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# Comparison of Transition Matrices Between Metropolitan and Non-metropolitan Areas in the State of Utah Using Juvenile Court Data

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# COMPARISON OF TRANSITION MATRICES BETWEEM METROPOLITAN AND NON-METROPOLITAN AREAS IN THE STATE OF UTAH USING JUVENILE COURT DATA

by

Sung-Ik Song

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Using Juvenile Court Data

by

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The purpose of this paper is to use Markov Chains for the study of youths referred to the juvenile court in the metropolitan and non-metropolitan areas of the state of Utah.

Two computer programs were written for creating case histories for each person referred to the court and for testing for the significance of the difference among several transition matrices.

Another computer program, which was written by Soo Hong Uh, was used for analysing realizations of a Markov chains up to the 4th order; a third computer program, originally written by David White, was used for interpreting Markov chains.

The paper is divided into six chapters: intorduction and thesis goals, definition of SMSA (Standard Metropolitan Statistical Area), statistical background, methodology, analysis and summary and conclusions.

(91 pages)

# CHAPTER I

# INTRODUCTION AND THESIS GOALS

This study is a part of a larger study dealing with juvenile court data. The major purposes of this study are: 1) to determine how delinquent youths can be identified early, and 2) to develop methods by which to evaluate juvenile court policies. In this study, the case histories from the juvenile court can be considered as Markov chains.

This study is a part of a series of projects being carried out by Utah State University under contract with Utah State Juvenile Court to evaluate the effectiveness of court policies.

The knowledge of recent case histories of youth referred to the court are of genuine value in identifying those who are likely to be in trouble in the immediate future by analyzing those Markov chains. The quick feed-back to the intake officer of these case histories seems to be of considerable value.

Under certain circumstances, a person can be subjected to several differnet policies without any system or logical order. For example, a boy may have his probation officer assignment changed several times. In such cases, it will be in the interest of the court to know which probation officer or policy is most effective to a particular type of child.

## Review of Literature on Use of Stochastic Models in the Social Sciences

A stochastic process is one which develops in time according to probabilistic laws. This means that we cannot predict its future behavior with certainty. The most we can do is to attach probabilities to the various possible future states. Most of the applications of the ideas of quantative analysis were already familiar. The uncertainties associated with human behavior compel analytically oriented social and behavioral scientists to appeal to mathematical models based on probability theory and stochastic processes. However, progress has been much slower in the social sciences, one reason being the lack of persons qualified in both mathematics and the social sciences. A more fundamental reason is that many of the basic problems of measurement in the social sciences remain unsolved and so constitute a barrier to the application of sophisticated mathematical techniques. In spite of these difficulties, there have been some notable achievements. For example, in psychology Bush and Mosteller[1] have developed stochastic learning models. More recently, Steindhl[2] has demonstrated the possibilities for stochastic analysis in the field of economics. Coleman,[3] in his Introduction to Mathematical Sociology, has laid the foundations for the stochastic treatment of many parts of sociological theory. At a more elementary level the book by Kemeny and Snell[4] introduces undergraduates to the quantitative study of the social sciences.

In formulating and analyzing stochastic models, we make much use of the theory of Markov chains in discrete time. In analysing juvenile

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[1]Bush, R. R. and Mosteller, C. F., Stochastic Models for Learning, (New York: John Wiley & Sons Ltd., 1955).

[2]Steindhl, J., Random Processes and the Growth of Firms, (London: Griffin, 1965).

[3]Coleman, J. S., Introduction to Mathematical Sociology, (Englewood Cliffs: Prentice-Hall, 1964).

[4]Kemeny, J. G. and Snell, L., Mathematical Models in the Social Sciences, (Boston: Ginn and Co., 1962).

court data, Markov chains are a good tool because we usually consider the discrete parameter space, say one month or one week time interval, in dealing with court data.

Some applications of Markov processes in social sciences can be found in the following references. These are: "Finite Markov Process in Psychology" by B. A. Miller,[5] "A further Note on 'Finite Markov Process in Psychology'" by L. A. Goodman,[6] "Note on Miller's 'Finite Markov Process in Psychology'" by Richard C. W. Kao.[7] More recently, Kemeny and Snell applied Markov processes in learning theory,[8] Kintsch and Morris introduced "Application of a Markov Model to free Recall and Recongnition"[9] and Greeno and Steiner wrote several articles such as 'Markovian Process with Identifiable States: General Considerations and Application to all-or-none Learning",[10] the article about comments and revision on their previous paper mentioned earlier,[11] and "An Analysis of Some Conditions for Representing N States Markov

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[5]Miller, G. A., "Finite Markov Process in Psychology", Psychometrika, Vol. 17(1952), pp. 149-167.

[6]Goodman, L. A., "A Further Note on 'Finite Markov Process in Psychology'", Psychometrika, Vol. 18, No. 3(1953), pp. 245-248.

[7]Kao, Richard C. W., 'Note on Miller's 'Finite Markov Processes in Psychology'", Psychometrika, Vol. 18, No. 3(1953), pp. 241-243.

[8]Kemeny, J. G. and Snell, J. L., 'Markov Processes in Learning Theory", Psychometrika, Vol. 22(1957), pp. 221-230.

[9]Kintsch, W. and Morris, C. J., "Application of a Markov Model to free Recall and Recognition", Journal of Experimental Psychology, Vol. 69(1965), pp. 200-206.

[10]Greeno, J. G. and Steiner, T. E., 'Markovian Process with identifiable states: General considerations and Application to all-or-none Learning", Psychometrika, Vol. 29(1964), pp. 309-333.

[11]Greeno, J. G. and Steiner, T. E., "Comments on 'Markovian Process with identifiable states: General Considerations and Application to all-or-none Learning'", Psychometrika, Vol. 33(1968), pp. 169-172.

Processes as General all-or-none Model."[12]

Work done by the Utah State Juvenile Court

The studies, limited to District II (Salt Lake County), and having been made so far are as follows:

1. A computer program has been written with a single array orientation for analyzing realizations of Markov chains to the 9th order within machine limitations.[13]

2. The chain order has been obtained when a time interval of one month is assumed.

Thesis Goals

The objectives of this study are to use Markov chains for the study of youths referred to the juvenile court, and specifically:

1) To write a computer program for creating case histories for each person referred to the court.

2) To write a computer program to test for the significance of the difference among several transition matrices. This is actually a preliminary goal for goal 5. If it turns out that the transition matrices of metropolitan and non-metropolitan areas are not significantly different, there is no reason to compare those two areas in detail.

3) To determine the chain order which is significant for the data of the juvenile court when a one month time interval is assumed.

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[12]Greeno, J. G. and T. E. Steiner, "An Analysis of Some Conditions for representing N states Markov Processes as General all-or-none Model, Psychometrika, Vol. 34(1969), pp. 461-487.

[13]Uh, S. H., Analysis of Case Histories by Markov Chains Using Juvenile Court Data of State of Utah, Utah State Univ., 1973, pp. 17-23.

4) To examine whether there is any difference between metropolitan and non-metropolitan areas by comparing transition matrices.

5) Using these results, we are interested in knowing whether there are differences between urban and rural youth in the following problems:

a) Are there differences between rural and urban youth in crime rate in general, non-drug offense and drug offense?

b) Do drug-type referrals increase the probability of later referrals?

c) Do drug-type referrals increase crime in general or are people referred for drug offenses just more likely to commit a drug offense?

d) Can we identify youth who are likely to be back to the court?

e) Does probation help in reducing recidivism rates in youth?

f) Does probation help more with drug offenses or with non-drug offenses?

## Thesis Outline

Following the introductory chapter, Chapter II is the definition of SMSA (Standard Metropolitan Statistical Area). Chapter III is a review of statistical background. Chapter IV is concerned with the methodology. The nature of the data and the method of procedure is discussed in this chapter. The data are analyzed in Chapter V. Chapter VI is a summary and a conclusion. Appendices are: (A) a computer program for constructing case histories, (B) a computer program to test for the significance of the difference among several transition matrices, (C) the output list of transition probability matrices for the six states and one month time interval, (D) Master Coding Guide which contains the list of codes which have been stored on the Utah State Juvenile Court Referral Tape.

# CHAPTER II

## DEFINITION OF STANDARD METROPOLITAN STATISTICAL AREA (SMSA)

For many types of analysis, the entire area in and around a city, in which the activities form an integrated economic and social system, needs to be considered as a unit.

The SMSA classification provides a distinction between metropolitan and non-metropolitan areas by type of residence, supplementing the older rural-urban, farm-nonfarm distinctions. Further, SMSA's take into account places of industrial concentration (labor demand) and of population concentration (labor supply). So the SMSA has been used extensively by numerous government agencies as a standard area for data gathering, analysis, and publication of statistics.

In addition, the data used in this study are recorded on magnetic tape by district (each district consists of several counties) and by county. Since SMSA boundaries coincide with the county boundaries, it is very convenient to split the state using SMSA and non-SMSA classifications. The following definition and criteria for an SMSA is quoted from the Bureau of the Census (1972).[14]

The definition of an individual SMSA involves two considerations: First, a city or cities of specified population to constitute the central city and to identify the county in which it is located as the central county; and second, economic and social relationships with contiguous counties which are metropolitan in character, so that the periphery of the specific

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[14] County and City Data Book, (Social and Economic Statistics Administration, Bureau of the Census, 1972), pp. xxi-xxii.

metropolitan area may be determined. SMSA's may cross state lines.

## Population Criteria

The criteria for population relate to a city or cities of specified size according to the 1970 Census of Population.

1. Each standard metropolitan statistical area must include at least:

a. One city with 50,000 inhabitants or more, or

b. Two cities having contigous boundaries and constituting, for general economic and social purposes, a single community with a combined population of at least 50,000, the smaller of which must have a population of at least 15,000.

2. If two or more adjacent counties each have a city of 50,000 inhabitants or more(or twin cities under 1b above) and the cities are within 20 miles of each other (city limits to city limits), they are to be included in the same area unless there is definite evidence that the two cities are not economically and socially integrated.

## Criteria of Metropolitan Character

The criteria of metropolitan character relate primarily to the attributes of the county as a place of work or as a home for a concentration of non-agricultural workers. Specifically, these criteria are:

3. At least 75 percent of the labor force of the county must be in the non-agricultural labor force. Non-agricultural labor force is defined as those employed in non-agricultural occupations, those experienced unemployed whose last occupation was a non-agricultural occupation, members of the Armed Forces, and new workers.

4. In addition to criterion 3, the county must meet at least one of

the following conditions:

a. It must have 50 percent or more of its population living in contiguous minor civil divisions with a density of at least 150 persons per square mile, in an unbroken chain of minor civil divisions with such density radiating from a central city in the area. A contiguous minor civil division either adjoins a central city in a SMSA or adjoins an intermediate minor civil division of qualifying population density.

b. The number of nonagricultural workers employed in the county must equal at least 10 percent of the number of nonagricultural workers employed in the county containing the largest city in the area, or be the place of employment of 10,000 nonagricultural workers.

c. The nonagricultural labor force living in the county must equal at least 10 percent of the number in the nonagricultural labor force living in the county containing the largest city in the area, or a be the place of residence of a nonagricultural labor force of 10,000.

Criteria of Integration

The criteria of integration relate primarily to the extent of economic and social communication between the outlying counties and central county.

6. A county is regarded as integrated with the county or counties containing the central cities of the area if either of the following criteria is met.

a. 15 percent of the workers living in the county work in the county or counties containing central cities of the area, or

b. 25 percent of those working in the county live in the county or counties containing central cities of the area.

According to the definition and criteria mentioned above, there are three SMSA's in Utah, that is, Ogden SMSA, Salt Lake City SMSA and Provo-Orem SMSA. Ogden SMSA includes Weber County, Provo-Orem SMSA includes Utah County and Salt Lake City SMSA is consists of Davis and Salt Lake County. They are contiguous counties. The rest 25 counties are considered as non-metropolitan area.

According to the 1970 Census, the population inside SMSA's is 821,689 or 77.6 percent of the total population of State of Utah,[15] while the area is only 4.45 percent of the total area of the state.[16]

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[15] 1970 Census of Population, Vol. 1, Part 46, Utah, (Social and Economic Statistics Administration, Bireau of the Census, 1973, p. 19.

[16] Ibid, p. 14.

# CHAPTER III

## STATISTICAL BACKGROUND

### Definition of a Markov Chain

"Stochastic processes occuring in most real-life situations are such that for a discrete set of parameters $t_1,t_2,\ldots,t_n \in T$, the random variables $X(t_1),X(t_2),\ldots,X(t_n)$ exhibit some sort of dependence. This is called Markov-dependence, which may be defined as follows: consider a finite set of points $(t_0,t_1,\ldots,t_n,t)$, $t_0<t_1<t_2<\ldots<t_n<t$ and $t,t_r \in T(r=0,1,\ldots,n)$ where T is the parameter space of the process $\{X(t)\}$. The dependence exhibited by the process $\{X(t),t\in T\}$ is called Markov-dependence if the conditional distribution of X(t) for given values of $X(t_1),X(t_2),\ldots,X(t_n)$ depends only on $X(t_n)$ which is the most recent known value of the process, i.e., if

$$P[X(t)\leq x|X(t_n)=x_n,\ X(t_{n-1})=x_{n-1},\ldots,X(t_0)=x_0]$$
$$=P[X(t)\leq x|X(t_n)=x_n] \qquad (3.1)$$

The stochastic process exhibiting this property is called a Markov process.

Next, let $t_0$ and $t_1$ be two points in T such that $t_0\leq t_1$. Then we may define the conditional transition distribution function as

$$F(x_0,x_1;t_0,t_1)=P[X(t_1)\leq x_1|X(t_0)=x_0] \qquad (3.2)$$

When the stochastic process has discrete parameter and state spaces, we may define the transition probabilities as

$$P_{ij}^{(m,n)}=P(X_n=j|X_m=i),\ n\geq m \qquad (3.3)$$

A stochastic process $\{X(t),t\in T\}$ is said to be time-homogeneous if the transition distribution function given by (3.2) depends only on the difference $t_1-t_0$ instead of on $t_0$ and $t_1$. Then we have

$$F(x_0,x;t_0,t_0+t)=F(x_0,x;0,t) \qquad (3.4)$$

for $t_0$ T. For convenience we can write (3.4) as $F(x_0,x;t)$. The corresponding expression for the process $X_n, n=0,1,2,\ldots$ would then be $P_{ij}(n)$.

Whenever the parameter space is discrete and the process is time-homogeneous, we shall call such processes Markov chains."[17]

## The Chain Order

By a chain of order r is meant a chain in which the dependence extends over r+1 consecutive time intervals only. For such a chain there will therefore be r+1 subscripts in the transition probability $P_{ij\ldots k\ell}$.[18]

For example, for the first order chain,

let $n_i(t)$ be the number of people in state i at time t,

$n_{ij}(t)$ be the number of people in state i at time t-1, state j at time t,

and let $n_{ij}=\sum_{t=1}^{T} n_{ij}(t)$, $n_i=\sum_{t=1}^{T} n_i(t-1)$,

then $P_{ij}=n_{ij}/n_i$. Further, $P_{ijk}=P_{jk}$, that is, the probability that a person will enter state k given case history ij is unchanged if we omit knowledge of state i.

For the rth order chain,

let $n_{ij\ldots k\ell}(t)$ be the number of people with case history ij...k who are in state i at time t-r, j at time t-r+1, ... , k at time t-1, $\ell$ at time t,

and let $n_{ij\ldots k\ell}=\sum_{t=1}^{T} n_{ij\ldots k\ell}(t)$, $n_{ij\ldots k}=\sum_{t=1}^{T} n_{ij\ldots k}(t-1)$,

then $P_{ij\ldots k\ell}=n_{ij\ldots k\ell}/n_{ij\ldots k}$. Further, $P_{ij\ldots k\ell m}=P_{j\ldots k\ell m}$, that is, the probability that a person will enter state m given case history ij...k

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[17] Bhat, U. Narayan, Elements of Applied Stochastic Processes, (New York: John Wiley & Sons, Inc., 1972), pp. 11-13.

[18] Hoel, P. G., "A Test for Markov Chains", Biometrika, Vol. 41(1954), p. 430.

is unchanged if we omit the knowledge of state i.[19]

## Test for the Significance of Difference Among Several Transition Matrices

If we have several sets of realizations of a Markov chain of order 1, we can test the null hypotheses that the sets are homogeneous, that is, whether they come from the same (but unspecified) matrix of transition probabilities.

If there are s populations of a Markov chain of order 1 with m states, the null hypothesis is that $P_h(E_j | E_i)$ is the same for all $h (h=1,2,\ldots,s)$ for all i,j, where $i,j=1,2,\ldots,m$. The appropriate information statistic for the test is as follows:

We are given

$p_{ij}^{(h)}=n_{ij}^{(h)}/n_{i.}^{(h)}$ from population h, $h=1,2,\ldots,s$ and $i,j=1,2,\ldots,m$.

Let

$$p_{ij}^{(\cdot)}=\sum_{h=1}^{s} n_{i.}^{(h)}\ p_{ij}^{(h)} \Big/ \sum_{h=1}^{s} n_{i.}^{(h)}$$
$$=\sum_{h=1}^{s} n_{ij}^{(h)}/n_{i.}^{(\cdot)}$$

Then,

$$2\sum_{h=1}^{s}\sum_{i=1}^{m}\sum_{j=1}^{m} n_{ij}^{(h)} \ln[p_{ij}^{(h)}/p_{ij}^{(\cdot)}] \sim \chi^2_{m(s-1)(m-1)}$$

Results similar to those given above may be derived for testing hypotheses concerning Markov chains of higher order than 1.

Let's consider a kth order chain.

We are given

$p_{ij\ldots k\ell}^{(h)}=n_{ij\ldots k\ell}^{(h)}/n_{ij\ldots k.}^{(h)}$ from population h, $h=1,2,\ldots,s$ and $i,j,\ldots,k,\ell=1,2,\ldots,m$.

