INTERINDUSTRY FORECASTING PROJECT

UNIVERSITY OF MARYLAND

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TIME SERIES REGRESSION WITH PLOT

By

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TIME SERIES REGRESSION WITH PLOT
TISERP

This regression program is specifically designed for analysis of time series. Besides the usual statistics, it provides a plot of the actual and predicted values and partial derivatives of the regression coefficients with respect to one another. It reads variables one at a time in the order in which they are to be introduced, with the dependent variable read last. All observations on one variable are read before proceeding to the next. A variable may have several components; for example, if we wish to use per capita income as a variable but have series already punched only for income and population, we may have the machine make up the per capita series. We let income be the first component and direct that it should be added to the zero entry with which the program begins. Then population is the second component, and we direct that it should be divided into what is already in the variable. The description of the data cards explains the details. See also the comment cards in the program.

The TISERP deck is composed of three parts; a main program which loads the matrix of observations, X, into the computer, a REGRES subroutine which performs the regression and gives the results step-by-step if desired, and a PLOTER subroutine which plots the actual and predicted values. Actual values are plotted with an *; predicted, with a +. Plotter may be used independently of the other two for any time series plotting job, and REGRES and PLOTER may be used with any main program which forms the X matrix. With minor modification, REGRESS can be used for cross-section studies. The program follows closely the approach described in Matrix Methods in Economics by Clopper Almon (Addison-Wesley Publishing Co.), which should be read before asking any questions.

A listing of the Fortran accompanies this description.

1st card contains title of Regression

2nd card (613, 2 F10.10) contains

Number of Independent Variables(counting an intercept supplied by the pgm)

Number of Periods (or Observations)

Number of the variable after the introduction of which printed results are desured,

1 if the program is to supply the intercept; otherwise, a 0.

Last two digits of calendar date of year zero.

1 if the dependent variable is in logarithms. (otherwise zero).

vertical coordinate of the bottom line of the graph.

Vertical interval on the graph. (The graph contains 120 intervals).

The variables are then stacked in order, the dependent variable last. In the deck of each variable there is

Title Card (I3, 12A6) containing

The number of components in this variable,

(+1 if the logs or first differences are to be taken.)

The name of the variable

For each component there is a

Code and format card (I3, 12A6) containing

The code for what is to be done with this component: 1 add, 2 subtract, 3 multiply, 4 divide, 5 take logs of what is in the column already.

Format for the data

Data for the component.

