

SHORT TERM CRIME FORECASTING FOR PREVENTION OF CRIMES: A STUDY OF SATARA DISTRICT

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Abstract: This research paper highlights the importance of crime forecasting in crime prevention in Satara District police station jurisdiction. Crime investigation and prevention has very significant role of police system in any country. The crime data has been stored and processed using Common Integrated Police Application [CIPA] and it become useful for getting the criminal information but it does not help for the purpose of designing an action to prevent the crime, it has become a major challenge for police system to detect and prevent crimes and criminals. There is no any kind of information is available before happening of such criminal acts and it result into increasing crime rate. The presented paper highlights the use of Forecasting technique to identify the crime in a specific area which can be useful for crime prevention.

Keywords: Crime, NCRB, Investigation, CIPA, CrPC, Forecast, Crime Rate

I. INTRODUCTION

The Constitution of India assigns a responsibility to maintain the law and order in the country. Increasing graph of crime in nation is major challenge for the police force. There are many reasons for increasing crime rate and one them reason is lack of use of modern information technology in investigation and in prevention. Keeping these things in mind govt. of India designed G2G model. In 1986 Govt. of India created National Crime Record Bureau (NCRB). Under NCRB the state crime record bureau [SCRB] for state and District crime Record Bureau [DCRB] for districts has been created. In order to making use of information technology, The Government of India designed Crime Criminal Information System [CCIS] to store and retrieve crime and criminal records. To provide the input to CCIS, the Common Integrated Police Application [CIPA] was also designed. CIPA software install in every police station, CIPA is only limited to the informative purposes and doesn't forecast or shows any seasonal crime in specific police station region, therefore it need to be advancement in existing system such as use of data mining technology in CIPA as well as CCIS system.

II. SATARA DISTRICT POLICE CURRENT SCENARIO

To understand current scenario of crime detection, we need to know police structure and hierarchy, technological usage of police force.

Satara District Police System The motto of Maharashtra

Police is. 'सदृक्षणाय खलनिग्रहणाय' It means that Maharashtra Police is committed to PROTECTING THE RIGHTEOUS AND CONTROLLING & ANNIHILATING THE EVIL. The Head of state police is Director General of Police [DGP]. The state is divided into administrative units called as Districts. A group of districts called as a region and Head for each region is Deputy Inspector General of Police [DIGP]. Superintendent of Police [SP] is head for district and is assisted by Additional Superintendent of Police [Addl. SP] and Deputy Superintendent of Police [DySP] in each district.

Satara District police is headed by Superintendent of Police supported by an Addl. Superintendent of Police with 7 Deputy Superintendent of Police, 20 Police Inspector, 78 Asst. Police Inspector and Police Sub Inspector and adequate number of Constable are working.

Common Integrated Police Application

CIPA is aimed at building the basic infrastructure and mechanisms for the Crime and Criminal Information System, based on CrPC, which is uniform across the country, from Police Station level onwards. CIPA being a National project is to be implemented in a time-bound manner from police station level onwards for computerization of police records and use of IT in their functioning on a uniform basis throughout the country.

The national level Central CIPA Implementation Committee comprising of Director, NCRB and representatives from the Ministry of Home Affairs (Police Modernization and Union Territories Divisions), NIC, National Institute of Criminology and Forensic Science and States, has been constituted to monitor the implementation.

State Crime Records Bureau and State Police Training Academies are conducting State Specific courses in this connection with the assistance of NIC. NCRB has introduced two advanced courses on CIPA in its training calendar for resource persons, who in turn will impart training and attend to trouble-shooting in the States.

III. DATA MINING TECHNIQUES

Understanding and predicting Crime Incidences is vital to police officer to maintain law and order. While forecasts are never perfect, they are necessary to prepare for actual crime incidences. In order to maintain law and order

and effective control in the police station area, accurate crime incidences forecasts are imperative.

Business Intelligence [BI] is a concept and method to improve business decision making by using fact-based support systems. Business Intelligence often aims to support better business decision-making.

Data mining is basically used to find out unknown patterns from a large amount of data. There are popular tools of data mining to rub data mining algorithms. There are two approached to the implementation of data mining, first is to copy data from data warehouse and mine it. Other approach is to mine the data within a data warehouse. There are various data mining techniques available as follows:

Classification is used to classify database records into number of predefined classes on criteria. The data with sharing common properties are specified into predefined classes.

Clustering and segmentation is used to segment a database into subsets, or clusters based on set of attributes. It is a method to group data into classes with identical characteristics in which the similarity of intra-class is maximized or minimized.

Association identifies affinities/ associations among the collection of data as reflected in the examined records. A result is patterns describing rules of association in data.

Decision Tree is predictive model that can be viewed as tree, each branch is a classification question and leaves of the tree are partitions of data set with their classification. It divides data on each branch point without losing any of the data. The number of churners and nonchurners is conserved as we move up or down the tree. ID 3, C4.5, CART and CHAID are some algorithms used in this technique.