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[19]Anderson and Goodman, op. cit., pp. 99-102.

We wish to test the null hypothesis that $P_{ij\ldots k\ell}^{(h)}=P_{ij\ldots k\ell}$ for h=1,2,...,s, where $P_{ij\ldots k\ell}$ is unspecified.

Let

$$P_{ij\ldots k\ell}^{(\cdot)}=\sum_{h=1}^{s} n_{ij\ldots k.}^{(h)}\,P_{ij\ldots k\ell}^{(h)}\Big/\sum_{h=1}^{s} n_{ij\ldots k.}^{(h)}$$
$$=\sum_{h=1}^{s} n_{ij\ldots k\ell}^{(h)}/n_{ij\ldots k.}^{(\cdot)}$$

Then,

$$2\sum_{h=1}^{s}\sum_{i=1}^{m}\sum_{j=1}^{m}\cdots\sum_{k=1}^{m}\sum_{\ell=1}^{m} n_{ij\ldots k\ell}\ln\left[P_{ij\ldots k\ell}^{(h)}/P_{ij\ldots k\ell}^{(\cdot)}\right]\sim\chi^2_{m^k(s-1)(m-1)}$$

We can express this in simpler form.

Let t correspond to ij...k.

We are given

$P_{ij\ldots k\ell}^{(h)}=P_{t\ell}^{(h)}=n_{t\ell}^{(h)}/n_{t.}^{(h)}$ where $t=1,2,\ldots,m^k$ and $=1,2,\ldots,m$.

Let

$$P_{t\ell}^{(\cdot)}=\sum_{h=1}^{s} n_{t.}^{(h)}P_{t}^{(h)}\Big/\sum_{h=1}^{s} n_{t.}^{(h)}$$
$$=\sum_{h=1}^{s} n_{t\ell}^{(h)}/n_{t.}^{(\cdot)}$$

Then,

$$2\sum_{h=1}^{s}\sum_{t=1}^{m^k}\sum_{\ell=1}^{m} n_{t\ell}^{(h)}\ln\left[P_{t\ell}^{(h)}/P_{t\ell}^{(\cdot)}\right]\sim\chi^2\ m^k(s-1)(m-1).$$ [20]

This material is the basis for the program described in goal 2, page 4, and written to obtain the chi-square tests described above.

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[20] Kullback, S., Kupperman, M., Ku, H. H., Technometrics, Vol. 4, No. 4(1962), pp. 602-607;
Anderson, T. W. and Goodman, L. A., The Annals of Mathematical Statistics, Vol. 28, No. 1(1957), p. 103.

# CHAPTER IV

# METHODOLOGY

## Nature of the Data

The data used in this study were collected by the Juvenile Court of the State of Utah and all information collected has been recorded on magnetic tape and stored in the State Computer Center in Salt Lake City. A copy of a magnetic tape containing records of referrals to the court (without identification) through April of 1973 was used for this study.

### Description of the information on the Utah State Juvenile Court referral tape

This tape is collection of records consisting of case histories for juveniles referred to the court. Each case history consists of a consecutive set of records pertaining to one person. The first contains permanent information about a juvenile, such as his birth date and race, but omitting identifying information such as his name, address, names of parents, etc. Each subsequent record in the case history gives the circumstances for one instance in which the person was referred to the court, including the date when the person was referred, the name of the offense, disposition of the case, etc. The tape was created from more comprehensive records kept by the court, and includes only information which was thought to be of statistical value.

The records are each 80 bytes in length (similar to a standard IBM card) and are in blocks of 90 records (7200 bytes per block).

The preliminary record in each case history is identified by a "0" in column 1; this will be referred to as a type "0" record. All subsequent records in the case history--instances when the person was referred to the court--

have "1" in column one (referred to as a type "1" record). A brief description of the contents of each of these records appears in Table 1. The information on these records is in code, for the most part; translation of these code is given in an 'Master Coding Guide" in Appendix D.

Table 1. Description of information on the referral tape of Utah State Juvenile Court

| | Column Data Field Begins in | Length of Data Field | Type of Data | Description of Data |
|---|---|---|---|---|
| Record | 1 | 1 | N | "0" |
| Type 0 | 2 | 6 | N | Case number |
| * | 8 | 6 | N | Social number |
| | 14 | 1 | A | Sex (m-male, f-female) |
| | 15 | 6 | N | Birthdate mmddyy |
| | 21 | 2 | N | County code |
| | 23 | 3 | N | Area code |
| * | 26 | 1 | AN | Print control indicator |
| * | 27 | 12 | AN | Status indicator codes |
| | 39 | 36 | | Unused |
| | 75 | 6 | | Unused (used for sequencing print tape) |
| Record | 1 | 1 | N | "1" |
| Type 1 | 2 | 6 | N | Case number |
| | 8 | 6 | N | Referral date mmddyy |
| | 14 | 1 | AN | Referred by code |
| | 15 | 12 | N | Four 3-digit offense codes |
| * | 27 | 3 | N | Detension code |
| * | 30 | 3 | N | Severity code |
| * | 33 | 2 | AN | Probation officer code |
| | 35 | 13 | AN | Twelve social factor codes are given in these positions |
| | 48 | 6 | N | Closure date mmddyy |
| | 54 | 9 | N | Three 3-digit closure codes |
| | 63 | 11 | | Optional information codes |
| * | 74 | 1 | AN | Referral status indicator |
| | 75 | 6 | | Unused (used to sequence print tape) |

Note: a data field is a sequence of consecutive columns containing some kind of information. Information marked with an asterisk is not described in this report.

It should be pointed out that a referral may be for more than one offense; space on record type 1 is provided for up to four offense codes for a single referral to the court, using the three-digit offense code. In the same vein there is space for three codes indicating the action taken by the court, in case more than one code is required to describe that action.

## Construction of Case Histories For Each Person Referred to the Court

The sequence of events for a youth referred to the court is an actual case history. Such a sequence of referrals can be expressed in terms of "states" in which the youth finds himself during any given month. These states can be defined in any way we choose.

We can then translate a case history into a string of digits which represents the different states we define. Such strings are the "case histories" which can be analyzed by the methods described in this study. If certain assumptions to be described below are satisfied, such a string is called a "realization" of a Markov chain.

A six-state chain is defined for this study:

State 1: Not referred to the court during the month and not on probation.
State 2: Not referred to the court during the month and on probation.
State 3: Referred to the court for one or more offenses, none of which involves drugs during the month and not on probation.
State 4: Referred to the court for one or more offenses, none of which involves drugs during the month and on probation.
State 5: Referred to the court for one or more offenses, at least one of which involves drugs during the month and not on probation.
State 6: Referred to the court for one or more offenses, at least one of which involves drugs during the month and on probation.

For the purpose of analysis, realizations were obtained for all case histories which were at least fifty months long, counting from the time of the first referral to the creation date of the tape, or 18th birthday, whichever was first.

The computer program was written to accept the Utah State Juvenile Court Referral Tape as input. The required length of each string was 50 digits and the length of each time interval was 30 days.

The program reads the type "0" record to get the personal information of a youth such as birthdate and county code. Then it reads all subsequent type "1" records and saves them in the appropriate arrays to obtain all referral and disposition information for the same person such as referral date, offense code, closure code etc. Then it computes the length from the first referral date to his 18th birthdate. Next, it computes the length of time from the first referral date to tape creation date (April, 1973). If both lengths are long enough, i.e. at least 50 months, these records are used for constructing the string. Otherwise, this youth's records are ignored and another person's records are read.

At the next step, the program calculates the lengths between the first referral date and ith referral date (i=1,2,...,k). Now we are ready to construct a case history.

In the program, the storage position PROB is used for one's probation status. If PROB is 1, he is not on probation, if it is 2, he is on probation at some time. Then it picks up the first referral record from the array and test whether its closure code is probation or not. If it is a probation code, then set PROB equal to 2. This probation status is continued until he is released from the probation. Therefore, if he is on probation now, then test whether probation is released or not. If it is released, then set PROB equal to 1: that means he is not on probation now. Next, it tests whether a youth is referred for a drug offense or not. Then the program tests whether he is referred for a non-offense or not. Suppose a youth is referred to the court for improper care due to faults or habits of parents, then we should not treat this referral as his offense. If a youth is referred to the court more than once during the month, then the higher number is recorded in the string. SAVE is used for this purpose. That is, if he has more than one referral during the same time interval, the digit just created is saved in SAVE, and compared with the digit created next. The lower digit is replaced by the higher one. After the program creates digits for the first referral record, it picks up the next referral record from the array and creates more digits. This routine is continued until the number of digits equals 50. If it creates one complete realization, i.e. a string with 50 digits, test whether county belongs to metropolitan area or not, and write it on the appropriate tape. Therefore, we have two tapes of case histories, one with case histories of metropolitan areas, the other with those of non-metropolitan areas.

We continue this routine for all data on Referral Tape.

## Test for the Significance of the Difference among Several Transition Matrices

This program is based on the theory provided by S. Kullback, et al. mentioned in chapter III.

We are given state=1,2,...,m; order=r from s population. We should be provided with s different tapes each of which contains the list of each transition matrix to be compared. We can obtain these tapes when we run the program for stepwise testing of the order of a Markov chain written by Soo Hong Uh.[21] These tapes are used for data inputs.

[21] Uh, S. H., op. cit., pp. 17-23.

The program reads all tapes of the transition matrices until CODE is the desired order. The value of CODE is the order of the transition probability matrix to be read in. Now the chi-square statistic is ready to be calculated. The program reads the transition probability matrix one row at a time and creates a transition count matrix since we have only transition probability matrices. If the matrix for one group is read, the program reads the next transition probability matrix and creates another transition count matrix. Now we have corresponding transition count matrices along with the transition probability matrices. These two kinds of matrices are what we need for claculating the chi-square value for testing the null hypothesis that the realizations are homogeneous. Then the program computes a chi-square value according to the formula in chapter III.

This program is good for any number of states, any order chain and any number of populations by initializing the proper value in the DATA statement.

# CHAPTER V

## ANALYSIS

The computer program to construct case histories mentioned in Chapter IV was run for all five districts of Utah using the Utah State Juvenile Court Referral tape as input. 9,414 case histories were created from the total of 79,444 youths referred to the court for the period from 1968 through 1973. Among these strings, 7,940 strings belong to metropolitan area and 1,474 strings belong to non-metropolitan area.

Deleted strings included following cases:

(1) Either the length from the first referral date to his 18th birthdate or the length from the first referral date to tape creation date is less than 1470 days, which is long enough for creating 50-month long case histories.

(2) Records arranged not in chronological order.

(3) Wrong data, such as a number representing a certain month being less than or equal to 0 or greater than 12, etc.

With these case histories, transition probability matrices up to 4th order were obtained with the program already written by Soo Hong Uh.

Now, let's discuss about the thesis goals.

The first goal was to write a computer program for creating case histories for each person referred to the court. The second goal was to write a computer program to test for the significance of the difference among several transition matrices. These two goals were already discussed in chapter IV.

The third goal was to determine the chain order which is significant for the data of the juvenile court when a one month time interval is assumed.

Let's look at the following tables. These tables show the chi-square values for testing of the order of Markov chain.

Table 2. Chi-square values for six states with one month time interval (metropolitan areas)

| | $H_0 : H_A$ | Chi-square | Degrees of freedom |
|---|---|---|---|
| Chain order | 1 vs. 2 | 1760.344 | 150 |
| | 2 vs. 3 | 1439.770 | 900 * |
| | 3 vs. 4 | 1490.071 | 5400 |

Table 3. Chi-square values for six states with one month time interval (non-metropolitan areas)

| | $H_0 : H_A$ | Chi-square | Degrees of freedom |
|---|---|---|---|
| Chain order | 1 vs. 2 | 231.216 | 150 * |
| | 2 vs. 3 | 212.393 | 900 |
| | 3 vs. 4 | 232.070 | 5400 |

The chi-square value of 1439.77 with degrees of freedom of 900 in metropolitan areas and 231.22 with degrees of freedom 150 turned out to be highly significant. This means that the third order in metropolitan areas and the second order in non-metropolitan areas are the best fit for the data. In other words, 3 months and 2 months past court history are useful in prediction of the next state to be occupied by a youth in metropolitan and non-metropolitan areas respectively.

The fourth goal was to examine whether there is any differnece between metropolitan and non-metropolitan areas by comparing transition matrices.

A computer program was written under the theory developed by Anderson and Goodman(1957) for this purpose. A source program is shown in Appendix B. Owing to this program, we obtained the following chi-square values along with its degrees of freedom.

Table 4. Chi-square values for testing the homogeneity between metropolitan and non-metropolitan transition matrices

| Chain order | Chi-square | Degrees of freedom | Number of empty rows | |
|---|---|---|---|---|
| | | | Metropolitan | Non-metro. |
| 1 | 396.86 | 30 * | 0 | 0 |
| 2 | 400.35 | 180 * | 2 | 7 |
| 3 | 452.44 | 1080 | 77 | 133 |

Table shows chi-square values 396.86 with 30 degrees of freedom and 400.35 with 180 degrees of freedom are highly significant. Hence we can conclude that the transition matrices for the first order and the second order are different while the test for the difference between third order matrices was not significant. However, the reason for this is probably due to the number of empty rows. There are 77 empty rows in metropolitan areas and 133 empty rows in non-metropolitan areas in the third order transition matrix. The empty rows reduce the degrees of freedom although exact formula for this case have not developed so far. If the degrees of freedom are reduced a lot, then the test for the difference between third order matrices can be significant.

The fifth goal was to examine whether there are differences between urban and rural youth in the following problems using these results described above.

a) We examine whether there are differences between rural and urban youth in crime rate in general, non-drug offense and drug offense.

Let's look at the following tables.

Table 5. Probability that someone was in state i(metropolitan areas)

| | State | | | | | |
|---|---|---|---|---|---|---|
| | Not ref. not prob. | Not ref. probation | Non-drug not prob. | Non-drug probation | Drug off. not prob. | Drug off. probation |
| Probability | .908 | .061 | .016 | .010 | .003 | .002 |

Table 6. Probability that someone was in state i(non-metropolitan areas)

| | State | | | | | |
|---|---|---|---|---|---|---|
| | Not ref. not prob. | Not ref. probation | Non-drug not prob. | Non-drug probation | Drug off. not prob. | Drug off. probation |
| Probability | .933 | .051 | .008 | .005 | .002 | .001 |

These two tables show the following facts:

(1) Probability that a youth is referred to the court is .031 in metropolitan areas while .016 in non-metropolitan areas. This means that for those already referred to the court, the crime rate in the urban areas is about twice higher than that of the rural areas.

(2) The probability of referral for a non-drug offense is .026 in metropolitan areas, .013 in non-metropolitan areas. The probability of

referral for a drug offense is .005 in metropolitan areas and .003 in non-metropolitan areas. These show that the crime rates in non-drug offenses and drug offenses are about twice higher in the urban areas than in the rural areas.

(3) The probability that a youth is on probation is .073 in metropolitan areas while .057 in non-metropolitan areas. This might be the difference of the judges. If this is not so, we can say that youths in the city commit more serious offense than youths in the rural areas since probation is usually executed for more serious offense. The probability that someone was in state 4 or 6(referred to the court and on probation) is .012 in metropolitan areas while .006 in non-metropolitan areas shows that a higher percentage are referred while on probation in metropolitan areas than in non-metropolitan areas.

b) We examine whether drug-type referrals increase the probability of later referrals. Prior to examine this, we need the transition probability matrices.

Table 7. Transition matrix for the first order chain(metropolitan areas)

| State left | State entered | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | (Count) |
| 1 | .979 | .000 | .015 | .002 | .003 | .000 | 345878 |
| 2 | .026 | .865 | .002 | .089 | .000 | .017 | 23398 |
| 3 | .860 | .000 | .106 | .013 | .017 | .004 | 6105 |
| 4 | .014 | .746 | .003 | .208 | .000 | .030 | 3949 |
| 5 | .847 | .003 | .091 | .011 | .042 | .006 | 1047 |
| 6 | .013 | .696 | .000 | .195 | .000 | .096 | 743 |

Table 8. Transition matrix for the first order chain(non-metropolitan areas)

| State left | State entered | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | (Count) |
| 1 | .988 | .000 | .008 | .001 | .002 | .000 | 66004 |
| 2 | .034 | .904 | .001 | .048 | .000 | .012 | 3602 |
| 3 | .904 | .000 | .061 | .015 | .017 | .003 | 594 |
| 4 | .009 | .812 | .000 | .149 | .000 | .030 | 329 |
| 5 | .880 | .007 | .099 | .000 | .014 | .000 | 142 |
| 6 | .012 | .815 | .000 | .111 | .000 | .062 | 81 |

Now, let's look at the probabilities that a youth who committed a drug offense referred to the court again for any offense and a youth who committed a non-drug offense referred to the court again for any offense, where "any offense is meant either a drug or non-drug offense. That is, we want to find the following conditional probabilities.

These are:

$P(\text{any offense} \mid \text{drug offense}) = P(3 \text{ or } 4 \text{ or } 5 \text{ or } 6 \mid 5 \text{ or } 6)$ and

$P(\text{any offense} \mid \text{non-drug offense}) = P(3 \text{ or } 4 \text{ or } 5 \text{ or } 6 \mid 3 \text{ or } 4)$.

Let's consider following probability.

$P(A \text{ or } B \mid C \text{ or } D) = P(A \cup B \mid C \cup D) = P(A \mid C \cup D) + P(B \mid C \cup D)$, where A, B, C, D are mutually independent.

$P(A \mid C \cup D) = P[A \cap (C \cup D)] / P(C \cup D)$ by definition

$= P[(A \cap C) \cup (A \cap D)] / [P(C) + P(D)]$

$= P(A \mid C)P(C) + P(A \mid D)P(D) / [P(C) + P(D)]$ by theorem.

