

## CRIME AND ITS MATHEMATICAL MODELING

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### ABSTRACT

*Mathematical models are the useful tools to explain criminal activities. Criminal activities mislead the modeler in many ways. So every mathematician should know the misreporting factors while modeling the crime. This paper explains some factors which mislead the mathematical modeler. The author also presents a simplest mathematical model of a criminal activity to exhibit that how one criminal activity enhances the opportunity to occur a sequence of Criminal activities.*

**Keywords:** *Crime triangle, White collar criminality, agenda falsity, Crime multiplier.*

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### INTRODUCTION

The problem of crime is a major issue faced by all mankind. Different types of criminal activities occur in societies. A criminal is someone who commits a crime. Crimes mislead the people in many ways. Sometimes crimes are under- reported by Police and over- reported by news media or by insurance fraud. Illegal drug dealing is always under-reported in official accounts. Moreover, minor crime far exceeds major crime, but minor crimes are always under-reported. In many cases, the people who commit minor crime is not considered as a criminal. Thus, it is a major challenge for modelers to collect real crime –data. Mathematical modeler cannot depend on the local data measuring correctly what happens from time to time. They collect detailed knowledge about criminal acts occurring spatially and temporally. Mathematical modeler can accumulate accurate crime data if they can observe the crime phenomena closely. Mathematicians try to contribute advance models to solve basic issues about crime.

Since reporting of crime data always do not present the actual, true or clear picture, mathematicians are confronted with a variety of crimes- unknown; known but not reported, reported but not recorded; reported but upgraded and downgraded; reported and recorded but not detected; and reported and detected but not sustained in courts. Thus, crime confuses the modeler in various ways in the matter of collection of actual data.

Therefore the mathematician should always consider some misreporting factors while modeling the crime [1].

### MISREPRESENTATION OF CRIMES

**1. Insurance Misreporting-**In case of insurance claim it is sometimes found that insurance of ill persons are made hiding the fact and after his sudden death immediate claim is forwarded to the company. This act is also a serious crime but it never comes into the report on crime data. Moreover, Motor vehicle theft is over-reported due to the insurance fraud by the owner of the vehicles concealing the real fact. Moreover when the motor vehicles become old, the owner of the vehicle tactfully create the accident scene and claim the value of the vehicle from the insurance company.

**2. Insufficient Court Behavior-**Sometimes the court fails to hold the distinction between the real criminal and the innocent person due to the several factors (a) *Time Factors*-The police of an under developed or a developing country often presents an innocent person hurriedly before the court as an accused. Police fails to apprehend the real criminal due to the lack of investigating instrument and sufficient time. (b) *Communication Factor*-A very considerable number of crimes remain unreported due to the lack of communication facilities and traditional inhibition.

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**3. White Collar Criminality**-The other facts of hidden criminality which deserve special attention relate to crimes committed under the cover of office- the deliberate act of omission and commission which are considered necessary in the larger interests of the society. They are mostly offences committed by the public servants in the discharge of their duties for a desirable public objective. As for example, detection of crime itself includes violation of fundamental rights, unauthorized use of force, third degree methods and arbitrary arrests and false accusation.

**4. Theatric Falsity**-Property crimes (the simplest thefts, burglaries, ordinary fight and minor drug abuses *etc.*) far exceed violent crime (homicide) [1]. Most murders are the consequences of a simple quarrel. Hence there is no major difference between the homicide and the property crimes. But, neglecting the property crimes, only homicides are well publicized in dramatic way by the news media for their own benefit. The media display a horror distortion sequences repeatedly to draw public emotions and misconceptions. They publicize crimes in ways which are more dramatic than those usually occurred in practical field. Thus they create many theatric erroneous conceptions about crime and mislead the authority to make a proper investigation. So, the mathematician should be very careful about this false notion to know the crime and model it.

**5. The Not-me Falsity**-The not-me falsity [1] is such a notion that the criminals pleaded not guilty, blaming it on others to create such situation that he is too good to become a criminal. He tries to establish himself as a very good person in the society. It appears in the society that there is no difference between criminals and victims. Thus it misleads the actual investigation of the criminal activity as well as the mathematician to model it.

**6. Cleverness of Criminals**-There is a misconception among the victims that crime is not simple for the skillfulness of criminal. Moreover, because of the improvement of the technology, victims think that they are more conscious than criminals. But, in fact, it shows that criminals are more skillful than the victims. So, crime can be easily committed.

**7. Delayed Court Proceedings**-Most of the crimes occur without the presence of police and then police are informed. And some crimes are never reported to the police. So, they have little correct information about the happening and Police records what the public informs them.

