

DESCRIPTION OF LATANAL, A COMPUTER PROGRAM FOR
LATENT ROOT REGRESSION ANALYSIS

by

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Description of LATANAL, A Computer Program For

Latent Root Regression Analysis

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I. Introduction

Latent Root Regression Analysis is a technique proposed by the authors as an alternate or supplemental analysis to ordinary least squares when there is multicollinearity among the regressor variables (see [1], [2], and [3]). Basically the technique

(i) determines the presence of multicollinearity among the regressor variables;

(ii) aids in determining whether the multicollinearity has any predictive value;

(iii) yields prediction equations for ordinary least

squares and a modified least squares procedure which

removes the effect of non-predictive multicollinearities;

and

(iv) offers a modified procedure for variable selection

by analyzing the latent roots and latent vectors of the

"correlation matrix" of dependent and independent variables.

For further details of the procedure the reader is directed

to the references in the bibliography.

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The limits on these variables may all be increased by changing appropriate DIMENSION statements in the program.

per card may be used.

of KDESC) are for a description of the data. All 80 columns

b. The next one to five cards (depending on the value

The FORMAT used to read this information is 415.

KDESC: number of data description cards ($1 \leq KDESC \leq 5$) *

(max=5) *

which the input variables are to be read

cards needed to write the format statement by

KVR: number of variable format cards, i.e. number of

N: number of observations (max=100) *

variable (max=21) *

K: number of variables, including the dependent

following order

a. The first data card contains four values in the

II. Input

may be desirable for other systems.

double precision arithmetic is not used. Double precision

computer. Due to the large word length for this computer

is written in FORTRAN IV for the C.D.C. Cyber 70 Model 72

analysis is presented for checking out the program. The program

the input and output of the program are discussed and a sample

quired in latent root regression. In the following sections

program written to perform the calculations and analysis re-

The purpose of this document is to describe a computer

c. The next one to five cards (depending on the value of KVR) contains the format which is to be used to read in the dependent and independent variables. The program is set up to read the dependent variable last, i.e. the READ statement is

READ FMT (X(I,J),J=2,K),X(I,1).

This card may be changed to allow the dependent variable to be read in other than last position.

d. The final information needed are the values of the

independent and dependent variables. As mentioned in c.

the program reads in $X(I,2), \dots, X(I,K), X(I,1)$ for $I=1,2,\dots,N$, where $X(I,1)$ is the dependent variable.

4. If another set of data is to be analyzed repeat

steps a. to d. Otherwise insert a blank card.

III. Output

The output for the program conforms, as much as possible, with the notation presented in references [1], [2], and [3].

The input variables are printed out with the dependent variable first followed by the K-1 independent variables. This is

followed by the averages, $\bar{X}_j$, and the square roots of the sum

of squared deviations of the input variables from their re-

spective means, $\left\{ \sum_{i=1}^n (X_{ij} - \bar{X}_j)^2 \right\}^{1/2}$.

The latent roots are printed out from largest to smallest

and the corresponding latent vectors are printed out in the same

order as row vectors. One check on the accuracy of the calculation

of the latent roots and vectors by Subroutine EIGEN (a

subroutine from the I.B.M. Scientific Subroutines Package) is the calculation of $(A'A)(A'A)^{-1}$, where $(A'A)^{-1}$ is con-

structed from the latent roots and latent vectors of $A'A$.

The resulting matrix should be close to an identity matrix.

The program next prints out four sets of data. The first

set prints out the $[p_{uv}]$ matrix, SSE, SSE (deleting the i^{th}

regressor variable), the t statistic for deleting the i^{th}

regressor variable, the coefficients a_j for determining the

linear combination of latent vectors producing the least

squares estimate, and the least squares estimates of the re-

gression coefficients for both the standardized and unstandardized

regressor variables. The following three sets of data correspond

to the same calculations after the latent vector(s) corresponding

to the smallest, the two smallest, and the three smallest

latent roots have been removed from the analysis. In practice

the authors have rarely needed to delete more than three latent

vectors, usually only one or two. If it is desired to delete

more than three latent vectors, increase the value of KRHO in

subroutine ELMVAR.