In the same way,

$P(3 \text{ or } 4 \text{ or } 5 \text{ or } 6 \mid 5 \text{ or } 6)$

$= P(3 \mid 5 \text{ or } 6) + P(4 \mid 5 \text{ or } 6) + P(5 \mid 5 \text{ or } 6) + P(6 \mid 5 \text{ or } 6)$

$= [P(3|5)P(5)+P(3|6)P(6)+P(4|5)P(5)+P(4|6)P(6)+P(5|5)P(5)+P(5|6)P(6)$

$+P(6|5)P(5)+P(6|6)P(6)]/[P(5)+P(6)]$

$=(P_{53}n_5+P_{63}n_6+P_{54}n_5+P_{64}n_6+P_{55}n_5+P_{65}n_6+P_{56}n_5+P_{66}n_6)/(n_5+n_6)$

$=[(P_{53}+P_{54}+P_{55}+P_{56})n_5+(P_{63}+P_{64}+P_{65}+P_{66})n_6]/(n_5+n_6)$, where $n_i$ is the number of cases leaving state i,

and P(3 or 4 or 5 or 6|3 or 4)

$=[(P_{33}+P_{34}+P_{35}+P_{36})n_3+(P_{43}+P_{44}+P_{45}+P_{46})n_4]/(n_3+n_4)$.

By the formula above, we obtain the following values.

Table 9. Conditional probability of referral

| Month | | Probability | |
|---|---|---|---|
| t - 1 | t | Metro. | Non-metro. |
| Drug offense | Any offense | .2085 | .1348 |
| Non-drug offense | Any offense | .1797 | .1256 |

Table 9 shows us that a youth who is referred to the court for a drug offense is more likely to referred to the court again for any offense than a youth who is referred to the court for a non-drug offense. Here again, the referral probabilities are higher in metropolitan areas than in non-metropolitan areas.

c) We want to examine whether drug-type referrals increase crime in general or whether people referred for drug offenses are just more likely to commit a drug offense. We want to find the following probabilities this time.

P(non-drug offense|drug offense)

=P(3 or 4|5 or 6)

$=[(P_{53}+P_{54})n_5+(P_{63}+P_{64})n_6]/(n_5+n_6)$

P(non-drug offense|non-drug offense)

=P(3 or 4|3 or 4)

$=[(P_{33}+P_{34})n_3+(P_{43}+P_{44})n_4]/(n_3+n_4)$

P(drug offense|drug offense)

=P(5 or 6|5 or 6)

$=[(P_{55}+P_{56})n_5+(P_{65}+P_{66})n_6]/(n_5+n_6)$

P(drug offense|non-drug offense)

=P(5 or 6|3 or 4)

$=[(P_{35}+P_{36})n_3+(P_{45}+P_{46})n_4]/(n_3+n_4)$

Finally, we got the values in the following table.

Table 10. Conditional probability of referral

| Preceding month | Current month | | | |
|---|---|---|---|---|
| | Metropolitan | | Non-metropolitan | |
| | Drug off. | Non-drug | Drug off. | Non-drug |
| Drug offense | .0679 | .1406 | .0314 | .1034 |
| Non-drug offense | .0245 | .1551 | .0236 | .1020 |

Table 10 shows that a youth on drugs is less prone to commit a non-drug offense, but more likely to commit a drug offense in metropolitan areas. However, in case of non-metropolitan areas, a youth on drugs is more likely to commit both non-drug offense and drug offense.

Hence, we can say that a youth on drugs is just more likely to commit a drug offense in metropolitan areas while drug-type referrals increase crime in general in non-metropolitan areas.

Before examining the next goal, we are going to look at the second order transition matrices.

Table 11. Transition matrix for the second order chain(metropolitan area)

| State left | State entered | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | (Count) |
| 11 | .981 | .000 | .014 | .002 | .002 | .000 | 341840 |
| 12 | .000 | .826 | .000 | .130 | .000 | .043 | 23 |
| 13 | .870 | .000 | .098 | .013 | .015 | .004 | 5114 |
| 14 | .004 | .741 | .000 | .229 | .000 | .026 | 795 |
| 15 | .854 | .002 | .084 | .011 | .044 | .004 | 890 |
| 16 | .015 | .674 | .000 | .212 | .000 | .098 | 132 |
| 21 | .939 | .000 | .038 | .010 | .008 | .005 | 604 |
| 22 | .030 | .877 | .002 | .077 | .000 | .015 | 19759 |
| 23 | .762 | .000 | .167 | .024 | .048 | .000 | 42 |
| 24 | .020 | .768 | .004 | .183 | .000 | .025 | 2032 |
| 25 | .857 | .000 | .143 | .000 | .000 | .000 | 7 |
| 26 | .015 | .727 | .000 | .189 | .000 | .069 | 392 |
| 31 | .895 | .000 | .074 | .015 | .012 | .003 | 5133 |
| 32 | .000 | .500 | .000 | .500 | .000 | .000 | 2 |
| 33 | .792 | .002 | .168 | .014 | .019 | .005 | 625 |
| 34 | .000 | .692 | .000 | .269 | .000 | .038 | 78 |
| 35 | .811 | .011 | .158 | .000 | .021 | .000 | 95 |
| 36 | .000 | .545 | .000 | .273 | .000 | .182 | 22 |
| 41 | .887 | .000 | .057 | .019 | .019 | .019 | 53 |
| 42 | .009 | .798 | .002 | .165 | .000 | .025 | 2876 |
| 43 | .727 | .000 | .273 | .000 | .000 | .000 | 11 |
| 44 | .007 | .708 | .002 | .248 | .000 | .034 | 802 |
| 45 | 1.000 | .000 | .000 | .000 | .000 | .000 | 1 |
| 46 | .009 | .658 | .000 | .228 | .000 | .105 | 114 |
| 51 | .876 | .000 | .071 | .013 | .036 | .005 | 863 |
| 52 | .000 | .667 | .000 | .333 | .000 | .000 | 3 |
| 53 | .835 | .000 | .099 | .000 | .066 | .000 | 91 |
| 54 | .000 | .750 | .000 | .167 | .000 | .083 | 12 |
| 55 | .805 | .000 | .049 | .024 | .073 | .049 | 41 |
| 56 | .167 | .500 | .000 | .000 | .000 | .333 | 6 |
| 61 | 1.000 | .000 | .000 | .000 | .000 | .000 | 10 |
| 62 | .014 | .766 | .002 | .154 | .002 | .062 | 501 |
| 63 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 64 | .028 | .681 | .007 | .184 | .000 | .099 | 141 |
| 65 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 66 | .000 | .657 | .000 | .157 | .000 | .186 | 70 |

Table 12. Transition matrix for the second order chain(non-metropolitan areas)

| State left | State entered 1 | 2 | 3 | 4 | 5 | 6 | Total (Count) |
|---|---|---|---|---|---|---|---|
| 11 | .989 | .000 | .008 | .001 | .002 | .000 | 63879 |
| 12 | .000 | 1.000 | .000 | .000 | .000 | .000 | 6 |
| 13 | .901 | .000 | .064 | .012 | .019 | .004 | 515 |
| 14 | .010 | .876 | .000 | .093 | .000 | .021 | 97 |
| 15 | .898 | .000 | .087 | .000 | .016 | .000 | 127 |
| 16 | .000 | .909 | .000 | .045 | .000 | .045 | 22 |
| 21 | .958 | .000 | .033 | .008 | .000 | .000 | 120 |
| 22 | .037 | .908 | .001 | .042 | .000 | .010 | 3186 |
| 23 | 1.000 | .000 | .000 | .000 | .000 | .000 | 4 |
| 24 | .012 | .810 | .000 | .149 | .000 | .030 | 168 |
| 25 | 1.000 | .000 | .000 | .000 | .000 | .000 | 1 |
| 26 | .026 | .821 | .000 | .103 | .000 | .051 | 39 |
| 31 | .919 | .000 | .056 | .006 | .017 | .002 | 521 |
| 32 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 33 | .889 | .000 | .056 | .056 | .000 | .000 | 36 |
| 34 | .000 | .778 | .000 | .222 | .000 | .000 | 9 |
| 35 | .778 | .000 | .222 | .000 | .000 | .000 | 9 |
| 36 | .000 | .500 | .000 | .500 | .000 | .000 | 2 |
| 41 | 1.000 | .000 | .000 | .000 | .000 | .000 | 3 |
| 42 | .011 | .864 | .000 | .095 | .000 | .030 | 264 |
| 43 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 44 | .000 | .778 | .000 | .178 | .000 | .044 | 45 |
| 45 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 46 | .000 | .600 | .000 | .200 | .000 | .200 | 10 |
| 51 | .902 | .000 | .041 | .008 | .041 | .008 | 122 |
| 52 | 1.000 | .000 | .000 | .000 | .000 | .000 | 1 |
| 53 | 1.000 | .000 | .000 | .000 | .000 | .000 | 13 |
| 54 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 55 | .500 | .500 | .000 | .000 | .000 | .000 | 2 |
| 56 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 61 | 1.000 | .000 | .000 | .000 | .000 | .000 | 1 |
| 62 | .000 | .828 | .000 | .125 | .000 | .047 | 64 |
| 63 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 64 | .000 | .286 | .000 | .571 | .000 | .143 | 7 |
| 65 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 66 | .000 | .800 | .000 | .200 | .000 | .000 | 5 |

First, let's consider 0 count rows.

0 rows in metropolitan area is states 63 and 65. Frequency of these states is also 0 in non-metropolitan area. There is no case moving from the state that a youth referred for a drug offense and on probation to the state of being referred for a any offense and not on probation at the next month. This shows us that the probation status was never released in the next month when a youth on probation was referred for a drug offense.

In addition to the states mentioned above, 0 rows in non-metropolitan areas are as follows: from state 3 to state 2, from state 4 to state 3, from state 4 to state 5 and from state 5 to state 6. These states have considerably low frequency, almost negligible, in the metropolitan area, that is, frequency of 2, 11, 1, 12 and 6 respectively.

It is quite natural that there is no, or considerably low frequency from state 3 to state 2 since if a youth is referred to the court and not on probation and he is not referred to the court in next month, then he can hardly be put on probation. Considering moving from state 4 to state 3 or state 5, when a youth is referred to the court and on probation and he is referred again in the next month, then there is no reason to release him from probation. Hence, people don't move from state 4 to state 3 or 5. When moving from state 5 to state 6, a youth is referred to the court for an drug offense and not on probation, and then referred again for a drug offense and rarely put on probation. This means there is no serious offense involving drug. In case of 6 observations in metropolitan areas, we may interprete this fact that this is due to the other serious offense which change his probation status, but was replaced by the drug offense.

The other low frequency rows in both metropolitan and non-metropolitan areas are as follows. The number in parentheses represent the frequency counts in metropolitan and non-metropolitan areas respectively. From state 1 to state 2(23,6), from state 2 to state 3(42,4), from state 2 to state 5(7,1), from state 3 to state 6(22,2), from state 4 to state 1(53,3), from state 5 to state 2(3,1), from state 5 to state 5(41,2) and from state 6 to state 1(10,1).

Next, let's look at the high frequency rows. The first five highest frequency rows in both metropolitan and non-metropolitan areas are the rows from state 1 to state 1, from state 2 to state 2, from state 3 to state 1, from state 1 to state 3 and from state 4 to state 2. The next five highest frequency rows are: the rows from state 2 to state 4, from state 1 to state 5, from state 5 to state 1, from state 4 to state 4 and state 1 to state 4. Let's think about the reason of high frequencies in these rows.

Let's look at the table 5 and 6 on page 24 again.

Those tables show us that a youth is not referred to the court for the most part of time, that is, .969 in metropolitan areas and .984 in non-metropolitan areas. This means most of states are 1's and 2's. This fact explains the reason why the frequencies of the rows from state 1 to state 1 and from state 2 to state 2 are the highest. We can also find the reason why the frequencies of the rows from state 3 to state 1 and from state 1 to state 3 are the next highest from the same fact. The reason for high frequency of the rows from state 4 to state 2 and from state 2 to state 4 is the same; however, these frequencies are lower than those of the rows 31 and 13 because a youth is off probation for a higher percentage of time than he is on probation. In the same vein, the frequency of row 22 is lower than that of row 11.

Note that the frequency of these high frequency rows takes the most part of total frequency, that is, 99.2 percent and 99.5 percent of the total frequency in metropolitan and non-metropolitan areas respectively.

Now, let's return to our goals. Next goal is to examine whether we can identify youth who are likely to be back to the court. In order to do this, we are going to find out which youth with the high frequency case history is most likely to return to the court in the next 6 months. The reason for choosing high frequency case histories is because the case history involved most people is more important.

Let's look at the third order transition matrices and find out the high frequency rows.

Table 13. Transition matrix for the third order chain(metropolitan areas)

| State left | State entered | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | (Count) |
| 111 | .982 | .000 | .013 | .002 | .002 | .000 | 318817 |
| 112 | .000 | .850 | .000 | .100 | .000 | .050 | 20 |
| 113 | .874 | .000 | .094 | .013 | .015 | .004 | 4538 |
| 114 | .004 | .745 | .000 | .228 | .000 | .022 | 675 |
| 115 | .864 | .003 | .082 | .011 | .037 | .004 | 784 |
| 116 | .018 | .655 | .000 | .218 | .000 | .109 | 110 |
| 121 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 122 | .000 | .895 | .000 | .105 | .000 | .000 | 19 |
| 123 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 124 | .000 | .333 | .000 | .667 | .000 | .000 | 3 |
| 125 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 126 | .000 | 1.000 | .000 | .000 | .000 | .000 | 1 |
| 131 | .901 | .000 | .070 | .015 | .011 | .003 | 4359 |
| 132 | .000 | .000 | .000 | 1.000 | .000 | .000 | 1 |
| 133 | .825 | .000 | .141 | .010 | .019 | .004 | 481 |
| 134 | .000 | .687 | .000 | .284 | .000 | .030 | 67 |
| 135 | .838 | .014 | .135 | .000 | .014 | .000 | 74 |
| 136 | .000 | .611 | .000 | .167 | .000 | .222 | 18 |
| 141 | .667 | .000 | .333 | .000 | .000 | .000 | 3 |
| 142 | .003 | .809 | .000 | .166 | .000 | .022 | 580 |
| 143 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 144 | .006 | .676 | .000 | .279 | .000 | .039 | 179 |
| 145 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |

Table 13. Continued

| State left | State entered 1 | 2 | 3 | 4 | 5 | 6 | Total (Count) |
|---|---|---|---|---|---|---|---|
| 146 | .000 | .762 | .000 | .190 | .000 | .048 | 21 |
| 151 | .883 | .000 | .069 | .008 | .035 | .005 | 741 |
| 152 | .000 | 1.000 | .000 | .000 | .000 | .000 | 2 |
| 153 | .845 | .000 | .099 | .000 | .056 | .000 | 71 |
| 154 | .000 | .800 | .000 | .100 | .000 | .100 | 10 |
| 155 | .784 | .000 | .054 | .027 | .081 | .054 | 37 |
| 156 | .250 | .500 | .000 | .000 | .000 | .250 | 4 |
| . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . |
| 661 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 662 | .022 | .761 | .000 | .130 | .022 | .065 | 46 |
| 663 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 664 | .000 | .800 | .000 | .100 | .000 | .100 | 10 |
| 665 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 666 | .000 | .692 | .000 | .154 | .000 | .154 | 13 |

Table 14. Transition matrix for the third order chain(non-metropolitan areas)

| State left | State entered 1 | 2 | 3 | 4 | 5 | 6 | Total (Count) |
|---|---|---|---|---|---|---|---|
| 111 | .989 | .000 | .007 | .001 | .002 | .000 | 61843 |
| 112 | .000 | 1.000 | .000 | .000 | .000 | .000 | 6 |
| 113 | .911 | .000 | .057 | .013 | .017 | .002 | 470 |
| 114 | .011 | .889 | .000 | .078 | .000 | .022 | 90 |
| 115 | .902 | .000 | .080 | .000 | .018 | .000 | 112 |
| 116 | .000 | .900 | .000 | .050 | .000 | .050 | 20 |
| 121 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 122 | .000 | .833 | .000 | .167 | .000 | .000 | 6 |
| 123 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 124 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 125 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 126 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 131 | .924 | .000 | .053 | .004 | .016 | .002 | 450 |
| 132 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 133 | .879 | .000 | .061 | .061 | .000 | .000 | 33 |
| 134 | .000 | .833 | .000 | .167 | .000 | .000 | 6 |

Table 14. Continued

| State left | State entered | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | (Count) |
| 135 | .778 | .000 | .222 | .000 | .000 | .000 | 9 |
| 136 | .000 | .500 | .000 | .500 | .000 | .000 | 2 |
| 141 | 1.000 | .000 | .000 | .000 | .000 | .000 | 1 |
| 142 | .000 | .857 | .000 | .095 | .000 | .048 | 84 |
| 143 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 144 | .000 | .889 | .000 | .000 | .000 | .111 | 9 |
| 145 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 146 | .000 | 1.000 | .000 | .000 | .000 | .000 | 2 |
| . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . |
| 661 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 662 | .000 | 1.000 | .000 | .000 | .000 | .000 | 4 |
| 663 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 664 | .000 | .000 | .000 | 1.000 | .000 | .000 | 1 |
| 665 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |
| 666 | .000 | .000 | .000 | .000 | .000 | .000 | 0 |

Now, we have lots of rows with no observations. In general, the more states we have and the higher the order is, the more 0 frequency rows we have. We are interested in referral probabilities with high reliability (i.e., high frequency rows).

The rows with frequency over 800 are 111, 222, 113, 311, 131, 422 and 242 in metropolitan areas. The rows with frequency of over 150 in non-metropolitan areas, which is about same proportion as 800 in metropolitan areas, are 111, 222, 113, 311, 131 and 422. The next high frequency rows in metropolitan areas are 115, 151, 511, 114, 142, 221, 211 and 442. These rows have the frequency of over 540. The rows with frequency of over 100 in non-metropolitan areas are 242, 224, 211, 115, 151 and 511. Common rows in both areas are 115, 151, 511 and 211. The row 242 belongs to first high frequency group(over 800) in metropolitan areas. The rows 114, 142, 221 and 442 belong to high frequency group only for metropolitan areas while the row 224 belongs to high frequency group only for non-metropolian areas.

d) Let's examine which youth with the high frequency case history is most likely to return to the court in the next 6 months. We can consider this probability in two cases. First case is that the court does not put him on probation and second case is that the court put him on probation during the next 6 months period.