In most of the cases the actual criminal does not get arrested by the police. If some of them are arrested, all are not lead to trial and a very few convictions are based on trial or correct evidence. After a long time, the criminal gets punishment. Thus justice delayed, justice denied.

**8. The Agenda Falsity**-Many political organizations and religious groups have used the crime as their political agenda and fundamentalism to support their targeted causes [6]. The right-wing blames on the left-wing and vice-versa. Thus a permanent scene for criminal (activity) happening is created by such persons. It is assumed that because of the poverty, social injustice and unemployment the crime rate is increased in the society. However, in the case of developed countries the crime rates are still higher.

Though many democratic countries are implementing more social- welfare agenda to remove these social evils for preventing the crime, but the result is negative. Thus, crime has become a moral, religious, political and social-welfare agenda to motivate the people for their gaining of respective leadership.

**9. Innocent Youth Factor**-By the influence of media, books or something else, it is believed in our society that younger people are less criminal than older people. But, in fact, they can also commit crimes in teen ages because of their courage and strong energy. They do not think deeply about the results of their later life. Sometimes, it is over estimated that children are innocent to commit crime.

**10. The Organized-crime Factor**-It is the tendency to attribute much greater organization to crime conspiracies than they usually have. Making large groups and organizations, and chain and illegal network in which they involve many people to commit crime easily. Especially, juvenile gangs have organized groups which mislead the common people for committing dangerous crimes.

**11. The Vague-boundary Falsity**-There is a misconception among the criminologist that crime has no standard and distinct definition. In fact, crime is spatio-temporal activity which largely depended upon social and genetic structure.

**12. Random Crime Factor**-There is a wrong notion among the people that the probability of crime is a matter of luck and it cannot be prevented. This is the random- crime falsity which is harmful. But on the contrary, crime is both predictable and preventable. Crime does not just depend upon fate, but it clusters geographically that coincide with our routine behaviour and everyday lives.

## BASIC ELEMENTS OF CRIME

A mathematician should know the routine activity of everyday life [2], [4] for modeling crime. This theory consists of three minimal elements. These are (i) *motivated offenders* (ii) *suitable targets* and (iii) the absence of *capable guardians* to prevent the crime.

A *motivated offender* is one who is very potential with criminal inclinations and the ability to carry out those inclinations. The most *likely target* is something easy to commit crime easily. The *capable guardian* is one who is a simple person whose position in a favourable location serves to discourage crime.

These three elements move about in space and time. These spatio-temporal notions of these elements are to be remembered by every crime modeler [3]. Any setting with many motivated criminals and likely targets and few capable guardians will be exposed to substantial crime risk.

If these three elements remain inactive, crime risk goes down. Again in absence of any one of these elements is sufficient to prevent the successful completion of crime. The convergence in time and space of suitable targets and the absence of capable guardians may even lead to large increases in crime rates without necessarily requiring any increase in the structural conditions that motivate one to engage in crime [4]. That means that if the proportion of likely *offenders* or likely suitable *targets* were to remain stable in a community, changes in routine activities could nonetheless alter the likelihood of their convergence in space and time, thereby creating more opportunities for crimes to occur.

Thus crime is highly predictable from the routine activities of everyday life. Eck and Clarke (2003) have extended this simple model by adding some other elements to produce the “crime triangle” [5] as in Fig. 1.1



Fig.-1.1: Crime Triangles

The *offender* gets away from personal *Handlers* to find places without a place *Manager*, then target without *Guardians*. The crime triangle includes many new ideas for geographic thinking and mathematical modeling. Fortunately, some agent-based mathematical models and simulation models linking crime and routine activities are now entering the literature.

Moreover, every mathematician should remember some important notions while modeling crime.

The high variations of crime occur across time as time opportunity is fleeting. The high variations of crime occur across space as crime varies highly within high crime neighbourhoods. Crime rates can be very high on one block, or even a half block, while relatively low or moderate in the rest of the ‘high -crime’ neighbourhood [1]. Further, crime can be high at night but low in day time. It is very local phenomena in time and space. So, every modeler should understand the above conceptions of crime behavior, which gives them many idea of mathematical modelling.

