Crime Analysis and Prediction System
(CAPS)

Project report submitted in partial fulfillment of the requirement for the degree of Bachelor of Technology
in

Computer Science and Engineering/Information Technology

By

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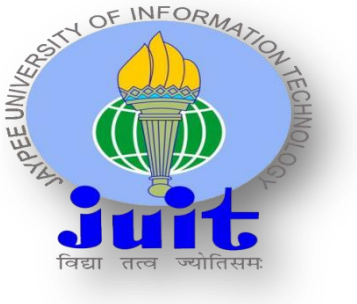
to



Department of Computer Science & Engineering and Information Technology

Candidate's Declaration

I hereby declare that the work presented in this report entitled **" Crime Analysis and Prediction System "** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering/Information Technology** submitted in the department of Computer Science & Engineering and Information Technology**,** Jaypee University of Information Technology, Waknaghat is an authentic record of my own work carried out over a period from August 2017 to December 2017 under the supervision of **Dr. Pradeep Kr. Gupta**(**Assistant Professor Sr. Grade Dept. of CSE**).

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

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This is to certify that the above statement made by the candidate is true to the best of my knowledge.

Dr. Pradeep Kr. Gupta

(Assistant Professor Sr. Grade)

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Dated: 23/05/2018

Acknowledgement

It is our privilege to express our sincerest regards to our project supervisor **Dr. Pradeep Kr. Gupta(Assistant Professor Sr. Grade)**, for their valuable inputs, able guidance, encouragement, whole-hearted cooperation and direction throughout the duration of our project.

We deeply express our sincere thanks to our Head of Department **Prof. Dr. Satya Prakash Ghrera** for encouraging and allowing us to present the project on the topic **"CRIME ANALYSIS AND PREDICTION SYSTEM"** at our department premises for the partial fulfillment of the requirements leading to the award of B-Tech degree.

At the end I would like to express my sincere thanks to all my friends and others who helped me directly or indirectly during this project work.

Date: 23-05-2018

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Abstract

Crime analysis and prevention is a systematic approach for identifying and analyzing patterns and trends in crime. Our system can predict regions which have high probability for crime occurrence and can visualize crime prone areas. With the increasing advent of computerized systems, crime data analysts can help the Law enforcement officers to speed up the process of solving crimes.

Using the concept of Machine Learning in R we can extract previously unknown, useful information from an unstructured data. Here we have an approach between computer science and criminal justice to develop a Machine Learning procedure that can help solve crimes faster. Instead of focusing on causes of crime occurrence like criminal background of offender, political enmity etc we are focusing mainly on crime factors of each day.

List of Contents

List of Figures

List of Graphs

List of Tables

CHAPTER 1
INTRODUCTION

1.1 Introduction

- Crimes are a typical social issue influencing the personal satisfaction and the monetary development of a general public. It is viewed as a fundamental factor that decides if individuals move to another city and what spots ought to be kept away from when they travel. With the expansion of violations, law requirement organizations are proceeding to request progressed geographic data frameworks and new information mining ways to deal with enhance wrongdoing examination and better secure their groups. Despite the fact that violations could happen all over, it is basic that offenders deal with wrongdoing openings they look in most commonplace territories for them. By giving an information mining way to deal with decide the most criminal hotspots and discover the sort, area and time of perpetrated wrongdoings, we want to raise individuals' mindfulness in regards to the perilous areas in certain eras. Hence, our proposed arrangement can possibly enable individuals to avoid the areas at a specific time alongside sparing lives. Also, having this sort of information would help individuals to enhance their living spot decisions. Then again, police powers can utilize this answer for increment the level of wrongdoing forecast and aversion. Besides, this would be helpful for police assets distribution. By having the majority of this data accessible, we want to make our group more secure for the general population living there and furthermore for others, who will go there.
- It is just inside the most recent couple of decades that the innovation made spatial information digging a handy answer for wide gatherings of people of Law implementation authorities which is moderate and accessible. This immense information is utilized as a record for making a wrongdoing record database. So the principle challenge before us is building up a superior, productive wrongdoing design location device to recognize wrongdoing designs viably. The fundamental difficulties we are confronting are:

•Increase in wrongdoing data that must be put away and dissected.

•Analysis of information is troublesome since information is inadequate and conflicting.

• Limitation in getting wrongdoing information records from Law Enforcement division.

• Accuracy of the program relies upon exactness of the preparation set.

Finding the patterns and trends in crime is a challenging factor. To identify a pattern, crime analysts takes a lot of time, scanning through data to find whether a particular crime fits into a known pattern. If it does not fit into an existing pattern then the data must be classified as a new pattern. After detecting a pattern, it can be used to predict, anticipate and prevent crime. Before this clustering algorithms have been used for crime analysis. For instance, one site it is revealed that suspect has black hair and from next site/witness it is revealed that suspect is youth and from third one reveals that the offender has tattoo on his left arm etc. By describing the offender details it gives a complete picture from different crime incidents. Today most of it is manually done with the help of multiple reports that the detectives usually get from the computer data analysts and their own crime logs. The reason for choosing this method is that we have only data about the known crimes we will get the crime pattern for a particular place. Therefore, classification technique that will rely on the existing and known solved crimes, will not give good predictive quality for future crimes. Also nature of crimes change over time, so in order to be able to detect newer and unknown patterns in future, clustering techniques work better.

There are steps in doing Crime Analysis:

- Data Collection
- Classification
- Pattern Identification
- Prediction
- Visualization

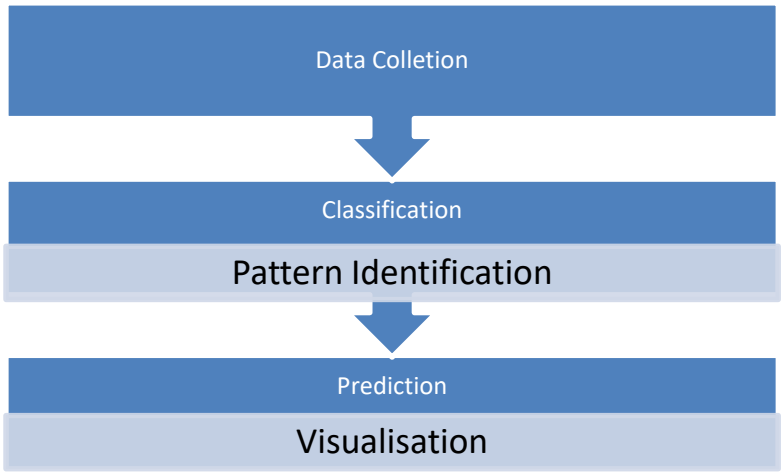


Fig. 1 Steps of doing crime analysis.

1.2 Problem Statement

Our investigation plans to discover spatial and transient criminal hotspots utilizing an arrangement of true datasets of wrongdoings. We will attempt to find the in all probability wrongdoing areas and their successive event time. Also, we will foresee what sort of wrongdoing may happen next in a particular area inside a specific time. At last, we expect to give an examination contemplate by joining our discoveries of a specific wrongdoings dataset with its socioeconomics data.

1.3Objective

• Develop a stage that can be utilized to break down wrongdoing information utilizing unmistakable and prescient information examination procedures.

• Using the proposed stage break down the spatial and transient (time of day, day

Of week, and seasons) connections in wrongdoing information.

• Suggest reasonable process reengineering steps and asset distributions in view of

the spatial and transient connections. For instance,

- Identify new police locale limits utilizing Heuristic-Based Polygonal

Bunching philosophy.

- Identifying clever watch courses that can join wrongdoing information and spatial

measurements utilizing Voronoi Tessellations.

• Analyze connection between wrongdoing information and registration information.

1.4 Methodology

We unequivocally trust that discovering connections between wrongdoing components could profoundly help in foreseeing potential risky hotspots at a specific time later on. In this way, our proposed approach intended to center around three primary components of wrongdoings information, which are the kind of wrongdoing, the event time and the wrongdoing area. We attempted to separate all conceivable intriguing successive examples in view of the wrongdoing factors. At that point, we connected some arrangement strategies keeping in mind the end goal to foresee potential wrongdoing writes in a particular area inside a specific time. In this area, we clarify how we arranged our datasets. From that point forward, we give how we examined the information utilizing some factual examination. At that point, we present how we developed our information mining models to accomplish our motivation.

Data Collection:

In data gathering step we are gathering data from different locales like news goals, web diaries, electronic long range interpersonal communication, RSS channels et cetera. The accumulated data is secured into database for moreover process. Since the assembled data is unstructured data we use Mongo DB. Bad behavior data is an unstructured data since the no of field, substance, and size of the record can differ beginning with one file then onto the following the better option is to have a mapping less database. In like manner the nonappearance of joins diminishes the multifaceted design. Distinctive favorable circumstances of using an unstructured database are that:

- Large volumes of organized, semi-organized, and unstructured information.
- Object-arranged programming that is anything but difficult to utilize and adaptable.

The upside of NoSQL database over SQL database is that it permits addition of information without a predefined composition. Not at all like SQL database it not have to comprehend what we are putting away ahead of time, determine its size and so forth.

Classification:

For arrangement we are utilizing a calculation called Naïve Bayes which is a regulated learning strategy and a measurable technique for order. Innocent Bayes classifier is a probabilistic classifier which when given an information gives a likelihood dispersion of set of all classes as opposed to giving a solitary yield. The calculation arranges a news article into a wrongdoing compose to which it fits the best. From characterization what we get is "What is the likelihood that a wrongdoing record D has a place with a given class C?"

The upside of utilizing Naive Bayes Classifier is that it is basic, and focalizes speedier than calculated relapse. Contrasted with different calculations like SVM (Support Vector Machine) which takes parcel of memory the ease for usage and elite makes it unique in relation to different calculations. Likewise if there should arise an occurrence of SVM as size of preparing set expands the speed of execution diminishes.

Utilizing Naive Bayes calculation we make a model via preparing wrongdoing information identified with vandalism, kill, theft, thievery, sex manhandle, group assault, fire related crime, equipped burglary, a scam, grabbing and so forth. Via preparing implies we need to show them on specific information sources with the end goal that we can test them for obscure data sources. For testing the exactness of the model we apply test information. Not at all like SVM as the span of preparing information expands precision of test set additionally

increments. Another preferred standpoint of Naïve Bayes is that it functions admirably for little measure of preparing to figure the grouping parameters.

Additionally it settles the Zero-recurrence issue i.e. while evaluating likelihood now and then while checking a likelihood P(A) * P(B/D) * P(C/D) * P(E/D) where P(C/D)=0. So the assessed likelihood result dependably give zero which prompts vulnerability in comes about. To stay away from this condition we add +1 to the check of each zero esteem classes to accomplish uniform conveyance.

We are likewise incorporating the idea of Named Entity Recognition (NER) in the wrongdoing articles. NER otherwise called Entity Extraction finds and arrange components in content into predefined classifications, for example, the individual names, associations, areas, date, time and so on. So by utilizing this idea in wrongdoing article we can get more subtle elements identified with wrongdoing like casualty and guilty party names, area of wrongdoing, date, time and so on. An example aftereffect of NER is appeared in Figure.2.

