Mathematical Modelling: A Study of Discrete Model of Corruption with Difference Equation Form

Sayaji Rastum Waykar[1], Dr. Udaykumar H. Naik[2]
Research Scholar, JIJT University, Rajasthan
1/C/O Assistant Professor, Department of Mathematics
Yashwantrao Chavan Mahavidyalaya, Halkarni Tal: Chandgad, Dist: Kolhapur, Maharashtra (India).
2 Associate Professor, Department of Mathematics, Willingdon College, Sangli, Maharashtra, (India).

Abstract: In this paper we have to study on the problem of ‘Corruption’ in different ways by using mathematical modelling. Also, we have to try a study of discrete model of corruption in the difference equation form. That is the comparatively mathematical study between the discrete model of corruption in the difference equation form and mathematical corruption model in the exponential form.

The problem of corruption is everywhere, so we will try to find the solution for the problem of corruption in the society. Therefore, how to measure the corruption in the society of any field or any country in the world? So, we have found the formula that is Mathematical corruption model for measuring the corruption in the society of any field or any country of the world. When we measure the corruption in the society then there will be no difficult to remove the corruption from the society of any country in the world.

Keywords: mathematical thinking, corruption mentality, modelling, applied.

I. Introduction

We have to study of discrete model of corruption in the difference equation form by using Mathematical Modelling. The basic idea here is to consider systems with changes which may be thought of as occurring discretely. One example would be cells which divide synchronously and which we follow at some fixed set of times following cell division. Other examples include any organism with discrete generations e.g. many insects, plants etc. in which we follow either population size or some measure of genetic structure such as allele frequencies. The key here is that there are relatively short and synchronized actions e.g.: breeding seasons which allows one to ignore the within-time period behavior for the purpose of the Mathematical Model. An alternative view of discrete models of corruption is that they are discrete of continuous time models. That is, we cannot really observe organism continuously, so we just monitor the quantities of interest at discrete intervals. An example would be locations of individuals which move continuously, but we only observe at discrete intervals. This is the basic idea of time series analysis, which is a statistical approach to describing, predicting and controlling the behavior of a time dependent system. The appropriate formulation of Mathematical discrete model for corruption depends upon the questions:

- How much corruption exists in a given country?
- How much money is paid every year for corruption?
- What operations are more at risk of corruption?
- What amounts are paid? When and by Whom?
- What are the sectors or regions most affected by corruption?
- What are the characteristics of victims and perpetrators?
- What portion of individuals or enterprises had to pay a bribe in a given year?
- How much corruption is reported to competent authorities?
- Has the level of corruption changed over time?
- Are there certain population groups more at risk of being victim of corruption that is vulnerable groups?

We are trying to address and the appropriate temporal and spatial scale at which to focus those questions. The limitations of the available data to develop the mathematical discrete model for corruption then evaluate it. Also, the question comes in my mind that how to examine “Human Behavior, Trust and Corruption.” Now we know, A general form for a first order difference equation is

\[ C_{n+1} = f(C_n) \]

Where C denotes corruption and the function f determines the new value of the variable at the next time step from the previous value. This is an iteration scheme and if you know the function f and an initial \( C_0 \) when Mathematical E-virus Constant \( K = 0 \) then we can just iterate the function through time to calculate successive
values of \( C_n \). However, the objective of mathematical analysis is to provide some general understanding of discrete models for corruption such as this, so that we can determine how the system behaves without having to iterate it numerically. Numerical iteration tells us only what one particular trajectory of the system will be through time. We had potentially had to do much iteration to get a general picture of the behavior of the system, and mathematical analysis saves us from having to do this.

II. Methodology

We have to use the four steps of mathematical modelling cycle for solving the problem of corruption in the society of any country of the world. The mathematical modelling process is as follows:

![Fig.1: The “Answer Plan of a Problem” for Mathematical modeling task](image)

A modelling task requires translations between reality and Mathematics what, in short, can be called Mathematical modelling. By reality, I mean according to Pollack (1979), the “rest of the world” outside mathematics including nature, society, everyday life and other scientific disciplines.

