

A THEORETICAL MARKOV CHAIN MODEL FOR EVALUATING CORRECTIONAL METHODS APPLIED TO PEOPLE WITH CRIMINAL TENDENCIES

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In this paper a stochastic method is applied in the study of the long time effect of confinement in a correctional institution on the behaviour of a person with criminal tendencies. The approach used is Markov chain, which uses past history to predict the state of a system in the future. A model is developed for comparing the effect of different correctional practices on people with criminal tendencies. The statistics for this comparison is the number of people whose criminal tendencies are completely destroyed at the end of their confinement. The model so developed is applied to a simulated data on deviants of the same criminal offence. The number of them who permanently recover and those who permanently remain unrecovered were obtained.

KEY WORD Markov Chain, Evaluating, Correctional Methods, Criminal Tendencies

1 INTRODUCTION

Fox (1972) observed that correction is part of society's agencies of social control that attempts to rehabilitate or neutralize the deviant behaviour of adult criminals and juvenile delinquents. It functions with social and legal authority after the criminal court has held an adult to be guilty of a violation of law or when the juvenile court acts in a child's interest after a complaint or a referral has been made alleging a delinquent act. During the early part of the century significant moves were made relating to the field of corrections. In 1908,

England began the Borstal institutions, which were minimum-security schools for delinquent youths. Belgium began classifying prisoners about the same time, a practice that was adopted in New Jersey, United States of America in 1928. In spite of these developments the first large scale significant research in criminology and its application to corrections was developed at the University of Chicago in the late 1920's under the leadership of Ernest Burgess. Furthermore, in the American set up, the most important current survey of American corrections as well as the entire system of criminal justice is the President's commission on law enforcement and administration of justice which did most of its work in 1966 and issued its publication in 1967. Another important literature is Lewis (1922) that considered the development of American prisons and prison customs. Tappian (1957) also discussed extensively issues of contemporary correction

The essence of confining criminals is to destroy the criminal tendencies in them during the period of confinement and make them harmless and useful citizens. There are two approaches to achieving this noble objective – these are punishment and training. It is generally accepted but not yet verified that a few of the criminals die during their

period of confinement, while a majority of them are released back to the society.

Training, whose objective is to prepare the inmates of a prison or reformatory by therapy or conditioning so that their response to stress will be socially acceptable when released from the prison or reformatory, is another method of correction applied. The training could be in the form of exposition to different vocational training, which will help them fend for themselves when freed, religious instruction which appeals to their conscience and academic training which appeals to their intellect. The essence of this is geared towards destroying the criminal tendencies in them and prepare them to meet the challenges of life when freed.

Punishment, on the other hand, which ranges from corporal to execution, inflicts different degrees of suffering on the culprit. It is observed in some cases that if big resentments are made out of little ones through punishment, the criminal may be worse when he is out than when he arrived to be confined. In view of this, punishment may intensify the individual's problem by adding frustration-to-frustration and thereby reinforcing failures. A simple illustration is what happens to a child who is always beaten seriously whenever he or she commits an offence. The child becomes hardened and worse. On the other hand, if the child is counseled and corrected, he or she may improve markedly instead of becoming worse. This then clearly shows that treatment or training approach may be a better approach to correction of deviants than punishment.

Since there are a number of different ways of imparting this training to the group of people in question as observed in section (3) the objective of this study is to develop a stochastic model which will be used in estimating the number of criminals associated with a certain kind of deviant behaviour who permanently recover or remain permanently un-recovered at the end of confinement is developed. This will help Government of a country justify the effort and money she puts into correctional institutions. Because of the random pattern in which different criminal behaviours appear in our society the deterministic approach may not be able to give a clear picture of the impact of the different correctional methods on a given category of criminals and we are persuaded that a stochastic approach will be more appropriate.

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THE MODELLING APPROACH

In this paper the stochastic approach to be adopted is the Markov chain. Consider a physical system which is observed at a discrete set of times. Let the successive observations be denoted by X_0, X_1, X_2, \dots . If we assume that X_n is a random variable and if each random variable is discrete and the following condition is satisfied: for any integer $w > 2$ and any set of w points $m_1 < m_2 < \dots < m_w$ the conditional distribution of $X_{m/w}$ for given values of $X_{n/1}, \dots, X_{n/w-1}$, depends only on $X_{n/w-1}$, the most recent known value. In particular if for real x_0, \dots, x_w it holds that

$$P[X_w = x_w / X_0 = x_0, \dots, X_{w-1} = x_{w-1}] = P[X_w = x_w / X_{w-1} = x_{w-1}] \quad 2.1$$

then the sequence of random variable $\{X_w\}$ is said to be a Markov chain.

This transient behaviour is captured by transient probability matrix A given by

$$A = p_{ij}, i, j = 0, 1, 2, \dots, p_{ij} \geq 0, \forall i, j \quad 2.2$$

and

$$\sum_j^n p_{ij} = 1 \quad \forall i \quad 2.3$$

In this study our interest is the state where a person becomes permanently corrected or permanently uncorrected in character; we assume that these two cases are absorbing states. Suppose the time before absorption is β_T , then the time at absorption α_T is given as

$$\alpha_T = \beta_T + 1 \tag{2.3}$$

Let M_j be the mean time for reaching this state termed state j in this study, then

$$\begin{aligned} M_j &= E\{\alpha_T \mid \text{the person is at state } j\} \\ &= 1 + E\{\beta_T \mid \text{the person is at state } j\} \\ &= 1 + M_k p_k + M_k q_k + M_k r_k \end{aligned} \tag{2.4}$$

where

p_{jk} is the probability of correction method being effective
 q_{jk} is the probability of correction method having negative effect.
 r_{jk} is the probability of correction method having no effect and the individual criminal tendencies remains unchanged.
 Using the matrix approach we have

$$M = I + QM$$

where Q represent p_{jk}, q_{jk} and r_{jk} .

