TIME-VARYING MARKOV MODELS

OF SCHOOL ENROLMENT

by

MARIA MANUELA MARTINS PINHEIRO DE MAGALHAES

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APPENDIX A

THE QUADRATIC PROGRAMMING PROBLEM FOR THE RESTRICTED LEAST SQUARES ESTIMATION PROCEDURE FOR THE BASIC MARKOV MODEL

A.1. The Quadratic Programing Problem to Solve the Restricted OLS Estimation Procedure

This procedure follows the method presented by TAKAYAMA and JUDGE [1971]. The mathematical programming problem is:

- find $\underline{\hat{p}}^s$ which minimises the positive quadratic form

$$\Phi = (\underline{n}^* - \underline{N}\,\underline{\hat{p}})'\,(\underline{n}^* - \underline{N}\,\underline{\hat{p}}) \qquad (A.1)$$

subject to

$$\underline{G}\,\underline{\hat{p}} = \underline{n}_{s+1} \qquad (A.2)$$

$$\underline{\hat{p}} \geq \underline{0}$$

The reducibility theorem [TAKAYAMA and JUDGE, pp.20] enables one to state that if $\underline{\hat{p}}^s$ is a solution of this quadratic programming problem, then the following linear programming has a solution that is exactly equal to $\underline{\hat{p}}^s$.

- find $\underline{\hat{p}}^s$ that maximises

$$(\underline{N}'\underline{n}^* - \underline{N}'\underline{N}\,\underline{\hat{p}}^s)'\,\underline{\hat{p}} \qquad (A.3)$$

subject to

$$\begin{aligned} \underline{G}\,\underline{\hat{p}} &\leq \underline{n}_{s+1} \\ -\underline{G}\,\underline{\hat{p}} &\leq -\underline{n}_{s+1} \\ \underline{\hat{p}} &\geq \underline{0} \end{aligned} \qquad (A.4)$$

The dual of this linear programming problem [DANTZIG and ORDEN, 1953] is:

- find $(\underline{\lambda}_1, \underline{\lambda}_2)$ that minimise

$$[\ \underline{\lambda}_1' \quad \underline{\lambda}_2'\ ] \begin{bmatrix} \underline{\eta}_{s+1} \\ -\underline{\eta}_{s+1} \end{bmatrix} \qquad (A.5)$$

subject to

$$[\ \underline{G}' \quad -\underline{G}'\ ] \begin{bmatrix} \underline{\lambda}_1 \\ \underline{\lambda}_2 \end{bmatrix} \geq \underline{N}'\underline{n}^* - \underline{N}'\underline{N}\ \underline{\hat{p}}^s \qquad (A.6)$$

$$\underline{\lambda}_1\ ,\ \underline{\lambda}_2 \geq \underline{0}$$

where $\underline{\lambda}_1$, $\underline{\lambda}_2$ are [(s+1) x 1] vectors of dual variables. Using the duality theorem of linear programming the following inequality can be written:

$$(\underline{N}'\underline{n}^* - \underline{N}'\underline{N}\ \underline{\hat{p}}^s)'\ \underline{\hat{p}} \leq \underline{\lambda}_1'\ \underline{\eta}_{s+1} - \underline{\lambda}_2'\ \underline{\eta}_{s+1}$$

for all $\underline{\hat{p}}^s$ satisfying condition (A.4) and:

$$(\underline{N}'\underline{n}^* - \underline{N}'\underline{N}\ \underline{\hat{p}}) = \underline{0}$$

for some $\underline{\hat{p}}^s$ satisfying (A.4). Taking into account the primal specification (A.3) and the dual specification (A.5) the following primal-dual quadratic programming formulation can be defined:

- find $(\underline{\hat{p}}^s, \underline{\lambda}_1, \underline{\lambda}_2)$ that maximise

$$(\underline{N}'\underline{n}^* - \underline{N}'\underline{N}\ \underline{\hat{p}})'\ \underline{\hat{p}} - \underline{\lambda}_1'\ \underline{\eta}_{s+1} + \underline{\lambda}_2'\ \underline{\eta}_{s+1} \leq \underline{0} \qquad (A.7)$$

subject to

$$\underline{G}\,\hat{\underline{p}} \leq \underline{\eta}_{s+1}$$
$$-\underline{G}\,\hat{\underline{p}} \leq -\underline{\eta}_{s+1} \qquad \text{(A.8)}$$
$$[\ \underline{G}' \ \ -\underline{G}'\ ] \begin{bmatrix} \underline{\lambda}_1 \\ \underline{\lambda}_2 \end{bmatrix} \geq \underline{N}'\underline{n}^* - \underline{N}'\underline{N}\,\hat{\underline{p}}$$

$$\hat{\underline{p}},\ \underline{\lambda}_1,\ \underline{\lambda}_2 \geq \underline{0}$$

Introducing slack vectors of appropriate dimensions in the constraints inequalities, in order to form a proper computational algorithm, (A.8) can be converted to:

$$\underline{G}\,\hat{\underline{p}} + \underline{\alpha}_1 = \underline{\eta}_{s+1}$$
$$-\underline{G}\,\hat{\underline{p}} + \underline{\alpha}_2 = -\underline{\eta}_{s+1}$$
$$\underline{G}'\underline{\lambda}_1 - \underline{G}'\underline{\lambda}_2 = \underline{N}'\underline{n}^* - \underline{N}'\underline{N}\,\hat{\underline{p}} + \underline{\beta}$$
$$\hat{\underline{p}},\ \underline{\lambda}_1,\ \underline{\lambda}_2,\ \underline{\alpha}_1,\ \underline{\alpha}_2,\ \underline{\beta} \geq \underline{0} \qquad \text{(A.9)}$$

The objective function (A.7) can then be written:

$$(\underline{G}'\underline{\lambda}_1 - \underline{G}'\underline{\lambda}_2 - \underline{\beta})'\hat{\underline{p}} - \underline{\lambda}_1'\,\underline{\eta}_{s+1} + \underline{\lambda}_2'\,\underline{\eta}_{s+1} \leq \underline{0}$$
$$\underline{\lambda}_1'\,\underline{G}\,\hat{\underline{p}} - \underline{\lambda}_2'\,\underline{G}\,\hat{\underline{p}} - \underline{\beta}'\hat{\underline{p}} - \underline{\lambda}_1'\,\underline{\eta}_{s+1} + \underline{\lambda}_2'\,\underline{\eta}_{s+1} \leq \underline{0}$$
$$\underline{\lambda}'_1\,(\underline{G}\,\hat{\underline{p}} - \underline{\eta}_{s+1}) - \underline{\lambda}_2'\,(\underline{G}\,\hat{\underline{p}} - \underline{\eta}_{s+1}) - \underline{\beta}'\hat{\underline{p}} \leq \underline{0}$$
$$-\underline{\lambda}_1'\,\underline{\alpha}_1 - \underline{\lambda}_2'\,\underline{\alpha}_2 - \underline{\beta}'\hat{\underline{p}} \leq \underline{0} \qquad \text{(A.10)}$$

The quadratic programming problem can then be formulated in the following form:

- find ($\hat{\underline{p}}^s$, $\underline{\lambda}_1$, $\underline{\lambda}_2$) that maximise

$$-\,(\ \underline{\lambda}_1'\,\underline{\alpha}_1 + \underline{\lambda}_2'\,\underline{\alpha}_2 + \underline{\beta}'\,\hat{\underline{p}}\ )$$

subject to constraints (A.9).

As the objective function is less than or equal to zero, the maximum value it can take is zero. So, at the optimum,

$$- (\underline{\lambda}_1' \, \underline{\alpha}_1 + \underline{\lambda}_2' \, \underline{\alpha}_2 + \underline{\beta}' \, \underline{p}^s) = \underline{0}$$

This problem can be solved using the simplex version of the quadratic programming algorithm developed by WOLFE [1959]. The coefficients of the problem for the restricted OLS estimator can be presented in the following simplex tableau:

	$\underline{\lambda}_1$	$\underline{\lambda}_2$	$\hat{\underline{p}}$	$\underline{\alpha}_1$	$\underline{\alpha}_2$	$\underline{\beta}$
$\underline{\eta}_{s+1}$			$\underline{G}$	$\underline{I}$		
$-\underline{\eta}_{s+1}$			$\underline{G}'$		$\underline{I}$	
$\underline{N}'\underline{n}^*$	$\underline{G}'$	$-\underline{G}'$	$\underline{N}'\underline{N}$			$-\underline{I}$

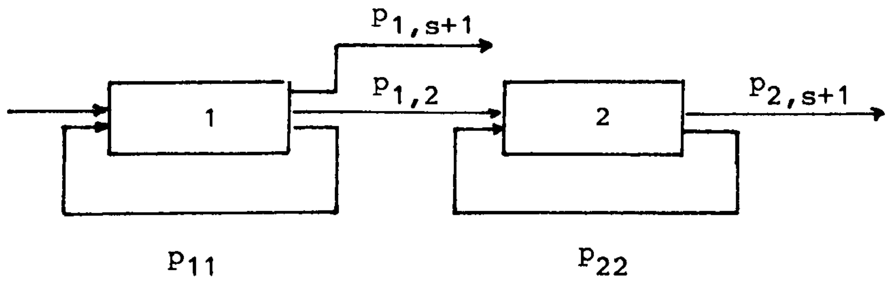
A.2. The Relationship Between Some of the Coefficients of the Objective Function for the Quadratic Programming Problem

The mathematical quadratic programming problem is:

$$\min_{\underline{\hat{p}}} \; (\underline{n}^* - \underline{N}\,\underline{\hat{p}})'(\underline{n}^* - \underline{N}\,\underline{\hat{p}})$$

$$\text{s.t.} \quad \underline{G}\,\underline{\hat{p}} = \underline{n}_{s+1}$$

Let us consider a simple system with only two grades



and a series of k+1 observed values of the students enrolled in each grade.

The matrix $\underline{n}^* - \underline{N}\,\underline{\hat{p}}$ can be written, with t=1, ... ,k:

$$\begin{bmatrix} n_1^*(1) \\ \cdot \\ n_1^*(k) \\ n_2^*(1) \\ \cdot \\ n_2^*(k) \\ n_{s+1}^*(1) \\ \cdot \\ n_{s+1}^*(k) \end{bmatrix} - \begin{bmatrix} n_1(0) & n_2(0) & 0 & 0 & 0 & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ n_1(k-1) & n_2(k-1) & 0 & 0 & 0 & 0 \\ 0 & 0 & n_1(0) & n_2(0) & 0 & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ 0 & 0 & n_1(k-1) & n_2(k-1) & 0 & 0 \\ 0 & 0 & 0 & 0 & n_1(0) & n_2(0) \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ 0 & 0 & 0 & 0 & n_1(k-1) & n_2(k-1) \end{bmatrix} \begin{bmatrix} p_{11} \\ 0 \\ p_{12} \\ p_{22} \\ p_{1,s+1} \\ p_{2,s+1} \end{bmatrix}$$

$$= \begin{bmatrix} n_1^*(1) - n_1(0) \\ \cdots \\ n_1^*(k) - n_1(k-1)\ p_{11} \\ n_2^*(1) - n_1(0)\ p_{12} - n_2(0)\ p_{22} \\ \cdots \\ n_2^*(k) - n_1(k-1)\ p_{12} - n_2(k-1)\ p_{22} \\ n_{s+1}^*(1) - n_1(0)\ p_{1,s+1} - n_2(0)\ p_{2,s+1} \\ \cdots \\ n_{s+1}^*(k) - n_1(k-1)\ p_{1,s+1} - n_2(k-1)\ p_{2,s+1} \end{bmatrix}$$

(3k x 1)

$$\begin{aligned} (\underline{n}^*-\underline{N}\ \underline{\hat{p}})'(n^*-\underline{N}\ \underline{\hat{p}}) = & \sum_t [n_1^*(t) - n_1(t-1)\ p_{11}]^2 \\ & + \sum_t [n_2^*(t) - n_1(t-1)\ p_{12} - n_2(t-1)\ p_{22}]^2 \\ & + \sum_t [n_{s+1}^*(t) - n_1(t-1)\ p_{1,s+1} - n_2(t-1)\ p_{2,s+1}]^2 \end{aligned}$$

$$\begin{aligned} = & \sum_t [n_1^{*2}(t) - 2n_1^*(t)\ n_1(t-1)\ p_{11} + n_1^2(t-1)\ p_{11}^2] \\ & + \sum_t [n_2^{*2}(t) - 2n_2^*(t)\ n_1(t-1)\ p_{12} + n_1^2(t-1)\ p_{12}^2 \\ & \quad - 2n_2^*(t)\ n_2(t-1)\ p_{22} + n_2^2(t-1)\ p_{22}^2 \\ & \quad + 2n_1(t-1)\ n_2(t-1)\ p_{12}\ p_{22}] \\ & + \sum_t [\ n_{s+1}^{*2}(t) - 2n_{s+1}^*(t)\ n_1(t-1)\ p_{1,s+1} \\ & \quad + n_1^2(t-2)\ p_{1,s+1}^2 - 2n_{s+1}^*(t)\ n_2(t-1)\ p_{2,s+1} \\ & \quad + n_2^2(t-1)\ p_{2,s+1}^2 + 2n_1(t-1)\ n_2(t-1)\ p_{1,s+1}\ p_{2,s+1}] \end{aligned}$$

Using letters to represent the coefficients of the transition probabilities

$A = \sum_t n_1^{*2}(t)$ $\qquad$ $G = \sum_t n_2^2(t-1)$

$B = \sum_t 2n_1^*(t)\ n_1(t-1)$ $\qquad$ $H = \sum_t 2n_1(t-1)\ n_2(t-1)$

$C = \sum_t n_1^2(t-1)$ $\qquad$ $I = \sum_t n_{s+1}^{*2}(t)$

$$D = \sum_t n_2^2(t) \qquad J = \sum_t 2n^*_{s+1}(t)\ n_1(t-1)$$

$$E = \sum_t 2n^*_2(t)\ n_1(t-1) \qquad L = \sum_t 2n^*_{s+1}(t)\ n_2(t-1)$$

$$F = \sum_t 2n^*_2(t)\ n_2(t-1)$$

the previous expression can be written as follows:

$$(\underline{n}^* - \underline{N}\ \underline{\hat{p}})'(\underline{n}^* - \underline{N}\ \underline{\hat{p}}) = A - B\ p_{11} + C\ p_{11}^2 + D - E\ p_{12} + C\ p_{12}^2 - F\ p_{22} + G\ p_{22}^2 + H\ p_{12}\ p_{22} + I - J\ p_{1,s+1} + C\ p_{1,s+1}^2 - L\ p_{2,s+1} + G\ p_{2,s+1}^2 + H\ p_{1,s+1}\ p_{2,s+1}$$

Replacing S = A + D + I and reorganizing:

$$(\underline{n}^* - \underline{N}\ \underline{\hat{p}})'(\underline{n}^* - \underline{N}\ \underline{\hat{p}}) = S - B\ p_{11} - E\ p_{12} - J\ p_{1,s+1} - L\ p_{2,s+1} + C\ p_{11}^2 + C\ p_{12}^2 + C\ p_{1,s+1}^2 + G\ p_{22}^2 + G\ p_{2,s+1}^2 + H\ p_{12}\ p_{22} + H\ p_{1,s+1}\ p_{2,s+1}$$

This equation shows that the coefficients of the objective function for the quadratic programming problem present some interesting relationships: (i) the coefficients of the square terms of the three transition probabilities (promotion, repetition, drop-out) associated with each grade are equal; (ii) also equal are the coefficients of the rectangular terms that link two different grades.

A.3. The Quadratic Programming Problem to Solve the Restricted GLS Estimation Procedure

The procedure undertaken in this section is the same as that followed in A.1. to find the restricted OLS estimator. The problem is now:

- find $\underline{\hat{p}}^s$ which minimises the positive quadratic form

$$\Phi = (\underline{n}^* - \underline{N}\ \underline{\hat{p}})'\ \underline{\Sigma}^{-1}\ (\underline{n}^* - \underline{N}\ \underline{\hat{p}}) \qquad (A.11)$$

subject to

$$\underline{R}\ \underline{\hat{p}} \leq \underline{\eta}_{s+1} \qquad (A.12)$$
$$\underline{\hat{p}} \geq \underline{0}$$

where $\underline{\eta}_{s+1}$ is a [(s+1) x 1] vector of unities and $\underline{R}$ is a matrix $[A_1, \ldots ,A_s]$ with each A_i a [(s+1) x (s+1)] diagonal matrix of entries zero or unity in the main diagonal. Applying the reducibility theorem of TAKAYAMA and JUDGE [1971] the quadratic programming problem can be transformed into the following linear programming problem:

- find $\underline{\hat{p}}^s$ that maximises

$$(\underline{N}'\ \underline{\Sigma}^{-1}\ \underline{n}^* - \underline{N}'\ \underline{\Sigma}^{-1}\ \underline{N}\ \underline{\hat{p}}^s)'\ \underline{\hat{p}} \qquad (A.13)$$

subject to

$$\underline{R}\ \underline{\hat{p}} \leq \underline{\eta}_{s+1} \qquad (A.14)$$
$$\underline{\hat{p}} \geq \underline{0}$$

where $\underline{\hat{p}}^s$ is the optimal solution we are seeking. The dual problem is then:

- find $\underline{\lambda}$ that minimises

$$\underline{\lambda}' \, \underline{\eta}_{s+1} \qquad (A.15)$$

subject to

$$\underline{R}' \, \underline{\lambda} \geq (\underline{N}' \, \underline{\Sigma}^{-1} \, \underline{n}^* - \underline{N} \, \underline{\Sigma}^{-1} \, \underline{N} \, \underline{\hat{p}}^s) \qquad (A.16)$$

$$\underline{\lambda} \geq \underline{0}$$

where $\underline{\lambda}$ is the (sk x 1) vector of dual variables. From inequalities (A.12) and (A.16) results:

$$(\underline{N}' \, \underline{\Sigma}^{-1} \, \underline{n}^* - \underline{N}' \, \underline{\Sigma}^{-1} \, \underline{N} \, \underline{\hat{p}}^s)' \, \underline{\hat{p}} \leq (\underline{R}' \, \underline{\lambda})' \, \underline{\hat{p}}$$

$$(\underline{N}' \, \underline{\Sigma}^{-1} \, \underline{n}^* - \underline{N}' \, \underline{\Sigma}^{-1} \, \underline{N} \, \underline{\hat{p}}^s)' \, \underline{\hat{p}} \leq \underline{\lambda}' \, \underline{R} \, \underline{\hat{p}} \leq \underline{\lambda}' \, \underline{\eta}_{s+1}$$

$$(\underline{N}' \, \underline{\Sigma}^{-1} \, \underline{n}^* - \underline{N}' \, \underline{\Sigma}^{-1} \, \underline{N} \, \underline{\hat{p}}^s)' \, \underline{\hat{p}} - \underline{\lambda}' \, \underline{\eta}_{s+1} \leq \underline{0} \qquad (A.17)$$

Taking into account that:

$$\underline{\hat{p}}^s{}_{s+1} = \underline{\eta}_{s+1} - \underline{R} \, \underline{\hat{p}}^s$$

and

$$\underline{R}' \, \underline{\lambda} = \underline{\beta} + \underline{N}' \, \underline{\Sigma}^{-1} \, \underline{n}^* - \underline{N}' \, \underline{\Sigma}^{-1} \, \underline{N} \, \underline{\hat{p}}^s$$

where $\underline{\hat{p}}^s{}_{s+1}$ and $\underline{\beta}$ are the vectors of slack variables, inequality (A.17) can be rewritten as follows:

$$(\underline{R}' \, \underline{\lambda} - \underline{\beta})' \, \underline{\hat{p}} - \underline{\lambda}' \, \underline{\eta}_{s+1} \leq \underline{0}$$

$$\underline{\lambda}' \underline{R} \, \underline{\hat{p}} - \underline{\beta}' \underline{\hat{p}} - \underline{\lambda}' \underline{\eta}_{s+1} \leq \underline{0}$$

$$\underline{\lambda}' (\underline{R} \, \underline{\hat{p}} - \underline{\eta}_{s+1}) - \underline{\beta}' \underline{\hat{p}} \leq \underline{0}$$

$$-\underline{\lambda}' \underline{\hat{p}}^s{}_{s+1} - \underline{\beta}' \underline{\hat{p}}^s \leq \underline{0}$$

and the primal-dual problem becomes:

- find ($\underline{\lambda}$, $\underline{\hat{p}}^s$) which maximise

$$- (\underline{\lambda}' \, \underline{\hat{p}}_{s+1} + \underline{\beta}' \, \underline{\hat{p}}) \; < \; \underline{0} \qquad \text{(A.18)}$$

subject to

$$\underline{R} \, \underline{\hat{p}} + \underline{\hat{p}}_{s+1} = \underline{\eta}_{s+1}$$
$$\underline{N}' \, \underline{\Sigma}^{-1} \, \underline{n}^* - \underline{N}' \, \underline{\Sigma}^{-1} \, \underline{N} \, \underline{\hat{p}} + \underline{\beta} = \underline{R}' \, \underline{\lambda} \qquad \text{(A.19)}$$
$$\underline{\hat{p}} \, , \, \underline{\hat{p}}_{s+1} \, , \, \underline{\lambda} \, , \, \underline{\beta} \; > \; \underline{0}$$

This problem can be solved using the standard simplex method. From (A.18) we conclude that at the optimum, $-\underline{\lambda}'\underline{\hat{p}}^s{}_{s+1} = \underline{\beta}'\underline{\hat{p}}^s$ which means that, as none of the variables can be negative, some must be zero. The corresponding simplex tableau is:

	$\underline{\lambda}$	$\underline{\hat{p}}$	$\underline{\hat{p}}_{s+1}$	$\underline{\beta}$
$\underline{\eta}_{s+1}$		$\underline{R}$	$\underline{I}$	
$\underline{N} \, \underline{\Sigma}^{-1} \, \underline{n}^*$	$\underline{R}'$	$\underline{N}'\underline{\Sigma}^{-1} \, \underline{N}$		$-\underline{I}$

APPENDIX B

THE APPLICATION OF THE BASIC MARKOV MODEL TO THE WHOLE PORTUGUESE EDUCATIONAL SYSTEM: PROGRAMS AND TABLES

PROGRAM SPSSREG

```
/*ST=(MFZ,SP),TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
GETFEP(DATA,$SPSS(CON2)$)
SPSS(D)
####S
RUN NAME        ESTIMATION OF COEFFICIENTS-OLS
VARIABLE LIST   V04 TO V11,V23
VAR LABELS      V04  REPET. GRADE 5 YEAR T
                V05 STUD. GRADE 5 YEAR T
                V06  STUD. GRADE 6 YEAR T
                V07  STUD. GRADE 7 YEAR T
                V08  STUD. GRADE 8 YEAR T
                V09  STUD. GRADE 9 YEAR T
                V10  STUD. GRADE 10 YEAR T
                V11  STUD. GRADE 11 YEAR T
                V23  DROPOUTS YEAR T-1
INPUT FORMAT    FIXED(1X,9F7.0)
N OF CASES      11
INPUT MEDIUM    DISK
COMPUTE         V12=LAG(V05)
COMPUTE         V13=LAG(V06)
COMPUTE         V14=LAG(V07)
COMPUTE         V15=LAG(V08)
COMPUTE         V16=LAG(V09)
COMPUTE         V17=LAG(V10)
COMPUTE         V18=LAG(V11)
ASSIGN MISSING  V04(14816),V05(99769),V06(73647),V07(52015),V08(42239),
                V09(26499),V10(13051),V11(10519),V12(92599),V13(64315),
                V14(48158),V15(38202),V16(21654),V17(13087),V18(8466)
REGRESSION      VARIABLES=V04 TO V18,V23/
                REGRESSION=V04 WITH V12/RESID = 0/
                REGRESSION=V06 WITH V12,V13/RESID = 0/
                REGRESSION=V07 WITH V13,V14/RESID = 0/
                REGRESSION=V08 WITH V14,V15/RESID = 0/
                REGRESSION=V09 WITH V15,V16/RESID = 0/
                REGRESSION=V10 WITH V16,V17/RESID = 0/
                REGRESSION=V11 WITH V17,V18/RESID = 0/
                REGRESSION=V23 WITH V12 TO V18/RESID = 0/
OPTIONS         1,6,11,19
STATISTICS      ALL
READ INPUT DATA
FINISH
```

```
PROGRAM JOB(M)


/* ST=MFZ,TI=4,C=A
FTN5(DB=0/PMD)
LGO.
####S
      PROGRAM MAT
C     MULT. (N*-NP)'(N*-NP)
      REAL A,B,C
      DIMENSION A(11,3),B(11,6),C(6)
      OPEN(3,FILE='INPUT')
      OPEN(4,FILE='OUTPUT')
C     ZEROIZE THE ARRAY
      DO 10,I=1,11
      DO 10,J=1,6
   10 B(I,J)=0.0
      DO 20,J=1,6
   20 C(J)=0.0
      DO 60,K=1,5
      WRITE(4,150)
150   FORMAT (1H1,'MATRIX A')
      DO 21,J=1,6
   21 C(J)=0.0
      DO 30,I=1,11
      READ(3,100)(A(I,J),J=1,3)
   30 WRITE(4,200)(A(I,J),J=1,3)
100   FORMAT (3F7.0)
200   FORMAT (1H0,3F10.0)
      WRITE(4,300)
300   FORMAT (1H0,'MATRIX B')
      DO 40,I=1,11
      B(I,1)=A(I,1)*A(I,1)
      B(I,2)=A(I,2)*A(I,2)
      B(I,3)=A(I,3)*A(I,3)
      B(I,4)=2*A(I,1)*A(I,2)
      B(I,5)=2*A(I,1)*A(I,3)
      B(I,6)=2*A(I,2)*A(I,3)
   40 WRITE(4,400)(B(I,J),J=1,6)
400   FORMAT (1H0,6(E14.8,2X))
      WRITE(4,500)
500   FORMAT (////1H0,'MATRIX C')
      DO 50,J=1,6
      DO 50,I=1,11
   50 C(J)=B(I,J)+C(J)
      WRITE(4,600)(C(J),J=1,6)
600   FORMAT (1H0,6(E14.8,2X))
   60 CONTINUE
      STOP
      END
####S
  52015  64315  48158
  60249  76647  52015
  81206  83987  60249
  98785  98906  81206
 104322 105879  98785
  92023 115997 104322
 101845 127153  92023
  91417 120590 101845
  94553 121383  91417
```

97738	124346	94553
101797	129714	97738
42239	48158	38202
44534	52015	42239
47341	60249	44534
69906	81206	47341
77394	98785	69906
108500	104322	77394
88998	92023	108500
73778	101845	88998
70132	91417	73778
74893	94553	70132
77250	97738	74893
26499	38202	21654
33340	42239	26449
36798	44534	33340
48705	47341	36798
62547	69906	48705
77348	77394	62547
104730	108500	77348
72335	88998	104730
72704	73778	72235
63803	70132	72704
64405	74893	63803
13051	21654	13087
17875	26499	13051
21110	33340	17875
41156	36798	21110
37196	48705	41156
45976	62547	37196
44029	77348	45976
43770	104730	44029
41554	72335	43770
46246	72704	41554
47953	63803	46246
10519	13087	8466
10983	13051	10519
14445	17875	10983
20129	21110	14445
37693	41156	20125
44658	37196	37693
52462	45976	44658
38345	44029	52462
39537	43770	38345
47867	41554	39537
57119	46246	47867

####S

```
PROGRAM JOB(MMM)


/* ST=MFZ,TI=4,C=A
FTN5(DB=0/PMD)
LGO.
####S
      PROGRAM MAT
C     MULT. (N*-NP)'(N*-NP)
      REAL A,B,C
      DIMENSION A(11,8),B(11,36),C(36)
      OPEN(3,FILE='INPUT')
      OPEN(4,FILE='OUTPUT')
C     ZEROIZE THE ARRAY
      DO 10,I=1,11
      DO 10,J=1,8
   10 B(I,J)=0.0
      DO 20,J=1,36
   20 C(J)=0.0
      WRITE(4,150)
150   FORMAT (1H1,'MATRIX A')
      DO 30,I=1,11
      READ(3,100)(A(I,J),J=1,8)
   30 WRITE(4,200)(A(I,J),J=1,8)
100   FORMAT (8F7.0)
200   FORMAT (1H0,8F10.0)
      WRITE(4,300)
300   FORMAT (1H0,'MATRIX B')
      DO 40,I=1,11
      DO 41,J=1,8
   41 B(I,J)=A(I,J)*A(I,J)
      DO 42,J=1,7
   42 B(I,J+8)=2*A(I,1)*A(I,J+1)
      DO 43,J=1,6
   43 B(I,J+15)=2*A(I,2)*A(I,J+2)
      DO 44,J=1,5
   44 B(I,21+J)=2*A(I,3)*A(I,J+3)
      DO 45,J=1,4
   45 B(I,26+J)=2*A(I,4)*A(I,J+4)
      DO 46,J=1,3
   46 B(I,30+J)=2*A(I,5)*A(I,J+5)
      DO 47 J=1,2
   47 B(I,33+J)=2*A(I,6)*A(I,J+6)
      B(I,36)=2*A(I,7)*A(I,8)
      WRITE(4,400)(B(I,J),J=1,36)
400   FORMAT (1H0,6(E14.9,2X))
   40 CONTINUE
      WRITE(4,500)
500   FORMAT (1H1,'MATRIX C')
      DO 50,J=1,36
      DO 50,I=1,11
   50 C(J)=B(I,J)+C(J)
      WRITE(4,600)(C(J),J=1,36)
600   FORMAT (1H0,6(E14.9,2X))
      STOP
      END
####S
 53214   92599  64315  48158  38202  21654  13087   8466
 51864   99769  73647  52015  42239  26499  13051  10519
 50523  115137  83987  60249  44534  33340  17875  10983
```

```
 30107  121980   98906   81206   47341   36798   21110   14445
 51412  117124  105879   98785   69906   48705   41156   20129
 64179  145407  115997  104322   77394   62547   37196   37693
101290  139809  127153   92023  108500   77348   45976   44658
188041  143749  120590  101845   88998  104730   44029   52462
120904  151456  121383   91417   73778   72335   43770   38345
101051  152338  124346   94553   70132   72704   41554   39537
111979  168327  129714   97738   74893   63803   46246   47867
####S
```

```
PROGRAM MPOS1


/* ST=MFZ,TI=4,C=A
LIBRARY(PROCLIB)
MPOS.
####S
SYMQUAD
TITLE
QP ESTIMATION COEFFICIENTS OLS
VARIABLES
V1 TO V20
MINIMIZE
-0.63V1-3.35V2-2.71V3-2.14V4-1.70V5-1.37V6-1.10V7-0.984V8-0.84V9-
0.50V10-0.30V11-0.29V12-0.27V13-2.57V14-2.09V15-1.65V16-1.37V17-1.25V18-
0.70V19-0.68V20+1.96V1*V1+1.96V2*V2+1.29V3*V3+1.29V4*V4+0.82V5*V5+
0.82V6*V6+0.54V7*V7+0.54V8*V8+0.42V9*V9+0.42V10*V10+0.14V11*V11+
0.14V12*V12+0.12V13*V13+1.96V14*V14+1.29V15*V15+0.82V16*V16+0.54V17*V17+
0.42V18*V18+0.14V19*V19+0.12V20*V20+3.21V2*V3+2.05V4*V5+1.31V6*V7+
0.93V8*V9+0.47V10*V11+0.26V12*V13+3.17V14*V15+2.51V14*V16+2.01V14*V17+
1.73V14*V18+1.02V14*V19+0.93V14*V20+2.04V15*V16+1.65V15*V17+1.42V15*V18+
0.83V15*V19+0.76V15*V20+1.31V16*V17+1.13V16*V18+0.64V16*V19+0.60V16*V20+
0.93V17*V18+0.54V17*V19+0.50V17*V20+0.47V18*V19+0.45V18*V20+0.26V19*V20
CONSTRAINTS
V1 +V2 +V14 = 1
V3 +V4 +V15 = 1
V5 +V6 +V16 = 1
V7 +V8 +V17 = 1
V9 +V10 +V18 =1
V11 +V12 +V19 =1
V13 +V20 = 1
BOUNDS
V1 TO V20 .LE. 1
V1 TO V20 .GE. 0
EPSILON 1.E-5
PRINT
QCHECK GO
*    CHECK FINAL SOLUTION
CHECK
OPTIMIZE
####S
****
```

PROGRAM RESIDD

```
/*ST=MFZ,TI=10,C=B
FTN5,DB=0/PMD.
LGO.
####S
      PROGRAM RES(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT)
      REAL C,S,T,B,N,M,A,P,Y,X,V,N1,F
      DIMENSION N(11,7),P(7,7),M(11,7),R(11,7),A(11,7),S(13),B(7)
      DIMENSION C(7),Y(7),V(13),X(13),TP(2),Q(7),RS(7),RR(7),RF(7)
      DIMENSION N1(7),Y1(6),YY(7),VAR(13),F(6)
C     ZEROISE THE ARRAY
      DO 10,I=1,11
      DO 10,J=1,7
      R(I,J)=0.0
   10 A(I,J)=0.0
      DO 97,J=1,6
  97  F(J)=0.0
      DO 33,J=1,7
      B(J)=0.0
      C(J)=0.0
      RR(J)=0.0
      RS(J)=0.0
      N1(J)=0.0
      Q(J)=0.0
      RF(J)=0.0
  33  Y(J)=0.0
      DO 13,J=1,7
   13 Y1(J)=0.0
      DO 5,J=1,2
   5  TP(J)=0.0
      DO 22,J=1,13
      V(J)=0.0
      X(J)=0.0
   22 S(J)=0.0
      WRITE(4,500)
  500 FORMAT (1H1,T5,'MATRIX N')
      DO 15,J=1,11
      READ(3,100)(N(J,I),I=1,7)
   15 WRITE(4,300)(N(J,I),I=1,7)
  100 FORMAT (1X,8F7.0)
  300 FORMAT (1H0,8F7.0)
      WRITE(4,600)
  600 FORMAT (1H0,T5,'MATRIX M    (N*)')
      DO 40,I=1,11
      READ(3,100)(M(I,J),J=1,7)
   40 WRITE(4,300)(M(I,J),J=1,7)
      WRITE(4,350)
350   FORMAT (////1H0,'MATRIX P')
      DO 50,I=1,7
      READ(3,400)(P(I,J),J=1,7)
   50 WRITE(4,450)(P(I,J),J=1,7)
400   FORMAT (7 F10.5)
450   FORMAT (1H0,7 F10.5)
      WRITE(4,550)
550   FORMAT (////1H0,'PRODUCT MATRIX NP')
      DO 20,I=1,11
      DO 20,J=1,7
      DO 20,L=1,7
```

```
  20  A(I,J)=N(I,L)*P(L,J)+A(I,J)
      DO 31,I=1,11
  31  WRITE(4,800)(A(I,J),J=1,7)
      WRITE (4,700)
700   FORMAT (////1H0,'MATRIX OF RESIDUALS')
      DO 30,I=1,11
      DO 30 J=1,7
  30  R(I,J)=M(I,J)-A(I,J)
      DO 44,I=1,11
  44  WRITE(4,800)(R(I,J),J=1,7)
800   FORMAT (1H0,7(E14.8,2X))
C     CALCUL OF THE SIGMA SQUARE VALUES
      DO 90,J=1,7
      DO 90,I=1,11
  90  C(J)=C(J)+R(I,J)*R(I,J)
      B(1)=0.1*C(1)
      B(2)=0.111*C(2)
      B(3)=0.111*C(3)
      B(4)=0.111*C(4)
      B(5)=0.111*C(5)
      B(6)=0.111*C(6)
      B(7)=0.111*C(7)
      WRITE(4,710)
 710  FORMAT (///1H0,'SIGMA SQUARE VALUES')
      WRITE(4,800)(B(J),J=1,7)
C     CALCUL OF THE STANDARD ERRORS OF THE ESTIMATED COEFFICIENTS
C     OF RESTRICTED OLS
      DO 35,J=1,7
      DO 35,I=1,11
  35  N1(J)=N1(J)+N(I,J)
      DO 98,J=1,7
  98  N1(J)=0.0909091*N1(J)
      WRITE(4,730)
 730  FORMAT(///1H0,T5,'VALUES OF N1')
      WRITE(4,800)(N1(J),J=1,7)
      DO 36,J=1,7
      DO 36,I=1,11
  36  Y(J)=Y(J)+(N(I,J)-N1(J))**2
      WRITE(4,740)
 740  FORMAT(///1H0,T5,'VALUES OF Y')
      WRITE(4,800)(Y(J),J=1,7)
      DO 37,J=1,6
      DO 37,I=1,11
  37  F(J)=(N(I,J)-N1(J))*(N(I,J+1)-N1(J+1))
      DO 67,J=1,6
  67  Y1(J)=Y1(J)+F(J)
      WRITE(4,760)
 760  FORMAT(///1H0,T5,'VALUES OF Y1')
      WRITE(4,800)(Y1(J),J=1,7)
      VAR(1)=B(1)/Y(1)
      DO 38,J=2,7
      YY(J)=Y(J-1)*Y(J)-Y1(J-1)**2
      VAR(2*J-2)=B(J)*Y(J-1)/YY(J)
  38  VAR(2*J-1)=B(J)*Y(J)/YY(J)
      WRITE(4,775)
 775  FORMAT(///1H0,T5,'VALUES OF YY')
      WRITE(4,800)(YY(J),J=1,6)
      DO 80,I=1,13
  80  S(I)=SQRT(VAR(I))
      WRITE(4,900)
```

```
900   FORMAT (////1H0,'STANDARD ERRORS OF THE ESTIMATED COEFICIENTS')
      WRITE(4,850)(I,S(I),I=1,13)
850   FORMAT(1H0,'X',I2,10X,E14.8)
C     CALCUL OF THE CONFIDENCE INTERVALS
      X(1)=P(1,1)-1.833*S(1)
      V(1)=P(1,1)+1.833*S(1)
      DO 75,J=2,7
      DO 75,I=J-1,J
      L=I+J-1
      X(L)=P(I,J)-1.860*S(L)
  75  V(L)=P(I,J)+1.860*S(L)
      WRITE(4,520)
520   FORMAT (////1H0,'90% CONFIDENCE INTERVALS')
      WRITE(4,525)
525   FORMAT (/1H0,3X,'L. BOUND',10X,'U. BOUND')
      WRITE(4,530)(X(L),V(L),L=1,13)
530   FORMAT (1H0,E14.8,10X,E14.8)
      X(1)=P(1,1)-2.262*S(1)
      V(1)=P(1,1)+2.262*S(1)
      DO 64,J=2,7
      DO 64,I=J-1,J
      L=I+J-1
      X(L)=P(I,J)-2.306*S(L)
   64 V(L)=P(I,J)+2.306*S(L)
      WRITE(4,620)
620   FORMAT (////1H0,'95% CONFIDENCE INTERVAL')
      WRITE(4,525)
      WRITE(4,530)(X(L),V(L),L=1,13)
      X(1)=P(1,1)-3.250*S(1)
      V(1)=P(1,1)+3.250*S(1)
      DO 72,J=2,7
      DO 72,I=J-1,J
      L=I+J-1
      X(L)=P(I,J)-3.355*S(L)
  72  V(L)=P(I,J)+3.355*S(L)
      WRITE(4,720)
720   FORMAT (////1H0,'99% CONFIDENCE INTERVAL')
      WRITE(4,525)
      WRITE(4,530)(X(L),V(L),L=1,13)
C     CALCUL OF F - VALUE
C     (CALCUL OF THE NUMERATOR)
      DO 11,I=1,11
   11 TP(1)=N(I,1)*M(I,1)+TP(1)
      Q(1)=P(1,1)*TP(1)*0.5
      DO 14,I=1,11
      TP(1)=N(I,1)*M(I,1)+TP(1)
   14 TP(2)=N(I,2)*M(I,1)+TP(2)
      Q(2)=(P(1,2)*TP(1)+P(2,2)*TP(2))*0.5
      DO 16,I=1,11
      TP(1)=N(I,2)*M(I,2)+TP(1)
   16 TP(2)=N(I,3)*M(I,2)+TP(2)
      Q(3)=(P(2,3)*TP(1)+P(3,3)*TP(2))*0.5
      DO 18,I=1,11
      TP(1)=N(I,3)*M(I,3)+TP(1)
   18 TP(2)=N(I,4)*M(I,3)+TP(2)
      Q(4)=(P(3,4)*TP(1)+P(4,4)*TP(2))*0.5
      DO 6,I=1,11
      TP(1)=N(I,4)*M(I,4)+TP(1)
    6 TP(2)=N(I,5)*M(I,4)+TP(2)
      Q(5)=(P(4,5)*TP(1)+P(5,5)*TP(2))*0.5
```

```
      DO 26,I=1,11
      TP(1)=N(I,5)*M(I,5)+TP(1)
   26 TP(2)=N(I,6)*M(I,5)+TP(2)
      Q(6)=(P(5,6)*TP(1)+P(6,6)*TP(2))*0.5
      DO 27,I=1,11
      TP(1)=N(I,6)*M(I,6)+TP(1)
   27 TP(2)=N(I,7)*M(I,6)+TP(2)
      Q(7)=(P(6,7)*TP(1)+P(7,7)*TP(2))*0.5
C     (CALCUL OF THE DENOMINATOR)
      WRITE(4,1100)
1100  FORMAT (////1H0,'F-VALUES')
      DO 2,J=1,7
      DO 2,I=1,11
    2 RS(J)=RS(J)+R(I,J)*R(I,J)
      RR(1)=RS(1)*0.111
      DO 3,J=2,7
    3 RR(J)=RS(J)*0.125
      DO 4,J=1,7
    4 RF(J)=Q(J)/RR(J)

      WRITE(4,1200)(J,RF(J),J=1,7)
1200  FORMAT (1H0,'EQUATION ',I2,10X,E14.8)
      STOP
      END
####S
   92599  64315  48158  38202  21654  13087   8466
   99769  73647  52015  42239  26499  13051  10519
  115137  83987  60249  44534  33340  17875  10983
  121980  98906  81206  47341  36798  21110  14445
  117124 105879  98785  69906  48705  41156  20129
  145407 115997 104322  77394  62547  37196  37693
  139809 127153  92023 108500  77348  45976  44658
  143749 120590 101845  88998 104730  44029  52462
  151456 121383  91417  73778  72335  43770  38345
  152338 124346  94553  70132  72704  41554  39537
  168327 129714  97738  74893  63803  46246  47867
   14816  73647  52015  42239  26499  13051  10519
   14965  83987  60249  44534  33340  17875  10983
   14968  98906  81206  47341  36798  21110  14445
    7313 105879  98785  69906  48705  41156  20129
   15226 115997 104322  77394  62547  37196  37693
   14541 127153  92023 108500  77348  45976  44658
   20971 120590 101845  88998 104730  44029  52462
   27312 121383  91417  73778  72335  43770  38345
   28776 124346  94553  70132  72704  41554  39537
   33514 129714  97738  74893  63803  46246  47867
   33665 137784 101797  77250  64405  47953  57119
   0.16353   0.83647   0         0         0         0         0
   0         0.02557   0.73131   0         0         0         0
   0         0         0.14354   0.85646   0         0         0
   0         0         0         0         0.92677   0         0
   0         0         0         0         0         0.24758   0
   0         0         0         0         0         0.58221   0.41779
   0         0         0         0         0         0         0.58614
####S
```