1. Given training data set D which consists of documents belonging to different
Class says class A and B
2. Calculate the prior probability of class A= number of objects
Of class A / total number of object
Calculate the prior probability of class B= number of objects
Of class B / total number of object
3. Find ni.the total number of word frequency of each class
Na=the total number of word frequency of class A
Nb=the total number of word frequency of class B
4. Find conditional probability of keyword occurrence given a class
P(word1 / class A)= wordcount / ni(A)
P(word1 / class B)= wordcount / ni(B)
P(word1 / class A)= wordcount / ni(A)
.....
P(word1 / class A)= wordcount / ni(A)
5. Avoid zero frequency problems by applying uniform distribution
6. Classify a new document C based on the probability P(C/W)
a) Find P(A/W) =P(A)*P(word1/class A)*P(word2/ classA).....*P(word n/classA)
b) Find P(B/W) = P(B)*P(word1/class B)*P(word2/ classB).....*P(word n/classB)
7. Assign document to class that has higher probability.}

Fig.2 Pseudo code of Naïve Bayes

Additionally identified with violations like robbery we can remove the rundown of weapons guilty party utilized while carrying out the wrongdoing. We have incorporated an idea called Co-reference Resolution to locate the referenced substances in a content. In semantics, Co-reference happens when at least two articulations in a content allude to a similar individual or thing i.e. in the event that they have a similar referent.

1) Input: NAVI MUMBAI: The bicycle borne chain snatchers focused on two ladies people on foot in Sanpada and Panvel on May 6, 2014, Tuesday and ransacked their gold decorations. While, 60-year-old lady's gold chain worth Rs 20,000 was grabbed by the bicycle's pillion rider around 3.45 pm, while she was strolling in the city close HDFC bank in division 14, Sanpada, yet another lady from Khalapur was focused by the pillion rider while she was strolling along the street close old Thane naka in Panvel. The hoodlum grabbed away her gold neckband worth Rs 67,500. In both the occurrences, theft case under Section 392 and 34 has been enrolled at Turbhe and Panvel police headquarters separately.

{
“nerlist”:[
{
=location”:= “Vashi”
}
{
=”location”:= “Mumbai”
}
{
=”location”:= ”Sanpada”}
{
=”location”:= “panvel”
}
{
=”date”:= “May 6,2018”}
{
=”day”:= “Sunday”
}

Fig.3 Sample output of NER

For example: Seema said she would come i.e. here "she" insinuates individual "Seema". In like way we are isolating each and every referenced component in a substance. Underneath case shows the working of Co-reference thought. An illustration is showed up underneath in Fig .4

2) Input: E.g.: A pillion bike rider got away a gold mangalsutra worth Rs 85,000 of a 60-year-old woman individual by walking in zone 19, Kharghar on Friday. The setback, Shakuntala Mande, was walking around a vegetable outlet around 9.40am, when a bike moved toward her and the pillion rider snatched her mangalsutra. A thievery case has been enlisted at Kharghar police base camp.

["The Victim" ->"Shakuntala Mande"

"her mangalsutra"->"a gold mangalsutra"

"Kharghar"->"Kharghar on Friday"

"her" ->"Shakuntala Mande"

"the pillion rider"->"Apillion bike rider"]

Fig.4 Sample output of Co reference Resolution

Pattern Identification:

Third stage is the example recognizable proof stage where we need to distinguish patterns and examples in wrongdoing. For discovering wrongdoing design that happens regularly we are utilizing Apriori calculation. Apriori can be utilized to decide affiliation rules which feature general patterns in the database. The aftereffect of this stage is the wrongdoing design for a specific place. Here relating to every area we take the properties of that place like VIP nearness, climate characteristics, region affectability, outstanding occasion, nearness of criminal gatherings and so on. In the wake of getting a general wrongdoing design for a place, when another case arrives and in the event that it takes after a similar wrongdoing design then we can state that the zone has a possibility for wrongdoing event. Data with respect to designs causes police authorities to encourage assets in a viable way. They can maintain a strategic distance from wrongdoing event by giving security/watching in wrongdoing inclined territories, settling robber alerts/CCTV and so on.

Take an example rundown of 100 news for a place and apply Apriori calculation in it. It will mine the continuous wrongdoing designs for a place. So if there is an example in which wrongdoing happened then we expect that if again that example happens in a place at that point there is likelihood for wrongdoing event in that place. We are thinking about a few traits for wrongdoing design discovery.

E.g.: For a place Meerut the pattern after mining will be:

- attribute 1, attribute 2, attribute 3, attribute 4
- attribute 1, attribute 3, attribute 4, attribute 5

So the above will be the wrongdoing design for Meerut. So wrongdoing happens just if the above examples happen on a day. On the off chance that any of these examples happen then no one but we can state that there is likelihood for wrongdoing event.

Prediction and Regression:

For expectation we are utilizing the choice tree idea. A choice tree is like a chart in which inside hub speaks to test on a trait, and each branch speaks to result of a test. The fundamental favorable position of utilizing choice tree is that it is easy to comprehend and translate. Alternate focal points incorporate its strong nature and furthermore it functions admirably with huge informational collections. This component encourages the calculations to settle on better choices about factors.

Corresponding to each place we build a model. So for getting the crime prone areas we pass current date and current attributes into the prediction software. The result is shown using some visualization mechanisms. Table.1 shows the example of a decision tree model. Below shown is the example of decision trees of two different places Meerut and Delhi.

Area sensitivity	Notable event	VIP presence	Criminal group	Crime
Yes	**Yes**	**Yes**	**No**	**Yes**
Yes	**Yes**	**No**	**Yes**	**No**
No	**No**	**No**	**Yes**	**No**
Yes	**No**	**No**	**No**	**No**
Yes	**Yes**	**Yes**	**Yes**	**Yes**
No	**Yes**	**No**	**No**	**No**

Table 1. Decision tree for Delhi.

The working of decision tree seems to be little confusing but it's really easy. Consider a variety of plant species. We classify them according to order, genus, species etc. Instead we have to classify them into a common category as shrubs and trees. If a new species is identified then we have to classify this into any of the two categories. Basically we categorize it based on its characteristics i.e. we have a set of questions to check whether it satisfies the conditions. If first condition is satisfied then we check the next case and if the first condition itself is not satisfied then there is no need to check the rest. So the series of questions and their answers can be organized in the form of a decision tree. The tree has three types of nodes:

- A Root node, that has incoming edges and zero or more outgoing edges.
- Internal nodes, each of which has one incoming edge and two or more outgoing edges.
- Leaf node or end node, each of which has exactly one incoming edge and no outgoing edges.

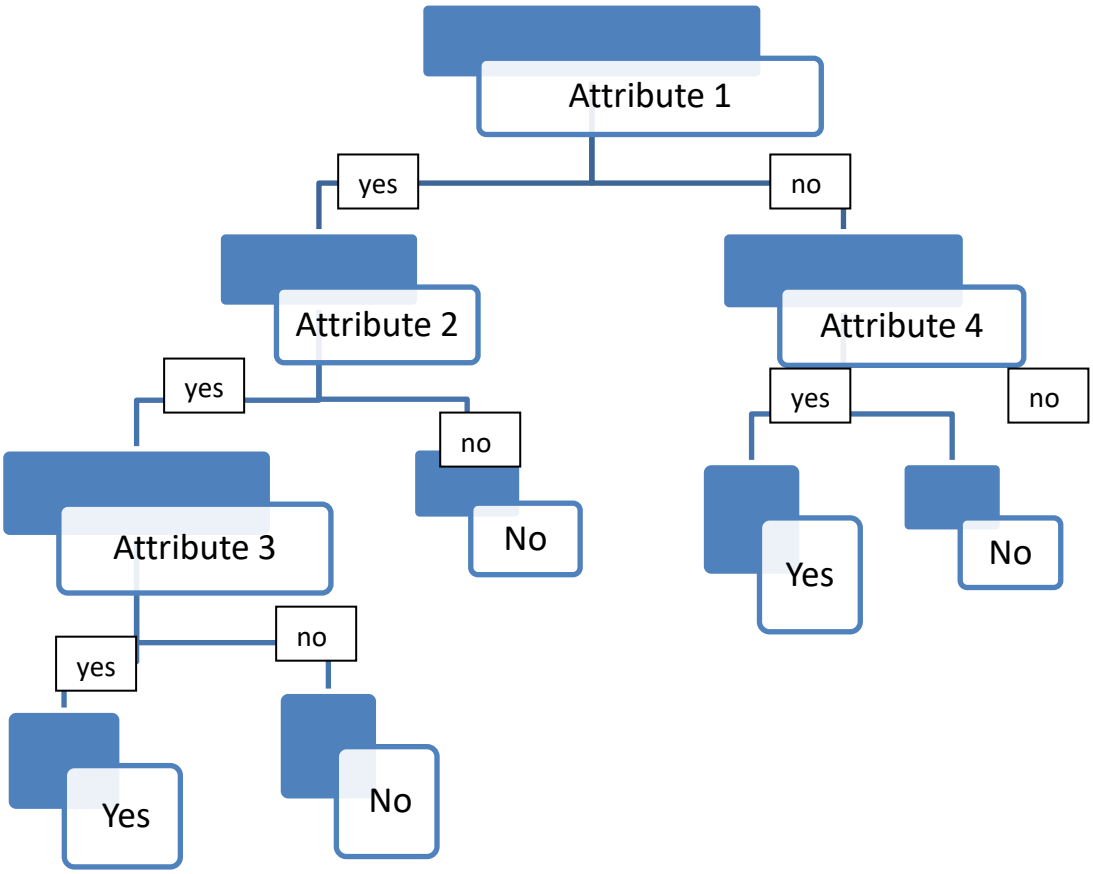


Fig.5 Example of decision tree.

Visualization:

The wrongdoing inclined territories can be graphically spoken to utilizing a warmth outline demonstrates level of action, typically darker hues to show low action and brighter hues to demonstrate high movement. Beneath figure is a case of a warmth outline. Underneath Figure demonstrates the districts that have high likelihood for wrongdoing event. The upsides of utilizing heat maps over other authentic systems are:

Numeric and classification based shading pictures

.• Gradient shading range

.• Analyze just the information we need.

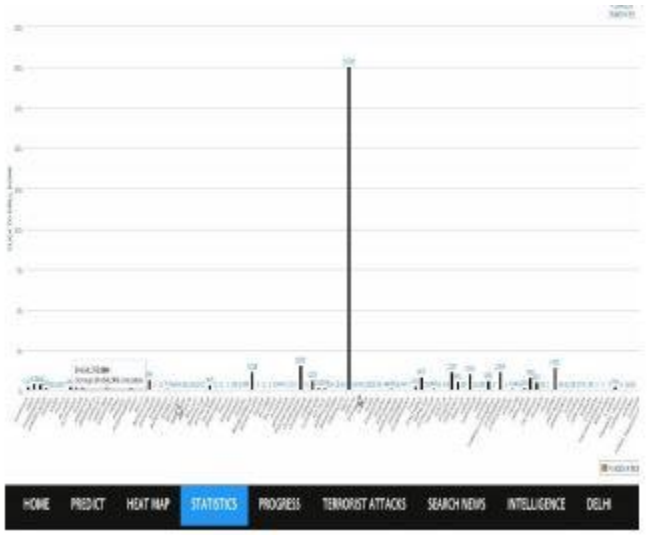
• Out of range information is consequently disposed of. So by knowing about the probable regions we can prevent crimes by taking preventive mechanisms like night patrolling, fixing burglar alarms, fixing CCTV camera etc.

Fig.6 Maps shows crime prone area in India.