IV References

- [1] Webster, J. T., Gunst, R. F., and Mason, R. L. (1973). "Recent Developments in Stepwise Regression Procedures," Presented at the University of Kentucky Conference on Regression with a Large Number of Predictor Variables, October 10-12, 1973.

- [2] Gunst, R. F. and Mason, R. L. (1973). "Some Additional Indices for Selecting Variables in Regression," Presented at the Annual Meetings of the American Statistical Association, Biometric Society, and the Institute of Mathematical Statistics, December 27-30, 1973, New York City.
- [3] Webster, J. T., Gunst, R. F., and Mason, R. L. (1974). "Latent Root Regression Analysis," submitted to Technometrics.

LATANAL VERSION 1.1 MAY, 1974

K=NUMBER OF VARIABLES, MAX=21, WITH X(1) THE DEPENDENT VARIABLE

AA=SUMS OF SQUARES AND PRODUCTS MATRIX

IDEESC=KDESC#10

```
111 FORMAT(1H1,4 DATA DESCRIPTION #,/)

```

```
101 FORMAT(45X,/,*,* INPUT VARIABLES *)
```

103 FORMAT(2X,I5,10F12.5,/, (7X,10F12.5))

```
112 FORMAT(/,1X,* MEANS OF INPUT VARIABLES #,/, (7X,10F12.5))
```

IS FROM THEIR MEANS *, /, (7X, 10F12.5))

COMPUTING THE AA MATRIX

268 FORMAT(11F12.8)

TRANSFORM AA INTO VECTOR AT, WHICH CONTAINS THE ELEMENTS OF AA

ON AND ABOVE THE MAIN DIAGONAL. THE ELEMENTS ARE STORED
COLUMNWISE. ELEMENT (I,J) OF AA IS ELEMENT (I+(J-1)/2) OF AT.
R IS A VECTOR CONTAINING THE LATENT VECTORS OF AA. THESE ARE
ALSO STORED COLUMNWISE IN THE SAME ORDER AS THE LATENT ROOTS.
SEE SUBROUTINE EIGEN

```

120 CONTINUE
DO 120 J=1,K
DO 120 I=1,J
KNT=KNT+1
AT(KNT)=AA(I,J)
CALL EIGEN(AT,R,K,0)
PRINT 200
DO 130 J=1,K
J1=J*(J+1)/2
ALAMV(J)=AT(J1)
IF (ALAMV(J) .LT. 1.0E-13) GO TO 220
ALAMV(J)=1.0/ALAMV(J)
GO TO 222
220 ALAMV(J)=0.
K0=K-J
PRINT 221,K0
FORMAT(//,* LAMBDA(J) INVERSE SET TO ZERO FOR J=*,13,/)
222 ALAMST(J)=ALAMV(J)/(R(I+K*(J-1))**2)
228 PRINT 201,ALAMV(J),ALAMST(J)
130 CONTINUE
PRINT EIGENMATRIX BY ROWS
EACH ROW OF PRINTED EIGENMATRIX IS AN EIGENVECTOR
PRINT 206
DO 150 J=1,K
J=J-1
JM=K-J
IBEG=K*J+1
ISTOP=K*J+K
PRINT 208,JM
PRINT 207,(R(I),I=IBEG,ISTOP)
150 CONTINUE
FORMAT(//,52H LATENT ROOTS FOR SUM OF SQUARES AND PRODUCTS MATRIX
1,10X,* LAMBDA-STARS *,/)
201 FORMAT(E35.8,E39.8)
206 FORMAT(//,43X,25H MATRIX OF LATENT VECTORS )
207 FORMAT(11F12.8)
208 FORMAT(//,50X,4HGAM(,12,1H),/)
CALCULATION OF INVERSE OF AA
DO 310 I=1,K
DO 310 J=1,K
AAINV(I,J)=0.
DO 310 M=1,K
AAINV(I,J)=AAINV(I,J)+R(I+K*(M-1))*ALAMV(M)*R(J+K*(M-1))
310 CONTINUE
CHECK ON SUBROUTINE EIGEN--RESULTING MATRIX SHOULD BE CLOSE TO
THE IDENTITY MATRIX

