              F20 ";; B[8,.];;     TSTAT[8,.];
"                              F21 ";; B[9,.];;     TSTAT[9,.];
"                              F22 ";; B[10,.];;    TSTAT[10,.];
"                              F23 ";; B[11,.];;    TSTAT[11,.];
"                              F27 ";; B[12,.];;    TSTAT[12,.];
"                              F30 ";; B[13,.];;    TSTAT[13,.];
"                              F31 ";; B[14,.];;    TSTAT[14,.];
"                              F34 ";; B[15,.];;    TSTAT[15,.];
"                              F35 ";; B[16,.];;    TSTAT[16,.];
"                              F36 ";; B[17,.];;    TSTAT[17,.];
"                              F37 ";; B[18,.];;    TSTAT[18,.];
"                                                                               ";
"                                                                               ";
"                                ERROR VARIANCE ";;  S;
"                                          RSQ ";;  RSQ;
"                                 MODIFIED DW ";;   DW;
"                                MODIFIED RHO ";;   RHO;
"                               BREUSCH-PAGAN ";;   BP;;
" CHI-SQ(";; FORMAT /RDS 1,0; DFBP;;")"; FORMAT /M1 /RD 12,4;
"                                       RESET ";;   RESET;;
" F(";; FORMAT /RDS 1,0; 3;; DFR;;")";

"\f";

FORMAT /M1 /RD 12,4;

@=============================================================================@
@                                                                             @
@    >>>>>>>>>   MODELS WITH RAILROAD EFFECTS AND NO TIME TREND   <<<<<<<<<    @
@                                                                             @
@=============================================================================@

X        =  X1 ~ X2 ~ DUMR;
K2       =  COLS(X);

B        =  INV(X'X)*X'Y;
E        =  Y - X*B;
S2       =  E'E;
S        =  INV(NT - K2)*S2;
COV      =  INV(X'X)*S;
TSTAT    =  B ./ SQRT(DIAG(COV));
RSQ      =  1 - S2/((NT - 1)*STDC(Y)^2);
```

```
E1      =  DELIF(E,SEL1);
E2      =  DELIF(E,SEL2);
DE      =  E1 - E2;

RHO     =  INV(E2'E2)*E1'E2;
DW      =  2*(1 - RHO);

SH      =  S2/NT;
U       =  E^2;
BU      =  INV(X'X)*X'U;
UH      =  X*BU;
BP      =  (NT - 1)*(STDC(UH)^2)/(2*SH^2);
DFBP    =  K2 - 1;

Q1      =  (X*B)^2;
Q2      =  (X*B)^3;
Q3      =  (X*B)^4;
XR      =  X ~ Q1 ~ Q2 ~ Q3;
BR      =  INV(XR'XR)*XR'Y;
KR      =  COLS(XR);
ER      =  Y - XR*BR;
SR      =  ER'ER;
RESET   =  ((S2 - SR)/3)/(SR/(NT - KR));
DFR     =  NT - KR;

"                                                                                  ";
"                                                                         DPR2.PRG";
">>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>     TABLE  5    <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<";
"                                                                                  ";
FORMAT 1,8;
"                              ";; $NAMES[YI,.];;" ACCOUNT                         ";
FORMAT /M1 /RD 12,4;
"                                                                                  ";
"                                                                                  ";
"      OLS REGRESSION ON MODEL WITH RAILROAD EFFECTS AND NO TIME TREND             ";
"                                                                                  ";
"                   COEFFICIENT  ESTIMATE        T-RATIO                           ";
"                                                                                  ";
FORMAT 1,8;
"                         ";; $NAMES[X1I,.];;    FORMAT /M1 /RD 12,4;
                               B[1,.];;          TSTAT[1,.];
FORMAT 1,8;
"                         ";; $NAMES[X2I,.];;    FORMAT /M1 /RD 12,4;
                               B[2,.];;          TSTAT[2,.];
"                                                                                  ";
"                         F5  ";; B[3,.];;       TSTAT[3,.];
"                         F8  ";; B[4,.];;       TSTAT[4,.];
"                         F10 ";; B[5,.];;       TSTAT[5,.];
"                         F18 ";; B[6,.];;       TSTAT[6,.];
"                         F20 ";; B[7,.];;       TSTAT[7,.];
"                         F21 ";; B[8,.];;       TSTAT[8,.];
"                         F22 ";; B[9,.];;       TSTAT[9,.];
"                         F23 ";; B[10,.];;      TSTAT[10,.];
"                         F27 ";; B[11,.];;      TSTAT[11,.];
"                         F30 ";; B[12,.];;      TSTAT[12,.];
"                         F31 ";; B[13,.];;      TSTAT[13,.];
"                         F34 ";; B[14,.];;      TSTAT[14,.];
"                         F35 ";; B[15,.];;      TSTAT[15,.];
```