PROGRAM SIGMA

```
/* ST=MFZ,TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
NAG.
FTN5(DB=0/PMD)
LGO.
####S
      PROGRAM SIGMA(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT)
C     CALCUL OF COVARIANCE MATRIX OF RESIDUALS
      REAL R,A,S,UNIT,WKSPCE,S10T9
      DIMENSION R(11,7),A(7,7),S(7,7),UNIT(7,7),WKSPCE(7)
      SQRT10=SQRT(10.0)
      SQRT9=SQRT(9.0)
      S10T9=SQRT10*SQRT9
C     ZEROIZE THE ARRAY
      DO 10,I=1,7
      DO 10,J=1,7
      A(I,J)=0.0
      UNIT(I,J)=0.0
   10 S(I,J)=0.0
      WRITE(4,200)
200   FORMAT(1H1,'MATRIX OF RESIDUALS')
      DO 15,I=1,11
      READ(3,100)(R(I,J),J=1,7)
   15 WRITE(4,300)(R(I,J),J=1,7)
100   FORMAT (1X,7F10.2)
300   FORMAT (1H0,7F14.2)
      DO 20,J=1,7
      DO 20,I=1,7
      DO 20,L=1,11
   20 A(I,J)=R(L,I)*R(L,J)+A(I,J)
      WRITE(4,400)
400   FORMAT (////1H0,'MATRIX R *R')
      DO 30,I=1,7
   30 WRITE (4,500)(A(I,J),J=1,7)
500   FORMAT (1H0,7(E14.8,2X))
C     CALCUL OF THE VALUES OF SIGMA
      S(1,1)=A(1,1)*0.1
      DO 40,I=2,7
   40 S(I,I)=A(I,I)/9
      DO 50,J=2,7
      S(1,J)=A(1,J)/S10T9
   50 S(J,1)=S(1,J)
      DO 60,J=3,7
      DO 60,I=2,7
      S(I,J)=A(I,J)/S10T9
   60 S(J,I)=S(I,J)
      WRITE(4,600)
600   FORMAT (////1H0,'MATRIX SIGMA')
      DO 70,I=1,7
   70 WRITE (4,700)(S(I,J),J=1,7)
700   FORMAT (1H0,7(E14.8,2X))
C     CALCUL OF INVERSE OF SIGMA
      CALL F01AAF(S,7,7,UNIT,7,WKSPCE,0)
      WRITE(4,800)
800   FORMAT (////1H0,'MATRIX INV SIGMA')
      DO 80,I=1,7
```

```
   80 WRITE(4,700)(UNIT(I,J),J=1,7)
      STOP
      END
####S
    -40.83  -2316.80   -620.92   1704.63  -9689.63   -744.24  -2239.28
    108.18   8023.20   7613.08   3999.63  -2848.63   4079.76  -1775.28
  -3504.88   3123.41  13361.46  -2886.91  -4455.06   2028.74  -2831.90
 -12251.79   1118.53  15426.30   4087.96   5008.20  18784.94   -653.44
  -3565.68  11796.52  11083.81  -4498.68  -2627.45  -4956.25   -760.58
  -8788.48   2902.88  -8807.29  21487.73   6187.14   6703.45   4894.30
  -1460.32  -4046.22  -1141.91   6277.41   3776.04  -4516.06   3808.64
   4248.54  -3407.98 -11174.51 -13161.81  -5711.70  -4665.37 -10738.84
   4476.00  -5258.45  -4965.94  -7000.17   6333.87  -4579.16  -5710.49
   9072.49  -1391.81  -4515.64  -3969.04   1167.63   2192.59   4105.31
   6658.18  -4539.85  -4568.08  -4629.23  -4078.31     11.51   7422.85
####S
```

PROGRAM UNGLS

```
/*ST=MFZ,TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
NAG.
FTN5(DB=0/PMD)
LGO.
####S
      PROGRAM UNGLS(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT)
C     THIS PROGRAM COMPUTES THE ESTIMATIORS FOR THE UNREST. GLS
      REAL N,M,S,X,A,Y,W,W1,Y1,X1,V,B,C,P
      DIMENSION N(11,7),M(11,7),S(7,7),X(7),A(13,13),Y(6),W(5),W1(4)
      DIMENSION Y1(3),X1(2),UNIT(13,13),WKSPCE(13),B(7,7),C(13),P(13)
C     ZEROISE THE ARRAY
      DO 17,I=1,7
   17 X(I)=0.0
      DO 13,I=1,13
      DO 13,J=1,13
      UNIT(I,J)=0.0
   13 A(I,J)=0.0
      DO 5,J=1,6
    5 Y(J)=0.0
      DO 6,J=1,5
    6 W(J)=0.0
      DO 7,J=1,4
    7 W1(J)=0.0
      DO 8,J=1,3
    8 Y1(J)=0.0
      DO 9,J=1,2
    9 X1(J)=0.0
      DO 3,I=1,7
      DO 3,J=1,7
    3 B(I,J)=0.0
      DO 2,J=1,13
      C(J)=0.0
    2 P(J)=0.0
      WRITE(4,500)
  500 FORMAT (1H1,T5,'MATRIX N')
```

```
      DO 15,J=1,11
      READ(3,100)(N(J,I),I=1,7)
   15 WRITE(4,300)(N(J,I),I=1,7)
  100 FORMAT (1X,8F7.0)
  300 FORMAT (1H0,8F7.0)
      WRITE(4,600)
  600 FORMAT (1H0,T5,'MATRIX M    (N*)')
      DO 40,I=1,11
      READ(3,100)(M(I,J),J=1,7)
   40 WRITE(4,300)(M(I,J),J=1,7)
      WRITE(4,350)
350   FORMAT (////1H0,'MATRIX INV. SIGMA')
      DO 50,I=1,7
      READ(3,400)(S(I,J),J=1,7)
   50 WRITE(4,450)(S(I,J),J=1,7)
400   FORMAT (5(E14.8,2X)/2(E14.8,2X))
450   FORMAT (1H0,7(E14.8,2X))
C     CALCUL OF N'*INVSIGMA* N
      WRITE(4,220)
220    FORMAT (//1H0,'MATRIX A')
      DO 16,J=1,7
      DO 16,I=1,11
  16  X(J)=N(I,1)*N(I,J)+X(J)
      A(1,1)=S(1,1)*X(1)
      DO 18,J=1,6
      K=2*J
      A(1,K)=S(1,J+1)*X(J)
   18 A(1,K+1)=S(1,J+1)*X(J+1)
      WRITE(4,450)(A(1,J),J=1,13)
      DO 12,J=1,13
  12  A(J,1)=A(1,J)
      A(2,2)=S(2,2)*X(1)
      A(2,3)=S(2,2)*X(2)
      A(3,2)=A(2,3)
      DO 51,J=2,7
      DO 51,L=1,11
   51 Y(J-1)=N(L,2)*N(L,J)+Y(J-1)
      A(3,3)=S(2,2)*Y(1)
      DO 60,I=3,7
      K=2*I
      A(2,K-2)=X(I-1)*S(2,I)
      A(2,K-1)=X(I)*S(2,I)
      A(3,K-2)=Y(I-2)*S(2,I)
   60 A(3,K-1)=Y(I-1)*S(2,I)
      DO 65,J=4,13
      DO 65,I=2,3
   65 A(J,I)=A(I,J)
      DO 69,I=2,3
   69 WRITE(4,450)(A(I,J),J=1,13)
      DO 70,J=3,7
      DO 70,L=1,11
  70  W(J-2)=N(L,3)*N(L,J)+W(J-2)
      A(4,4)=Y(1)*S(3,3)
      A(4,5)=Y(2)*S(3,3)
      A(5,5)=W(1)*S(3,3)
      DO 75,I=4,7
      K=2*I
      A(4,K-2)=Y(I-2)*S(3,I)
      A(4,K-1)=Y(I-1)*S(3,I)
      A(5,K-2)=W(I-3)*S(3,I)
```

```
   75 A(5,K-1)=W(I-2)*S(3,I)
      DO 78,J=5,13
      DO 78,I=4,5
   78 A(J,I)=A(I,J)
      DO 79,I=4,5
   79 WRITE(4,450)(A(I,J),J=1,13)
      DO 45,J=4,7
      DO 45,L=1,11
   45 W1(J-3)=N(L,4)*N(L,J)+W1(J-3)
      A(6,6)=W(1)*S(4,4)
      A(6,7)=W(2)*S(4,4)
      A(7,7)=W1(1)*S(4,4)
      DO 46,I=5,7
      K=2*I
      A(6,K-2)=W(I-3)*S(4,I)
      A(6,K-1)=W(I-2)*S(4,I)
      A(7,K-2)=W1(I-4)*S(4,I)
   46 A(7,K-1)=W1(I-3)*S(4,I)
      DO 47,J=7,13
      DO 47,I=6,7
 47   A(J,I)=A(I,J)
      DO 49,I=6,7
   49 WRITE(4,450)(A(I,J),J=1,13)
      DO 62,J=5,7
      DO 62,L=1,11
   62 Y1(J-4)=N(L,5)*N(L,J)+Y1(J-4)
      A(8,8)=W1(1)*S(5,5)
      A(8,9)=W1(2)*S(5,5)
      A(9,9)=Y1(1)*S(5,5)
      DO 64,I=6,7
      K=2*I
      A(8,K-2)=W1(I-4)*S(5,I)
      A(8,K-1)=W1(I-3)*S(5,I)
      A(9,K-2)=Y1(I-5)*S(5,I)
   64 A(9,K-1)=Y1(I-4)*S(5,I)
      DO 66,J=9,13
      DO 66,I=8,9
   66 A(J,I)=A(I,J)
      DO 68,I=8,9
   68 WRITE(4,450)(A(I,J),J=1,13)
      DO 80,J=6,7
      DO 80,L=1,11
   80 X1(J-5)=N(L,6)*N(L,J)+X1(J-5)
      A(10,10)=Y1(1)*S(6,6)
      A(10,11)=Y1(2)*S(6,6)
      A(11,11)=X1(1)*S(6,6)
      A(10,12)=Y1(2)*S(6,7)
      A(10,13)=Y1(3)*S(6,7)
      A(11,12)=X(1)*S(6,7)
      A(11,13)=X1(2)*S(6,7)
      DO 81,J=10,13
      DO 81,I=10,11
   81 A(J,I)=A(I,J)
      DO 83,I=10,11
   83 WRITE(4,450)(A(I,J),J=1,13)
      V=0
      DO 22,I=1,11
   22 V=N(I,7)*N(I,7)+V
      A(12,12)=X1(1)*S(7,7)
      A(12,13)=X1(2)*S(7,7)
```

```
      A(13,13)=V*S(7,7)
      A(13,12)=A(12,13)
      DO 88,I=12,13
   88 WRITE(4,450)(A(I,J),J=1,13)
C     CALCUL OF INV(N' *INVSIGMA* N)
      CALL F01AAF(A,13,13,UNIT,13,WKSPCE,0)
      WRITE(4,990)
990   FORMAT (////1H0,'MATRIX INV   NT *INVSIGMA* N')
      DO 77,I=1,13
   77 WRITE(4,450)(UNIT(I,J),J=1,13)
C     CALCUL OF NT * INVSIGMA * N*
      DO 92,L=1,7
      DO 92,J=1,7
      DO 92,I=1,11
   92 B(L,J)=N(I,L)*M(I,J)+B(L,J)
      WRITE(4,700)
700   FORMAT (////1H0,'MATRIX B')
      DO 94,L=1,7
   94 WRITE(4,450)(B(L,J),J=1,7)
      DO 96,J=1,7
      C(1)=S(1,J)*B(1,J)+C(1)
      C(2)=S(2,J)*B(1,J)+C(2)
      C(3)=S(2,J)*B(2,J)+C(3)
      C(4)=S(3,J)*B(2,J)+C(4)
      C(5)=S(3,J)*B(3,J)+C(5)
      C(6)=S(4,J)*B(3,J)+C(6)
      C(7)=S(4,J)*B(4,J)+C(7)
      C(8)=S(5,J)*B(4,J)+C(8)
      C(9)=S(5,J)*B(5,J)+C(9)
      C(10)=S(6,J)*B(5,J)+C(10)
      C(11)=S(6,J)*B(6,J)+C(11)
      C(12)=S(7,J)*B(6,J)+C(12)
   96 C(13)=S(7,J)*B(7,J)+C(13)
      WRITE(4,750)
750   FORMAT (////1H0,'MATRIX NT * INVSIGMA * N*')
      DO 97,I=1,13
   97 WRITE(4,770)(C(I))
770   FORMAT (E14.8)
C     CALCUL OF ESTIMATORS OF TRANSITION PROBABILITIES
      WRITE(4,780)
 780  FORMAT (////1H0,'ESTIMATORS OF TRANSITION PROBABILITIES')
      DO 33,J=1,13
      DO 33,I=1,13
   33 P(J)=UNIT(J,I)*C(I)+P(J)
      DO 34,J=1,13
  34  WRITE(4,770)(P(J))
      END
####S
   92599  64315  48158  38202  21654  13087   8466
   99769  73647  52015  42239  26499  13051  10519
  115137  83987  60249  44534  33340  17875  10983
  121980  98906  81206  47341  36798  21110  14445
  117124 105879  98785  69906  48705  41156  20129
  145407 115997 104322  77394  62547  37196  37693
  139809 127153  92023 108500  77348  45976  44658
  143749 120590 101845  88998 104730  44029  52462
  151456 121383  91417  73778  72335  43770  38345
  152338 124346  94553  70132  72704  41554  39537
  168327 129714  97738  74893  63803  46246  47867
   14816  73647  52015  42239  26499  13051  10519
```

```
   14965  83987  60249  44534  33340  17875  10983
   14968  98906  81206  47341  36798  21110  14445
    7313 105879  98785  69906  48705  41156  20129
   15226 115997 104322  77394  62547  37196  37693
   14541 127153  92023 108500  77348  45976  44658
   20971 120590 101845  88998 104730  44029  52462
   27312 121383  91417  73778  72335  43770  38345
   28776 124346  94553  70132  72704  41554  39537
   33514 129714  97738  74893  63803  46246  47867
   33665 137784 101797  77250  64405  47953  57119
 .18246594E-06  -.58789088E-08   .62008624E-07   .97561255E-07
.20011183E-07
 .18836084E-07  -.90014527E-07
-.58789088E-08   .58482009E-07  -.27154839E-07  -.20075588E-07
.76629827E-08
 .12512849E-07   .10900339E-07
 .62008624E-07  -.27154839E-07   .47134641E-07   .42734762E-07
.79644893E-08
-.10937012E-07  -.33047703E-07
 .97561255E-07  -.20075588E-07   .42734762E-07   .79204992E-07
.68818327E-09
-.42809782E-08  -.65604825E-07
 .20011183E-07   .76629827E-08   .79644893E-08   .68818327E-09
.45330333E-07
-.35418437E-08  -.11630974E-07
 .18836084E-07   .12512849E-07  -.10937012E-07  -.42809782E-08
-.35418437E-08
 .38250373E-07  -.60609087E-08
-.90014527E-07   .10900339E-07  -.33047703E-07  -.65604825E-07
-.11630974E-07
-.60609087E-08   .94626753E-07
####S
```

PROGRAM SIGMA2

```
/*ST=MFZ,TI=4,C=A
FTN5(DB=0/PMD)
LGO.
####S
      PROGRAM SIGMA2(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT)
C     THIS PROG. MULT. SIGMA BY (N*-NP) VECTOR
      REAL N,S,T,A,C,D
      DIMENSION N(11,21),S(7,7),T(77,21),A(11,63),C(7,63),D(21)
C     ZEROIZE THE ARRAY
      DO 10,J=1,21
      D(J)=0.0
      DO 10,I=1,77
   10 T(I,J)=0.0
      DO 11,I=1,11
      DO 11,J=1,63
   11 A(I,J)=0.0
      DO 52,I=1,7
      DO 52,J=1,63
```

```
   52  C(I,J)=0.0

       WRITE(4,100)
100    FORMAT (1H1,'MATRIX N* - NP')
       DO 20,I=1,11
       READ(3,200)(N(I,J),J=1,21)
   20  WRITE(4,220)(N(I,J),J=1,21)
200    FORMAT (10F8.0/10F8.0/F8.0)
220    FORMAT (1H0,10F8.0)
       WRITE(4,300)
300    FORMAT (////1H0,'MATRIX INV. SIGMA')
       DO 30,I=1,7
       READ(3,440)(S(I,J),J=1,7)
   30  WRITE(4,400)(S(I,J),J=1,7)
440    FORMAT (5(E14.8,2X)/2(E14.8,2X))
400    FORMAT (1H0,7(E14.8,2X))
C      CALCUL OF INVSIGM * (N* - NP)
       DO 40,K=2,7
       DO 40,J=1,3
       DO 40,I=1,11
       R=I+11*(K-1)
       T(I,J)=S(1,1)*N(I,J)
   40  T(R,J)=S(K,1)*N(I,J)
       DO 50,K=2,7
       DO 50,J=4,6
       DO 50,I=1,11
       R=I+11*(K-1)
       T(I,J)=S(1,2)*N(I,J)
   50  T(R,J)=S(1,2)*N(I,J)
       DO 60,K=2,7
       DO 60,J=7,9
       DO 60,I=1,11
       R=I+11*(K-1)
       T(I,J)=S(1,3)*N(I,J)
   60  T(R,J)=S(K,3)*N(I,J)
       DO 70,K=2,7
       DO 70,J=10,12
       DO 70,I=1,11
       R=I+11*(K-1)
       T(I,J)=S(1,4)*N(I,J)
   70  T(R,J)=S(K,4)*N(I,J)
       DO 75,K=2,7
       DO 75,J=13,15
       DO 75,I=1,11
       R=I+11*(K-1)
       T(I,J)=S(1,5)*N(I,J)
   75  T(R,J)=S(K,5)*N(I,J)
       DO 80,K=2,7
       DO 80,J=16,18
       DO 80,I=1,11
       R=I+11*(K-1)
       T(I,J)=S(1,6)*N(I,J)
   80  T(R,J)=S(K,6)*N(I,J)
       DO 85,K=2,7
       DO 85,J=19,21
       DO 85,I=1,11
       R=I+11*(K-1)
       T(I,J)=S(1,7)*N(I,J)
   85  T(R,J)=S(K,7)*N(I,J)
       DO 82,K=1,6
```

```
      DO 82 I=1,77
      H=1+3*K
      T(I,1)=T(I,1)+T(I,H)
   82 T(I,H)=0
      WRITE(4,500)
500   FORMAT (////1H0,'MATRIX  INVSIGMA  *   (N* - NP)')
      DO 83,I=1,77
   83 WRITE(4,600)(T(I,J),J=1,21)
600   FORMAT (7(E14.8,2X))
C     CALCUL OF (N* -NP)' * INVSIGMA * (N* -NP)
      WRITE(4,1100)
1100 FORMAT (////1H0,'(N* -NP) * INVSIGMA * (N* -NP)')
      DO 35,I=1,11
      DO 35,K=1,21
      A(I,K)=N(I,1)*T(I,K)
      A(I,21+K)=N(I,2)*T(I,K)
   35 A(I,42+K)=N(I,3)*T(I,K)
      DO 34,J=1,63
      DO 34,I=1,11
   34 C(1,J)=A(I,J)+C(1,J)
      WRITE(4,600)(C(1,J),J=1,63)
      DO 12,I=1,11
      DO 12,K=1,21
      A(I,K)=N(I,4)*T(I,K)
      A(I,21+K)=N(I,5)*T(I,K)
   12 A(I,42+K)=N(I,6)*T(I,K)
      DO 14,J=1,63
      DO 14,I=1,11
      DO 14,K=1,21
   14 C(2,J)=A(I,J)+C(2,J)
      WRITE(4,600)(C(2,J),J=1,63)
      DO 13,I=1,11
      DO 13,K=1,21
      A(I,K)=N(I,7)*T(I,K)
      A(I,21+K)=N(I,8)*T(I,K)
   13 A(I,42+K)=N(I,9)*T(I,K)
      DO 16,J=1,63
      DO 16,I=1,11
      DO 16,K=1,21
   16 C(3,J)=A(I,J)+C(3,J)
      WRITE(4,600)(C(3,J),J=1,63)
      DO 18,I=1,11
      DO 18,K=1,21
      A(I,K)=N(I,10)*T(I,K)
      A(I,21+K)=N(I,11)*T(I,K)
   18 A(I,42+K)=N(I,12)*T(I,K)
      DO 19,J=1,63
      DO 19,I=1,11
      DO 19,K=1,21
   19 C(4,J)=A(I,J)+C(4,J)
      WRITE(4,600)(C(4,J),J=1,63)
      DO 22,I=1,11
      DO 22,K=1,21
      A(I,K)=N(I,13)*T(I,K)
     A(I,21+K)=N(I,14)*T(I,K)
  22 A(I,42+K)=N(I,15)*T(I,K)
      DO 23,J=1,63
      DO 23,I=1,11
      DO 23,K=1,21
   23 C(5,J)=A(I,J)+C(5,J)
```

```
      WRITE(4,600)(C(5,J),J=1,63)
      DO 33,I=1,11
      DO 33,K=1,21
      A(I,K)=N(I,16)*T(I,K)
      A(I,21+K)=N(I,17)*T(I,K)
   33 A(I,42+K)=N(I,18)*T(I,K)
      DO 38,J=1,63
      DO 38,I=1,11
      DO 38,K=1,21
   38 C(6,J)=A(I,J)+C(6,J)
      WRITE(4,600)(C(6,J),J=1,63)
      DO 36,I=1,11
      DO 36,K=1,21
      A(I,K)=N(I,19)*T(I,K)
      A(I,21+K)=N(I,20)*T(I,K)
   36 A(I,42+K)=N(I,21)*T(I,K)
      DO 42,J=1,63
      DO 42,I=1,11
      DO 42,K=1,21
   42 C(7,J)=A(I,J)+C(7,J)
      WRITE(4,600)(C(7,J),J=1,63)
      DO 26,J=1,21
      DO 26,I=1,7
  26  D(J)=D(J)+C(I,J)
      WRITE(4,990)
990   FORMAT (////1H0,'MATRIX D - D(1,J)')
      WRITE(4,600)(D(J),J=1,21)
      STOP
      END
####S
   14816  -92599       0   73647  -92599  -64315   52015  -64315  -48158
42239
  -48158  -38202   26499  -38202  -21654   13051  -21654  -13087   10519
-13087
   -8466
   14965  -99769       0   83987  -99769  -73647   60249  -76647  -52015
44534
  -52015  -42239   33340  -42239  -26499   17875  -26499  -13051   10983
-13051
  -10519
   14968 -115137       0   98906 -115137  -83987   81206  -83987  -60249
47341
  -60249  -44534   36798  -44534  -33340   21110  -33340  -17875   14445
-17875
  -10983
    7313 -121980       0  105879 -121980  -98906   98785  -98906  -81206
69906
  -81206  -47341   48705  -47341  -36798   41156  -36798  -21110   20129
-21110
  -14445
   15226 -117124       0  115997 -117124 -105879  104322 -105879  -98785
77394
  -98785  -69906   62547  -69906  -48705   37196  -48705  -41156   37693
-41156
  -20125
   14541 -145407       0  127153 -145407 -115997   92023 -115997 -104322
108500
 -104322  -77394   77348  -77394  -62547   45967  -62547  -37196   44658
-37196
  -37693
```

```
   20971 -139809       0  120590 -139809 -127153  101845 -127153  -92023
88998
  -92023 -108500  104730 -108500  -77348   44029  -77348  -45976   52462
-45976
  -44658
   27312 -143749       0  121383 -143749 -120590   91417 -120590 -101845
73778
 -101845  -88998   72335  -88998 -104730   43770 -104730  -44029   38345
-44029
  -52462
   28776 -151456       0  124346 -151456 -121383   94553 -121383  -91417
70132
  -91417  -73778   72734  -73778  -72335   41554  -72335  -43770   39537
-43770
  -38345
   33514 -152338       0  129714 -152338 -124346   97738 -124340  -94553
74893
  -94553  -70132   63803  -70132  -72704   46246  -72704  -41554   47867
-41554
  -39537
   33665 -168327       0  137784 -168327 -129714  101797 -129714  -97738
77250
  -97738  -74893   64405  -74893  -63803   47953  -63803  -46246   57119
-46246
  -47867
 .18246594E-06  -.58789088E-08   .62008624E-07   .97561255E-07
.20011183E-07
 .18836084E-07  -.90014527E-07
-.58789088E-08   .58482009E-07  -.27154839E-07  -.20075588E-07
.76629827E-08
 .12512849E-07   .10900339E-07
 .62008624E-07  -.27154839E-07   .47134641E-07   .42734762E-07
.79644893E-08
-.10937012E-07  -.33047703E-07
 .97561255E-07  -.20075588E-07   .42734762E-07   .79204992E-07
.68818327E-09
-.42809782E-08  -.65604825E-07
 .20011183E-07   .76629827E-08   .79644893E-08   .68818327E-09
.45330333E-07
-.35418437E-08  -.11630974E-07
 .18836084E-07   .12512849E-07  -.10937012E-07  -.42809782E-08
-.35418437E-08
 .38250373E-07  -.60609087E-08
-.90014527E-07   .10900339E-07  -.33047703E-07  -.65604825E-07
-.11630974E-07
-.60609087E-08   .94626753E-07
####S
```

PROGRAM MPOS4

```
/*ST=(MFZ,SP),TI=4,C=A
LIBRARY(PROCLIB)
MPOS.
####S
SYMQUAD
TITLE
QP ESTIMATION COEFFICIENTS GLS
VARIABLES
V1 TO V13
MINIMIZE
-22.98V1+5.22V2+4.24V3+10.1V4-2.23V5-5.15V6-4.17V7
+0.98V8+3.12V9+0.91V10+0.54V11+4.2V12+3.81V13+0.36V1*V1
-0.242V2*V2-0.16V3*V3+1.68V4*V4+1.06V5*V5+1.67V6*V6
+1.1V7*V7+0.23V8*V8+0.174V9*V9+0.164V10*V10+0.06V11*V11-0.265V12*V12
-0.23V13*V13+7.51V1*V2+6.07V1*V3+6.19V1*V4+4.9V1*V5
+4.92V1*V6+3.95V1*V7+3.87V1*V8+3.327V1*V9+3.326V1*V10
+1.96V1*V11+1.9V1*V12+1.738V1*V13-2.16V2*V3+1.88V2*V4
+1.49V2*V5+2.42V2*V6+1.94V2*V7+0.3V2*V8+0.263V2*V9+0.241V2*V10
+0.14V2*V11+1.02V2*V12-0.937V2*V13+1.52V3*V4+2.73V3*V5+1.964V3*V6
+1.79V3*V7+0.246V3*V8+0.21V3*V9+0.19V3*V10+1.15V3*V11-0.84V3*V12
-0.75V3*V13+3.42V4*V6+2.76V4*V7+1.416V4*V8+1.22V4*V9+2.66V4*V5
+1.1V4*V10+0.71V4*V11+0.247V4*V12-0.2V4*V13+2.73V5*V6+2.19V5*V7
+1.13V5*V8+0.97V5*V9+0.95V5*V10+0.562V5*V11-0.198V5*V12-0.17V5*V13
+2.68V6*V7+1.62V6*V8+1.39V6*V9+1.373V6*V10+0.81V6*V11+0.05V6*V12
-0.05V6*V13+1.33V7*V8+1.15V7*V9+1.13V7*V10+0.66V7*V11+0.05V7*V12
+0.04V7*V13+0.395V8*V9+0.38V8*V10+0.22V8*V11-0.4V8*V12-0.37V8*V13
+0.338V9*V10+0.194V9*V11+-0.35V9*V12-0.33V9*V13+0.184V10*V11
-0.36V10*V12-0.33V10*V13-0.205V11*V12-0.193V11*V13-0.48V12*V13
CONSTRAINTS
V1 +V2 .LE. 1
V3 +V4 .LE. 1
V5 +V6 .LE. 1
V7 +V8 .LE. 1
V9 +V10 .LE.1
V11 +V12 .LE.1
V13 .LE. 1
BOUNDS
V1 TO V13 .LE. 1
V1 TO V13 .GE. 0
EPSILON 1.E-5
PRINT
QCHECK GO
*    CHECK FINAL SOLUTION
CHECK
OPTIMIZE
####S
****
```

PROGRAM RETUR1

```
/*ST=MFZ,TI=4,C=A
FTN5,DB=0/PMD.
LGO.
####S
      PROGRAM RETUR(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT)
C     FIRST COMPUTE OF I-MATRIX AND R-MATRIX
      REAL N,PI,PR,R,Q,S,A,B
      DIMENSION N(11,7),PI(13),PR(13),R(8,7),Q(8,7),S(8,7),B(6)
      DIMENSION A(11,7)
      DO 10,I=1,8
      DO 10,J=1,7
      R(I,J)=0.0
      Q(I,J)=0.0
   10 S(I,J)=0.0
      DO 12,I=1,11
      DO 12,J=1,7
   12 A(I,J)=0.0
      DO 13,I=2,7
   13 B(I)=0.0
      WRITE(4,150)
  150 FORMAT (1H1,'MATRIX N')
      DO 20,I=1,11
      READ(3,100)(N(I,J),J=1,7)
   20 WRITE(4,300)(N(I,J),J=1,7)
  100 FORMAT (1X,8F7.0)
  300 FORMAT (1H0,8F7.0)
      WRITE(4,200)
  200 FORMAT (////1H0,'VECTOR PI')
      READ(3,230)(PI(I),I=1,13)
      WRITE(4,250)(PI(I),I=1,13)
230   FORMAT (13(F5.2))
  250 FORMAT (13F5.2)
      R(1,1)=N(4,1)-.54*177627-.15*121980
      DO 40,J=2,7
   40 R(1,J)=N(4,J)-N(3,J-1)*PI(2*J-2)-N(3,J)*PI(2*J-1)
      DO 44,I=2,8
   44 R(I,1)=R(I-1,1)*PI(3)
      DO 50,I=2,8
      DO 50,J=2,7
   50 R(I,J)=R(I-1,J-1)*PI(2*J-2)+R(I-1,J)*PI(2*J-1)
      WRITE(4,400)
400   FORMAT (////1H0,'MATRIX R')
      DO 55,I=1,8
 55   WRITE(4,300)(R(I,J),J=1,7)
      Q(2,1)=N(5,1)-0.54*179453-0.15*(N(4,1)-R(1,1))-R(2,1)
      DO 42,J=2,7
      B(J)=(N(4,J-1)-R(1,J-1))*PI(2*J-2)+(N(4,J)-R(1,J))*PI(2*J-1)
   42 Q(2,J)=N(5,J)-B(J)-R(2,J)
      Q(2,4)=0
      DO 33,I=3,8
   33 Q(I,1)=Q(I-1,1)*PI(1)
      DO 52,I=3,8
      DO 52,J=2,7
 52   Q(I,J)=Q(I-1,J-1)*PI(2*J-2)+Q(I-1,J)*PI(2*J-1)
      WRITE(4,500)
500   FORMAT(////1H0,'MATRIX Q')
      DO 60,I=1,8
```

```
   60  WRITE(4,300)(Q(I,J),J=1,7)
       DO 65,I=1,8
       DO 65,J=1,7
   65  S(I,J)=R(I,J)+Q(I,J)
       DO 70,I=1,3
       DO 70,J=1,7
   70  A(I,J)=N(I,J)
       DO 75,I=1,8
       DO 75,J=1,7
  75   A(I+3,J)=N(I+3,J)-S(I,J)
       WRITE(4,600)
600    FORMAT (////1H0,'MATRIX S')
       DO 76,I=1,8
   76  WRITE(4,300)(S(I,J),J=1,7)
       WRITE(4,700)
700    FORMAT (////1H0,'MATRIX A')
       DO 78,I=1,11
   78  WRITE(4,300)(A(I,J),J=1,7)
       STOP
       END
####S
   99769  73647  52015  42239  26499  13051  10519
  115137  83987  60249  44534  33340  17875  10983
  121980  98906  81206  47341  36798  21110  14445
  117124 105879  98785  69906  48705  41156  20129
  145407 115997 104322  77394  62547  37196  37693
  139809 127153  92023 108500  77348  45976  44658
  143749 120590 101845  88998 104730  44029  52462
  151456 121383  91417  73778  72335  43770  38345
  152338 124346  94553  70132  72704  41554  39537
  168327 129714  97738  74893  63803  46246  47867
  178243 137784 101797  77250  64405  47953  57119
  .15  .72  .16  .69  .23  .66  .23  .63  .23  .61  .06  .74  .12
####S
```

NOTE: A summary description of the programs is presented in Appendix G

Table B.1 Matrix R, Estimated Matrix of Enrolment for the Returnee Students Allocated in 1974/75 - Whole Country

School Year	Grade 5	6	7	8	9	10	11
1974/75	2098	2228	11662	5422	10417	17443	2274
1975/76	465	2451	4266	9076	5811	7401	13240
1976/77	74	727	2672	4903	7055	3989	7065
1977/78	12	170	1116	2891	4712	4543	3800
1978/79	2	36	374	1402	2905	3147	3818
1979/80	0	7	111	569	1551	1961	2787
1980/81	0	1	30	204	715	1064	1785
1981/82	0	0	8	67	293	500	1002

Table B.2 Matrix Q, Estimated Matrix of Enrolment for the Returnee Students Allocated in 1975/76 - Whole Country

School Year	Grade 5	6	7	8	9	10	11
1974/75	0	0	0	0	0	0	0
1975/76	30905	14727	8545	0	7304	5017	4822
1976/77	4636	24608	12127	5640	1680	3756	4291
1977/78	695	7275	19769	9301	3939	1310	4035
1978/79	104	1665	9566	15186	6766	2482	1454
1979/80	16	341	3349	9807	11124	4276	2011
1980/81	2	66	1006	4466	8737	7042	3406
1981/82	0	12	277	1691	4823	5752	5620

Table B.3 Matrix S, Estimated Matrix of Enrolment for the Returnee Students - Whole Country

School Year	Grade 5	6	7	8	9	10	11
1974/75	2908	2228	11862	5422	10417	17443	2774
1975/76	31370	17178	12811	9076	13116	12417	18063
1976/77	4710	25335	14799	10543	8735	8745	11356
1977/78	707	7445	20885	12192	8651	5853	7834
1978/79	106	1700	9940	16588	9671	5628	5271
1979/80	16	349	3460	10376	12675	6237	4797
1980/81	2	67	1036	4670	9452	8106	5191
1981/82	0	12	285	1758	5116	6252	6621

Table B.4 Matrix A, Estimated Smoothed Matrix of Enrolment - Whole Country

School Year	Grade 5	6	7	8	9	10	11
1970/71	92599	64315	48158	38202	21654	13087	8466
1971/72	99769	73647	52015	42239	26499	13051	10519
1972/73	115137	83987	60249	44534	33340	17875	10983
1973/74	121980	98906	81206	47341	36798	21110	14445
1974/75	114216	103651	86923	64484	38288	23713	17355
1975/76	114037	98819	91511	68318	49431	24799	19630
1976/77	135099	101819	77224	97957	68613	37231	33302
1977/78	143042	113145	80960	76806	96079	38176	44628
1978/79	151350	119683	81477	57190	62664	38143	33074
1979/80	152322	123997	91093	59756	60029	35317	34740
1980/81	168325	129647	96702	70223	54351	38140	42676
1981/82	178243	137772	101512	75492	59289	41701	50498

Table B.5 : Constant Transition Probabilities, Mean Values of the Observed Point Estimates in 1971, 1972, 1973

Transition Probability	Value	Transition Probability	Value
p_{45}	.54	p_{88}	.23
p_{55}	.15	p_{89}	.63
p_{56}	.72	p_{99}	.23
p_{66}	.16	$p_{9,10}$	.61
p_{67}	.69	$p_{10,10}$	.06
p_{77}	.23	$p_{10,11}$	.74
p_{78}	.66	$p_{11,11}$	.12

Table B.6 : Repeaters and Drop-outs Corresponding to Matrix A

Year	Repeaters in Grade 5*	Drop-outs**
1971	14816	53214
1972	14965	51864
1973	14968	50523
1974	7319	30107
1975	14790	41539
1976	9836	34368
1977	20264	80635
1978	27205	173379
1979	28760	109709
1980	33514	91671
1981	33665	103500

* A repeater in year t is a student that failing grade 5 in school year t-1/t, is matriculated as a repeater in the same grade in t/t+1.

** A drop-out in year t is a student who leaves the school system during or at the end of the school year t-1/t.

Table B.7 Matrix R1 for the Returnee Students Allocated in 1974/75

School Year	Grade 5	6	7	8	9	10	11
1974/75	2908	2228	11862	5422	10417	17443	2724
1975/76	611	2488	5489	8473	6470	8278	14357
1976/77	128	907	3414	5412	6775	4707	7075
1977/78	27	197	1739	3401	5226	4255	4001
1978/79	6	57	727	1894	3613	3389	3569
1979/80	2	15	289	910	3274	2419	2850
1980/81	0	4	110	401	1605	2081	2041
1981/82	0	1	41	266	762	1172	1747

Table B.8 Matrix Q1 for the Returnee Students Allocated in 1975/76

School Year	Grade 5	6	7	8	9	10	11
1974/75	0	0	0	0	0	0	0
1975/76	17707	11696	12630	0	5588	7476	3125
1976/77	3718	16742	11441	7583	1900	4121	6193
1977/78	781	2639	14050	8760	4741	1670	3503
1978/79	164	1056	6501	10620	6342	2702	1439
1979/80	34	317	3543	6556	7891	3694	2244
1980/81	7	84	1430	3765	6223	4652	3074
1981/82	2	21	551	1799	4149	3965	3876

Table B.9 Matrix S1 Corresponding to the Returnee Students Enrolment

School Year	Grade 5	6	7	8	9	10	11
1974/75	2908	2228	11862	5422	10417	17443	2724
1975/76	18318	14184	18127	8473	12058	15754	17482
1976/77	3846	17649	14855	12995	8675	8828	13268
1977/78	808	2836	15789	12161	9967	5925	7503
1978/79	170	1113	7228	12514	9955	6091	5508
1979/80	36	332	3832	7466	11165	6113	5094
1980/81	7	88	1540	4166	7828	6733	5115
1981/82	2	22	592	2065	4911	5137	5623

Table B.10 Matrix A1, Estimated Smoothed Matrix of Enrolment Using the Transition Probabilities Estimated for S - Whole Country

School Year	Grade 5	6	7	8	9	10	11
1970/71	92599	64315	48158	38202	21654	13087	8466
1971/72	99769	73647	52015	42293	26499	13051	10519
1972/73	115137	83987	60249	44534	33340	17875	10983
1973/74	121980	98906	81206	47341	36798	21110	14445
1974/75	114216	103651	86923	64484	38288	23713	17355
1975/76	127089	101813	86195	68921	50489	21442	20211
1976/77	135963	109504	77168	95505	68673	37148	31390
1977/78	142941	117754	86056	76837	94763	38104	44959
1978/79	151286	120270	84189	61264	62380	37679	33346
1979/80	152302	124014	90721	62666	61539	35441	34443
1980/81	168320	129626	96198	70727	55975	39513	42752
1981/82	178241	137762	101205	75185	59494	42816	51494

Table B.11 : Repeaters and Drop-outs Corresponding to Matrix A1[(a)]

Year	Repeaters in Grade 5*	Drop-outs**
1971	14816	53214
1972	14965	51864
1973	14968	50523
1974	7319	30107
1975	14615	44692
1976	12709	38373
1977	20165	79662
1978	27142	175413
1979	28740	111364
1980	33506	92548
1981	33664	104786

* A repeater in year t is a student that failing grade 5 in school year t-1/t, is matriculated as a repeater in the same grade in t/t+1.