III. A Study of Discrete Model of Corruption with Difference Equation Form

The discrete model of corruption in the difference equation can be modeled using the formula,

\[ T = T_1 - T_2, \text{ where } T = \text{Change; } T_1 = \text{Future Value; } T_2 = \text{Present Value.} \]

A dynamical system allows us to describe the change from one state of the system to the next. At \( n^{th} \) stage, the change is described by

\[ \text{Change at stage } n = \text{future } (n+1)^{th} \text{ stage} - \text{present } n^{th} \text{ stage} \]

The difference \( C_{n+1} - C_n \) is usually denoted by \( \Delta C_n \) and is called a change or \( n^{th} \) first difference. A difference equation is an equation of the form \( \Delta C_n = f(C_n) \) is a discrete analogue of the autonomous differential equation \( \frac{dC}{dt} = f(C) \) correspond to the accumulation points of the sequence \( C_n \) that is the solution of difference equation \( \Delta C_n = f(C_n) \) with the initial value \( C_0 \). Recall that the equilibrium solutions were obtained by solving \( f(C) = 0 \) for \( C \). Analogously, we obtain the limiting values by solving \( f(C) = 0 \) for \( C \). This fact can be explained also by the following argument. Note that if \( \lim_{n \to \infty} C_n = C \), then the values of \( C_{n+1} \) and of \( C_n \) will be close to each other for large values of \( n \).

Thus, \( \Delta C_n = C_{n+1} - C_n = f(C_n) \) is close to 0. so, when \( n \to \infty \) \( f(C_n) \to 0 \). Thus, if \( C \) is the limiting value, \( \lim_{n \to \infty} C_n \), then \( C \) can be obtained as a solution of the equation \( f(C) = 0 \). Let us consider a dynamical system \( C_{n+1} = f(C_n) \). If \( C \) is the limiting value, \( \lim_{n \to \infty} C_n \), then \( \lim_{n \to \infty} C_{n+1} \) is equal to \( C \) as well. Thus, \( C \) can obtained as a solution of the equation \( C = f(C) \). Note that a limit of sequence \( C_n \) also corresponds to the values of the sequence satisfying \( C_{n+1} = f(C_n) \) with initial value \( C_0 = C \).
Namely, if \( C \) is such that \( C = f(C) \) and we consider a dynamical system given by \( C_{n+1} = f(C_n) \) and \( C_0 = C \), then \( C_1 = f(C_0) = f(C) = C, C_2 = f(C_1) = f(C) = C \), \( \ldots C_{n+1} = f(C_n) = f(C) = C \). We obtain a constant sequence with all terms equal to \( C \). Because of this, the limiting value \( C \) of a dynamical system \( f(C) \) is fixed. If and only if \( C = f(C) \) when \( C_0 = C \). The same terminology regarding stability is used as in the case of autonomous differential equations.

Let \( k \) be positive number. A frequently used dynamical system is obtained when assuming that a certain quantity is changing by a multiple of \( k \) in every time unit. Thus, this process can be modeled by the dynamical system \( C_{n+1} = kC_n \) or alternatively by the difference equation \( \Delta C_n = (k-1)C_n \). If Mathematical Effected virus constant \( K \) is taken as \( k-1 \), the difference equation becomes \( \Delta C_n = KC_n \) the quantity \( K = k-1 \) can be interpreted as the percent change. The equilibrium solution is obtained from equation \( KC=0 \) and is \( C=0 \). I distinguish the following cases:

i) If \( K > 0 \), the equilibrium solution is unstable. The corruption sequences with positive initial values are increasing without bounds. It is a Positive Corruption.

ii) If \( K = 0 \), the corruption sequence is constant. Every term is equal to the initial value. It is a Constant Corruption.

iii) If \( K < 0 \), the equilibrium solution is stable. The corruption sequences with positive initial values are Decreasing towards 0. It is a Negative Corruption.

It is not hard to determine the explicit formula describing the terms of the sequence.

Let \( C_0 \) denote the initial value. Then \( C_1 = kC_0, C_2 = k^2C_0, C_3 = k^3C_0 \). …

Thus \( C_n = k^nC_0 \) or \( C_n = C_0(k+1)^n \). The continuous analogue of the difference equation, \( \Delta C_n = KC_n \), with initial value \( C_0 \) is the differential equation, \( \frac{dc}{dt} = KC, (0) = C_0 \).

Note that this is an autonomous differential equation with equilibrium solution \( C=0 \) that is unstable for \( K > 0 \) and stable for \( K < 0 \), the differential equation \( \frac{dc}{dt} = KC \) has solution \( C = C_0e^{kt} \) is a Mathematical Corruption Model.

If we consider \( n \) as a measure of time elapsed in the discrete case, the solution \( C_n = C_0(k+1)^n \) of difference equation corresponds to the exponential function \( C = C_0(k+1)^t \).

Thus, if \( C_0 \) is the initial size, we have that:

iv) A quantity increasing by percent \( K \) in discrete time intervals has the size given \( C = C_0(k+1)^t \).

v) A quantity increasing by percent \( K \) continuously has the size given by \( C = C_0e^{Kt} = C_0(e^K)^t \).