Memo # 4

```
IBFTC GRL      SDD
C*RL      GENERAL REGRESSION LOADING PROGRAM
      COMMON NP,NIV,X(50,8),P(50,2),TITLE(13),A(8,8)
      DIMENSION VARTIT(12),FMT(13),Q(50)
    1 DO 2 I = 1,50
      DO 2 J = 1,8
    2 X(I,J) = 0.
    5 READ                (5,10)(TITLE(I), I = 1,13)
      WRITE               (6,11)(TITLE(I), I = 1,13)
   10 FORMAT(13A6)
   11 FORMAT(1H1 13A6)
      READ                (5,15)NIV,NP,ISTART,INTCEP,IO,LOGS,XBOT,XINT
      WRITE               (6,15)NIV,NP,ISTART,INTCEP,IO,LOGS,XBOT,XINT
   15 FORMAT(6I3,2F10.10)
      NP1 = NIV + 1
      INT = INTCEP + 1
      DO 40 N = INT,NP1
      READ                (5,20)NCOMP,(VARTIT(I),I = 1,12)
      WRITE               (6,20)N    ,(VARTIT(I),I = 1,12)
   20 FORMAT(I3,12A6)
      DO 39 M = 1,NCOMP
      READ                (5,20)NCODE,(FMT(I),I = 1,12)
C      IF NCODE =
C           1  ADD IN THIS COMPONENT
C           2 SUBTRACT THIS COMPONENT
C           3 MULTIPLY BY THIS SERIES
C           4  DIVIDE BY THIS SERIES
C           5  TAKE LOGARITHMS AND ADD
C           6  TAKE LOGARITHMS AND SUBTRACT
C           7  TAKE FIRST DIFFERENCE OF PRECEEDIND SERIES. READ ONLY YEAR
C                ZERO OBSERVATION  UN FIRST 12 COLUMNS OF FOLLOWING CARD.
C      IF IT IS DESIRED TO MULTIPLY THE COMPONENT BY A CONSTANT BEFORE PUTTING
C      IT IN, JUST ADD 10 TO NCODE AND PUT THE CONSTANT IN THE FIRST 12
C      COLUMNS OF THE FIRST CARD AFTER THE COMPONENT.
      IF(NCODE - 7) 25,37,25
   25 READ                (5,FMT)(Q(I), I = 1,NP)
      IF(NCODE - 10) 26,26,22
   22 READ                (5,23)W
   23 FORMAT(F12.0)
      DO 24 I = 1,NP
   24 Q(I) = Q(I)*W
      NCODE = NCODE - 10
   26 GO TO (31,32,33,34,35,36),NCODE
   31 DO 131 I = 1,NP
  131 X(I,N) = X(I,N) + Q(I)
      GO TO 39
   32 DO 132 I = 1,NP
  132 X(I,N) = X(I,N) - Q(I)
      GO TO 39
   33 DO 133 I = 1,NP
  133 X(I,N) = X(I,N)*Q(I)
      GO TO 39
   34 DO 134 I = 1,NP
  134 X(I,N) = X(I,N)/Q(I)
      GO TO 39
   35 DO 135 I = 1,NP
  135 X(I,N) = ALOG (Q(I))
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      GO TO 39
   36 DO 136 I = 1,NP
  136 X(I,N) = ALOG(O(I))
      GO TO 39
   37 READ          (5,EMT)W
      DO 137 I = 2,NP
  137 X(I,N) = X(I,N-1) - X(I-1,N-1)
      X(1,N) = X(2,N-1) - W
      GO TO 39
   39 CONTINUE
   40 CONTINUE
      CALL REGRES(ISTART,INTCEP,IO,XBOT,XINT,LOGS)
      GO TO 1
      END



      SUBROUTINE REGRES(ISTART,INTCEP,IO,TAXIS,YINT,LOGS)
C       REGRESSION WITH PLOTTING OF PREDICTED VALUES.
C      N IS THE NUMBER OF INDEPENDENT VARIABLES INCLUDING THE INTERCEPT
C      IF IT IS TO BE SUPPLIED. NO IS THE NUMBER OF OBSERVATIONS.
C      ISTART IS THE NUMBER OF THE VARIABLE AFTER THE INTRODUCTION
C      OF WHICH PRINTED RESULTS ARE DESIRED
C   INTCEP IS 1 IF YOU WANT THE PROGRAM TO SUPPLY AN INTERCEPT,OTHERWISE 0.