** A drop-out in year t is a student who leaves the school system during or at the end of the school year t-1/t.

APPENDIX C

REGIONAL APPLICATION OF THE BASIC MARKOV MODEL TO THE PORTUGUESE EDUCATIONAL SYSTEM: TABLES

Table C.1.a : Enrolment by Grade in the Preparatory and Secondary Education - AVEIRO

School	Grade						
Year	5	6	7	8	9	10	11
1970/71	7698	5024	2617	1964	1096	485	194
1971/72	8264	5555	3078	2412	1516	622	406
1972/73	9361	6362	3612	2616	1845	970	500
1973/74	9920	7581	6103	2540	1754	1204	796
1974/75	9043	8025	6354	4804	3045	2287	1097
1975/76	11140	8520	7040	5557	4296	2181	2222
1976/77	10660	9578	6117	7562	5063	2763	2913
1977/78	10120	8556	6298	5232	6180	2284	3170
1978/79	11923	8198	5183	4312	3741	2664	2486
1979/80	11958	9119	5263	4001	3770	2097	2283
1980/81	12613	9515	5385	4068	3484	2514	2629
1981/82	13209	9926	6105	4365	3332	2469	2979

Table C.1.b : Enrolment by Grade in the Preparatory and Secondary Education - BEJA

School	Grade						
Year	5	6	7	8	9	10	11
1970/71	1995	1470	1013	589	391	181	124
1971/72	2017	1659	1010	749	473	199	142
1972/73	2389	1757	1160	829	509	252	144
1973/74	2422	2102	1647	621	501	186	168
1974/75	2554	2149	1457	1047	703	518	145
1975/76	3121	2477	1919	1199	993	423	461
1976/77	3036	2666	1657	1978	1148	470	447
1977/78	2846	2653	1792	1630	1956	362	662
1978/79	2885	2518	1895	1575	1556	578	363
1979/80	3008	2325	1877	1368	1441	677	505
1980/81	2923	2458	1634	1205	1097	670	856
1981/82	3045	2444	1935	1450	1193	640	846

SOURCE: Diagnostico/Previsoes, Educational Planning Bureau (GEP), Ministry of Education, 1983

Table C.1.c : Enrolment by Grade in the Preparatory and Secondary Education - BRAGA

School Year	Grade 5	6	7	8	9	10	11
1970/71	7708	4439	2447	1833	1061	597	370
1971/72	7916	4984	2682	2051	1199	636	488
1972/73	9821	5849	3074	2191	1483	791	505
1973/74	10190	7116	4991	2085	1534	877	693
1974/75	10086	8243	6333	3820	2359	1897	810
1975/76	11691	8497	6714	5341	3237	2226	2011
1976/77	11896	9085	5566	6603	4375	2435	2084
1977/78	11605	8745	6274	5411	5549	2593	2804
1978/79	13419	8730	4869	3974	3779	2417	1963
1979/80	12206	9020	5039	3455	3923	2311	2218
1980/81	15351	10403	5212	3700	3099	2554	2902
1981/82	15123	10685	5571	3897	3148	2462	3171

Table C.1.d : Enrolment by Grade in the Preparatory and Secondary Education - BRAGANCA

School Year	Grade 5	6	7	8	9	10	11
1970/71	2199	1422	968	638	543	298	141
1971/72	2492	1849	1109	1072	678	190	194
1972/73	2932	2247	1369	1034	986	283	157
1973/74	2809	2695	2219	978	848	479	226
1974/75	2699	2477	2059	1578	1244	800	366
1975/76	3659	2701	2721	1833	1758	845	785
1976/77	3210	2849	1983	2644	2363	973	885
1977/78	3094	2628	2151	1897	2979	982	871
1978/79	3408	2716	2391	1960	2207	1091	1049
1979/80	3545	2832	2187	1721	2274	838	828
1980/81	4086	2991	2350	1790	1574	1062	1081
1981/82	4172	3342	2569	1841	1616	879	1458

SOURCE: Diagnostico/Previsoes, Educational Planning Bureau (GEP), Ministry of Education, 1983

Table C.1.e : Enrolment by Grade in the Preparatory and Secondary Education - C.BRANCO

School Year	Grade 5	6	7	8	9	10	11
1970/71	2515	1896	1336	1292	777	328	248
1971/72	2688	2021	1448	1309	880	424	277
1972/73	3072	2315	1578	1247	1217	632	345
1973/74	3105	2746	1579	1099	1108	554	346
1974/75	2868	2887	2235	1619	1184	1001	608
1975/76	3893	3326	2256	2276	1259	857	928
1976/77	3403	3390	2054	2509	1876	1029	952
1977/78	3721	3169	2069	2206	2278	911	991
1978/79	3873	3168	2108	1735	2006	1313	946
1979/80	3575	3155	2372	1716	2216	1247	1266
1980/81	3824	3109	2464	2080	1951	1328	1474
1981/82	3997	3345	2474	1943	1752	1329	1669

Table C.1.f : Enrolment by Grade in the Preparatory and Secondary Education - COIMBRA

School Year	Grade 5	6	7	8	9	10	11
1970/71	4118	3152	2409	2133	1379	832	609
1971/72	4599	3614	2883	2382	1696	933	689
1972/73	5066	3915	3199	2485	1748	1120	749
1973/74	5305	4458	4170	2554	2104	1240	907
1974/75	5169	5253	4838	3561	2864	2176	1246
1975/76	6170	5185	5295	4206	3692	2039	2052
1976/77	6508	5812	4558	5520	4030	2349	2190
1977/78	6855	5601	4906	4393	5278	1991	2611
1978/79	7224	5766	4365	3812	3873	2358	2273
1979/80	7284	6102	4774	3322	3680	2364	2032
1980/81	7740	6381	4904	3602	3082	2555	2564
1981/82	8256	6709	4890	3813	3094	3084	3080

SOURCE: Diagnostico/Previsoes, Educational Planning Bureau (GEP), Ministry of Education, 1983

Table C.1.g : Enrolment by Grade in the Preparatory and Secondary Education - EVORA

School Year	Grade 5	6	7	8	9	10	11
1970/71	2007	1511	927	873	489	282	213
1971/72	2439	1631	1064	884	640	230	187
1972/73	2462	2081	1305	966	818	417	198
1973/74	2645	2149	1515	1174	938	452	285
1974/75	2303	2244	1853	1357	1100	845	300
1975/76	2845	2423	2038	1127	1340	478	376
1976/77	2580	2753	1832	2087	1746	1135	1044
1977/78	2545	2360	1916	1784	2273	840	1115
1978/79	2570	2216	1760	1558	1643	900	782
1979/80	2318	1799	1842	1448	1623	920	874
1980/81	2763	2374	1931	1560	1411	820	1019
1981/82	2876	2326	2085	1589	1418	1078	1374

Table C.1.h : Enrolment by Grade in the Preparatory and Seconday Education - FARO

School Year	Grade 5	6	7	8	9	10	11
1970/71	2977	2266	2100	1876	1164	627	401
1971/72	2970	2726	2123	2016	1363	727	458
1972/73	3443	2868	2276	1889	1587	897	497
1973/74	3605	2972	3330	1526	1525	964	622
1974/75	3376	3380	3359	2494	1954	1720	799
1975/76	4449	3673	3685	3075	2605	1559	1611
1976/77	4417	4322	3330	3864	3096	1957	1874
1977/78	4535	4454	3702	3298	3686	1595	2269
1978/79	4532	4048	3439	2797	2696	1632	869
1979/80	4878	4168	3639	2660	2688	1672	1286
1980/81	5093	4266	3502	2662	2439	1634	1754
1981/82	5676	4292	3796	2994	2501	1705	1993

SOURCE: Diagnostico/Previsoes, Educational Planning Bureau (GEP), Ministry of Education, 1983

Table C.1.i : Enrolment by Grade in the Preparatory and Secondary Education - GUARDA

School Year	Grade 5	6	7	8	9	10	11
1970/71	1474	993	781	689	399	360	175
1971/72	1836	1122	786	731	514	240	188
1972/73	2565	1713	955	854	817	392	231
1973/74	2792	2270	1431	825	760	475	305
1974/75	2523	2457	1511	1220	957	932	416
1975/76	3401	2542	1921	1735	1713	779	1067
1976/77	3035	2833	1632	1977	1821	1068	923
1977/78	2997	2508	1722	1588	2131	898	1154
1978/79	2933	2479	1570	1486	1627	1172	933
1979/80	3083	2657	1473	1251	1514	1048	1016
1980/81	3303	2616	1648	1342	1285	1070	1163
1981/82	3546	2939	1669	1376	1275	1111	1461

Table C.1.j : Enrolment by Grade in the Preparatory and Secondary Education - LEIRIA

School Year	Grade 5	6	7	8	9	10	11
1970/71	3455	2513	1537	1316	665	392	229
1971/72	3848	2784	1521	1392	857	363	249
1972/73	4803	3312	2100	1527	1103	655	305
1973/74	5468	4328	3635	1573	1226	648	494
1974/75	5433	4947	4076	2822	1739	1520	700
1975/76	6639	5158	3986	2950	2186	1375	1456
1976/77	6206	5814	3531	4157	2756	1755	2175
1977/78	6760	5037	3777	3576	4186	1561	1981
1978/79	7122	5616	3257	2587	2554	1475	1443
1979/80	7105	5848	3442	2506	2402	1235	1163
1980/81	7572	6062	3644	2667	2137	1499	1377
1981/82	7890	6416	4088	2861	2141	1447	1744

SOURCE: Diagnostico/Previsoes, Educational Planning Bureau (GEP), Ministry of Education, 1983

Table C.1.k : Enrolment by Grade in the Preparatory and Secondary Education - LISBOA

School Year	Grade 5	6	7	8	9	10	11
1970/71	18554	13857	14016	11055	6466	4208	2860
1971/72	19786	16161	15369	12177	7497	4311	3815
1972/73	22069	18124	17376	12419	9292	5572	3885
1973/74	23271	20387	19080	13738	10842	6708	4636
1974/75	24016	21780	26023	18808	13304	11997	6318
1975/76	30483	24836	24407	18539	14886	10305	11610
1976/77	29344	27099	21576	25651	19086	12815	12736
1977/78	30223	26560	26189	22679	25995	13865	15673
1978/79	30026	28117	24085	18660	17865	11774	11003
1979/80	30538	27236	24296	19420	18191	11596	11931
1980/81	32783	26995	25510	21172	17295	12550	13504
1981/82	34534	28261	25903	20451	17914	13928	15609

Table C.1.1 :Enrolment by Grade in the Preparatory and Secondary Education - PORTALEGRE

School Year	Grade 5	6	7	8	9	10	11
1970/71	1382	1057	683	612	327	190	99
1971/72	1621	1227	653	655	424	171	129
1972/73	1191	1470	753	638	513	255	127
1973/74	1834	1601	977	722	561	259	163
1974/75	1604	1675	1141	832	639	506	202
1975/76	1957	1724	1369	982	910	553	525
1976/77	1917	1968	1120	1296	989	535	643
1977/78	2157	1700	1300	1014	1208	499	606
1978/79	2290	1831	1212	967	1064	688	478
1979/80	2005	1828	1204	997	1009	656	621
1980/81	2088	1787	1220	1022	897	749	790
1981/82	2266	1837	1254	1072	918	810	927

SOURCE: Diagnostico/Previsoes, Educational Planning Bureau (GEP), Ministry of Education, 1983

Table C.1.m : Enrolment by Grade in the Preparatory and Secondary Education - PORTO

School Year	Grade 5	6	7	8	9	10	11
1970/71	15692	10804	8216	6151	2934	2311	1617
1971/72	16475	12217	8733	6497	4036	1871	1686
1972/73	18572	13521	10001	7606	5128	2822	1762
1973/74	20143	15870	12923	8896	6059	3463	2566
1974/75	19712	17134	17232	12036	7957	8286	3594
1975/76	24032	18586	18207	11413	9930	5969	5600
1976/77	22706	20832	15835	18922	11876	7735	7190
1977/78	23314	19323	17114	14625	18776	6537	8807
1978/79	25994	19501	14671	11862	11535	6942	6308
1979/80	26381	20343	15751	10704	11625	6682	6028
1980/81	29950	21168	15975	11094	9316	7442	7580
1981/82	32982	23648	16433	11960	9125	6985	8987

Table C.1.n : Enrolment by Grade in the Preparatory and Secondary Education - SANTAREM

School Year	Grade 5	6	7	8	9	10	11
1970/71	4445	3251	2384	1650	875	615	242
1971/72	4814	3653	2264	1934	1209	475	415
1972/73	5687	4321	2623	1951	1374	529	318
1973/74	6180	5040	4886	1918	1521	839	436
1974/75	5607	5327	4884	3301	2390	1839	877
1975/76	7057	5789	5641	4453	3402	2042	1954
1976/77	6383	6135	4990	5616	3565	2258	1796
1977/78	6768	5987	5212	4539	5435	2341	2449
1978/79	6781	5498	4536	3693	3884	1847	1787
1979/80	6851	5855	4383	3428	3669	2040	1773
1980/81	7241	5772	4504	3497	3207	2457	2209
1981/82	7776	6230	4451	3676	3167	2471	2571

SOURCE: Diagnostico/Previsoes, Educational Planning Bureau (GEP), Ministry of Education, 1983

Table C.1.o : Enrolment by Grade in the Preparatory and Secondary Education - SETUBAL

School Year	Grade 5	6	7	8	9	10	11
1970/71	5823	4420	3912	3664	1484	579	329
1971/72	6782	5331	4326	3388	1950	789	398
1972/73	7135	5534	4865	3609	2615	1219	580
1973/74	8076	6869	6749	3783	2841	1483	929
1974/75	8057	7368	8127	5976	3947	3254	1569
1975/76	9773	8273	8520	5397	4948	2933	2842
1976/77	9009	8757	7865	9346	6989	3643	3834
1977/78	11122	9488	8719	7618	9938	3686	4322
1978/79	10937	9311	8386	6413	5957	3321	2403
1979/80	10751	9143	9031	6166	6201	3155	2719
1980/81	12369	9972	9085	7296	6045	3431	3547
1981/82	13005	10558	9343	7214	6284	3593	4282

Table C.1.p : Enrolment by Grade in the Preparatory and Secondary Education - V.CASTELO

School Year	Grade 5	6	7	8	9	10	11
1970/71	3010	1792	547	557	312	193	143
1971/72	3271	1890	668	588	332	215	178
1972/73	3626	2375	1061	665	538	232	159
1973/74	4198	2936	1347	908	633	291	175
1974/75	3634	3060	2017	1320	902	796	338
1975/76	3815	3282	2228	1032	932	402	386
1976/77	4343	3662	2168	2101	1511	619	678
1977/78	4226	3428	2044	1580	1856	569	757
1978/79	3853	3191	1825	1483	1263	568	592
1979/80	4696	3461	1862	1271	1472	398	628
1980/81	5000	3768	1836	1405	1285	642	478
1981/82	5285	3980	2035	1415	1287	976	1096

SOURCE: Diagnostico/Previsoes, Educational Planning Bureau (GEP), Ministry of Education, 1983

Table C.1.q : Enrolment by Grade in the Preparatory and Secondary Education - V.REAL

School Year	Grade 5	6	7	8	9	10	11
1970/71	2858	1945	1174	1083	608	323	238
1971/72	2896	2027	1158	1011	658	291	268
1972/73	3671	2414	1305	964	831	356	231
1973/74	3817	2878	1792	1017	882	396	265
1974/75	2911	2593	2491	1523	1099	774	318
1975/76	4654	3768	3065	2233	1913	980	1021
1976/77	4259	3785	2970	2821	2273	1027	957
1977/78	4402	3264	3040	2803	2688	995	957
1978/79	4669	3464	2830	2274	2405	1324	1024
1979/80	4697	3750	2922	1998	2316	1070	953
1980/81	5341	3837	3024	2106	1888	1447	1211
1981/82	5724	4196	3500	2466	1850	1167	1819

Table C.1.r : Enrolment by Grade in the Preparatory and Secondary Education - VISEU

School Year	Grade 5	6	7	8	9	10	11
1970/71	4649	2503	1091	916	484	388	339
1971/72	4945	3186	1139	991	577	354	352
1972/73	6472	3809	1637	1192	943	481	321
1973/74	6200	4908	2164	1321	1165	592	433
1974/75	5529	4880	2800	1788	1318	1198	526
1975/76	6718	5242	3310	2791	2547	1144	1375
1976/77	6951	5813	3239	3846	2885	1410	1337
1977/78	6459	5129	3620	3125	4338	1516	1884
1978/79	7017	5016	3035	2630	2683	1706	1652
1979/80	7459	5705	3196	2435	2690	1553	1413
1980/81	8287	6240	3469	2625	2311	1822	1745
1981/82	8879	6722	3696	2867	2416	1821	2043

SOURCE: Diagnostico/Previsoes, Educational Planning Bureau (GEP), Ministry of Education, 1983

TABLE C.2: Constant Transition Probabilities, Mean Values of the Observed Point Estimates in 1971, 1972, 1973.

Transition Probability	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu
p_{55}	.13	.11	.15	.15	.15	.12	.17	.19	.13	.12	.17	.14	.13	.15	.19	.13	.15	.12
p_{56}	.69	.76	.62	.75	.72	.77	.71	.73	.75	.74	.76	.74	.71	.75	.75	.64	.65	.66
p_{66}	.12	.14	.14	.19	.17	.13	.19	.22	.16	.16	.18	.17	.15	.16	.19	.13	.19	.14
p_{67}	.61	.57	.56	.65	.59	.76	.60	.79	.69	.71	.86	.52	.69	.67	.84	.43	.49	.43
p_{77}	.23	.32	.25	.30	.21	.25	.23	.22	.19	.17	.22	.20	.25	.26	.22	.20	.29	.22
p_{78}	.67	.51	.63	.71	.64	.70	.54	.65	.79	.74	.65	.75	.65	.62	.66	.79	.58	.73
p_{88}	.21	.27	.19	.23	.23	.22	.29	.22	.19	.17	.22	.24	.24	.25	.23	.21	.29	.24
p_{89}	.64	.57	.56	.66	.64	.66	.62	.63	.73	.64	.63	.65	.62	.61	.54	.69	.56	.65
p_{99}	.16	.20	.22	.24	.27	.19	.36	.20	.26	.18	.23	.20	.22	.21	.20	.20	.31	.35
$p_{9,10}$	.59	.45	.56	.42	.54	.66	.53	.60	.65	.02	.67	.52	.63	.50	.55	.63	.47	.69
$p_{10,10}$	.07	.03	.04	.01	.07	.04	.05	.06	.01	.03	.07	.04	.05	.07	.06	.02	.06	.07
$p_{10,11}$	.76	.66	.76	.59	.61	.73	.62	.64	.77	.69	.79	.60	.76	.64	.67	.76	.72	.74
$p_{11,11}$	.14	.11	.11	.25	.19	.12	.23	.10	.08	.09	.12	.14	.13	.13	.12	.07	.09	.18

TABLE C.3: Number of Repeaters in Grade 5

School	Aveiro		Beja		Braga		Braganca		C.Branco		Coimbra		Evora		Faro		Guarda	
Year	O.D	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.
1971/72	1155	1155	219	219	1233	1233	213	213	402	402	535	535	381	381	536	536	206	206
1972/73	1074	1074	242	242	1267	1267	296	296	376	376	552	552	451	451	564	564	239	239
1973/74	1123	1123	263	263	1179	1179	292	292	430	430	557	557	491	491	654	654	333	333
1974/75	595	595	145	145	714	714	162	162	155	155	159	159	132	132	150	150	109	109
1975/76	904	664	255	221	1210	1158	198	114	344	282	517	501	345	345	439	439	353	353
1976/77	891	860	312	188	1284	1044	216	3	312	141	740	668	199	106	445	218	306	164
1977/78	1273	1269	516	502	1784	1748	370	337	511	485	1041	1040	464	448	706	663	395	376
1978/79	2024	2024	484	483	2205	2200	368	363	595	591	1234	1234	484	481	771	762	390	388
1979/80	2146	2146	577	577	2415	2414	462	461	620	619	1373	1373	437	437	906	904	469	469
1980/81	2511	2511	662	662	2807	2807	651	651	787	787	1530	1530	556	556	1069	1069	617	617
1981/82	2639	2649	614	614	3377	3377	598	598	688	688	1858	1858	553	553	1192	1192	628	628

O.D. - Observed Data

A.D. - Adjusted Data

TABLE C.3: Number of Repeaters in Grade 5 (Continued)

School	Leiria		Lisboa		Portalegre		Porto		Santarem		Setubal		V.Castelo		V.Real		Viseu	
Year	O.D	A.D	O.D.	A.D	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.
1971/72	449	449	3340	3340	207	207	2353	2353	756	756	1173	1173	421	421	486	486	604	604
1972/73	500	500	3581	3581	243	243	2142	2142	722	722	1221	1221	425	425	405	405	643	643
1973/74	528	528	3310	3310	239	239	2229	2229	739	739	1427	1427	399	399	514	514	712	712
1974/75	219	219	1862	1862	92	92	1007	1007	247	247	727	727	210	210	229	229	186	186
1975/76	489	421	4082	3858	208	208	2563	2519	616	616	1450	1375	182	182	349	349	442	442
1976/77	465	240	3658	2463	157	107	2644	2019	917	690	1173	785	347	327	228	51	537	432
1977/78	931	903	4695	4492	306	299	3406	3324	957	923	1802	1728	521	518	554	527	765	752
1978/79	1149	1146	6045	6010	388	387	4663	4652	1151	1146	2669	2655	507	507	924	920	1033	1031
1979/80	1140	1140	5705	5699	389	389	5459	5458	1221	1220	2406	2403	617	617	794	793	1193	1193
1980/81	1350	1350	6413	6413	441	441	6331	6331	1439	1439	3010	3010	892	892	986	986	1417	1417
1981/82	1363	1363	5901	5901	397	397	6290	6290	1396	1396	2226	2226	900	900	961	961	1575	1575

O.D. - Observed Data

A.D. - Adjusted Data

TABLE C.4 Total Number of Drop-outs in Grades 5-11

Year	Aveiro		Beja		Braga		Braganca		C.Branco		Coimbra		Evora		Faro		Guarda	
	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.
1971	4432	4322	1305	1305	4959	4959	1089	1089	1629	1629	2097	2097	1282	1282	1473	1473	988	988
1972	4917	4917	1361	1361	4788	4788	1107	1107	1280	1280	3220	3220	886	886	1796	1796	283	283
1973	4166	4166	1642	1642	5226	5226	1193	1193	2536	2536	2611	2611	1304	1304	1873	1873	1134	1134
1974	3721	3721	1485	1485	3307	3307	1591	1591	1383	1383	935	935	1314	1314	660	660	1265	1265
1975	3953	3275	840	592	4328	3520	349	0	1149	648	3986	3385	1884	1706	437	0	-290	0
1976	6043	3692	1902	1086	8253	5332	2305	1328	2670	1609	3434	2155	- 62	419	1769	0	2598	1700
1977	11634	9959	1840	1195	8850	6862	2982	2293	3085	2310	5142	4276	2412	2091	3147	2245	2896	2386
1978	13257	11281	2939	2540	15044	13737	2249	1847	3476	2935	7485	6739	3499	3229	7299	6612	3341	3173
1979	9811	9084	2794	2519	10825	9885	3568	3227	2548	2078	6091	5620	2487	2284	3002	2487	2780	2480
1980	8381	7776	2632	2400	7471	6805	2571	2107	2372	1993	5068	4668	1163	992	3708	3307	2296	2113
1981	8391	7877	1718	1523	10950	10437	2422	2145	3021	2686	4253	3888	1446	1318	3017	2678	1968	1765

O.D. - Observed Data

A.D. - Adjusted Data

SOURCE for O.D. : Diagnostico/Previsoes, GEP, Ministry of Education, 1983

TABLE C.4 Total Number of Drop-outs in Grades 5-11 (Continued)

	Leiria		Lisboa		Portalegre		Porto		Santarem		Setubal		V.Castelo		V.Real		Viseu	
	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.	O.D.	A.D.
1971	2487	2487	8299	8299	886	886	10578	10578	2776	2776	1899	1899	2254	2254	2329	2329	3147	3147
1972	1492	1492	8839	8839	883	883	8727	8727	2946	2946	3324	3324	1833	1833	1795	1795	2535	2535
1973	1394	1394	10101	10101	1220	1220	6471	6471	1451	1451	1464	1464	1948	1948	2015	2015	3643	3643
1974	1367	1367	-1480	0	1006	1006	4644	4644	1968	1968	-258	0	1841	1841	2023	2023	4073	4073
1975	3633	2995	13686	11309	331	201	11645	9475	585	0	3913	2619	3616	3396	-921	0	1192	1063
1976	3075	1644	12496	6340	1319	704	10045	4689	5336	3004	1028	0	1023	378	3471	1703	4085	2882
1977	5369	4531	12735	9299	1837	1448	19072	15905	9167	7694	3867	2434	4334	4043	3793	2500	5089	4317
1978	8810	8375	43776	40455	1920	1687	30831	28483	10342	9328	15420	14400	5023	4810	3957	3045	8336	7645
1979	6320	5891	22801	19756	1307	1145	20029	18004	5084	4385	8177	7351	3056	2777	4196	3578	5581	5047
1980	4933	4541	20012	17823	1414	1260	18376	16548	4508	3948	5355	4617	3540	3281	3206	2638	4839	4387
1981	4915	4524	21877	19902	1350	1226	19497	17786	4926	4486	8741	8067	3252	3021	2677	2214	5409	5005

O.D. - Observed Data

A.D. - Adjusted Data

Table C.5.a : Enrolment by Grade in the Preparatory and Secondary Education (smoothed matrix) - AVEIRO

School	Grade						
Year	5	6	7	8	9	10	11
1970/71	7698	5024	2617	1964	1096	485	194
1971/72	8264	5555	3078	2412	1516	622	406
1972/73	9361	6362	3612	2616	1845	970	500
1973/74	9920	7581	6103	2540	1754	1204	796
1974/75	9043	7755	6028	4622	1906	1119	1026
1975/76	9295	7170	6117	5010	3263	1203	994
1976/77	10366	8134	5081	6828	4547	2085	1998
1977/78	10089	8218	5184	4384	5628	1932	2527
1978/79	11919	8136	4721	3388	3110	2314	2129
1979/80	11957	9109	5119	3497	3078	1700	1967
1980/81	12613	9513	5346	3866	3051	2078	2283
1981/82	13209	9926	6095	4296	3123	2183	2599

Table C.5.b : Enrolment by Grade in the Preparatory and Secondary Education (smoothed matrix) - BEJA

School	Grade						
Year	5	6	7	8	9	10	11
1970/71	1995	1470	1013	589	391	181	124
1971/72	2017	1659	1010	749	473	199	142
1972/73	2389	1757	1160	829	509	252	144
1973/74	2422	2102	1647	621	501	186	168
1974/75	2102	2135	1457	1008	454	231	141
1975/76	1993	1897	1683	1015	665	211	168
1976/77	2910	1727	1251	1808	978	316	275
1977/78	2832	2426	1127	1377	1825	281	542
1978/79	2833	2475	1553	1167	1386	517	296
1979/80	3008	2318	1743	1083	1175	598	457
1980/81	2923	2457	1587	1060	882	548	799
1981/82	3045	2444	1919	1387	1067	539	759

Table C.5.c : Enrolment by Grade in the Preparatory and Secondary Education (smoothed Matrix) - BRAGA

School Year	Grade 5	6	7	8	9	10	11
1970/71	7708	4439	2447	1844	1061	597	370
1971/72	7916	4984	2682	2051	1199	636	488
1972/73	9821	5849	3074	2191	1483	791	505
1973/74	10190	7116	4991	2085	1534	877	693
1974/75	9742	7314	5233	3540	1505	894	743
1975/76	10076	7064	5404	3969	2314	879	761
1976/77	11654	7883	4436	5517	3404	1864	923
1977/78	11569	8427	5318	4493	4727	2026	2242
1978/79	13414	8663	4452	3198	3084	1934	1470
1979/80	12205	9007	4897	3045	3335	1903	1797
1980/81	15351	10401	5169	3533	2740	2209	2545
1981/82	15123	10685	5559	3838	2975	2247	2869

Table C.5.d : Enrolment by Grade in the Preparatory and Secondary Education (smoothed matrix) - BRAGANCA

School Year	Grade 5	6	7	8	9	10	11
1970/71	2199	1422	968	938	543	296	141
1971/72	2492	1849	1109	1072	678	190	194
1972/73	2932	2247	1369	1034	986	283	157
1973/74	2809	2695	2219	978	848	479	226
1974/75	2141	2477	2059	1578	849	361	339
1975/76	2234	2076	2228	1825	1245	360	298
1976/77	2992	1662	1429	2292	2235	753	477
1977/78	3060	2239	1213	1423	2176	926	639
1978/79	3403	2617	1857	1185	1831	980	958
1979/80	3544	2809	1962	1163	1672	679	740
1980/81	4086	2986	2268	1502	1062	808	965
1981/82	4172	3341	2541	1716	1303	661	1279

Table C.5.e : Enrolment by Grade in the Preparatory and Secondary Education (smoothed Matrix) - C.BRANCO

School Year	Grade 5	6	7	8	9	10	11
1970/71	2515	1896	1336	1292	777	328	248
1971/72	2688	2021	1448	1309	880	424	277
1972/73	3072	2315	1578	1247	1217	632	345
1973/74	3105	2746	1579	1099	1108	554	346
1974/75	2452	2702	1952	1263	1003	637	404
1975/76	2754	2225	2004	1540	982	586	465
1976/77	3231	2383	1351	2179	1330	861	699
1977/78	3695	2874	1327	1680	1919	604	840
1978/79	3869	3099	1778	1139	1573	1098	730
1979/80	3574	3140	2262	1368	1718	998	1094
1980/81	3824	3106	2432	1930	1594	1042	1289
1981/82	3997	3344	2466	1888	1559	1116	1459

Table C.5.f : Enrolment by Grade in the Preparatory and Secondary Education (smoothed matrix) - COIMBRA

School Year	Grade 5	6	7	8	9	10	11
1970/71	4118	3152	2409	2133	1379	832	604
1971/72	4599	3614	2883	2382	1696	933	689
1972/73	5066	3915	3199	2485	1748	1120	749
1973/74	5305	4458	4170	2554	2104	1240	907
1974/75	5036	4664	4431	3481	2085	1438	1014
1975/76	5570	4484	4653	3867	2694	1434	1172
1976/77	6436	5259	3865	4996	3617	1666	1643
1977/78	6846	5473	4312	3792	4853	1691	2047
1978/79	7223	5743	4120	3264	3396	2066	1986
1979/80	7284	6098	4695	3030	3228	2037	1784
1980/81	7740	6380	4881	3482	2803	2243	2296
1981/82	8256	6709	4884	3771	2962	2888	2820

Table C.5.g : Enrolment by Grade in the Preparatory and Secondary Education (smoothed Matrix) - EVORA

School Year	Grade 5	6	7	8	9	10	11
1970/71	2007	1511	927	873	489	282	213
1971/72	2439	1631	1064	884	640	230	187
1972/73	2462	2081	1305	966	818	417	198
1973/74	2645	2149	1515	1174	938	452	285
1974/75	2303	2244	1638	1159	1066	520	300
1975/76	2297	2061	1723	953	1102	443	174
1976/77	2487	2295	1543	1867	1553	1007	976
1977/78	2529	2207	1575	1564	2067	731	1020
1978/79	2567	2176	1590	1310	1432	785	693
1979/80	2318	1789	1779	1284	1393	803	782
1980/81	2763	2372	1911	1478	1227	692	925
1981/82	2876	2326	2079	1554	1301	974	1273

Table C.5.h : Enrolment by Grade in the Preparatory and Secondary Education (smoothed matrix) - FARO

School Year	Grade 5	6	7	8	9	10	11
1970/71	2977	2266	2100	1876	1164	627	401
1971/72	2970	2726	2123	2016	1363	727	458
1972/73	3443	2868	2276	1889	1587	897	497
1973/74	3605	2972	3330	1526	1525	964	622
1974/75	3376	3285	3080	2494	1266	973	679
1975/76	3252	3187	3273	2551	1824	818	691
1976/77	4190	3341	2856	3481	2610	1444	1308
1977/78	4492	4072	2823	2905	3348	1272	1884
1978/79	4524	3932	2944	2139	2381	1410	624
1979/80	4876	4137	3439	2193	2211	1470	1119
1980/81	5093	4258	3433	2429	2050	1335	1608
1981/82	5676	4290	3774	2898	2276	1453	1787

Table C.5.i : Enrolment by Grade in the Preparatory and Secondary Education (smoothed Matrix) - GUARDA

School Year	Grade 5	6	7	8	9	10	11
1970/71	1474	993	781	689	399	260	175
1971/72	1836	1122	786	731	514	240	188
1972/73	2565	1713	955	854	817	392	231
1973/74	2792	2270	1431	825	760	475	305
1974/75	2398	2457	1511	1220	800	499	390
1975/76	2306	2192	1921	1425	1099	525	415
1976/77	2892	1956	1390	1918	1435	666	675
1977/78	2978	2260	1071	1386	1988	543	825
1978/79	2931	2425	1275	933	1442	1076	711
1979/80	3083	2647	1380	913	1062	927	925
1980/81	3303	2614	1623	1204	921	775	1062
1981/82	3546	2939	1663	1330	1080	871	1226

Table C.5.j : Enrolment by Grade in the Preparatory and Secondary Education (smoothed matrix) - LEIRIA

School Year	Grade 5	6	7	8	9	10	11
1970/71	3455	2513	1537	1316	665	392	229
1971/72	3848	2784	1521	1392	857	363	249
1972/73	4803	3312	2100	1527	1103	655	305
1973/74	5468	4328	3635	1573	1226	648	494
1974/75	4866	4739	3691	2822	1227	780	492
1975/76	4763	4359	3773	2665	2027	784	582
1976/77	5977	4298	2928	3951	2545	1639	1689
1977/78	6732	4625	2598	3094	4016	1427	1857
1978/79	7119	5529	2764	1633	2215	1366	1339
1979/80	7105	5832	3297	1979	1730	1022	1078
1980/81	7572	6059	3608	2470	1679	1076	1222
1981/82	7890	6415	4080	2801	1932	1150	1438

Table C.5.k : Enrolment by Grade in the Preparatory and Secondary Education (smoothed Matrix) - LISBOA

School Year	Grade 5	6	7	8	9	10	11
1970/71	18554	13857	14016	11055	6466	4208	2860
1971/72	19896	16171	15370	12177	7497	4311	3815
1972/73	22069	18124	17376	12419	9292	5572	3885
1973/74	23271	20387	19080	13738	10842	6708	4636
1974/75	22702	21356	21730	15424	11149	7734	5856
1975/76	23453	21097	23098	15004	12259	8011	6812
1976/77	28147	21083	18073	24022	16255	10894	10348
1977/78	30019	24567	20245	20044	24318	11834	13869
1978/79	29991	27603	21063	13217	15819	10508	9182
1979/80	30532	27117	23189	16478	14921	10137	10712
1980/81	32782	26969	25164	19806	14690	10257	12205
1981/82	34534	28256	25805	19926	16454	12022	13642

Table C.5.1 : Enrolment by Grade in the Preparatory and Secondary Education (smoothed matrix) - PORTALEGRE

School Year	Grade 5	6	7	8	9	10	11
1970/71	1382	1057	683	612	327	190	99
1971/72	1621	1227	653	655	424	171	129
1972/73	1991	1470	753	638	513	255	127
1973/74	1834	1601	977	722	561	259	163
1974/75	1604	1629	1028	832	582	302	178
1975/76	1596	1464	1053	897	657	314	206
1976/77	1866	1656	922	1039	883	394	455
1977/78	2150	1610	1098	803	1019	438	495
1978/79	2289	1810	1125	765	889	588	426
1979/80	2005	1824	1176	883	843	561	553
1980/81	2088	1786	1212	974	790	659	724
1981/82	2266	1837	1252	1054	865	751	864

Table C.5.m : Enrolment by Grade in the Preparatory and Secondary Education (smoothed Matrix) - PORTO

School Year	Grade 5	6	7	8	9	10	11
1970/71	15692	10804	8216	6151	2934	2311	1617
1971/72	16475	12217	8733	6497	4036	1871	1686
1972/73	18572	13521	10001	7606	5128	2822	1762
1973/74	20143	15870	12923	8896	6059	3463	2566
1974/75	19373	16682	14181	10535	6849	3990	2965
1975/76	19228	16257	15056	9070	8038	4514	2254
1976/77	22080	17071	13440	16311	10007	6471	5649
1977/78	23233	18315	13921	12442	16746	5296	7646
1978/79	25983	19292	13177	9262	9735	5601	5214
1979/80	26380	20304	15233	9109	9617	5481	4867
1980/81	29950	21161	15819	10375	7885	6117	6516
1981/82	32982	23647	16389	11686	8364	6017	7842

Table C.5.n : Enrolment by Grade in the Preparatory and Secondary Education (smoothed matrix) - SANTAREM

School Year	Grade 5	6	7	8	9	10	11
1970/71	4445	3251	2384	1650	875	615	242
1971/72	4814	3653	2264	1934	1209	475	415
1972/73	5687	4321	2623	1951	1374	529	318
1973/74	6180	5040	4886	1918	1521	839	436
1974/75	5605	5327	4647	3301	1489	891	594
1975/76	5545	5056	4777	3706	2326	802	601
1976/77	6156	4884	4274	4894	2884	1633	827
1977/78	6734	5617	4187	3915	4851	1957	1923
1978/79	6776	5413	4021	2902	3381	1528	1473
1979/80	6850	5838	4192	2911	3081	1766	1528
1980/81	7241	5769	4443	3250	2768	2144	2002
1981/82	7776	6229	4433	3576	2924	2230	2344

Table C.5.o : Enrolment by Grade in the Preparatory and Secondary Education (smoothed Matrix) - SETUBAL

School Year	Grade 5	6	7	8	9	10	11
1970/71	5863	4420	3912	2664	1484	579	329
1971/72	6782	5331	4326	3388	1950	789	398
1972/73	7135	5534	4865	3609	2615	1219	580
1973/74	8076	6869	6749	3783	2841	1483	929
1974/75	7661	7362	7255	5324	2989	1652	1105
1975/76	7731	7145	7780	4671	4005	1743	1239
1976/77	8621	7011	6754	8691	6336	3053	2845
1977/78	11048	8865	7008	6734	9388	3292	3808
1978/79	10923	9137	7487	5081	5281	2995	2077
1979/80	10748	9100	8687	5266	5213	2764	2461
1980/81	12368	9962	8973	6862	5271	2864	3254
1981/82	13005	10556	9310	7040	5852	3134	3867

Table C.5.p : Enrolment by Grade in the Preparatory and Secondary Education (smoothed matrix) - V.CASTELO

School Year	Grade 5	6	7	8	9	10	11
1970/71	3010	1792	547	557	312	193	143
1971/72	3271	1890	668	588	332	215	178
1972/73	3626	2375	1061	665	538	232	159
1973/74	4198	2936	1347	908	633	291	175
1974/75	3634	3060	1532	1255	753	405	233
1975/76	3664	2724	1622	635	857	300	81
1976/77	4323	3493	1807	1539	1222	570	579
1977/78	4223	3394	1899	1177	1410	386	713
1978/79	3853	3185	1781	1284	896	284	450
1979/80	4696	3460	1851	1195	1261	161	402
1980/81	5000	3768	1833	1380	1190	504	282
1981/82	5285	3980	2034	1408	1251	913	978

Table C.5.q : Enrolment by Grade in the Preparatory and Secondary Education (smoothed Matrix) - V.REAL

School Year	Grade 5	6	7	8	9	10	11
1970/71	2959	1945	1174	1083	608	323	238
1971/72	2896	2027	1158	1011	658	291	268
1972/73	3671	2414	1305	964	831	356	231
1973/74	3817	2878	1792	1017	882	396	265
1974/75	2911	2593	1930	1334	843	438	309
1975/76	3386	2385	1830	1506	1009	422	343
1976/77	4082	2756	1934	1894	1586	568	495
1977/78	4375	2954	2236	1933	1956	644	585
1978/79	4665	3388	2445	1555	1691	959	738
1979/80	4696	3733	2773	1566	1692	713	664
1980/81	5341	3833	2972	1894	1453	1132	928
1981/82	5724	4195	3483	2375	1597	944	1567

Table C.5.r : Enrolment by Grade in the Preparatory and Secondary Education (smoothed matrix) - VISEU

School Year	Grade 5	6	7	8	9	10	11
1970/71	4649	2503	1091	916	484	388	339
1971/72	4945	3186	1139	991	577	364	352
1972/73	6472	3809	1637	1192	943	481	321
1973/74	6200	4908	2164	1321	1165	592	433
1974/75	5529	4779	2587	1788	1266	845	516
1975/76	5847	4318	2624	2317	1605	933	718
1976/77	6846	5108	2691	3232	2248	746	1063
1977/78	6446	4961	3196	2577	3716	1030	1343
1978/79	7015	4984	2870	2189	2109	1242	1195
1979/80	7459	5700	3146	2209	2203	1125	988
1980/81	8287	6239	3456	2534	1993	1456	1351
1981/82	8879	6722	3693	2835	2246	1576	1701

Table C.6.a. The Observed Point Estimates of the Transition Probabilities - AVEIRO

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.15	.64	.13	.52	.18	.73	.26	.67	.19	.54	.07	.77	.17	.21	.35	.09	.07	.28	.16	.83
1972	.13	.70	.11	.54	.19	.70	.19	.67	.15	.61	.07	.68	.18	.17	.35	.11	.14	.25	.25	.82
1973	.12	.73	.12	.77	.33	.57	.18	.58	.13	.62	.06	.78	.07	.15	.11	.10	.24	.25	.16	.93
1974	.06	.79	.03	.76	.09	.72	.16	1.14	.08	1.29	.09	.87	.06	.15	.21	.19	-.30	-.38	.11	.94
1975	.10	.83	.13	.79	.11	.73	.19	.73	.26	.68	.05	.88	.19	.07	.08	.16	.08	.06	.07	.81
1976	.08	.80	.08	.64	.09	.92	.19	.72	.25	.59	.10	1.20	.13	.12	.28	-.01	.09	.16	-.30	.87
1977	.12	.71	.11	.52	.22	.63	.18	.61	.31	.41	.08	.84	.29	.17	.37	.15	.21	.29	.01	.71
1978	.20	.69	.14	.46	.20	.52	.20	.48	.20	.42	.04	.70	.28	.11	.40	.28	.32	.38	.26	.72
1979	.18	.66	.14	.47	.28	.55	.27	.60	.32	.48	.11	.78	.08	.16	.39	.17	.13	.20	.11	.92
1980	.21	.68	.15	.46	.23	.58	.26	.61	.28	.56	.19	.91	.32	.11	.39	.19	.13	.16	-.10	.68
1981	.21	.67	.15	.51	.24	.62	.25	.64	.21	.66	.07	.91	.26	.12	.34	.14	.11	.14	.02	.74
Estimates																				
Unr.OLS	.15	.56	.33	.43	.41	.80	.06	1.02	-.22	.19	.70	.81	.29	.31	.61	-1.35	.13	2.03	-1.08	.63
Rest.OLS	.16	.52	.39	.61	.15	.85	.00	.84	.00	.42	.19	.84	.17	.32	.00	.00	.16	.58	.00	.83
Unr.OLS (Matrix A)	.15	.67	.16	.44	.38	.72	.14	.83	-.03	.28	.51	.80	.40	-.09	1.29	-1.54	-.35	2.02	1.59	-1.08
Rest.OLS (Matrix A)	.15	.47	.44	.51	.28	.72	.15	.82	.00	.15	.57	.43	1.00	.38	.05	.00	.03	.85	.00	.00

Table C.6.b. The Observed Point Estimates of the Transition Probabilities - BEJA

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.11	.73	.14	.50	.28	.59	.25	.71	.14	.50	.01	.75	.06	.16	.36	.13	.04	.36	.24	.94
1972	.12	.75	.14	.50	.33	.56	.35	.49	.28	.51	.06	.06	.09	.13	.36	.11	.16	.21	.28	.91
1973	.11	.79	.12	.70	.35	.38	.22	.50	.17	.35	.03	.56	.19	.10	.18	.27	.28	.48	.41	.81
1974	.06	.86	.03	.59	.13	.57	.16	1.09	.06	1.01	.05	.75	.04	.08	.38	.30	-.25	-.08	.20	.96
1975	.10	.85	.14	.83	.09	.68	.19	.70	.37	.57	.05	.76	.46	.05	.03	.23	.11	.06	.19	.54
1976	.10	.72	.17	.62	.07	.84	.31	.65	.37	.45	.04	.83	.21	.18	.21	.09	.04	.18	.13	.79
1977	.17	.73	.16	.56	.18	.75	.20	.87	.21	.30	.03	1.13	.30	.10	.28	.07	-.07	.49	-.16	.70
1978	.17	.74	.15	.57	.22	.68	.22	.60	.30	.29	.04	.43	.31	.09	.28	.10	.18	.41	.53	.69
1979	.20	.64	.19	.54	.27	.53	.24	.60	.32	.40	.08	.85	.04	.16	.27	.20	.16	.28	.07	.96
1980	.22	.64	.23	.51	.24	.44	.27	.50	.28	.42	.10	.84	.56	.14	.26	.32	.23	.30	.06	.44
1981	.21	.68	.19	.61	.27	.69	.27	.75	.27	.53	.09	.76	.39	.11	.20	.04	-.02	.21	.15	.61
Estimates																				
Unr.OLS	.15	.76	.12	1.01	-.79	.59	.29	.96	-.04	.20	.60	.90	.23	1.45	-1.68	.51	-0.05	-1.63	-1.49	-.13
Rest.OLS	.14	.63	.27	.73	.00	.71	.11	.89	.00	.23	.39	.61	1.00	.23	.00	.29	.00	.77	.00	.00
Unr.OLS (Matrix A)	.16	.77	.10	.74	.05	.51	.40	.81	.13	.18	.61	.91	.28	1.10	-.44	.07	-1.45	1.54	.34	-.94
Rest.OLS (Matrix A)	.16	.64	.27	.53	.30	.67	.19	.81	.12	.16	.67	.25	.97	.20	.21	.03	.00	.72	.08	.03

Table C.6.c. The Observed Point Estimates of the Transition Probabilities - BRAGA

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.16	.56	.16	.49	.21	.66	.23	.54	.18	.58	.03	.78	.06	.28	.35	.13	.23	.23	.19	.94
1972	.16	.65	.14	.51	.20	.65	.22	.58	.25	.54	.04	.77	.04	.19	.35	.15	.20	.11	.19	.96
1973	.12	.64	.13	.67	.35	.59	.12	.55	.22	.56	.06	.74	.22	.24	.20	.06	.33	.23	.20	.88
1974	.07	.78	.04	.81	.12	.70	.16	1.09	.06	1.23	.01	.92	.01	.15	.15	.18	-.25	-.25	.07	.99
1975	.12	.76	.10	.70	.15	.69	.25	.69	.26	.92	.03	.91	.34	.12	.20	.16	.06	-.17	.06	.66
1976	.11	.68	.13	.59	.08	.84	.18	.65	.27	.72	.05	.76	.20	.21	.28	.08	.17	.01	.19	.80
1977	.15	.64	.13	.56	.22	.71	.22	.63	.31	.54	.10	.80	.41	.21	.31	.07	.15	.15	.10	.59
1978	.19	.63	.16	.42	.19	.48	.18	.48	.21	.43	.02	.54	.20	.18	.42	.33	.34	.36	.44	.80
1979	.18	.57	.15	.44	.24	.53	.22	.65	.35	.55	.09	.77	.18	.25	.41	.23	.13	.09	.14	.82
1980	.23	.72	.17	.46	.20	.58	.23	.65	.22	.58	.11	.84	.43	.05	.37	.22	.12	.17	.05	.57
1981	.22	.60	.14	.42	.23	.59	.23	.65	.24	.70	.11	.88	.32	.18	.44	.18	.12	.06	.01	.68
Estimates																				
Unr.OLS	.16	.34	.59	.35	.48	.66	.20	.85	-.02	-.05	1.13	.97	.07	1.86	-3.33	.88	-.06	1.86	.49	1.66
Rest.OLS	.15	.45	.44	.56	.17	.83	.00	.84	.00	.39	.32	.68	.27	.49	.00	.00	.16	.61	.00	.73
Unr.OLS (Matrix A)	.17	.35	.56	.39	.40	.55	.31	.74	.09	.19	.75	1.05	.02	2.43	-4.70	1.37	.15	1.66	-.30	4.28
Rest.OLS (Matrix A)	.18	.40	.52	.48	.28	.72	.13	.84	.00	.49	.08	.92	.01	.42	.00	.00	.03	.51	.00	.99

Table C.6.d. The Observed Point Estimates of the Transition Probabilities - BRAGANCA