```

```

DO 311 I=1,K
DO 311 J=1,K
ATEST(I,J)=0.
DO 311 M=1,K
ATEST(I,J)=ATEST(I,J) + AA(I,M)*AAINV(M,J)
311 CONTINUE
PRINT 316
316 FORMAT(///,45X,* INVERSE OF AA *,/)
DO 317 I=1,K
PRINT 321,(AAINV(I,J),J=1,K)
317 CONTINUE
PRINT 318
318 FORMAT(///,45X,* AA TIMES INVERSE *,/)
DO 319 I=1,K
PRINT 321,(ATEST(I,J),J=1,K)
319 CONTINUE
321 FORMAT(10E13.6)
CALL ELVAR(R,ALAM,K,XSQ(1),XSQ,N)
GO TO 1
END

```

```

SUBROUTINE TRANSX(K,N,X,XM,XSQ)
DIMENSION X(100,21),XM(21),XSQ(21)

```

STANDARDIZING THE X VARIABLES

```

DO 150 J=1,K
XM(J)=0.0
XSQ(J)=0.0
DO 140 I=1,N
XM(J)=XM(J)+X(I,J)
XSQ(J)=XSQ(J)+X(I,J)*X(I,J)
140 CONTINUE
XM(J)=XM(J)/N
XSQ(J)=SQRT(XSQ(J)-N*XM(J)*XM(J))
DO 150 I=1,N
X(I,J)=(X(I,J)-XM(J))/XSQ(J)
150 CONTINUE
RETURN
END

```

```

SUBROUTINE ELVAR(R,ALAM,K,ETAHLF,XSQ,N)
DIMENSION R(441),ALAM(21),RHO(21,21),AMUI(21),A(21),B(21),XSQ(21)
1 BORIG(21)
ETA=ETAHLF*ETAHLF
KMI=K-1
NDF=N-KMI-1
KRHO=4
PRINT 11,KMI,ETA
11 FORMAT(1H1,* NUMBER OF INDEPENDENT VARIABLES = *,13,/,
1* TOTAL SUM OF SQUARES (ADJUSTED FOR THE MEAN) = *,F20.5)

```

```

DO 200 KJ=1,KRHO
  KMJ=KJ-1
  KMK=K-KJ+1
  DO 50 IT=1,K
  DO 45 IU=1,K
  RHO(IT,IU)=0.0
  DO 40 J=1,KMK
  RHO(IT,IU)=RHO(IT,IU)+R(IT+K*(J-1))*R(IU+K*(J-1))/ALAM(J)
  CONTINUE
  RHO(IU,IT)=RHO(IT,IU)
  45 CONTINUE
  PRINT 60,IT,(RHO(IT,L),L=1,K)
  50 CONTINUE
  60 FORMAT(//,57X,4HRHO(,I2,3H,J),/(8E15.8))
  DO 70 I=2,K
  AMUI(I)=RHO(I,1)/(RHO(1,1)*RHO(I,1)-RHO(1,I)*RHO(I,1))
  AMUI(I)=AMUI(I)*ETA
  70 CONTINUE
  SSE=ETA/RHO(1,1)
  PRINT 80,SSE
  DO 72 I=2,K
  IM=I-1
  T=SQR((AMUI(I)/SSE-1.)*NDF)
  PRINT 81,IM,AMUI(I),T
  72 CONTINUE
  80 FORMAT(//,*, SUM OF SQUARES FOR ERROR (LEAST SQUARES) = *,E20.8, /
  1/* ADJUSTED SSE (ELIMINATING VARIABLE I) MODIFIED T STATISTIC (
  ZIGNORING SIGN),*,/)
  81 FORMAT(1X,I5,E20.8,F30.4)
  SUM=0.
  DO 75 J=1,KMK
  SUM=SUM+(R(K*(J-1)+1)**2)/ALAM(J)
  75 CONTINUE
  DO 90 J=1,KMK
  IF (ABS(ALAM(J)) .GT. .000001) GO TO 88
  A(J)=0.
  GO TO 90
  88 IF (ABS(R(1+K*(J-1))) .GT. .000001) GO TO 89
  A(J)=0.
  GO TO 90
  89 A(J)=R(K*(J-1)+1)*ETAHLF/ (SUM*ALAM(J))
  90 CONTINUE
  DO 100 JR=2,K
  B(JR)=0.
  DO 101 J=1,KMK
  B(JR)=B(JR)-A(J)*R(JR+K*(J-1))
  101 CONTINUE
  BORIG(JR)=B(JR)/XSQ(JR)
  100 CONTINUE
  PRINT 110,KMJ,KMI,(A(J),J=1,KMK)
  110 FORMAT(//,*, COEFFICIENTS A(J) (TIMES ETA) FOR PREDICTORS *,I3,
  1* THROUGH *,I3,/(8E16.8))
  PRINT 112,(B(J),J=2,K)
  PRINT 113,(BORIG(J),J=2,K)
  112 FORMAT(//,*, LEAST SQUARES PREDICTOR--STANDARDIZED INDEPENDENT VARIA
  BLES *,/(8E16.8))
  113 FORMAT(//,*, LEAST SQUARES PREDICTOR--UNSTANDARDIZED INDEPENDENT VAR
  IABLES *,/(8E16.8))