```
"                          F36 ";; B[16,.];;      TSTAT[16,.];
"                          F37 ";; B[17,.];;      TSTAT[17,.];
"                                                                    ";
"                                                                    ";
"                            ERROR VARIANCE ";;   S;
"                                      RSQ ";;   RSQ;
"                               MODIFIED DW ";;   DW;
"                              MODIFIED RHO ";;   RHO;
"                             BREUSCH-PAGAN ";;   BP;;
" CHI-SQ(";; FORMAT /RDS 1,0; DFBP;;")";
FORMAT /M1 /RD 12,4;
"                                       RESET ";;   RESET;;
" F(";; FORMAT /RDS 1,0; 3;; DFR;;")";
FORMAT /M1 /RD 12,4;

@=================================================================================@
@                                                                                 @
@   >>>>>>>>>>>>   F-STAT FOR INCREMENTAL POWER OF TIME TREND   <<<<<<<<<<<<    @
@                                                                                 @
@=================================================================================@

DF1      =  1.;
DF2      =  NT - K1;
DF       =  DF1~DF2;
F        =  ((S2 - S1)/DF1)/(S1/DF2);

"                                                                    ";
"                                                                    ";
"                  F-STATISTIC FOR TIME TREND:  F(";;
FORMAT /RDS 1,0; DF;; ") = ";; FORMAT /M1 /RD 5,2; F;
"                                                                    ";

"\f";
FORMAT /M1 /RD 12,4;

@=================================================================================@
@                                                                                 @
@     >>>>>>>>>>   MODEL WITH RAILROAD EFFECTS AND TIME EFFECTS   <<<<<<<<<<    @
@                                                                                 @
@=================================================================================@

X        =  X1 ~ X2 ~ DUMR ~ DUMT;
K3       =  COLS(X);

CLEAR X1, X2, DUMR, DUMT;

B        =  INV(X'X)*X'Y;
E        =  Y - X*B;
S3       =  E'E;
S        =  INV(NT - K3)*S3;
COV      =  INV(X'X)*S;
TSTAT    =  B ./ SQRT(DIAG(COV));
RSQ      =  1 - S3/((NT - 1)*STDC(Y)^2);

E1       =  DELIF(E,SEL1);
E2       =  DELIF(E,SEL2);
DE       =  E1 - E2;

RHO      =  INV(E2'E2)*E1'E2;
DW       =  2*(1 - RHO);
```

```
SH      =  S1/NT;
U       =  E^2;
BU      =  INV(X'X)*X'U;
UH      =  X*BU;
BP      =  (NT - 1)*(STDC(UH)^2)/(2*SH^2);
DFBP    =  K3 - 1;

Q1      =  (X*B)^2;
Q2      =  (X*B)^3;
Q3      =  (X*B)^4;
XR      =  X ~ Q1 ~ Q2 ~ Q3;
KR      =  COLS(XR);
BR      =  INV(XR'XR)*XR'Y;
ER      =  Y - XR*BR;
SR      =  ER'ER;
RESET   =  ((S3 - SR)/3)/(SR/(NT - KR));
DFR     =  NT - KR;