Trans Probab.	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$	P_{5d}	P_{6d}	P_{7d}	P_{8d}	P_{9d}	$P_{10,d}$	$P_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.15	.73	.17	.61	.26	.82	.30	.57	.27	.35	.00	.66	.00	.12	.22	-.08	.13	.38	.34	1.00
1972	.16	.75	.21	.61	.22	.75	.19	.78	.23	.41	.03	.59	.23	.09	.18	.03	.03	.36	.38	.77
1973	.13	.78	.18	.74	.41	.56	.20	.62	.22	.49	.00	.51	.52	.09	.08	.03	.18	.30	.49	.48
1974	.06	.87	.01	.72	.06	.68	.09	1.24	.04	.94	.00	.76	.00	.07	.27	.26	-.33	.02	.24	1.00
1975	.08	.86	.15	.91	.23	.67	.29	.84	.34	.67	.01	.94	.08	.06	-.06	.10	-.13	-.01	.05	.92
1976	.08	.69	.13	.68	.06	.91	.10	.95	.35	.55	.00	.82	.24	.23	.19	.03	-.05	.09	.18	.76
1977	.13	.69	.15	.61	.21	.66	.22	.85	.29	.38	.09	.64	.28	.18	.24	.13	-.09	.33	.27	.72
1978	.14	.74	.16	.67	.29	.61	.34	.64	.33	.37	.00	.74	.37	.12	.17	.10	.02	.31	.26	.63
1979	.17	.69	.18	.54	.31	.43	.35	.63	.47	.34	.08	.76	.00	.14	.28	.26	.02	.19	.16	1.00
1980	.23	.70	.19	.56	.34	.55	.34	.53	.29	.43	.10	.98	.32	.07	.25	.11	.13	.28	-.08	.68
1981	.20	.69	.18	.64	.28	.57	.28	.64	.30	.52	.06	.99	.38	.11	.18	.15	.08	.18	-.05	.62
Estimates																				
Unr.OLS	.12	.72	.17	1.10	-.31	.67	.23	1.01	.08	.18	.63	.58	.52	.04	.26	.31	.74	.09	-4.14	3.77
Rest.OLS	.13	.69	.23	.77	.12	.88	.00	1.00	.06	.42	.02	.06	1.00	.18	.00	.00	.00	.52	.91	.00
Unr.OLS (Matrix A)	.12	.71	.17	1.07	.34	.56	.36	.80	.27	.36	.16	.25	.92	1.25	-2.35	2.06	-1.32	.62	1.63	-.40
Rest.OLS (Matrix A)	.13	.57	.36	.64	.26	.73	.19	.81	.28	.45	.00	.49	.65	.30	.00	.01	.00	.27	.51	.35

Table C.6.e. The Observed Point Estimates of the Transition Probabilities - CASTELO BRANCO

Trans Probab.	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$	P_{5d}	P_{6d}	P_{7d}	P_{8d}	P_{9d}	$P_{10,d}$	$P_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.16	.67	.17	.59	.24	.72	.27	.51	.29	.51	.09	.73	.15	.17	.24	.04	.22	.21	.18	.85
1972	.14	.73	.18	.64	.20	.68	.21	.76	.26	.70	.04	.64	.26	.13	.18	.12	.03	.05	.32	.74
1973	.14	.76	.17	.55	.20	.53	.22	.65	.25	.42	.07	.46	.16	.10	.28	.27	.13	.34	.47	.84
1974	.05	.88	.05	.74	.13	.92	.16	.99	.08	.90	.00	1.04	.09	.07	.21	-.05	-.15	-.01	-.04	.91
1975	.12	.99	.17	.62	.21	.75	.36	.59	.26	.71	.01	.83	.17	-.11	.21	.04	.05	-.03	.16	.83
1976	.08	.77	.11	.59	.05	.95	.16	.61	.38	.81	.02	.96	.14	.15	.30	.00	.23	-.18	.02	.86
1977	.15	.79	.14	.54	.11	.79	.23	.67	.31	.47	.02	.80	.18	.06	.32	.10	.10	.21	.18	.82
1978	.16	.71	.17	.53	.21	.64	.19	.60	.30	.52	.14	.90	.13	.13	.30	.15	.21	.18	-.04	.87
1979	.16	.69	.16	.52	.35	.59	.28	.81	.40	.59	.04	.93	.05	.15	.32	.06	-.09	.01	.03	.95
1980	.22	.72	.17	.60	.24	.66	.30	.73	.31	.57	.06	.75	.42	.06	.23	.10	-.03	.12	.19	.58
1981	.18	.73	.18	.60	.25	.59	.23	.61	.25	.54	.20	.92	.30	.09	.22	.16	.16	.22	-.12	.70
Estimates																				
Unr.OLS	.15	.30	.69	.35	.54	.68	.28	.51	.47	.44	.33	.48	.64	.97	-.80	-.99	1.15	.74	.07	.15
Rest.OLS	.15	.53	.42	.58	.21	.79	.14	.52	.45	.25	.62	.38	.74	.32	.00	.00	.34	.29	.00	.25
Unr.OLS (Matrix A)	.15	.79	.09	.54	.25	.59	.34	.49	.50	.53	.13	.34	.82	1.17	1.73	.42	.16	1.64	-.25	-.26
Rest.OLS (Matrix A)	.15	.42	.54	.46	.39	.61	.34	.51	.49	.51	.21	.79	.35	.43	.00	.00	.15	.00	.00	.65

Table C.6.f. The Observed Point Estimates of the Transition Probabilities - COIMBRA

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.13	.77	.13	.70	.29	.78	.24	.68	.17	.64	.05	.76	.09	.10	.17	-.07	.08	.18	.19	.91
1972	.12	.76	.11	.71	.22	.67	.23	.62	.17	.63	.06	.70	.14	.12	.18	.11	.15	.21	.24	.86
1973	.11	.77	.15	.87	.24	.66	.18	.69	.22	.70	.02	.72	.14	.12	-.02	.10	.13	.08	.26	.86
1974	.03	.97	.03	1.03	.06	.79	.10	1.07	.07	1.02	.03	.98	.04	.00	-.06	.15	-.17	-.08	-.01	.96
1975	.10	.82	.18	.83	.19	.72	.21	.76	.35	.66	.06	.76	.32	.08	-.01	.09	.03	-.01	.18	.68
1976	.12	.82	.15	.79	.09	.88	.21	.70	.29	.60	.06	.80	.27	.06	.06	.03	.09	.11	.14	.73
1977	.16	.75	.13	.73	.15	.77	.16	.70	.36	.46	.06	.85	.28	.09	.14	.08	.14	.18	.09	.72
1978	.18	.69	.18	.58	.22	.57	.23	.61	.22	.44	.02	.77	.29	.13	.24	.21	.16	.33	.21	.71
1979	.19	.70	.18	.62	.28	.56	.23	.63	.33	.51	.16	.78	.08	.11	.20	.16	.14	.16	.06	.92
1980	.21	.72	.19	.60	.27	.57	.27	.64	.26	.60	.14	.81	.31	.07	.21	.16	.09	.13	.05	.69
1981	.24	.68	.22	.56	.27	.56	.30	.62	.28	.82	.22	.84	.37	.08	.22	.17	.08	-.11	-.06	.63
Estimates																				
Unr.OLS	.16	.53	.44	.45	.52	.68	.22	.97	-.04	.05	1.01	.74	.34	.60	.13	-1.58	-.12	2.17	1.52	-1.53
Rest.OLS	.16	.63	.31	.69	.21	.79	.08	.92	.00	.19	.72	.27	.78	.21	.00	.00	.00	.81	.00	.22
Unr.OLS (Matrix A)	.16	.86	.01	.44	.51	.58	.34	.82	.10	-.01	1.15	.36	.76	-.32	1.54	-1.50	-.16	1.51	1.55	-1.42
Rest.OLS (Matrix A)	.17	.60	.34	.66	.24	.76	.12	.88	.01	.12	.89	.11	1.00	.23	.00	.00	.00	.87	.00	.00

Table C.6.g. The Observed Point Estimates of the Transition Probabilities - EVORA

Trans Probab.	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$	P_{5d}	P_{6d}	P_{7d}	P_{8d}	P_{9d}	$P_{10,d}$	$P_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10,	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.19	.66	.21	.53	.28	.69	.29	.54	.35	.45	.04	.65	.01	.15	.26	.03	.17	.20	.31	.99
1972	.17	.73	.19	.68	.18	.65	.31	.67	.35	.63	.05	.82	.05	.10	.13	.17	.02	.02	.13	.95
1973	.17	.73	.16	.58	.23	.70	.27	.65	.38	.52	.06	.39	.63	.10	.26	.07	.08	.10	.55	.37
1974	.05	.83	.02	.75	.16	.78	.15	.85	.11	.88	.04	.66	.00	.12	.23	.06	.00	.01	.30	1.00
1975	.15	.86	.19	.78	.15	.53	.11	.78	.26	.42	.01	.44	.01	-.01	.03	.32	.11	.32	.55	.99
1976	.07	.86	.13	.68	.09	.92	.18	1.26	.24	.80	.13	1.81	.47	.07	.19	-.01	-.44	-.04	-.94	.53
1977	.18	.69	.21	.64	.08	.74	.19	.85	.29	.40	.12	.77	.24	.13	.15	.16	-.04	.31	.11	.76
1978	.19	.69	.19	.57	.22	.65	.17	.66	.20	.40	.00	.80	.10	.12	.24	.13	.17	.40	.20	.90
1979	.17	.54	.18	.61	.27	.61	.24	.68	.35	.53	.06	.86	.13	.29	.21	.12	.08	.12	.08	.87
1980	.24	.87	.20	.83	.24	.63	.28	.63	.31	.49	.03	.85	.27	-.11	-.03	.13	.09	.21	.12	.73
1981	.20	.69	.18	.68	.24	.63	.24	.68	.25	.71	.09	1.07	.48	.11	.14	.13	.08	.03	-.16	.52
Estimates																				
Unr.OLS	.16	.84	.07	.32	.64	.85	.02	.83	.19	.58	.05	.32	.79	.53	.25	-2.52	2.16	2.07	.75	-1.90
Rest.OLS	.18	.66	.29	.72	.14	.86	.00	.92	.07	.33	.38	.36	.72	.17	.00	.00	.08	.60	.27	.28
Unr.OLS (Matrix A)	.17	1.02	-.19	.23	.75	.76	.11	.82	.20	.38	.31	.71	.40	.31	1.81	-2.61	-1.01	1.51	-.04	1.02
Rest.OLS (Matrix A)	.17	.83	.06	.66	.19	.81	.05	.95	.05	.34	.38	.62	.48	.00	.28	.00	.00	.61	.00	.52

Table C.6.h. The Observed Point Estimates of the Transition Probabilities - FARO

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.18	.72	.25	.71	.24	.70	.29	.61	.19	.60	.05	.66	.11	.10	.04	.06	.10	.22	.29	.89
1972	.19	.75	.24	.68	.20	.69	.21	.66	.19	.61	.09	.61	.12	.06	.08	.11	.13	.20	.30	.88
1973	.19	.72	.17	.99	.21	.55	.15	.61	.23	.58	.05	.65	.08	.09	-.16	.24	.24	.19	.30	.92
1974	.05	.91	.03	1.04	.08	.68	.14	1.20	.08	1.11	.03	.82	.02	.04	-.07	.24	-.34	-.19	.15	.98
1975	.13	.91	.18	1.02	.07	.79	.16	.83	.27	.76	.04	.86	.16	-.04	.20	.14	.01	-.03	.10	.84
1976	.10	.85	.15	.82	.09	.91	.16	.78	.27	.69	.10	.88	.31	.05	.03	.00	.06	.03	.02	.69
1977	.16	.82	.19	.72	.18	.75	.20	.66	.36	.46	.08	.77	.40	.02	.09	.07	.14	.18	.15	.60
1978	.17	.73	.17	.63	.18	.61	.16	.60	.19	.43	.03	.32	.16	.10	.20	.21	.24	.38	.65	.84
1979	.20	.74	.20	.67	.27	.57	.24	.66	.31	.56	.10	.79	.00	.06	.13	.16	.10	.14	.10	1.00
1980	.21	.69	.21	.60	.28	.55	.25	.63	.29	.56	.07	.79	.34	.10	.19	.17	.12	.15	.14	.66
1981	.21	.70	.17	.69	.24	.68	.23	.69	.27	.64	.08	.90	.30	.09	.14	.08	.08	.08	.02	.70
Estimates																				
Unr.OLS	.17	.59	.38	.36	.64	.58	.33	.95	-.02	.12	.84	.94	.01	-.59	2.50	-1.18	-.66	2.89	-3.90	.29
Rest.OLS	.18	.82	.13	.74	.21	.79	.08	.92	.00	.50	.15	.84	.07	.00	.13	.00	.00	.50	.00	.93
Unr.OLS (Matrix A)	.17	.76	.17	.47	.50	.60	.30	.79	.12	.25	.59	.92	.06	1.71	.19	-1.72	-.71	2.07	-3.24	.97
Rest.OLS (Matrix A)	.20	.70	.26	.74	.21	.79	.09	.91	.00	.50	.10	.90	.00	.10	.00	.00	.00	.50	.00	1.00

Table C.6.i. The Observed Point Estimates of the Transition Probabilities - GUARDA

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.14	.66	.16	.66	.17	.77	.19	.63	.20	.60	.00	.70	.03	.20	.18	.06	.18	.19	.30	.97
1972	.13	.83	.17	.72	.18	.92	.18	.88	.34	.76	.01	.91	.07	.04	.11	-.10	-.06	-.10	.08	.93
1973	.13	.77	.16	.70	.23	.69	.19	.67	.24	.58	.01	.70	.14	.10	.14	.08	.14	.19	.29	.86
1974	.04	.87	.01	.63	.05	.83	.05	1.12	.05	1.22	.01	.86	.02	.09	.36	.12	-.17	-.26	.13	.98
1975	.14	.87	.15	.67	.18	.96	.24	1.00	.52	.80	.02	1.09	.13	-.01	.18	-.14	-.24	-.32	-.11	.87
1976	.09	.75	.12	.59	.07	.88	.17	.74	.31	.61	.02	1.05	.10	.16	.29	.05	.09	.08	-.07	.90
1977	.13	.69	.14	.53	.14	.73	.20	.71	.40	.48	.02	.96	.14	.18	.33	.13	.09	.12	.02	.86
1978	.13	.70	.15	.47	.22	.63	.26	.77	.19	.46	.22	.84	.16	.17	.38	.15	-.03	.35	-.06	.84
1979	.16	.75	.18	.44	.24	.58	.23	.67	.31	.49	.21	.68	.24	.09	.38	.18	.10	.19	.11	.76
1980	.20	.70	.18	.48	.26	.67	.28	.72	.26	.62	.13	.86	.26	.10	.34	.07	.00	.12	.01	.74
1981	.19	.75	.18	.48	.25	.66	.21	.70	.26	.76	.12	.93	.40	.06	.34	.09	.09	-.03	-.05	.60
Estimates																				
Unr.OLS	.14	.83	.06	.58	.14	.85	.09	1.24	-.18	.33	.54	.87	.23	.70	-.45	-1.13	.18	1.81	-.69	.83
Rest.OLS	.13	.87	.00	.33	.29	.71	.00	1.00	.20	.80	.00	1.00	.00	.00	.67	.00	.00	.00	.00	1.00
Unr.OLS (Matrix A)	.14	.78	.11	.54	.18	.80	.13	.88	.12	.37	.43	.30	.85	.88	2.15	1.67	-1.35	2.14	.42	1.18
Rest.OLS (Matrix A)	.15	.58	.37	.63	.07	.93	.00	1.00	.00	.23	.60	.40	.69	.26	.00	.00	.77	.00	.32	.00

Table C.6.j. The Observed Point Estimates of the Transition Probabilities - LEIRIA

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.13	.68	.17	.52	.13	.75	.18	.56	.18	.53	.03	.56	.13	.19	.31	.12	.26	.29	.41	.87
1972	.13	.75	.15	.65	.19	.83	.19	.69	.17	.74	.05	.78	.09	.12	.20	-.02	.12	.09	.17	.91
1973	.11	.80	.15	.96	.22	.64	.15	.67	.18	.58	.02	.73	.04	.09	-.11	.14	.18	.24	.25	.96
1974	.04	.89	.02	.85	.11	.71	.14	1.06	.06	1.21	.05	1.07	.01	.07	.13	.18	-.20	-.27	-.12	.99
1975	.09	.83	.13	.71	.12	.64	.12	.59	.31	.78	.02	.91	.11	.08	.16	.24	.29	-.08	.07	.89
1976	.07	.81	.08	.63	.07	.86	.24	.74	.27	.77	.05	1.25	.31	.12	.29	.07	.02	-.03	-.30	.69
1977	.15	.69	.13	.54	.18	.80	.18	.84	.26	.49	.12	.83	.24	.16	.33	.02	-.02	.25	.05	.76
1978	.17	.70	.18	.52	.18	.53	.17	.49	.19	.34	.02	.65	.21	.13	.30	.29	.34	.47	.33	.79
1979	.16	.72	.13	.48	.23	.56	.26	.63	.30	.43	.10	.75	.04	.12	.39	.21	.11	.27	.15	.96
1980	.19	.70	.18	.50	.20	.61	.22	.63	.23	.56	.12	.78	.36	.11	.32	.19	.15	.20	.10	.64
1981	.18	.74	.13	.53	.25	.62	.23	.62	.23	.61	.09	.95	.23	.08	.34	.13	.15	.16	-.04	.77
Estimates																				
Unr.OLS	.13	.61	.27	.51	.18	.79	.13	1.47	-.37	.13	.85	1.08	-.01	.64	.87	-1.30	-.06	2.86	1.39	-1.59
Rest.OLS	.18	.66	.30	.65	.16	.84	.06	.94	.00	.00	.48	.52	.00	.17	.05	.00	.00	1.00	.00	1.00
Unr.OLS (Matrix A)	.14	.67	.24	.38	.48	.70	.16	.89	-.04	.21	.61	1.00	.07	-.39	2.09	-2.16	.53	1.42	-2.05	1.20
Rest.OLS (Matrix A)	.18	.67	.27	.73	.00	.23	.63	.36	.52	.48	.00	.00	.00	.15	.00	.77	.00	.00	1.00	1.00

Table C.6.k. The Observed Point Estimates of the Transition Probabilities – LISBOA

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.18	.73	.19	.87	.24	.67	.25	.56	.20	.64	.05	.81	.14	.09	-.06	.09	.19	.16	.14	.86
1972	.18	.77	.18	.87	.21	.64	.21	.61	.24	.71	.05	.82	.09	.04	-.05	.15	.18	.05	.13	.91
1973	.15	.78	.17	.84	.22	.64	.21	.70	.23	.67	.08	.74	.14	.07	-.01	.14	.09	.10	.18	.86
1974	.08	.89	.05	1.13	.16	.89	.14	.89	.10	1.03	.13	.88	.09	.03	-.18	-.05	-.03	-.13	-.01	.91
1975	.17	.84	.21	.97	.12	.59	.17	.64	.21	.73	.05	.88	.16	-.01	-.18	.29	.19	.06	.07	.84
1976	.12	.77	.15	.77	.10	.94	.14	.84	.24	.78	.11	.96	.25	.11	.08	-.04	.02	-.02	-.07	.75
1977	.16	.76	.16	.82	.18	.84	.18	.76	.35	.66	.11	.93	.29	.08	.02	-.02	.06	.00	-.04	.71
1978	.20	.73	.23	.72	.19	.56	.18	.58	.18	.44	.03	.54	.23	.07	.05	.25	.24	.38	.43	.77
1979	.19	.74	.18	.66	.23	.61	.26	.70	.28	.59	.09	.89	.13	.07	.16	.16	.04	.13	.02	.87
1980	.21	.71	.19	.71	.26	.67	.25	.65	.26	.63	.10	.91	.25	.08	.10	.07	.10	.11	-.01	.75
1981	.18	.72	.17	.72	.25	.63	.21	.66	.22	.72	.12	.97	.25	.10	.11	.12	.13	.05	-.09	.75
Estimates																				
Unr.OLS	.17	.77	.17	.53	.48	.56	.36	.99	-.11	-.02	.09	.85	.22	8.05	-7.02	-4.55	-4.06	4.87	11.56	-5.64
Rest.OLS	.18	.82	.12	.88	.12	.78	.10	.90	.00	.34	.47	.53	.49	.00	.00	.10	.00	.66	.00	.51
Unr.OLS (Matrix A)	.17	.84	.66	.44	.57	.66	.23	.93	-.04	-.33	1.60	.85	.23	1.22	-.54	-.05	-1.10	2.52	-4.49	2.23
Rest.OLS (Matrix A)	.19	.73	.22	.78	.21	.79	.09	.90	.00	.36	.43	.57	.45	.08	.00	.00	.00	.64	.00	.55

Table C.6.1. The Observed Point Estimates of the Transition Probabilities - PORTALEGRE

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.15	.76	.17	.49	.20	.73	.26	.59	.20	.49	.05	.61	.13	.09	.34	.07	.15	.30	.34	.87
1972	.15	.76	.20	.51	.19	.72	.26	.66	.18	.59	.03	.59	.20	.09	.29	.09	.08	.22	.38	.80
1973	.12	.69	.15	.56	.20	.79	.20	.70	.23	.49	.04	.60	.09	.19	.29	.01	.10	.28	.36	.91
1974	.05	.90	.01	.66	.09	.72	.11	.82	.08	.90	.01	.77	.02	.05	.33	.14	.07	.02	.22	.98
1975	.13	.92	.15	.73	.12	.69	.24	.91	.24	.85	.03	.98	.13	-.05	.12	.19	-.15	-.09	-.01	.87
1976	.08	.90	.13	.58	.09	.80	.20	.80	.23	.55	.06	.89	.28	.02	.29	.11	.00	.22	.05	.72
1977	.16	.74	.15	.55	.20	.71	.17	.71	.29	.47	.07	.87	.22	.10	.30	.09	.12	.24	.06	.78
1978	.18	.71	.17	.55	.21	.60	.18	.75	.21	.55	.04	.49	.38	.11	.28	.19	.07	.25	.47	.62
1979	.17	.68	.15	.48	.27	.69	.17	.77	.27	.59	.09	.83	.11	.15	.37	.04	.06	.14	.08	.89
1980	.22	.71	.20	.50	.25	.59	.31	.64	.26	.66	.12	.82	.40	.07	.30	.16	.05	.08	.06	.60
1981	.08	.73	.17	.55	.22	.68	.24	.66	.27	.77	.16	.84	.37	.08	.28	.10	.10	-.04	.00	.63
Estimates																				
Unr.OLS	.15	.52	.44	.63	.09	.78	.11	.67	.32	.24	.71	.75	.36	.90	-.58	-.58	1.12	.71	-2.21	1.44
Rest.OLS	.15	.51	.44	.56	.20	.80	.09	.71	.28	.44	.37	.63	.49	.34	.00	.00	.20	.28	.00	.51
Unr.OLS (Matrix A)	.15	.57	.36	.62	.07	.56	.36	.53	.46	.11	.94	.42	.75	1.67	-1.15	-.45	.42	.22	-2.74	2.29
Rest.OLS (Matrix A)	.22	.71	.27	.73	.01	.99	.00	.33	.20	.00	.97	.03	1.00	.06	.00	.00	.67	.80	.00	.00

Table C.6.m. The Observed Point Estimates of the Transition Probabilities - PORTO

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.15	.66	.17	.62	.25	.61	.24	.55	.22	.57	.03	.67	.09	.17	.21	.14	.21	.21	.30	.90
1972	.13	.72	.13	.65	.24	.67	.25	.65	.22	.67	.07	.78	.16	.13	.22	.09	.10	.11	.15	.84
1973	.12	.74	.15	.81	.22	.71	.24	.65	.24	.65	.05	.83	.13	.15	.04	.02	.11	.11	.12	.87
1974	.05	.82	.03	.93	.18	.79	.14	.82	.11	1.12	.10	.95	.09	.03	.04	.03	.04	-.22	-.05	.91
1975	.13	.78	.19	.93	.13	.57	.23	.63	.30	.71	.06	.63	.15	.19	-.12	.30	.14	-.01	.31	.85
1976	.11	.75	.15	.74	.12	.87	.24	.71	.28	.67	.18	.98	.25	.15	.11	.01	.05	.05	-.16	.75
1977	.15	.72	.15	.68	.19	.69	.20	.66	.36	.51	.07	.85	.22	.15	.17	.12	.14	.12	.08	.78
1978	.20	.68	.19	.58	.21	.52	.20	.51	.24	.41	.01	.68	.23	.19	.23	.27	.29	.35	.31	.77
1979	.21	.65	.17	.58	.30	.52	.28	.65	.34	.51	.12	.80	.08	.17	.25	.18	.07	.14	.08	.92
1980	.24	.67	.17	.58	.29	.51	.28	.56	.27	.57	.12	.83	.33	.17	.25	.20	.16	.16	.05	.67
1981	.21	.66	.18	.55	.29	.54	.28	.60	.26	.57	.10	.90	.30	.18	.27	.17	.12	.07	.00	.70
Estimates																				
Unr.OLS	.17	.54	.38	.50	.44	.77	.04	.99	-.11	.20	.69	.58	.48	3.03	-4.79	-1.04	1.79	2.06	1.99	-1.02
Rest.OLS	.18	.61	.29	.71	.18	.82	.00	.90	.00	.24	.54	.46	.53	.21	.00	.00	.10	.76	.00	.47
Unr.OLS (Matrix A)	.17	.55	.35	.55	.35	.74	.07	.93	.05	.06	.94	.99	.07	1.02	-.51	-.86	.28	.93	-1.91	2.19
Rest.OLS (Matrix A)	.19	.56	.36	.64	.25	.75	.08	.92	.00	.46	.12	.88	.08	.25	.00	.00	.00	.54	.00	.92

Table C.6.n. The Observed Point Estimates of the Transition Probabilities – SANTAREM

Trans Probab.	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$	P_{5d}	P_{6d}	P_{7d}	P_{8d}	P_{9d}	$P_{10,d}$	$P_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.17	.69	.19	.54	.21	.59	.32	.63	.19	.52	.03	.64	.08	.14	.27	.20	.05	.28	.33	.92
1972	.15	.77	.17	.58	.22	.68	.21	.59	.19	.42	.04	.57	.11	.08	.25	.10	.20	.39	.39	.89
1973	.13	.79	.13	.91	.36	.58	.20	.60	.25	.56	.13	.70	.20	.08	-.04	.06	.20	.19	.17	.80
1974	.04	.84	.02	.86	.12	.61	.17	1.14	.13	1.18	.05	.97	.14	.12	.12	.27	-.31	-.31	-.02	.86
1975	.11	.91	.13	.93	.14	.73	.27	.81	.31	.74	.15	.87	.41	-.02	-.06	.13	-.08	-.05	-.02	.59
1976	.13	.73	.09	.76	.10	.82	.22	.59	.28	.61	.19	.64	.25	.14	.15	.06	.19	.11	.27	.75
1977	.15	.81	.14	.70	.18	.71	.18	.69	.44	.60	.10	.87	.27	.04	.16	.11	.13	-.03	.03	.73
1978	.17	.70	.13	.61	.17	.55	.18	.67	.15	.32	.05	.51	.24	.13	.26	.28	.15	.53	.44	.76
1979	.18	.72	.17	.61	.23	.61	.18	.75	.23	.49	.08	.92	.04	.10	.22	.16	.07	.28	.00	.96
1980	.21	.68	.19	.57	.27	.60	.25	.65	.27	.62	.09	.82	.30	.11	.24	.13	.10	.11	.09	.70
1981	.19	.72	.18	.59	.23	.65	.22	.69	.23	.70	.09	.83	.24	.09	.23	.12	.09	.08	.08	.76
Estimates																				
Unr.OLS	.15	.60	.34	.79	.09	.65	.23	.96	-.04	-.10	1.23	1.18	-.25	.59	-.88	-.49	2.25	1.04	-3.21	1.80
Rest.OLS	.16	.84	.05	.72	.16	.84	.00	.86	.00	.30	.40	.60	.25	.00	.23	.00	.14	.70	.00	.75
Unr.OLS (Matrix A)	.15	.91	-.05	.77	.08	.61	.26	.77	.15	.05	.99	1.00	-.02	1.92	-3.44	.38	.46	2.29	3.11	-2.94
Rest.OLS (Matrix A)	.17	.65	.29	.71	.17	.83	.00	.85	.00	.00	.94	.06	.94	.18	.00	.00	.15	1.00	.00	.05

Table C.6.o. The Observed Point Estimates of the Transition Probabilities - SETUBAL

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.20	.76	.20	.77	.23	.66	.31	.64	.17	.50	.09	.67	.03	.04	.03	.11	.05	.33	.24	.97
1972	.18	.68	.17	.74	.22	.67	.20	.64	.23	.60	.07	.64	.19	.14	.09	.11	.16	.17	.29	.81
1973	.20	.81	.20	1.03	.21	.64	.19	.63	.21	.55	.03	.70	.12	-.01	-.23	.15	.18	.24	.27	.88
1974	.09	.87	.05	1.03	.16	.77	.20	.95	.13	1.14	.01	1.04	-.05	.04	-.08	.07	-.15	-.26	-.05	.96
1975	.18	.82	.22	.98	.16	.52	.20	.63	.30	.69	.06	.73	.29	.00	-.20	.32	.17	.02	-.21	.71
1976	.12	.73	.19	.84	.11	.92	.28	.97	.35	.67	.10	1.02	.30	.15	-.03	-.03	-.25	-.03	-.12	.70
1977	.20	.85	.21	.84	.17	.75	.18	.80	.35	.48	.09	.86	.31	-.05	-.05	.08	.02	.16	.05	.69
1978	.24	.66	.21	.68	.23	.57	.19	.60	.14	.43	.02	.49	.14	.10	.11	.20	.21	.53	.49	.86
1979	.22	.66	.20	.75	.24	.59	.19	.71	.28	.50	.06	.76	.08	.12	.05	.17	.10	.23	.18	.98
1980	.28	.72	.25	.78	.22	.64	.25	.70	.28	.51	.08	.86	.30	.00	-.03	.14	.28	.20	.06	.70
1981	.18	.72	.17	.76	.20	.62	.20	.70	.20	.54	.09	.89	.35	.10	.07	.18	.20	.26	.02	.65
Estimates																				
Unr.OLS	.20	.30	.72	.39	.63	.83	.00	1.12	-.19	-.02	1.09	.87	.16	4.95	-6.27	-1.35	.48	2.67	3.77	2.63
Rest.OLS	.20	.76	.18	.82	.20	.81	.04	.96	.00	.02	.93	.06	.97	.03	.00	.00	.00	.98	.00	.03
Unr.OLS (Matrix A)	.20	.80	.11	.65	.36	.76	.08	1.02	-.09	-.03	1.12	.96	.07	-1.59	6.66	-4.39	-.15	.71	-4.62	3.50
Rest.OLS (Matrix A)	.21	.74	.20	.80	.20	.80	.05	.95	.00	.38	.20	.80	.16	.04	.00	.00	.00	.62	.00	.83

Table C.6.p. The Observed Point Estimates of the Transition Probabilities - VIANA DO CASTELO

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.14	.55	.13	.32	.18	.82	.25	.54	.10	.68	.02	.92	.01	.31	.55	.00	.21	.22	.06	.99
1972	.13	.65	.13	.49	.22	.82	.19	.74	.30	.69	.01	.68	.07	.22	.38	-.04	.07	.01	.31	.93
1973	.11	.72	.13	.48	.19	.74	.18	.80	.19	.53	.02	.67	.13	.17	.39	.07	.02	.28	.31	.87
1974	.05	.71	.02	.63	.12	.91	.10	.85	.21	1.18	.16	1.14	.03	.24	.35	-.03	.05	-.39	-.30	.97
1975	.05	.85	.07	.67	.09	.41	.16	.57	.20	.42	.03	.46	.06	.10	.26	.50	.27	.38	.51	.94
1976	.08	.89	.08	.58	.11	.81	.29	1.05	.46	.65	.03	1.51	.19	.03	.34	.08	-.34	-.11	-.54	.81
1977	.12	.71	.09	.47	.15	.57	.16	.66	.31	.36	.04	1.09	.12	.17	.44	.28	.18	.33	-.13	.88
1978	.12	.66	.22	.38	.25	.46	.35	.47	.28	.29	.05	.63	.31	.22	.40	.29	.18	.44	.32	.69
1979	.16	.79	.13	.44	.25	.51	.24	.70	.34	.26	.12	.73	.36	.05	.43	.24	.06	.40	.15	.64
1980	.18	.70	.14	.39	.26	.57	.28	.61	.35	.38	.20	.76	.28	.12	.47	.17	.11	.27	.04	.72
1981	.18	.68	.14	.42	.24	.59	.24	.69	.35	.69	.14	1.04	.40	.14	.44	.17	.07	.06	-.18	.60
Estimates																				
Unr.OLS	.13	.35	.60	.38	.38	.94	-.25	.82	.12	.29	.43	.62	.53	4.12	-8.21	2.79	2.47	2.62	3.75	-1.33
Rest.OLS	.14	.42	.52	.48	.22	.78	.00	.86	.02	.35	.15	.59	.39	.44	.00	.00	.14	.63	.26	.61
Unr.OLS (Matrix A)	.13	.57	.31	.36	.38	1.07	-.49	.50	.48	.23	.57	1.25	-.01	-3.20	9.27	-7.84	-2.34	1.63	-2.35	4.44
Rest.OLS (Matrix A)	.14	.77	.05	.44	.24	.76	.00	.40	.59	.41	.00	1.00	.00	.09	.51	.00	.60	.00	.00	1.00

Table C.6.q. The Observed Point Estimates of the Transition Probabilities - VILLA REAL

Trans Probab.	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$	P_{5d}	P_{6d}	P_{7d}	P_{8d}	P_{9d}	$P_{10,d}$	$P_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.17	.58	.19	.42	.29	.58	.31	.44	.29	.46	.04	.77	.08	.25	.39	.13	.25	.26	.19	.92
1972	.14	.72	.17	.45	.33	.61	.26	.64	.29	.50	.10	.68	.12	.14	.38	.06	.10	.22	.22	.88
1973	.14	.65	.20	.60	.26	.56	.29	.61	.35	.46	.05	.70	.06	.21	.20	.18	.10	.19	.25	.94
1974	.06	.66	.03	.77	.15	.78	.12	.93	.17	.87	.02	.80	.01	.28	.20	.07	-.05	-.04	.18	.99
1975	.12	1.12	.19	1.03	.16	.76	.22	1.02	.32	.82	.10	1.10	.54	-.24	-.22	.08	-.24	-.15	-.20	.46
1976	.05	.77	.08	.70	.11	.81	.16	.72	.35	.48	.12	.81	.16	.18	.22	.08	.12	.17	.07	.84
1977	.13	.63	.15	.64	.20	.67	.28	.62	.42	.37	.15	.79	.15	.24	.21	.13	.10	.21	.06	.85
1978	.21	.66	.17	.67	.21	.54	.23	.56	.31	.49	.00	.71	.33	.13	.16	.25	.21	.19	.29	.67
1979	.17	.69	.15	.61	.28	.46	.30	.53	.46	.36	.15	.72	.00	.14	.24	.26	.17	.17	.13	.00
1980	.21	.66	.19	.58	.29	.50	.32	.54	.35	.52	.22	.82	.35	.13	.23	.21	.14	.12	-.04	.65
1981	.18	.68	.15	.62	.37	.59	.33	.60	.31	.55	.09	.88	.45	.14	.23	.04	.07	.13	.03	.55
Estimates																				
Unr.OLS	.15	.28	.69	.34	.65	.81	-.02	.87	.08	.35	.38	1.17	-.18	.41	.73	-2.15	1.01	1.25	-1.43	1.77
Rest.OLS	.13	.55	.35	.65	.25	.75	.09	.91	.04	.41	.25	.75	.32	.32	.00	.00	.00	.55	.00	.68
Unr.OLS (Matrix A)	.15	.63	.20	.17	.86	.40	.53	.62	.34	.41	.23	-.91	2.43	1.16	.19	-2.21	-.52	1.31	-1.22	2.92
Rest.OLS (Matrix A)	.16	.42	.51	.49	.43	.57	.32	.68	.29	.22	.68	.32	1.00	.42	.00	.00	.00	.49	.00	.00

Table C.6.r. The Observed Point Estimates of the Transition Probabilities - VISEU

Trans Probab.	p_{55}	p_{56}	p_{66}	p_{67}	p_{77}	p_{78}	p_{88}	p_{89}	p_{99}	$p_{9,10}$	$p_{10,10}$	$p_{10,11}$	$p_{11,11}$	p_{5d}	p_{6d}	p_{7d}	p_{8d}	p_{9d}	$p_{10,d}$	$p_{11,d}$
VAR CODE / YEAR	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
1971	.13	.59	.18	.36	.22	.68	.28	.48	.28	.74	.02	.70	.23	.28	.46	.10	.24	-.01	.28	.77
1972	.13	.69	.13	.43	.24	.86	.22	.71	.42	.72	.18	.68	.20	.18	.44	-.10	.07	-.15	.14	.80
1973	.11	.69	.12	.49	.19	.65	.22	.76	.28	.62	.01	.83	.10	.20	.39	.16	.02	.09	.16	.90
1974	.03	.78	.01	.54	.07	.77	.09	.97	.03	1.03	.00	.87	.03	.19	.45	.16	-.06	-.06	.13	.97
1975	.08	.86	.10	.60	.13	.87	.20	1.06	.50	.86	.01	1.00	.35	.06	.30	.00	-.26	-.35	-.01	.65
1976	.08	.80	.08	.56	.10	1.06	.12	.74	.33	.55	.01	.91	.21	.12	.36	-.16	.14	.12	.08	.79
1977	.11	.64	.11	.53	.17	.69	.23	.77	.48	.51	.03	.98	.38	.25	.36	.14	.00	.01	-.01	.62
1978	.16	.66	.14	.46	.18	.55	.21	.60	.19	.39	.01	.80	.23	.18	.40	.27	.19	.42	.19	.77
1979	.17	.72	.13	.49	.24	.59	.24	.68	.34	.53	.08	.77	.06	.11	.38	.17	.08	.13	.15	.94
1980	.19	.71	.17	.46	.26	.61	.28	.65	.27	.61	.12	.93	.22	.10	.37	.13	.07	.12	-.05	.78
1981	.19	.68	.17	.47	.22	.64	.24	.70	.25	.73	.07	.88	.25	.13	.36	.14	.06	.03	.05	.75
Estimates																				
Unr.OLS	.14	.88	-.03	.36	.61	.65	.22	1.08	.25	.05	.94	.87	.21	.64	.76	-2.74	.60	2.39	-1.30	1.73
Rest.OLS	.14	.48	.44	.56	.10	.90	.00	1.00	.00	.17	.71	.29	.76	.38	.00	.00	.00	.83	.00	.24
Unr.OLS (Matrix A)	.13	.69	.14	.43	.29	.56	.38	1.18	-.25	.11	.89	.45	.68	1.04	-.64	.91	-1.89	1.17	-4.83	4.97
Rest.OLS (Matrix A)	.14	.46	.47	.53	.13	.87	.02	.98	.00	.08	.91	.09	1.00	.40	.00	.00	.00	.92	.00	.00

APPENDIX D

THE QUADRATIC PROGRAMMING PROBLEM FOR THE RESTRICTED LEAST SQUARES ESTIMATION PROCEDURE FOR THE EXTENDED MARKOV MODEL

D.1. The Quadratic Programming Problem to Solve the Restricted OLS Estimation Procedure

The process described is analogous to the one described in A.1 in Appendix A for the basic model. The quadratic programming problem is now formulated as follows:

- find $\underline{\hat{\delta}}^s$ which minimises the positive quadratic form

$$\Phi = (\underline{n}^* - \underline{N}\ \underline{X}\ \underline{\hat{\delta}})'\ (\underline{n}^* - \underline{N}\ \underline{X}\ \underline{\hat{\delta}}) \qquad (D.1)$$

subject to

$$\begin{aligned} \underline{G}\ \underline{X}\ \underline{\hat{\delta}} &= \underline{n}_{(s+1)k} \\ \underline{X}\ \underline{\hat{\delta}} &\geq \underline{0} \end{aligned} \qquad (D.2)$$

As $\underline{\hat{\delta}}^s$ is the optimal solution of this problem, the reducibility theorem makes it possible to rewrite the problem in a linear programming form:

- find $\underline{\hat{\delta}}^s$ that maximises

$$[(\underline{N}\ \underline{X})'\underline{n}^* - (\underline{N}\ \underline{X})'(\underline{N}\ \underline{X})\ \underline{\hat{\delta}}^s]'\ \underline{\hat{\delta}} \qquad (D.3)$$

subject to

$$\begin{aligned} \underline{G}\ \underline{X}\ \underline{\hat{\delta}} &\leq \underline{n}_{(s+1)k} \\ -\underline{G}\ \underline{X}\ \underline{\hat{\delta}} &\leq -\underline{n}_{(s+1)k} \\ -\underline{X}\ \underline{\hat{\delta}} &\leq \underline{0} \end{aligned} \qquad (D.4)$$

where $\underline{\hat{\delta}}^s$ is the optimal restricted OLS estimator. The dual of this linear programming problem is:

- find $(\underline{\lambda}_1, \underline{\lambda}_2, \underline{\theta})$ that minimise

$$[\ \underline{\lambda}_1' \quad \underline{\lambda}_2' \quad \underline{\theta}\ ] \begin{bmatrix} \underline{\eta}_{(s+1)k} \\ -\underline{\eta}_{(s+1)k} \\ \underline{0} \end{bmatrix} \qquad (D.5)$$

subject to

$$[\ (\underline{G}\ \underline{X})' \quad -(\underline{G}\ \underline{X})' \quad -\underline{X}'\ ] \begin{bmatrix} \underline{\lambda}_1 \\ \underline{\lambda}_2 \\ \underline{\theta} \end{bmatrix} > (\underline{N}\ \underline{X})'\underline{n}^* - (\underline{N}\ \underline{X})'(\underline{N}\ \underline{X})\ \underline{\hat{\delta}}^s \qquad (D.6)$$

where $\underline{\lambda}_1$, $\underline{\lambda}_2$, $\underline{\theta}$ are [(s+1)k x 1] vectors of dual variables. This last relation can be written as:

$$(\underline{N}\ \underline{X})'\underline{n}^* - (\underline{N}\ \underline{X})'(\underline{N}\ \underline{X})\ \underline{\hat{\delta}}^s < (\underline{G}\ \underline{X})'\underline{\lambda}_1 - (\underline{G}\ \underline{X})'\underline{\lambda}_2 - \underline{X}'\underline{\theta}$$

Transposing and multiplying both sides of the inequality by the solution $\underline{\hat{\delta}}$:

$$[(\underline{N}\ \underline{X})'\underline{n}^* - (\underline{N}\ \underline{X})'(\underline{N}\ \underline{X})\ \underline{\hat{\delta}}^s]'\ \underline{\hat{\delta}} < \underline{\lambda}_1'\ \underline{G}\ \underline{X} - \underline{\lambda}_2'\ \underline{G}\ \underline{X} - \underline{\theta}'\underline{X}$$

and using equations (D.4):

$$[(\underline{N}\ \underline{X})'\underline{n}^* - (\underline{N}\ \underline{X})'(\underline{N}\ \underline{X})\ \underline{\hat{\delta}}^s]'\ \underline{\hat{\delta}} < \underline{\lambda}_1'\ \underline{\eta}_{(s+1)k} - \underline{\lambda}_2'\ \underline{\eta}_{(s+1)k}$$

The primal-dual formulation of the quadratic programming problem becomes:

- find ($\hat{\underline{\delta}}^s$, $\underline{\lambda}_1$, $\underline{\lambda}_2$, $\underline{\theta}$) that maximise

$$[(\underline{N}\ \underline{X})'\underline{n}^* - (\underline{N}\ \underline{X})'(\underline{N}\ \underline{X})\ \hat{\underline{\delta}}^s]'\ \hat{\underline{\delta}} - \underline{\lambda}_1'\ \underline{n}_{(s+1)k} + \underline{\lambda}_2'\ \underline{n}_{(s+1)k} \leq \underline{0} \qquad (D.7)$$

subject to

$$\begin{aligned} \underline{G}\ \underline{X}\ \hat{\underline{\delta}} &\leq \underline{n}_{(s+1)k} \\ -\underline{G}\ \underline{X}\ \hat{\underline{\delta}} &\leq -\underline{n}_{(s+1)k} \\ -\underline{X}\ \hat{\underline{\delta}} &\leq \underline{0} \end{aligned} \qquad (D.8)$$

$$[(\underline{G}\ \underline{X})' \ -(\underline{G}\ \underline{X})' \ \ -\underline{X}'\ ] \begin{bmatrix} \underline{\lambda}_1 \\ \underline{\lambda}_2 \\ \underline{\theta} \end{bmatrix} \geq (\underline{N}\ \underline{X})'\underline{n}^* - (\underline{N}\ \underline{X})'(\underline{N}\ \underline{X})\ \hat{\underline{\delta}}^s$$

$$\underline{\lambda}_1\ ,\ \underline{\lambda}_2\ ,\ \underline{\theta}\ \geq\ \underline{0}$$

Using slack vectors of appropriate dimensions to transform the constraint inequalities to equalities, relations (D.8) can be written as follows:

$$\begin{aligned} \underline{G}\ \underline{X}\ \hat{\underline{\delta}} + \underline{\alpha}_1 &= \underline{n}_{(s+1)k} \\ -\underline{G}\ \underline{X}\ \hat{\underline{\delta}} + \underline{\alpha}_2 &= \underline{n}_{(s+1)k} \\ -\underline{X}\ \hat{\underline{\delta}} + \underline{\gamma} &= \underline{0} \end{aligned} \qquad (D.9)$$

$$(\underline{G}\ \underline{X})'\underline{\lambda}_1 - (\underline{G}\ \underline{X})'\underline{\lambda}_2 - \underline{X}'\underline{\theta} = (\underline{N}\ \underline{X})'\underline{n}^* - (\underline{N}\ \underline{X})'(\underline{N}\ \underline{X})\ \hat{\underline{\delta}}^s + \underline{\beta}$$

$$\underline{\lambda}_1\ ,\ \underline{\lambda}_2\ ,\ \underline{\theta}\ ,\ \underline{\alpha}_1\ ,\ \underline{\alpha}_2\ ,\ \underline{\beta}\ ,\ \underline{\gamma}\ \geq\ \underline{0}$$

Also relation (D.7) may be written as:

$$[(\underline{G}\ \underline{X})'\underline{\lambda}_1 - (\underline{G}\ \underline{X})'\underline{\lambda}_2 - \underline{X}'\underline{\theta} - \underline{\beta}]'\hat{\underline{\delta}} - \underline{\lambda}_1'\ \underline{n}_{(s+1)k} + \underline{\lambda}_2'\ \underline{n}_{(s+1)k} \leq \underline{0}$$

$$\underline{\lambda}_1'\ \underline{G}\ \underline{X}\ \hat{\underline{\delta}} - \underline{\lambda}_2'\ \underline{G}\ \underline{X}\ \hat{\underline{\delta}} - \underline{\theta}'\underline{X}\ \hat{\underline{\delta}} - \underline{\beta}'\hat{\underline{\delta}} - \underline{\lambda}_1'\ \underline{n}_{(s+1)k} + \underline{\lambda}_2'\ \underline{n}_{(s+1)k} \leq \underline{0}$$

$$\underline{\lambda}_1'[\underline{G}\,\underline{X}\,\underline{\hat{\delta}} - \underline{n}_{(s+1)k}] - \underline{\lambda}_2'[\underline{G}\,\underline{X}\,\underline{\hat{\delta}} - \underline{n}_{(s+1)k}] - \underline{\theta}'\underline{X}\,\underline{\hat{\delta}} - \underline{\beta}'\underline{\hat{\delta}} < \underline{0}$$

and using (D.9) results:

$$-\underline{\lambda}_1'\,\underline{\alpha}_1 - \underline{\lambda}_2'\,\underline{\alpha}_2 - \underline{\theta}'\underline{\gamma} - \underline{\beta}'\underline{\hat{\delta}} < \underline{0}$$

The quadratic programming problem can now be reformulated as:

- find ($\underline{\hat{\delta}}^s$, $\underline{\lambda}_1$, $\underline{\lambda}_2$, $\underline{\theta}$) that minimise

$$-\underline{\lambda}_1'\,\underline{\alpha}_1 - \underline{\lambda}_2'\,\underline{\alpha}_2 - \underline{\theta}'\underline{\gamma} - \underline{\beta}'\underline{\hat{\delta}} < \underline{0}$$

subject to constraints (D.9).