Both of the functions are exponential functions. The first one has base \( 1 + K \) and the second base \( e^K \). Note that the values of \( 1+K \) and \( e^K \) are close for small values of \( K \). That is \( 1+K = e^K \).

Note also that \( 1+K \) are the first two terms of the Taylor series of \( e^K \) centered at zero, \( e^K = \sum_{n=0}^{\infty} \frac{k^n}{n!} = 1 + K + \ldots = 1+K \).

Therefore the discrete mathematical Corruption model is of the form, therefore \( C = C_0(k+1)^t \) \( \quad \text{(i)} \)

Where \( K = \) Mathematical E-virus Constant and \( t = \) Mathematical Model period.

This is known as Mathematical Discrete Model of Corruption with the Difference Equation Form.

Also, we know that the Mathematical E-virus Constant with related time \( K \) in exponential equation form. It is of the following:

\[ e^K = \left( \frac{C(t)}{C(0)} \right)^\frac{1}t \]

But \( e^K \approx 1+K \), putting in the above equation, we get

Therefore, \( 1+K = \left( \frac{C(t)}{C(0)} \right)^\frac{1}t \)

\[ K = \left( \frac{C(t)}{C(0)} \right)^\frac{1}t - 1 \] \( \quad \text{(ii)} \)

This is known as Mathematical E-virus Constant Model with Related Time Formula in the Difference Equation Form.

Also, the another discrete model is of the form,

\[ C = C_0(k+1)^{-t} \] \( \quad \text{(iii)} \)

Where \( K = \) Mathematical E-virus Constant and \( t = \) Mathematical Model period.

This is known as Mathematical Decay of Discrete Model of Corruption with the Difference Equation Form or Mathematical Corruption Control Model (MCC Model).
Also, we know that the Mathematical E-virus Constant $K$ with related Corruption in exponential equation form. It is of the following:

\[ e^K = \left( \frac{D(C)}{D(0)} \right)^t \]  \hspace{2cm} (iv)

But $e^K \approx 1 + K$, putting in the equation (iii), we get

\[ 1 + K = \left( \frac{D(C)}{D(0)} \right)^t - 1 \]  \hspace{2cm} (v)

This is known as Mathematical E-virus Constant Model with Related Corruption Formula in the Difference Equation Form.

Also, we know that the Mathematical Corruption Development Model in exponential equation form. It is as follows:

\[ D(C) = D(0)e^{KC} \]  \hspace{2cm} (vi)

But $e^K \approx 1 + K$, putting in the equation (vi), we get

\[ D = D(0)[1 + K]^t \]  \hspace{2cm} (vii)

This is known as Mathematical Corruption Development Model with the Difference Equation Form.

We know that the Mathematical Development Model in exponential equation form. It is as follows:

\[ D = D(0)e^{KT} \]  \hspace{2cm} (viii)

But $e^K \approx 1 + K$, putting in the equation (viii), we get

\[ D = D(0)[1 + K]^t \]  \hspace{2cm} (ix)

This is known as Mathematical Development Model with the Difference Equation Form.

IV. Mathematical Results

We have observed and it concluded that the Mathematical Results for finding or measuring the “Corruption” in the society. These mathematical results are as follows:

i. Mathematical Discrete Model of Corruption with the Difference Equation (or MC Model) Formula:

\[ C = C(0)(K + 1)^t \]

ii. Mathematical Decay of Discrete Model of Corruption with the Difference Equation (or MCC Model) Formula:

\[ C = C(0)(K + 1)^{-t} \]

iii. Mathematical Corruption Development Model with the Difference Equation (or MCD Model) Formula:

\[ D(C) = D(0)(1 + K)^t \]

iv. Mathematical Development Model with the Difference Equation (or MD Model) Formula:

\[ D = D(0)(1 + K)^t \]

v. Mathematical E-virus Constant Model with Related Time in the Difference Equation Formula:

\[ K = \left( \frac{C(0)}{C(t)} \right)^{-1} - 1, \hspace{0.5cm} -1 < K < 1 \]

vi. Mathematical E-virus Constant Model with Related Corruption in the Difference Equation Formula:

\[ K = \left( \frac{D(C)}{D(0)} \right)^t - 1, \hspace{0.5cm} -1 < K < 1 \]

Note that if the value of $K$ is more than 1 then we choose or take the value approximately to 1 but not equal to 1. From equation (i) is a Mathematical Corruption Model and it is used for measuring the corruption in various fields of the society of any country in the world.