```

PRINT 115
 115 FORMAT(//,56X,20H*****)
 200 CONTINUE
 END

SUBROUTINE EIGEN(A,R,N,MV)
 DIMENSION A(1),R(1)

SUBROUTINE EIGEN

PURPOSE
 COMPUTE EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC
 MATRIX

USAGE
 CALL EIGEN(A,R,N,MV)

DESCRIPTION OF PARAMETERS
 A - ORIGINAL MATRIX (SYMMETRIC), DESTROYED IN COMPUTATION.
 RESULTANT EIGENVALUES ARE DEVELOPED IN DIAGONAL OF
 MATRIX A IN DESCENDING ORDER.
 R - RESULTANT MATRIX OF EIGENVECTORS (STORED COLUMNWISE,
 IN SAME SEQUENCE AS EIGENVALUES)
 N - ORDER OF MATRICES A AND R
 MV - INPUT CODE
 0 COMPUTE EIGENVALUES AND EIGENVECTORS
 1 COMPUTE EIGENVALUES ONLY (R NEED NOT BE
 DIMENSIONED BUT MUST STILL APPEAR IN CALLING
 SEQUENCE)

REMARKS
 ORIGINAL MATRIX A MUST BE REAL SYMMETRIC (STORAGE MODE=1)
 MATRIX A CANNOT BE IN THE SAME LOCATION AS MATRIX R
 SUBROUTINES AND FUNCTION SUBPROGRAMS REQUIRED
 NONE

METHOD
 DIAGONALIZATION METHOD ORIGINATED BY JACOBI AND ADAPTED
 BY VON NEUMANN FOR LARGE COMPUTERS AS FOUND IN *MATHEMATICAL
 METHODS FOR DIGITAL COMPUTERS*, EDITED BY A. RALSTON AND
 H.S. WILF, JOHN WILEY AND SONS, NEW YORK, 1962, CHAPTER 7

GENERATE IDENTITY MATRIX

```

5  RANGE=1.0E-12
10 IF(MV-1) 10,25,10
    IQ=-N
    DO 20 J=1,N
    IQ=IQ+N
    DO 20 I=1,N
    IJ=IQ+1
    R(IJ)=0.0
    IF(I-J) 20,15,20
15  R(IJ)=1.0
20  CONTINUE

```

COMPUTE INITIAL AND FINAL NORMS (ANORM AND ANORMX)

```

25 ANORM=0.0
DO 35 I=1,N
DO 35 J=1,N
IF(I-J) 30,35,30
30 IA=I+(J-J)/2