The coefficients of the problem can be presented in the following tableau:

	$\underline{\lambda}_1$	$\underline{\lambda}_2$	$\underline{\theta}$	$\underline{\hat{\delta}}$	$\underline{\alpha}_1$	$\underline{\alpha}_2$	$\underline{\gamma}$	$\underline{\beta}$
$\underline{n}_{(s+1)k}$				$\underline{G}\,\underline{X}$	$\underline{I}$			
$-\underline{n}_{(s+1)k}$				$-\underline{G}\,\underline{X}$		$\underline{I}$		
				$-\underline{X}$			$\underline{I}$	
$(\underline{N}\,\underline{X})'\underline{n}^*$	$(\underline{G}\,\underline{X})'$	$-(\underline{G}\,\underline{X})'$	$-\underline{X}'$	$(\underline{N}\,\underline{X})'(\underline{N}\,\underline{X})$				$-\underline{I}$

D.2. The Quadratic Programming Problem to Solve the Restricted GLS Estimation Procedure

The quadratic programming problem for the restricted GLS estimation is now:

- find $\underline{\hat{\delta}}^s$ which minimises the positive quadratic form

$$\Phi = (\underline{n}^* - \underline{N}\ \underline{X}\ \underline{\hat{\delta}})'\ \underline{\Theta}^{-1}\ (\underline{n}^* - \underline{N}\ \underline{X}\ \underline{\hat{\delta}})$$

subject to

$$\underline{R}\ \underline{X}\ \underline{\hat{\delta}} = \underline{\eta}_{(s+1)k}$$
$$\underline{X}\ \underline{\hat{\delta}} \geq \underline{0}$$

The reducibility theorem turns the problem into the following programming problem:

- find $\underline{\hat{\delta}}^s$ which maximises

$$[\underline{N}'\underline{X}'\underline{\Theta}^{-1}\ \underline{n}^* - \underline{N}'\underline{X}'\underline{\Theta}^{-1}\ \underline{N}\ \underline{X}\ \underline{\hat{\delta}}^s]'\ \underline{\hat{\delta}}$$

subject to

$$\underline{R}\ \underline{X}\ \underline{\hat{\delta}} \leq \underline{\eta}_{(s+1)k}$$
$$-\underline{R}\ \underline{X}\ \underline{\hat{\delta}} \leq -\underline{\eta}_{(s+1)k}$$
$$-\underline{X}\ \underline{\eta} \leq \underline{0}$$

The dual of this linear programming problem is:

- find $(\underline{\lambda}_1, \underline{\lambda}_2, \underline{\theta})$ which minimise

$$[\ \underline{\lambda}_1'\ \ \underline{\lambda}_2'\ \ \underline{\theta}\ ] \begin{bmatrix} \underline{\eta}_{(s+1)k} \\ -\underline{\eta}_{(s+1)k} \\ \underline{0} \end{bmatrix}$$

subject to

$$[\ (\underline{R}\ \underline{X})' \quad -(\underline{R}\ \underline{X})' \quad -\underline{X}'\ ] \begin{bmatrix} \underline{\lambda}_1 \\ \underline{\lambda}_2 \\ \underline{\theta} \end{bmatrix} \geq \underline{N}'\underline{X}'\underline{\Theta}^{-1}\ \underline{n}^* - \underline{N}'\underline{X}'\underline{\Theta}^{-1}\ \underline{N}\ \underline{X}\ \underline{\hat{\delta}}^s$$

$$\underline{\lambda}_1\ ,\ \underline{\lambda}_2\ ,\ \underline{\theta}\ \geq\ \underline{0}$$

The primal-dual formulation becomes one of maximising:

$$[\underline{N}'\underline{X}'\underline{\Theta}^{-1}\ \underline{n}^* - \underline{N}'\underline{X}'\underline{\Theta}^{-1}\ \underline{N}\ \underline{X}\ \underline{\hat{\delta}}^s]'\underline{\hat{\delta}} - [\ \underline{\lambda}_1' \quad \underline{\lambda}_2' \quad \underline{\theta}\ ] \begin{bmatrix} \underline{n}_{(s+1)k} \\ -\underline{n}_{(s+1)k} \\ \underline{0} \end{bmatrix}$$

subject to

$$\underline{R}\ \underline{X}\ \underline{\hat{\delta}} + \underline{\alpha}_1 = \underline{n}_{(s+1)k}$$

$$-\underline{R}\ \underline{X}\ \underline{\hat{\delta}} + \underline{\alpha}_2 = -\underline{n}_{(s+1)k}$$

$$-\ \underline{X}\ \underline{\hat{\delta}} + \underline{\gamma} = \underline{0}$$

$$[\ (\underline{R}\ \underline{X})' \quad -(\underline{R}\ \underline{X})' \quad -\underline{X}'\ ] \begin{bmatrix} \underline{\lambda}_1 \\ \underline{\lambda}_2 \\ \underline{\theta} \end{bmatrix} + \underline{N}'\underline{X}'\underline{\Theta}^{-1}\ \underline{N}\ \underline{X}\ \underline{\hat{\delta}}^s - \underline{\beta} = \underline{N}'\underline{X}'\underline{\Theta}^{-1}\ \underline{n}^*$$

$$\underline{\alpha}_1\ ,\ \underline{\alpha}_2\ ,\ \underline{\lambda}_1\ ,\ \underline{\lambda}_2\ ,\ \underline{\theta}\ ,\ \underline{\beta}\ ,\ \underline{\gamma}\ \geq\ \underline{0}$$

where $\underline{\alpha}_1$, $\underline{\alpha}_2$, $\underline{\gamma}$ and $\underline{\beta}$ are the slack vectors introduced in the constraints in order to turn the inequalities into equalities. The coefficients of the quadratic programming problem are then expressed in the following tableau:

	$\underline{\lambda}_1$	$\underline{\lambda}_2$	$\underline{\theta}$	$\hat{\underline{\delta}}$	$\underline{\alpha}_1$	$\underline{\alpha}_2$	$\underline{\gamma}$	$\underline{\beta}$
$\underline{\eta}_{(s+1)k}$				$\underline{R}\ \underline{X}$	$\underline{I}$			
$-\underline{\eta}_{(s+1)k}$				$-\underline{R}\ \underline{X}$		$\underline{I}$		
				$-\underline{X}$			$\underline{I}$	
$(\underline{N}\ \underline{X})'\underline{\Theta}^{-1}\underline{n}^*$	$(\underline{R}\ \underline{X})'$	$-(\underline{R}\ \underline{X})'$	$-\underline{X}'$	$(\underline{N}\ \underline{X})'\underline{\Theta}^{-1}(\underline{N}\ \underline{X})$				$-\underline{I}$

APPENDIX E

THE APPLICATION OF THE EXTENDED MARKOV MODEL TO THE WHOLE PORTUGUESE EDUCATION SYSTEM: PROGRAMS

JOB PROGRAM JOBB

```
/*ST=(MFZ,SP),TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
GETFEP(DATA,$DADO(CON)$)
GETFEP(PROG,$PROGRM(VAR)$)
FTN5(I=PROG,DB=0/PMD)
LGO(DATA,,,,SVFILE)
REWIND(SVFILE)
COPYSP(SVFILE)
PUTFEP(SVFILE,$MYDADO(CON)$)
####S
```

PROGRAM PROGRM(VAR)

```
      PROGRAM MATRIX(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT,TAPE5)
      PARAMETER (IXOG=17,VAR=14+2*IXOG)
      REAL M,N
      REAL X(11,IXOG),R(77,14+2*IXOG),A(11,IXOG)
      REAL B(11,IXOG),C(11,IXOG),D(11,IXOG),E(11,IXOG)
      REAL F(11,IXOG),G(11,IXOG),X1(11,10),X2(11,7)
      DIMENSION M(11,7),N(11,7)
      DO 10,I=1,77
      DO 10,J=1,VAR
   10 R(I,J)=0.0
      DO 12,I=1,11
      DO 12,J=1,IXOG
      A(I,J)=0.0
      B(I,J)=0.0
      C(I,J)=0.0
      D(I,J)=0.0
      E(I,J)=0.0
      F(I,J)=0.0
      X(I,J)=0.0
   12 G(I,J)=0.0
      WRITE(4,100)
  100 FORMAT(1H1,T5,'MATRIX M - STUDENTS YEAR T')
      DO 15,I=1,11
      READ(3,200)(M(I,J),J=1,7)
   15 WRITE(4,200)(M(I,J),J=1,7)
  200 FORMAT(1X,7F7.0)
      WRITE(4,250)
  250 FORMAT(///1H0,T5,'MATRIX N - STUDENTS YEAR T-1')
      DO 20,I=1,11
      READ(3,200)(N(I,J),J=1,7)
   20 WRITE(4,200)(N(I,J),J=1,7)
```

```
      WRITE(4,300)
  300 FORMAT(///1H0,T5,'MATRIX X - EXPLANATORY VARIABLES')
      DO 25,I=1,11
      READ(3,350)(X1(I,J),J=1,10)
   25 WRITE(4,350)(X1(I,J),J=1,10)
  350 FORMAT(10F7.2)
      DO 27,I=1,11
      READ(3,380)(X2(I,J),J=1,7)
   27 WRITE(4,380)(X2(I,J),J=1,7)
  380 FORMAT(7F7.2)
      DO 28,I=1,11
      DO 28,J=1,10
   28 X(I,J)=X1(I,J)
      DO 29,I=1,11
      DO 29,J=1,7
   29 X(I,J+10)=X2(I,J)
      DO 30,J=1,6
      DO 30,I=1,11
   30 R(I+11*J,1)=M(I,J+1)
      DO 31,I=1,11
      R(I,1)=M(I,1)
   31 R(I,2)=N(I,1)
      DO 35,J=1,6
      DO 35,I=1,11
      R(I+11*J,2*J+1)=N(I,J)
   35 R(I+11*J,2*J+2)=N(I,J+1)
      DO 40,I=1,11
      DO 40,J=1,IXOG
      A(I,J)=N(I,1)*X(I,J)
      B(I,J)=N(I,2)*X(I,J)
      C(I,J)=N(I,3)*X(I,J)
      D(I,J)=N(I,4)*X(I,J)
      E(I,J)=N(I,5)*X(I,J)
      F(I,J)=N(I,6)*X(I,J)
   40 G(I,J)=N(I,7)*X(I,J)
      DO 50,I=1,11
      DO 50,J=1,IXOG
      K=14+IXOG
      R(I,J+14)=A(I,J)
      R(I+11,J+K)=A(I,J)
      R(I+11,J+14)=B(I,J)
      R(I+22,J+K)=B(I,J)
      R(I+22,J+14)=C(I,J)
      R(I+33,J+K)=C(I,J)
      R(I+33,J+14)=D(I,J)
      R(I+44,J+K)=D(I,J)
      R(I+44,J+14)=E(I,J)
      R(I+55,J+K)=E(I,J)
      R(I+55,J+14)=F(I,J)
      R(I+66,J+K)=F(I,J)
   50 R(I+66,J+14)=G(I,J)
      WRITE(4,400)
  400 FORMAT (///1H0,T5,'MATRIX R -DATA MATRIX FOR OLS')
      DO 60,I=1,77
   60 WRITE(4,500)(R(I,J),J=1,14)
  500 FORMAT(14(1X,F7.0))
      DO 70,I=1,77
   70 WRITE(4,600)(R(I,J),J=15,14+2*IXOG)
  600 FORMAT( 10(1X,F11.3))
      DO 80,I=1,77
```

```
  80  WRITE(5,700)(R(I,J),J=1,14+2*IXOG)
 700  FORMAT(5(1X,F13.4))
      STOP
      END
####S
```

DATA FILE DADO(CON)

```
  14816  73647  52015  42239  26499  13051  10519  53214
  14965  83987  60249  44534  33340  17875  10983  51864
  14968  98906  81206  47341  36798  21110  14445  50523
   7313 105879  98785  69906  48705  41156  20129  30107
  15226 115997 104322  77394  62547  37196  37693  51412
  14541 127153  92023 108500  77348  45976  44658  64179
  20971 120590 101845  88998 104730  44029  52462 101290
  27312 121383  91417  73778  72335  43770  38345 188041
  28776 124346  94553  70132  72704  41554  39537 120904
  33514 129714  97738  74893  63803  46246  47867 101051
  33665 137784 101797  77250  64405  47953  57119 111979
  92599  64315  48158  38202  21654  13087   8466
  99769  73647  52015  42239  26499  13051  10519
 115137  83987  60249  44534  33340  17875  10983
 121980  98906  81206  47341  36798  21110  14445
 117124 105879  98785  69906  48705  41156  20129
 145407 115997 104322  77394  62547  37196  37693
 139809 127153  92023 108500  77348  45976  44658
 143749 120590 101845  88998 104730  44029  52462
 151456 121383  91417  73778  72335  43770  38345
 152338 124346  94553  70132  72704  41554  39537
 168327 129714  97738  74893  63803  46246  47867
 -2.09  -5.34   5.21  -2.92  -0.53   6.07  -8.31  -4.34  -6.04   6.80
  1.16  -4.63   1.79  -2.29  -0.96   3.55   2.90  -4.34  -6.04   4.35
  2.32  -3.20   6.43  -6.83  -1.86   2.98   0.13  -3.15  -0.63   2.42
 -2.85  -2.85  -0.73  -2.29  -3.81   2.53   4.28  -2.42  -0.20   1.06
  7.96   2.45  -3.21   1.63   8.36  -1.19   2.89  -1.13   0.83  -0.17
 -2.38   2.45  -0.83   1.23   1.39  -0.60   0.90   1.19   3.15  -1.16
  0.30   3.52  -3.98   1.03  -4.18  -1.82   0.23   0.70   0.70  -1.86
 -2.88   1.67  -0.73   0.60   0.33  -0.90   0.03   1.69   0.70  -2.45
  1.35   0.67  -2.98   1.23   0.86  -2.62  -0.30   2.35   0.76  -2.82
  2.32   2.45   0.07   4.10   0.50  -3.85  -0.73   4.31   2.45  -3.48
 -2.49   2.79  -1.02   4.51  -0.10  -4.15  -2.02   5.14   4.32  -2.69
 -3.52  -4.14   5.11  -4.45  -4.64  -4.34  -3.35
 -2.65  -3.58   4.05  -3.02  -4.64  -3.35  -3.02
 -1.29  -2.92   2.98  -3.88  -4.64  -2.82  -2.59
 -2.02  -2.16   1.92  -2.45   3.88  -2.12  -3.15
 -2.69  -1.33   1.03  -1.49   4.54  -1.19  -2.06
 -2.22  -1.23  -0.03   0.83   2.68  -0.73  -0.99
 -0.90   0.66  -1.09   2.42   1.06   0.32   0.07
  0.93   1.73  -2.19   3.98   0.70   1.36   1.46
  3.48   2.99  -2.92   4.15  -0.27   2.09   3.28
  5.37   4.31  -3.98   2.82   0.43   4.61   4.25
  5.51   5.67  -4.88   1.99   0.90   6.17   6.10
```

PROGRAM REG(EXTCON)

```
/*ST=(MFZ,SP),TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
GETFEP(DATA,$MYDADO(CON)$)
SPSS(D,L)
PUTFEP(BCDOUT,$AAA(CON)$)
####S
RUN NAME          ESTIMATION OF OLS DELTA COEFFICIENTS
VARIABLE LIST     V1 TO V48
INPUT FORMAT      FREEFIELD
N OF CASES        77
INPUT MEDIUM      DISK
REGRESSION        METHOD=STEPWISE/VARIABLES=V1 TO V48/
                  REGRESSION=V1 WITH V2 TO V14(8),V15 TO V48/
OPTIONS           19,16
STATISTICS        ALL
READ INPUT DATA
FINISH
####S
```

PROGRAM STAT(CON)

```
/*ST=(MFZ,SP),TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
FTN5(DB=0/PMD)
LGO(,,,,SVFILE,OUT)
PUTFEP(SVFILE,$PPPP(CONN)$)
PUTFEP(OUT,$EXOG(CONN)$)
####S
      PROGRAM PROB(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT,TAPE5,TAPE6)
      PARAMETER(IXOG1=9,IXOG2=9,ITOT=IXOG1+IXOG2)
      REAL DR(1,IXOG1),DP(1,IXOG2),X(11,17),X1(11,10),X2(11,7)
      DIMENSION EX1(11,IXOG1),EX2(11,IXOG2),P(11,13)
      DIMENSION D(11,7),A(1,7),B(1,6),S(11),T(11),EXOG(11,ITOT)
      DO 10,I=1,11
      S(I)=0.0
 10   T(I)=0.0
      DO 15,I=1,11
      DO 15,J=1,13
 15   P(I,J)=0.0
      DO 16,I=1,11
      DO 16,J=1,7
 16   D(I,J)=0.0
      WRITE(4,300)
300   FORMAT(///1H0,T5,'MATRIX X - EXPLANATORY VARIABLES')
      DO 25,I=1,11
      READ(3,350)(X1(I,J),J=1,10)
 25   WRITE(4,350)(X1(I,J),J=1,10)
350   FORMAT(10F7.2)
```

```
      DO 27,I=1,11
      READ(3,380)(X2(I,J),J=1,7)
  27  WRITE(4,380)(X2(I,J),J=1,7)
 380  FORMAT(7F7.2)
      DO 28,I=1,11
      DO 28,J=1,10
   28 X(I,J)=X1(I,J)
      DO 29,I=1,11
      DO 29,J=1,7
  29  X(I,J+10)=X2(I,J)
      DO 40,I=1,11
      EX1(I,1)=X(I,2)
      EX1(I,2)=X(I,5)
      EX1(I,3)=X(I,6)
      EX1(I,4)=X(I,7)
      EX1(I,5)=X(I,8)
      EX1(I,6)=X(I,9)
      EX1(I,7)=X(I,11)
      EX1(I,8)=X(I,15)
  40  EX1(I,9)=X(I,16)
      DO 41,I=1,11
      EX2(I,1)=X(I,2)
      EX2(I,2)=X(I,5)
      EX2(I,3)=X(I,6)
      EX2(I,4)=X(I,7)
      EX2(I,5)=X(I,8)
      EX2(I,6)=X(I,9)
      EX2(I,7)=X(I,11)
      EX2(I,8)=X(I,15)
  41  EX2(I,9)=X(I,16)
      WRITE(4,130)
 130  FORMAT(///1H0,T5,'MATRIX-EX1')
      DO 33,I=1,11
  33  WRITE(4,350)(EX1(I,J),J=1,IXOG1)
      WRITE(4,110)
 110  FORMAT(///1H0,T5,'MATRIX-EX2')
      DO 37,I=1,11
  37  WRITE(4,350)(EX2(I,J),J=1,IXOG2)
      READ(3,400)(DR(1,I),I=1,IXOG1)
      WRITE(4,500)(DR(1,I),I=1,IXOG1)
 400  FORMAT(8F9.5)
 500  FORMAT(///,8F9.5)
      READ(3,400)(DP(1,I),I=1,IXOG2)
      WRITE(4,500)(DP(1,I),I=1,IXOG2)
      READ(3,400)(A(1,I),I=1,7)
      WRITE(4,500)(A(1,I),I=1,7)
      READ(3,400)(B(1,I),I=1,6)
      WRITE(4,500)(B(1,I),I=1,6)
      DO 75,I=1,11
      DO 75,J=1,IXOG1
  75  EXOG(I,J)=EX1(I,J)
      DO 77,I=1,11
      DO 77,J=1,IXOG2
  77  EXOG(I,J+IXOG1)=EX2(I,J)
      DO 78,I=1,11
  78  WRITE(6,350)(EXOG(I,J),J=1,ITOT)
      DO 20,I=1,11
      DO 20,J=1,IXOG1
  20  S(I)=S(I)+DR(1,J)*EX1(I,J)
      DO 21,I=1,11
```

```
      DO 21,J=1,IXOG2
   21 T(I)=T(I)+DP(1,J)*EX2(I,J)
      DO 30,I=1,11
      DO 30,K=1,7
   30 P(I,2*K-1)=A(1,K)+S(I)
      DO 44,I=1,11
      DO 44,K=1,6
   44 P(I,2*K)=B(1,K)+T(I)
      WRITE(4,100)
  100 FORMAT (1H1,T5,'MATRIX OF PROBABILITIES')
      DO 50,I=1,11
   50 WRITE(4,200)(P(I,J),J=1,13)
  200 FORMAT (///1H0,13F9.5)
      WRITE(4,100)
      DO 60,I=1,11
   60 WRITE(4,250)(P(I,J),J=1,13)
  250 FORMAT(1H0,13F5.2)
      DO 66,I=1,11
   66 WRITE(5,255)(P(I,J),J=1,13)
  255 FORMAT(13F6.3)
      STOP
      END
####S
```

```
 -2.09  -5.34   5.21  -2.92  -0.53   6.07  -8.31  -4.34  -6.04   6.80
  1.16  -4.63   1.79  -2.29  -0.96   3.55   2.90  -4.34  -6.04   4.35
  2.32  -3.20   6.43  -6.83  -1.86   2.98   0.13  -3.15  -0.63   2.42
 -2.85  -2.85  -0.73  -2.29  -3.81   2.53   4.28  -2.42  -0.20   1.06
  7.96   2.45  -3.21   1.63   8.36  -1.19   2.89  -1.13   0.83  -0.17
 -2.38   2.45  -0.83   1.23   1.39  -0.60   0.90   1.19   3.15  -1.16
  0.30   3.52  -3.98   1.03  -4.18  -1.82   0.23   0.70   0.70  -1.86
 -2.88   1.67  -0.73   0.60   0.33  -0.90   0.03   1.69   0.70  -2.45
  1.35   0.67  -2.98   1.23   0.86  -2.62  -0.30   2.35   0.76  -2.82
  2.32   2.45   0.07   4.10   0.50  -3.85  -0.73   4.31   2.45  -3.48
 -2.49   2.79  -1.02   4.51  -0.10  -4.15  -2.02   5.14   4.32  -2.69
 -3.52  -4.14   5.11  -4.45  -4.64  -4.34  -3.35
 -2.65  -3.58   4.05  -3.02  -4.64  -3.35  -3.02
 -1.29  -2.92   2.98  -3.88  -4.64  -2.82  -2.59
 -2.02  -2.16   1.92  -2.45   3.88  -2.12  -3.15
 -2.69  -1.33   1.03  -1.49   4.54  -1.19  -2.06
 -2.22  -1.23  -0.03   0.83   2.68  -0.73  -0.99
 -0.90   0.66  -1.09   2.42   1.06   0.32   0.07
  0.93   1.73  -2.19   3.98   0.70   1.36   1.46
  3.48   2.99  -2.92   4.15  -0.27   2.09   3.28
  5.37   4.31  -3.98   2.82   0.43   4.61   4.25
  5.51   5.67  -4.88   1.99   0.90   6.17   6.10
 0.086    0.016    0.056   -0.003   -0.050   -0.040    0.077   -0.077
-0.010
-0.038   -0.028   -0.018    0.067    0.123   -0.365   -0.051    0.059
 0.133
 0.15     0.49     0.12     0.35     0.07     0.58     0.42
 0.46     0.75     0.56     0.86     0.30     0.67
####S
```

PROGRAM ERROR(CASE)

```
/*ST=(MFZ,SP),TI=8,C=B
LIBRARY(PROCLIB)
NEWPROC.
GETFEP(DATA,$PPPP(CONN)$)
GETFEP(DATA1,$AAA(CON)$)
GETFEP(DATA2,$EXOG(CONN)$)
FTN5(DB=0/PMD)
LGO(DATA,,,,DATA1,DATA2)
####S
      PROGRAM ERRO(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT,TAPE5,TAPE6)
      INTEGER VAR
      PARAMETER (IXOG1=9,IXOG2=9,IXOG=IXOG1+IXOG2,VAR=IXOG+13)
      DIMENSION P(11,13),C(VAR,VAR),X(11,13),A(13),B(13,IXOG1)
      DIMENSION D(13,IXOG2),F(IXOG1,IXOG1),G(IXOG2,IXOG2),V(11,13)
      DIMENSION V1(11),V2(11),W(11,13),R1(11),R2(11)
      DIMENSION SE(11,13),T(11,13),X1(11,IXOG1),X2(11,IXOG2)
      DO 5,I=1,11
      R1(I)=0.0
      R2(I)=0.0
      V1(I)=0.0
    5 V2(I)=0.0
      DO 6,I=1,11
      DO 6,K=1,13
    6 W(I,K)=0.0
      WRITE(4,105)
  105 FORMAT(1H1,T5,'MATRIX P')
      DO 10,I=1,11
      READ(3,100)(P(I,J),J=1,13)
   10 WRITE(4,100)(P(I,J),J=1,13)
  100 FORMAT(13F6.3)
      WRITE(4,125)
  125 FORMAT(///1H0,T5,'MATRIX OF COVARIANCE ')
      DO 12,I=1,VAR
      READ(5,120)(C(I,J),J=1,VAR)
   12 WRITE(4,120)(C(I,J),J=1,5)
  120 FORMAT(6E13.5)
      WRITE(4,145)
  145 FORMAT(///1H0,T5,'MATRIX OF EXPLANATORY VARIABLES')
      DO 14,I=1,11
      READ(6,140)(X(I,J),J=1,IXOG)
   14 WRITE(4,140)(X(I,J),J=1,IXOG)
      DO 16,I=1,11
      DO 16,J=1,IXOG1
   16 X1(I,J)=X(I,J)
      DO 17,I=1,11
      DO 17,J=1,IXOG2
   17 X2(I,J)=X(I,J+IXOG1)
  140 FORMAT(10F7.2)
      DO 15,J=1,13
   15 A(J)=C(J,J)
      WRITE(4,*)('VECTOR A')
      WRITE(4,120)(A(I),I=1,13)
      DO 20,I=1,13
      DO 20,J=1,IXOG1
   20 B(I,J)=C(I,J+13)
      DO 21,I=1,13
```

```
      DO 21,J=1,IXOG2
   21 D(I,J)=C(I,J+IXOG1+13)
      DO 22,I=1,IXOG1
      DO 22,J=1,IXOG1
   22 F(I,J)=C(I+13,J+13)
      DO 23,I=1,IXOG2
      DO 23,J=1,IXOG2
   23 G(I,J)=C(I+IXOG1+13,J+IXOG1+13)
      DO 80,L=1,6
      DO 80,I=1,11
      DO 24,J=1,IXOG1
   24 V1(I)=V1(I)+(X1(I,J)**2)*F(J,J)
      DO 27,J=1,IXOG2
   27 V2(I)=V2(I)+(X2(I,J)**2)*G(J,J)
      DO 25,K=1,6
      DO 25,J=1,IXOG1
   25 W(I,2*K-1)=W(I,2*K-1)+X1(I,J)*B(2*K-1,J)*2
      DO 88,J=1,IXOG1
   88 W(I,13)=W(I,13)+X1(I,J)*B(13,J)*2
      DO 26,K=1,6
      DO 26,J=1,IXOG2
   26 W(I,2*K)=W(I,2*K)+X2(I,J)*D(2*K,J)*2
      JM1=IXOG1-1
      DO 30,JC=1,JM1
      JCP1=JC+1
      DO 30,JRC=JCP1,IXOG1
   30 R1(I)=R1(I)+X1(I,JC)*X1(I,JRC)*F(JC,JRC)*2
      JM2=IXOG2-1
      DO 32,JC=1,JM2
      JCP1=JC+1
      DO 32,JRC=JCP1,IXOG2
   32 R2(I)=R2(I)+X2(I,JC)*X2(I,JRC)*G(JC,JRC)*2
      V(I,13)=A(13)+V1(I)+W(I,13)+R1(I)
      V(I,2*L-1)=A(2*L-1)+V1(I)+W(I,2*L-1)+R1(I)
   80 V(I,2*L)=A(2*L)+V2(I)+W(I,2*L)+R2(I)
      WRITE(4,*)('VALUES OF V1 AND V2')
      WRITE(4,380)(V1(I),I=1,11)
      WRITE(4,380)(V2(I),I=1,11)
      WRITE(4,*)('VALUES OF R1(I) AND R2(I)')
      WRITE(4,380)(R1(I),I=1,11)
      WRITE(4,380)(R2(I),I=1,11)
      WRITE(4,500)
  500 FORMAT(1H1,T5,'VARIANCE MATRIX')
      DO 55,I=1,11
   55 WRITE(4,380)(V(I,J),J=1,13)
  380 FORMAT(/7F10.4)
      WRITE(4,200)
  200 FORMAT(1H1,T5,'STANDARD ERROR MATRIX')
      DO 45,I=1,11
      DO 45,J=1,13
   45 SE(I,J)=SQRT(V(I,J))
      DO 40,I=1,11
   40 WRITE(4,350)(SE(I,J),J=1,13)
      DO 50,I=1,11
      DO 50,J=1,13
   50 T(I,J)=P(I,J)/SE(I,J)
      WRITE(4,400)
  400 FORMAT(///1H0,T5,'T-VALUES MATRIX')
      DO 60,I=1,11
   60 WRITE(4,350)(T(I,J),J=1,13)
```

```
  350  FORMAT(//1H0,13F6.2)
       STOP
       END
```

PROGRAM PROGRM(VAR)

```
      PROGRAM MATRIX(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT,TAPE5)
      PARAMETER (IXOG=17,VAR=14+2*IXOG)
      REAL M,N
      REAL X(11,IXOG),R(77,14+2*IXOG),A(11,IXOG)
      REAL B(11,IXOG),C(11,IXOG),D(11,IXOG),E(11,IXOG)
      REAL F(11,IXOG),G(11,IXOG),X1(11,10),X2(11,7)
      DIMENSION M(11,7),N(11,7)
      DO 10,I=1,77
      DO 10,J=1,VAR
   10 R(I,J)=0.0
      DO 12,I=1,11
      DO 12,J=1,IXOG
      A(I,J)=0.0
      B(I,J)=0.0
      C(I,J)=0.0
      D(I,J)=0.0
      E(I,J)=0.0
      F(I,J)=0.0
      X(I,J)=0.0
   12 G(I,J)=0.0
      WRITE(4,100)
  100 FORMAT(1H1,T5,'MATRIX M - STUDENTS YEAR T')
      DO 15,I=1,11
      READ(3,200)(M(I,J),J=1,7)
   15 WRITE(4,200)(M(I,J),J=1,7)
  200 FORMAT(1X,7F7.0)
      WRITE(4,250)
  250 FORMAT(///1H0,T5,'MATRIX N - STUDENTS YEAR T-1')
      DO 20,I=1,11
      READ(3,200)(N(I,J),J=1,7)
   20 WRITE(4,200)(N(I,J),J=1,7)
      WRITE(4,300)
  300 FORMAT(///1H0,T5,'MATRIX X - EXPLANATORY VARIABLES')
      DO 25,I=1,11
      READ(3,350)(X1(I,J),J=1,10)
   25 WRITE(4,350)(X1(I,J),J=1,10)
  350 FORMAT(10F7.2)
      DO 27,I=1,11
      READ(3,380)(X2(I,J),J=1,7)
   27 WRITE(4,380)(X2(I,J),J=1,7)
  380 FORMAT(7F7.2)
      DO 28,I=1,11
      DO 28,J=1,10
   28 X(I,J)=X1(I,J)
      DO 29,I=1,11
      DO 29,J=1,7
   29 X(I,J+10)=X2(I,J)
```

```
      DO 30,J=1,6
      DO 30,I=1,11
   30 R(I+11*J,1)=M(I,J+1)
      DO 31,I=1,11
      R(I,1)=M(I,1)
   31 R(I,2)=N(I,1)
      DO 35,J=1,6
      DO 35,I=1,11
      R(I+11*J,2*J+1)=N(I,J)
   35 R(I+11*J,2*J+2)=N(I,J+1)
      DO 40,I=1,11
      DO 40,J=1,IXOG
      A(I,J)=N(I,1)*X(I,J)
      B(I,J)=N(I,2)*X(I,J)
      C(I,J)=N(I,3)*X(I,J)
      D(I,J)=N(I,4)*X(I,J)
      E(I,J)=N(I,5)*X(I,J)
      F(I,J)=N(I,6)*X(I,J)
   40 G(I,J)=N(I,7)*X(I,J)
      DO 50,I=1,11
      DO 50,J=1,IXOG
      K=14+IXOG
      R(I,J+14)=A(I,J)
      R(I+11,J+K)=A(I,J)
      R(I+11,J+14)=B(I,J)
      R(I+22,J+K)=B(I,J)
      R(I+22,J+14)=C(I,J)
      R(I+33,J+K)=C(I,J)
      R(I+33,J+14)=D(I,J)
      R(I+44,J+K)=D(I,J)
      R(I+44,J+14)=E(I,J)
      R(I+55,J+K)=E(I,J)
      R(I+55,J+14)=F(I,J)
      R(I+66,J+K)=F(I,J)
   50 R(I+66,J+14)=G(I,J)
      WRITE(4,400)
  400 FORMAT (///1H0,T5,'MATRIX R -DATA MATRIX FOR OLS')
      DO 60,I=1,77
   60 WRITE(4,500)(R(I,J),J=1,14)
  500 FORMAT(14(1X,F7.0))
      DO 70,I=1,77
   70 WRITE(4,600)(R(I,J),J=15,14+2*IXOG)
  600 FORMAT( 10(1X,F11.3))
      DO 80,I=1,77
   80 WRITE(5,700)(R(I,J),J=1,14+2*IXOG)
  700 FORMAT(5(1X,F13.4))
      STOP
      END
####S
```

PROGRAM FACTOR(SUPPLY)

```
/*ST=(MFZ,SP),TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
GETFEP(DATA,$SUPPLY$)
SPSS(D)
####S
RUN NAME        FACTOR ANALISIS OF PARTICIPATION EXPLANATORY VARIABLES
VARIABLE LIST   EDUC,PEDUC,PCAP,COST,TEARN,PUTEA,PUCLASS,BUS,HELP,UNQUAL
VAR LABELS      EDUC EDUCATION EXPENDITURE
                PEDUC PERCENTAGE OF EDUC EXPENDITURE IN GDP
                PCAP PERCENTAGE OF CAPITAL EXPEND. IN EDUC EXPEND.
                COST EXPEND. PER STUDENT
                TEARN TEACHERS EARNINGS PER MONTH
                PUTEA PUPIL TEACHER RATIO
                PUCLASS PUPIL CLASSROOM RATIO
                BUS PERCENTAGE OF STUDENTS USING SCHOOL BUSSING
                HELP PERCENTAGE OF STUD. GETTING SCHOOLARSHIP
                UNQUAL PERCENTAGE OF TEACHERS WITHOUT QUALIFIC.
INPUT FORMAT    FIXED (10F7.2)
N OF CASES      11
INPUT MEDIUM    DISK
FACTOR          VARIABLES = EDUC,PEDUC,PCAP,COST,TEARN,PUTEA,PUCLASS,
                            BUS,HELP,QUAL/
                ROTATE = OBLIQUE/
STATISTICS      2,4,5,6,7,8
READ INPUT DATA
FINISH
####S
```

PROGRAM FACTOR(DEMAND)

```
/*ST=(MFZ,SP),TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
GETFEP(DATA,$DEMAND$)
SPSS(D)
####S
RUN NAME        FACTOR ANALISIS OF PARTICIPATION EXPLANATORY VARIABLES
VARIABLE LIST   GDP,LIFE,ILLIT,UNEMP,EARN,LFLEV,POPLEV
VAR LABELS      LIFE LIFE EXPECTATION
                GDP GROSS DOMESTIC PRODUCT
                ILLIT ILLITERATE RARE
                UNEMP NUMBER OF UMEMPLOYED WORKERS
                EARN EARNINGS MONTHLY
                LFLEV LABOUR FORCE WITH PREP. AND SEC. LEVEL
                POPLEV POPULATION WITH PREP. AND SEC. LEVEL
INPUT FORMAT    FIXED (7F7.2)
N OF CASES      11
INPUT MEDIUM    DISK
FACTOR          VARIABLES = GDP,LIFE,ILLIT,UNEMP,EARN,LFLEV,POPLEV/
                ROTATE = OBLIQUE/
STATISTICS      2,4,5,6,7,8
READ INPUT DATA
FINISH
####S
```

PROGRAM PRIN(SUPPLY)

```
/*ST=(MFZ,SP),TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
NAG.
FTN5(DB=0/PMD)
LGO.
####S
      PROGRAM PRINFAC(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT)
      REAL DEM,FAC,A,Z
      DIMENSION DEM(11,10),FAC(10,3),A(11,3),Z(1)
      DO 10,I=1,11
      DO 10,J=1,3
  10  A(I,J)=0.0
      WRITE(4,200)
 200  FORMAT (///1H0,T5,'MATRIX DEM')
 300  FORMAT (10F7.2)
      DO 15,I=1,11
      READ(3,300)(DEM(I,J),J=1,10)
  15  WRITE(4,300)(DEM(I,J),J=1,10)
      WRITE(4,450)
 450  FORMAT (///1H0,T5,'FACTOR MATRIX')
      DO 20,I=1,10
      READ(3,100)(FAC(I,J),J=1,3)
  20  WRITE(4,500)(FAC(I,J),J=1,3)
 100  FORMAT (3F9.3)
      WRITE(4,480)
 480  FORMAT (///1H0,T5,'MATRIX COEF.')
 500  FORMAT (1H0,3F14.5)
      CALL F01CKF(A,DEM,FAC,11,3,10,Z,1,1,0)
      DO 65,I=1,11
  65  WRITE(4,500)(A(I,J),J=1,3)
      STOP
      END
####S
  -2.09  -5.34   5.21  -2.92  -0.53   6.07  -8.31  -4.34  -6.04   6.80
   1.16  -4.63   1.79  -2.29  -0.96   3.55   2.90  -4.34  -6.04   4.35
   2.32  -3.20   6.43  -6.83  -1.86   2.98   0.13  -3.15  -0.63   2.42
  -2.85  -2.85  -0.73  -2.29  -3.81   2.53   4.28  -2.42  -0.20   1.06
   7.96   2.45  -3.21   1.63   8.36  -1.19   2.89  -1.13   0.83  -0.17
  -2.38   2.45  -0.83   1.23   1.39  -0.60   0.90   1.19   3.15  -1.16
   0.30   3.52  -3.98   1.03  -4.18  -1.82   0.23   0.70   0.70  -1.86
  -2.88   1.67  -0.73   0.60   0.33  -0.90   0.03   1.69   0.70  -2.45
   1.35   0.67  -2.98   1.23   0.86  -2.62  -0.30   2.35   0.76  -2.82
   2.32   2.45   0.07   4.10   0.50  -3.85  -0.73   4.31   2.45  -3.48
  -2.49   2.79  -1.02   4.51  -0.10  -4.15  -2.02   5.14   4.32  -2.69
   15.430  -54.375  -80.277
   10.444  -34.452  -50.096
  -23.677   83.162  121.798
  -29.864  103.963  151.775
   -0.479    2.368    2.937
   60.281 -214.040 -311.397
   10.312  -35.743  -50.943
  102.996 -359.315 -524.237
  -10.092   34.340   49.699
   32.891 -113.842 -167.359
####S
```