From equation (ii) is a Mathematical Corruption Control Model and it is used for removing or controlling corruption from the society of any country of the world.

From equation (iii) is a Mathematical Corruption-Development Model and it is used for finding the actual value of development except or related corruption in the society of any country in the world.

From equation (iv) is a Mathematical Development Model related time and it is used for finding the value of development related to a particular period. Also from equations (v) and (vi) are same that is finding the value of a Mathematical Effected Virus Constant.

V. Some Illustrations

5 Mathematical Corruption growths in various fields of the society (general) in India:

Suppose there was no corruption at 15 August 1947. That is $C=0$ when $t=0$ and MEV constant $K = 0$. Now we take Mathematical model period $t= 10$ years. Therefore after 10 years,

5.1 Model-I: we assume that corruption was 0.25 % of total population 35 crore that is 0.0875 crore on 15 August, 1957.
Therefore at MEV constant $K=0$. When t=0, $C(0) = C_0 = 0.0875 \text{ crore}$ and when t= 10 years, $C(t)$ depends on MEV constant. We know that MEV constant formula,

$$K = \frac{C(0)}{C(0)^{1+t}} - 1$$

Putting in Mathematical corruption model formula (i), it is of the form,

$$C = C_0(K + 1)^t$$

Therefore,

$$C = 0.0875 \times \left(\frac{0.105}{0.0875}\right)^t \quad \text{---------------- (i)}$$

Where $K$ is known as MEV constant. So we take the various values of MEV constant $K$. It is lies between 0 and 1. Such values are 0, 0.20, 0.40, 0.60, 0.80 and 0.9988.

**Case-I:** we take $K=0$ and $t= 10$ years then from (i), $C = C_0 = 0.0875 \text{ crore}$

Therefore, $C = 0.0875 \text{ crore}$

**Case-II:** when, we take $K=0.20$ and $t= 10$ years, $C(t) = 0.105 \text{ crore}$ then from (i),

Therefore, $C = 0.0875 \times \left(\frac{0.105}{0.0875}\right)^{10}$

$$C = 0.105 \text{ crore}$$

When MM period $t = 10$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times [1.20]^{10}$

$$C = 0.0875 \times 1.20$$

$C = 0.105 \text{ crore}$

When MM period $t = 20$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times [1.20]^{20}$

$C = 0.0875 \times 1.44$

$C = 0.126 \text{ crore}$

When MM period $t = 30$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times [1.20]^{30}$

$C = 0.0875 \times 1.728$

$C = 0.1512 \text{ crore}$

When MM period $t = 40$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times [1.20]^{40}$

$C = 0.0875 \times 2.0736$

$C = 0.18144 \text{ crore}$

When MM period $t = 50$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times [1.20]^{50}$

$C = 0.0875 \times 2.48832$

$C = 0.217728 \text{ crore}$

When MM period $t = 60$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times [1.20]^{60}$

$C = 0.0875 \times 2.985984$

$C = 0.2612736 \text{ crore}$

When MM period $t = 70$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times [1.20]^{70}$

$C = 0.0875 \times 3.5831808$

$C = 0.31352832 \text{ crore}$

When MM period $t = 80$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times [1.20]^{80}$

$C = 0.0875 \times 4.29981696$

$C = 0.376233984 \text{ crore}$

When MM period $t = 90$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times [1.20]^{90}$

$C = 0.0875 \times 5.159780352$

$C = 0.4514807808 \text{ crore}$

When MM period $t = 100$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times [1.20]^{100}$

$C = 0.0875 \times 6.1917364224$

$C = 0.54177693696 \text{ crore}$

**Case-III:** when, we take $K=0.40$ and $t= 10$ years, $C(t) = 0.1225 \text{ crore}$ then from (i),
Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^t \quad \text{---------- (iii)}$

When MM period $t = 10$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^{10}$

$C = 0.1225 \text{ crore}$

When MM period $t = 20$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^{20}$

$C = 0.1715 \text{ crore}$

When MM period $t = 30$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^{30}$

$C = 0.2401 \text{ crore}$

When MM period $t = 40$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^{40}$

$C = 0.33614 \text{ crore}$

When MM period $t = 50$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^{50}$

$C = 0.470596 \text{ crore}$

When MM period $t = 60$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^{60}$

$C = 0.6588344 \text{ crore}$

When MM period $t = 70$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^{70}$

$C = 0.92236816 \text{ crore}$

When MM period $t = 80$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^{80}$

$C = 1.291315424 \text{ crore}$

When MM period $t = 90$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^{90}$

$C = 1.8078415936 \text{ crore}$

When MM period $t = 100$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.1225}{0.0875} \right)^{100}$

$C = 2.53097823104 \text{ crore}$

Case-IV: when we take $K=0.60$ and $t=10$ years, $C(t) = 0.14$ crore then from (i),

Therefore, $C = 0.0875 \times \left( \frac{0.14}{0.0875} \right)^{10} \quad \text{---------- (iv)}$

When MM period $t = 10$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.14}{0.0875} \right)^{10}$

$C = 0.14 \text{ crore}$

When MM period $t = 20$ years from base that is 15 August 1947. What is $C$ ?