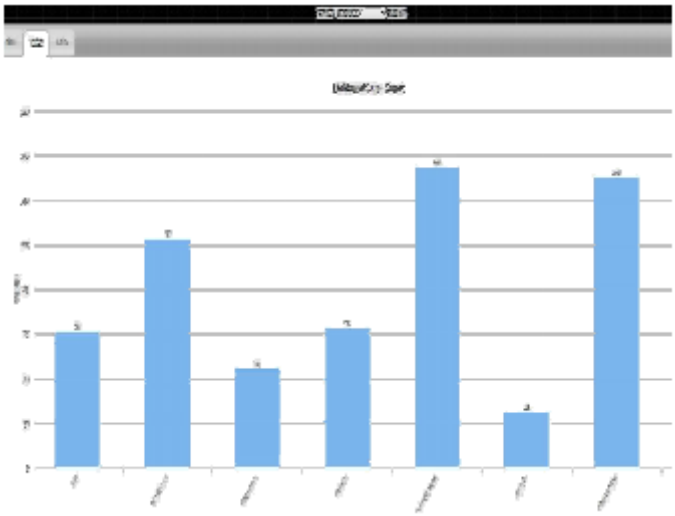
Figure 6 shows the statistical data. In the x-axis all main locations in India are plotted whereas in y-axis the crime rate is plotted. The graph shows the regions which has maximum crime rate. It is calculated based on the crime rate in crime records.

From the graph plotted based on historical data, it is clear that Delhi has maximum crime. The data plotted here is based on the historical records. The graph changes over time when we add more data into the records. Graph 1 and 2 shows the rate/percentage of crime occurrence in places like airport, temples, bus station, railway stations, bank, casino, jewelry shops, bar, ATM, airport, bus station, highways etc. In the x axis the main spots like temple, bank, bus station, railway station, ATM etc are plotted while in y axis the rate of crime is plotted.

This representation is strictly based on the historic crime records in the database. So our results shows that crimes like robbery, murder, highway robbery and burglary is higher in regions which lacks proper security and also less inhabited whereas crimes like arson, vandalism occurs when there is any notable event happening or VIP presence. Crimes can be solved to a great extend by fixing burglar alarms, providing proper security in less inhabited/ crime prone areas, increasing night patrolling and fixing CCTV's in sensitive areas.



Graph.1 Statistical Graph I.



Graph.2 Statistical Graph II.

CHAPTER 2

LITERATURE SURVEY

2.1 A Brief History of Crime Mapping:

Strangely, the most punctual endeavors at wrongdoing mapping can be followed to the underlying foundations of the train of criminology itself. In the mid nineteenth century, various examinations analyzed the circulation of wrongdoing in France and England. Branting ham and Branting ham (1991a) gave an outline of a portion of the discoveries of the fundamental investigations from this time. Guerry and Quetelet mapped violations in France at the division level and found that wrongdoings were not circulated equitably crosswise over offices. They likewise found that there was soundness after some time in the two zones with high wrongdoing and territories with low wrongdoing over the long run. These discoveries were reverberated in England with examines by Plint, Glyde, and Mayhew.

In the United States, Shaw and McKay's (1942) fundamental investigation of adolescent wrongdoing in Chicago made broad utilization of wrongdoing maps. Shaw and McKay obtained Park and Burgess' (1924) biological model and separated the city into five distinct zones. They found that the zone adjoining the focal business area, the zone of progress, unendingly experienced the most elevated rates of adolescent misconduct and other social issues paying little respect to the particular ethnic gathering possessing the zone at the time. This examination was instrumental in advancing social disruption hypothesis and roused various comparative mapping ventures in Chicago; Philadelphia; Richmond, Virginia; Cleveland, Ohio; Birmingham, Alabama; Denver, Colorado; Seattle, Washington; and other cities.which were exceptionally tedious and given just an essential perception of wrongdoing designs.

The utilization of GIS programs for mapping has been the most critical progress in the field of wrongdoing mapping. There are a few imperative points of interest in utilizing virtual maps rather than physical maps. To begin with, PCs have significantly diminished the time and exertion required to create wrongdoing maps. Given the moderately minimal effort and ease of use of huge numbers of these product programs, it never again requires a considerable venture for organizations that desire to participate in wrongdoing mapping. Second, these GIS programs lessen the measure of blunder related with doling out geographic directions to wrongdoing occasions. Third, virtual maps are substantially more adaptable than physical maps, enabling specialists and wrongdoing investigators to analyze the geographic dispersion of violations against different attributes of the region under scrutiny (e.g., registration department data, city arranging and zoning maps, and maps delivered by different organizations). At long last, GIS and other spatial investigation programming give effective measurable devices to examining and distinguishing examples of criminal action that can't be identified through basic visual examination.

Despite the fact that the main occurrences of mechanized wrongdoing mapping happened in the mid-1960s in St. Louis, Missouri, the selection of mechanized wrongdoing mapping over the United States remained generally moderate. In spite of the fact that various offices, specifically in bigger locales, turned out to be early adopters of modernized wrongdoing mapping innovation, the huge time of development in mechanized wrongdoing mapping did not start until the late 1980s and mid 1990s (Weisburd and Lum, 2005). The rate of reception

of wrongdoing mapping among divisions significantly expanded as personal computers ended up less expensive and all the more capable and GIS programming wound up simpler to utilize and all the more capable. The Comp detail program, which began in 1994 in New York City, accentuated wrongdoing mapping as a focal segment to key police arranging and promoted wrongdoing mapping among police organizations.

2.2 Hypothetical Perspectives in Crime Mapping Research

As already noticed, the improvement of instruments and strategies of wrongdoing mapping have been joined by an extending collection of criminological hypothesis situated toward clarifying the geographic examples of wrongdoing. It is critical, while talking about hypotheses about the spatial conveyance of wrongdoing, to recognize speculations that clarify guiltiness and speculations that clarify criminal occasions. Conventional criminological methodologies have a tendency to underline singular level social and mental attributes as the principle factors that prompt guiltiness, that is, the affinity toward carrying out criminal acts. These hypotheses center predominately around clarifying why guilty parties connect with and endure in criminal ways of life. On the other hand, speculations that examine the spatial circulation of wrongdoing center around clarifying the examples found in criminal occasions, that is, the events of wrongdoing. These speculations concentrate on the inspirations of wrongdoers and more consideration on elements of the condition that advance wrongdoing.

Social Disorganization Theory

Despite the fact that various speculations have been proposed to clarify why specific neighborhoods encounter high wrongdoing rates, social confusion hypothesis has been the most persuasive. Social confusion hypothesis, as first proposed by Shaw and McKay (1942), can be viewed as the principal endeavor to develop a criminological hypothesis of place. The idea of social confusion alludes to "the powerlessness of nearby groups to understand the normal estimations of their occupants or take care of generally experienced issues" (Bursik, 1988, p. 521). All things considered, complicated groups experience the ill effects of reduced abilities to practice social control and can't manage the conduct of group individuals (see Bursik and Grasmick, 1993). As the limit of a group to direct the conduct of its individuals diminishes, the potential for unlawful action increments.

A focal precept of social confusion hypothesis is that basic conditions inside an area weaken the social ties that advance social union and empower group individuals to practice social control. Financial depravation makes unfortunate living conditions that advance private flimsiness and populace heterogeneity. Since social binds expect time to shape, high private flimsiness in neighborhoods keeps the improvement of social ties as inhabitants often move (Bursik and Grasmick, 1993). In neighborhoods with elevated amounts of populace heterogeneity the breadth of kinship and associate systems through which social control is practiced is restricted due to social and social obstructions between occupants (Bursik and Grasmick, 1993). Auxiliary factors, for example, these trade off the social coordination of neighborhood occupants and undermine impression of aggregate adequacy, that is, the aggregate feeling of put stock in, social union, and eagerness to mediate in the interest of people in general great (Sampson, Raudenbush, and Earls, 1997). Neighborhoods that have low aggregate viability are probably going to encounter elevated amounts of wrongdoing.

Routine Activities Theory

Cohen and Felson's (1979) routine exercises hypothesis has been connected widely to look into on spatial examples of wrongdoing. To Cohen and Felson, wrongdoing is a ruthless action and, all things considered, can subsist just close examples of genuine action. Thusly, to comprehend wrongdoing designs it is important to comprehend the examples of regular routine exercises around which wrongdoing is sorted out. Criminal exploitation happens where routine exercises create a meeting in space and time of the three essential conditions for wrongdoing to happen: (1) a reasonable target, (2) a spurred wrongdoer, and (3) the nonappearance of able watchmen (Cohen and Felson, 1979). Felson (1998) clarified that reasonable targets have an incentive to the guilty party, are noticeable to the wrongdoer, are effectively moved or evacuated, and are available by the guilty party. The idea of guardianship has additionally been expanded and incorporates hint handlers, who are in charge of checking the conduct of wrongdoers; gatekeepers, who are in charge of ensuring targets; and place supervisors, who are in charge of observing and controlling access to specific spaces (see Eck, 2001). In utilizations of this hypothesis to spatial wrongdoing examination, basic highlights of the city, examples of land utilize, and the normal exercises related with specific areas can focus persuaded guilty parties and reasonable focuses into zones with restricted guardianship. This, thus, encourages open doors for criminal exploitation.

Crime Pattern Theory

Branting ham and Branting ham (1991b, 1993) built up a point of view alluded to as wrongdoing design hypothesis that consolidates components of the discerning decision, routine exercises, and other spatial viewpoints on wrongdoing. As indicated by this viewpoint, people make a subjective guide of their spatial condition with which they are well-known through their standard exercises. The activity space of an individual comprises of (a) hubs, the goals of movement, for example, work, home, and stimulation areas, and (b) ways, the movement courses that people take to move starting with one hub then onto the next. Through rehashed development along ways to different hubs, people build up a mindfulness space comprising of the zones in a city with which they are commonplace. As indicated by this hypothesis, guilty parties scan for reasonable targets essentially inside this mindfulness space by looking at potential focuses against layouts, or mental conceptualizations of the attributes of proper targets. The probability of a specific target being chosen by a guilty party drastically diminishes as a wrongdoer moves from his or her mindfulness space, a procedure regularly alluded to as separation rot (see Rengert, Piquero, and Jones, 1999). One fascinating use of this hypothesis is geographic profiling, which endeavors to limit the extent of police examinations by utilizing data on rehashed violations to distinguish the mindfulness space of a rehash criminal (Rossmo, 2000).

2.3 Spatial Crime Research and Planning Intervention

Hot Spots

As beforehand showed, countless have shown that criminal occasions are spatially focused. Despite the fact that the degree of focus varies between ponders, all exact confirmation proposes that few spots represent the larger part of wrongdoing inside any given city. Sherman and associates (1989) promoted the term problem area to portray these regions where wrongdoing is concentrated. The identification and clarification of these problem areas is a noteworthy worry of research in wrongdoing mapping. Problem area investigation is as of now extremely well known among police offices since it gives a strategy to arrange mediations in developing issue regions. Various examinations have exhibited the advantages of problem area investigation to help arrange police reactions to wrongdoing. For instance, in a randomized trial in Minneapolis, Sherman and Weisburd (1995) found that gathered watch endeavors in problem area zones created a critical decrease in calls for benefit. Police reactions to wrongdoing are not restricted to upgraded watch. In another randomized trial in Jersey City, New Jersey, Weisburd and Green (1995) found that in the wake of distinguishing drug advertise problem areas utilizing wrongdoing mapping, an organized strategy of drawing in entrepreneurs and group individuals combined with police crackdowns yielded generous reductions in scatter calls for benefit. Actually, an as of late led meta-investigation on road level medication authorization demonstrated that methodologies that emphasis on community– police organizations in sedate market problem areas were more successful than implementation just methodologies (Mazerolle, Soole, and Rombouts, 2006). This recommends the best approach is a planned procedure between cops and group individuals toward lessening wrongdoing in distinguished problem areas.