PROGRAM PRIN(DEMAND)

```
/*ST=(MFZ,SP),TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
NAG.
FTN5(DB=0/PMD)
LGO.
####S
      PROGRAM PRINFAC(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT)
      REAL DEM,FAC,A,Z
      DIMENSION DEM(11,7),FAC(7,2),A(11,2),Z(1)
      DO 11,I=1,11
      DO 11,J=1,2
   11 A(I,J)=0.0
      WRITE(4,200)
  200 FORMAT (///1H0,T5,'MATRIX DEM')
  300 FORMAT (7F7.2)
      DO 15,I=1,11
      READ(3,300)(DEM(I,J),J=1,7)
   15 WRITE(4,300)(DEM(I,J),J=1,7)
      WRITE(4,450)
  450 FORMAT (///1H0,T5,'FACTOR MATRIX')
      DO 20,I=1,7
      READ(3,100)(FAC(I,J),J=1,2)
   20 WRITE(4,500)(FAC(I,J),J=1,2)
  100 FORMAT (2F8.5)
      WRITE(4,480)
  480 FORMAT (///1H0,T5,'MATRIX COEF.')
  500 FORMAT (1H0,2F10.5)
      CALL F01CKF(A,DEM,FAC,11,2,7,Z,1,1,0)
      DO 40,I=1,11
   40 WRITE(4,500)(A(I,J),J=1,2)
      STOP
      END
####S
  -3.52  -4.14   5.11  -4.45  -4.64  -4.34  -3.35
  -2.65  -3.58   4.05  -3.02  -4.64  -3.35  -3.02
  -1.29  -2.92   2.98  -3.88  -4.64  -2.82  -2.59
  -2.02  -2.16   1.92  -2.45   3.88  -2.12  -3.15
  -2.69  -1.33   1.03  -1.49   4.54  -1.19  -2.06
  -2.22  -1.23  -0.03   0.83   2.68  -0.73  -0.99
  -0.90   0.66  -1.09   2.42   1.06   0.32   0.07
   0.93   1.73  -2.19   3.98   0.70   1.36   1.46
   3.48   2.99  -2.92   4.15  -0.27   2.09   3.28
   5.37   4.31  -3.98   2.82   0.43   4.61   4.25
   5.51   5.67  -4.88   1.99   0.90   6.17   6.10
-1.81965 0.0
 5.20887 0.0
-5.24856 0.0
-2.22117 0.0
-0.93385 0.0
-4.11996 0.0
-1.31752 0.0
####S
```

NOTE: A summary description of the programs is presented in Appendix G

APPENDIX F

REGIONAL APPLICATION OF THE EXTENDED MARKOV MODEL TO THE PORTUGUESE EDUCATIONAL SYSTEM: PROGRAMS AND TABLES

PROGRAM REGSHAX

```
/*ST=(MFZ,SP),TI=10,C=B
LIBRARY(PROCLIB)
NEWPROC.
GETFEP,TAPE4,NEWDATA.
SHAZAM(OUTPUT=OUT)
PUTFEP(OUT,SHAZ1)
FTN5(DB=0/PMD)
LGO.
PUTFEP(TAPE7,FILE2)
####S
PAR=180
SOLO 48 1386
IO NOHD
WRITE CV
NAME 2 ALFA1 3 ALFA2 4 ALFA3 5 ALFA4 6 ALFA5 7 ALFA6 8 ALFA7
NAME 2 ALFA1 3 ALFA2 4 ALFA3 5 ALFA4 6 ALFA5 7 ALFA6 8 ALFA7
NAME 9 ALFA8 10 ALFA9 11 ALFA10 12 ALFA11 13 ALFA12 14 ALFA13
NAME EDUC1 PEDUC1 PCAP1 COST1 TEARN1 PUTEA1 PUCLASS1 BUS1 HELP1 UNOUAL1
NAME GDP1 LIFE1 ILLIT1 UNEMP1 EARN1 LFLEV1 POPLEV1
NAME EDUC2 PEDUC2 PCAP2 COST2 TEARN2 PUTEA2 PUCLASS2 BUS2 HELP2 UNQUAL2
NAME GDP2 LIFE2 ILLIT2 UNEMP2 EARN2 LFLEV2 POPLEV2
DATA FI((5F14.4))
OLS 1 2-14 (15-48) /FO RS CV
MERC
####S
       PROGRAM GETCV(OUT,OUTPUT,TAPE7,TAPE3=OUT,TAPE2=OUTPUT)
       CHARACTER*150 IICHAR
       REWIND 3
   10  READ(3,'(A)',END=200)IICHAR
       IF(IICHAR(2:20) .NE. 'VARIANCE-COVARIANCE') GO TO 10
   20  READ(3,'(A)',END=100)IICHAR
       WRITE(7,'(A)')IICHAR
       GO TO 20
  100  STOP
  200  WRITE(2,*) ('ERROR IN CV MATRIX')
       STOP
       END
####S
```

PROGRAM REGSHA3A

```
/*ST=(MFZ,SP),TI=10,C=B
LIBRARY(PROCLIB)
NEWPROC.
GETFEP,TAPE4,REGION1.
SHAZAM(OUTPUT=OUT)
PUTFEP(OUT,SHAZ)
FTN5(DB=0/PMD)
LGO.
PUTFEP(TAPE7,FILE7)
####S
PAR=198
SOLO 21 693
IO DP
NAME 2 ALFA1 3 ALFA2 4 ALFA3 5 ALFA4 6 ALFA5 7 ALFA6 8 ALFA7
NAME 9 ALFA8 10 ALFA9 11 ALFA10 12 ALFA11 13 ALFA12 14 ALFA13
NAME EDUC1 GDP1
NAME PCAP2 TEARN2 HELP2
NAME UNEMP2 LFLEV2
DATA FI(3(5F14.4/),70X/,56X,F14.4//,42X,F14.4,14X/,F14.4,42X,F14.4/,
56X,F14.4/14X,F14.4,42X)
POOL 1 2-21 /NC=9 FO RS CV
MERC
####S
      PROGRAM GETCV(OUT,OUTPUT,TAPE7,TAPE3=OUT,TAPE2=OUTPUT)
      CHARACTER*150 IICHAR
      REWIND 3
   10 READ(3,'(A)',END=200)IICHAR
      IF(IICHAR(2:20) .NE. 'VARIANCE-COVARIANCE') GO TO 10
   20 READ(3,'(A)',END=100)IICHAR
      WRITE(7,'(A)')IICHAR
      GO TO 20
  100 STOP
  200 WRITE(2,*) ('ERROR IN CV MATRIX')
      STOP
      END
####S
```

PROGRAM PROGRM(STACK)

```
/*ST=(C20,LP=4,WS=512),TI=40,C=B
PATTACH,PROCLIB.
BEGIN,,GETFEP,DATA,STADATA.
FORTRAN.
LOAD.
GO.
BEGIN,,PUTFEP,OUT,RESULT.
####S
      PROGRAM STACK
      ROWWISE A(385,20),B(770,22),C(231,24),X(1386,171)
      OPEN(3,FILE='DATA')
      OPEN(4,FILE='OUT')
      DO 5,J=1,171
      DO 5,I=1,1386
    5 X(I,J)=0.0
      DO 20,I=1,385
   20 READ(3,120)(A(I,J),J=1,20)
  120 FORMAT((5F14.4)/(5F14.4)/(5F14.4)/(5F14.4))
      DO 25,I=1,770
   25 READ(3,150)(B(I,J),J=1,22)
  150 FORMAT((5F14.4)/(5F14.4)/(5F14.4)/(5F14.4)/(2F14.4))
      DO 30,I=1,231
   30 READ(3,180)(C(I,J),J=1,24)
  180 FORMAT((5F14.4)/(5F14.4)/(5F14.4)/(5F14.4)/(4F14.4))
      DO 40,J=1,14
      DO 40,I=1,385
   40 X(I,J)=A(I,J)
      DO 50,J=1,14
      DO 50,I=1,770
   50 X(I+385,J)=B(I,J)
      DO 55,J=1,14
      DO 55,I=1,231
   55 X(I+1155,J)=C(I,J)
      DO 58,J=15,20
      DO 58,I=1,77
   58 X(I,J)=A(I,J)
      DO 60,K=1,4
      DO 60,J=15,20
      DO 60,I=1,77
   60 X(I+77*K,J+6*K)=A(I+77*K,J)
      DO 65,J=15,22
      DO 65,I=1,77
   65 X(I+385,J+30)=B(I,J)
      DO 68,K=1,9
      DO 68,J=15,22
      DO 68,I=1,77
      L=J+30
      M=385+77*K
   68 X(I+M,L+8*K)=B(I+77*K,J)
      DO 70,J=15,24
      DO 70,I=1,77
      X(I+1155,J+110)=C(I,J)
      X(I+1232,J+120)=C(I+77,J)
   70 X(I+1309,J+130)=C(I+154,J)
      DO 80,I=1,77
      X(I,155)=1.0
```

```
      X(I+77,156)=1.0
   80 X(I+154,157)=1.0
      DO 82,I=1,77
      X(I+231,165)=1.0
      X(I+308,171)=1.0
   82 X(I+385,158)=1.0
      DO 84,I=1,77
      X(I+462,160)=1.0
      X(I+539,161)=1.0
      X(I+616,162)=1.0
      X(I+693,163)=1.0
   84 X(I+847,166)=1.0
      DO 86,I=1,77
      X(I+924,167)=1.0
      X(I+1001,169)=1.0
      X(I+1078,170)=1.0
   86 X(I+1155,159)=1.0
      DO 88,I=1,77
      X(I+1232,164)=1.0
   88 X(I+1309,168)=1.0
      DO 75,I=1,1386
   75 WRITE(4,600)(X(I,J),J=1,171)
  600 FORMAT(5F14.4)
      STOP
      END
```

PROGRAM STACK

```
/*ST=(C20,LP=8,WS=1024),TI=100,C=C
PATTACH,LIBAPPL.
PATTACH,PROCLIB.
BEGIN,,GETFEP,DATA,RESULT.
FORTRAN.
LOAD,LIB=NAGLIB.
GO.
BEGIN,,PUTFEP,OUT,COEF.
####S
      PROGRAM STACK(OUTPUT)
      INTEGER OBS,VAR
      PARAMETER (OBS=1386,VAR=170)
      DIMENSION B(VAR,OBS),D(VAR,VAR)
      DIMENSION E(OBS),Z(1),S(VAR),WKSPCE(VAR)
      DIMENSION UNIT(VAR,VAR),DELTA(VAR)
      OPEN(3,FILE='DATA')
      OPEN(4,FILE='OUTPUT')
      OPEN(5,FILE='OUT')
      DO 25,J=1,VAR
      DO 25,I=1,VAR
      UNIT(I,J)=0.0
   25 D(I,J)=0.0
      DO 27,I=1,VAR
      S(I)=0.0
   27 DELTA(I)=0.0
      DO 30,I=1,OBS
```

```
   30 READ(3,100)E(I),(B(J,I),J=1,VAR)
  100 FORMAT(5F14.4)
      CALL F01CLF(D,B,B,VAR,VAR,OBS,0)
      WRITE(4,*) 'AT 1'
      CALL F01AAF(D,VAR,VAR,UNIT,VAR,WKSPCE,0)
      WRITE(4,*) 'AT 2'
      CALL F01CKF(S,B,E,VAR,1,OBS,Z,1,1,0)
      WRITE(4,*) 'AT 3'
      CALL F01CKF(DELTA,UNIT,S,VAR,1,VAR,Z,1,1,0)
      WRITE(4,*) 'AT 4'
      WRITE(4,200)
  200 FORMAT(1H1,T5,'COEFFICINTS ALFA DELTA DUMMIES')
      DO 40,I=1,VAR
   40 WRITE(4,300)(DELTA(I))
  300 FORMAT(10F14.8)
      DO 50,I=1,VAR
   50 WRITE(5,300)(DELTA(I))
      STOP
      END
```

PROGRAM UNRESID

```
/*ST=(C20,LP=8,WS=1024),TI=200,C=C
PATTACH,LIBAPPL.
PATTACH,PROCLIB.
BEGIN,,GETFEP,DATA,RESULT.
BEGIN,,GETFEP,DATA1,COEF.
FORTRAN.
LOAD,LIB=NAGLIB.
GO.
BEGIN,,PUTFEP,OUT,COV.
BEGIN,,PUTFEP,OUT1,STAND.
####S
      PROGRAM STACK(OUTPUT)
      INTEGER OBS,VAR
      REAL LB,M
      PARAMETER (OBS=1386,VAR=170)
      DIMENSION B(OBS,VAR),C(VAR,OBS),X(VAR,VAR),X1(VAR),COV(VAR,VAR)
      DIMENSION E(OBS),Z(1),T(VAR),WKSPCE(VAR),A(OBS),B1(VAR),M(VAR,VAR)
      DIMENSION UNIT(VAR,VAR),DELTA(VAR),R(OBS),LB(VAR),UB(VAR),AA(OBS)
      DIMENSION X2(VAR)
      OPEN(3,FILE='DATA')
      OPEN(4,FILE='OUTPUT')
      OPEN(5,FILE='DATA1')
      OPEN(6,FILE='OUT')
      OPEN(7,FILE='OUT1')
       WRITE(4,*)' START OF PROGRAM'
      DO 13,J=1,VAR
   13 B1(J)=0.0
      DO 14,I=1,OBS
   14 AA(I)=0.0
      DO 25,J=1,VAR
      DO 25,I=1,VAR
      M(I,J)=0.0
```

```
      COV(I,J)=0.0
   25 UNIT(I,J)=0.0
      DO 30,I=1,OBS
   30 READ(3,100)E(I),(B(I,J),J=1,VAR)
  100 FORMAT(5F14.4)
      WRITE(4,*) 'VECTOR E'
      WRITE(4,*) (E(I),I=1,20)
      WRITE(4,*) 'MATRIX B'
      DO 42,I=1,11
   42 WRITE(4,*)(B(I,J),J=1,20)
      DO 35,I=1,VAR
   35 READ(5,200)(DELTA(I))
  200 FORMAT(F14.8)
      WRITE(4,*) 'VECTOR DELTA'
      WRITE(4,*) (DELTA(I),I=1,20)
C     CALCUL OF THE RESIDUALS
      DO 40,J=1,VAR
      DO 40,I=1,OBS
   40 C(J,I)=B(I,J)
      WRITE(4,*) 'MATRIX C'
      IFAIL = 1
      CALL F01CKF(A,B,DELTA,OBS,1,VAR,Z,1,1,IFAIL)
      IF(IFAIL.NE.0) WRITE(4,*) ' IFAIL IS ', IFAIL
      DO 50,I=1,OBS
   50 R(I)=E(I)-A(I)
      WRITE(4,250)
  250 FORMAT(1H1,T3,'VECTOR OF RESIDUALS')
C     CALCUL OF THE STANDARD ERRORS
C     ESTIMATION OF S2
      Y=0.0
      DO 45,I=1,OBS
   45 Y=Y+(E(I)-A(I))**2
      S=(1.0/(OBS-171.0))*Y
      WRITE(4,*) 'VALUE OF Y IS',Y
      WRITE(4,*) 'VALUE OF S IS',S
C     CALCUL OF THE COVARIANCE MATRIX
      IFAIL=1
C       CALCUL OF THE MEAN VALUES
      DO 32,J=1,VAR
      DO 38,I=1,OBS
   38 B1(J)=B1(J)+B(I,J)
   32 B1(J)=B1(J)/VAR
C        CALCUL OF THE MOMENTS
      DO 37,K=1,VAR
      DO 37,J=1,VAR
      DO 37,I=1,OBS
   37 M(K,J)=M(K,J)+(B(I,K)-B1(K))*(B(I,J)-B1(J))
      CALL F01AAF(M,VAR,VAR,UNIT,VAR,WKSPCE,IFAIL)
      IF(IFAIL.NE.0) WRITE(4,*) ' IFAIL IS ', IFAIL
      DO 55,J=1,VAR
      X1(J)=S*UNIT(J,J)
   55 X2(J)=SQRT(X1(J))
      WRITE(4,650)
  650 FORMAT(1H1,T3,'STANDARD ERRORS')
   60 WRITE(4,300)(X2(J),J=1,VAR)
  300 FORMAT(//10F12.6)
      WRITE(7,750)(X2(J),J=1,VAR)
  750 FORMAT(6F13.6)
      DO 66,I=1,VAR
      DO 66,J=1,VAR
```

```
   66 COV(I,J)=S*UNIT(I,J)
      WRITE(4,280)
  280  FORMAT(//1H0,T5,'MATRIX OF THE MOMENTS')
      DO 39,I=1,VAR
   39 WRITE(6,750)(COV(I,J),J=1,VAR)
C     CALCUL OF THE T VALUES
      DO 65,I=1,VAR
   65 T(I)=DELTA(I)/X2(I)
      WRITE(4,350)
  350 FORMAT(///1H0,T5,'T VALUES')
      WRITE(4,300)(T(I),I=1,VAR)
C     CALCUL OF THE CONFIDENCE INTERVALS
      DO 70,I=1,VAR
      LB(I)=DELTA(I)-1.96*X2(I)
   70 UB(I)=DELTA(I)+1.96*X2(I)
  380 FORMAT(///1H0,T5,'95% CONFIDENCE INTERVALS')
      WRITE(4,380)
      WRITE(4,400)
  400 FORMAT(1H0,3X,'L. BOUND',10X,'U. BOUND')
      WRITE(4,450)(LB(I),UB(I),I=1,VAR)
  450 FORMAT(1H0,F14.8,10X,F14.8)
C       CALCUL OF CORRELATION COEFICIENT
       TSS=0.0
      F=0.0
      DO 86,I=1,OBS
   86 F=F+E(I)
      F=F/OBS
      DO 85,I=1,OBS
   85 TSS=TSS+(E(I)-F)**2
      DO 88,J=1,VAR
      DO 88,I=1,OBS
   88 AA(I)=AA(I)+B(I,J)*DELTA(J)
      ESS=0.0
      DO 89,I=1,OBS
   89 ESS=ESS+(AA(I)-F)**2
      CORR=ESS/TSS
      WRITE(4,500)
  500 FORMAT(//1H0,T5,'CORRELATION COEF.  R-SQUARE')
      WRITE(4,550)(CORR)
  550 FORMAT(1H0,F10.6)
      WRITE(4,555)
  555 FORMAT(///1HO,T5,'F-VALUE')
      FF=(CORR/VAR)/((1-CORR)/(OBS-VAR+1))
      WRITE(4,550)(FF)
      STOP
      END
```

```
PROGRAM  PROBSTAK(LIS)



/*ST=(MFZ,SP),TI=4,C=A
LIBRARY(PROCLIB)
NEWPROC.
FTN5(DB=0/PMD)
LGO(,,,,SVFILE)
PUTFEP(SVFILE,$PPP1(LIS)$)
####S
      PROGRAM PROB(INPUT,OUTPUT,TAPE3=INPUT,TAPE4=OUTPUT,TAPE5)
      PARAMETER (IXOG=4)
      REAL DR(1,IXOG),DP(1,IXOG),X(11,IXOG)
      DIMENSION A(1,7),B(1,6),S(11),T(11),P(11,13)
      DO 10,I=1,11
      S(I)=0.0
   10 T(I)=0.0
      DO 15,I=1,11
      DO 15,J=1,13
   15 P(I,J)=0.0
      WRITE(4,150)
  150 FORMAT (1H1,T5,'MATRIX X')
      DO 16,I=1,11
      READ(3,300)(X(I,J),J=1,IXOG)
   16 WRITE(4,300)(X(I,J),J=1,IXOG)
  300 FORMAT(4F8.4)
      READ(3,400)(DR(1,I),I=1,IXOG)
      WRITE(4,500)(DR(1,I),I=1,IXOG)
  400 FORMAT(7F9.5)
  500 FORMAT(///,7F9.5)
      READ(3,400)(DP(1,I),I=1,IXOG)
      WRITE(4,500)(DP(1,I),I=1,IXOG)
      READ(3,400)(A(1,I),I=1,7)
      WRITE(4,500)(A(1,I),I=1,7)
      READ(3,400)(B(1,I),I=1,6)
      WRITE(4,500)(B(1,I),I=1,6)
      DO 20,I=1,11
      DO 20,J=1,IXOG
      S(I)=S(I)+DR(1,J)*X(I,J)
   20 T(I)=T(I)+DP(1,J)*X(I,J)
      DO 30,I=1,11
      DO 30,K=1,7
   30 P(I,2*K-1)=A(1,K)+S(I)
      DO 40,I=1,11
      DO 40,K=1,6
   40 P(I,2*K)=B(1,K)+T(I)
      WRITE(4,100)
  100 FORMAT (1H1,T5,'MATRIX OF PROBABILITIES')
      DO 50,I=1,11
   50 WRITE(4,200)(P(I,J),J=1,13)
  200 FORMAT (///1H0,13F9.5)
      WRITE(4,100)
      DO 60,I=1,11
   60 WRITE(4,250)(P(I,J),J=1,13)
  250 FORMAT(1H0,13F5.2)
      DO 66,I=1,11
   66 WRITE(5,255)(P(I,J),J=1,13)
  255 FORMAT(13F6.3)
      STOP
```

```
      END
####S
  0.7503  0.1949  0.3827 -0.9660
 -2.3586 -0.7718 -2.3607 -1.3246
 -0.5382 -0.3897 -0.2562 -0.7686
  0.2419 -0.7425  1.0614 -0.6506
  0.3328  2.6972  0.5511 -0.7596
 -1.0675 -0.6047 -1.0996 -0.0936
  0.3874 -0.2857  0.2055  0.4229
  0.2240 -0.0844  0.2749  0.2637
  1.0314 -0.0238  0.8256  0.9930
  1.0057  0.6884  0.7949  1.0422
 -0.0094 -0.6779 -0.3796  1.8412
  0.08795  0.01667 -0.08104  0.00957
 -0.12930 -0.04478  0.13560 -0.02414
  0.13383  0.37412  0.66057  0.23140 -0.03449  0.89760  0.30535
  0.60558  0.35691  0.67934  0.92150  0.15155  0.70414
####S
```

PROGRAM COVAR2

```
/*ST=(MFZ,SP),TI=8,C=B
LIBRARY(PROCLIB)
NEWPROC.
GETFEP(DATA,COV1)
FTN5(DB=0/PMD)
LGO(DATA,,OUT,OUT1,OUT2)
PUTFEP(OUT,$COVV1(CB)$)
PUTFEP(OUT1,$COVV1(LEI)$)
PUTFEP(OUT2,$COVV1(SET)$)
####S
      PROGRAM COV(INPUT,TAPE3=INPUT,TAPE4,TAPE5,TAPE6,TAPE7,TAPE8)
      PARAMETER(IXOG=5,IPAR=2*IXOG,IPAR1=4*IXOG,IPAR2=6*IXOG)
      DIMENSION A(170,170),B(13+IPAR,13+IPAR),C(13+IPAR,13+IPAR)
      DIMENSION D(13+IPAR,13+IPAR)
       DO 10,I=1,13+IPAR
       DO 10,J=1,13+IPAR
       B(I,J)=0.0
       C(I,J)=0.0
   10  D(I,J)=0.0
       DO 15,I=1,170
  15  READ(3,100)(A(I,J),J=1,170)
 100  FORMAT(6F13.6)
      DO 20,I=1,13
      DO 20,J=1,13
      B(I,J)=A(I,J)
      C(I,J)=A(I,J)
  20  D(I,J)=A(I,J)
      DO 30,I=1,IPAR
      DO 30,J=1,IPAR
      B(I+13,J+13)=A(I+123,J+123)
      C(I+13,J+13)=A(I+IPAR+123,J+IPAR+123)
  30  D(I+13,J+13)=A(I+IPAR1+123,J+IPAR1+123)
      DO 40,I=1,13
      DO 40,J=1,IPAR
      B(I,J+13)=A(I,J+123)
      C(I,J+13)=A(I,J+IPAR+123)
  40  D(I,J+13)=A(I,J+IPAR1+123)
      DO 50,I=1,IPAR+13
  50  WRITE(4,100)(B(I,J),J=1,IPAR+13)
      DO 60,I=1,IPAR+13
  60  WRITE(5,100)(C(I,J),J=1,IPAR+13)
      DO 70,I=1,IPAR+13
  70  WRITE(6,100)(D(I,J),J=1,IPAR+13)
      STOP
      END
```

NOTE: A summary description of the programs is presented in Appendix G

Table F.1

Pupil - Teacher Ratio (PUTEA)

District Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu	WHOLE COUNTRY
1971	18.0	18.5	18.8	21.5	19.8	15.0	20.7	23.0	19.3	20.8	18.4	16.5	19.3	20.3	19.7	18.4	20.2	20.2	18.8
1972	17.1	15.5	17.5	16.6	17.8	14.2	15.6	18.9	15.7	17.6	17.4	16.0	15.8	17.5	21.4	17.2	20.3	18.3	17.2
1973	17.8	15.6	17.6	17.4	19.3	12.3	16.0	19.0	16.4	14.2	17.3	16.2	16.5	17.1	19.9	17.2	17.6	16.5	16.8
1974	15.2	16.8	18.1	17.4	16.7	12.5	12.4	17.4	16.4	14.7	17.4	13.9	16.6	15.2	21.3	15.9	17.2	16.5	16.5
1975	12.2	14.3	15.2	15.2	15.5	11.3	10.8	13.5	14.0	11.4	15.5	9.9	15.8	12.2	14.5	14.6	19.4	14.2	14.1
1976	13.4	15.4	14.2	15.4	15.5	11.6	12.4	14.8	18.6	14.1	14.6	13.0	16.3	14.1	14.5	13.7	18.2	17.3	14.5
1977	15.3	12.9	14.1	13.4	14.1	11.8	12.4	14.0	13.7	12.3	14.6	12.3	14.5	13.3	13.0	13.0	15.8	14.1	13.7
1978	13.6	14.5	14.3	13.3	14.0	12.9	12.4	14.0	14.4	14.0	14.8	12.9	14.5	13.6	15.1	14.3	14.6	14.6	14.3
1979	14.2	12.2	14.1	13.0	13.9	12.2	12.4	12.6	14.1	13.7	12.8	12.2	13.9	12.9	13.5	12.2	12.3	13.0	13.2
1980	13.0	12.0	13.5	12.4	11.8	11.1	12.0	11.5	14.8	11.9	13.1	11.6	12.2	11.8	12.9	12.5	12.1	9.8	12.4
1981	13.2	10.3	11.3	12.6	12.4	11.1	10.5	12.6	13.4	12.2	12.6	10.8	12.1	12.1	12.4	12.1	15.2	12.0	12.2

NOTE: The data refer to Public Schools only

Source: INE, Statistics of Education

Table F.2

Pupil - Classroom Ratio (PUCLASS)

District Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu	WHOLE COUNTRY
1971	33.0	33.3	33.7	38.7	32.4	30.8	25.4	45.0	29.7	40.1	46.4	26.7	38.4	29.0	46.6	36.9	32.6	34.3	38.0
1972	40.0	44.5	37.1	37.0	46.3	36.0	34.2	55.6	30.8	50.0	53.4	31.5	48.4	47.2	45.5	31.7	51.3	35.1	51.0
1973	41.0	31.3	42.9	40.6	60.2	39.8	41.6	59.6	50.2	39.9	57.7	35.1	53.0	46.3	52.6	42.0	53.3	35.7	47.0
1974	40.0	33.7	56.3	63.5	47.6	39.4	55.4	53.3	37.4	47.7	67.3	34.2	56.0	47.7	53.9	63.8	55.9	49.4	52.8
1975	44.1	41.5	61.9	51.2	46.2	39.8	35.3	51.7	36.3	45.2	61.0	26.6	60.1	50.5	52.9	59.1	41.0	46.5	51.0
1976	44.3	48.2	47.4	40.4	48.1	45.2	40.0	43.9	37.8	45.6	56.8	37.9	53.3	41.9	56.0	49.9	50.8	46.1	48.7
1977	45.8	53.4	51.2	44.7	43.6	47.1	41.0	47.7	32.6	44.6	54.2	31.4	50.9	42.3	51.0	57.2	45.5	44.2	47.9
1978	45.2	53.5	51.4	43.4	44.7	44.0	34.4	50.7	33.6	43.1	56.0	36.4	48.9	44.9	53.0	52.1	44.5	41.6	47.7
1979	44.7	54.8	52.8	43.4	45.0	45.2	35.5	50.1	34.8	44.1	57.5	35.2	50.2	45.1	52.5	53.2	45.5	42.8	47.3
1980	43.7	54.0	51.9	42.8	44.8	45.0	35.7	49.3	35.7	44.0	57.0	34.3	49.7	46.2	51.8	52.4	43.8	43.2	46.8
1981	42.1	53.8	51.5	43.0	44.4	44.2	36.0	45.0	36.2	43.7	56.8	34.2	49.5	46.8	52.1	51.8	43.5	43.0	45.3

SOURCE: INE, Statistics of Education

Table F.3

Percentage of Students who use the School Busing (BUS)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu	WHOLE COUNTRY
1971	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
1972	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
1973	1.8	2.6	0.4	1.5	7.9	5.3	6.2	0.2	26.2	3.6	0.7	6.8	0.3	3.6	2.3	15.3	9.3	12.8	3.5
1974	2.5	10.4	3.0	4.3	18.7	7.0	10.2	0.5	32.7	11.3	0.7	6.8	1.6	8.4	3.0	12.0	14.3	22.4	5.6
1975	6.0	15.0	4.8	12.9	26.4	16.8	16.7	8.5	36.1	16.0	3.0	19.4	3.2	14.4	3.8	18.6	12.4	20.3	9.5
1976	13.3	37.1	11.0	25.7	39.8	16.2	26.7	19.7	40.4	28.6	4.6	30.0	6.8	25.0	8.5	34.9	27.2	27.2	16.3
1977	14.7	35.5	13.0	24.3	42.7	16.1	20.2	17.4	42.5	24.8	3.2	32.0	8.3	19.1	7.1	36.0	28.0	30.1	14.8
1978	16.4	39.0	16.9	33.3	41.0	19.1	24.0	26.9	45.6	28.7	4.4	33.6	9.5	24.7	10.3	28.1	36.3	33.6	17.8
1979	21.7	33.8	23.4	36.4	40.7	18.5	28.7	28.7	46.8	35.1	5.7	30.8	10.0	33.5	14.7	30.0	36.7	33.9	19.7
1980	26.5	43.1	29.3	42.0	44.5	24.6	26.4	33.3	51.9	39.1	10.2	31.7	18.7	43.8	18.8	36.9	43.4	37.2	25.5
1981	31.9	44.5	40.2	44.1	47.6	24.7	26.8	36.0	51.3	40.4	13.3	34.0	19.0	45.0	19.8	34.7	47.4	38.8	28.0

SOURCE: IASE, Ministry of Education

Table F.4

Percentage of Students who get Scholarships from the Social Services (HELP)

District	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu	WHOLE COUNTRY
Year																			
1971	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1973	9.8	16.5	14.9	9.9	15.5	13.7	10.4	11.1	13.4	9.6	9.7	16.6	13.9	11.0	13.7	13.2	17.0	17.3	12.8
1974	13.5	19.7	15.9	16.2	17.7	13.7	19.2	14.5	16.5	14.4	10.8	19.2	13.1	12.3	13.6	15.8	20.5	17.1	13.8
1975	12.4	18.8	16.4	14.0	17.9	17.2	17.6	18.8	11.6	12.6	11.0	20.7	19.2	12.6	14.0	16.1	20.2	15.8	16.2
1976	15.0	29.9	23.1	26.7	23.3	24.2	29.2	24.9	21.5	21.4	21.3	23.0	19.0	15.8	19.9	18.2	39.2	29.3	21.7
1977	13.8	30.9	21.0	24.6	21.8	14.2	15.7	21.9	17.8	20.3	10.0	23.1	12.6	13.5	7.8	24.3	36.0	26.0	15.9
1978	13.1	27.5	23.1	23.9	22.1	13.3	16.8	20.6	21.7	17.4	10.7	18.5	12.9	17.0	8.9	30.4	18.0	25.5	15.9
1979	12.8	25.0	24.0	29.5	19.8	13.0	17.7	19.5	21.0	18.4	15.3	23.1	14.0	17.9	9.7	27.8	30.7	26.2	16.1
1980	16.3	34.0	26.8	39.7	22.9	17.1	20.7	24.6	26.8	21.9	16.3	23.5	18.8	22.1	12.1	30.8	40.7	32.8	20.0
1981	20.1	35.1	34.1	40.9	26.2	17.6	24.4	24.4	29.8	40.0	13.8	29.7	26.5	23.8	15.0	27.9	56.7	34.9	24.4

SOURCE: IASE, Ministry of Education

Table F.5

Percentage of Teachers without Qualification (UNQUAL)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu	WHOLE COUNTRY
1971	30.9	50.2	29.9	60.2	52.1	28.4	60.2	35.7	58.2	43.6	18.1	53.2	25.3	43.2	45.3	52.0	59.1	54.2	51.9
1972	28.1	46.5	26.5	50.1	49.8	25.3	50.2	33.2	55.2	43.1	14.8	50.2	22.5	40.5	42.1	50.0	54.3	42.6	42.6
1973	26.7	38.2	26.0	46.3	46.5	22.5	44.2	30.9	47.3	36.9	11.2	44.6	20.3	36.7	40.2	48.0	49.2	38.2	35.5
1974	18.5	35.1	25.3	44.1	42.3	19.9	46.9	28.7	48.2	35.2	15.7	40.3	16.5	34.1	36.5	42.0	45.1	35.4	30.4
1975	16.6	32.0	24.4	40.1	40.3	17.7	35.3	25.9	35.6	32.4	13.1	39.1	14.2	32.5	34.1	40.0	40.2	32.6	25.8
1976	15.1	31.2	23.4	36.5	35.2	15.8	30.2	24.6	34.2	29.1	11.0	38.2	12.1	29.6	30.2	39.0	32.6	29.4	22.3
1977	13.8	30.1	22.2	32.3	33.4	14.2	29.1	22.3	30.1	27.2	9.7	35.4	12.1	27.3	25.3	33.2	33.1	27.6	19.5
1978	12.9	29.2	20.9	31.9	27.2	12.9	27.4	20.1	27.2	24.1	7.9	33.2	10.7	25.4	22.1	27.8	27.6	25.3	17.4
1979	12.2	28.2	19.5	29.2	24.1	11.8	25.9	18.7	25.2	20.4	7.1	30.1	9.5	20.3	18.1	25.3	25.8	22.5	15.9
1980	11.9	27.7	17.5	27.0	23.0	11.1	25.4	17.9	23.3	18.3	6.1	27.1	8.7	19.5	17.2	21.6	25.0	20.5	13.5
1981	11.6	35.7	17.2	30.4	21.9	10.8	32.1	24.4	24.9	19.2	7.4	26.7	8.8	21.7	19.5	19.4	26.1	20.0	16.4

SOURCE DGEB and DGES/Ministry of Education
GEP/Analise Conjuntural 1983,1984 - Ministry of Education

Table F.6

Life Expectation at Birth (LIFE)*

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu	WHOLE COUNTRY
1971	68.08	68.31	66.67	63.99	70.15	66.04	67.80	71.60	67.90	68.75	65.72	69.43	65.03	70.59	72.91	68.92	52.60	66.18	67.16
1972	68.52	68.60	67.17	64.43	70.30	66.24	68.09	71.91	68.28	68.97	66.10	69.63	65.53	70.73	73.21	69.28	52.71	66.61	67.56
1973	68.99	68.97	67.71	64.97	70.53	66.59	68.49	72.21	68.68	69.24	66.60	69.92	66.12	70.91	73.46	69.66	53.29	67.11	68.02
1974	69.47	69.41	68.29	65.62	70.83	67.11	69.00	72.48	69.12	69.55	67.22	70.29	66.79	71.12	73.68	70.05	54.33	67.65	68.55
1975	69.96	69.93	68.89	66.36	71.19	67.78	69.64	72.74	69.59	69.91	67.96	70.74	67.54	71.37	73.85	70.47	55.82	68.26	69.14
1976	70.47	70.52	69.53	67.20	71.62	68.61	70.39	72.97	70.09	70.31	68.82	71.28	68.37	71.66	73.98	70.90	57.78	68.92	69.80
1977	70.99	71.19	70.19	68.15	72.12	69.60	71.26	73.19	70.63	70.76	69.81	71.90	69.28	71.98	74.04	71.36	60.19	69.64	70.52
1978	71.52	71.94	70.89	69.20	72.68	70.74	72.25	73.38	71.20	71.25	70.91	72.60	70.28	72.34	74.10	71.83	63.06	70.42	71.30
1979	72.08	72.76	71.63	70.35	73.32	72.04	73.35	73.56	71.80	71.79	72.14	73.39	71.35	72.73	74.10	72.32	66.40	71.26	72.15
1980	72.64	73.66	72.39	71.60	74.02	73.50	74.57	73.71	72.43	72.37	73.49	74.26	72.51	73.16	74.04	72.83	70.19	72.15	73.06
1981	73.22	74.63	73.19	72.95	74.79	75.12	75.91	73.84	73.10	73.00	74.96	75.22	73.75	73.63	73.96	73.36	74.44	73.10	74.04

SOURCE INE National Institute of Statistics
Estudos 56, Tabuas abreviadas de Mortalidade 1941-1975, M J. Carrilho (1980)

* the values for some intermediate years have been estimated using equation $y = a + bx^2$

table F.7

Illiteracy Rate (ILLIT)*

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu	WHOLE COUNTRY
1971	20.1	40.0	25.0	33.0	37.5	27.7	34.4	33.6	33.5	29.8	16.0	38.0	18.3	30.0	24.0	28.0	30.8	30.1	24.9
1972	19.5	39.5	24.2	32.4	37.0	27.1	33.9	32.9	32.9	29.1	15.5	37.6	17.7	29.2	23.2	27.4	30.2	29.5	24.2
1973	18.9	39.0	23.4	31.9	36.5	26.4	33.3	32.3	32.3	28.3	15.0	37.1	17.1	28.5	22.4	27.4	29.5	28.9	23.5
1974	18.3	38.4	22.6	31.3	36.0	25.7	32.7	31.6	31.7	27.6	14.5	36.5	16.5	27.8	21.6	26.2	28.9	28.3	22.8
1975	17.8	38.0	21.8	30.7	35.4	25.0	32.1	30.8	31.0	26.9	14.0	36.0	16.0	27.2	20.8	25.7	28.3	27.7	22.2
1976	17.3	37.4	21.1	30.1	34.9	24.3	31.5	30.1	30.3	26.1	13.8	35.4	15.4	26.5	20.0	25.1	27.7	27.1	21.5
1977	16.8	36.9	20.3	29.5	34.3	23.5	30.9	29.3	29.6	25.4	13.0	34.8	14.9	25.8	19.3	24.6	27.1	26.5	20.8
1978	16.4	36.5	19.6	28.9	33.7	22.8	30.2	28.5	28.8	24.7	12.6	34.1	14.5	25.2	18.6	24.1	26.5	25.9	20.1
1979	16.0	36.0	18.9	28.3	33.1	22.0	29.6	27.7	28.0	24.0	12.1	33.5	14.0	24.6	17.9	23.7	25.9	25.3	19.6
1980	15.6	35.5	18.3	27.6	32.4	21.3	29.0	26.8	27.2	23.2	11.6	32.8	13.6	24.0	17.2	23.2	25.3	24.6	18.9
1981	15.3	35.1	17.7	27.0	31.8	20.5	28.3	25.9	26.4	22.5	11.1	32.1	13.2	23.4	16.5	22.8	24.7	24.0	18.3

SOURCE: Ministry of Education, D.G.E.A.

* the values for some intermediate years have been estimated using equation $y = a + bx + cx^2$

Table F.8

Number of Unemployed Workers (UNEMP)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu	WHOLE COUNTRY
1971*	1974	1269	2894	406	612	2958	2437	4864	316	1995	13322	2082	7915	2196	5710	1201	643	1191	52985
1972*	2677	1361	4476	526	1018	4011	2614	5116	526	2705	16345	1161	12235	2800	7004	1857	833	1979	69244
1973*	3001	1331	4490	564	1515	4496	2556	5496	781	3033	14584	1135	12277	3272	6235	1863	893	1947	70433
1974*	5092	2796	6242	790	2001	7628	5371	8318	1031	5145	25064	2385	27069	5109	10741	2590	1419	4891	112682
1975	6400	2142	8831	1557	2621	9595	4114	8955	1348	6498	39232	1823	24115	6473	14613	3669	2465	5111	140922
1976	10105	4693	14149	2153	3814	11419	5156	12676	1947	8812	49736	2171	31067	13132	22870	5687	3234	7232	210053
1977	15341	6506	18374	5189	5078	15419	3806	15728	4174	12300	53280	2351	37610	14226	24753	8389	5537	9810	257871
1978	17201	7224	23986	6179	6022	18374	5253	16302	5031	13261	69515	2412	42188	15944	29213	8804	6740	10739	304388
1979	17487	7161	23504	5685	5061	18461	6369	15502	4846	10882	76567	2482	45601	13511	30755	8728	4794	11572	308963
1980	14329	6623	23474	5935	6866	14355	6915	13005	2778	10269	59347	2757	40434	12219	27274	7535	5437	11738	269290
1981	14814	8290	19370	3254	5276	15024	6803	11820	3271	9025	52506	2628	28507	14701	27011	5796	4127	12147	244470

SOURCE: MT/SNE - Employment Service of the Ministry of Labour

* Estimated values by district using the same districtal distribution observed in 1975

Table F.9

Mean Values of the Monthly Earnings (at 1970 prices) (EARN)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guerda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu	WHOLE COUNTRY
1971*	1703	1949	1553	1962	1851	2040	2053	1773	1697	1934	2993	1672	1924	1955	2726	1843	1670	1803	1947
1972*	1703	1949	1553	1962	1851	2040	2053	1773	1637	1934	2993	1672	1924	1955	2726	1843	1670	1803	1947
1973	1703	1949	1553	1962	1851	2040	2053	1773	1637	1934	2993	1672	1924	1955	2726	1843	1670	1803	1947
1974	2509	2844	2161	2710	2468	2529	2880	2638	2537	2626	3865	2490	2632	2624	3776	2669	2343	2307	3071
1975	2649	2964	2486	3331	3039	2865	2983	2782	2531	2721	3596	2979	2899	2778	3531	2890	2911	2917	3156
1976	2668	2788	2254	2760	2584	2700	2840	2694	2651	2563	3428	2538	2683	2682	3110	2632	2460	2478	2910
1977	2462	2588	2113	2530	2295	2666	2636	2530	2358	2544	3061	2364	2515	2511	2850	2570	2317	2439	2698
1978	2419	2463	2063	2463	2166	2463	2621	2390	2273	2527	3094	2394	2509	2547	2724	2540	2330	2365	2650
1979	2220	2409	1968	2563	2032	2299	2443	2294	2098	2321	2957	2405	2342	2282	2629	2312	2258	2273	2524
1980	2293	2478	2106	2651	2248	2487	2570	2338	2312	2472	2948	2500	2501	2338	3002	2466	2264	2384	2615
1981	2341	2557	2101	2758	2257	2442	2676	2440	2071	2412	3178	2332	2422	2419	3035	2278	2302	2429	2674

SOURCE: MT/DEP (Inquerito de Niveis)

* Due to the unavailability of data referring to 1971 and 1972 it has been assumed that these years have real salaries equal to 1973.