Let's consider the first case.

P(a youth is referred in the next 6 months given the court does not put him on probation during the period and case history ijk)

$$=1 - P[111111|(1 \cup 3 \cup 5) \cap ijk]$$

$$=1 - [P_{ijk1}/(P_{ijk1}+P_{ijk3}+P_{ijk5})][P_{jk11}/(P_{jk11}+P_{jk13}+P_{jk15})][P_{k111}/(P_{k111}+P_{k113}+P_{k115})][P_{1111}/(P_{1111}+P_{1113}+P_{1115})]^3.$$

The second case is:

P(a youth is referred in the next 6 months given the court put him on probation during the period and case history ijk)

$$=1 - P[222222|(2 \cup 4 \cup 6) \cap ijk]$$

$$=1 - [P_{ijk2}/(P_{ijk2}+P_{ijk4}+P_{ijk6})][P_{jk22}/(P_{jk22}+P_{jk24}+P_{jk26})][P_{k222}/(P_{k222}+P_{k224}+P_{k226})][P_{2222}/(P_{2222}+P_{2224}+P_{2226})]^3.$$

A computer program for this calculation was originally written by David White and modified by Kim Andriano, of the USU Statistics Department. Owing to his program, I obtained following results.

Table 15. The probability of being referred in next 6 months given case history ijk

| Case History | Probability | | | | Sample size | |
|---|---|---|---|---|---|---|
| | Metropolitan | | Non-metropolitan | | Metro. | Non-metro. |
| | Off prob. | On prob. | Off prob. | On prob. | | |
| 111 | .1001 | .9904 | .0617 | .9761 | 318817 | 61843 |
| 222 | .2085 | .5087 | .1371 | .4106 | 16898 | 2834 |
| 113 | .3074 | .0000 | .2260 | .0000 | 4538 | 470 |
| 311 | .1541 | .9571 | .0984 | .9217 | 4456 | 467 |
| 131 | .2211 | .9842 | .1663 | .0000 | 4349 | 450 |
| 422 | .2953 | .5460 | .0982 | .4356 | 2251 | 223 |
| 242 | .2783 | .5834 | .0576 | .4513 | 1516 | 134 |

Table shows that case histories 113, 422 and 242 have high probabilities that a youth is referred in the next 6 months when the court does not put him on probation during the period and case histories 111, 131 and 311 have high probabilities when the court put him on probation during the period in metropolitan areas. In non-metropolitan areas, case histories 113 and 131 have the high probabilities when he is not put on probation and case histories 111 and 311 have high probabilities when he is put on probation during the period.

e) We want to examine whether probation help for reducing recidivism rates in youth. And f) if this is so, we will test that probation helps more with drug offenses or with non-drug offenses. In order to examine these, we should calculate the conditional probabilities of referral given on probation for 1 month, for 2 months, for 3 months and for 4 months, so on. We need the fourth order transition probability matrices to calculate these probabilities. Look at the following tables.

Now, we should find the following conditional probabilities.

P(not referred|on probation for 1 month)

=P(1 or 2|1112 or 1114 or 1116 or 1132 or 1134 or 1136 or 1152 or 1154 or 1156 or 1312 or 1314 or 1316 or 1332 or 1334 or 1336 or 1352 or 1354 or 1356 or 1512 or 1514 or 1516 or 1532 or 1534 or 1536 or 1552 or 1554 or 1556 or 3112 or 3114 or ... or 5112 or ... or 5556)

=P(1|1112 or 1114 or ... or 5556)+P(2|1112 or 1114 or ... or 5556)

$=(P_{11121}n_{1112}+P_{11141}n_{1114}+\cdots+P_{55561}n_{5556})/(n_{1112}+n_{1114}+\cdots+n_{5556})$
$+(P_{11122}n_{1112}+P_{11142}n_{1114}+\cdots+P_{55562}n_{5556})/(n_{1112}+n_{1114}+\cdots+n_{5556})$

$=[(P_{11121}+P_{11122})n_{1112}+(P_{11141}+P_{11142})n_{1114}+\cdots+(P_{55561}+P_{55562})n_{5556}]$
$/(n_{1112}+n_{1114}+\cdots+n_{5556})$

P(not referred|on probation for 2 months)

=P(1 or 2|1122 or 1124 or 1126 or 1142 or 1144 or 1146 or 1162 or 1164 or 1166 or 1322 or 1324 or 1326 or 1342 or 1344 or 1346 or 1362 or 1364 or 1366 or 1522 or 1524 or 1526 or 1542 or 1544 or 1546 or 1562 or 1564 or 1566 or 3122 or 3124 or ... or 5122 or ... or 5566)

$=[(P_{11221}+P_{11222})n_{1122}+(P_{11241}+P_{11242})n_{1124}+\cdots+(P_{55661}+P_{55662})n_{5566}]$
$/(n_{1122}+n_{1124}+\cdots+n_{5566})$

P(not referred|on probation for 3 months)

=P(1 or 2|1222 or 1224 or 1226 or 1242 or 1244 or 1246 or 1262 or 1264 or 1266 or 1422 or 1424 or 1426 ro 1442 or 1444 or 1446 or 1462 or 1464 or 1466 or 1622 or 1624 or 1626 or 1642 or 1644 or 1646 or 1662 or 1664 or 1666 or 3222 or 3224 or ... or 5222 or ... or 5666)

$=[(P_{12221}+P_{12222})n_{1222}+(P_{12241}+P_{12242})n_{1224}+\cdots+(P_{56661}+P_{56662})n_{5666}]$
$/(n_{1222}+n_{1224}+\cdots+n_{5666})$

P(not referred|on probation for 4 or more months)

=P(1 or 2|2222 or 2224 or 2226 or 2242 or 2244 or 2246 or 2262 or 2264 or 2266 or 2422 or 2424 or 2426 or 2442 or 2444 or 2446 or 2462 or 2464 or 2466 or 2622 or 2624 or 2626 or 2642 or 2644 or 2646 or 2662 or 2664 or 2666 or 4222 or 4224 or ... or 6222 or ... or 6666)

$=[(P_{22221}+P_{22222})n_{2222}+(P_{22241}+P_{22242})n_{2224}+ \cdots +(P_{66661}+P_{66662})n_{6666}]$
$/(n_{2222}+n_{2224}+ \cdots +n_{6666})$

Next, we will find the probabilities about non-drug offense.

P(non-drug offense|on probation for 1 month)

=P(3 or 4|1112 or 1114 or ... or 5556)

$=[(P_{11123}+P_{11124})n_{1112}+(P_{11143}+P_{11144})n_{1114}+ \cdots +(P_{55563}+P_{55564})n_{5556}]$
$/(n_{1112}+n_{1114}+ \cdots +n_{5556})$

P(non-drug offense|on probation for 2 months)

=P(3 or 4|1122 or 1124 or ... or 5566)

$=[(P_{11223}+P_{11224})n_{1122}+(P_{11243}+P_{11244})n_{1124}+ \cdots +(P_{55663}+P_{55664})n_{5566}]$
$/(n_{1122}+n_{1124}+ \cdots +n_{5566})$

P(non-drug offense|on probation for 3 months)

=P(3 or 4|1222 or 1224 or ... or 5666)

$=[(P_{12223}+P_{12224})n_{1222}+(P_{12243}+P_{12244})n_{1224}+ \cdots +(P_{56663}+P_{56664})n_{5666}]$
$/(n_{1222}+n_{1224}+ \cdots +n_{5666})$

P(non-drug offense|on probation for 4 or more months)

=P(3 or 4|2222 or 2224 or ... or 6666)

$=[(P_{22223}+P_{22224})n_{2222}+(P_{22243}+P_{22244})n_{2224}+ \cdots +(P_{66663}+P_{66664})n_{6666}]$
$/(n_{2222}+n_{2224}+ \cdots +n_{6666})$

Next, we will find the probabilities about drug offense.

P(drug offense|on probation for 1 month)

=P(5 or 6|1112 or 1114 or ... or 5556)

$=[(P_{11125}+P_{11126})n_{1112}+(P_{11145}+P_{11146})n_{1114}+ \cdots +(P_{55565}+P_{55566})n_{5556}]$
$/(n_{1112}+n_{1114}+ \cdots +n_{5556})$

P(drug offense|on probation for 2 months)

$=P(5 \text{ or } 6 | 1122 \text{ or } 1124 \text{ or } \ldots \text{ or } 5566)$

$= [(P_{11225}+P_{11226})n_{1122}+(P_{11245}+P_{11246})n_{1124}+ \cdots +(P_{55665}+P_{55666})n_{5566}]$

$/(n_{1122}+n_{1124}+ \cdots +n_{5566})$

P(drug offense|on probation for 3 months)

$=P(5 \text{ or } 6 | 1222 \text{ or } 1224 \text{ or } \ldots \text{ or } 5666)$

$= [(P_{12225}+P_{12226})n_{1222}+(P_{12245}+P_{12246})n_{1224}+ \cdots +(P_{56665}+P_{56666})n_{5666}]$

$/(n_{1222}+n_{1224}+ \cdots +n_{5666})$

P(drug offense|on probation for 4 or more months)

$=P(5 \text{ or } 6 | 2222 \text{ or } 2224 \text{ or } \ldots \text{ or } 6666)$

$= [(P_{22225}+P_{22226})n_{2222}+(P_{22245}+P_{22246})n_{2224}+ \cdots +(P_{66665}+P_{66666})n_{6666}]$

$/(n_{2222}+n_{2224}+ \cdots +n_{6666})$

In order to calculate these, we use the 4th order transition matrix. Finally, we obtain the following values in table 16.

Table 16. Conditional probability of referral given on probation for 1, 2, 3 or $4^+$ months

| Period | No offense | | Non-drug off. | | Drug offense | | Sample size | |
|---|---|---|---|---|---|---|---|---|
| of prob. (months) | Metro. | Non-met. | Metro. | Non-met. | Metro. | Non-met. | Metro. | Non-met. |
| 1 | .7268 | .8926 | .2278 | .0845 | .0455 | .0231 | 989 | 130 |
| 2 | .7737 | .8515 | .1917 | .1015 | .0349 | .0417 | 1007 | 128 |
| 3 | .7956 | .9055 | .1675 | .0632 | .0347 | .0235 | 1034 | 127 |
| $4^+$ | .8807 | .9319 | .0998 | .0549 | .0195 | .0133 | 23947 | 3358 |

The probability of no referral given on probation for 1 month is less than that given on probation for 2 months, which is less than that given on probation for 3 months and the probability of no referral given on probation for 3 months is less than that given on probation for 4 or more months in metropolitan areas. In other words, the probability of any offense become less and less when the period of probation increases. This fact is also true for non-drug offense and drug offense in metropolitan areas. Hence we can conclude that probation helps for reducing juvenile offenses in metropolitan areas.

In non-metropolitan areas, however, this is not the case. The probability of no referral given on probation for 1 month is more than that given on probation for 2 months, which, however, is less than that given on probation for 3 months, and the probability of no referral given on probation for 3 months is also less than that given on probation for 4 or more months. In other words, the probability of any offense is the largest when probation is 2 months, the probability is the second largest when probation is 1 month, that is the next largest when probation is 3 months and the probability is the smallest when probation is 4 or more months. Note that this result may be due to randomness, what are the sample sizes. This fact is also true for non-drug offense and drug offense in non-metropolitan areas.

From the facts above, we can conclude that 4 or more months probation is the best for reducing crime rate in both metropolitan and non-metropolitan areas.

Note that probability of referral decreases about 2.28 times in metropolitan areas and 1.54 times in non-metropolitan areas when a youth is on probation for 4 months than when he is on probation for 1 month for non-drug offense while the probability decreases 2.33 and 1.74 times for drug offense. Hence, probation helps a little more with drug offenses.

# CHAPTER VI

# SUMMARY AND CONCLUSION

## Summary

The first objective of this study was to write a computer program for each person referred to the court for all five distiricts of Utah. Only 9,414 strings were selected from the total of 79,444 strings. The main reason for deleting so many strings is that the length of period from the first referral date either to his 18th birthdate or to tape creation date was not long enough for 50-month long case history. If we cut down the length of each case history, then more strings can be included. However, a larger portion of each referral record would be omitted.

The second objective of this study was to write a computer program to test for the significance of the difference among several transition matrices. This program was generalized for comparing any number of transition matrices of any number of states, any order of chain. Either cards or magnetic tapes can be used for data input. However, if the transition matrix is of higher than 3rd order and more than six states, we had better use magnetic tape since it is lot more expensive to punch cards.

The third objective was to determine the chain order which is significant for the data of the juvenile court when a one month time interval is assumed. The chi-square value of 1439.77 with degrees of freedom of 900 in metropolitan areas and 231.22 with degrees of freedom 150 in non-metropolitan areas turned out to be highly significant. This means that the third order in metropolitan areas and the second order in non-metropolitan areas are the best fit for the data.

The fourth objective was to examine whether there is any difference between metropolitan and non-metropolitan areas by comparing transition matrices. By the program described in the second objective, these two matrices are significantly different. Actually we examined the differences in detail in chapter V.

The last objective was to examine whether there are differences between urban and rural youth in the following problems.

a) To examine whether there are differences between rural and urban youth in crime rate in general, the non-drug offense and drug offense. The crime rate in the metropolitan areas is about twice as high as that of the non-metropolitan areas for those already referred to the court. And the crime rates in the non-drug offense and drug offense are about twice as high in the urban areas as in the rural areas also.

b) To examine whether drug-type referrals increase the probability of later referrals. Drug-type referrals increase the probability of later referrals in both areas.

c) To examine whether drug-type referrals increase crime in general or whether people referred for drug offenses are just more likely to commit a drug offense. A youth on drugs is less likely to commit a non-drug offense and more likely to commit a drug offense in metropolitan areas while in non-metropolitan areas, a youth on drug is more likely to commit both non-drug and drug offenses.

d) To examine whether we can identify youth who are likely to be back to the court. Among youths with the high frequency case histories, youths with case history 113 are most likely to return to the court in the next 6 months when he is off probation. The probabilities of referral of this case history are .3074 and .2260 in metropolitan and non-metropolitan areas respectively. Youths with case histories 111, 131 and 311 are most likely to return to the court when he is on probation in metropolitan areas. The probabilities of referral of these case histories are .9904, .9842 and .9571 respectively. Youths with case histories 111 and 311 are most likely to return to the court when he is on probation in non-metropolitan areas. These probabilities are .9761 and .9217 respectively.

e) To examine whether probation helps in reducing recidivism rates in youth. Probation apparently helps for reducing recidivism rates in both metropolitan and non-metropolitan areas.

f) To examine whether probation helps more with drug offenses or with non-drug offenses. Probation helps a little more with drug offenses.

## Conclusion

Transition matrices of metropolitan and non-metropolitan areas are significantly different. And the recidivism rate in metropolitan areas is much higher than that of non-metropolitan areas.

Unfortunately, only less than 12 percent of the total actual case histories were used for creating "case histories"--strings of digits--which can be analyzed by the methods described in this study. Moreover, only first several records of case history were used for creating a youth's case history, i.e. a string of digits.

It is desired that all the case histories and the whole records of each case history would be used. Therefore, further study is needed for chains of unequal length in Markov chains.