```

ANORM=ANORM+A(IA)*A(IA)
35 CONTINUE

IF (ANORM) 165,165,40
40 ANORM=1.414*SQRT(ANORM)

INITIALIZE INDICATORS AND COMPUTE THRESHOLD, THR

```

IND=0
THR=ANORM
45 THR=THR/LOAT(N)
50 L=1
55 M=L+1

```

COMPUTE SIN AND COS

$$\begin{aligned} 2 / (7-7+7) &= 07 \\ 2 / (W-W+W) &= 0W \quad 09 \end{aligned}$$

```

62 IF (ABS(A(LM)) - THR) 130,65,65
65 IND=1
68 LM=L+MQ
68 Y=-A(LM) / SQRT(A(LM)*A(LM)+X*X)
68 IF (X) 70,75,75
70 Y=-Y
75 SINX=Y / SQRT(2.0*(1.0+(SQRT(1.0-Y*Y))))
78 COSX=SQRT(1.0-SINX2)
COSX2=COSX*COSX
SINCS=SINX*COSX
ROTATE L AND M COLUMNS
C
C
C
LQ=N*(L-1)
MQ=N*(M-1)
DO 125 I=1,N
IQ=(1-I-1)/2
IF(I-L) 80,115,80
IF(I-M) 85,115,90
85 IM=I+MQ
GO TO 95
90 IM=M+IQ
95 IF(I-L) 100,105,105
100 IL=I+LQ
GO TO 110
105 IL=L+IQ
110 X=A(IL)*COSX-A(IM)*SINX
A(IM)=A(IL)*SINX+A(IM)*COSX
A(IL)=X
115 IF(MV-1) 120,125,120
120 ILR=ILQ+I
IMR=IMQ+I
X=R(ILR)*COSX-R(IMR)*SINX
R(IMR)=R(ILR)*SINX+R(IMR)*COSX
125 CONTINUE
X=2.0*A(LM)*SINCS
Y=A(LL)*COSX2+A(MM)*SINX2-X
X=A(LL)*SINX2+A(MM)*COSX2+X
A(LM)=(A(LL)-A(MM))*SINCS+A(LM)*(COSX2-SINX2)
A(LL)=Y
A(MM)=X
TESTS FOR COMPLETION
C
C
C
C
C
TEST FOR M = LAST COLUMN
130 IF(M-N) 135,140,135
135 M=M+1
GO TO 60
TEST FOR L = SECOND FROM LAST COLUMN
C
C
C
140 IF(L-(N-1)) 145,150,145
145 L=L+1

```

```

150 IF (IND-1) 160,155,160
155 IND=0
GO TO 50
COMPARE THRESHOLD WITH FI
160 IF (THR-ANRMX) 165,165,45
SORT EIGENVALUES AND EIG
165 IQ=-N
N=1
DO 185 J=1,N
IQ=IQ+N
L=I+I*(I-1)/2
JQ=N*(I-2)
DO 185 J=1,N
JQ=JQ+N
WM=J+J*(J-1)/2
IF (A(L)-A(MM)) 170,185,185

```

DATA DESCRIPTION

SAMPLE DATA WITH FIVE INDEPENDENT VARIABLES

INPUT VARIABLES

1	2.00000	91.50000	85.70000	61.50000	87.00000	8.21000
2	4.50000	96.00000	88.00000	65.50000	91.00000	7.08000
3	1.00000	95.00000	88.50000	68.90000	90.90000	6.38000
4	1.00000	90.60000	82.00000	58.00000	86.00000	7.97000
5	5.50000	92.80000	84.50000	60.20000	88.00000	6.56000
6	8.00000	92.30000	84.20000	60.00000	88.20000	6.65000
7	9.00000	92.00000	84.00000	57.50000	87.20000	5.64000
8	9.00000	90.50000	82.00000	55.00000	85.00000	5.86000
9	7.50000	92.50000	84.50000	61.00000	87.80000	5.78000
10	10.00000	91.20000	81.20000	51.80000	85.70000	4.82000
11	4.00000	93.30000	84.50000	59.00000	88.10000	5.45000
12	3.00000	93.00000	85.20000	59.00000	88.10000	5.96000
13	4.00000	91.60000	83.20000	58.60000	86.50000	6.55000
14	5.00000	89.00000	81.00000	55.20000	84.00000	6.02000
15	4.50000	91.90000	83.50000	56.90000	86.80000	6.18000