C      IO IS THE YEAR 0 OF THE GRAPH
C      TAXIS AND YINT ARE THE ORDINATE OF THE BOTTOM OF THE GRAPH AND THE
C      VERTICAL INTERVAL (OF WHICH THERE ARE 115) RESPECTIVELY.
C      LOGS  = 1 IF THE DEPENDENT VARIABLE IS IN LOGS AND YOU WANT THE
C      PLOTTING DONE IN THE ORIGINAL UNIT, OTHERWISE PUT LOGS = 0.
C      X IS THE MATRIX OF OBSERVATIONS, WITH THE DEPENDENT VARIABLE IN
C      COLUMN N + 1.
      COMMON NO,N,X(50,8),P(50,2),TITLE(13),A(8,8)
      DIMENSION S(8)
      NP1 = N + 1
      INT = INTCEP + 1
      DO 110 I = 1,NO
  110 WRITE (6,111)          (X(I,J), J = 1,NP1)
  111 FORMAT(8F13.5)
      YBAR = 0.
      IF(INT -1) 13,13,113
C       IF AN INTERCEPT IS TO BE SUPPLIED, TAKE MEANS AND DEVIATIONS FROM
C         MEANS.  FIX FIRST ROW AND COLUMN OF A AS IT WOULD BE AFTER
C         PIVOT ON FIRST VARIABLE WHEN THAT IS A CONSTANT 1.0 .
  113 XNO = NO
      DO 115 J = 2,NP1
      A(1,J) = 0.
      DO 114 I = 1,NO
  114 A(1,J) = A(1,J) + X(I,J)
      A(1,J) = A(1,J)/XNO
      A(J,1) = - A(1,J)
      DO 115 I = 1,NO
  115 X(I,J) = X(I,J) - A(1,J)
      A(1,1) = 1./XNO
      YBAR = A(1,NP1)
C         FORM CROSS-PRODUCTS MATRIX, XPRIMEX
   13 DO 14 I = INT,NP1
      DO 14 J = I,NP1
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```
      A(I,J)=0.0
      DO 14 KI=1,NO
   14 A(I,J)=A(I,J)+X(KI,I)*X(KI,J)
C      RECORD THE MEAN OF THE SQUARED DEVIATIONS OF THE DEPENDENT
C        VARIABLE.  IT IS USED IN CALCULATION  OF RBARSQ.
      T = NO - 1
      SSDY = A(NP1,NP1)/T
      RBARSQ = 0.
      IF(INTCEP.EQ.1) GO TO 19
      YBAR = 0.
      DO 17 I=1,NO
   17 YBAR = YBAR+X(I,NP1)
      T=NO
      YBAR = YBAR/T
      SSDY = 0.
      DO 18 I=1,NO
   18 SSDY = SSDY+(X(I,NP1)-YBAR)**2
      T = NO-1
      SSDY = SSDY/T
      YBAR = 0.
C       INVERSION
   19 DO 100 I = INT,N
      IM1 = I - 1
      T = A(I,I)
      A(I,I) = 1.
      DO 20 K = I,NP1
      A(K,I) = A(I,K)
   20 A(I,K) = A(I,K)/T
      IF(IM1) 23,23,21
   21 DO 22 K = 1,IM1
   22 A(I,K) = - A(K,I)/T
   23 DO 30 J = 1,NP1
      IF(I - J)24,30,24
   24 T = A(J,I)
      A(J,I) = 0.
      DO 26 K = J,NP1
   26 A(J,K) = A(J,K) - A(I,K) * T
   30 CONTINUE
C       ARE WE READY FOR OUTPUT TO BE PRINTED/ NO,YES,YES
      IF(I-ISTART) 100,31,31
   31 WRITE                (6,5)(TITLE(K),K= 1,12),TAXIS,YINT
    5 FORMAT(1H1 12A6/ 7HOTAXIS=  F12.3, 6H YINT=  F10.4)
C       COMPUTE RSQ
      T = NO - 1
      RSQ = 1. - A(NP1,NP1)/(T*SSDY)
C       COMPUTE RBARSQ IF INTERCEPT HAS BEEN SUPPLIED
      IF(INT -1) 34,34,33
   33 T = NO - I
      RBARSQ = 1.  - A(NP1,NP1)/(T*SSDY)
C       REGRESSION COEFFICIENTS ARE IN (A(J,NP1), J = 1,I)
   34 WRITE                (6,35)I,A(NP1,NP1),RBARSQ,RSQ,(A(J,NP1),J =1,I)
      T = NO - I
C       COMPUTE STANDARD ERRORS OF REGRESSION COEFFICIENTS