Therefore

$$(I - Q)M = I$$

therefore

$$M = (I - Q)^{-1} I \tag{2.5}$$

In this paper we are using time homogeneous Markov chains in which the transition probabilities are independent of time. The study leads us to an absorbing Markov chain which can be partitioned into the canonical form

$$= \begin{vmatrix} I & 0 \\ R & Q \end{vmatrix} \tag{2.6}$$

where

I is an identity sub-matrix which corresponds to absorbing States (permanently corrected and permanently uncorrected)

R is a sub-matrix of probabilities of transient to recurrent states.

Q is a sub-matrix of probabilities of transient states.

0 is a sub-matrix of zeros.

What will be of interest to us in this study is being able to calculate

$$M = (I - Q)^{-1} \quad 2.7$$

which is called the fundamental matrix. This gives us the expected duration in each state before finally reaching the absorbing states.

Finally, using the equation

$$W = M * R \quad 2.8$$

leads us to obtaining the probabilities of reaching the absorbing state from a transient state. Finite Markov chains have been applied by many researchers in modeling different problems in different fields. For example, Prais (1955) applied it in measuring social mobility, Chukwu and Ugwuowo (1998) used it to model soil erosion, Parzen (1962) and Feller (1968) discussed it extensively in their books. Levin et al (1986) applied it in determining paid up and bad debt among accounts receivables.

3 MODEL OF BEHAVIOURAL STATUS OF INDIVIDUALS WITH CRIMINAL TENDENCIES UNDER CERTAIN CORRECTIONAL METHOD

Tappian(1957) observed that emphasis in the approach of effecting correction in a correctional institution depends on the training of the person in charge of the institution. When an educator is the administrator of a correctional institution he or she favours education as the primary bases of correctional treatment as in the case of many reformatories and other correctional institutions. A social worker hired as the administrator of a correctional institution emphasizes social work approach while a law enforcement person hired as the administrator of a correctional institution emphasizes discipline, security and orderly process. In view of the above observations there appears to be many approaches to treatment in the correctional fields. Since the intention of creation of correctional institutions, be it reformatory or prison, is to destroy the criminal tendency in the individual in question and give him or her a new start in life, then the best thing is to evaluate the different alternative approaches available in the correctional institutions to obtain the one that achieves the highest percentage correction in the criminals.

In this paper we shall develop a model for evaluating the correctional techniques. We assume that people who have criminal tendencies undergoing correctional training can be classified into four recovery stages. We also assume that the percentage of correction depends mainly on the effectiveness of the correctional technique. We shall be interested in four states of behaviour of the individuals with criminal tendencies. These are:

- (a) permanently uncorrected
- (b) permanently corrected
- (c) major improvement
- (d) minor improvement

All these states have their respective probabilities of moving from one state to another.

who will be permanently reformed and those who will be permanently unreformed. We partition the matrix A into four sub-matrices as discussed in the paper as follows

$$A = \begin{vmatrix} 1 & 0 & \vdots & 0 & 0 \\ 0 & 1 & \vdots & 0 & 0 \\ \dots & \dots & \dots & \dots & \dots \\ 0.1 & 0.5 & \vdots & 0.2 & 0.2 \\ 0.3 & 0.2 & \vdots & 0.3 & 0.2 \end{vmatrix}$$

$$R = \begin{vmatrix} 0.1 & 0.5 \\ 0.3 & 0.2 \end{vmatrix} \quad \text{and} \quad Q = \begin{vmatrix} 0.2 & 0.2 \\ 0.3 & 0.2 \end{vmatrix}$$

Then

$$M = |I - Q|$$

$$= \begin{vmatrix} 0.8 & -0.2 \\ -0.3 & 0.8 \end{vmatrix}$$

then

$$N = M^{-1} = (1/59) \begin{vmatrix} 0.8 & 0.2 \\ 0.3 & 0.8 \end{vmatrix}$$

The matrix S is

$$S = NR$$

$$= (1/59) \begin{vmatrix} 0.8 & 0.2 \\ 0.3 & 0.8 \end{vmatrix} \begin{vmatrix} 0.1 & 0.5 \\ 0.3 & 0.2 \end{vmatrix}$$

$$= (1/59) \begin{vmatrix} 0.14 & 0.44 \\ 0.27 & 0.31 \end{vmatrix}$$

Therefore to obtain the number of criminals who will end up completely reformed or permanently unreformed we multiply the vector [1650 , 900] by S .

$$[1650 \quad 900](1/59) \begin{vmatrix} 0.14 & 0.44 \\ 0.27 & 0.31 \end{vmatrix} = [800 \quad 1700]$$

The result is interpreted to mean that of the 2550 criminals who were treated with the same correctional technique 800 were permanently corrected while 1700 were permanently uncorrected procedure applied to criminals of the same offence category by estimating un-recovered at the end of the period of confinement. The correctional procedure that has the greatest number of permanently recovered criminals will be assumed to be the best under that circumstance.

CONCLUSION

In conclusion, we assert that the model so developed will be adequate for justifying the method applied in rehabilitating deviants of a particular criminal tendency since the model will be able to estimate the number of criminals who are permanently corrected at the end of their confinement. This is because the whole essence of confinement is to destroy the criminal tendencies in the inmates and make them better human beings.

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