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# APPENDIX A

## SOURCE PROGRAM FOR CONSTRUCTING CASE HISTORIES

```
FILE  11=JULY,UNIT=TAPE,RECORD=14,BLOCKING=30,BUFFER=1
FILE  12=METRO,UNIT=TAPE,RECORD=9,BLOCKING=50,BUFFER=1,SAVE=60
FILE  13=NON,UNIT=TAPE,RECORD=9,BLOCKING=50,BUFFER=1,SAVE=60

C  THIS IS THE PROGRAM TO CREATE CASE HISTORIES FROM JUVENILE COURT
C  REFERRAL TAPE.  THE MEANING OF VARIABLE NAMES ARE AS FOLLOWS:
C  RT=RECORD TYPE, BM,BD,BY=BIRTH DATE(MONTH,DAY,YEAR), CTY=COUNTY
C  CODE, RM,RD,RY=REFERRAL DATE(MONTH,DAY,YEAR), CLC=CLOSURE CODE,
C  OC=OFFENSE CODE, BM1,BD1,BY1=BIRTH DATE(READ IN BY T FORMAT),
C  CTY1=COUNTY CODE(READ IN BY T FORMAT).

      INTEGER RT,BM,BD,BY,CTY,RM(90),RD(90),RY(90),CLC1(90),CLC2(90),
     *CLC3(90),OC1(90),OC2(90),OC3(90),OC4(90),BM1,BD1,BY1,CTY1,LOM(12),
     *LENG(90),DIGIT(50),PROB,SAVE
      DATA LOM/0,31,59,90,120,151,181,212,243,273,304,334/

C  FOLLOWING COUNTERS ARE USED.
C  KT=THE COUNTER FOR THE NUMBER OF YOUTHS REFERRED TO THE COURT.
C  KOUNT=THE COUNTER FOR THE NUMBER OF CASE HISTORIES CREATED.
C  METRO=THE COUNTER FOR THE NUMBER OF CASE HISTORIES OF METROPOLITAN
C       AREA
C  NON=THE COUNTER FOR THAT OF NON-METROPOLITAN AREA.
C  NE=THE COUNTER FOR THE NUMBER OF DATA TYPE ERRORS.
C  NOE=THE COUNTER FOR THE NUMBER OF PARITY ERRORS.

      KT=0
      KOUNT=0
      METRO=0
      NON=0
      NE=0
      NOE=0
      K=0
      GO TO 50
   55 NE=NE+1
      GO TO 50
   56 NOE=NOE+1

C  READ UNTIL FIRST TYPE 0 RECORD IS ENCOUNTERED.

   50 READ(11,100,DATA=55,ERR=56,END=99)RT,BM,BD,BY,CTY
  100 FORMAT(I1,13X,4I2)
      IF(RT.NE.0)GO TO 50
   53 IF(BM.EQ.0.OR.BM.GT.12.OR.BD.GT.31)GO TO 50
   52 K=K+1
      IF(K.GT.90)K=90

C  READ ALL TYPE 1 RECORDS UNTIL NEXT TYPE 0 RECORD IS ENCOUNTERED.
C  BM1,BD1,BY1,CTY1 ARE USED FOR THE TYPE 0 RECORD BY MEANS OF T FORMAT.
```

```
      READ(11,200,DATA=55,ERR=56,END=99)RT,RM(K),RD(K),RY(K),OC1(K),
     *OC2(K),OC3(K),OC4(K),CLC1(K),CLC2(K),CLC3(K),BM1,BD1,BY1,CTY1
  200 FORMAT(I1,6X,3I2,1X,3I3,I2,28X,3I3,T15,4I2)
      IF(RT.EQ.1)GO TO 52
      K=K-1
      IF(K.EQ.0)GO TO 72

C  CALCULATE THE LENGTH FROM FIRST REFERRAL DATE TO 18TH BIRTHDATE.

      IRM=RM(1)
      IF(IRM.LE.0.OR.IRM.GT.12)GO TO 49
      LENGB=(BY+18-RY(1)*365+LOM(BM)+BD-LOM(IRM)-RD(1)
   49 BM=BM1
      BD=BD1
      BY=BY1
      IF(K.EQ.0)GO TO 72
      IF(IRM.LE.0.OR.IRM.GT.12)GO TO 72
      IF(LENGB.GE.1470)GO TO 51
      GO TO 72

C  CALCULATE THE LENGTH FROM FIRST REFERRAL DATE TO TAPE CREATION DATE.
C  IF BOTH LENGTHS ARE LONG ENOUGH (AT LEAST 50 MONTHS), THIS RECORD IS
C  USED FOR CREATING CASE HISTORY.

   51 LENGT=(73-RY(1))*365+LOM(4)+10-LOM(IRM)-RD(1)
      IF(LENGT.LT.1470)GO TO 72

C  CALCULATE THE LENGTH BETWEEN FIRST REFERRAL DATE AND ITH REFERRAL
C  DATE. (I=1,2,...,K)

      DO 1 J=1,K
      JRM=RM(J)
      IF(JRM.LE.0.OR.JRM.GT.12)GO TO 72
      LENG(J)=(RY(J)-RY(1))*365+LOM(JRM)+RD(J)-LOM(IRM)-RD(1)
    1 CONTINUE

C  CREATES A CASE HISTORY BY FOLLOWING STEPS. 'PROB' STAND FOR PROBA-
C  TION STATUS.  IF 'PROB' IS 1, THEN HE IS NOT ON PROBATION, IF IT IS
C  2, HE IS ON PROBATION AT SOME TIME.

      SAVE=0
      INTV=0
      I=1
      PROB=1
      II=1
      LENG(K+1)=2000
   69 IF(LENG(I).GT.INTV)GO TO 60


C  IT TESTS WHETHER CLOSURE CODE IS PROBATION OR NOT.

   64 IF(CLC1(I).GE.601.AND.CLC1(I).LE.607.OR.CLC1(I).EQ.611.OR.
     *CLC1(I).EQ.801.OR.CLC1(I).EQ.830)GO TO 65
```

```
      IF(CLC2(I).GE.601.AND.CLC2(I).LE.607.OR.CLC2(I).EQ.611.OR.
     *CLC2(I).EQ.801.ORCLC2(I).EQ.830)GO TO 65
      IF(CLC3(I).GE.601.AND.CLC3(I).LE.607.OR.CLC3(I).EQ.611.OR.
     *CLC3(I).EQ.801.OR.CLC3(I).EQ.830)GO TO 65
      IF(PROB.EQ.2)GO TO 651
      GO TO 66
   65 PROB=2
      GO TO 66

C  IT TESTS WHETHER PROBATION IS RELEASED OR NOT.

  651 IF(CLC1(I).EQ.810.OR.CLC1(I).EQ.811.OR.CLC1(I).EQ.834)PROB=1
      IF(CLC2(I).EQ.810.OR.CLC2(I).EQ.811.OR.CLC2(I).EQ.834)PROB=1
      IF(CLC3(I).EQ.810.OR.CLC3(I).EQ.811.OR.CLC3(I).EQ.834)PROB=1

C  IT TESTS WHETHER A YOUTH IS REFERRED FOR A DRUG OFFENSE OR NOT.

   66 IF(OC1(I).GE.40.AND.OC1(I).LE.49)GO TO 61
      IF(OC2(I).GE.40.AND.OC2(I).LE.49)GO TO 61
      IF(OC3(I).GE.40.AND.OC3(I).LE.49)GO TO 61
      IF(OC4(I).GE.40.AND.OC4(I).LE.49)GO TO 61

C  IT TESTS WHETHER A YOUTH IS REFERRED FOR A NON-OFFENSE OR NOT.

      IF((OC1(I).GE.150.AND.OC1(I).LE.359).AND.((OC2(I).GE.150.AND.
     *OC2(I).LE.359).OR.OC2(I).EQ.0).AND.((OC3(I).GE.150.AND.OC3(I).
     *LE.359).OR.OC3(I).EQ.0).AND.((OC4(I).GE.15.AND.OC4(I).LE.35).
     *OR.OC4(I).EQ.0))GO TO 661
      DIGIT(II)=2+PROB
      GO TO 662
  661 DIGIT(II)=PROB
  662 IF(SAVE.GT.DIGIT(II))DIGIT(II)=SAVE
      SAVE=0
      GO TO 62
   61 DIGIT(II)=4+PROB
      IF(SAVE.GT.DIGIT(II))DIGIT(II)=SAVE
      SAVE=0
   62 IF(II.GE.50)GO TO 70
      I=I+1

C  IF A YOUTH IS REFERRED TO THE COURT MORE THAN ONCE DURING THE
C  MONTH, MORE SERIOUS OFFENSE OVERRIDES LESS SERIOUS ONE.  'SAVE'
C  IS USED FOR THIS PURPOSE.

   67 IF(LENG(I).LE.INTV)GO TO 63
   68 INTV=INTV+30
      II=II+1
      GO TO 69
   63 SAVE=DIGIT(II)
      GO TO 64
   60 DIGIT(II)=PROB
      IF(II.GE.50)GO TO 70
```

```
      GO TO 68
C  IT TESTS WHETHER COUNTY BELONGS TO METROPOLITAN AREA OR NOT, AND
C  WRITE CASE HISTORIES FOR METROPOLITAN AREA AND NON-METROPOLITAN
C  AREA ON A DIFFERENT TAPE SEPARATELY.
   70 IF(CTY.EQ.6.OR.CTY.EQ.18.OR.CTY.EQ.25.OR.CTY.EQ.29)GO TO 75
      WRITE(13,600)(DIGIT(II),II=1,50)
  600 FORMAT(50I1)
      NON=NON+1
      GO TO 71
   75 WRITE(12,600)(DIGIT(II),II=1,50)
      METRO=METRO+1
   71 KOUNT=KOUNT+1
   72 K=0
      KT=KT+1
      CTY=CTY1
      GO TO 53
   99 WRITE(6,700)KOUNT,METRO,NON,NE,NOE,KT
  700 FORMAT('0',10X,'THE NUMBER OF STRINGS ARE',I5,'METRO',I5,'NON',
     *4I6)
      STOP
      END
```

# APPENDIX B

## SOURCE PROGRAM TO TEST FOR THE DIFFERENCE AMONG SEVERAL TRANSITION MATRICES

```
FILE  15=MTRAN, UNIT=TAPE,RECORD=14,BLOCKING=30,BUFFER=1
FILE  16=NTRAN,UNIT=TAPE,RECORD=14,BLOCKING=30,BUFFER=1

C  THIS IS THE PROGRAM TO TEST FOR THE DIFFERENCE AMONG SEVERAL TRAN-
C  SITION MATRICES.
C  WE ARE GIVEN STATES=1,2,...,M; ORDER=R FROM S POPULATIONS.  THEN
C  WE SHOULD CREATE S DIFFERENT TAPES EACH OF WHICH IS THE LIST OF
C  EACH TRANSITION MATRIX.  THESE TAPES CAN BE OBTAINED IN THE PROCESS
C  OF RUNNING THE PROGRAM FOR STEPWISE TESTING OF THE ORDER OF A
C  MARKOV CHAIN WRITTEN BY S. H. UH.  HOWEVER, A MINOR MODIFICATION OF
C  MODIFICATION OF THAT PROGRAM IS NEEDED, TO PROVIDE TAPE OUTPUT.  THE
C  TAPE USED AS INPUT FOR THIS PROGRAM REQUIRED THE FOLLOWING MODIFI-
C  CATIONS OF UH'S PROGRAM.

C      DATA FOR/'(MF9.7',',6X,I7',',12X,I',')     '/
C  WHERE M IS THE NUMBER OF STATES.

C  THE ABOVE DATA STATEMENT GIVES THE FORMAT CURRENTLY REQUIRED FOR THE
C  TRANSITION MATRIX INPUT, WHERE M IN MF9.7 IS NOT LITERAL BUT SHOULD
C  BE REPLACED WITH THE NO. OF STATES.  NEXT, THE FOLLOWING STATEMENT
C  SHOULD BE ADDED JUST BEFORE THE STATEMENT:
C 609 N1=N1+IST
C  IN UH'S PROGRAM.
C
C      WRITE(IR,FOR)(NX(I),I=N1,NST),ND(N),KX
C  WHERE IR IS THE TAPE FILE NUMBER, ON WHICH WE WROTE THE TRANSITION
C  MATRIX.

C  "MTRAN" AND "NTRAN" ARE THOSE TAPES.  FILE NUMBERS SHOULD BE CONSECU-
C  TIVE NUMBERS TO FIT THIS PROGRAM.

C  WE NEED FOLLOWING ARRAYS: NTL(S,M**R,M),NTLD(M**R,M),PTL(S,M**R,M),
C  PTLD(M**R,M), NT(S,M**R), NTD(M**R); STATE, ORDER, POP SHOULD BE INI-
C  TIALIZED IN ACCORDANCE WITH THE PROBLEM. THE FIRST 4 STATEMENTS IN
C  THE PROGRAM NEED TO BE MODIFIED FOR EACH SET OF DATA USED AS INPUT.

      REAL NTL(2,36,6),NTLD(36,6)
      DIMENSION PTL(2,36,6),PTLD(36,6),NT(2,36),NTD(36)
      INTEGER STATE,ORDER,DF,CODE,POP
      DATA STATE,ORDER,POP/6,2,2/
      LAST=STATE**ORDER

C  READ ALL TAPES OF THE TRANSITION MATRICES AND FIND OUT THE RIGHT
C  POSITION OF TAPE OF TRANSITION MATRIX OF DESIRED ORDER.
```

```
   14 READ(15,11)CODE
      READ(16,11)CODE
   11 FORMAT(79X,I1)
      IF(CODE.EQ.ORDER)GO TO 15
      GO TO 14

C  BACKSPACE ALL TAPES.  THE FOLLOWING 3 STATEMENTS SHOULD BE MODIFIED
C  ALSO EVERY TIME. IR SHOULD BE THE FIRST FILE NUMBER.

   15 BACKSAPCE 15
      BACKSPACE 16
      IR=15
      DO 1 I=1,POP
      DO 2 J=1,LAST

C  THE PROGRAM READS ALL TRANSITION PROBABILITY MATRICES, THEN CREATES
C  TRANSITION COUNT MATRICES.

      READ(IR,10)(PTL(I,J,K),K=1,STATE),NT(I,J)
   10 FORMAT(6F9.7,6X,I7)
      DO 2 K=1,STATE

      NTL(I,J,K)=NT(I,J)*PTL(I,J,K)
    2 CONTINUE
      IR=IR+1
    1 CONTINUE

C  IT COMPUTES CHI-SQUARE VALUE FOR TESTING THE NULL HYPOTHESIS THAT THE
C  REALIZATIONS ARE HOMOGENEOUS.

      DO 3 J=1,LAST
      DO 4 I=1,POP
      NTD(J)=NTD(J)+NT(I,J)
      DO 4 K=1,STATE
      NTLD(J,K)=NTLD(J,K)+NTL(I,J,K)
    4 CONTINUE
      IF(NTD(J).EQ.0)GO TO 3
      DO 5 K=1,STATE
      PTLD(J,K)=NTLD(J,K)/FLOAT(NTD(J))
    5 CONTINUE
    3 CONTINUE
      SUM=0.
      DO 6 I=1,POP
      DO 6 J=1,LAST
      DO 6 K=1,STATE
      IF(PTLD(J,K).EQ.0)GO TO 6
      ARG=PTL(I,J,K)/PTLD(J,K)
      IF(ARG.EQ.0.)GO TO 6
      SUM=SUM+NTL(I,J,K)*ALOG(ARG)
    6 CONTINUE
      SUM=SUM*2
      DF=STATE**ORDER*(POP-1)*(STATE-1)
```

```
   WRITE(6,20)SUM,DF
20 FORMAT(10X,'CHI-SQUARE=',F10.5,5X,'WITH D.F. OF ',I4)
   STOP
   END
```

# APPENDIX C

## THE OUTPUT LIST OF TRANSITION PROBABILITY MATRICES

## METROPOLITAN AREAS

*** THE TRANSITION PROBABILITY MATRIX OF ORDER 1 ***

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 1 | 0.979 | 0.000 | 0.015 | 0.002 | 0.003 | 0.000 | 345878 |
| 2 | 0.026 | 0.865 | 0.002 | 0.089 | 0.000 | 0.017 | 23398 |
| 3 | 0.860 | 0.000 | 0.106 | 0.013 | 0.017 | 0.004 | 6105 |
| 4 | 0.014 | 0.746 | 0.003 | 0.208 | 0.000 | 0.030 | 3949 |
| 5 | 0.847 | 0.003 | 0.091 | 0.011 | 0.042 | 0.006 | 1047 |
| 6 | 0.013 | 0.696 | 0.000 | 0.195 | 0.000 | 0.096 | 743 |

*** THE TRANSITION PROBABILITY MATRIX OF ORDER 2 ***

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 11 | 0.981 | 0.000 | 0.014 | 0.002 | 0.002 | 0.000 | 331840 |
| 12 | 0.000 | 0.826 | 0.000 | 0.130 | 0.000 | 0.043 | 23 |
| 13 | 0.870 | 0.000 | 0.098 | 0.013 | 0.015 | 0.004 | 5114 |
| 14 | 0.004 | 0.741 | 0.000 | 0.229 | 0.000 | 0.026 | 795 |
| 15 | 0.854 | 0.002 | 0.084 | 0.011 | 0.044 | 0.004 | 890 |
| 16 | 0.015 | 0.674 | 0.000 | 0.212 | 0.000 | 0.098 | 132 |
| 21 | 0.939 | 0.000 | 0.038 | 0.010 | 0.008 | 0.005 | 604 |
| 22 | 0.030 | 0.877 | 0.002 | 0.077 | 0.000 | 0.015 | 19759 |
| 23 | 0.762 | 0.000 | 0.167 | 0.024 | 0.048 | 0.000 | 42 |
| 24 | 0.020 | 0.768 | 0.004 | 0.183 | 0.000 | 0.025 | 2032 |
| 25 | 0.857 | 0.000 | 0.143 | 0.000 | 0.000 | 0.000 | 7 |
| 26 | 0.015 | 0.727 | 0.000 | 0.189 | 0.000 | 0.069 | 392 |
| 31 | 0.895 | 0.000 | 0.074 | 0.015 | 0.012 | 0.003 | 5133 |
| 32 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 33 | 0.792 | 0.002 | 0.168 | 0.014 | 0.019 | 0.005 | 625 |
| 34 | 0.000 | 0.692 | 0.000 | 0.269 | 0.000 | 0.038 | 78 |
| 35 | 0.811 | 0.011 | 0.158 | 0.000 | 0.021 | 0.000 | 95 |
| 36 | 0.000 | 0.545 | 0.000 | 0.273 | 0.000 | 0.182 | 22 |
| 41 | 0.887 | 0.000 | 0.057 | 0.019 | 0.019 | 0.019 | 53 |
| 42 | 0.009 | 0.798 | 0.002 | 0.165 | 0.000 | 0.025 | 2876 |
| 43 | 0.727 | 0.000 | 0.273 | 0.000 | 0.000 | 0.000 | 11 |
| 44 | 0.007 | 0.708 | 0.002 | 0.248 | 0.000 | 0.034 | 802 |
| 45 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 46 | 0.009 | 0.658 | 0.000 | 0.228 | 0.000 | 0.105 | 114 |
| 51 | 0.876 | 0.000 | 0.071 | 0.013 | 0.036 | 0.005 | 863 |
| 52 | 0.000 | 0.667 | 0.000 | 0.333 | 0.000 | 0.000 | 3 |
| 53 | 0.835 | 0.000 | 0.099 | 0.000 | 0.066 | 0.000 | 91 |
| 54 | 0.000 | 0.750 | 0.000 | 0.167 | 0.000 | 0.083 | 12 |
| 55 | 0.805 | 0.000 | 0.049 | 0.024 | 0.073 | 0.049 | 41 |
| 56 | 0.167 | 0.500 | 0.000 | 0.000 | 0.000 | 0.333 | 6 |
| 61 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 10 |
| 62 | 0.014 | 0.766 | 0.002 | 0.154 | 0.002 | 0.062 | 501 |
| 63 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 64 | 0.028 | 0.681 | 0.007 | 0.184 | 0.000 | 0.099 | 141 |
| 65 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 66 | 0.000 | 0.657 | 0.000 | 0.157 | 0.000 | 0.186 | 70 |