Community-Level Factors Affecting Crime

When planning procedures to address wrongdoing in problem area territories, it is vital to consider the group setting that adds to rise and support of problem areas. Neighborhood-level research on spatial wrongdoing designs enlightens the variables related with elevated levels of wrongdoing. As beforehand specified, financial depravation, private portability, and populace heterogeneity all add to larger amounts of wrongdoing in an area by blocking the improvement of social ties between occupants (Bursik and Grasmick, 1993). Family disintegration and insufficient supervision of youths likewise add to expanded levels of wrongdoing. Truth be told, the nearness of unsupervised youths in a group is an essential indicator of savage wrongdoing in an area (Veysey and Messner, 1999). Rose and Clear (1998) recommended that earlier wrongdoing arrangements that outcome in mass imprisonment may likewise weaken group working, on the grounds that in a few groups this speaks to a significant misfortune in the social and human capital on which casual social control depends.

City Features and Crime Locations

In really far reaching techniques for tending to wrongdoing in problem area territories, it is imperative not exclusively to look at neighborhood-level factors that add to the rise of a wrongdoing problem area yet in addition to consider microlevel put qualities that advance wrongdoing. As Sherman and associates (1989) noted, even inside high-wrongdoing neighborhoods there is considerable fluctuation in the levels of wrongdoing. A few places

inside these areas encounter low levels of wrongdoing, though different spots are in charge of a significant measure of the wrongdoing.

Various investigations have exhibited that problem areas of wrongdoing have a tendency to develop around specific highlights of the urban condition, for example, bars and bars (Roncek and Maier, 1993), fast food eateries (Brantingham and Brantingham, 1982), schools (Roncek and Faggiani, 1985), open lodging (Roncek, Bell, and Francik, 1981), empty structures (Spelman, 1993), and open transportation (Block and Davis, 1996). These areas may advance wrongdoing by comparing persuaded guilty parties and appropriate focuses without able gatekeepers. Moreover, the example and timing of criminal occasions in these regions take after the beat of honest to goodness social movement in these territories. For instance, wrongdoing around bars is more typical amid nighttimes and ends of the week, since more authentic supporters visit bars amid this time. Wrongdoing is more typical around schools amid the school year and after school, in light of the fact that numerous understudies collaborate as of now close school grounds without educator or parental supervision. Understanding the connection between the example of honest to goodness social action and criminal movement around these territories enables analysts and policymakers to plan appropriate wrongdoing aversion systems.

Crime Displacement

Unforeseen results are dependably a worry when outlining an intercession. For intercessions in wrongdoing problem areas, wrongdoing uprooting is of specific significance. After the intercession is actualized and wrongdoing openings are decreased, it is conceivable that guilty parties essentially move their exercises to territories outside the mediation site. For instance, if a police crackdown on tranquilize trafficking is started at a specific crossing point that is a problem area for sedate giving, it is conceivable that guilty parties will essentially move to a close-by convergence, and medication deals will proceed. Different sorts of wrongdoing uprooting, for example, guilty parties perpetrating wrongdoing amid various circumstances, guilty parties choosing diverse targets, or even guilty parties carrying out various kinds of violations, additionally are conceivable. Given the wide scopes of various reactions that may constitute wrongdoing dislodging, it is hard to decisively exhibit that wrongdoing relocation did not happen amid a specific report. Thus, any analysts or policymakers executing place-based intercession procedures ought to be quick to the likelihood of wrongdoing uprooting. Luckily, the observational writing on wrongdoing uprooting is determinedly blended, and it creates the impression that numerous intercessions don't prompt obvious wrongdoing dislodging impacts (Clarke, 1997).

2.4 Criminal law analysis:

By definition, Osborne (2003) gives it as a law authorization work that incorporates some deliberate investigation for distinguishing proof and examination of examples and patterns in turmoil and wrongdoing when all is said in done. With the data on designs, the organizations in law requirement would have the capacity to convey enough assets in a more proficient way. It can also help the analysts in the recognizable proof and in addition worry of wrongdoing suspects, and in this way, wrongdoing investigation can be said to assume urgent part in avoidance of wrongdoing and detailing of systems to forestall wrongdoing in the land. In the wrongdoing investigation process, the members in this utilization some quantitative sociologies and this is in information examination techniques.

In any case, some subjective techniques are noted to be urgent in this notwithstanding the quantitative sociologies. Osborne (2003) noticed that, this field of criminal law happens in strategic, vital and operational levels. Basically, the investigators contemplate the wrongdoing reports, the captures reports and the police calls for administration; and all these is for ID of the rising examples, patterns and arrangement in explaining wrongdoing. The police put into mind numerous elements that drop by in tackling wrongdoing, and single out the most valuable of all to battle a specific arrangement of wrongdoing. Vellani (2001) puts the idea of wrongdoing examination as a train of the general population security investigation, and significantly the arrangement of data that help the missions of law requirement of the organizations for criminal equity. In particular, this includes the investigation of the criminal episodes, indention of the wrongdoing patterns, the wrongdoing examples and wrongdoing issue. Ultimately, the examination of wrongdoing includes spread of urgent data to the offices for these offices to pick and create strategies and additionally procedures to explain these patterns, the examples and the issues intrinsic.

2.5 Types of Crime Analysis

The sorts of wrongdoing examination are composed around a few components, including the nature and wellspring of the information, the procedures connected, the consequences of the investigation, the normality and recurrence of the examination, and the target group and reason. No typology will ever bring about an arrangement of definitions that are totally select or thorough; we should dependably be set up for some cover in definitions relying upon the conditions, and new thoughts and methods to develop. The objective of this segment is to give a structure to the concentration and work of wrongdoing investigators, to help with wrongdoing examination instruction and preparing, and to help proficient exercises, for example, sets of responsibilities, parts, and duties. All the more particularly, thinking regarding classifications helps the calling in a few ways:

•It helps police organizations recognize regions needing advancement in both examination and reaction, and to guarantee that their investigators are giving a full scope of administrations

• It enables examiners to distinguish territories in which they have to create aptitudes and to design day by day, week by week, month to month, and yearly errands .

• It enables examiners to classify items and plan plans for item spread.

• It features which methods and instruments work better for which purposes The IACA perceives four noteworthy classifications of wrongdoing investigation, requested from particular to general:

1) Crime insight examination,

2) Tactical crime examination,

3) Strategic crime examination, and

4) Administrative crime examination.

Every one of these sorts has various sub-classes and procedures; we specify some of them in the definitions underneath, yet these sub-classifications ought not be viewed as comprehensive. Wrongdoing Intelligence Analysis Crime knowledge investigation is the examination of information about individuals engaged with violations, especially rehash guilty parties, rehash casualties, and criminal associations and systems. It tries to see more about the setting of the lives, employments, exercises, intentions, and plans of these people and systems, utilizing this data to discover approaches to prevent or disturb destructive movement, frequently through need requirement, arraignment, and military or paramilitary activity, yet additionally methodologies that don't rely upon implementation, for example, centered discouragement. To this degree, wrongdoing knowledge investigation may utilize police record information as a beginning stage, yet the core of the procedure includes the private accumulation of data—"insight"— about people and systems, with related concerns identified with information security, access, and protection, and the ensuing change of that data from information into insight through examination. Procedures and methods of wrongdoing knowledge examination include:

• Repeat guilty party and casualty examination

• Criminal history investigation

• Link investigation

• Commodity stream investigation

• Communication investigation

• Social media investigation

"Criminal knowledge investigation" verifiably created as a calling parallel to wrongdoing examination, drawing from a custom of military insight and applying its procedures to household "adversaries" like sorted out wrongdoing undertakings. It has prospered in national, global, and unique reason associations, for example, the U.S. Government Bureau of Investigation, the U.K. Security Service, and Interpol; in U.S. Combination Centers; and in substantial nearby police associations. Beside the extensive neighborhood police offices, these different offices have orders that by and large confine their expository needs to investigation of individuals, systems, and criminal associations. This, thus, legitimizes the proceeded with improvement of criminal insight investigation as a specific calling. For those investigators who perform just knowledge examination, it bodes well for them to order themselves as a calling unmistakable from wrongdoing investigation. In neighborhood level police associations, be that as it may, which require a wide range of wrongdoing investigation, we respect the division of knowledge examination from the general calling of wrongdoing examination as simulated, even hurtful to an aggregate comprehension of the wrongdoing dynamic of a purview. (for a more extended dialog of these issues and avocation for an incorporated approach in a neighborhood level police office.) Tactical Crime Analysis Tactical wrongdoing examination is the examination of police information coordinated

towards the fleeting advancement of watch and investigative needs and arrangement of assets. Its branches of knowledge incorporate the investigation of room, time, guilty party, casualty, and usual methodology for singular prominent wrongdoings, rehash occurrences, and wrongdoing designs, with a particular spotlight on wrongdoing arrangement (see International Association of Crime Analysts, 2011, for meanings of wrongdoing design composes). The vast majority of the information utilized as a part of strategic wrongdoing examination originates from police databases, especially police reports of violations. Procedures and systems of strategic wrongdoing investigation include:

• Repeat occurrence investigation

• Crime design examination

• Linking known guilty parties to past violations.

To the degree that criminal "profiling" or criminal investigative examination happens inside neighborhood police offices, we view it as characteristic in the strategic investigation process, as its spotlight is quite often on a progression of violations. Key Crime Analysis Strategic wrongdoing examination is the investigation of information coordinated towards improvement and assessment of long haul methodologies, arrangements, and counteractive action procedures. Its subjects incorporate long haul factual patterns, problem areas, and issues. In spite of the fact that it regularly begins with information from police records frameworks, key examination for the most part incorporates the accumulation of essential information from an assortment of different sources through both quantitative and subjective techniques. Procedures and methods of key wrongdoing examination include:

• Trend investigation

• Hot spot investigation

• Problem investigation

The real commitment this paper makes to the comprehension of key wrongdoing investigation is that we consider "issue examination" as a piece of it. In different distributions, "issue examination"

regularly exists as a different kind of investigation, or even outside to the wrongdoing examination field. 5 Administrative Crime Analysis Administrative wrongdoing investigation is examination coordinated towards the authoritative needs of the police organization, its legislature, and its group. As a general classification, it incorporates an assortment of methods and items, performed both consistently and on ask for, including insights, information printouts, maps, and diagrams. Illustrations incorporate workload counts by zone and move, officer action reports, reactions to media demands, insights accommodated concede applications, reports to group gatherings, and money saving advantage investigation of police programs. In this classification, we subsume the class portrayed as "tasks examination" or "police activities investigation" by a few writings. In spite of its notoriety and some recorded perspectives, managerial investigation is a substantial and important class

of wrongdoing examination, supporting a police office's endeavors in arranging, group relations, and financing, among numerous different regions. It does exclude regulatory undertakings that are not genuinely "investigation, for example, planning flyers for police occasions or performing fundamental innovation bolster. That wrongdoing investigators regularly do numerous things disconnected to examination is a reality of the calling, yet not one that we require classify into a typology of the field. Procedures and strategies of managerial wrongdoing investigation include:

• Districting and re-districting investigation

• Patrol staffing investigation

• Cost-advantage investigation

• Resource sending for extraordinary occasions.

Exchange of a Crime Analysis Typology As beforehand noticed, no wrongdoing investigation typology will bring about an altogether totally unrelated arrangement of definitions. There is impressive cover amongst strategic and vital wrongdoing investigation in the dubious definition between "long haul" and "here and now"; between strategic wrongdoing examination and wrongdoing insight investigation relying upon whether we begin with an arrangement of violations with obscure guilty parties or an arrangement of guilty parties with obscure violations; and between key wrongdoing examination and regulatory wrongdoing examination in contemplations, for example, when a measurable report turns into a "pattern examination." The support for the measurements that make up this typology originates from a general partition of information, assignments, and results among four classifications. The main measurement is the classification of the explanatory item, and it tends to agree with the second measurement. Wrongdoing knowledge examination and strategic wrongdoing investigation items are quite often inner items, kept private to abstain from trading off an investigative or watch methodology. Key wrongdoing investigation and managerial wrongdoing examination items are more probable than strategic and insight examination items to advise gatherings of people outside the police office.