MEANS OF INPUT VARIABLES

5.20000	92.21333	84.13333	59.20667	87.35333	6.34067
---------	----------	----------	----------	----------	---------

SQRT OF SUM OF SQUARED DEVIATIONS OF INPUT VARIABLES FROM THEIR MEANS

10.92703	6.50056	8.17517	15.56950	7.13143	3.36162
----------	---------	---------	----------	---------	---------

SUMS OF SQUARES AND PRODUCTS MATRIX AA

1.00000000	-.25115489	-.43938066	-.55793152	-.32030641	-.64852595
-.25115489	1.00000000	.90685815	.80010118	.97758758	.05220777
-.43938066	.90685815	1.00000000	.93583935	.94327145	.29607468
-.55793152	.80010118	.93583935	1.00000000	.87897116	.44106770
-.32030641	.97758758	.94327145	.87897116	1.00000000	.16320188
-.64852595	.05220777	.29607468	.44106770	.16320188	1.00000000

LATENT ROOTS FOR SUM OF SQUARES AND PRODUCTS MATRIX

LAMBDA-STARS

.40667282E+01
 .14320260E+01
 .33653033E+00
 .11462162E+00
 .40279283E-01
 .98146150E-02

.50030613E+02
 .43086862E+01
 .59062891E+00
 .76186616E+01
 .42384553E+03
 .68424978E+01

MATRIX OF LATENT VECTORS

GAM(5)

-.28510488 .44307233 .48164553 .47829952 .46731954 .20799453

GAM(4)

.57650492 .33724720 .12031848 -.04084024 .25566921 -.68731011

GAM(3)

.75483974 -.03309896 .06542892 .07969976 .05604886 .64447417

GAM(2)

.12265745 -.54823678 .24665969 .69894090 -.25889344 -.26078035

GAM(1)

.00974848 .06896675 -.82408120 .45962929 .32356625 -.00919344

GAM(0)

-.03787296 -.61930261 .09648455 -.25185737 .73578753 -.03008687

INVERSE OF AA

.222495E+01	.185027E+01	-.146383E+00	.195985E+01	-.284213E+01	.989093E+00
.185027E+01	.419493E+02	-.860458E+01	.133708E+02	-.445303E+02	.292747E+01
-.146383E+00	-.860458E+01	.184192E+02	-.103068E+02	.144007E+00	-.576684E+00
.195985E+01	.133708E+02	-.103068E+02	.160462E+02	-.167069E+02	-.726329E+00
-.284213E+01	-.445303E+02	.144007E+00	-.167069E+02	.584536E+02	-.173187E+01
.989093E+00	.292747E+01	-.576684E+00	-.726329E+00	-.173187E+01	.226236E+01

AA TIMES INVERSE

.100000E+01	.611067E-12	-.408562E-13	.261124E-12	-.831335E-12	.710543E-14
-.717204E-13	.100000E+01	.176081E-12	-.481615E-12	.215650E-11	-.114575E-12
-.603961E-13	-.157030E-11	.100000E+01	-.455636E-12	.204281E-11	-.852651E-13
-.461853E-13	-.118661E-11	.870415E-13	.100000E+01	.230571E-11	-.959233E-13
-.390799E-13	-.945022E-12	.247802E-12	-.292211E-12	.100000E+01	-.728306E-13
-.106581E-13	-.341061E-12	-.497380E-13	-.994760E-13	.504485E-12	.100000E+01

NUMBER OF INDEPENDENT VARIABLES = 5
TOTAL SUM OF SQUARES (ADJUSTED FOR THE MEAN) = 119.40000

.22249490E+01	.18502703E+01	-.14638272E+00	.19598517E+01	-.28421321E+01	.98909294E+00
			RHO(1,J)		