Therefore, $C = 0.0875 \times \left( \frac{0.14}{0.0875} \right)^{20}$

$C = 0.14 \text{ crore}$
When MM period $t = 30$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.14 & 30 \\ 0.0875 & 1 \end{bmatrix}$

$C = 0.224$ crore

When MM period $t = 40$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.14 & 40 \\ 0.0875 & 1 \end{bmatrix}$

$C = 0.3584$ crore

When MM period $t = 50$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.14 & 50 \\ 0.0875 & 1 \end{bmatrix}$

$C = 0.917504$ crore

When MM period $t = 60$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.14 & 60 \\ 0.0875 & 1 \end{bmatrix}$

$C = 1.4680064$ crore

When MM period $t = 70$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.14 & 70 \\ 0.0875 & 1 \end{bmatrix}$

$C = 2.34881024$ crore

When MM period $t = 80$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.14 & 80 \\ 0.0875 & 1 \end{bmatrix}$

$C = 3.758096384$ crore

When MM period $t = 90$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.14 & 90 \\ 0.0875 & 1 \end{bmatrix}$

$C = 6.0129542144$ crore

When MM period $t = 100$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.14 & 100 \\ 0.0875 & 1 \end{bmatrix}$

$C = 9.62072674304$ crore

Case-V: when, we take $K=0.80$ and $t=10$ years, $C(t) = 0.1575$ crore then from (i),

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.1575 & 1 \\ 0.0875 & 1 \end{bmatrix}$

$C = 0.1575$ crore

When MM period $t = 20$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.1575 & 20 \\ 0.0875 & 1 \end{bmatrix}$

$C = 0.2835$ crore

When MM period $t = 30$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.1575 & 30 \\ 0.0875 & 1 \end{bmatrix}$

$C = 0.5103$ crore

When MM period $t = 40$ years from base that is 15 August 1947. What is $C$?

Therefore, $C = 0.0875 \times \begin{bmatrix} 0.1575 & 40 \\ 0.0875 & 1 \end{bmatrix}$

$C = 0.4545$ crore
C = 0.91854 crore
When MM period t = 50 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.1575^{50}}{0.0075^{50}} \right) \)
\( C = 0.0875 \times 18.89568 \)

C = 1.653372 crore
When MM period t = 60 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.1575^{60}}{0.0075^{60}} \right) \)
\( C = 0.0875 \times 30.233088 \)

C = 2.6453952 crore
When MM period t = 70 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.1575^{70}}{0.0075^{70}} \right) \)
\( C = 0.0875 \times 54.4195584 \)

C = 4.76171136 crore
When MM period t = 80 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.1575^{80}}{0.0075^{80}} \right) \)
\( C = 0.0875 \times 97.95520512 \)

C = 8.571080448 crore
When MM period t = 90 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.1575^{90}}{0.0075^{90}} \right) \)
\( C = 0.0875 \times 176.319369216 \)

C = 15.4279448064 crore
When MM period t = 100 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.1575^{100}}{0.0075^{100}} \right) \)
\( C = 0.0875 \times 317.3748645888 \)

Case-VI: when, we take \( \text{ كب}=0.9988 \) and t= 10 years, C (t) = 0.174895 crore then from (i),
Therefore, \( C = 0.0875 \times \left( \frac{0.174895^{10}}{0.0075^{10}} \right) \)  
------------------ (vi)

When MM period t = 10 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.174895^{10}}{0.0075^{10}} \right) \)
\( C = 0.0875 \times 1.9988 \)

C = 0.174895 crore
When MM period t = 20 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.174895^{20}}{0.0075^{20}} \right) \)
\( C = 0.0875 \times 3.99520144 \)

C = 0.34958013 crore
When MM period t = 30 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.174895^{30}}{0.0075^{30}} \right) \)
\( C = 0.0875 \times 7.98560864 \)

C = 0.69874076 crore
When MM period t = 40 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.174895^{40}}{0.0075^{40}} \right) \)
\( C = 0.0875 \times 15.9616345 \)