The second measurement is the consistency and speed of the investigation in every classification and it tends to agree with the principal measurement. Strategic investigation is a day by day process by which the expert (in addition to other things) looks for developing examples, and the consistency of regulatory examination demands makes it an exceptionally visit process too. Vital wrongdoing investigation and wrongdoing insight examination are slower and more cautious, consider forms that seldom result in every day items, as they tend to help long haul procedures (however of various sorts) as opposed to here and now tasks.

The third measurement is the significance of the guilty party in respect to the investigation procedure. But in rehash casualty examination, a wrongdoer is quite often the focal point of wrongdoing knowledge investigation, and with the exception of on account of here and now wrongdoing designs that are not arrangement, a lot of strategic wrongdoing examination centers around depicting and recognizing guilty parties. Anxiety and indictment of guilty

parties is regularly the result of the two procedures. The examination of particular wrongdoers goes up against substantially less significance in both vital wrongdoing investigation and regulatory wrongdoing investigation, however for various reasons. The fourth measurement is the significance of police occurrence information with respect to essential information gathered by the investigator, officers, or other police faculty. Both strategic wrongdoing examination and managerial wrongdoing investigation can be performed to a great extent from the information that exists in the run of the mill police PC helped dispatch or records administration framework, while both wrongdoing insight examination and key wrongdoing examination rely upon the think accumulation of extra information to put either people or violations in a more extensive setting.

Fig. 7 Types of crime analysis in four dimensions.

2.6 CRIME PREDICTION MODELS:

In this segment, we exhibit the numerical plan of two worldwide models and three zone particular models. A. Worldwide Model The worldwide model gauges the relative danger of wrongdoing write T at point p utilizing an arrangement of indicator includes as takes after:

$$Pr\,(Label_p = T|f_1(\theta_p), ..., f_{12}(\theta_p)) = F(f_1(\theta_p), ..., f_{12}(\theta_p))$$

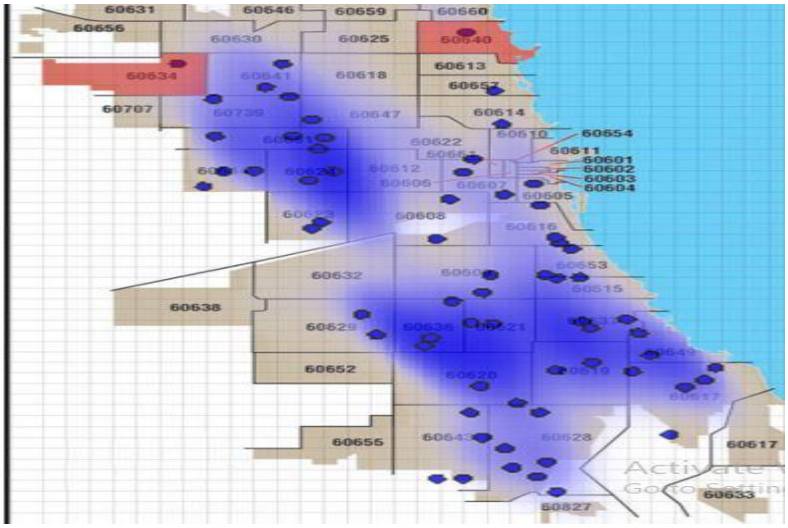
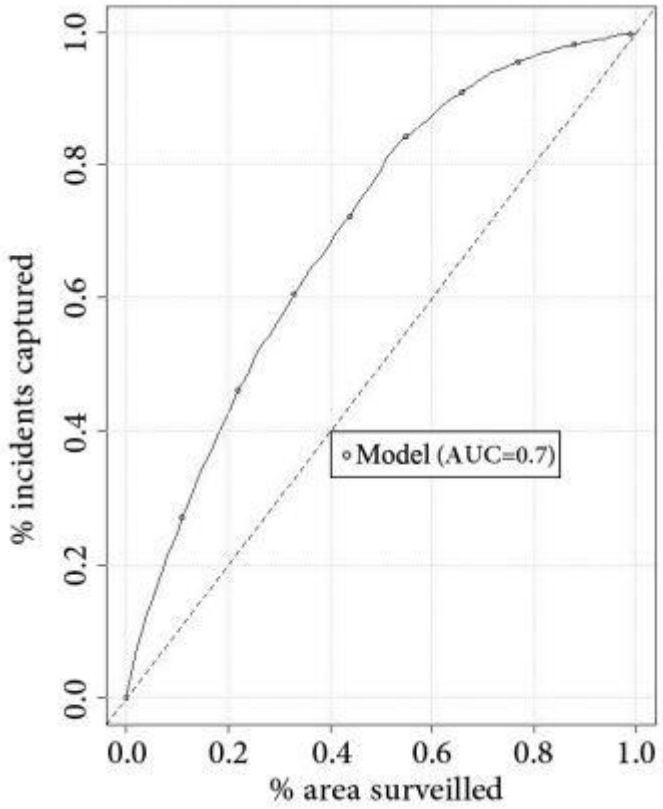


Fig.8 Hotspots for prone areas.

$$f1(p, t1, t2) = \mathrm{k(p, h)} = \sum_{\mathrm{j=1}}^{\mathrm{P}} \mathrm{K}(\frac{\| \mathrm{p} - \mathrm{pj} \|}{\mathrm{h}})$$

where P is the aggregate number of wrongdoings of sort T that happened between times t1 and t2, h is a smoothing parameter, p is the time when the thickness appraise is ascertained, || • || is the L-2 standard, and K is a standard typical likelihood thickness work; f2(θp) to f12(θp) are the spatial highlights from Table II, which are parameterized by θp = {p}. These spatial highlights either gauge the straight separation from p to the element (e.g., direct separation to a noteworthy road), or they assess the thickness of the physical element at p, as estimated by yet another KDE (e.g., the incentive at p of the KDE worked from police headquarters areas). At long last, F is a connection work relating the indicators to the reaction. We utilized the calculated capacity:



Graph. 3. Rate of efficiency using CAPS

CHAPTER 3

SYSTEM DEVELOPMENT

3.1 Apriori Algorithm:

Apriori is a computation for visit thing set mining and connection control learning over esteem based databases. It proceeds by perceiving the standard individual things in the database and extending them to greater and greater thing sets as long as those thing sets show up enough much of the time in the database. The ceaseless thing sets controlled by Apriori can be used to choose association rules which highlight general examples in the database: this has applications in regions, for instance, promote container examination.

The Apriori figuring was proposed by Agrawal and Srikant in 1994. Apriori is expected to take a shot at databases containing trades (for example, aggregations of things bought by customers, or purposes of enthusiasm of a site frequentation). Distinctive counts are planned for finding alliance represents in data having no trades Winepi and Minepi, or having no timestamps. Each trade is seen as a game plan of things.

Apriori uses a "base up" approach, where visit subsets are expanded one thing at any given minute (a phase known as cheerful age), and social affairs of contenders are attempted against the data. The estimation closes when no further productive enlargements are found.

3.2 Limitations:

Apriori, while truly critical, experiences various wasteful aspects or exchange offs, which have produced different calculations. Hopeful age produces substantial quantities of subsets (the calculation endeavors to stack up the competitor set with however many as could be expected under the circumstances previously each output). Base up subset investigation (basically an expansiveness first traversal of the subset cross section) finds any maximal subset S simply after the greater part of its appropriate subsets.

Later calculations, for example, Max-Miner endeavor to distinguish the maximal successive thing sets without identifying their subsets, and perform "bounces" in the pursuit space as opposed to a simply base up approach.

3.3 Computational Model:

A computational model for simulating spatial aspects of crime in urban environments

We exhibit a novel way to deal with computational displaying of social frameworks. By joining the unique state machine (ASM) formalism with the multi-specialist displaying worldview, we get a formal semantic structure for demonstrating and coordination of built up hypotheses of wrongdoing examination and expectation. We center here around spatial and fleeting parts of wrongdoing in urban regions. Our work adds to another multidisciplinary inquire about exertion extensively delegated Computational Criminology.

Fig.8.1 Aspects of computational Model

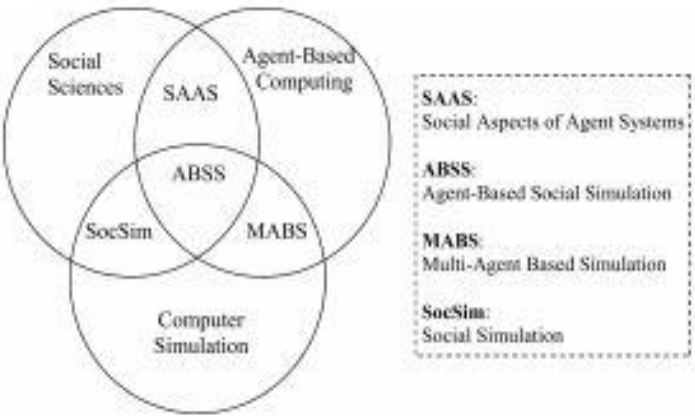


Fig.8.2 Computational Model

3.4 Algorithms Selected for Analysis:

Linear Regression - The calculation utilizes straight relapse for forecast and uses the Akaike basis to choose models; the calculation could work with weighted occasions. This technique for relapse is straightforward and gives a sufficient and interpretable portrayal of how the info influences the yield. It demonstrates a variable Y (a reaction esteem) as a straight capacity of another variable X (called an indicator variable); Given n tests or information purposes of the shape (x1, y1), (x2, y2), ..., (xn, yn), where xi ∈X and yi ∈Y, prescient relapse can be communicated as Y = α + β X, where α and β are relapse coefficients. Expecting that the fluctuation of Y is a steady, the coefficients can be settled utilizing the minimum squares strategy. This limits the blunder between the genuine information point and the relapse line.

$$\beta = \frac{\sum[\,(xi - mean\ y)(yi - mean\ y)]}{[\sum(xi - mean\ x)^2]} \quad and\ \alpha = mean\ y - \beta * mean\ x$$

Where mean x and mean y are the mean values for random variables X and Y given in a data training set. The X variable is the input value (independent) and Y is the response output value (dependent) that depends on X.

Decision Stump:

This calculation is a class for building and uses a choice stump alongside a boosting calculation. The calculation does relapse (in view of mean-squared mistake) or arrangement (in view of entropy). The missing qualities are dealt with as partitioned esteems. Choice trees have a powerful nature that enables them to function admirably with extensive datasets and encourages calculations to settle on better choices about the factors. Choice trees commonly have numerous layers comprising of three sorts of hubs as appeared in Figures 1-2 [12] and clarified beneath: Root hub - has approaching edges and at least zero active edges.

Inner hub - every one of which makes them approaching edge and at least two active edges Leaf hub - normally alluded to as an end hub, every one of which has precisely one approaching edge and no friendly edges.

Additive Regression:

This is a meta classifier calculation that could upgrade the execution of a relapse base classifier. Every emphasis of the calculation fits a model for the residuals from the past cycle of the order procedure. Forecast is refined by including the expectations of every classifier. Lessening the shrinkage (learning rate) parameter averts over-fitting and has a smoothing impact yet builds the learning time. Each info include makes a different commitment to the yield, and they are simply included. It is meant by the accompanying condition.

$$E = \left[Y|X| = \underset{x}{\rightarrow}\right] = \alpha + \sum_{j=1}^{p} fi(xj)$$

3.5 Mathematical analysis:

Relationship coefficient, Mean outright mistake, Root mean squared blunder, Relative total blunder, and the Root relative squared blunder. The outcomes for these five measurements will be utilized as a part of the similar assessment of the wrongdoing insights. The target of this examination is to display how compelling the calculations can be in deciding examples of criminal exercises.