Another important factor is to be known to the mathematical modelers for modelling crime (as in Fig. 1.2)

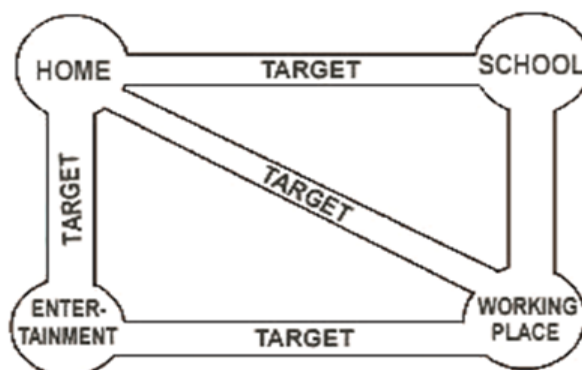


Fig.-1.2: Target of Criminal

All criminals do not wander in search of their victims. Some offenders take opportunity for their victims to go home after working hour or school hour or *entertainment* places. Some offenders encounter victims taking place by accident. But some offenders wander for their victims as like as animal predators wander for their prey. It implies that wandering principles, applicable in animal ecology is also applicable in the field of criminal activity.

The factors which are also helpful for mathematical modeling of crime [6] are-(i) It is not possible for offenders to commit only one type of crime or all types of crimes. So, potential offenders have propensity to commit various types of crime without doing all. So offenders are relatively generalists. (ii) Totally random offenders find fewer targets and so there is less possibility of success. The offenders who are totally regular have much possibility to be apprehended and hence will fail to find the new targets. So offenders are to be moderately regular.(iii) Adult offenders have more tendencies to wander alone and commit crime alone. But younger offenders act in a peer group. So every crime modelers should remember that offenders are regular, but they are neither static nor dynamic.

Moreover, mathematical modelers should also understand that the opportunity to successfully perform the crime is central concept for crime's reality [7], [8]. The opportunity theory provides the link to the tangible world in systematic language that can be presented into mathematical language. So opportunity is the most essential elements for the modeling crime.

A mathematician will find many techniques to apply mathematical models in the field of crime if they acquire more knowledge about crime opportunity.

Keeping in view all these factors we are now, in a position to present a basic model for crime.

### CRIME MULTIPLIER MODEL

Crime multiplier model says that how one crime enhances the opportunity for other crimes to occur.

Already we have discussed how routine activity of everyday life allows motivated offenders to find suitable targets in absence of active guardians. So each potential offender always takes the opportunity to carry out a crime. We also consider how one crime enhances the opportunity to occur other crimes. Sometimes, with this opportunity, criminal activity occurs sequentially.

We discuss a simple sequence of stealing. We suppose that a stealing has taken place in a residence and a motor cycle is taken away. Then the sequence of illegal act will be as follows:-

1. The criminal has taken away the motor cycle.
2. Then the criminal sells the motor cycle illegally.
3. The individual who has purchased the stolen motor cycle, has information that the motor cycle is stolen, so it is illegal purchase- hence a crime.
4. Above buyer again re-sells the motor cycle, which is again an illegal act.

Neglecting the impact of illegal drug and violent crime on the stealing, it is seen that there is a sequence of four criminal acts for same stealing.

This sequence of criminal activities can be shown as -

Stealing of motor cycle → illegal sale of motor cycle → illegal purchase of stolen motor cycle → illegal re -sells of stolen motor cycle.

We consider a city having population of  $X$  Stealing within a fixed period. We assume two subsets of  $X$  Stealing, one subset is cash and another subset is stolen goods.

Let,  $X/2$  out of  $X$  Stealing includes property, which is sold immediately by the thief.

Hence this  $X/2$  property is purchased immediately by someone illegally (which are illegal act).

Suppose, out of  $X/2$  property,  $X/4$  goods are re-sold (which is also illegal act).

We can arrange these criminal activities as:-

- (i) Total Primary stolen properties =  $X$
- (ii) Illegal sales of stolen properties =  $X/2$
- (iii) Illegal purchase of stolen properties =  $X/2$
- (iv) Illegal re-sales of stolen properties =  $X/4$

So, total crimes =  $X + X/2 + X/2 + X/4 = 2.25X$

Therefore, the crime multipliers =  $2.25X / X = 2.25$

This estimation exhibits that each crime generates at least twice as many other crimes.

## CONCLUSION

Every mathematician should always consider some important misreporting factors of criminal activities while modeling the Criminal activities. Besides these factors, a mathematical modeler should know the Routine activity theory, Crime Triangle, Crime opportunity and Rational choice theory. A mathematician will find many techniques to apply mathematical models in the field of criminology if they acquire more knowledge about Crime opportunities and misreporting factors. The above estimation shows that studies of crime and victim behaviour are convergent and each crime generates more than twice other crimes.

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