C = 1.39664302 crore
When MM period t = 50 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.174895^{50}}{0.0075^{50}} \right) \)
\( C = 0.0875 \times 31.904115 \)

C = 2.79161006 crore
When MM period t = 60 years from base that is 15 August 1947. What is C ?
Therefore, \( C = 0.0875 \times \left( \frac{0.174895^{60}}{0.0075^{60}} \right) \)
Mathematical Modelling: A Study of Discrete Model of Corruption with Difference Equation Form

C = 0.0875 \times 63.7699451

C = 5.5798702 crore

When MM period t = 70 years from base that is 15 August 1947. What is C ?
Therefore, C = 0.0875 \times \left(\frac{0.174895}{0.0875}\right)^{70}
C = 0.0875 \times 254.773776

C = 11.1530445 crore

When MM period t = 80 years from base that is 15 August 1947. What is C ?
Therefore, C = 0.0875 \times \left(\frac{0.174895}{0.0875}\right)^{80}
C = 0.0875 \times 509.241823

C = 22.2927054 crore

When MM period t = 90 years from base that is 15 August 1947. What is C ?
Therefore, C = 0.0875 \times \left(\frac{0.174895}{0.0875}\right)^{90}
C = 0.0875 \times 1017.379256

C = 44.5586595 crore

When MM period t = 100 years from base that is 15 August 1947. What is C ?
Therefore, C = 0.0875 \times \left(\frac{0.174895}{0.0875}\right)^{100}
C = 0.0875 \times 2074.78449

C = 89.063849 crore

Mathematical Results-I:
From case-I, case-II, case-III, case-IV, case-V and case-VI, we can write the above mathematical results in tabular form of the following:

<table>
<thead>
<tr>
<th>MM period t() (years)</th>
<th>MEV constant ('K') (0.20)</th>
<th>0.40</th>
<th>0.60</th>
<th>0.80</th>
<th>0.9988</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.105</td>
<td>0.1225</td>
<td>0.14</td>
<td>0.1575</td>
<td>0.174895</td>
</tr>
<tr>
<td>20</td>
<td>0.126</td>
<td>0.1715</td>
<td>0.224</td>
<td>0.2835</td>
<td>0.34958013</td>
</tr>
<tr>
<td>30</td>
<td>0.1512</td>
<td>0.2401</td>
<td>0.3584</td>
<td>0.5103</td>
<td>0.69874076</td>
</tr>
<tr>
<td>40</td>
<td>0.18144</td>
<td>0.33614</td>
<td>0.917504</td>
<td>0.91854</td>
<td>1.39646302</td>
</tr>
<tr>
<td>50</td>
<td>0.217728</td>
<td>0.470596</td>
<td>1.4680064</td>
<td>1.653372</td>
<td>2.79161006</td>
</tr>
<tr>
<td>60</td>
<td>0.2612736</td>
<td>0.6588344</td>
<td>2.3886102</td>
<td>2.6453952</td>
<td>5.5798702</td>
</tr>
<tr>
<td>70</td>
<td>0.315283</td>
<td>0.9223682</td>
<td>3.75809644</td>
<td>4.7617114</td>
<td>11.1380445</td>
</tr>
<tr>
<td>80</td>
<td>0.3762339</td>
<td>1.2913154</td>
<td>6.0129542</td>
<td>8.5710804</td>
<td>22.2927054</td>
</tr>
<tr>
<td>90</td>
<td>0.4514808</td>
<td>1.8078416</td>
<td>9.6207267</td>
<td>15.4279448</td>
<td>44.5586595</td>
</tr>
<tr>
<td>100</td>
<td>0.5417769</td>
<td>2.509782</td>
<td>15.391628</td>
<td>27.7703006</td>
<td>89.063849</td>
</tr>
</tbody>
</table>

Average \(\overline{X}\) = \sum_{f} x f = 0.27256615 \times 0.85521738 = 4.02416607 \times 6.26996444 \times 17.8059597

Statistical Study Of Corruption For Model-I:

<table>
<thead>
<tr>
<th>Data (X)</th>
<th>Sample-I (f)</th>
<th>f (x)</th>
<th>(D_x = (x - \overline{X}))</th>
<th>(D_x^2)</th>
<th>(f \cdot D_x^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.139979</td>
<td>1.39979</td>
<td>-78</td>
<td>6084</td>
<td>851.63236</td>
</tr>
<tr>
<td>20</td>
<td>0.23691603</td>
<td>4.6183206</td>
<td>-68</td>
<td>4642</td>
<td>1071.91221</td>
</tr>
<tr>
<td>30</td>
<td>0.3974815</td>
<td>11.7524445</td>
<td>-58</td>
<td>3364</td>
<td>1317.84078</td>
</tr>
<tr>
<td>40</td>
<td>0.7500534</td>
<td>30.002136</td>
<td>-48</td>
<td>2304</td>
<td>1728.12303</td>
</tr>
<tr>
<td>50</td>
<td>1.32026249</td>
<td>66.0131245</td>
<td>-38</td>
<td>1444</td>
<td>1906.45904</td>
</tr>
<tr>
<td>60</td>
<td>2.29883672</td>
<td>137.930203</td>
<td>-28</td>
<td>784</td>
<td>1802.28799</td>
</tr>
<tr>
<td>70</td>
<td>4.18174976</td>
<td>292.722483</td>
<td>-18</td>
<td>324</td>
<td>1354.83692</td>
</tr>
<tr>
<td>80</td>
<td>7.70857865</td>
<td>616.308629</td>
<td>-8</td>
<td>64</td>
<td>493.36083</td>
</tr>
<tr>
<td>90</td>
<td>14.3733307</td>
<td>1293.59076</td>
<td>2</td>
<td>4</td>
<td>57.493328</td>
</tr>
<tr>
<td>100</td>
<td>27.0600136</td>
<td>2706.00136</td>
<td>12</td>
<td>144</td>
<td>3896.64196</td>
</tr>
</tbody>
</table>

\(N\sum f = 58.456\) \sum f \cdot x = 5160.74825 \sum f \cdot D_x^2 = 14480.64444

\(X = \text{Mean} = \frac{\sum f \cdot x}{N} = \frac{5160.74825}{58.456} = 88.2843207 \approx 88\)
Therefore, Mean = 88

We know that the formula for Standard Deviation is as follows:

\[
S.\ D. = \sigma = \sqrt{\frac{\sum fD^2}{N}} = \sqrt{\frac{14480.6444}{58.456}} = \sqrt{247.718701}
\]

\[
S.\ D. = 15.739082
\]

Therefore the standard deviation of corruption in India with related period is 15.74.

<table>
<thead>
<tr>
<th>MEV Constant 'K'</th>
<th>Corruption 'C' (crore)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0875</td>
</tr>
<tr>
<td>0.20</td>
<td>0.2725662</td>
</tr>
<tr>
<td>0.40</td>
<td>0.8552174</td>
</tr>
<tr>
<td>0.60</td>
<td>4.0241661</td>
</tr>
<tr>
<td>0.80</td>
<td>6.2699644</td>
</tr>
<tr>
<td>0.9988</td>
<td>17.805997</td>
</tr>
</tbody>
</table>

The Graph Between MEV Constant ‘K’ And Corruption ‘C’

We have observed that when we assumed value 0.25%, C (0) = 0.0875 crore.

First stage corruption: when 0 < K ≤ 0.40, C = 0.8552174 crore.

Medium stage corruption: when 0.40 < K ≤ 0.80, C = 5.414747 crore.

Final stage corruption: when 0.80 < K < 1, C = 11.5359953 crore.

5.2 Mathematical Growth of Development Model except Corruption:

We assume that corruption was 0.25% of total population 35 crore that is 0.0875 crore on 15 August, 1957. Then D (0) = 0.1750 crore (in rupees) when C = 0 and we take MM Period t = 10 years. Therefore D(C) depends on MEV constant K. We know that Mathematical E-virus constant model with related corruption, we have

\[
D(C) = D(0) \left[ 1 + \frac{D(C)}{D(0)} \right]^{\frac{C}{K}}
\]

Putting this value in the MCD Model, we get

\[
D(C) = 0.1750 \times \left[ \frac{D(C)}{D(0)} \right]^{\frac{C}{K}} \quad \text{---------------- (vi)}
\]

When K = 0, C = 0, from (vi), \( D(C) = D(0) = 0.1750 \text{ crore} \)

When K = 0.20, C = 0.2725662 crore then D(C) = 0.2100 from (vi), we have

\[
D(C) = 0.1750 \times 0.2100 \times 0.2725662
\]

D(C) = 0.1750 × 1.050950

\[
D(C) = 0.1839163 \text{ crore}
\]

When K = 0.40, C = 0.8552174 crore, then D(C) = 0.2450 from (vi), we have

\[
D(C) = 0.1750 \times 0.2450 \times 0.8552174
\]

D(C) = 0.1750 × 1.3334331223

\[
D(C) = 0.2333507964 \text{ crore}
\]