Correlation Coefficient:

The correlation coefficient measures the strength of association between two variables. The value of a correlation coefficient will range between -1 and 1. The larger the absolute value of the correlation coefficient, the more stronger is the relationship between the variables. The strongest relationships are indicated by coefficient values of -1 or 1. The weaker relationships are indicated by a value of 0. If the correlation is positive, it means that as one variable becomes larger, the other variable tends to become larger. For example, as an individual's level of education increases (xaxis), the wage per hour that they will make per hour increases (y-axis). A negative correlation means that if one of the variables grow larger, the other usually gets smaller. Again for example, the more failing grades a student receives, the lower the probability of that student passing becomes. Strong correlations on the scatter plots are indicated by the data points plotted just as a straight line whether positive or negative. The more random the data points, the weaker the correlations between the variables.

The correlation coefficient is evaluated by the equation

$$Ci = \frac{Cov(T,P)}{\sigma * \sigma p}$$

where Cov(T,P) is the covariance of the target and model outputs; and σt and σp are the standard deviations calculated as follows:

$$Cov(T,P) = \frac{1}{n}\sum_{j=1}^{n}(Tj - T)(Pj - P) \quad \sigma i = \sqrt{\frac{\sum_{j=1}^{n}(Tj-T)^2}{n}} \quad \sigma p = \sqrt{\frac{\sum_{j=1}^{n}(Pj-P)^2}{n}}$$

where Pj is the value predicted by a machine learning algorithm for sample case j (out of n sample cases); Tj is the target value for sample case j; T and P are respectively the means of the target values and predicted values for the test samples.

Mean Absolute Error:

The mean absolute error (MAE) measures the absolute difference between the predicted values and observed values of the target feature. MAE is evaluated by the following equation:

$$MAE = \frac{1}{N}\sum_{i=1}^{N}|x\ pred - x\ abs|$$

The absolute value of the difference from the predicted values and known values are taken and then divided by the number of observations in the dataset. In essence, it measures the average magnitude of the error. The values of the mean absolute error can range anywhere from 0 to infinite. It also presents negatively-oriented values, which means the lower the value the more accurate will be the algorithm.

Root Mean Squared Error:

The root mean squared error (RMSE) is the square root of the average of the square of total error. The root mean squared error is commonly used to measure the accuracy of errors for numerical predictions. It is defined by the equation below, where xpred and xobs are the predicted and observed values.

$$RMSE = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x\ pred - x\ abs)^2}$$

Relative Absolute Error:

The relative absolute error (RAE) is a total of the absolute error. It works by taking the total absolute error and normalizing it by diving by the total absolute error of the prediction. It is denoted as follows, where Pj and Tj are respectively the predicted and targeted values for test sample j and T is the mean of the targeted values for the test samples.

$$\boldsymbol{RAE = \frac{\sum_{j=1} |\ Pj - Tj|}{\sum_{j=1}^{N} |Tj - T|}}$$

Root Relative Squared Error:

The root relative squared error (RRSE) is denoted by the equation below, where Pj and Tj are respectively the predicted and targeted values for test sample j and T is the mean of the targeted values for the test samples.

$$\boldsymbol{RRSE = \sqrt{\frac{\sum_{j=1}^{N}(Pj - Tj)^2}{\sum_{j=1}^{N}(Tj - T)^2}}}$$

CHAPTER 4
PERFORMANCE ANALYSIS

4.1 Performance Analysis:

This section presents all of the results from the implementations of the Linear Regression, Additive Regression, and Decision Stump algorithms. The algorithms were run to predict each of the following features in the datasets: murders, murdPerPop, rapes, rapesPerPop, robberies, robbbPerPop, assaults, assaultPerPop, and ViolentCrimesPerPop. Note that perPop refers to for every 100K of people. The algorithm that gives the lowest error values for each feature and the highest correlation coefficient is highlighted in the results presented in Tables 3 through 11.

Table 3: Results for Murder [Total Number of Instances - 2215]

Algorithm	*Correlation Coefficient*	*Mean Absolute Error*	*Root Mean Squared Error*	*Relative Absolute Error*	*Root Relative Squared Error*
Linear Regression Model	0.99	3.0	6.4	26%	11%
Additive Regression Model	0.98	3.5	11.1	30%	19%
Decision Stump Model	0.83	7.6	32.3	65%	55%

Table 4: Results for Murder per 100K of Population [Total Number of Instances - 2215]

Algorithm	*Correlation Coefficient*	*Mean Absolute Error*	*Root Mean Squared Error*	*Relative Absolute Error*	*Root Relative Squared Error*
Linear Regression Model	0.83	3.5	5.2	56%	56%
Additive Regression Model	0.88	2.6	4.4	41%	48%
Decision Stump Model	0.67	3.9	6.8	61%	74%

One could infer that this is so due to the fact that the linear regression algorithm also factors in all other present features into its implementation. These other features aid in increasing the effectiveness of the algorithm.

Table 5: Results for Rape
[Total Number of Instances - 2007]

Algorithm	*Correlation Coefficient*	*Mean Absolute Error*	*Root Mean Squared Error*	*Relative Absolute Error*	*Root Relative Squared Error*
Linear Regression Model	0.98	7.6	17.3	22%	16%
Additive Regression Model	0.96	12.4	27.9	36%	26%
Decision Stump Model	0.76	23.8	68.1	69%	64%

Table 6: Results for Rape per 100K of Population [Total Number of Instances - 2007]

Algorithm	*Correlation Coefficient*	*Mean Absolute Error*	*Root Mean Squared Error*	*Relative Absolute Error*	*Root Relative Squared Error*
Linear Regression Model	0.73	15.7	23.3	61%	68%
Additive Regression Model	0.83	13.2	19.2	52%	56%
Decision Stump Model	0.64	18.2	26.3	71%	77%

Table 7: Results for Robberies
[Total Number of Instances - 2214]

Algorithm	*Correlation Coefficient*	*Mean Absolute Error*	*Root Mean Squared Error*	*Relative Absolute Error*	*Root Relative Squared Error*
Linear Regression Model	0.99	53.4	109	15%	5%
Additive Regression Model	0.98	109	333	30%	15%
Decision Stump Model	0.88	208	1081	55%	48%

Table 8: Results for Robberies per 100K of Population [Total Number of Instances - 2214]

Algorithm	*Correlation Coefficient*	*Mean Absolute Error*	*Root Mean Squared Error*	*Relative Absolute Error*	*Root Relative Squared Error*
Linear Regression Model	0.95	47	69.6	31%	30%
Additive Regression Model	0.91	59	99.5	39%	42%
Decision Stump Model	0.69	102	169	67%	72%

Table 9: Results for Assaults
[Total Number of Instances - 2202]

Algorithm	*Correlation Coefficient*	*Mean Absolute Error*	*Root Mean Squared Error*	*Relative Absolute Error*	*Root Relative Squared Error*
Linear Regression Model	0.99	107	224	25%	11%
Additive Regression Model	0.98	136	354	31%	18%
Decision Stump Model	0.91	262	810	60%	41%

Table 10: Results for Assaults per 100K of Population [Total Number of Instances - 2202]

Algorithm	*Correlation Coefficient*	*Mean Absolute Error*	*Root Mean Squared Error*	*Relative Absolute Error*	*Root Relative Squared Error*
Linear Regression Model	0.93	92.8	163	30%	37%
Additive Regression Model	0.88	128	210	42%	48%
Decision Stump Model	0.71	197	310	65%	71%

Table 11: Results for Violent Crimes per 100K of Population [Total Number of Instances - 1994]

Algorithm	*Correlation Coefficient*	*Mean Absolute Error*	*Root Mean Squared Error*	*Relative Absolute Error*	*Root Relative Squared Error*
Linear Regression Model	1	0.004	0.006	0.0009%	0.001%
Additive Regression Model	0.97	116	168	26%	27%
Decision Stump Model	0.78	276	379	62%	62%

The overall accuracy of the algorithms is based on the error values. The algorithm that had the greatest correlation coefficient value also generated the lowest error values among the three algorithms. The decision stump model was the least accurate of the algorithms for each of the nine goal features. The additive regression model seemed to be most prominent for all of the crimes per 100K population features except for the RobberiesPerPop, AssaultsPerPop, and ViolentCrimesPerPop features. Also, aforementioned, the additive regression model adds the weights of each feature and factors that into its output evaluation. There are some values in the RobberiesPerPop, AssaultsPerPop, and ViolentCrimesPerPop features that are either missing or are equal to zero. Overall, given the associated task for this particular dataset and the features that have been provided, the linear regression algorithm is the most accurate of the three. Finally, a comparison has been done between the model produced by WEKA and the crime statistical data provided by neighborhoodscout.com. Aforementioned, regression makes the best prediction for an upcoming event by using the mean value of past events.

Selected attribute Name: rapesperPop Type: Numeric Missing:208(9%) Distinct: 1621 Unique: 1446 (65%)	
Statistic	Value
Minimum	**0**
Maximum	**401.35**
Mean	**36.258**
StdDev	**34.24**

Fig.9 Selected Attribute Viewer Information Window

4.2 WEKA Tool:

The mean values that were provided by WEKA were modeled for crimes that occurred for every 100K people in the population. The data that was provided by neighborhoodscout.com was modeled for occurrences for 1000 people in the population. For consistency, the crimes statistics from neighborhoodscout.com were scaled to 100K per population. The product of this rate and the mean values of the four crime per population features were used to scale the values with the neighborhoodscout.com 100K population crime totals. These projections for the MurderPerPop and RapePerPop features are relatively close, unlike the RobbPerPop and AssaultPerPop features whose residuals are greater. This is due to the fact that the error values from the robbery and assault features are greater than that of the murder and rape features.

	Murder	Rape	Robbery	Assault
Mean per 100K	**6**	**36**	**62**	**178**
Project Crime Totals	**179**	**1076**	**2485**	**4635**

Table 13: WEKA Crime Totals

	Murder	Rape	Robbery	Assault
Mean per 100K	**7**	**31**	**81**	**156**
Estimated Crime Totals	**195**	**930**	**2409**	**4680**

Table 13: Crime Totals

CHAPTER 5
CONCLUSION

5.1 Conclusion:

We watch the straight relapse calculation to be exceptionally successful and exact in anticipating the wrongdoing information in light of the preparation set contribution for the three calculations. The moderately poor execution of the Decision Stump calculation could be credited to a specific factor of haphazardness in the different wrongdoings and the related highlights (shows a low connection coefficient among the three calculations); the branches of the choice trees are more unbending and give exact outcomes just if the test set takes after the example displayed. Then again, the direct relapse calculation could deal with irregularity in the test tests to a specific degree (without bringing about a lot of forecast mistake). Information mining has turned into an essential piece of wrongdoing recognition and avoidance. Despite the fact that the extent of this task was to demonstrate how compelling and exact machine learning calculations can be at anticipating rough wrongdoings, there are different utilizations of information mining in the domain of law implementation, for example, deciding criminal "problem areas", making criminal profiles, and learning wrongdoing patterns. Using these uses of information mining can be a long and repetitive process for law requirement authorities who need to filter through vast volumes of information. In any case, the accuracy in which one could induce and make new information on the best way to back off wrongdoing is definitely justified even despite the wellbeing and security of individuals.