*** THE TRANSITION PROBABILITY MATRIX OF ORDER 3 ***

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 111 | 0.982 | 0.000 | 0.013 | 0.002 | 0.002 | 0.000 | 318817 |
| 112 | 0.000 | 0.850 | 0.000 | 0.100 | 0.000 | 0.050 | 20 |
| 113 | 0.874 | 0.000 | 0.094 | 0.013 | 0.015 | 0.004 | 4538 |
| 114 | 0.004 | 0.745 | 0.000 | 0.228 | 0.000 | 0.022 | 675 |
| 115 | 0.864 | 0.003 | 0.082 | 0.011 | 0.037 | 0.004 | 784 |
| 116 | 0.018 | 0.655 | 0.000 | 0.218 | 0.000 | 0.109 | 110 |
| 121 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 122 | 0.000 | 0.895 | 0.000 | 0.105 | 0.000 | 0.000 | 19 |
| 123 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 124 | 0.000 | 0.333 | 0.000 | 0.667 | 0.000 | 0.000 | 3 |
| 125 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 126 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 131 | 0.901 | 0.000 | 0.070 | 0.015 | 0.011 | 0.003 | 4349 |
| 132 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 133 | 0.825 | 0.000 | 0.141 | 0.010 | 0.019 | 0.004 | 481 |
| 134 | 0.000 | 0.687 | 0.000 | 0.284 | 0.000 | 0.030 | 67 |
| 135 | 0.838 | 0.014 | 0.135 | 0.000 | 0.014 | 0.000 | 74 |
| 136 | 0.000 | 0.611 | 0.000 | 0.167 | 0.000 | 0.222 | 18 |
| 141 | 0.667 | 0.000 | 0.333 | 0.000 | 0.000 | 0.000 | 3 |
| 142 | 0.003 | 0.809 | 0.000 | 0.166 | 0.000 | 0.022 | 580 |
| 143 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 144 | 0.006 | 0.676 | 0.000 | 0.279 | 0.000 | 0.039 | 179 |
| 145 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 146 | 0.000 | 0.762 | 0.000 | 0.190 | 0.000 | 0.048 | 21 |
| 151 | 0.883 | 0.000 | 0.069 | 0.008 | 0.035 | 0.005 | 741 |
| 152 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 153 | 0.845 | 0.000 | 0.099 | 0.000 | 0.056 | 0.000 | 71 |
| 154 | 0.000 | 0.800 | 0.000 | 0.100 | 0.000 | 0.100 | 10 |
| 155 | 0.784 | 0.000 | 0.054 | 0.027 | 0.081 | 0.054 | 37 |
| 156 | 0.250 | 0.500 | 0.000 | 0.000 | 0.000 | 0.250 | 4 |
| 161 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 162 | 0.012 | 0.762 | 0.000 | 0.167 | 0.000 | 0.060 | 84 |
| 163 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 164 | 0.000 | 0.704 | 0.000 | 0.185 | 0.000 | 0.111 | 27 |
| 165 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 166 | 0.000 | 0.769 | 0.000 | 0.077 | 0.000 | 0.154 | 13 |
| 211 | 0.944 | 0.002 | 0.038 | 0.005 | 0.011 | 0.000 | 558 |
| 212 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 213 | 0.870 | 0.000 | 0.087 | 0.000 | 0.043 | 0.000 | 23 |
| 214 | 0.000 | 0.833 | 0.000 | 0.167 | 0.000 | 0.000 | 6 |
| 215 | 0.800 | 0.000 | 0.000 | 0.000 | 0.200 | 0.000 | 5 |
| 216 | 0.000 | 0.667 | 0.000 | 0.333 | 0.000 | 0.000 | 3 |
| 221 | 0.939 | 0.000 | 0.038 | 0.010 | 0.007 | 0.005 | 572 |
| 222 | 0.033 | 0.883 | 0.002 | 0.069 | 0.000 | 0.013 | 16898 |
| 223 | 0.771 | 0.000 | 0.143 | 0.029 | 0.057 | 0.000 | 35 |
| 224 | 0.024 | 0.780 | 0.004 | 0.170 | 0.000 | 0.022 | 1480 |
| 225 | 0.800 | 0.000 | 0.200 | 0.000 | 0.000 | 0.000 | 5 |
| 226 | 0.017 | 0.743 | 0.000 | 0.181 | 0.000 | 0.059 | 288 |
| 231 | 0.968 | 0.000 | 0.032 | 0.000 | 0.000 | 0.000 | 31 |
| 232 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

(continued)

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 233 | 0.429 | 0.143 | 0.429 | 0.000 | 0.000 | 0.000 | 7 |
| 234 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 235 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 236 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 241 | 0.872 | 0.000 | 0.051 | 0.026 | 0.026 | 0.026 | 39 |
| 242 | 0.016 | 0.805 | 0.003 | 0.146 | 0.001 | 0.028 | 1516 |
| 243 | 0.750 | 0.000 | 0.250 | 0.000 | 0.000 | 0.000 | 8 |
| 244 | 0.008 | 0.731 | 0.000 | 0.235 | 0.000 | 0.025 | 361 |
| 245 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 246 | 0.021 | 0.729 | 0.000 | 0.125 | 0.000 | 0.125 | 48 |
| 251 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 6 |
| 252 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 253 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 254 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 255 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 256 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 261 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 6 |
| 262 | 0.018 | 0.764 | 0.004 | 0.141 | 0.000 | 0.072 | 276 |
| 263 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 264 | 0.055 | 0.699 | 0.014 | 0.137 | 0.000 | 0.096 | 73 |
| 265 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 266 | 0.000 | 0.538 | 0.000 | 0.115 | 0.000 | 0.346 | 26 |
| 311 | 0.912 | 0.001 | 0.062 | 0.011 | 0.012 | 0.002 | 4456 |
| 312 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 313 | 0.810 | 0.000 | 0.155 | 0.019 | 0.011 | 0.005 | 373 |
| 314 | 0.000 | 0.654 | 0.000 | 0.282 | 0.000 | 0.064 | 78 |
| 315 | 0.774 | 0.000 | 0.145 | 0.016 | 0.065 | 0.000 | 62 |
| 316 | 0.000 | 0.846 | 0.000 | 0.154 | 0.000 | 0.000 | 13 |
| 321 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 322 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 323 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 324 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 325 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 326 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 331 | 0.841 | 0.000 | 0.114 | 0.014 | 0.027 | 0.004 | 483 |
| 332 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 333 | 0.703 | 0.000 | 0.238 | 0.030 | 0.030 | 0.000 | 101 |
| 334 | 0.000 | 0.778 | 0.000 | 0.111 | 0.000 | 0.111 | 9 |
| 335 | 0.636 | 0.000 | 0.273 | 0.000 | 0.091 | 0.000 | 11 |
| 336 | 0.000 | 0.333 | 0.000 | 0.667 | 0.000 | 0.000 | 3 |
| 341 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 342 | 0.000 | 0.704 | 0.000 | 0.296 | 0.000 | 0.000 | 54 |
| 343 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 344 | 0.000 | 0.905 | 0.000 | 0.095 | 0.000 | 0.000 | 21 |
| 345 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 346 | 0.000 | 0.667 | 0.000 | 0.333 | 0.000 | 0.000 | 3 |
| 351 | 0.851 | 0.000 | 0.081 | 0.041 | 0.027 | 0.000 | 74 |
| 352 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 353 | 0.733 | 0.000 | 0.133 | 0.000 | 0.133 | 0.000 | 15 |
| 354 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

(continued)

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 355 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 356 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 361 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 362 | 0.000 | 0.750 | 0.000 | 0.250 | 0.000 | 0.000 | 12 |
| 363 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 364 | 0.000 | 0.600 | 0.000 | 0.200 | 0.000 | 0.200 | 5 |
| 365 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 366 | 0.000 | 0.750 | 0.000 | 0.250 | 0.000 | 0.000 | 4 |
| 411 | 0.844 | 0.000 | 0.111 | 0.000 | 0.000 | 0.044 | 45 |
| 412 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 413 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 3 |
| 414 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 415 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 416 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 421 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 26 |
| 422 | 0.012 | 0.834 | 0.002 | 0.128 | 0.000 | 0.024 | 2251 |
| 423 | 0.667 | 0.000 | 0.333 | 0.000 | 0.000 | 0.000 | 6 |
| 424 | 0.011 | 0.752 | 0.000 | 0.215 | 0.002 | 0.020 | 452 |
| 425 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 426 | 0.000 | 0.704 | 0.000 | 0.211 | 0.000 | 0.085 | 71 |
| 431 | 0.857 | 0.000 | 0.000 | 0.143 | 0.000 | 0.000 | 7 |
| 432 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 433 | 0.333 | 0.000 | 0.667 | 0.000 | 0.000 | 0.000 | 3 |
| 434 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 435 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 436 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 441 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 6 |
| 442 | 0.000 | 0.791 | 0.002 | 0.189 | 0.000 | 0.018 | 556 |
| 443 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 0.000 | 2 |
| 444 | 0.010 | 0.694 | 0.010 | 0.245 | 0.000 | 0.041 | 196 |
| 445 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 446 | 0.000 | 0.593 | 0.000 | 0.296 | 0.000 | 0.111 | 27 |
| 451 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 452 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 453 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 454 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 455 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 456 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 461 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 462 | 0.000 | 0.781 | 0.000 | 0.192 | 0.000 | 0.027 | 73 |
| 463 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 464 | 0.000 | 0.577 | 0.000 | 0.346 | 0.000 | 0.077 | 26 |
| 465 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 466 | 0.000 | 0.667 | 0.000 | 0.333 | 0.000 | 0.000 | 12 |
| 511 | 0.896 | 0.000 | 0.051 | 0.012 | 0.031 | 0.010 | 732 |
| 512 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 513 | 0.833 | 0.000 | 0.100 | 0.000 | 0.067 | 0.000 | 60 |
| 514 | 0.000 | 0.818 | 0.000 | 0.091 | 0.000 | 0.091 | 11 |
| 515 | 0.786 | 0.000 | 0.000 | 0.000 | 0.179 | 0.036 | 28 |
| 516 | 0.000 | 0.500 | 0.000 | 0.250 | 0.000 | 0.250 | 4 |

(continued)

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 521 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 522 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 523 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 524 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 525 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 526 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 531 | 0.803 | 0.000 | 0.127 | 0.042 | 0.028 | 0.000 | 71 |
| 532 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 533 | 0.857 | 0.000 | 0.143 | 0.000 | 0.000 | 0.000 | 7 |
| 534 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 535 | 0.667 | 0.000 | 0.333 | 0.000 | 0.000 | 0.000 | 6 |
| 536 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 541 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 542 | 0.000 | 0.667 | 0.000 | 0.222 | 0.000 | 0.111 | 9 |
| 543 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 544 | 0.000 | 0.500 | 0.000 | 0.000 | 0.000 | 0.500 | 2 |
| 545 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 546 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1 |
| 551 | 0.806 | 0.000 | 0.097 | 0.000 | 0.097 | 0.000 | 31 |
| 552 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 553 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 554 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 555 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 556 | 0.000 | 0.500 | 0.000 | 0.000 | 0.000 | 0.500 | 2 |
| 561 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 562 | 0.000 | 0.333 | 0.000 | 0.333 | 0.000 | 0.333 | 3 |
| 563 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 564 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 565 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 566 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 611 | 0.800 | 0.000 | 0.000 | 0.200 | 0.000 | 0.000 | 10 |
| 612 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 613 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 614 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 615 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 616 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 621 | 0.667 | 0.000 | 0.167 | 0.000 | 0.167 | 0.000 | 6 |
| 622 | 0.011 | 0.812 | 0.005 | 0.117 | 0.005 | 0.050 | 377 |
| 623 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 624 | 0.014 | 0.676 | 0.027 | 0.176 | 0.000 | 0.108 | 74 |
| 625 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 626 | 0.033 | 0.633 | 0.000 | 0.200 | 0.000 | 0.133 | 30 |
| 631 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 632 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 633 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 634 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 635 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 636 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 641 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4 |
| 642 | 0.000 | 0.677 | 0.000 | 0.280 | 0.000 | 0.043 | 93 |

(continued)

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 643 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 644 | 0.000 | 0.750 | 0.000 | 0.208 | 0.000 | 0.042 | 24 |
| 645 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 646 | 0.000 | 0.385 | 0.000 | 0.538 | 0.000 | 0.077 | 13 |
| 651 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 652 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 653 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 654 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 655 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 656 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 661 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 662 | 0.022 | 0.761 | 0.000 | 0.130 | 0.022 | 0.065 | 46 |
| 663 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 664 | 0.000 | 0.800 | 0.000 | 0.100 | 0.000 | 0.100 | 10 |
| 665 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 666 | 0.000 | 0.692 | 0.000 | 0.154 | 0.000 | 0.154 | 13 |

*** THE TRANSITION PROBABILITY MATRIX OF ORDER 4 ***

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 1111 | 0.983 | 0.000 | 0.013 | 0.002 | 0.002 | 0.000 | 306570 |
| 1112 | 0.000 | 0.846 | 0.000 | 0.077 | 0.000 | 0.077 | 13 |
| 1113 | 0.880 | 0.000 | 0.088 | 0.013 | 0.015 | 0.004 | 4107 |
| 1114 | 0.005 | 0.745 | 0.000 | 0.228 | 0.000 | 0.022 | 589 |
| 1115 | 0.874 | 0.003 | 0.082 | 0.011 | 0.026 | 0.004 | 697 |
| 1116 | 0.022 | 0.613 | 0.000 | 0.247 | 0.000 | 0.118 | 93 |
| 1121 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1122 | 0.000 | 0.941 | 0.000 | 0.059 | 0.000 | 0.000 | 17 |
| 1123 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1124 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 1125 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1126 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1131 | 0.904 | 0.000 | 0.068 | 0.015 | 0.011 | 0.002 | 3875 |
| 1132 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 1133 | 0.814 | 0.000 | 0.147 | 0.012 | 0.022 | 0.005 | 408 |
| 1134 | 0.000 | 0.661 | 0.000 | 0.305 | 0.000 | 0.034 | 59 |
| 1135 | 0.862 | 0.000 | 0.123 | 0.000 | 0.015 | 0.000 | 65 |
| 1136 | 0.000 | 0.563 | 0.000 | 0.188 | 0.000 | 0.250 | 16 |
| 1141 | 0.667 | 0.000 | 0.333 | 0.000 | 0.000 | 0.000 | 3 |
| 1142 | 0.004 | 0.815 | 0.000 | 0.159 | 0.000 | 0.022 | 497 |
| 1143 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1144 | 0.000 | 0.709 | 0.000 | 0.258 | 0.000 | 0.033 | 151 |
| 1145 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1146 | 0.000 | 0.667 | 0.000 | 0.267 | 0.000 | 0.067 | 15 |
| 1151 | 0.894 | 0.000 | 0.062 | 0.009 | 0.032 | 0.003 | 661 |
| 1152 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1153 | 0.833 | 0.000 | 0.117 | 0.000 | 0.050 | 0.000 | 60 |
| 1154 | 0.000 | 0.889 | 0.000 | 0.111 | 0.000 | 0.000 | 9 |
| 1155 | 0.821 | 0.000 | 0.071 | 0.036 | 0.036 | 0.036 | 28 |
| 1156 | 0.333 | 0.333 | 0.000 | 0.000 | 0.000 | 0.333 | 3 |
| 1161 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1162 | 0.000 | 0.765 | 0.000 | 0.162 | 0.000 | 0.074 | 68 |
| 1163 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1164 | 0.000 | 0.696 | 0.000 | 0.174 | 0.000 | 0.130 | 23 |
| 1165 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1166 | 0.000 | 0.750 | 0.000 | 0.083 | 0.000 | 0.167 | 12 |
| 1211 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1212 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1213 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1214 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1215 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1216 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1221 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1222 | 0.000 | 0.824 | 0.000 | 0.176 | 0.000 | 0.000 | 17 |
| 1223 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1224 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1225 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1226 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1231 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1232 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

(continued)

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 1233 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1234 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1235 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1236 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1241 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1242 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1243 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1244 | 0.500 | 0.500 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1245 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1246 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1251 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1252 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1253 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1254 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1255 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1256 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1261 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1262 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1263 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1264 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1265 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1266 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1311 | 0.915 | 0.001 | 0.062 | 0.010 | 0.011 | 0.002 | 3803 |
| 1312 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1313 | 0.814 | 0.000 | 0.152 | 0.020 | 0.010 | 0.003 | 296 |
| 1314 | 0.000 | 0.662 | 0.000 | 0.277 | 0.000 | 0.062 | 65 |
| 1315 | 0.813 | 0.000 | 0.125 | 0.021 | 0.042 | 0.000 | 48 |
| 1316 | 0.000 | 0.909 | 0.000 | 0.091 | 0.000 | 0.000 | 11 |
| 1321 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1322 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1323 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1324 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1325 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1326 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1331 | 0.855 | 0.000 | 0.103 | 0.016 | 0.023 | 0.003 | 387 |
| 1332 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1333 | 0.750 | 0.000 | 0.188 | 0.031 | 0.031 | 0.000 | 64 |
| 1334 | 0.000 | 0.600 | 0.000 | 0.200 | 0.000 | 0.200 | 5 |
| 1335 | 0.667 | 0.000 | 0.333 | 0.000 | 0.000 | 0.000 | 9 |
| 1336 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 1341 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1342 | 0.000 | 0.674 | 0.000 | 0.326 | 0.000 | 0.000 | 46 |
| 1343 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1344 | 0.000 | 0.947 | 0.000 | 0.053 | 0.000 | 0.000 | 19 |
| 1345 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1346 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 1351 | 0.864 | 0.000 | 0.085 | 0.034 | 0.017 | 0.000 | 59 |
| 1352 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 1353 | 0.900 | 0.000 | 0.100 | 0.000 | 0.000 | 0.000 | 10 |
| 1354 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