Neural Networks are biological systems that detect patterns, make predictions and learn. The artificial neural networks are computer programs implementing sophisticated pattern detection and machine learning algorithms on a computer to build predictive models for historical databases.

The Microsoft Time Series Algorithm is a novel forecasting algorithm it is a hybrid of auto regression and decision tree technique.

IV. CRIME FORECASTING

Crime forecasting helps police to take tactical actions such as targeting patrols to hot spots, conducting surveillance for deployment of special units, scheduling vacation and training of the cops. (Gorr 2003 and Liu and Brown 2003)

Crime forecasting requires crime place (Cohen & Felson1979), ecology of crime (Brantingham & Brantingham 1984) and Hot Spot (Sherman, Gartin, & Buerger, 1989). In order to find out the next month crime forecast we need to know the history of crime. For this research paper we had taken the crime incidences of few categories of crimes from Jan 2010 to November 2010.

Table 1

Total Crime Happens during the January 2010- November 2010

Month	Murder	Att to Murder	RIOT	Hurt	Rape	Dacoity	Robbery	Theft
Jan	2	5	16	38	3	2	11	96
Feb	4	5	13	35	4	3	6	69
Mar	7	7	27	49	5	1	3	58
Apr	3	8	32	49	6	4	9	57
May	4	6	9	49	1	1	4	59
Jun	6	5	18	32	2	2	6	79
Jul	3	5	11	32	2	2	8	80
Aug	1	4	26	28	0	6	7	87
Sep	4	5	18	34	2	0	8	63
Oct	1	5	23	41	0	2	6	64
Nov	3	1	17	39	1	2	5	59

The short term forecasting of crime helps in tactical decision making at police station or at district level. It is divided into two categories (Felson & Poulsen 2003) use data for fixed geographic observation in police station jurisdiction, whereas (Corcoran, Wilson & Ware 2003) and (Liu & Brown 2003) work with adhoc areas for spatial cluster of crimes.

To measure the accuracy of forecasted values we need to check the Mean Absolute Percent Error [MAPE], Mean Square Deviation [MSD] and Mean Absolute Deviation [MAD] values.

The Minitab 16 generate the fitted line for Crime Type Murder using the equation

$$Y_t = 4.59 + (-0.19 * t)$$

The t represents the month during which each data point was collected.

Forecast accuracy in the crime incidences can be measured using the MAPE. [10]

Fitted Value is $Y_t = a + (b * t)$

Value of a and b can be calculated using,

$$\sum X, \sum Y, \sum XY, \sum X^2$$

$$\begin{aligned}\sum X &= 1 + 2 + \dots + 11 = 66 \\ \sum Y &= 5 + 10 + \dots + 17 = 38 \\ \sum XY &= 5 + 20 + \dots + 170 = 207 \\ \sum X^2 &= 1 + 4 + \dots + 100 = 506\end{aligned}$$

$$\begin{aligned}\sum Y &= N a + b \sum X \\ \sum XY &= a \sum X + b \sum X^2\end{aligned}$$

In order to calculate the value for a and b we have line equation

$$\begin{aligned}\sum Y - N a + b \sum X &= \dots \dots \dots 1 \\ \sum XY - a \sum X + b \sum X^2 &= \dots \dots \dots 2\end{aligned}$$

From equation 1 and 2

$38 = 11a + 66b$	_____3
$207 = 66a + 506b$	_____4

Multiplying equation 3 by 66 and equation 4 by 11 we get

$2508 = 726a + 4356b$	_____5
$2277 = 726a + 5566b$	_____6

Equation 6- equation 5 we get

$-231 = 1210b$

$b = -0.19$

Substituting value b into equation 3 we get

$38 = 11a + (66 \times -0.19)$

$a = 4.59$

$a = 4.59$

$b = -0.19$

Absolute Deviation = Volume [Y] – Fitted Value
Squared Deviation = Square of Absolute Deviation
MAD = Sum of Absolute Deviation / Number of Observation
MSD = Sum of Squared Deviation / Number of Observation
MAPE = Mean Absolute Deviation [MAD]/ Mean Ratio Or MAPE = Sum of Absolute Deviation/ Total Crime Incidences

Hence the for the month of Nov 2010 forecast value for Murder is as below

$Y_{12} = 4.59 + (-0.19 \times 12)$
$= 2.31$
$= 3$

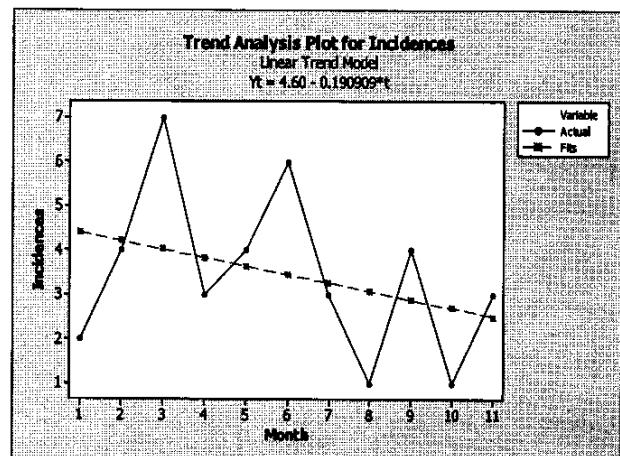
This show that December 2010 may have murder incidences 2 in the Satara District police Jurisdiction. The fitted value, Absolute Deviation, Squared Deviation and Absolute Percent Error for the category Murder is shown in below