When K = 0.60, C = 4.0241661 crore, then D(C) = 0.2800 from (vi), we have

\[
D(C) = 0.1750 \times 0.2800 \times 4.0241661
\]

D(C) = 0.1750 × 6.62846114

\[
D(C) = 1.1599807 \text{ crore}
\]

\[y = 1.1323x^2 - 4.7901x + 4.4784\]

\[R^2 = 0.9557\]
When $K = 0.80$, $C = 6.2699644$ crore, then $D(C) = 0.3150$ from (vi), we have
Therefore, $D(C) = 0.1750 \times \frac{0.3150}{0.1750}$ 6.2699644
$D(C) = 0.1750 \times 39.861122$

$D(C) = 6.9756964$ crore

When $K = 0.9988$, $C = 17.8059597$ crore, then $D(C) = 0.34979$ from (vi), we have
Therefore, $D(C) = 0.1750 \times \frac{0.34979}{0.1750}$ 17.8059597
$D(C) = 0.1750 \times 226718.3962154$

$D(C) = 39675.7193377$ crore

Now we have observed that when we assumed value 0.25%, $D(0) = 0.1750$ crore. Then

**First stage corruption:**
When $0 < K \leq 0.40$, $C = 1.1277836$ crore then
$D(C) = 0.4172671$ crore

**Medium stage corruption:**
When $0.40 < K \leq 0.80$, $C = 10.2941305$ crore
$D(C) = 74.2756617$ crore

**Final stage corruption:**
When $0.80 < K < 1$, $C = 17.8059597$ crore
$D(C) = 39675.7193377$ crore

**Mathematical Result-II:**
The mathematical result of the above data can be written in the following table. Also, we have observed that the relation between MEV Constant, Corruption (in population size) and Development (in rupees)

<table>
<thead>
<tr>
<th>MEV Constant ‘$K$’</th>
<th>Corruption ‘$C$’ (crore)</th>
<th>Development ‘$D$’ (crore)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0875</td>
<td>0.1750</td>
</tr>
<tr>
<td>0.20</td>
<td>0.2725662</td>
<td>0.1839163</td>
</tr>
<tr>
<td>0.40</td>
<td>0.8552174</td>
<td>0.2333508</td>
</tr>
<tr>
<td>0.60</td>
<td>4.0241661</td>
<td>1.1599807</td>
</tr>
<tr>
<td>0.80</td>
<td>6.2699644</td>
<td>6.9756964</td>
</tr>
<tr>
<td>0.9988</td>
<td>17.8059597</td>
<td>39675.7193377</td>
</tr>
</tbody>
</table>

| Regression Square ($R^2$) | 0.985 | 0.994 |

The graphs of Table-II are as follows:

**Graph-II: The Graph between MEV Constant and Corruption**

![Graph showing the relationship between Corruption ('C' (crore)) and MEV Constant ('K') with exponential regression equation y = 0.0339e^0.0724x, R^2 = 0.985, and data points for 0.0875, 0.2725662, 0.8552174, 4.0241661, 6.2699644, 17.8059597.]
This shows that the Mathematical Corruption Model is statistically fit for exponential, polynomial and power form. Also it is linear. Therefore it is valid for the above illustrations.

VI. Conclusion

We have observed and it concluded that the mathematical results are as follows:

First stage corruption:
When $0 < K \leq 0.40$ \hspace{1cm} $C = 1.1277836$ crore \hspace{1cm} $D(C) = 0.4172670789$ crore

Medium stage corruption:
When $0.40 < K \leq 0.80$ \hspace{1cm} $C = 10.2941305$ crore \hspace{1cm} $D(C) = 74.275661664$ crore

Final stage corruption:
When $0.80 < K < 1$ \hspace{1cm} $C = 17.8059597$ crore \hspace{1cm} $D(C) = 39675.719337696$ crore

Therefore the Mathematical Corruption Model is valid for the above two illustrations and the S.D. means the inflation, it is 15.74. Also we have observed that ‘the corruption and inflation are related to each other’. When corruption increases then inflation increases and vice versa\(^\cite{18}\). Also the regression square ($R^2$) is less than 1. Therefore the mathematical corruption model is fit statistically.

References

[14]. Treilibs, V; Burkhardt, H; and Low, l (1980). Formulation processes in Mathematical Modelling; Notti ningham: shell centre for Mathematical Education.
[15]. Transparency International (2005). ‘India Corruption Study 2005’ Published by Transparency International India LajpatBhawan, Lajpat Nagar IV, New Delhi