(continued)

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 1355 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1356 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1361 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1362 | 0.000 | 0.727 | 0.000 | 0.273 | 0.000 | 0.000 | 11 |
| 1363 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1364 | 0.000 | 0.000 | 0.000 | 0.500 | 0.000 | 0.500 | 2 |
| 1365 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1366 | 0.000 | 0.750 | 0.000 | 0.250 | 0.000 | 0.000 | 4 |
| 1411 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1412 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1413 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1415 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1416 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1421 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1422 | 0.004 | 0.845 | 0.000 | 0.133 | 0.000 | 0.017 | 466 |
| 1423 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1424 | 0.011 | 0.761 | 0.000 | 0.217 | 0.000 | 0.011 | 92 |
| 1425 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1426 | 0.000 | 0.615 | 0.000 | 0.231 | 0.000 | 0.154 | 13 |
| 1431 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1432 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1433 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1434 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1435 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1436 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1441 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1442 | 0.000 | 0.826 | 0.000 | 0.157 | 0.000 | 0.017 | 121 |
| 1443 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1444 | 0.000 | 0.660 | 0.000 | 0.240 | 0.000 | 0.100 | 50 |
| 1445 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1446 | 0.000 | 0.571 | 0.000 | 0.286 | 0.000 | 0.143 | 7 |
| 1451 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1452 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1453 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1454 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1455 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1456 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1461 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1462 | 0.000 | 0.750 | 0.000 | 0.250 | 0.000 | 0.000 | 16 |
| 1463 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1464 | 0.000 | 0.750 | 0.000 | 0.250 | 0.000 | 0.000 | 4 |
| 1465 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1466 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1511 | 0.909 | 0.000 | 0.043 | 0.013 | 0.028 | 0.008 | 634 |
| 1512 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1513 | 0.840 | 0.000 | 0.080 | 0.000 | 0.080 | 0.000 | 50 |
| . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . |

(continued)

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 6553 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6554 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6555 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6556 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6561 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6562 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6563 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6564 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6565 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6566 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6611 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6612 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6613 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6614 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6615 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6616 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6621 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 6622 | 0.029 | 0.735 | 0.000 | 0.206 | 0.000 | 0.029 | 34 |
| 6623 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6624 | 0.000 | 0.833 | 0.000 | 0.000 | 0.000 | 0.167 | 6 |
| 6625 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 6626 | 0.000 | 0.667 | 0.000 | 0.000 | 0.000 | 0.333 | 3 |
| 6631 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6632 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6633 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6634 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6635 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6636 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6641 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6642 | 0.000 | 0.625 | 0.000 | 0.375 | 0.000 | 0.000 | 8 |
| 6643 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6644 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1 |
| 6645 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6646 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 6651 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6652 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6653 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6654 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6655 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6656 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6661 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6662 | 0.000 | 0.889 | 0.000 | 0.000 | 0.111 | 0.000 | 9 |
| 6663 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6664 | 0.000 | 0.500 | 0.000 | 0.000 | 0.000 | 0.500 | 2 |
| 6665 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6666 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |

NON-METROPOLITAN AREAS

*** THE TRANSITION PROBABILITY MATRIX OF ORDER 1 ***

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 1 | 0.988 | 0.000 | 0.008 | 0.001 | 0.002 | 0.000 | 66004 |
| 2 | 0.034 | 0.904 | 0.001 | 0.048 | 0.000 | 0.012 | 3602 |
| 3 | 0.904 | 0.000 | 0.061 | 0.015 | 0.017 | 0.003 | 594 |
| 4 | 0.009 | 0.812 | 0.000 | 0.149 | 0.000 | 0.030 | 329 |
| 5 | 0.880 | 0.007 | 0.099 | 0.000 | 0.014 | 0.000 | 142 |
| 6 | 0.012 | 0.815 | 0.000 | 0.111 | 0.000 | 0.062 | 81 |

*** THE TRANSITION PROBABILITY MATRIX OF ORDFR 2 ***

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 11 | 0.989 | 0.000 | 0.008 | 0.001 | 0.002 | 0.000 | 63879 |
| 12 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 6 |
| 13 | 0.901 | 0.000 | 0.064 | 0.012 | 0.019 | 0.004 | 515 |
| 14 | 0.010 | 0.876 | 0.000 | 0.093 | 0.000 | 0.021 | 97 |
| 15 | 0.898 | 0.000 | 0.087 | 0.000 | 0.016 | 0.000 | 127 |
| 16 | 0.000 | 0.909 | 0.000 | 0.045 | 0.000 | 0.045 | 22 |
| 21 | 0.958 | 0.000 | 0.033 | 0.008 | 0.000 | 0.000 | 120 |
| 22 | 0.037 | 0.908 | 0.001 | 0.042 | 0.000 | 0.010 | 3186 |
| 23 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4 |
| 24 | 0.012 | 0.810 | 0.000 | 0.149 | 0.000 | 0.030 | 168 |
| 25 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 26 | 0.026 | 0.821 | 0.000 | 0.103 | 0.000 | 0.051 | 39 |
| 31 | 0.919 | 0.000 | 0.056 | 0.006 | 0.017 | 0.002 | 521 |
| 32 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 33 | 0.889 | 0.000 | 0.056 | 0.056 | 0.000 | 0.000 | 36 |
| 34 | 0.000 | 0.778 | 0.000 | 0.222 | 0.000 | 0.000 | 9 |
| 35 | 0.778 | 0.000 | 0.222 | 0.000 | 0.000 | 0.000 | 9 |
| 36 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 41 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 3 |
| 42 | 0.011 | 0.864 | 0.000 | 0.095 | 0.000 | 0.030 | 264 |
| 43 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 44 | 0.000 | 0.778 | 0.000 | 0.178 | 0.000 | 0.044 | 45 |
| 45 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 46 | 0.000 | 0.600 | 0.000 | 0.200 | 0.000 | 0.200 | 10 |
| 51 | 0.902 | 0.000 | 0.041 | 0.008 | 0.041 | 0.008 | 122 |
| 52 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 53 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 13 |
| 54 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 55 | 0.500 | 0.500 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 56 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 61 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 62 | 0.000 | 0.828 | 0.000 | 0.125 | 0.000 | 0.047 | 64 |
| 63 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 64 | 0.000 | 0.286 | 0.000 | 0.571 | 0.000 | 0.143 | 7 |
| 65 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 66 | 0.000 | 0.800 | 0.000 | 0.200 | 0.000 | 0.000 | 5 |

*** THE TRANSITION PROBABILITY MATRIX OF ORDER 3 ***

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 111 | 0.989 | 0.000 | 0.007 | 0.001 | 0.002 | 0.000 | 61843 |
| 112 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 6 |
| 113 | 0.911 | 0.000 | 0.057 | 0.013 | 0.017 | 0.002 | 470 |
| 114 | 0.011 | 0.889 | 0.000 | 0.078 | 0.000 | 0.022 | 90 |
| 115 | 0.902 | 0.000 | 0.080 | 0.000 | 0.018 | 0.000 | 112 |
| 116 | 0.000 | 0.900 | 0.000 | 0.050 | 0.000 | 0.050 | 20 |
| 121 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 122 | 0.000 | 0.833 | 0.000 | 0.167 | 0.000 | 0.000 | 6 |
| 123 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 124 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 125 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 126 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 131 | 0.924 | 0.000 | 0.053 | 0.004 | 0.016 | 0.002 | 450 |
| 132 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 133 | 0.879 | 0.000 | 0.061 | 0.061 | 0.000 | 0.000 | 33 |
| 134 | 0.000 | 0.833 | 0.000 | 0.167 | 0.000 | 0.000 | 6 |
| 135 | 0.778 | 0.000 | 0.222 | 0.000 | 0.000 | 0.000 | 9 |
| 136 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 141 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 142 | 0.000 | 0.857 | 0.000 | 0.095 | 0.000 | 0.048 | 84 |
| 143 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 144 | 0.000 | 0.889 | 0.000 | 0.000 | 0.000 | 0.111 | 9 |
| 145 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 146 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 151 | 0.910 | 0.000 | 0.045 | 0.000 | 0.036 | 0.009 | 111 |
| 152 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 153 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 10 |
| 154 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 155 | 0.500 | 0.500 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 156 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 161 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 162 | 0.000 | 0.789 | 0.000 | 0.105 | 0.000 | 0.105 | 19 |
| 163 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 164 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 165 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 166 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 211 | 0.974 | 0.000 | 0.018 | 0.000 | 0.009 | 0.000 | 114 |
| 212 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 213 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4 |
| 214 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 215 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 216 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 221 | 0.957 | 0.000 | 0.034 | 0.009 | 0.000 | 0.000 | 116 |
| 222 | 0.039 | 0.909 | 0.001 | 0.041 | 0.000 | 0.009 | 2834 |
| 223 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4 |
| 224 | 0.008 | 0.818 | 0.000 | 0.136 | 0.000 | 0.038 | 132 |
| 225 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 226 | 0.033 | 0.833 | 0.000 | 0.100 | 0.000 | 0.033 | 30 |
| 231 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4 |
| 232 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

(continued)

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 233 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 234 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 235 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 236 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 241 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 242 | 0.022 | 0.888 | 0.000 | 0.067 | 0.000 | 0.022 | 134 |
| 243 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 244 | 0.000 | 0.773 | 0.000 | 0.182 | 0.000 | 0.045 | 22 |
| 245 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 246 | 0.000 | 0.600 | 0.000 | 0.200 | 0.000 | 0.200 | 5 |
| 251 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 252 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 253 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 254 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 255 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 256 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 261 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 262 | 0.000 | 0.844 | 0.000 | 0.156 | 0.000 | 0.000 | 32 |
| 263 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 264 | 0.000 | 0.667 | 0.000 | 0.333 | 0.000 | 0.000 | 3 |
| 265 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 266 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 311 | 0.936 | 0.002 | 0.030 | 0.013 | 0.017 | 0.002 | 467 |
| 312 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 313 | 0.731 | 0.000 | 0.154 | 0.000 | 0.077 | 0.038 | 26 |
| 314 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 3 |
| 315 | 0.778 | 0.000 | 0.222 | 0.000 | 0.000 | 0.000 | 9 |
| 316 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 321 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 322 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 323 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 324 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 325 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 326 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 331 | 0.867 | 0.000 | 0.133 | 0.000 | 0.000 | 0.000 | 30 |
| 332 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 333 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 334 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 335 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 336 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 341 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 342 | 0.000 | 0.857 | 0.000 | 0.143 | 0.000 | 0.000 | 7 |
| 343 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 344 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 345 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 346 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 351 | 0.714 | 0.000 | 0.000 | 0.143 | 0.143 | 0.000 | 7 |
| 352 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 353 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 354 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

(continued)

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 355 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 356 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 361 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 362 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 363 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 364 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 365 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 366 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 411 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 3 |
| 412 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 413 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 415 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 416 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 421 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 422 | 0.027 | 0.883 | 0.000 | 0.072 | 0.000 | 0.018 | 223 |
| 423 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 424 | 0.045 | 0.864 | 0.000 | 0.091 | 0.000 | 0.000 | 22 |
| 425 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 426 | 0.000 | 0.714 | 0.000 | 0.143 | 0.000 | 0.143 | 7 |
| 431 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 432 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 433 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 434 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 435 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 436 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 441 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 442 | 0.000 | 0.771 | 0.000 | 0.200 | 0.000 | 0.029 | 35 |
| 443 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 444 | 0.000 | 0.875 | 0.000 | 0.125 | 0.000 | 0.000 | 8 |
| 445 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 446 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 451 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 452 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 453 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 454 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 455 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 456 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 461 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 462 | 0.000 | 0.600 | 0.000 | 0.200 | 0.000 | 0.200 | 5 |
| 463 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 464 | 0.000 | 0.000 | 0.000 | 0.500 | 0.000 | 0.500 | 2 |
| 465 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 466 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 511 | 0.916 | 0.000 | 0.037 | 0.000 | 0.037 | 0.009 | 107 |
| 512 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 513 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4 |
| 514 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 515 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 5 |
| 516 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |

(continued)

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 521 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 522 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 523 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 524 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 525 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 526 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 531 | 0.846 | 0.000 | 0.000 | 0.000 | 0.154 | 0.000 | 13 |
| 532 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 533 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 534 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 535 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 536 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 541 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 542 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 543 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 544 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 545 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 546 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 551 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 552 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 553 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 554 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 555 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 556 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 561 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 562 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 563 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 564 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 565 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 566 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 611 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 612 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 613 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 614 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 615 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 616 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 621 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 622 | 0.020 | 0.878 | 0.000 | 0.020 | 0.000 | 0.082 | 49 |
| 623 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 624 | 0.000 | 0.625 | 0.000 | 0.375 | 0.000 | 0.000 | 8 |
| 625 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 626 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 631 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 632 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 633 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 634 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 635 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 636 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 641 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 642 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |

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| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 643 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 644 | 0.000 | 0.333 | 0.000 | 0.667 | 0.000 | 0.000 | 3 |
| 645 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 646 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1 |
| 651 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 652 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 653 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 654 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 655 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 656 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 661 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 662 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4 |
| 663 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 664 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 665 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 666 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

*** THE TRANSITION PROBABILITY MATRIX OF ORDER 4 ***

| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 1111 | 0.990 | 0.000 | 0.007 | 0.001 | 0.002 | 0.000 | 59869 |
| 1112 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4 |
| 1113 | 0.915 | 0.000 | 0.053 | 0.013 | 0.016 | 0.002 | 449 |
| 1114 | 0.012 | 0.880 | 0.000 | 0.084 | 0.000 | 0.024 | 83 |
| 1115 | 0.899 | 0.000 | 0.091 | 0.000 | 0.010 | 0.000 | 99 |
| 1116 | 0.000 | 0.889 | 0.000 | 0.056 | 0.000 | 0.056 | 18 |
| 1121 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1122 | 0.000 | 0.833 | 0.000 | 0.167 | 0.000 | 0.000 | 6 |
| 1123 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1124 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1125 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1126 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1131 | 0.930 | 0.000 | 0.051 | 0.002 | 0.014 | 0.002 | 414 |
| 1132 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1133 | 0.889 | 0.000 | 0.037 | 0.074 | 0.000 | 0.000 | 27 |
| 1134 | 0.000 | 0.833 | 0.000 | 0.167 | 0.000 | 0.000 | 6 |
| 1135 | 0.714 | 0.000 | 0.286 | 0.000 | 0.000 | 0.000 | 7 |
| 1136 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1141 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1142 | 0.000 | 0.848 | 0.000 | 0.101 | 0.000 | 0.051 | 79 |
| 1143 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1144 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 7 |
| 1145 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1146 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1151 | 0.908 | 0.000 | 0.041 | 0.000 | 0.041 | 0.010 | 98 |
| 1152 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1153 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 8 |
| 1154 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1155 | 0.500 | 0.500 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1156 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1161 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1162 | 0.000 | 0.765 | 0.000 | 0.118 | 0.000 | 0.118 | 17 |
| 1163 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1164 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1165 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1166 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1211 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1212 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1213 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1214 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1215 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1216 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1221 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1222 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 5 |
| 1223 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1224 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 1225 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1226 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1231 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1232 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

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| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 1233 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1234 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1235 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1236 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1241 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1242 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1243 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1244 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1245 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1246 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1251 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1252 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1253 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1254 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1255 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1256 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1261 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1262 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1263 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1264 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1265 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1266 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1311 | 0.938 | 0.002 | 0.027 | 0.012 | 0.017 | 0.002 | 406 |
| 1312 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1313 | 0.714 | 0.000 | 0.143 | 0.000 | 0.095 | 0.048 | 21 |
| 1314 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1315 | 0.857 | 0.000 | 0.143 | 0.000 | 0.000 | 0.000 | 7 |
| 1316 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1321 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1322 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1323 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1324 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1325 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1326 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1331 | 0.889 | 0.000 | 0.111 | 0.000 | 0.000 | 0.000 | 27 |
| 1332 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1333 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1334 | 0.000 | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 2 |
| 1335 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1336 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1341 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1342 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 5 |
| 1343 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1344 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 1345 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1346 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1351 | 0.714 | 0.000 | 0.000 | 0.143 | 0.143 | 0.000 | 7 |
| 1352 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1353 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2 |
| 1354 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

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| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 1355 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1356 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1361 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1362 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1363 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1364 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 1365 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1366 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1411 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 1412 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1413 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1415 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1416 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1421 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1422 | 0.043 | 0.914 | 0.000 | 0.029 | 0.000 | 0.014 | 70 |
| 1423 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1424 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 7 |
| 1425 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1426 | 0.000 | 0.500 | 0.000 | 0.250 | 0.000 | 0.250 | 4 |
| 1431 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1432 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1433 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1434 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1435 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1436 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1441 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1442 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 8 |
| 1443 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1444 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1445 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1446 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1 |
| 1451 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1452 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1453 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1454 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1455 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1456 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1461 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1462 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1 |
| 1463 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1464 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1465 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1466 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1511 | 0.918 | 0.000 | 0.041 | 0.000 | 0.031 | 0.010 | 98 |
| 1512 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 1513 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4 |
| . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . |

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| | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| 6553 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6554 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6555 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6556 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6561 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6562 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6563 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6564 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6565 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6566 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6611 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6612 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6613 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6614 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6615 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6616 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6621 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6622 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4 |
| 6623 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6624 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6625 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6626 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6631 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6632 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6633 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6634 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6635 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6636 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6641 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6642 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6643 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6644 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |
| 6645 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6646 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6651 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6652 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6653 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6654 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6655 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6656 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6661 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6662 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6663 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6664 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6665 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| 6666 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

# APPENDIX D

## MASTER CODING GUIDE

VIOLATIONS OF LAW

ASSAULTS
B001 Assault
B002 Assault & Battery
B003 Assault With Deadly Weapon
B009 Other (specify)

AUTOMOBILE CASES
M010 Auto Theft
M011 Depriving Owner of Vehicle
M012 Illegal Entry of Vehicle For Theft (Car Prowl)
M013 Tampering With Vehicle (Car Strip)
0014 Gas Theft
0019 Other (specify)

FIRE, FIREARMS, FIRE ALARMS, FIREWORKS
M020 Arson
0021 Fire Setting
0022 Unlawful Use of Firearms
0023 False Alarms
0024 Fireworks
0029 Other (specify)

ILLEGAL ENTRY
M030 Burglary
B031 Unlawful Entry to Injure, Damage or Annoy

JEOPARDY OF SELF
S040 Public Intoxication
S041 Possession Of Alcohol
S043 Minor in Tavern
S043 Possession of Tabacco
S044 Wrongfully Inhaling Fumes
S045 Attempted Suicide
S046 Possession or Use of Drugs, Including Possession of Instruments For Use
S047 Making, Sale, Distribution or Disposing of Drugs
S048 Group Possession i.e. Present Where Drugs Are Used
S049 Other (specify)

MISCHIEF OR VANDALISM
0050 Destruction of Property
0051 Fighting
0052 Distrubing the Peace
0053 Riot
0054 Trespass
0055 Throwing Objects at Vehicle
0059 Other (specify)

SEX OFFENSES
B060 Rape
M061 Illicit Sex Acts
0062 Unnatural Sex Acts
M063 Molest
0064 Indecent Acts
069 Other (specify)

THEFT
M070 Grand Larceny
M071 Petit Larceny
0072 Bicycle Theft
M073 Shoplifting
M074 Receiving Stolen Property

OTHER VIOLATIONS OF LAW

FELONY TYPE
M080 Robbery
M081 Bad Checks & Fraud
B082 Homicide
M083 Negligent Homicide
M089 Other Felony Type

MISDEMEANOR TYPE
0090 Cruelty to Animals
0091 Curfew
0092 Tampering With Railroads
0093 Resisting Arrest
0094 Refusing to Disperse
0095 Fish & Game Violation
0096 Boating Violation
0097 Foul & Abusive Language
0098 Giving False Information
0099 Other (specify)

BEHAVIORAL PROBLEMS
0100 Out of Control (Ungov.)
0101 Runaway
0102 Runaway-Transient
0103 Habitual Truancy
0104 Truancy
0105 Truant in Auto
0106 Contempt of Court
0109 Other Behavior or Condition Endangering to Welfare (specify)

NEGLECTED OR DEPENDENT
R150 Abandoned
R151 Mistreatment or Abuse
R152 Improper Care Due to Faults or Habits of Parents

NEGLECTED OR DEPENDENT (cont.)