      DO 32 J = 1,I
   32 S(J) = SQRT (A(J,J) * A(NP1,NP1)/T)
      WRITE                (6,36)(S(J),J = 1,I)
   35 FORMAT(1H0I3,11H VAR  SSR =  E16.8,9H RBARSQ = F8.4,6H RSQ =F8.4/
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     *24H REGRESSION COEFFICIENTS     /(8F14.6))
  26 FORMAT( 1X,8(2H (F11.6,1H)))
     WRITE                (6,39)
C     COMPUTE PARTIAL DERIVATIVES OF REGRESSION COEFFICIENTS WITH
C     RESPECT TO EACH OTHER.
     DO 38 J = 1,I
     JM1 = J - 1
     DO 37 K = 1,JM1
  37 S(K) = A(K,J)/A(J,J)
     DO 137 K = J,I
 137 S(K) = A(J,K)/A(J,J)
  38 WRITE                (6,381)(S(K), K = 1,I)
 381 FORMAT(8F14.6)
  39 FORMAT(66HOPARTIAL DERIVATIVES OF REGRESSION COEF WITH RESPECT TO
    1EACH OTHER    )
     DW = 0.
     DO 402 L = 1,NO
     P(L,1) = YBAR
     P(L,2) = X(L,NP1) + YBAR
     DO 40 K = INT,I
  40 P(L,1) = P(L,1) + A(K,NP1) *X(L,K)
     IF (L.EQ.1) GO TO 402
     DW = DW +((P(L,2) - P(L,1)) - (P(L - 1,2) - P(L - 1,1))) **2
 402 CONTINUE
     DW = DW/A(NP1,NP1)
     WRITE (6,401) DW
 401 FORMAT (16HODURBIN-WATSON = F6.2)
     IF (LOGS) 44,44,41
  41 DO 42 L = 1,NO
     P(L,1) = EXP (P(L,1))
  42 P(L,2) = EXP (P(L,2))
  44 WRITE                (6,45)(P(L,1), L = 1,NO)
     WRITE                (6,46)(P(L,2), L = 1,NO)
  45 FORMAT (12H1PREDICTIONS/(10F12.3))
  46 FORMAT(7HOACTUAL /(10F12.3))
     CALL PLOTER(P,NO,2,TAXIS, YINT,IO)
 100 CONTINUE
     RETURN
     END
$IBFTC DPLOT   SDD




     SUBROUTINE PLOTER  (X,NO,NV,XBOT,XINT,IO)
C X IS MATRIX OF TIME SERIES TO BE PLOTTED,EACH SERIES IN A COLUMN. NO =
C  NUMBER OF OBSERVATIONS,NV=NUMBER OF VARIBLES,XBOT=BOTTOM LINE OF GRAPH
C  XINT = INTERVAL THERE BEING 115 OF THEM, IO IS INITIAL DATE
C
C                         WARNING
C     IF THIS ROUTINE IS USED TO PLOT MORE THAN ONE SERIES, YOU MUST BE SURE
C       THAT  THE DIMENSION STATEMENT FOR X HERE HAS THE SAME NUMBER OF
C       ROWS  AS DOES THE CORRESPONDING MATRIX IN THE CALLING PROGRAM
C
     DIMENSION X(50,4),A(125),DOT(4),LJ(4)
     DATA OUT,BLANK,(DOT(I),I=1,4)/1HA,1H ,1H+,1H*,1HO,1HX/
    1 DO 5 I = 1,125
    5 A(I) = BLANK
```

```
      M = 1
    6 DO 10 I = 1,125,10
   10 A(I) = DOT(1)
      WRITE (6,13) (A(I),I = 1,125)
   13 FORMAT(5X,125A1)
      GO TO (14,100),M
   14 DO 15 I = 1,125,10
   15 A(I) = BLANK
      DO 30 I = 1,NO
      DO 25 J = 1,NV
      L = (X(I,J) - XBOT)/XINT  + 1.
      IF(125 - L).21,23,23
   21 A(125) = OUT
      LJ(J) = 125
      GO TO  25
   23 IF(L) 22,22,24
   22 A(I) = OUT
      LJ(J) = 1
      GO TO 25
   24 A(L) = DOT(J)
      LJ(J) = L
   25 CONTINUE
      IDATE = 10 +I
      WRITE (6,12) IDATE,(A(K),K=1,125)
   12 FORMAT(1HO I4,125A1)
      DO 26 J = 1,NV
      L = LJ(J)
   26 A(L) = BLANK
   30 CONTINUE
      M = 2
      GO TO 6
  100 RETURN
      END
```