5.2 Future Scope:

Criminal Profiling

Notwithstanding this another idea called Criminal profiling which causes the wrongdoing examiners to record the qualities of lawbreakers. It is an exceptionally exact apparatus for profiling the qualities or subtle elements of guilty parties is a behavioral and investigative instrument that is proposed to help agents to precisely foresee and profile the attributes of obscure criminal subjects or wrongdoers. The principle objective of doing criminal profiling is that:

• To furnish wrongdoing examiners with a social and mental appraisal of the wrongdoer;

• To assess assets found in the ownership of the guilty party.

For doing this we have to analyze the criminal establishments and criminal records for social affair the best criminal data. So the best purposes of enthusiasm of each criminal is accumulated from criminal records. i.e. at the point when wrongdoings like theft happens in a specific place then from reports like FIR we get the guilty party subtle elements and their modus operandi(mode of activity). Subsequent to getting these points of interest we can think about the crooks with these conduct. So filtering through every wrongdoing record after a specific wrongdoing event is dreary errand. So all things being equal we can utilize some perception systems to speak to the criminal points of interest in a human justifiable shape.

For speaking to criminal information we utilize a diagram database called Neo4j. We propose an information model and inquiry dialect that incorporates an express displaying and questioning of diagrams easily into a standard database condition. It permits portrayal of apportioning object classes into basic classes, connect classes and way classes whose protest can be seen as hubs and edges.. Utilizing this we can speak to every criminal and their qualities in an adaptable hub design. The following is an example case of criminal information spoke to utilizing Neo4j. Here just certain qualities of offenders like name, hair-shading, eye-shading, nationality, blood gathering, age, conjugal status, regardless of whether individual from any criminal gatherings and so forth. Fig 9 demonstrates a case of criminal records spoke to utilizing Graph DB.

Snatching

We are focusing more on wrongdoings like grabbing to get more subtle elements identified with it like wrongdoing area, time, date, wrongdoing type(which sort of grabbing), casualty and guilty party names and so on.
As of now we are getting wrongdoing points of interest like:
1) Name of individual (casualties, guilty parties)
2) Location
3) Organization
4) Type of wrongdoing (regardless of whether kill, burglary)
5) Subcategories of wrongdoing compose (for grabbing there are different classes like chain grabbing, satchel grabbing and so on.)
6) Type of vehicle wrongdoer utilized.
7) Whether any weapons utilized.
8) Time of occurrence
9) Date
10) Incident outline
11) Criminal gatherings included

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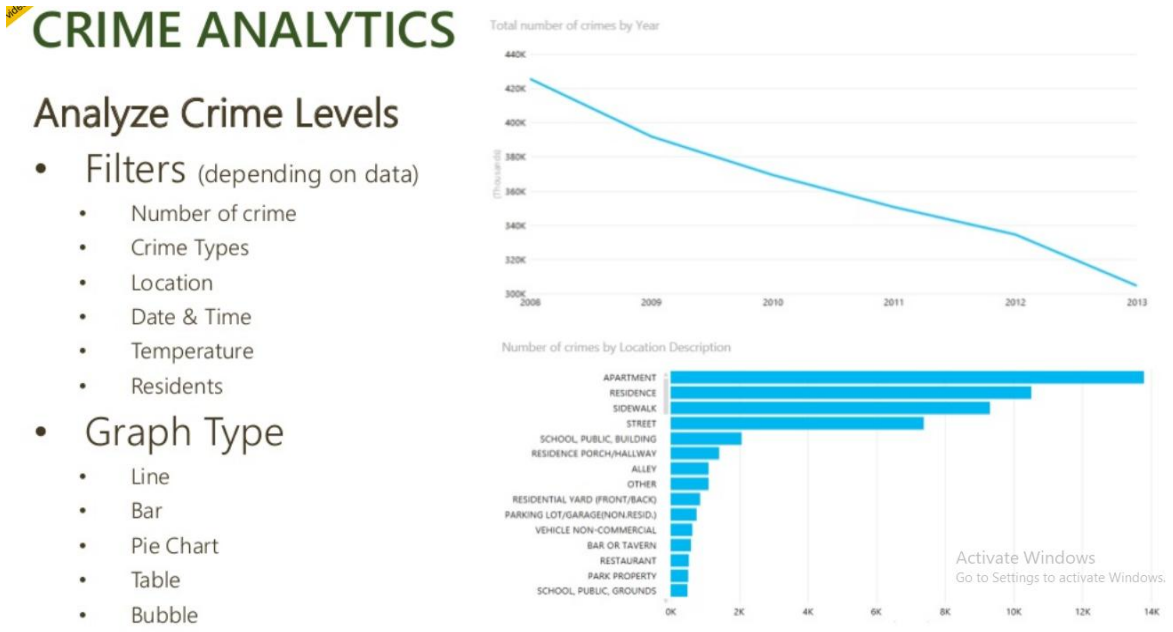
APPENDICES

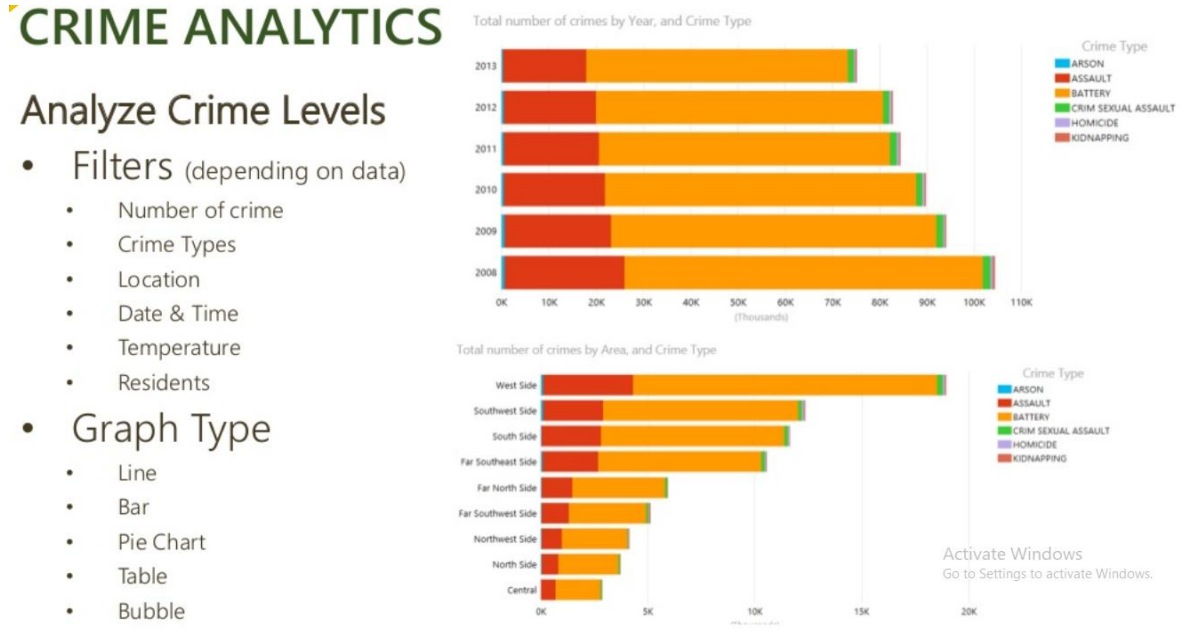
SCREENSHOTS:

1.



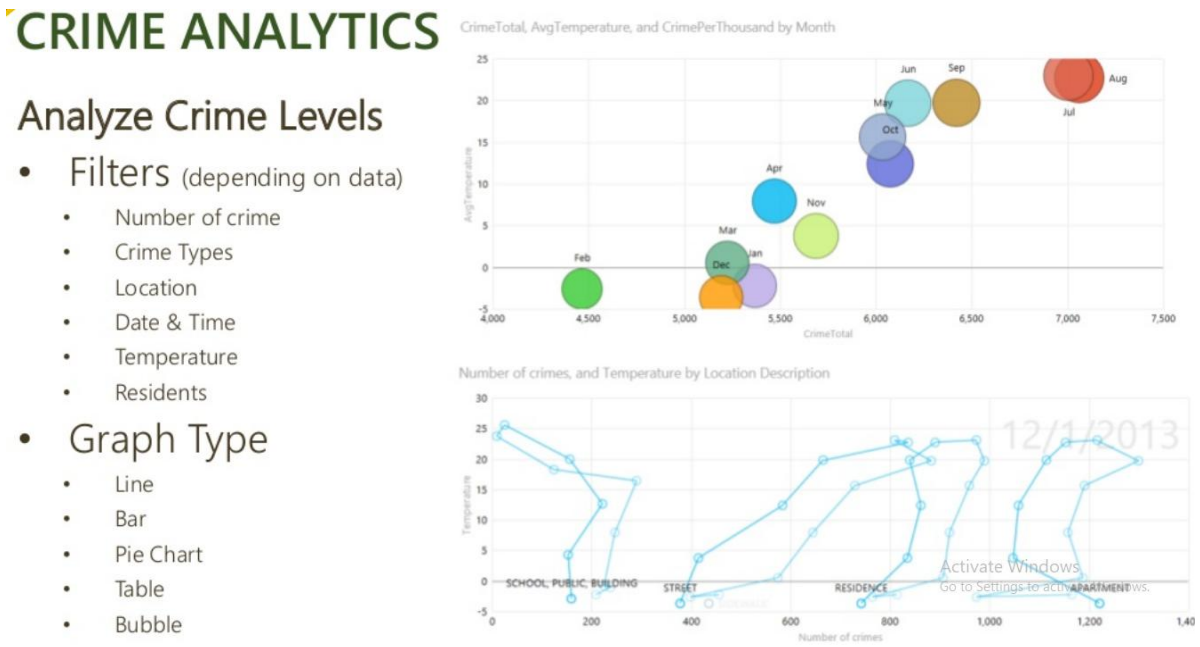
Dashboard for CAPS

2.



Dashboard for CAPS

3.



Dashboard for CAPS

4.

Dashboard for CAPS

CODES:

1. server. R :

```
Library(shiny)
library(rCharts)
library(ggmap)
library(ggplot2)
library(dplyr)
library(leaflet.extras)
library(rMaps)
library(plyr)
library(data.table)
library(RColorBrewer)



d <- read.csv("del.csv")


options(stringsAsFactors = FALSE)

shinyServer(function(input, output, session) {


  output$mod <- renderPlot({

  options = reactiveValues(choose="")

  options(stringsAsFactors = FALSE)

  choice = d[,grep(options$choose, colnames(d))]

  input$city
  input$year
  input$variable

  pid <- input$city
  pid = as.numeric(as.character(pid))

  y <- input$year
  y = as.numeric(as.character(y))

  c <- input$variable
  c = as.numeric(as.character(c))

  cr= as.numeric(as.character(cr))
```

```
if((y==200) && (c==100))
        {cr <- d$viol2017[pid] }
else {
    if((y==201) && (c==100))
        {cr <- d$violChan[pid] }
else {
    if((y==200) && (c==101))
        { cr <- d$prop2017[pid] }
else {
    if((y==201) && (c==101))
        {cr <- d$propChan[pid] }
}}}


cr= as.numeric(as.character(cr))

cit <- d$Count[pid]


mod <- lm( cit ~ cr, data = d)
      cit ~ cr

      class( cit ~ cr )

      resid(mod)

      qplot( cr, predict(mod), data = d, geom = "line")

      qplot( cr, cit, data = d) +
      geom_smooth(se = FALSE, method = lm)


      lm(cit ~ 1 + cr, data = d)
      lm(cit ~ cr, data = d)
      lm(cit ~ cr - 1, data = d)
      lm(cit ~ 0 + cr, data = d)


  summary(mod)
 plot(mod)

 })

  output$SSET <- renderPrint({

    options = reactiveValues(choose="")
      mod <- lm(city ~ variable + year, data = d)
```

```
      SSE <- sum(mod$residuals^2)
      SSE

  })
   output$predict <- renderPrint({

    options = reactiveValues(choose="")
     mod <- lm(city ~ variable + year, data = d)

     predictTest <- predict(mod, newdata=d)
     predictTest

  })
   nwl <- read.csv("del.csv", stringsAsFactors = FALSE)
   nwl$long1 = as.numeric(as.character(nwl$longg))
   nwl$lat1 = as.numeric(as.character(nwl$latt))

   crimes <- read.csv("del.csv", stringsAsFactors = FALSE)
   crimecounts <- as.data.frame(table(round(crimes$long,3),round(crimes$lat,3)))
   crimecounts$long = as.numeric(as.character(crimecounts$Var1))
   crimecounts$lat = as.numeric(as.character(crimecounts$Var2))


   options = reactiveValues(choose="")


   display <- eventReactive(input$go, {
    input$city
    pid <- input$city
    pid = as.numeric(as.character(pid))

    plon <- nwl$long1[pid]
    plat <- nwl$lat1[pid]


    mp1 <- get_map(location = c(plon, plat), zoom = 12)
    #ggmap(mp1) + geom_point( data = crimecounts , aes(x = long, y=lat)) +
scale_color_gradient (low="yellow", high="red")

    ggmap(mp1) + geom_point(data=crimecounts, aes( x= long, y = lat, color=Freq,
size=Freq)) +
      scale_color_gradient(low='green', high='red')




   #  ggmap(mp1, extent = "device") + geom_density2d(data = crimecounts,
   #  aes(x = long, y = lat), size = 0.3) + stat_density2d(data = crimecounts,
```

```
  #  aes(x = long, y = lat, alpha = .5), size = 0.01,
  #  bins = 16, geom = "polygon") + scale_fill_gradient(low = "green", high = "red") +
  #    scale_alpha(range = c(0, 0.3), guide = FALSE)



     # data(crimecounts, package="ggmap")
      #crimecounts <- as.data.table(crimecounts)



       # baseMap <- Leaflet$new()
        #baseMap$setView(c(plon,plan), 10)
        #baseMap$tileLayer(provider = "Esri.WorldStreetMap")
        #baseMap



        #crime_dat <- crimecounts[(lat != ""), .(count = .N), by=.(lat, long)]

        #j <- paste0("[",crime_dat[,lat], ",", crime_dat[,long], ",", crime_dat[,count], "]",
collapse=",")
       # j <- paste0("[",j,"]")

      #  tags$body(tags$script(HTML(sprintf("
          #                       var addressPoints = %s
         #                        var heat = L.heatLayer(addressPoints).addTo(map)"
         #                        , j
        #))))



 })

    output$del.csv <- renderPlot({

     display()
 })

    # output$my.map <- renderMap({

     #my.map <- Leaflet$new()
     #my.map$setView(c(28.4236173,77.0764361), 10)
     #my.map$tileLayer(provider = "Esri.WorldStreetMap")
     #my.map

   #})

    observeEvent(input$go,{

     name_link = switch(input$variable, "Violent Crime"="prop", "Property Crime"="viol")
```

```
    options$choose = paste(name_link, substr(input$year,1,4), sep="")

    choice = d[,grep(options$choose, colnames(d))]

    output$hist <- renderPlot({

    hist(choice, xlab=NULL, breaks=15, col="dodgerblue",

    ylab="Crimes of Cities", border="white", main=paste(input$year, input$variable, sep="
"))

    abline(v=d[,grep(options$choose, colnames(d))][d$CITY==input$city], lwd=2)

    abline(v=mean(choice, na.rm=T), lty=2)

    box()

    if(input$year=="2017"){position <- "topright"} else{position <- "topleft"}

    legend(position, inset=0.05, c(input$city, "Avg of All Cities"), lwd=c(2,1), lty=c(1,2),
bty="n")

  })

    output$data1 <- renderPrint({

      paste(input$city, " ", input$variable, " ", input$year, ": ", d[,grep(options$choose,
colnames(d))][d$CITY==input$city],
        " (", round(ecdf(choice[!is.na(choice)])(d[,grep(options$choose,
colnames(d))][d$CITY==input$city]),4), " percentile)", sep="")
  })

    output$data2 <- renderPrint({

      summary(choice)
  })
})

    output$var_desc <- renderText({

      data_link = switch(input$variable,
                "Property Crime" = "is the number of nonviolent crimes including burglary,
motor vehicle theft and larceny per 100,000 population.",
                "Violent Crime"= "is the number of violent crimes including aggravated
assault, robbery, and homicide per 100,000 population. ")
      paste(input$variable, data_link)
})

    output$yr_desc <- renderText({
```

```
        yr_link = switch(input$year,
                         "2017" = "figures show a predicted crime rate for 2017.  These values are
generated by ILSSC based on a model using the trend in crime over the last 15 years.
                          The forecasted value has a degree of uncertainty, but is the model's 'best guess'
for the level of crime in 2017.",
                          "Change, 2015-2017" = "presents the difference in the predicted crime rate in
2017 compared to the actual crime rate in 2015.")
        paste(input$year, yr_link)
  })


})
```

2 ui.R :

```
library(shiny)
library(shinydashboard)
library(rCharts)
library(leaflet)
library(ggmap)
library(ggplot2)
library(dplyr)
library(leaflet.extras)
library(rMaps)

d <- read.csv("del.csv")



names <- as.character(unique(unlist(d$CITY)))

ui <- dashboardPage(
  dashboardHeader(title = "Predicted Crime Rates", titleWidth = 300),
  dashboardSidebar(width = 300,
                   sidebarMenu(
                     #h5(strong("Choose Crime Type:")),
                     # selectInput("variable", label= "Choose Crime Type",
                      #            choices = list("","Violent Crime", "Property Crime"), selected=""),
                     selectInput("variable", label= "Choose Crime Type",
                                 choices = list("","Violent Crime" = 100, "Property Crime"= 101),
selected=""),
                     #h5(strong("Choose Time Period:")),
                     # selectInput("year", label= "Choose Time Period",
                       #            choices = list("","2017", "Change, 2015-2017"), selected=""),
                     selectInput("year", label= "Choose Time Period",
                                 choices = list("","2017" = 200, "Change, 2015-2017" = 201),
selected=""),
                      # h5(strong("Choose City:")),
    #selectInput("city", label= "Choose City", choices = names[order(names)], selected="New
Delhi"),
     selectInput("city", label="Choose City", choices = list("Adarsh Nagar" =  1,"Ambedkar
Nagar" =  2,"Babarpur" =  3,"Badarpur" =  4
                                         ,"Badli" =  5,"Ballimaran" =  6,"Bawana" =  7,"Burari" =
8,"Chandni Chowk" =  9,"Chhatarpur" =  10
                                         ,"Delhi Cantt" =  11,"Deoli" =  12,"Dwarka" =  13,"Gandhi
Nagar" =  14,"Ghonda" =  15,"Gokalpur" =  16
                                         ,"Greater Kailash" =  17,"Hari Nagar" =  18,"Janakpuri" =
19,"Jangpura" =  20,"Kondli" =  21,"Karawal Nagar" =  22
                                         ,"Karol Bagh" =  23,"Kasturaba Nagar" =  24,"Kalkaji" =
25,"Madipur" =  26,"Malviya Nagar" =  27,"Matiala" =  28
```

```
                                    ,"Matia Mahal" =  29,"Mehrauli" =  30,"Mangol Puri" =
31,"Model Town" =  32,"Moti Nagar" =  33,"Mundka" =  34
                                    ,"Mustafabad" =  35,"Najafgarh" =  36
                                    ,"Nangloi Jat" =  37,"Narela" =  38,"Okhla" =  39,"Palam" =
40
                                    ,"Patel Nagar" =  41,"Patparganj" =  42,"Rajinder Nagar" =
43,"Rajouri Garden" =  44
                                    ,"Rithala" =  45,"R.K. Puram" =  46,"Rohtas Nagar" =
47,"Rohini" =  48,"Sadar Bazar" =  49
                                    ,"Sangam Vihar" =  50,"Shahdara" =  51,"Shakur Basti" =
52,"Shalimar Bagh" =  53
                                    ,"Seelam Pur" =  54,"Seemapuri" =  55,"Sultan Pur Majra" =
56,"Timarpur" =  57
                                    ,"Tilak Nagar" =  58,"Trilokpuri" =  59,"Tri Nagar" =
60,"Tughlakabad" =  61
                                    ,"Uttam Nagar" =  62,"Vishwas Nagar" =  63,"Vikaspuri" =
64,"Wazirpur" =  65
                                    ,"Kirari" =  66,"Bijwasan" =  67,"Noida" =  68,"Faridabad"
=  69,"Gaziabad" =  70
                                    ,"Shamli" =  71,"Gurgaon" =  72,"New Delhi" =  73),
selected = 73),

    br(),
    div(style="display:center-align;",actionButton("go", label = "Analyize", icon =
icon("paper-plane"))),
    br(),
    p(strong("Data Notes:")),

    #p(textOutput("var_desc")),
    br(),
    #textOutput("yr_desc"),
    br(),
    #a("NOTES :"),
    br(),
    a("       "),
    br(),
    a("",href="http://www.delhipolice.nic.in/"),
    br(),
    img(src= 'ilssc.png', height=100, width=100)

  )),
 dashboardBody(
fluidRow(
 tabsetPanel(

  tabPanel("Introduction", textOutput("bhai ji "),
        tags$iframe(src = 'include.html', # put testdoc.html to /www
                width = '100%', height = '800px',
                frameborder = 0, scrolling = 'auto')
        #p(strong("Data Notes:")),
```

```
        #p(textOutput("var_desc")),
        #br(),
        #textOutput("yr_desc"),
        #br(),
        #a("NOTES :"),
        #br(),
        #a("       "),
        #br(),
        #a("",href="http://www.delhipolice.nic.in/"),
        #br(),
        #img(src="ilssc.png", height=100, width=100)
  ),

    tabPanel( title = "Histogram",
          h2("Cities in New Delhi- Histogram"),
          p(em("Predicted crime values of all cities in New Delhi are displayed below.")),
          plotOutput("hist", height = 400),

          br(),
          p(".   Value for selected city:"),
          verbatimTextOutput("data1"),
          p(".   Values for all cities:"),
          verbatimTextOutput("data2")
          ),



  tabPanel("Heatmap",
        h2("Cities in New Delhi- Heatmap"),

       p(em("Predicted crime location of all cities in New Delhi are displayed below.")),
        br(),
       plotOutput("del.csv"),
       chartOutput("my.map", "leaflet"),
       tags$style('.leaflet {height: calc(100vh -80px) !important; padding: 0; margin: 0; min-
height: 500px}')
      # tags$head(tags$script(src="http://leaflet.github.io/Leaflet.heat/dist/leaflet-heat.js"))
        ),



  tabPanel("Linear Regression", textOutput("this wiredsoft"),
        h2("Cities in New Delhi- Linear Regression"),
        p(em("Linear regression all cities in New Delhi are displayed below.")),
        br(),
        plotOutput("mod", height = 400)
        ),

  tabPanel("Predictive Values", textOutput("this values"),
        h2("Cities in New Delhi- Predictive Data"),
```

```
        p(em("Predicted crimes values of all cities in New Delhi are displayed below.")),
        h3(textOutput("predict")),
        br(),
        h3(p("Sum of squared errors (SSE) for calcuating R squared :")),
        h3(textOutput("SSET"))
 ),

 tabPanel("About", textOutput("this")


    )
   )
  )
 )
)
```