Table 2
Statistical Value Calculated for Murder Category

Crime Analysis								
Month	Murder	t	X2	XY	Fitted Value	Absolute Deviation	Squared Deviation	Absolute Percent Error
Jan	2	1	1	2	4.4	-2.4	5.76	0.025
Feb	4	2	4	8	4.21	-0.21	0.0441	0.0125
Mar	7	3	9	21	4.02	2.98	8.8804	0.007143
Apr	3	4	16	12	3.83	-0.83	0.6889	0.016667
May	4	5	25	20	3.64	0.36	0.1296	0.0125
Jun	6	6	36	36	3.45	2.55	6.5025	0.008333
Jul	3	7	49	21	3.26	-0.26	0.0676	0.016667
Aug	1	8	64	8	3.07	-2.07	4.2849	0.05
Sep	4	9	81	36	2.88	1.12	1.2544	0.0125
Oct	1	10	100	10	2.69	-1.69	2.8561	0.05
Nov	3	11	121	33	2.5	0.5	0.25	0.016667
	38	66	506	207		0.05	30.7185	0.227976
	EY	EX	EX2	EXY		SUM	SUM	SUM
						0.004545	2.792591	0.020725
						MAD	MSD	MAPE

MAD is the average of absolute deviation. An absolute deviation is the absolute value of the actual crime minus the fitted value. The best fitted line should have zero MAD and Murder Category MAD value is approximately Zero value hence model is suited perfect. The trend analysis plot for murder is generated as below

Graph 2
Trend Analysis for Murder Incidences



Similarly Trend Analysis Plot for all Crime categories has been plotted.

Table 3
Statistical Value Calculated for All Categories

	Att to Murder	RIOT	Hurt	Rape	Dacoity	Robbery	Theft
A	7.00	18.65	42.82	4.87	2.38	7.45	76.04
B	-0.32	0.07	-0.68	-0.42	-0.02	-0.14	-0.99
Forecast	3	20	35	0	2	6	64
MAD	0.01	0.02	-0.012	0.013	0.012	0.026	0.009
MSD	1.797	46.575	46.64	1.755	2.377	4.591	152.627
MAPE	0.031	0.013	0	0.005	0.005	0.004	0

Accordingly Crime Forecast has been plotted

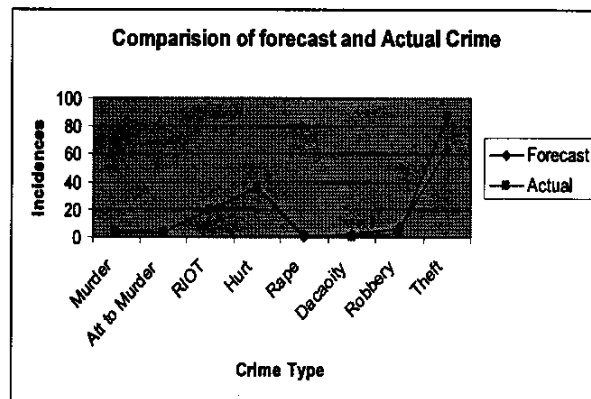
Table 4
Crime Forecast of all categories for the month December 2010

Crime Type	Att to Murder	RIOT	Hurt	Rape	Dacoity	Robbery	Theft
Forecast	3	20	35	0	2	6	64

Table 4
Actual Crime of all categories for the month December 2010

Crime Type	Murder	Att to Murder	RIOT	Hurt	Rape	Dacoity	Robbery	Theft
Actual	3	3	20	36	1	0	3	88

Graph 3
Comparison of Crime Forecast and Actual Crime Incidences of all categories for the Month December 2010



IV CONCLUSIONS

Crime Investigation is one of the important tasks of police organization in the India. In today's IT enabled era many techniques are available for crime prevention and investigation.

Crime forecasting is one aspect of crime investigation, for which numerous technique are available such as secular trend cyclic trend, irregular trend etc., secular trend is used for short time forecasting. In the present study the researchers has used short time forecasting of crimes in Satara district for the month December 2010 using the crime data of the period Jan 2010 to November 2010.

From the study it has observed that actual no of crime reported during the December 2010 are approximately

same as the forecasted crimes using short term forecasting. Hence the short term forecasting method is very useful in crime prevention and investigation Process.

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