TABLE E10: Pupil and Teacher Ratio (PUTEA)
(Standardised Values)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu
1971	5.21	5.80	4.71	7.40	5.37	6.93	8.23	6.96	6.30	7.86	4.97	4.91	4.67	7.06	3.22	5.57	4.11	5.61
1972	3.71	1.59	3.08	1.59	2.85	4.81	2.45	3.12	0.30	4.01	3.35	4.18	0.93	3.62	4.81	3.82	4.22	3.52
1973	4.88	1.76	3.22	2.52	4.74	-0.17	2.89	3.22	1.46	-0.07	3.25	4.48	2.02	3.12	3.42	3.82	1.13	1.53
1974	0.63	3.42	3.91	2.52	1.46	0.36	-1.16	1.72	1.46	0.53	3.35	1.03	2.19	0.80	4.71	1.86	0.66	1.53
1975	-4.28	-0.10	-0.20	-0.10	-0.03	-2.82	-2.91	-1.96	-2.55	-3.45	-0.30	-4.94	0.90	-2.89	-1.56	-0.07	3.18	-1.03
1976	-2.32	1.46	-1.63	0.13	-0.03	-1.99	-1.16	-0.73	5.11	-0.20	-1.16	-0.30	1.69	-0.56	-1.56	-1.39	1.79	-2.39
1977	0.76	-2.09	-1.76	-2.26	-1.79	-1.49	-1.16	-1.46	-3.05	-2.35	-1.16	-1.36	-1.16	-1.53	-2.95	-2.39	-0.96	-1.13
1978	-1.99	0.20	-1.46	-2.35	-1.92	1.43	-1.16	-1.46	-1.89	-0.30	-0.83	-0.46	-1.16	-1.16	-1.03	-0.53	-2.32	-0.60
1979	-1.03	-3.05	-1.76	-2.72	-2.06	-0.43	-1.16	-2.79	-2.39	-0.07	-4.08	-1.49	-2.12	-2.05	-2.49	-3.65	-4.97	-2.51
1980	-2.98	-3.32	-2.57	-3.45	-4.64	-3.32	-1.59	-3.82	-1.23	-2.85	-3.58	-2.42	-4.77	3.38	-3.05	-3.18	-5.21	-5.94
1981	-2.65	-5.70	-5.74	-3.45	-3.95	-3.32	-3.25	-2.79	-3.58	-2.52	-4.41	-3.62	-4.98	-3.02	-3.52	-3.78	-1.63	-3.48

TABLE F.11: Pupil and Classroom Ratio (PUCLASS)
(Standardised Values)

istrict / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu
1971	-8.32	-4.38	-6.14	-2.59	-6.96	-7.16	-5.54	-3.58	-3.81	-4.81	-6.80	-5.74	-7.60	-9.02	-5.47	-4.54	-6.87	-5.14
1972	-1.96	-0.33	-4.78	-3.38	0.30	-3.71	-1.59	3.75	-3.15	6.40	-2.16	-1.39	-1.46	1.69	-6.67	-3.65	2.69	-4.61
1973	-1.06	-5.11	-2.42	-1.72	7.53	-1.16	-1.76	6.53	8.76	-5.07	0.63	1.86	1.39	1.16	1.06	-2.79	3.68	-4.21
1974	-1.96	-4.25	2.98	8.66	0.93	-1.43	8.03	2.16	0.90	3.78	6.90	1.06	3.22	1.99	2.45	4.78	5.01	4.94
1975	1.76	-1.46	5.24	3.05	0.23	-1.16	-1.06	1.06	0.23	0.96	2.82	-5.80	5.74	3.62	1.39	3.15	-2.59	3.02
1976	1.93	0.90	-0.63	-1.82	1.23	2.52	1.06	-4.34	1.19	1.39	0.03	4.38	1.56	-1.49	4.75	-0.03	2.42	2.75
1977	3.28	2.75	0.93	0.13	-1.13	3.81	1.49	-1.72	-2.02	0.27	-1.66	-1.53	0.10	-1.19	-0.66	2.49	-0.30	1.49
1978	2.72	2.79	0.99	-0.46	-0.53	1.66	-1.49	0.36	-1.43	-1.43	-0.50	3.02	-1.19	0.33	1.49	0.73	-0.80	-0.27
1979	2.29	3.25	1.56	-0.46	-0.40	2.52	-0.99	-0.03	-0.70	-0.30	0.50	1.96	-0.33	0.43	0.96	1.09	-0.80	0.53
1980	1.39	2.98	1.19	-0.73	-0.50	2.38	-0.90	-0.60	-0.13	-0.40	0.20	1.13	-0.66	1.06	0.20	0.83	-1.16	0.83
1981	0.07	2.92	1.06	-0.66	-0.70	1.82	-0.76	-3.58	0.17	-0.76	0.03	1.06	-0.76	1.43	0.50	0.63	-1.29	0.66

TABLE F.12: Percentage of Students Who Use the School Busing (BUS) (Standardised Values)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu
1971	-3.65	-4.34	-3.18	-3.91	-5.04	-4.97	-5.07	-3.62	-6.10	-4.48	-3.22	-4.74	-3.35	-4.01	-3.75	-5.31	-4.54	-5.57
1972	-3.65	-4.34	-3.18	-3.91	-5.04	-4.97	-5.07	-3.62	-6.10	-4.48	-3.22	-4.74	-3.35	-4.01	-3.75	-5.31	-4.54	-5.57
1973	-3.12	-3.88	-3.09	-3.62	-3.65	-3.05	-3.22	-3.58	-1.39	-3.71	-2.69	-3.18	-3.22	-3.28	-2.65	-1.69	-2.72	-2.52
1974	-2.89	-2.45	-2.45	-3.08	-1.69	-2.39	-2.02	-3.48	-0.23	-2.06	-2.69	-3.18	-2.59	-2.32	-2.32	-2.45	-1.76	-0.20
1975	-1.86	-1.59	-2.02	-1.43	-0.30	1.23	-0.07	-1.63	0.40	-1.03	-0.90	-0.23	-1.86	-1.09	-1.96	-0.90	-2.12	-0.73
1976	0.30	2.45	-0.46	1.03	2.09	0.99	2.95	0.96	1.16	1.72	0.33	2.22	-0.10	1.06	0.23	2.95	0.80	0.93
1977	0.73	2.16	0.03	0.73	2.62	0.96	0.99	0.43	1.53	0.90	-0.73	2.69	0.60	-0.13	0.43	3.22	0.93	1.63
1978	1.23	2.79	0.99	2.45	2.32	2.09	2.12	2.62	2.09	1.76	0.20	3.05	1.16	0.99	1.06	1.36	2.59	2.45
1979	2.82	1.86	2.59	3.05	2.26	1.87	3.55	3.05	2.32	3.12	1.19	2.42	1.43	2.79	3.08	1.79	2.65	2.55
1980	4.25	3.55	4.01	4.15	2.92	4.12	2.85	4.11	3.22	3.98	4.64	2.59	5.57	4.88	5.01	3.42	3.98	3.31
1981	5.84	3.81	6.77	4.54	3.52	4.15	2.98	4.74	3.12	4.28	7.06	3.12	5.20	5.14	5.47	2.92	4.74	3.71

TABLE E13: Percentage of Students Who Get Scholarships from the Social Services (HELP) (Standardised Values)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu
1971	-6.10	-5.84	-5.74	-4.88	-6.34	-6.00	-5.70	-5.94	-5.61	-4.78	-5.64	-6.27	-5.70	-5.73	-5.64	-5.57	-4.84	-5.70
1972	-6.10	-5.84	-5.74	-4.88	-6.34	-6.00	-5.70	-5.94	-5.61	-4.78	-5.64	-6.27	-5.70	-5.73	-5.64	-5.57	-4.84	-5.70
1973	-0.93	-1.36	-1.03	-2.52	-0.56	0.27	-1.93	-1.93	-1.06	-1.92	-0.56	-0.46	0.10	-0.99	1.79	-1.63	-1.59	-0.86
1974	1.06	-0.50	-0.70	-1.03	0.27	0.27	1.33	-0.70	0.03	-0.50	-0.00	0.43	-0.23	-0.50	1.66	-0.83	-0.93	-0.93
1975	0.46	-0.76	-0.53	-1.56	0.33	1.89	0.73	0.86	-1.63	-1.03	0.10	0.96	2.32	-0.30	1.92	-0.76	-0.99	-1.29
1976	1.86	2.26	1.59	1.49	2.32	5.11	4.97	3.08	1.76	1.63	5.47	1.76	2.26	1.09	5.14	-0.13	2.65	2.45
1977	1.19	2.52	0.90	0.99	1.79	0.50	0.03	1.99	0.50	1.29	-0.43	1.79	-0.43	0.10	-1.43	1.76	1.99	1.56
1978	0.83	1.59	1.59	0.80	1.89	0.10	0.43	1.53	1.82	0.43	-0.07	0.20	-0.30	1.63	-0.83	3.55	-1.39	1.43
1979	0.66	0.93	1.86	2.16	-1.03	-0.03	0.76	1.13	1.59	0.73	2.35	1.79	0.17	1.99	-0.40	2.75	1.06	1.59
1980	2.52	3.35	2.75	4.57	2.19	1.86	1.86	2.98	3.58	1.75	2.85	1.96	2.12	3.85	0.90	3.65	2.92	3.45
1981	4.54	3.65	5.04	4.84	3.42	2.06	3.22	2.92	4.61	7.16	1.56	4.11	5.41	4.54	2.45	2.79	6.00	4.01

TABLE E15: Life Expectatious at Birth (LIFE)
(Standardised Values)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu
1971	-4.78	-4.05	-4.61	-4.11	-3.11	-3.58	-4.05	-5.61	-4.71	-4.18	-3.95	-3.85	-4.28	-4.05	-7.00	-4.68	-3.28	-4.34
1972	-3.91	-3.59	-3.85	-3.62	-3.52	-3.38	-3.68	-4.25	-3.98	-3.65	-3.55	-3.52	-3.68	-3.62	-4.51	-3.88	-3.22	-3.75
1973	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-3.15	-2.92	-3.15	-3.02	-3.02	-3.02	-3.02	-2.97	-2.45	-3.02	-2.97	-3.02
1974	-2,09	-2.32	-2.16	-2.32	-2.39	-2.45	-2.52	-1.72	-2.29	-2.26	-2.35	-2.39	-2.26	-2.32	-0.63	-2.09	-2.55	-2.26
1975	-1.13	-1.53	-1.23	-1.53	-1.63	-1.72	-1.69	-0.56	-1.33	-1.46	-1.56	-1.63	-1.43	-1.53	0.76	-1.19	-1.86	-1.33
1976	-0.13	-0.60	-0.23	-0.56	-0.73	-0.86	-0.76	0.43	-0.33	-0.53	-0.66	-0.70	-0.43	-0.60	1.86	-0.23	-0.99	-0.43
1977	0.86	0.46	0.76	0.50	0.33	0.20	0.40	1.39	0.73	0.53	0.40	0.33	0.56	0.50	2.32	0.80	0.07	0.66
1978	1.89	1.63	1.82	1.66	1.53	1.46	1.63	2.22	1.89	1.66	1.59	1.53	1.72	1.63	2.82	1.86	1.33	1.72
1979	2.98	2.89	2.95	2.89	2.89	2.82	3.02	3.02	3.08	2.92	2.89	2.85	2.92	2.89	2.82	2.97	2.75	2.95
1980	4.08	4.31	4.18	4:31	4.34	4.41	4.54	3.71	4.38	4.26	4.31	4.38	4.25	4.28	2.32	4.15	4.44	4.21
1981	5.24	5.80	5.37	5.80	6.00	6.14	6.26	4.28	5.70	5.74	5.90	6.00	5.64	5.80	1.66	5.31	6.30	5.57

TABLE E16: Illiteracy Rate (ILLIT)
(Standardised Values)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu
1971	5.47	5.04	5.17	4.88	4.74	4.81	4.81	4.74	4.68	5.04	5.04	4.58	5.34	5.24	5.14	5.31	5.07	4.97
1972	4.18	4.05	4.11	3.91	3.87	3.98	4.01	3.84	3.84	4.04	4.01	3.91	4.17	4.01	4.08	4.14	4.11	3.98
1973	2.98	3.02	3.02	3.05	3.02	3.02	3.02	3.05	3.02	2.95	2.98	3.08	2.98	2.95	3.02	2.98	2.92	2.98
1974	1.72	1.82	1.92	2.06	2.12	2.06	2.06	2.15	2.15	1.99	1.99	2.09	1.82	1.89	1.96	1.86	1.99	1.99
1975	0.73	1.26	0.86	1.06	1.09	1.06	1.06	1.09	1.19	1.09	0.96	1.22	0.87	0.96	0.90	0.90	0.99	0.99
1976	-0.30	-0.20	-0.10	0.07	0.20	0.13	-0.10	0.20	0.20	-0.07	-0.07	0.20	-0.33	-0.10	-0.20	-0.27	-0.13	0.33
1977	-1.33	-1.19	-1.19	-0.93	-0.83	-0.96	-0.90	-0.83	-0.76	-1.03	-1.09	-0.76	-1.29	-1.19	-1.13	-1.22	-1.13	-0.96
1978	-2.19	-1.99	-2.12	-1.92	-1.89	-1.92	-1.99	-1.92	-1.89	-1.99	-1.89	-1.96	-2.09	-2.09	-2.06	-2.18	-2.09	-1.92
1979	-2.98	-2.98	-3.08	-2.92	-2.95	-3.05	-3.02	-2.92	-3.05	-2.95	-2.95	-2.95	-3.05	-2.98	-2.98	-2.95	-3.05	-2.95
1980	-3.81	-4.01	-3.87	-4.11	-4.18	-4.01	-4.01	-4.11	-4.14	-4.05	-3.98	-4.11	-3.83	-3.87	-3.91	-3.91	-3.84	-4.08
1981	-4.48	-4.81	-4.71	-5.14	-5.21	-5.01	-5.14	-5.31	-5.24	-5.01	-5.01	-5.31	-4.61	-4.81	-4.81	-4.71	-4.84	-5.04

TABLE E17: Unemployed Workers (UNEMP)
(Standardised Values)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu
1971	-4.25	-3.88	-4.21	-3.52	-4.84	-4.71	-4.41	-4.44	-3.88	-4.68	-4.31	-5.01	-4.77	-4.41	-4.34	-4.44	-4.01	-4.64
1972	-3.85	-3.75	-3.58	-3.35	-4.15	-4.11	-4.05	-4.25	-3.49	-4.08	-3.88	-4.61	-3.71	-4.05	-3.91	-3.71	-3.71	-4.05
1973	-3.65	-3.78	-3.58	-3.28	-3.28	-3.81	-4.18	-3.94	-3.02	-3.82	-4.15	-4.74	-3.72	-3.82	-4.18	-3.72	-3.65	-3.25
1974	-2.55	-2.02	-2.89	-2.98	-2.45	-1.99	1.43	-1.82	-2.52	-2.06	-2.59	1.82	-2.52	-2.65	-2.65	-2.89	-2.85	-2.52
1975	-1.86	-2.82	-1.56	-1.92	-1.39	-0.86	-1.13	-1.33	-1.92	-0.96	-0.50	-1.13	-0.76	-1.79	-1.36	-1.63	-1.26	-1.56
1976	0.13	0.23	0.20	-1.09	0.63	0.20	0.96	1.49	-0.80	0.99	1.03	0.73	0.96	2.29	1.36	0.66	-0.07	0.10
1977	2.95	2.42	1.56	3.12	2.79	2.52	-1.69	3.82	3.42	3.88	1.56	1.66	2.59	2.95	1.99	3.75	3.42	2.09
1978	3.95	3.28	4.05	4.48	4.41	4.25	1.16	4.25	5.04	4.68	3.94	1.99	3.71	4.01	3.49	4.25	5.27	2.82
1979	4.08	3.22	3.91	3.81	2.75	4.28	3.35	3.65	4.68	2.72	4.97	2.35	4.54	2.52	4.01	4.15	2.29	3.48
1980	2.39	2.55	3.85	4.16	2.42	1.96	4.37	1.76	0.76	2.19	2.45	3.82	3.28	1.69	2.85	2.79	3.28	3.62
1981	2.65	4.54	2.26	0.60	3.12	2.29	4.18	0.83	1.73	1.13	1.46	3.12	0.36	3.25	2.75	0.80	1.29	3.91

TABLE E18: Mean Values of the Monthly Earnings[a] (EARN)
(Standardised Values)

District / Year	Aveiro	Beja	Braga	Braganca	C.Branco	Coimbra	Evora	Faro	Guarda	Leiria	Lisboa	Portalegre	Porto	Santarem	Setubal	V.Castelo	V.Real	Viseu
1971	-4.81	-4.58	-4.68	-4.34	-3.55	-4.37	-4.65	-4.74	-4.58	-4.84	-2.09	-4.71	-4.65	-4.55	-2.32	-4.62	-4.58	-4.52
1972	-4.81	-4.58	-4.68	-4.34	-3.55	-4.37	-4.65	-4.74	-4.58	-4.84	-2.09	-4.71	-4.65	-4.55	-2.32	-4.62	-4.58	-4.52
1973	-4.81	-4.58	-4.68	-4.34	-3.55	-4.37	-4.65	-4.74	-4.58	-4.84	-2.09	-4.71	-4.65	-4.55	-2.32	-4.62	-4.58	-4.52
1974	2.39	3.62	1.79	1.56	2.09	1.33	3.45	2.89	3.31	2.95	7.33	1.69	2.42	2.82	7.13	2.86	1.23	0.31
1975	3.62	4.71	5.27	6.47	7.30	5.24	4.44	4.15	3.28	4.05	4.41	5.51	5.11	4.52	4.91	4.84	6.10	6.17
1976	3.81	3.08	2.79	1.96	3.15	3.33	3.05	3.38	4.31	2.25	2.55	2.06	2.93	3.48	1.13	2.52	2.22	1.96
1977	1.96	1.26	1.29	0.13	0.50	2.92	1.06	1.92	1.76	2.06	-1.36	0.70	1.26	1.59	-1.26	1.96	1.26	1.59
1978	1.56	0.20	0.76	-0.43	-0.66	0.56	0.90	0.70	0.99	1.86	-1.49	0.93	1.19	1.96	-2.59	1.69	1.06	0.86
1979	-0.20	-0.36	-0.27	0.40	-1.89	-1.36	-0.87	-0.17	-0.53	-0.50	-2.49	1.03	-0.46	-0.96	-3.22	-0.36	0.50	0.00
1980	0.53	0.27	1.23	1.06	0.00	0.83	-0.39	0.23	1.36	1.23	-2.59	1.76	1.13	-0.33	0.15	0.99	0.53	1.11
1981	0.86	0.96	1.16	1.89	0.17	0.30	1.49	1.13	-0.76	0.53	-0.07	0.46	0.33	0.56	0.53	-0.66	0.83	1.49

(a) at 1970 prices

TABLE E19: Estimated Values of the a and δ Coefficients, Using Stepwise Regression on the Significant Supply Side and Demand Side Explanatory Variables (Region 1) - Method V

Unrestricted OLS				Restricted OLS			
Coefficient	Estimated Value	Stand Dev.	t-value	Coefficient	Estimated Value	Stand Dev.	t-value
a_{55}	.16	.0097	16.29	a_{55}	.15	.0112	13.02
a_{56}	.77	.1016	7.53	a_{56}	.79	.1055	7.47
a_{66}	.22	.1244	1.75*	a_{66}	.17	.1292	1.34*
a_{67}	.45	.0738	6.07	a_{67}	.30	.0766	3.97
a_{77}	.60	.0844	7.10	a_{77}	.74	.0875	8.50
a_{78}	.74	.0753	9.80	a_{78}	.78	.0895	8.74
a_{88}	.20	.0926	2.17	a_{88}	.13	.1103	1.14*
a_{89}	.83	.0758	11.00	a_{89}	.65	.0863	7.52
a_{99}	.11	.0884	1.26*	a_{99}	.31	.1005	3.04
$a_{9,10}$	.35	.0869	3.98	$a_{9,10}$	.52	.0945	5.54
$a_{10,10}$	.69	.1389	4.95	$a_{10,10}$	.36	.1514	2.40
$a_{10,11}$	.74	.1318	5.59	$a_{10,11}$	.53	.1526	3.48
$a_{11,11}$	.34	.1380	2.48	$a_{11,11}$	.52	.1605	3.25
ILLIT 1	-.031	.0095	3.27	COST 1	.037	.0082	4.57
EARN 1	-.023	.0108	2.11	PUCLASS 1	-.034	.0059	5.72
EDUC 2	.024	.0084	2.83	EDUC 2	.046	.0058	7.99
TEARN 2	-.040	.0085	4.67	PEDUC 2	-.064	.0106	6.01
HELP 2	.037	.0111	3.30	TEARN 2	-.047	.0053	8.78
UNQUAL 2	.042	.0179	2.33	HELP 2	.034	.0065	5.69
UNEMP 2	-.036	.0140	2.59	UNQUAL 2	.057	.0137	4.19
EARN 2	.036	.0119	3.07	ILLIT 2	-.358	.0457	7.83
				UNEMP 2	-.082	.0315	6.27
				EARN 2	.029	.0278	4.49
				LFLEV 2	-.240	.0305	7.85

R^2 = .9589 $\bar{R}$ = .9576 df = 672

R^2 = .9933 $\bar{R}$ = .9931 df = 767

TABLE E20: Estimated Values of the a and δ Coefficients, Using Stepwise Regression on the Significant Supply Side and Demand Side Explanatory Variables (Region 2) - Method V

Unrestricted OLS				Restricted OLS			
Coefficient	Estimated Value	Stand Dev.	t-value	Coefficient	Estimated Value	Stand Dev.	t-value
a_{55}	.16	.0062	26.35	a_{55}	.13	.0073	17.56
a_{56}	.30	.0853	3.57	a_{56}	.43	.0054	7.94
a_{66}	.70	.1000	7.02	a_{66}	.51	.0069	7.37
a_{67}	.26	.0480	5.33	a_{67}	.18	.0037	4.81
a_{77}	.77	.0523	14.74	a_{77}	.80	.0056	14.22
a_{78}	.56	.0510	11.08	a_{78}	.72	.0056	12.79
a_{88}	.36	.0618	5.87	a_{88}	.17	.0068	2.51
a_{89}	.74	.0514	14.50	a_{89}	.89	.0062	14.47
a_{99}	.19	.0600	3.22	a_{99}	.10	.0065	1.57
$a_{9,10}$	.23	.0667	3.40	$a_{9,10}$	.15	.0054	2.74
$a_{10,10}$	.75	.1029	7.25	$a_{10,10}$	.82	.1025	7.98
$a_{10,11}$	.81	.0788	10.30	$a_{10,11}$	.85	.1164	7.32
$a_{11,11}$	.28	.0813	3.41	$a_{11,11}$	.24	.1243	1.96
TEARN 1	.018	.0066	2.68	POPLEV 1	.038	.0070	5.43
HELP 1	-.028	.0113	2.51	EDUC 2	.011	.0028	3.99
UNQUAL 1	-.031	.0117	2.63	UNEMP 2	-.023	.0047	-4.98
EARN 1	-.019	.0095	1.97	LFLEV 2	.096	.0131	7.31
EDUC 2	.025	.0053	4.40	POPLEV 2	-.118	.0148	7.98
TEARN 2	-.069	.0077	9.01				
PUTEA 2	-.045	.0099	4.57				
HELP 2	.066	.0117	5.64				
UNQUAL 2	.095	.0155	6.16				
UNEMP 2	-.031	.0088	3.50				
EARN 2	.027	.0097	2.79				

Unrestricted OLS: R^2 = .9882, $\bar{R}^2$ = .9878, df = 668

Restricted OLS: R^2 = .9953, $\bar{R}^2$ = .9952, df = 773

TABLE E21: Method V - Transition Probability Estimates Using the Stepwise Regression Applied to the Significant Variables of the Supply Side and Demand Side of the Education System - Region 1 - LISBOA (Unrestricted OLS)

YEAR	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$
1971	.13 (5.35)	.80 (7.95)	.19 (1.48)	.48 (5.62)	.57 (6.15)	.77 (8.77)	.17 (1.61)	.86 (9.34)	.08 (.77)	.38 (3.52)	.66 (4.30)	.77 (5.06)	.31 (2.10)
1972	.14 (6.17)	.79 (7.75)	.20 (1.56)	.47 (5.79)	.58 (6.32)	.76 (8.68)	.18 (1.73)	.85 (10.12)	.09 (.89)	.37 (3.56)	.67 (4.42)	.76 (5.24)	.32 (2.19)
1973	.15 (7.13)	.83 (8.12)	.21 (1.64)	.51 (6.44)	.59 (6.48)	.80 (9.14)	.19 (1.86)	.89 (11.05)	.10 (1.01)	.41 (3.56)	.68 (4.53)	.80 (5.47)	.33 (2.28)
1974	.12 (6.77)	.80 (9.43)	.18 (1.21)	.48 (8.60)	.56 (6.28)	.77 (11.86)	.16 (1.39)	.86 (13.46)	.07 (.45)	.38 (5.81)	.65 (4.37)	.92 (6.74)	.27 (1.95)
1975	.14 (6.00)	.81 (7.54)	.20 (1.42)	.49 (5.60)	.58 (6.41)	.78 (10.38)	.18 (1.64)	.87 (10.25)	.09 (.72)	.39 (3.40)	.67 (4.47)	.78 (6.49)	.32 (2.08)
1976	.18 (10.05)	.77 (8.02)	.24 (1.62)	.45 (6.26)	.62 (8.86)	.74 (11.05)	.22 (1.95)	.83 (10.38)	.13 (1.02)	.35 (4.02)	.71 (4.78)	.74 (5.78)	.36 (2.30)
1977	.19 (14.08)	.65 (7.14)	.25 (1.91)	.33 (6.14)	.63 (7.31)	.62 (8.20)	.23 (2.36)	.71 (10.38)	.14 (1.43)	.23 (3.86)	.72 (5.10)	.62 (5.39)	.37 (2.57)
1978	.20 (19.58)	.65 (6.25)	.26 (1.99)	.33 (4.36)	.64 (7.40)	.62 (7.65)	.24 (2.47)	.71 (8.06)	.15 (1.55)	.23 (3.03)	.73 (5.23)	.62 (4.43)	.38 (2.65)
1979	.22 (16.98)	.70 (6.27)	.28 (2.12)	.38 (4.39)	.66 (7.42)	.67 (7.56)	.26 (2.60)	.76 (8.07)	.17 (1.71)	.28 (2.96)	.75 (5.34)	.67 (4.40)	.40 (2.75)
1980	.21 (17.07)	.71 (6.74)	.27 (2.19)	.39 (5.17)	.65 (7.55)	.68 (8.50)	.25 (2.72)	.77 (9.60)	.16 (1.81)	.29 (3.18)	.74 (5.44)	.68 (5.09)	.39 (2.80)
1981	.21 (14.07)	.71 (6.99)	.27 (2.12)	.39 (5.22)	.65 (7.33)	.68 (8.95)	.25 (2.61)	.77 (8.95)	.16 (1.70)	.29 (3.56)	.74 (5.38)	.68 (4.86)	.39 (2.72)

Figures in parenthesis are t-values.

TABLE F22: Method V - Transition Probability Estimates Using the Stepwise Regression Applied to the Significant Variables of the Supply Side and Demand Side of the Education System - Region 1 - LISBOA (Restricted OLS)

YEAR	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$
1971	.19 (9.44)	.77 (7.39)	.21 (1.53)	.28 (3.38)	.78 (8.40)	.76 (8.48)	.17 (1.47)	.63 (7.69)	.35 (3.29)	.50 (4.93)	.40 (2.46)	.51 (3.23)	.56 (3.39)
1972	.15 (10.21)	.79 (7.48)	.17 (1.27)	.30 (3.74)	.74 (8.29)	.48 (8.82)	.13 (1.15)	.65 (7.92)	.31 (3.08)	.52 (5.34)	.36 (2.27)	.53 (3.53)	.52 (3.20)
1973	.07 (3.05)	.87 (8.18)	.09 (.68)	.38 (4.76)	.66 (7.11)	.86 (10.23)	.05 (.42)	.73 (8.93)	.23 (2.34)	.60 (5.59)	.28 (1.63)	.61 (3.99)	.44 (2.64)
1974	.05 (3.10)	.99 (9.39)	.07 (.58)	.50 (6.34)	..64 (7.22)	.98 (11.46)	.03 (.30)	.85 (10.56)	.21 (2.20)	.72 (6.91)	.26 (1.66)	.73 (4.93)	.42 (2.59)
1975	.14 (11.46)	.80 (7.48)	.16 (1.24)	.31 (3.65)	.73 (8.31)	.79 (8.93)	.12 (1.07)	.66 (7.54)	.30 (2.92)	.53 (4.80)	.35 (2.34)	.54 (4.42)	.51 (3.16)
1976	.16 (14.86)	.80 (7.63)	.18 (1.42)	.31 (3.89)	.75 (8.59)	.79 (9.04)	.14 (1.29)	.66 (7.36)	.32 (3.15)	.53 (5.18)	.37 (2.50)	.54 (3.32)	.53 (3.32)
1977	.18 (15.59)	.80 (7.36)	.20 (1.53)	.31 (4.30)	.77 (8.73)	.79 (7.18)	.16 (1.42)	.66 (8.00)	.34 (3.27)	.53 (5.73)	.39 (2.59)	.54 (3.31)	.55 (3.41)
1978	.16 (14.67)	.66 (6.19)	.18 (1.41)	.17 (2.21)	.75 (8.58)	.65 (6.71)	.14 (1.28)	.52 (5.12)	.32 (3.16)	.39 (4.77)	.37 (2.48)	.40 (2.38)	.53 (3.31)
1979	.16 (14.47)	.74 (6.88)	.18 (1.39)	.25 (3.32)	.75 (8.55)	.73 (8.01)	.14 (1.25)	.60 (5.84)	.32 (3.12)	.47 (5.09)	.37 (2.48)	.48 (2.99)	.53 (3.29)
1980	.19 (14.38)	.74 (6.92)	.21 (1.66)	.25 (3.35)	.78 (8.80)	.73 (7.77)	.17 (1.52)	.60 (6.15)	.35 (3.25)	.47 (4.79)	.40 (2.79)	.48 (3.07)	.56 (3.47)
1981	.20 (14.22)	.72 (6.91)	.22 (1.71)	.23 (2.95)	.79 (8.83)	.71 (7.41)	.18 (1.57)	.58 (5.83)	.36 (3.28)	.45 (4.68)	.41 (2.84)	.46 (2.79)	.57 (3.50)

Figures in parenthesis are t-values

TABLE F23: Method V - Transition Probability Estimates Using the Stepwise Regression Applied to the Significant Variables of the Supply Side and Demand Side of the Education System - Region 2 - BRAGANCA (Unrestricted OLS)

YEAR	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$
1971	.16 (1.03)	.29 (1.49)	.70 (3.20)	.25 (1.01)	.77 (2.84)	.55 (1.67)	.36 (1.11)	.73 (2.13)	.19 (.52)	.22 (.57)	.75 (1.84)	.80 (1.85)	.28 (.71)
1972	.19 (1.35)	.31 (2.12)	.73 (3.84)	.27 (1.48)	.80 (3.28)	.57 (2.32)	.39 (1.40)	.75 (3.33)	.22 (.68)	.24 (.84)	.78 (2.18)	.82 (2.87)	.31 (.88)
1973	.17 (1.53)	.33 (2.69)	.71 (4.87)	.29 (1.92)	.78 (4.02)	.59 (2.94)	.37 (1.83)	.77 (4.10)	.20 (.80)	.26 (1.12)	.76 (2.71)	.84 (3.59)	.29 (1.07)
1974	.12 (1.31)	.39 (3.86)	.66 (5.27)	.35 (2.91)	.73 (4.82)	.65 (4.11)	.32 (2.00)	.83 (4.69)	.15 (.77)	.32 (1.72)	.71 (3.60)	.90 (3.89)	.24 (1.23)
1975	.18 (.97)	.24 (1.64)	.72 (2.56)	.20 (.84)	.79 (2.51)	.50 (2.06)	.38 (.92)	.68 (2.21)	.21 (.51)	.17 (.58)	.77 (1.73)	.75 (2.07)	.30 (.60)
1976	.15 (1.87)	.29 (4.74)	.69 (5.87)	.25 (2.24)	.76 (6.34)	.55 (8.82)	.35 (2.40)	.73 (5.62)	.18 (1.27)	.22 (2.22)	.74 (5.38)	.80 (4.78)	.27 (1.80)
1977	.15 (1.37)	.35 (4.35)	.69 (5.33)	.31 (2.78)	.76 (4.47)	.61 (5.20)	.35 (2.54)	.79 (5.69)	.18 (.88)	.28 (1.58)	.74 (3.70)	.86 (5.65)	.27 (1.29)
1978	.18 (2.39)	.21 (2.39)	.72 (8.04)	.17 (1.25)	.79 (7.24)	.47 (3.52)	.38 (4.61)	.65 (4.28)	.21 (1.90)	.14 (.73)	.77 (7.21)	.72 (4.00)	.30 (2.45)
1979	.17 (1.87)	.23 (2.68)	.71 (5.95)	.19 (1.30)	.78 (5.60)	.49 (3.88)	.37 (2.85)	.67 (3.90)	.20 (1.33)	.16 (.83)	.76 (5.00)	.74 (3.73)	.29 (1.74)
1980	.15 (1.22)	.31 (2.83)	.69 (4.06)	.27 (1.44)	.76 (3.81)	.57 (3.46)	.35 (1.73)	.75 (3.11)	.18 (.77)	.24 (.94)	.74 (3.04)	.82 (2.98)	.27 (1.06)
1981	.13 (1.04)	.35 (3.80)	.67 (3.82)	.31 (1.92)	.74 (3.64)	.61 (4.76)	.33 (1.55)	.79 (3.68)	.16 (.66)	.28 (1.30)	.72 (2.86)	.86 (3.26)	.25 (.96)

Figures in parenthesis are t-values

TABLE E24: Method V - Transition Probability Estimates Using the Stepwise Regression Applied to the Significant Variables of the Supply Side and Demand Side of the Education System - Region 2 - BRAGANCA (Restricted OLS)

YEAR	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$
1971	.09	.44	.47	.19	.76	.73	.13	.90	.06	.16	.78	.86	.20
	(8.23)	(8.37)	(6.75)	(4.88)	(13.25)	(12.30)	(1.89)	(14.53)	(.90)	(2.74)	(7.38)	(7.28)	(1.61)
1972	.10	.47	.48	.22	.77	.76	.14	.93	.07	.19	.79	.89	.21
	(8.92)	(8.73)	(6.80)	(5.72)	(13.37)	(13.22)	(1.94)	(15.19)	(.95)	(3.17)	(7.44)	(7.83)	(1.64)
1973	.10	.47	.48	.22	.77	.76	.14	.93	.07	.19	.79	.89	.21
	(10.01)	(8.77)	(6.89)	(5.86)	(13.53)	(13.43)	(2.02)	(15.33)	(1.03)	(3.19)	(7.53)	(8.00)	(1.68)
1974	.09	.49	.47	.74	.76	.78	.13	.95	.06	.21	.78	.91	.20
	(8.65)	(8.90)	(6.79)	(6.31)	(13.33)	(14.33)	(1.93)	(15.19)	(.93)	(3.76)	(7.42)	(7.40)	(1.63)
1975	.11	.51	.49	.26	.78	.80	.15	.97	.08	.23	.80	.93	.22
	(11.48)	(9.03)	(6.98)	(6.79)	(13.71)	(14.21)	(2.19)	(15.59)	(1.14)	(3.70)	(7.63)	(8.87)	(1.73)
1976	.12	.44	.50	.19	.79	.73	.16	.90	.09	.16	.81	.86	.23
	(14.90)	(8.18)	(7.18)	(5.23)	(14.05)	(13.26)	(2.32)	(14.67)	(1.36)	(3.06)	(7.84)	(7.17)	(1.84)
1977	.13	.42	.51	.17	.80	.71	.17	.88	.10	.14	.82	.84	.24
	(18.11)	(7.40)	(7.35)	(4.37)	(14.31)	(11.81)	(2.50)	(13.61)	(1.56)	(2.82)	(8.02)	(7.07)	(1.94)
1978	.13	.43	.51	.18	.80	.72	.17	.89	.10	.15	.82	.85	.24
	(18.11)	(7.31)	(7.35)	(4.45)	(14.31)	(11.95)	(2.50)	(13.16)	(1.56)	(3.22)	(8.02)	(6.65)	(1.94)
1979	.17	.34	.55	.09	.84	.63	.21	.80	.14	.06	.86	.76	.28
	(18.92)	(6.28)	(7.78)	(2.33)	(14.69)	(10.07)	(2.98)	(12.12)	(2.15)	(1.16)	(8.43)	(6.35)	(2.22)
1980	.18	.39	.56	.14	.85	.68	.22	.85	.15	.11	.87	.81	.29
	(17.50)	(6.85)	(7.88)	(3.53)	(14.68)	(11.36)	(3.09)	(12.63)	(2.30)	(1.92)	(8.50)	(6.88)	(2.29)
1981	.20	.38	.58	.13	.87	.67	.24	.84	.17	.10	.89	.80	.31
	(15.00)	(6.86)	(8.02)	(3.09)	(14.52)	(11.62)	(3.28)	(12.22)	(2.54)	(1.45)	(3.60)	(6.33)	(2.42)

Figures in parenthesis are t-values

TABLE E25: Comparison between Estimates Obtained for the Stepwise Regression Using the Significant Supply Side and Demand Side Variables, by Regions

Transition Probability	Method V - Stepwise Regression for Region 1 Using Significant Supply and Demand Variables - LISBOA								Method V - Stepwise Regression for Region 2 Using the Significant Supply and Demand Variables - BRAGANCA							
	Unrestricted OLS				Restricted OLS				Unrestricted OLS				Restricted OLS			
	Mean Value	Stand Dev.	R	D-W	Mean Value	Stand Dev.	R	D-W	Mean Value	Stand Dev.	R	D-W	Mean Value	Stand Dev.	R	D-W
P_{55}	.1601	.0412	.71070	2.09	.1500	.0482	.69208	2.06	.1600	.0202	.10329	.47*	.1286	.0378	.71046	.92*
P_{56}	.7699	.0869	.81639	1.52	.7901	.0864	.83314	1.81	.2999	.0570	..12459	1.08	.4345	.0500	.82481	1.55
P_{66}	.2201	.0412	.48406	2.65	.1700	.0482	.58476	2.98	.7000	.0202	.63367	.98*	.5086	.0378	.33912	2.01
P_{67}	.4499	.0869	.90002	2.54	.3001	.0864	.83481	2.25	.2599	.0570	-.07318	1.21	.1845	.0500	.78281	1.95
P_{77}	.6001	.0412	.56623	.59*	.7400	.0482	.31449	.74*	.7700	.0202	.47661	1.76	.7986	.0378	.34528	2.44
P_{78}	.7399	.0869	.61605	1.94	.7801	.0864	.59495	1.89	.5599	.0570	.10984	1.25	.7245	.0500	.53217	1.73
P_{88}	.2001	.0412	.53617	.99*	.1300	.0482	.42992	1.20	.3600	.0202	.39984	1.09	.1686	.0378	.52615	2.17
P_{89}	.8299	.0869	.58765	1.55	.6501	.0864	.69939	1.33	.7399	.0570	.41725	1.33	.8945	.0500	.55215	2.59
P_{99}	.1101	.0412	.57625	2.38	.3100	.0482	.52400	2.62	.1900	.0202	.45180	1.13	.0986	.0378	.49150	1.97
$P_{9,10}$	.3499	.0869	.86928	1.84	.5201	.0864	.86189	1.82	.2299	.0570	.45790	1.15	.1545	.0500	.60232	1.54
$P_{10,10}$	.6901	.0412	.11377	2.17	.3600	.0482	-.11589	2.03	.7500	.0202	-.15433	1.65	.8186	.0378	.74189	3.05
$P_{10,11}$	.7399	.0869	.23421	1.94	.5301	.0864	.25115	1.82	.8099	.0570	-.13226	.79*	.8545	.0500	-.27292	1.16
$P_{11,11}$	.3401	.0412	.61875	1.32	.5200	.0482	.62753	1.33	.2800	.0202	.11866	2.07	.2386	.0378	.26775	2.37

TABLE E26: Pooled Cross-Section Time-Series Estimation Using the Results of the Unrestricted OLS Applied to the Significant Explanatory Variables Selected from the Supply Side and the Demand Side Separately. (Method VII)

Region 1				Region 2			
Coeff.	Estimated Value	Stand Error	t-value	Coeff.	Estimated Value	Stand Error	t-value
a_{55}	.16	.0117	13.83	a_{55}	.14	.0088	16.32
a_{56}	.44	.0933	4.70	a_{56}	.33	.0842	3.98
a_{66}	.54	.1125	4.82	a_{66}	.65	.1026	6.37
a_{67}	.39	.0686	5.65	a_{67}	.18	.0484	3.75
a_{77}	.60	.0803	7.47	a_{77}	.83	.0615	13.45
a_{78}	.69	.0623	11.11	a_{78}	.54	.0694	7.79
a_{88}	.21	.0762	2.75	a_{88}	.39	.0840	4.68
a_{89}	.88	.0689	12.71	a_{89}	.74	.0740	9.99
a_{99}	.06	.0781	.72*	a_{99}	.23	.0823	2.86
$a_{9,10}$	.26	.0720	3.62	$a_{9,10}$	.27	.0677	4.04
$a_{10,10}$	.69	.1206	5.54	$a_{10,10}$	.63	.1152	5.49
$a_{10,11}$	.68	.1273	5.34	$a_{10,11}$	.79	.1161	6.80
$a_{11,11}$	.39′	.1337	2.94	$a_{11,11}$	.29	.1227	2.40
ILLIT 1	-.030	.0105	2.84	TEARN 1	.013	.0096	1.38*
EARN 1	-.026	.0108	2.38	HELP 1	-.002	.0177	.02*
EDUC 1	.015	.0064	2.41	UNQUAL 1	-.027	.0161	1.68*
TEARN 2	-.021	.0062	3.35	EARN 1	-.033	.0119	2.74
HELP 2	.035	.0096	3.67	EDUC 2	.008	.0074	1.09*
UNQUAL 2	.046	.0158	2.89	TEARN 2	-.015	.0104	1.49*
UNEMP 2	-.034	.0130	2.61	PUTEA 2	-.023	.0120	1.94
EARN 2	.024	.0115	2.05	HELP 2	.017	.0183	.94*
				UNQUAL 2	.047	.0192	2.45
				UNEMP 2	-.046	.0124	3.70
				EARN 2	.041	.0122	3.31

Region 1: R^2 = .9673, $\bar{R}^2$ = .9663, DW = 2.1721

Region 2: R^2 = .9852, $\bar{R}^2$ = .9847, DW = 2.0857

TABLE E27: Method VII - Transition Probability Estimates Using Pooled Cross-Section Time-Series Regression Using The Significant Variables of Method V - Region 1-LISBOA

YEAR	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$
1971	.11 (6.37)	.50 (5.55)	.46 (4.15)	.43 (5.95)	.53 (6.71)	.72 (11.04)	.17 (2.30)	.91 (11.63)	.48 (6.08)	.29 (3.55)	.62 (5.01)	.70 (5.30)	.35 (2.69)
1972	.14 (8.46)	.50 (5.47)	.49 (4.46)	.43 (6.08)	.56 (6.96)	.72 (10.93)	.20 (2.71)	.91 (12.65)	.51 (6.28)	.29 (3.41)	.65 (5.30)	.70 (5.46)	.38 (2.85)
1973	.16 (10.96)	.54 (6.05)	.51 (4.70)	.47 (6.54)	.58 (7.21)	.76 (12.46)	.22 (3.01)	.95 (12.30)	.53 (6.55)	.33 (4.03)	.67 (5.55)	.74 (5.52)	.40 (3.00)
1974	.13 (8.40)	.56 (6.32)	.48 (4.28)	.49 (7.46)	.55 (6.97)	.78 (12.73)	.19 (2.46)	.97 (15.62)	.50 (6.47)	.35 (4.32)	.64 (5.21)	.76 (6.20)	.37 (2.80)
1975	.16 (7.93)	.47 (5.28)	.51 (4.85)	.40 (5.57)	.58 (6.89)	.69 (11.66)	.22 (3.14)	.88 (11.80)	.53 (5.91)	.26 (3.22)	.67 (5.43)	.67 (5.71)	.40 (2.95)
1976	.13 (8.28)	.53 (5.44)	.48 (11.29)	.46 (5.90)	.55 (6.96)	.75 (11.91)	.19 (2.48)	.94 (12.25)	.50 (6.43)	.32 (3.61)	.64 (5.21)	.73 (5.45)	.37 (2.80)
1977	.15 (11.74)	.48 (5.18)	.50 (4.64)	.41 (6.21)	.57 (7.26)	.70 (10.30)	.21 (2.90)	.89 (14.16)	.52 (6.71)	.27 (3.55)	.66 (5.54)	.68 (5.33)	.39 (2.98)
1978	.16 (13.45)	.39 (4.45)	.51 (4.61)	.32 (4.87)	.58 (7.40)	.61 (9.26)	.22 (2.83)	.80 (10.68)	.53 (7.06)	.18 (3.13)	.67 (5.61)	.59 (4.55)	.40 (3.03)
1979	.19 (15.11)	.41 (4.32)	.54 (4.96)	.34 (4.71)	.61 (7.63)	.63 (9.14)	.25 (3.16)	.82 (10.75)	.56 (7.23)	.20 (2.83)	.70 (5.92)	.61 (4.53)	.43 (3.21)
1980	.23 (13.86)	.40 (4.45)	.58 (5.36)	.33 (4.81)	.65 (7.70)	.62 (9.35)	.29 (3.51)	.81 (10.55)	.60 (7.08)	.19 (2.63)	.74 (6.16)	.60 (4.43)	.47 (3.35)
1981	.21 (12.88)	.39 (4.50)	.56 (5.04)	.32 (4.86)	.63 (7.60)	.61 (8.75)	.27 (3.15)	.80 (10.44)	.58 (7.17)	.18 (2.38)	.72 (5.94)	.59 (4.39)	.45 (3.24)