R153 Improper Care - Failure to ProvideSubsistence, Education, Medical Care or Other Care
R154 Dependent
R155 Permanent Termination of Parental Rights

OTHER JURISDICTION - JUVENILE

R250 Request Consent for Marriage
R251 Request Consent for Employment
R252 Request Consent for Enlistment
R253 Request Expungement of Record
R254 Determination of Custody on Transfer From District Court
R255 Change of Custody
0256 Violation of Probation
R257 Request For Renewal of Custody
R258 Request Termination
R259 Other (specify)
R260 Review Hearing
R261 Probation Officer Progress Report
R262 Probation Officer Transfer
R263 Request Restoration of Custody

ADMINISTRATIVE

R300 Supervision Under Interstate Compact
R301 Supervision - Other District
R302 Supervision of Parolee
R303 Investigation For Other Agency
R304 Courtesy Supervision
R309 Other Administrative Case (specify)

ADULT CASES

350 Contribution to Delinquency of a Minor
351 Contributing to Neglect of Child
352 Willful Abuse, Neglect or Abandonment
353 Contempt of Court - Adult
359 Other (specity)

TRAFFIC VIOLATIONS

MOVING VIOLATIONS

0400 Minor Speeding (1-9 over)
0401 Intermediate Speeding (10-19)
0402 Major Speeding (20 or more over)
04031 Too Fast For Existing Conditions
0404 Speed Contest or Exhibition of Speed
0405 Stop Sign
0406 Stop Light
0407 Improper Turn
0408 Follow Too Close
0409 Improper Lookout
0410 Failure to Yield Right of Way
0411 Negligent Collision
M412 Hit & Run
0413 Reckless Driving
M414 Driving Under Influence of Intoxicants
0415 Leaving Scene of Accident
0419 Other (specify)

NON-MOVING VIOLATIONS

0420 No Driver's License
0421 Violation of Learner's Permit
0422 Violation of Suspended Revocation of Court Order
R423 Improper Registration
R424 Improper Muffler
R425 Other Mechanical Defect
0426 Altered or Misuse of Driver's License
R427 Parking Violation
0428 Violations of Pedestrian
0429 Other (specify)

CLOSURE CODES

NON-JUDICIAL

N501 Non-Judicial Adjustment by Court Through Its Probation Department
P502 Probation-Interstate Compact
P503 Supervision of Parolee
N504 Investigation For Other Agency
505 Other (specify)
508 Form Letter

CLOSED WITHOUT ACTION

N510 Insufficient Facts to Justify Referral
N511 Referral Returned - Request of Referrer

CLOSED WITHOUT ACTION (cont.)

N512 Other (specify)
N513 Referred to Another Agency
N514 Unable to Locate
N515 Forwarded to Another Court's Jurisdiction
N516 Runaway-Transient Returned to His Home
J517 Returned to State Industrial School

DISMISSAL OF PETITION

N520 Dismissed With Admonishment
N521 Dismissed - Lack of Evidence
N523 Dismissed

PLACED UNDER SUPERVISION OF COURT

P601 Probation
P602 Probation & Restitution
P603 Probation & Fine
P604 Probation & Work Order
P605 Probation, Restitution & Fine
P606 Probation, Restitution, Fine & Work Order
P607 Probation, Fine & Work Order
P608 Protective Supervision
P609 Probation Out of State Under Interstate Compact
P610 Other (specify)
P611 Probation Without Active Supervision

PLACED UNDER SUPERVISION OF AGENCY

P621 Protective Supervision by Welfare Department
P622 Protective Supervision by Agency Other Than Welfare Department
P623 Protective Supervision by Individual
P624 Probation, Supervision by Welfare Depanmment
P625 Probation, Supervision by Agency Other Than Welfare Department
P626 Probation, Supervision by Individual
P627 Other (specify)

LEGAL CUSTODY OR GUARDIANSHIP OR BOTH TRANSFERRED

J701 Committed to State Industrial School
J702 Committed to State Training School
J703 Committed to State Hospital
J704 Committed to Other Institution
P705 Temporary Guardianship to Welfare Department
P706 Temporary Guardianship to Agency Other Taan Welfare Department
707 Temporary Guardianship to Individual Other Than Parent
708 Temporary Guardianship to Other Parent
709 Parental Rights Permanently Terminated, Guardianship to Welfare Department
710 Parental Rights Permanently Terminated, Guardianship to Agency Other Than Welfare Department
711 Parental Rights Permanently Terminated, Guardianship to Individual
712 Parental Rights of One Parent Permanently Terminated, Guardianship to Other Parent
713 Other (specify)
714 Custody and/or Guardianship Restored to Original Condition

OTHER DISPOSITIONS

N801 Suspended Commitment to State Industrial School
F802 Restrained From Driving
F803 Fine
F804 Restitution
F805 Work Order
F806 Restitution & Fine
F807 Fine & Work Order
F808 Restitution & Work Order
F809 Fine, Restitution & Work Order
N810 Jurisdiction Terminated After Admonishment
N811 Jurisdiction Terminated
N812 Attend School
N813 Restrained, Other
J814 Jail
815 Certified For Criminal Proceeding
N816 Treatment, Medical or Psychological
N817 Consent to Marriage
N818 Consent for Employment

OTHER DISPOSITIONS (cont.)

| | |
|---|---|
| N819 | Consent to Enlist |
| N820 | Other (specify) |
| R821 | Request for Expungement Granted |
| R822 | Request For Expungement Denied |
| R823 | Jurisdiction Continued |
| R824 | Previous Order of the Court Cont. |
| N825 | Sentence Suspended |
| N826 | Admonished |
| N827 | Traffic School |
| N828 | Write an Essay |
| J829 | Returned to State Industrial School |
| N830 | Stayed Commitment State Industrial School |
| J831 | Recommitment State Inductrial School |
| R832 | Paroled From State Industrial School |
| R833 | Released From State Industrial School |
| R834 | Released From Probation - Jurisdiction Continued |

TREATMENT RESOURCE CODES

| | |
|---|---|
| ITU | Intensive Treatment Unit |
| CMH | Community Mental Health |
| ICS | Initial Counseling Service |
| FSS | Family Service Society |
| CSS | Children Service Society |
| LDS | LDS Youth Guidance |
| CAC | Catholic Charities |
| CAS | Childrens Aid Society |
| USH | Utah State Hospital |
| PSY | Private Psychotherapist |
| ORS | Vocational Rehabilitation |

COUNTY CODES

| | | | |
|---|---|---|---|
| 01 | Beaver | 16 | Piute |
| 02 | Box Elder | 17 | Rich |
| 03 | Cache | 18 | Salt Lake |
| 04 | Carbon | 19 | San Juan |
| 05 | Dagget | 20 | Sanpete |
| 06 | Davis | 21 | Sevier |
| 07 | Duchesne | 22 | Summit |
| 08 | Emery | 23 | Tooele |
| 09 | Garfield | 24 | Uintah |
| 10 | Grand | 25 | Utah |
| 11 | Iron | 26 | Wasatch |
| 12 | Juab | 27 | Washington |
| 13 | Kane | 28 | Wayne |
| 14 | Millard | 29 | Weber |
| 15 | Morgan | | |

DISTRICT I

BOX ELDER COUNTY 02

401 Bear River
402 Beaver Dam
403 Bothwell
404 Brigham City
408 Corinne
409 Deweyville
410 Fielding
411 Garland
412 Grouse Creek
414 Honeyville
415 Howell
416 Mantua
417 Perry
418 Plymouth
419 Portage
420 Promatory
421 Riverside
422 Rosette
423 Snowville
424 Thatcher
425 Tremonton
426 Willard
427 Yost
428 Unincorporated areas

CACHE COUNTY 03

301 Avon
302 Clarkston
303 Cornish
304 Cove
305 Hyde Park
306 Hyrum
307 Lewiston
308 Logan
312 Mendon
313 Millville
314 Newton
315 Nibley
316 North Logan
317 Paradise
318 Providence
319 Richmond
320 River Heights
321 Smithfield
322 Trenton
323 Wellsville
324 Unincorporated Areas

DAVIS COUNTY 06

Bountiful:
201 North of 500 South to City Limits Between East & West City Limits
202 South of 500 South to City Limits Between East & West City Limits

205 Centerville
206 Clearfield
209 Clearfield Job Corp
210 Clinton
211 East Layton
212 Farmington
213 Kaysville
215 Layton
217 Laytona
218 South Weber
219 Sunset
220 Syracuse
221 Weber Basin Job Corp
222 West Bountiful
224 West Point
226 Woods Cross
227 Unincorporated Areas

MORGAN COUNTY 15

501 Croyden
502 Cevils Slide
503 Milton
504 Morgan
505 Mountain Green
506 Porterville
507 Stoddard
508 Unincorporated Areas

RICH COUNTY 17

601 Garden City
602 Laketown
603 Pickleville

RICH COUNTY 17 (cont.)

604 Randolph
605 Round Valley
606 Woodruff
607 Unincorporated Areas

WEBER COUNTY 29

100 Eden
101 Hooper
102 Huntsville
103 Liberty
104 North Ogden

Ogden City:

105 West of Washington Blvd. to R.R. Tracks Between South City Limits & 17th St.
106 West of Washington Blvd. to R.R. Tracks Between North City Limits & 17th Street
107 Bound by Washington Blvd. & Harrison Blvd. between 17th St. & 36th St.
108 Bound by Washington Blvd. & Harrison Blvd. Between North City Limits & 17th St.
109 East of Harrison Blvd. to City Limits Between 17th St. & 36th St.
110 East of Harrison Blvd. to City Limits Between North City Limits & 17th St.
111 East of West City Limits Between South City Limits & 36th St.
112 West of R.R. Tracks to City Limits Between North & South City Limits

115 Ogden Canyon
116 Plain City
117 Pleasant View
118 Riverdale
119 Roy
122 South Ogden
125 Taylorville
126 Uintah
127 Washington Terrace
130 Unincorporated Areas

DISTRICT II

SALT LAKE COUNTY 18

Salt Lake City:

103 North of North Temple to County Line; West of Interstate to County Line
104 North of 9th South to County Line; West of State Street to the Interstate
105 North of South Temple to County Line; East of State St. to County Line
106 North of 21st South to North Temple; West of Interstate to City Limits
107 North of 9th South to South Temple; East of State St. to City Limits
108 East of Interstate to 13th East; South of 9th South to 21st So. Except East of 5th East Extending to 27th South
109 North of 27th South to 9th South; East of 13th East to County Line
110 Magna
111 Granger, Hunter
112 South Salt Lake
113 Holiday
114 Kearns
115 Taylorsville, West Jordan, Riverton
116 Murray
117 Southeast County (Draper)
118 Midvale - Sandy

SUMMIT COUNTY 22

No Areas Codes Used

TOOELE COUNTY 23

No Area Codes Used

DISTRICT III

JUAB COUNTY 12

077 Trout Creek
628 Eureka
639 Levan
641 Mammoth
645 Mona
648 Nephi

MILLARD COUNTY 14

624 Delta
625 Deseret
631 Fillmore
635 Hinckley
636 Holden
637 Kanosh
638 Leamington
640 Lynndyl

MILLARD COUNTY 14 (cont.)

644 Meadow
649 Oak City
650 Oasis
656 Scipio
728 Garrison

SANPETE COUNTY 20

621 Axtell
622 Centerfield
623 Chester
626 Elberta
627 Ephraim
629 Fairview
630 Fayette
632 Fountain Green
634 Gunnison
642 Manti
643 Mayfield
646 Moroni
647 Mt. Pleasant
662 Spring City
665 Sterling
667 Wales

UTAH COUNTY 25

003 American Fork
043 Lehi
057 Orem
062 Pleasant Grove
601 Provo
626 Elberta
651 Payson
653 Salem
655 Santaquin
660 Spanish Fork
663 Springville
666 Thistle

WASATCH COUNTY 26

032 Heber City
049 Midway
082 Wallsburg

DISTIRCT IV

BEAVER COUNTY 01

713 Beaver
731 Greenville
751 Milford
752 Minersville

GARFIELD COUNTY 09

712 Antimony
716 Boulder
717 Bryce Canyon
718 Cannonville
726 Escalente
735 Hatch
736 Henrieville
759 Panquitch
776 Tropic

IRON COUNTY 11

714 Beryl
721 Cedar City
742 Kanarraville
748 Lund
753 Modena
756 Newcastle
760 Paragonah
761 Parowan
772 Summit

KANE COUNTY 13

710 Alton
729 Glendale
741 Kanab
755 Mount Carmel
758 Orderville

PIUTE COUNTY 16

732 Greenwich
740 Junction
743 Kingston
750 Marysvale

SEVIER COUNTY 21

620 Aurora
652 Redmond
654 Salina
657 Rigurd
701 Richfield
711 Annabella
722 Central
724 Elsinore
730 Glenwood
739 Joseph
744 Koosharem
754 Monroe
766 Sevier
777 Venice

WASHINGTON COUNTY 27

725 Enterprise
733 Gunlock
737 Hurricane
738 Ivins
745 LaVerkin

BOX 37

(LA) CHILD'S LIVING ARRANGEMENT

A. Natural Parents
B. Adoptive Parents
C. Mother and Stepfather
D. Father and Stepmother
E. Mother Only
F. Father Only
G. With Spouse
H. With Step-Parent
I. With Relatives
J. Foster Home
K. Institution
Z. Other

BOX 38

(RA) RELIGIOUS ACTIVITY

A. Active
I. Inactive

BOX 39

(E) PARENT'S EMPLOYMENT

1. Father Working
2. Mother Working
3. Both Working
4. Neither Working

BOX 40

(I) PARENT'S INCOME

1. Public Assistance
2. Under $3,000
3. $3,000 - $4,999
4. $5,000 - $9,999
5. $10,000 & Over

BOX 41

(MS) PARENT'S MARITAL STATUS

1. Parents Living Together
2. Father Deceased
3. Mother Deceased
4. Both Parents Deceased
5. Divorced or Separated
6. Father Deserted
7. Mother Deserted
8. Parents Not Married
9. Other

BOX 42

(E) CHILD'S EMPLOYMENT

1. Full Time
2. Part Time
3. Not Employed

BOXES 43 - 44

(GR) LAST GRADE COMPLETED

00 Through 12
20 Special Education

BOX 45

(PL) SCHOOL PLACEMENT

1. Not in School
2. Retarded
3. Average
4. Advanced

BOX 46

(PR) SCHOOL PROGRESS

0. Not Applicable
1. Average or Better
2. Poor
3. Failing

BOX 47

(PR) SCHOOL BEHAVIORAL PROBLEM

Y. Yes
N. No.

BOX 63

ATTORNEY REPRESENTATION

1. County Attorney Only
2. Juvenile Attorney Only (Privately Retained)
3. Juvenile Attorney Only (Court Appointed)
4. County Attorney & Juvenile Attorney (privately Retained)
5. County Attorney & Juvenile Attorney (Court Appointed)

# VITA

Sung-Ik Song

Candidate for the degree of

Master of Science

Thesis: Comparison of Transition Matrices between Metropolitan and Non-metropolitan areas in the State of Utah using Juvenile Court Data

Major Field: Applied Statistics

Biographic Information:

Personal Data: Born at Seoul, Korea, February 10, 1941, son of Heung Kook Song and Yong Hee Lee.

Education: Graduate from Kyunggi High School in 1959, received a Bachelor of Arts from Seoul National University with a major in Sociology in 1963, completed requirements for Master of Science at Utah State University in 1974.