"                                                                                ";
"                                                                       DPR2.PRG";
">>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>      TABLE  6     <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<";
"                                                                                ";
FORMAT 1,8;
"                                  ";; $NAMES[YI,.];;" ACCOUNT                    ";
FORMAT /M1 /RD 12,4;
"                                                                                ";
"                                                                                ";
"      OLS REGRESSION ON MODEL WITH RAILROAD EFFECTS AND TIME EFFECTS            ";
"                                                                                ";
"                                                                                ";
"                      COEFFICIENT  ESTIMATE      T-RATIO                        ";
"                                                                                ";
FORMAT 1,8;
"                           ";; $NAMES[X1I,.];; FORMAT /M1 /RD 12,4;
                                   B[1,.];;     TSTAT[1,.];
FORMAT 1,8;
"                           ";; $NAMES[X2I,.];; FORMAT /M1 /RD 12,4;
                                   B[2,.];;     TSTAT[2,.];
"                                                                                ";
"                           F5  ";; B[3,.];;    TSTAT[3,.];
"                           F8  ";; B[4,.];;    TSTAT[4,.];
"                           F10 ";; B[5,.];;    TSTAT[5,.];
"                           F18 ";; B[6,.];;    TSTAT[6,.];
" .                         F20 ";; B[7,.];;    TSTAT[7,.];
"                           F21 ";; B[8,.];;    TSTAT[8,.];
"                           F22 ";; B[9,.];;    TSTAT[9,.];
"                           F23 ";; B[10,.];;   TSTAT[10,.];
"                           F27 ";; B[11,.];;   TSTAT[11,.];
"                           F30 ";; B[12,.];;   TSTAT[12,.];
"                           F31 ";; B[13,.];;   TSTAT[13,.];
"                           F34 ";; B[14,.];;   TSTAT[14,.];
"                           F35 ";; B[15,.];;   TSTAT[15,.];
"                           F36 ";; B[16,.];;   TSTAT[16,.];
"                           F37 ";; B[17,.];;   TSTAT[17,.];
"                                                                                ";
"                           T79        BASE YEAR                                 ";
"                           T80 ";; B[18,.];;   TSTAT[18,.];
"                           T81 ";; B[19,.];;   TSTAT[19,.];
"                           T82 ";; B[20,.];;   TSTAT[20,.];
```

```
"                          T83 ";; B[21,.];;    TSTAT[21,.];
"                          T84 ";; B[22,.];;    TSTAT[22,.];
"                          T85 ";; B[23,.];;    TSTAT[23,.];
"                          T86 ";; B[24,.];;    TSTAT[24,.];
"                          T87 ";; B[25,.];;    TSTAT[25,.];
"                                                                                ";
"                                                                                ";
"                            ERROR VARIANCE ";;   S;
"                                       RSQ ";;   RSQ;
"                              MODIFIED DW ";;   DW;
"                             MODIFIED RHO ";;   RHO;
"                            BREUSCH-PAGAN ";;   BP;;
" CHI-SQ(";; FORMAT /RDS 1,0; DFBP;;")";
FORMAT /M1 /RD 12,4;
"                                      RESET ";;   RESET;;
" F(";; FORMAT /RDS 1,0; 3;; DFR;;")";
FORMAT /M1 /RD 12,4;

@=============================================================================@
@                                                                             @
@    >>>  F-STAT FOR INCREMENTAL EXPLANATORY POWER OF THE TIME EFFECTS   <<<   @
@                                                                             @
@=============================================================================@

DF1      =  K3 - K2;
DF2      =  NT - K3;
DF       =  DF1 ~ DF2;
F        =  ((S2 - S3)/DF1)/(S3/DF2);

"                                                                                ";
"                                                                                ";
"                  F-STATISTIC FOR TIME EFFECTS:  F(";;
FORMAT /RDS 1,0; DF;;") = ";; FORMAT /M1 /RD 5,2; F;
"\f";
OUTPUT FILE = LPT1 OFF;
```