Figures in parenthesis are t-values

TABLE E28: Method VII - Transition Probability Estimates Using Pooled Cross-Section Time-Series Regression Using the Significant Variables of Method V - Region 2-BRAGANCA

YEAR	P_{55}	P_{56}	P_{66}	P_{67}	P_{77}	P_{78}	P_{88}	P_{89}	P_{99}	$P_{9,10}$	$P_{10,10}$	$P_{10,11}$	$P_{11,11}$
1971	.13 (6.76)	.34 (4.37)	.67 (6.64)	.20 (3.69)	.83 (12.68)	.56 (7.52)	.40 (4.65)	.75 (9.18)	.25 (2.77)	.31 (4.00)	.61 (5.24)	.81 (6.56)	.30 (2.37)
1972	.14 (7.20)	.34 (4.30)	.68 (6.69)	.20 (4.10)	.84 (12.82)	.56 (7.82)	.41 (4.67)	.75 (10.08)	.26 (2.85)	.31 (4.25)	.62 (5.32)	.81 (6.95)	.31 (2.41)
1973	.15 (9.80)	.30 (3.93)	.69 (6.83)	.16 (3.21)	.85 (13.40)	.52 (7.46)	.42 (4.96)	.71 (8.78)	.27 (3.09)	.27 (3.95)	.63 (5.56)	.77 (6.21)	.32 (2.58)
1974	.12 (6.74)	.39 (4.76)	.66 (6.57)	.25 (5.14)	.82 (12.92)	.61 (8.69)	.39 (4.52)	.80 (11.33)	.24 (2.77)	.36 (4.52)	.60 (4.97)	.86 (7.21)	.29 (2.24)
1975	.12 (4.49)	.36 (4.21)	.66 (6.43)	.22 (3.77)	.82 (11.54)	.58 (7.46)	.39 (3.83)	.77 (9.32)	.24 (2.54)	.33 (3.62)	.60 (4.66)	.83 (7.50)	.29 (2.28)
1976	.12 (9.37)	.35 (4.28)	.66 (6.72)	.21 (4.40)	.82 (13.53)	.57 (8.65)	.39 (4.84)	.76 (10.70)	.24 (2.87)	.32 (4.42)	.60 (5.22)	.82 (7.42)	.29 (2.44)
1977	.12 (8.40)	.29 (3.40)	.66 (6.67)	.15 (3.03)	.82 (13.15)	.51 (6.75)	.39 (4.94)	.70 (9.12)	.24 (2.84)	.26 (3.71)	.60 (5.18)	.76 (6.21)	.29 (2.34)
1978	.14 (14.03)	.28 (2.64)	.68 (6.96)	.08 (1.56)	.84 (14.03)	.44 (5.92)	.41 (5.15)	.63 (7.66)	.26 (3.25)	.19 (3.25)	.62 (5.70)	.69 (5.78)	.31 (2.66)
1979	.16 (16.93)	.26 (3.11)	.70 (7.12)	.12 (2.51)	.86 (14.40)	.48 (6.75)	.43 (5.19)	.67 (8.75)	.28 (3.58)	.23 (3.70)	.64 (5.97)	.73 (6.42)	.33 (2.82)
1980	.18 (12.83)	.24 (2.87)	.72 (7.14)	.10 (1.89)	.88 (13.95)	.46 (6.39)	.45 (5.15)	.65 (7.75)	.30 (3.62)	.21 (3.25)	.66 (5.95)	.71 (5.82)	.35 (2.85)
1981	.17 (11.97)	.33 (4.03)	.71 (7.10)	.19 (3.83)	.87 (13.80)	.55 (8.11)	.44 (5.09)	.74 (9.69)	.29 (3.56)	.30 (3.99)	.65 (5.85)	.80 (6.78)	.34 (2.80)

Figures in parenthesis are t-values

TABLE F29: Factor Matrix and Factor Loading for the Supply Side Explanatory Variables (2 Principal Components)

	AVEIRO					BEJA				
	Factor Matrix			Varimax Solution		Factor Matrix			Varimax Solution	
	Common Factor Loading		Communality	Common Factor Loading		Common Factor Loading		Communality	Common Factor Loading	
	I	II	h^2	I	II	I	II	h^2	I	II
EDUC	.07	.80	.6390	-.06	.80	-.01	.85	.7150	-.08	.84
PEDUC	.96	.03	.9169	.94	.18	.96	.15	.9472	.95	.23
PCAP	-.80	-.04	.6416	-.78	.17	-.76	.12	.5982	-.75	-.19
COST	-.87	-.02	.7523	.86	.12	.87	.08	.7652	.86	.16
TEARN	.34	.82	.7860	.21	.86	.22	.73	.5877	.16	.75
PUTEA	-.94	-.21	.9254	-.89	-.36	-.83	--.02	.6835	-.82	-.09
PUCLASS	.80	.05	.6364	.78	.17	.87	-.14	.7686	.87	-.07
BUS	.81	-.31	.7518	.85	-.18	.96	-.26	.9967	.98	-.18
HELP	.85	-.22	.7662	.87	-.08	.89	-.18	.8280	.90	-.10
UNQUAL	-.98	.19	1.0013	-1.00	.03	-.83	-.05	.6912	-.82	-.12
Latent root	6.4484	1.7471				6.3661	1.7368			
Percentage Variance	64.5	17.5	82.0			63.7	17.4	81.0		

TABLE F29: Factor Matrix and Factor Loading for the Supply Side Explanatory Variables (2 Principal Components) (Continued)

	BRAGA				
	Factor Matrix			Varimax Solution	
	Common Factor Loading		Communality	Common Factor Loading	
	I	II	h^2	I	II
EDUC	-.01	.75	.5994	-.13	.76
PEDUC	.93	.16	.8850	.88	.33
PCAP	-.73	-.22	.5798	-.65	-.35
COST	.89	.04	.7929	.87	.20
TEARN	.27	.68	.5307	.14	.71
PUTEA	-.96	.12	.9306	-.96	-.06
PUCLASS	.69	.38	.6185	.60	.50
BUS	.86	-.37	.8730	.91	-.20
HELP	.91	-.19	.8570	.93	-.02
UNQUAL	-.93	.22	.9088	-.95	.05
Latent root	6.2400	1.8900			
Percentage Variance	62.4	18.9	81.3		

TABLE F29: Factor Matrix and Factor Loading for the Supply Side Explanatory Variables (2 Principal Components) (Continued)

	COIMBRA					FARO				
	Factor Matrix			Varimax Solution		Factor Matrix			Varimax Solution	
	Common Factor Loading		Communality	Common Factor Loading		Common Factor Loading		Communality	Common Factor Loading	
	I	II	h^2	I	II	I	II	h^2	I	II
EDUC	.09	.73	.5402	-.01	.73	.02	1.01	1.0120	-.08	1.00
PEDUC	.98	.04	.9570	.96	.18	.97	.09	.9406	.95	.19
PCAP	-.74	-.01	.5448	-.73	-.12	-.76	-.08	.5798	-.75	-.15
COST	.80	.03	.6468	.79	.15	.90	-.05	.8170	.90	.05
TEARN	.31	.81	.7511	.19	.85	.29	.53	.3701	.23	.56
PUTEA	-.88	-.12	.7914	-.85	-.25	-.96	-.15	.9434	-.94	-.25
PUCLASS	.90	-.30	.8929	.93	-.17	-.47	.37	.3596	-.51	.32
BUS	.96	-.03	.9270	.96	.10	.88	-.24	.8293	.90	-.14
HELP	.80	.01	.6482	.79	.13	.92	-.06	.8387	.91	.06
UNQUAL	-.96	.22	.9655	-.98	.08	-.90	.01	.8093	-.90	-.08
Latent root	6.5001	1.6720				6.1518	1.7827			
Percentage Variance	65.0	16.7	81.7			61.5	17.8	79.3		

TABLE E29: Factor Matrix and Factor Loading for the Supply Side Explanatory Variables (2 Principal Components) (Continued)

	SANTAREM					VIANA DO CASTELO				
	Factor Matrix			Varimax Solution		Factor Matrix			Varimax Solution	
	Common Factor Loadings		Communality	Common Factor Loadings		Common Factor Loadings		Communality	Common Factor Loadings	
	I	II	h^2	I	II	I	II	h^2	I	II
EDUC	.08	.94	.8887	-.15	.93	-.01	.73	.5270	-.07	.72
PEDUC	.92	.05	.8441	.88	.27	.95	.16	.9278	.94	.23
PCAP	-.75	-.09	.5636	-.70	-.27	-.78	-.15	.6267	-.76	-.20
COST	.87	-.06	.7558	.86	.15	.85	.12	.7362	.84	.18
TEARN	.31	.59	.4369	.15	.64	.22	.83	.7380	.16	.84
PUTEA	-.99	-.15	1.0063	-.92	-.34	-.99	.07	.9752	-.99	-.00
PUCLASS	.47	.40	.3875	.36	.51	.66	.03	.6425	.66	.08
BUS	.91	-.28	.8967	.95	-.04	.92	-.16	.8672	.93	-.09
HELP	.90	-.19	.8469	.92	.04	.91	-.20	.8755	.93	-.13
UNQUAL	-.93	.24	.9305	-.96	.00	.91	.19	.8611	-.92	.12
Latent root	6.1121	1.8494				6.3766	1.7223			
Percentage Variance	61.1	18.5	79.6			63.8	17.2	81.0		

TABLE E29: Factor Matrix and Factor Loading for the Supply Side Explanatory Variables (2 Principal Components) (Continued)

VISEU

	Factor Matrix			Varimax Solution	
	Common Factor Loadings		Communality	Common Factor Loadings	
	I	II	h^2	I	II
EDUC	.02	.80	.6335	-.05	.79
PEDUC	.94	.13	.8980	.92	.22
PCAP	-.76	-.13	.5967	-.75	-.20
COST	.84	.11	.7129	.82	.19
TEARN	.24	.78	.6637	.17	.80
PUTEA	-.85	-.06	.7204	-.84	-.14
PUCLASS	.68	.02	.4684	.68	.09
BUS	.97	-.25	1.0005	.99	-.16
HELP	.91	-.25	.8851	.93	-.17
UNQUAL	.96	.12	.9295	-.96	.04
Latent root	6.2727	1.7339			
Percentage Variance	62.7	17.3	80.1		

TABLE E30: Factor Matrix and Factor Loadings for the Supply Side Explanatory Variables (3 Principal Components)

	C.BRANCO							BRAGANCA						
	Factor Matrix				Varimax Solution			Factor Matrix				Varimax Solution		
	Common Factor Loadings			Communality	Common Factor Loadings			Common Factor Loadings			Communality	Common Factor Loadings		
	I	II	III	h^2	I	II	III	I	II	III	h^2	I	II	III
EDUC	-.03	.90	.02	.8091	-.09	.87	.22	-.01	.80	.10	.6478	-.08	.80	.05
PEDUC	.94	.17	.07	.9251	.93	.23	.06	.93	.16	-.00	.8820	.90	.24	.13
PCAP	-.76	-.09	.14	.6053	-.74	-.18	.16	-.77	-.20	.39	.7755	-.70	-.19	-.50
COST	.90	.03	-.38	.9606	.87	.19	-.40	.88	.08	.06	.7794	.86	.17	.05
TEARN	.24	.72	-.28	.6563	.17	.78	-.12	.24	.74	.20	.6491	.17	.79	-.04
PUTEA	-.96	.07	.04	.9297	-.95	-.02	-.10	-.93	.02	-.05	.8609	-.92	-.07	-.04
PUCLASS	-.05	.28	.85	.8060	-.02	.08	.89	.09	.12	-.79	.6511	.01	-.02	.81
BUS	.99	-.13	.09	1.0011	1.00	-.07	.01	.95	-.23	.23	1.0004	.98	-.09	-.17
HELP	.87	-.04	.43	.9362	.89	-.05	.36	.92	-.25	.03	.9028	.94	-.15	.03
UNQUAL	-.92	.18	-.08	.8858	-.93	.11	.01	-.96	.10	.02	.9307	-.96	.01	-.10
Latent root	5.9483	1.7204	1.3391					5.9107	1.7189	1.1910				
Percentage	59.5	17.2	13.4	90.1				59.1	17.2	11.9	88.2			

TABLE E30: Factor Matrix and Factor Loadings for the Supply Side Explanatory Variables (3 Principal Components) (Continued)

	EVORA							GUARDA						
	Factor Matrix				Varimax Solution			Factor Matrix				Varimax Solution		
	Common Factor Loadings			Communality	Common Factor Loadings			Common Factor Loadings			Communality	Common Factor Loadings		
	I	II	III	h^2	I	II	III	I	II	III	h^2	I	II	III
EDUC	.06	.67	.60	.8183	-.06	-.90	.03	.06	.94	.21	.9273	-.05	.95	.17
PEDUC	.95	.09	-.05	.9158	.94	.16	-.01	.95	.09	-.00	.9041	.92	.21	-.10
PCAP	-.81	.01	-.08	.6559	-.78	-.14	-.15	-.77	-.10	-.32	.6988	-.71	-.18	.40
COST	.83	.18	-.27	.8017	.86	.08	-.24	.85	.05	-.37	.8604	.80	.14	-.45
TEARN	.33	.77	.20	.7465	.27	.76	-.31	.27	.65	-.06	.4909	.17	.67	-.11
PUTEA	-.92	.10	-.28	.9352	-.87	-.21	-.37	-.75	-.13	-.07	.5911	.73	-.23	.01
PUCLASS	.18	-.76	.62	1.0045	.11	-.17	.98	-.04	.03	1.00	1.0017	.05	.07	1.00
BUS	.94	-.07	-.25	.9578	.97	-.09	-.06	.95	-.16	.26	.9992	.99	-.03	.17
HELP	.86	-.25	.06	.8043	.85	-.05	.29	.87	-.35	.28	.9661	.94	-.22	.20
UNQUAL	-.91	.01	.09	.8427	-.92	-.05	-.02	-.97	.07	-.06	.9569	-.98	-.06	.04
Latent root	5.8333	1.8775	1.1109					5.6023	1.7143	1.4862				
Percentage	58.3	18.8	11.1	88.2				56.0	17.1	14.9	88.0			

TABLE F30: Factor Matrix and Factor Loadings for the Supply Side Explanatory Variables (3 Principal Components) (Continued)

	LEIRIA							LISBOA						
	Factor Matrix				Varimax Solution			Factor Matrix				Varimax Solution		
	Common Factor Loadings			Communality	Common Factor Loadings			Common Factor Loadings			Communality	Common Factor Loadings		
	I	II	III	h^2	I	II	III	I	II	III	h^2	I	II	III
EDUC	.03	.97	-.26	1.0026	-.12	.99	.02	.03	.77	-.21	.6400	-.09	.79	.08
PEDUC	.95	.11	-.06	.9167	.92	.26	.09	.93	.10	-.02	.8686	.88	.22	.23
PCAP	-.77	-.19	-.40	.7976	-.68	-.18	-.55	-.70	-.17	-.14	.5314	-.62	-.19	-.33
COST	-.87	.03	.11	.7758	.84	.12	.24	.88	-.02	-.21	.8198	.89	.18	-.01
TEARN	.26	.58	-.16	.4287	.17	.63	.03	.31	.70	-.33	.6896	.21	.80	.01
PUTEA	-.82	-.25	.10	.7468	-.77	-.38	-.09	-.98	.17	.10	1.0017	-1.00	-.01	-.06
PUCLASS	.10	.25	.87	.8232	-.02	.00	.91	.30	.38	.82	.8960	.09	.07	.94
BUS	.95	-.24	-.08	.9740	.98	-.07	-.06	.83	-.24	-.16	.7757	.88	-.05	-.04
HELP	.86	-.30	-.09	.8343	.90	-.13	-.04	.78	.00	.29	.6891	.71	-.01	.43
UNQUAL	-.93	.21	.16	.9352	-.96	.02	.08	-.82	.21	.03	.7187	-.84	.07	-.08
Latent root	5.6677	1.8237	1.2546					5.4433	1.6835	1.1653				
Percentage Variance	56.7	18.2	12.6	87.5				54.4	16.8	11.7	82.9			

TABLE E30: Factor Matrix and Factor Loadings for the Supply Side Explanatory Variables (3 Principal Components) (Continued)

	SETUBAL							VILA REAL						
	Factor Matrix				Varimax Solution			Factor Matrix				Varimax Solution		
	Common Factor Loadings			Communality	Common Factor Loadings			Common Factor Loadings			Communality	Common Factor Loadings		
	I	II	III	h^2	I	II	III	I	II	III	h^2	I	II	III
EDUC	.03	.71	-.41	.6690	-.07	-.03	.81	-.08	.65	.35	.5483	-.10	.73	.01
PEDUC	.95	.09	-.06	.9196	.84	.41	.22	.92	.20	.18	.9208	.92	.29	-.01
PCAP	-.71	-.02	.14	.5234	-.67	-.20	-.17	-.70	-.16	-.19	.5527	-.70	-.25	-.04
COST	.87	-.15	-.33	.8890	.93	.06	.14	.88	.24	-.12	.8486	.85	.18	-.29
TEARN	.32	.64	-.35	.6282	.20	.12	.76	.19	.84	.12	.7542	.14	.80	-.29
PUTEA	-.93	.06	.21	.9145	-.92	-.22	-.17	-.75	.29	.11	..6562	-.76	.29	.03
PUCLASS	.66	.31	.69	1.0021	.26	.97	-.00	-.11	-.56	.74	.8733	-.03	-.16	.92
BUS	.83	-.33	-.02	.7926	.85	.21	-.17	.96	-.23	-.14	1.0011	.97	-.24	-.10
HELP	.63	.38	.58	.8815	.25	.90	.11	.85	-.16	.08	.7559	.86	-.08	.07
UNQUAL	-.90	.34	.04	.9350	-.93	-.22	.16	-.99	.10	-.04	.9880	-.99	.04	.01
Latent root	5.6072	1.7077	1.3776					5.5078	2.0164	1.0021				
Percentage variance	56.1	17.1	13.8	86.9				55.1	20.2	10.1	85.3			

TABLE E31: Factor Loadings for Demand Side Explanatory Variables (Only One Principal Component)

DISTRICT	AVEIRO	BEJA	BRAGA	BRAGANCA	EVORA	GUARDA	LISBOA	PORTALEGRE	V.REAL	VISEU
GDP	.90	.92	.92	.93	.93	.91	.94	.92	91.6	.93
LIFE	1.01	1.00	1.00	1.01	1.00	1.00	1.00	1.00	98.7	1.00
ILLIT	-1.00	- .99	- .99	-1.00	-1.00	-1.00	- .98	-1.00	-1.00	-1.00
UNEMP	.90	.93	.92	.79	.90	.76	.81	.89	.79	.98
EARN	.45	.32	.50	.40	.39	.31	- .26	.49	.40	.52
LF	.98	.99	.99	.99	1.00	.99	.98	.99	1.00	.99
POP	.96	.98	.97	.97	.97	.98	.99	.97	.98	.98
Latent root	5.8154	5.8328	5.8686	5.6813	5.8295	5.5706	5.6167	5.8559	5.6566	6.0091
Percentage variance	83.1	83.3	83.8	81.2	83.3	79.6	80.2	83.7	80.8	85.8

TABLE E32: Factor Matrix and Rotated Factor Loadings for the Demand Side Explanatory Variables (2 Principal Components)

	C.BRANCO					COIMBRA				
	Factor Matrix			Varimax Solution		Factor Matrix			Varimax Solution	
	Common Factor Loadings		Communality	Common Factor Loadings		Common Factor Loadings		Communality	Common Factor Loadings	
	I	II	h^2	I	II	I	II	h^2	I	II
GDP	.94	-.24	.9422	.96	-.17	.93	-.32	.9699	.98	-.04
LIFE	1.00	-.02	.9987	1.00	.06	.99	-.10	.9929	.98	.19
ILLIT	-1.00	-.10	1.0052	-.99	-.17	-1.00	-.08	1.0049	-.94	-.36
UNEMP	.87	.14	.7766	.86	.21	.86	..23	.7880	.76	.47
EARN	.12	.95	.9148	.05	.96	.37	.88	.9205	.11	.95
LF	.99	.09	.9852	.99	.11	.99	-.03	.9774	.96	.25
POP	.99	-.12	.9899	.99	-.05	.98	.18	.9933	.99	.11
Latent root	5.6485	1.0795				5.6965	1.0524			
Percentage variance	80.7	15.4	96.1			81.4	95.0	96.4		

TABLE E32: Factor Matrix and Rotated Factor Loadings for the Demand Side Explanatory Variables (2 Principal Components) (Continued)

	FARO					LEIRIA				
	Factor Matrix			Varimax Solution		Factor Matrix			Varimax Solution	
	Common Factor Loadings		Communality	Common Factor Loadings		Common Factor Loadings		Communality	Common Factor Loadings	
	I	II	h^2	I	II	I	II	h^2	I	II
GDP	.90	-.39	.9671	.98	.06	.91	-.35	.9573	.98	.08
LIFE	.99	.12	1.0000	.83	.56	1.00	-.08	1.0025	.93	.36
ILLIT	-1.00	-.03	1.004	-.91	-.43	-1.00	-.05	1.0038	-.88	-.48
UNEMP	.79	.31	.7240	.57	.63	.80	.34	.7558	.58	.65
EARN	.50	.79	.8819	.09	.93	.52	.80	.9122	.12	.95
LF	.98	-.13	.9714	.93	.32	.98	-.10	.9787	.93	.34
POP	.96	-.27	.9895	.98	.20	.97	-.24	.9954	.98	.20
Latent root	5.5948	1.0657				5.6825	1.0356			
Percentage variance	79.9	15.2	95.1			81.2	14.8	96.0		

TABLE E32: Factor Matrix and Rotated Factor Loadings for the Demand Side Explanatory Variables (2 Principal Components) (Continued)

	PORTO					SANTAREM				
	Factor Matrix			Varimax Solution		Factor Matrix			Varimax Solution	
	Common Factor Loadings		Communality	Common Factor Loadings		Common Factor Loadings		Communality	Common Factor Loadings	
	I	II	h^2	I	II	I	II	h^2	I	II
GDP	.92	-.34	.9569	.98	.03	.92	-.35	.9682	.98	-.04
LIFE	1.00	-.06	1.0008	.95	.32	1.00	-.07	1.0012	.97	.25
ILLIT	-.99	-.12	1.0023	-.88	-.48	-.99	-.09	.9977	-.91	-.40
UNEMP	.82	.23	.7342	.68	.53	.86	.27	.8144	.73	.53
EARN	.45	.81	.8670	.12	.93	.39	.87	.9122	.09	.95
LF	.98	.09	.9706	.94	.29	.99	-.07	.9787	.96	.25
POP	.97	-.23	.9937	.99	.15	.98	-.20	.9961	.99	.12
Latent root	5.6600	1.0166				5.6819	1.0863			
Percentage variance	80.9	14.5	95.4			81.2	15.5	96.7		

TABLE E32: Factor Matrix and Rotated Factor Loadings for the Demand Side Explanatory Variables (2 Principal Components) (Continued)

	SETUBAL					V.CASTELO				
	Factor Matrix			Varimax Solution		Factor Matrix			Varimax Solution	
	Common Factor Loadings		Communality	Common Factor Loadings		Common Factor Loadings		Communality	Common Factor Loadings	
	I	II	h^2	I	II	I	II	h^2	I	II
GDP	.91	-.19	.8675	.90	-.24	.92	-.34	.9522	.98	-.02
LIFE	.85	.37	.8551	.87	.82	1.00	-.00	1.0046	.95	.32
ILLIT	-1.00	-.09	1.0004	-1.00	-.03	-1.00	-.10	1.0040	-.91	-.42
UNEMP	.94	.01	.8770	.94	-.04	.81	.21	.7092	.70	.47
EARN	-.10	.89	.8021	-.05	.89	.41	.87	.9224	.11	.95
LF	.98	.02	.9528	.98	-.04	.98	-.09	.9686	.96	.23
POP	.97	.18	.9672	.96	-.23	.97	-.24	.9943	.99	.09
Latent root	5.3300	1.1153				5.6133	1.0535			
Percentage variance	76.1	95.9	92.1			80.2	15.0	95.2		

TABLE E32: Factor Matrix and Rotated Factor Loadings for the Demand Side Explanatory Variables (2 Principal Components) (Continued)

	SETUBAL					V.CASTELO				
	Factor Matrix			Varimax Solution		Factor Matrix			Varimax Solution	
	Common Factor Loadings		Communality	Common Factor Loadings		Common Factor Loadings		Communality	Common Factor Loadings	
	I	II	h^2	I	II	I	II	h^2	I	II
GDP	.91	-.19	.8675	.90	-.24	.92	-.34	.9522	.98	-.02
LIFE	.85	.37	.8551	.87	.82	1.00	-.00	1.0046	.95	.32
ILLIT	-1.00	-.09	1.0004	-1.00	-.03	-1.00	-.10	1.0040	-.91	-.42
UNEMP	.94	.01	.8770	.94	-.04	.81	.21	.7092	.70	.47
EARN	-.10	.89	.8021	-.05	.89	.41	.87	.9224	.11	.95
LF	.98	.02	.9528	.98	-.04	.98	-.09	.9686	.96	.23
POP	.97	.18	.9672	.96	-.23	.97	-.24	.9943	.99	.09
Latent root	5.3300	1.1153				5.6133	1.0535			
Percentage variance	76.1	95.9	92.1			80.2	15.0	95.2		

TABLE E33: Principal Components for the Supply Side Explanatory Variables (Standardised Values)

YEAR	AVEIRO		BEJA		BRAGA		BRAGANCA		
	I	II	I	II	I	II	I	II	III
1971	-1.3668	-0.4797	-0.2169	-0.0657	-1.6267	-0.7762	-1.3277	-0.4661	-1.2963
1972	-1.6585	0.4568	-0.8623	0.4715	-1.1059	-0.0719	-1.3618	0.4148	-0.0329
1973	-1.2897	-0.0840	-0.2991	-0.0114	-1.0895	-0.4106	-1.0703	-0.2192	-0.8414
1974	-0.2190	-0.8817	-0.8737	0.5982	-0.6062	-0.3721	-0.8458	-1.0950	2.2446
1975	0.3220	2.5258	-0.5563	0.8830	-0.1068	2.7863	-0.0283	2.6812	0.6480
1976	0.1495	-0.7441	1.6255	-1.7541	0.2675	-0.0045	-0.0247	0.1314	0.8821
1977	0.6881	-0.5494	0.6157	-0.3524	0.4785	0.0375	0.7028	-0.3526	0.2890
1978	1.0263	0.7395	-1.5711	1.8315	0.6614	0.1226	0.7245	-0.0970	-0.6131
1979	0.5165	-0.8216	1.4418	-1.3502	0.5613	-0.7688	0.9806	-0.6976	-0.2169
1980	1.1070	-0.4720	0.6917	-0.4612	0.9525	0.2615	1.0664	-0.3460	-0.1424
1981	0.7246	0.3105	0.0047	0.2108	1.6139	-0.8038	1.1844	-0.6459	-0.9207

TABLE E33: Principal Components for the Supply Side Explanatory Variables (Standardised Values) (Continued)

YEAR	C.BRANCO			COIMBRA		EVORA			FARO	
	I	II	III	I	II	I	II	III	I	II
1971	-1.4789	-0.3883	-1.7597	-2.2419	1.0293	-1.4579	-0.7234	-1.0819	-1.8466	-0.7667
1972	-1.3506	0.3594	-0.6693	-0.4268	-0.9960	-1.7229	0.5815	-0.7885	-0.4573	0.6227
1973	-1.2385	0.0823	2.3322	-0.6460	0.2264	-1.0873	.0.2239	0.4594	-1.2786	0.4694
1974	-0.2920	-1.2585	0.5990	-0.2799	-1.1244	-0.2990	-0.8831	2.4402	-0.8494	-1.0702
1975	-0.0994	2.6232	0.0988	0.3095	1.6157	0.4472	2.6763	0.2070	-0.0113	1.4459
1976	0.9986	-0.5983	0.0053	0.2627	0.0568	0.1776	-1.1942	-0.6125	1.2728	0.4433
1977	0.5152	-0.0909	-0.0414	0.3616	0.0147	0.5086	-0.4091	0.1898	0.5140	0.3109
1978	0.4131	-0.6086	0.4616	1.3429	-1.6161	0.7177	-0.5364	0.5000	0.5425	-1.5476
1979	0.6441	-0.4360	-0.3280	-0.4544	1.1319	0.7859	-0.4803	-0.8049	0.2244	0.4027
1980	1.5477	-0.2110	-0.1469	0.4277	-0.2310	0.6920	0.3140	0.2755	0.8730	0.9960
1981	0.3407	0.5267	-0.5516	1.3445	-0.1073	1.2381	-0.5692	-0.7839	1.0165	-1.3114

TABLE E33: Principal Components for the Supply Side Explanatory Variables (Standardised Values) (Continued)

YEAR	GUARDA			LEIRIA			LISBOA			PORTALEGRE	
	I	II	III	I	II	III	I	II	III	I	II
1971	-1.6796	0.1377	-0.6557	-1.5545	-0.5680	-1.2051	0.7503	0.1949	0.3827	-1.7048	-0.4956
1972	-1.6197	-0.2894	-1.1180	-1.2573	0.6386	1.5222	-2.3586	-0.7718	-2.3607	0.0171	1.4591
1973	-0.9150	0.2205	2.5504	-0.8691	0.5253	-1.9015	-0.5382	-0.3897	-0.2562	-0.4613	0.2427
1974	-0.4817	-1.1503	0.2205	-0.9239	-1.7911	1.2969	0.2419	-0.7425	1.0614	-0.8504	-0.8533
1975	0.3610	2.1942	-0.1307	-0.1487	1.9879	0.5394	0.3328	2.6972	0.5511	0.6483	1.2660
1976	0.4934	-0.4155	0.2317	0.6832	-0.5740	0.4546	-1.0675	-0.6047	-1.0996	-0.3858	-0.8560
1977	0.7677	0.4945	-0.4226	0.6201	0.6286	0.3419	0.3874	-0.2857	0.2055	0.3882	-0.1646
1978	0.6523	-1.6367	-1.1185	0.3223	-0.9845	-0.2404	0.2240	-0.0844	0.2749	0.7139	-0.1546
1979	0.5145	0.4233	0.4068	0.9914	0.1376	-0.1086	1.0314	0.0238	0.8256	0.0437	-0.5516
1980	1.0373	0.4776	-0.2061	0.7929	0.2462	-0.3055	1.0057	0.6884	0.7949	-0.5573	-1.3851
1981	0.8698	-0.4559	0.2422	1.3436	-0.2468	-0.3939	-0.0094	-0.6779	-0.3796	2.1484	1.4930

TABLE E33: Principal Components for the Supply Side Explanatory Variables (Standardised Values) (Continued)

YEAR	PORTO		SANTAREM		SETUBAL			V.CASTELO	
	I	II	I	II	I	II	III	I	II
1971	-1.2048	-0.5341	-1.3583	-0.9116	-1.0416	-0.5664	-0.0772	-2.2615	-1.6841
1972	-1.4402	0.6679	-0.5553	0.1245	0.3489	-2.4113	-0.1508	1.0167	1.3937
1973	-1.1608	0.3551	-0.9381	-0.3030	-1.2592	0.6498	-0.0269	0.0063	0.2310
1974	0.0347	-0.9174	0.2941	0.4484	-1.3284	1.3644	-0.8971	0.8494	0.5908
1975	0.0681	0.1881	-0.2874	0.8094	-0.5908	0.7962	2.8810	0.0764	0.9854
1976	-0.3172	1.6534	1.7653	1.4443	1.3840	-0.0065	-0.3541	0.7586	0.6469
1977	0.3164	0.0626	-0.1357	-0.3105	0.4325	-0.2175	-0.0900	-0.9764	-1.3406
1978	1.3485	-1.9543	-0.1503	-0.8378	0.0338	0.4376	-0.5046	0.4707	0.1932
1979	-0.0842	1.1827	0.3947	-0.2488	0.8732	-0.4312	-0.6828	-0.8616	-1.1823
1980	1.4636	-0.1977	1.7129	1.5106	1.4596	-0.2810	0.0045	0.1386	-0.2198
1981	0.9759	-0.5013	-0.7419	-1.7255	-0.3120	0.6659	-0.1020	0.7828	0.3860

TABLE E33: Principal Components for the Supply Side Explanatory Variables (Standardised Values) (Continued)

YEAR	V.REAL			VISEU	
	I	II	III	I	II
1971	-1.7741	0.0404	-1.8034	-0.1810	-0.1912
1972	-0.3231	-0.6699	0.3522	-0.1726	-0.0030
1973	-0.7948	-0.5090	0.9391	-0.5143	0.3013
1974	-1.3869	0.0306	1.3582	-0.4936	0.3342
1975	-0.2790	1.9693	-0.5078	-0.3486	0.7206
1976	0.3899	1.1996	1.3615	0.8464	-0.8297
1977	0.7058	-0.3066	0.1715	-0.0200	0.0761
1978	0.6328	-0.5994	-0.4976	0.2545	-0.0995
1979	0.8880	-0.5276	-0.3373	0.8658	-0.8860
1980	0.5280	0.9200	0.1366	1.8500	-1.6589
1981	1.4134	-1.5474	-1.1730	-2.0866	2.2361

TABLE E34: Principal Components for the Demand Side Explanatory Variables (Standardised Values)

YEAR	AVEIRO	BEJA	BRAGA	BRAGANCA	C.BRANCO		COIMBRA		EVORA	FARO	
	I	I	I	I	I	II	I	II	I	I	II
1971	-0.4019	-0.0454	-1.3854	-1.3094	-1.3018	-1.3107	-0.9501	-1.3980	0.5835	-0.8519	-1.5519
1972	-1.8600	-1.5470	-1.1783	-1.1229	-0.8824	-0.8249	-0.9311	-1.4831	0.2656	-0.6745	-0.9351
1973	0.5986	-0.7716	-0.8855	-0.7711	-0.7804	-0.9676	-0.5136	-0.9157	0.5264	-0.5192	-0.8856
1974	0.1583	-1.1766	-0.6218	-0.5486	-0.6214	0.8495	-0.8058	0.8122	-1.9641	-0.9716	0.0942
1975	-1.1591	-0.0968	-0.4688	-0.7785	-0.8802	1.5404	-0.9165	0.8647	0.5214	-0.6594	1.6245
1976	0.2848	-0.0844	-0.0201	0.1308	0.1509	1.5427	-0.2706	1.7766	-1.2841	-0.7258	0.4097
1977	1.4486	0.4489	0.2745	0.1017	0.2989	0.6423	-0.1369	1.0298	-0.3998	-0.4476	-0.2849
1978	-0.6571	0.7282	0.5495	0.7125	-0.0058	-0.7077	0.2535	0.0710	-0.1584	0.7212	1.7169
1979	0.1913	0.0113	0.8946	0.7773	1.0952	-0.4518	1.1545	-0.3628	-0.5532	1.0452	-0.0032
1980	-0.0052	2.1796	1.2132	0.9346	1.1814	-0.2689	1.2974	-0.4600	1.1608	1.3468	-0.2738
1981	1.4077	0.3538	1.6281	1.8736	1.7456	-0.0433	1.8192	0.0653	1.3018	1.7368	0.0861

TABLE E34: Principal Components for the Demand Side Explanatory Variables (Standardised Values) (Continued)

YEAR	GUARDA	LEIRIA		LISBOA	PORTALEGRE	PORTO		SANTAREM		SETUBAL	
	I	I	II	I	I	I	II	I	II	I	II
1971	-1.3597	-0.7876	-1.5442	-0.9660	-0.6340	-0.8326	-1.5206	-0.9055	-1.1865	-1.4782	-1.0240
1972	-1.4482	-0.6903	-1.4540	-1.3246	-2.2061	-0.8546	-1.4694	-0.8813	-1.4179	-1.2700	-1.0729
1973	-0.4696	-0.4771	-1.0104	-0.7686	-0.0221	-0.5268	-0.9890	-0.5926	-1.1402	-0.8490	-0.3023
1974	-0.7232	-1.0230	1.0541	-0.6506	-0.4575	-0.8854	1.0611	-0.9263	0.3561	-0.6346	1.9047
1975	-0.3399	-0.8773	0.5987	-0.7596	-0.4752	-0.8043	0.7779	-0.7083	1.4470	-0.3390	1.2000
1976	-0.0403	-0.5013	1.3061	-0.0936	-0.0252	-0.4475	1.2059	-0.5518	0.8848	0.0233	0.6129
1977	0.3331	-0.2095	1.0417	0.4229	0.3104	-0.1484	0.9569	0.0685	1.4834	0.3717	0.6555
1978	0.3625	0.2609	0.3132	0.2637	0.6464	0.3358	0.5601	0.1972	0.0346	0.5687	-0.4051
1979	0.8981	1.0995	-0.0408	0.9930	0.2142	1.1712	-0.1792	1.1573	-0.1128	0.9283	-1.2335
1980	1.0329	1.3272	-0.3314	1.0422	0.9937	1.2216	-0.3284	1.3887	-0.1941	1.1784	0.0493
1981	1.7543	1.8785	0.0670	1.8412	1.6554	1.8710	-0.0753	1.7541	-0.1544	1.5004	-0.3846

TABLE E34: Principal Components for the Demand Side Explanatory Variables (Standardised Values) (Continued)

YEAR	V.CASTELO		V.REAL	VISEU
	I	II	I	I
1971	-0.9519	-1.4637	-1.3819	-1.3528
1972	-0.9134	-1.4278	-1.0770	-1.1631
1973	-0.5367	-0.9948	-0.7084	-0.9073
1974	-0.8107	1.1253	-0.5438	-0.6070
1975	-0.8934	1.0257	-0.8767	-0.4187
1976	-0.3136	1.1629	0.3313	-0.0464
1977	-0.0898	0.8583	0.4216	0.1881
1978	0.2945	0.4153	0.3484	0.5032
1979	1.1705	-0.0077	0.6383	0.8891
1980	1.1240	-0.4170	0.9284	1.2149
1981	1.9205	-0.2765	1.9198	1.7000

APPENDIX G

A SUMMARY OF THE COMPUTER PROGRAMS USED IN THE STATISTICAL ANALYSES

Most of the following computer programs were run on the CDC CYBER 7600 Computer System at the University of Manchester Computer Centre (UMRCC). Because of the very large amount of data involved, FORTRAN programs PROGRAM(STACK), STACK and UNRESID were run on the CYBER 205, also at UMRCC.

Basic Markov Model:

SPSSREG : SPSS; job control instructions by current author : 43 lines
This program describes the procedure to access the SPSS-7000, program REGRESSION, to produce the unrestricted OLS estimates of the constant transition probabilities.

JOB(M) + JOB(MMM) : current author : 47+53 lines
These programs help to obtain the expression $(\underline{n}^* - \underline{N}\ \hat{\underline{p}})'(\underline{n}^* - \underline{N}\ \hat{\underline{p}})$ that will be the objective function for the quadratic programming problem to compute the restricted OLS estimates of the transition probabilities.

MPOS1 : MPOS; job control instructions by current author : 39 lines
The program accesses the MPOS (version 4) package to solve the quadratic programming problem for the minimization of the sum of squares of the residuals for the restricted OLS estimator.

RESIDD : current author : 200 lines
Computes the statistics (standard errors, t-values, confidence intervals and F-value) for the restricted OLS estimates of the transition probabilities obtained after running the previous program.

SIGMA : NAG; current author : 59 lines
Computes the variance-covariance matrix of the residuals (matrix $\underline{\Sigma}$) and its inverse $\underline{\Sigma}^{-1}$ for the unrestricted OLS estimation procedure.

UNGLS : NAG; current author : 204 lines
The program computes the unrestricted GLS estimates of the transition probabilities through the expression $(\underline{N}'\underline{\Sigma}^{-1}\ \underline{N})^{-1}\ (\underline{N}'\underline{\Sigma}^{-1}\ \underline{n}^*)$

SIGMA2 : current author : 167 lines
The program helps the estimate of the expression $(\underline{n}^* - \underline{N}\ \hat{\underline{p}})'\ \underline{\Sigma}^{-1}\ (\underline{n}^* - \underline{N}\ \hat{\underline{p}})$ in which $\underline{\Sigma}^{-1}$ is the inverse of the variance-covariance matrix of the residuals obtained by performing the restricted OLS estimation procedure (the transition probability estimates obtained in MPOS1 were used in RESIDD to compute the residuals).

MPOS4 : MPOS; job control instructions by current author : 47 lines
As program MPOS1 this program produces the restricted GLS estimates of the transition probabilities by minimizing the corresponding objective function.

RETUR1 : current author : 76 lines
the program generates the matrices of returnee students and the smoothed data matrices of school enrolment.

Extended Markov Model:

JOBB + PROGRM(VAR) : current author : 106 lines
This program generates the data file for the unrestricted OLS estimation procedure creating the matrix $[\underline{n}^{*} \mid \underline{N}^{x}]$.

REG(EXTCON) : SPSS; job control instructions by current author : 18 lines
Computes the unrestricted OLS estimates for the $\underline{a}$ and $\underline{\delta}$ parameters using stepwise regression (Method I).

STAT(CON) : current author : 110 lines
Computes the transition probability estimates using the results obtained in the previous program.

ERROR(CASE) : current author : 119 lines
Computes the statistics fot the different transition probability estimates using the statistics generated for the estimates of the $\underline{a}$ and $\underline{\delta}$ parameters.

PROGRM(RESVAR) : current author : 118 lines
This program is similar to PROGRM(VAR) and generates the data file for the restricted OLS estimation method.

FACTOR(SUPPLY) : SPSS; job control instructions by current author : 29 lines
Performs the principal components analysis on the supply side explanatory variables.

FACTOR(DEMAND) : SPSS; job control instructions by current author : 24 lines
Performs the principal components analysis on the demand side explanatory variables.

PRIN(SUPPLY) : NAG; current author : 36 lines
Computes the principal components from the factor scores obtained in program FACTOR(SUPPLY).

PRIN(DEMAND) : current author : 33 lines
Computes the principal components from the factor scores obtained in program FACTOR(DEMAND).

REGSHAX : SHAZAM; job control instructions by current author : 36 lines
Computes the unrestricted stepwise OLS estimates of the coefficients using all stacked district data (Method III).

REGSHA3A : SHAZAM; job control instructions by current author : 34 lines
Performs the pooled cross-section time-series regression for Region 1 (Method IV).

PROGRM(STACK) : current author : 81 lines
The program generates the data matrix for the unrestricted OLS estimation procedure creating the matrix $[\underline{n}^* : \underline{N}^x : \langle \text{dummies} \rangle]$. Data file STADATA was created stacking all district data matrices $[\underline{n}^* : \underline{N}^x]$. Similar program was written to generate the data matrix for the restricted OLS estimation procedure.

STACK : NAG; current author : 45 lines
The program computes the unrestricted OLS estimates of the parameters for the time-varying model, for the stacked data with principal components and district dummy variables.

UNRESID : current author : 138 lines
Computes the residuals and the statistics for the unrestricted OLS estimation procedure performed in the previous program.

PROBSTAK(LIS) : current author : 57 lines
Computes the transition probability estimates for Lisbon and for the unrestricted OLS estimation procedure using the results of program UNRESID. Similar program computes the transition probability estimates for the restricted OLS estimation procedure.

COVAR2 : current author : 45 lines
Selects the variance-covariance matrix of the residuals for each district individually from the global variance-covariance matrix obtained after performing the program UNRESID.