.18502703E+01	.41949282E+02	-.86045833E+01	.13370804E+02	-.44530305E+02	.29274687E+01
			RHO(2,J)		

-.14638272E+00	-.86045833E+01	.18419211E+02	-.10306778E+02	.14400721E+00	-.57668407E+00
			RHO(3,J)		

.19598517E+01 .13370804E+02 -.10306778E+02 .16046189E+02 -.16706888E+02 -.72632911E+00
 RHO(4,J)

-.28421321E+01 -.44530305E+02 .14400721E+00 -.16706888E+02 .58453600E+02 -.17318742E+01
 RHO(5,J)

.98909294E+00 .29274687E+01 -.57668407E+00 -.72632911E+00 -.17318742E+01 .22623628E+01
 RHO(6,J)

SUM OF SQUARES FOR ERROR (LEAST SQUARES) = .53664151E+02
 ADJUSTED SSE (ELIMINATING VARIABLE 1) MODIFIED T STATISTIC (IGNORING SIGN)

1	.55707484E+02	.5854
2	.53692224E+02	.0686
3	.60133672E+02	1.0416
4	.57217920E+02	.7720
5	.66610029E+02	1.4735

COEFFICIENTS A(J) (TIMES ETA) FOR PREDICTORS 0 THROUGH 5
 -.34430364E+00 .19771254E+01 .11015714E+02 .52554449E+01 .11886047E+01 -.18951262E+02

LEAST SQUARES PREDICTOR--STANDARDIZED INDEPENDENT VARIABLES
 -.90869318E+01 .71890567E+00 -.96251010E+01 .13958102E+02 -.48575715E+01

LEAST SQUARES PREDICTOR--UNSTANDARDIZED INDEPENDENT VARIABLES
 -.13978682E+01 .87937749E-01 -.61820232E+00 .19572647E+01 -.14450088E+01

.20788036E+01 -.53951535E+00 .22593510E+00 .98797603E+00 -.28505455E-02 .87299270E+00
 RHO(1,J)

-.53951535E+00 .28712612E+01 -.25164041E+01 -.25214061E+01 .18979187E+01 .10289857E+01 RHO(2,J)

.22593510E+00 -.25164041E+01 .17470701E+02 -.78308439E+01 -.70893005E+01 -.28090898E+00 RHO(3,J)

.98797603E+00 -.25214061E+01 -.78308439E+01 .95831604E+01 .21744958E+01 -.14984023E+01 RHO(4,J)

-.28505455E-02 .18979187E+01 -.70893005E+01 .21744958E+01 .32926695E+01 .52369540E+00 RHO(5,J)

.87299270E+00 .10289857E+01 -.28090898E+00 -.14984023E+01 .52369540E+00 .21701310E+01 RHO(6,J)

SUM OF SQUARES FOR ERROR (LEAST SQUARES) = .57436884E+02

ADJUSTED SSE (ELIMINATING VARIABLE I) MODIFIED T STATISTIC (IGNORING SIGN)

1	.60381477E+02	.6793
2	.57517728E+02	.1126
3	.60396121E+02	.6810
4	.57436953E+02	.0033
5	.69112456E+02	1.3526

COEFFICIENTS A(J) (TIMES ETA) FOR PREDICTORS 1 THROUGH 5
 -.36850911E+00 .21161226E+01 .11790148E+02 .56249168E+01 .12721668E+01

LEAST SQUARES PREDICTOR--STANDARDIZED INDEPENDENT VARIABLES
 .28359105E+01 -.11876061E+01 -.51932008E+01 .14983618E-01 -.45888021E+01

LEAST SQUARES PREDICTOR--UNSTANDARDIZED INDEPENDENT VARIABLES
 .43625606E+00 -.14526997E+00 -.33354962E+00 .21010670E-02 -.13650565E+01

.20764442E+01 -.55620684E+00 .42538110E+00 .87673550E+00 -.81160786E-01 .87521772E+00
RHO(1,J)

-.55620684E+00 .27531754E+01 -.11054009E+01 -.33083898E+01 .13439041E+01 .10447269E+01
RHO(2,J)

.42538110E+00 -.11054009E+01 .61067264E+00 .15727958E+01 -.46939939E+00 -.46899928E+00
RHO(3,J)

.87673550E+00 -.33083898E+01 .15727958E+01 .43383032E+01 -.15177379E+01 -.13934954E+01
RHO(4,J)

-.81160786E-01 .13439041E+01 -.46939939E+00 -.15177379E+01 .69343948E+00 .59754695E+00
RHO(5,J)

.87521772E+00 .10447269E+01 -.46899928E+00 -.13934954E+01 .59754695E+00 .21680326E+01
RHO(6,J)

SUM OF SQUARES FOR ERROR (LEAST SQUARES) = .57502147E+02

ADJUSTED SSE (ELIMINATING VARIABLE I) MODIFIED T STATISTIC (IGNORING SIGN)

1	.60791907E+02	.7176
2	.67073636E+02	1.2240
3	.62866486E+02	.9163
4	.57766411E+02	.2034
5	.69292681E+02	1.3585

COEFFICIENTS A(J) (TIMES ETA) FOR PREDICTORS 2 THROUGH 5
-.36892782E+00 .21185271E+01 .11803544E+02 .56313081E+01

LEAST SQUARES PREDICTOR--STANDARDIZED INDEPENDENT VARIABLES
 .29269696E+01 --.22385154E+01 --.46137121E+01 .42709859E+00 --.46057249E+01

LEAST SQUARES PREDICTOR--UNSTANDARDIZED INDEPENDENT VARIABLES
 .45026395E+00 --.27381897E+00 --.29633013E+00 .59889591E-01 --.13700906E+01

.19451876E+01 .30465429E-01 .16142873E+00 .12879363E+00 .19588302E+00 .11542807E+01
 RHO(1,J)

.30465429E-01 .13095129E+00 .74375812E-01 .34654224E-01 .10561313E+00 --.20258919E+00
 RHO(2,J)

.16142873E+00 .74375812E-01 .79873950E-01 .68711712E-01 .87725686E-01 .92186332E-01
 RHO(3,J)

.12879363E+00 .34654224E-01 .68711712E-01 .76294028E-01 .60945235E-01 .19669381E+00
 RHO(4,J)

.19588302E+00 .10561313E+00 .87725686E-01 .60945235E-01 .10868228E+00 .85278253E-02
 RHO(5,J)

.11542807E+01 --.20258919E+00 .92186332E-01 .19669381E+00 .85278253E-02 .15747205E+01
 RHO(6,J)

SUM OF SQUARES FOR ERROR (LEAST SQUARES) = .61382255E+02

ADJUSTED SSE (ELIMINATING VARIABLE I) MODIFIED T STATISTIC (IGNORING SIGN)

1	.61606732E+02	.1814
2	.73752276E+02	1.3467
3	.69106492E+02	1.0642
4	.74993468E+02	1.4127
5	.10863512E+03	2.6322

COEFFICIENTS A(J) (TIMES ETA) FOR PREDICTORS 3 THROUGH 5
--.39382220E+00 .22614802E+01 .12600020E+02

LEAST SQUARES PREDICTOR--STANDARDIZED INDEPENDENT VARIABLES
--.17113860E+00 --.90682085E+00 --.72349421E+00 --.11003668E+01 --.64841361E+01

LEAST SQUARES PREDICTOR--UNSTANDARDIZED INDEPENDENT VARIABLES
--.26326731E-01 --.11092385E+00 --.46468686E-01 --.15429814E+00 --.19288720E+01

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The purpose of this paper is to present a computer program which will perform the calculations needed for Latent Root Regression Analysis. Latent Root Regression is a technique proposed by the authors to supplement ordinary least squares when multicollinearity exists in the matrix of regression variables. Included in the paper is a discussion			

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of input and output for the program, references for a discussion of the technique, a program listing, and sample output.

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