A Trend Analysis of crimes in Bangladesh

Saima Sharleen Islam
American International University-Bangladesh (AIUB)
Dhaka, Bangladesh
saimasharleen0@gmail.com

Md. Samiul Haque
Institute of Information Technology, University of Dhaka.
Dhaka, Bangladesh
s.h.shovon@gmail.com

M. Saef Ullah Miah
Universiti Malaysia Pahang
Pekan, Pahang, Malaysia
md.saefullah@gmail.com

Talha Bin Sarwar
Universiti Malaysia Pahang
Pekan, Pahang, Malaysia
talhasarwar40@gmail.com

Abhijit Bhowmik
American International University-Bangladesh (AIUB)
Dhaka, Bangladesh
abhijit@aiub.edu

ABSTRACT

This paper presents a trend analysis of crimes in Bangladesh based on the data provided by Bangladesh Police for the last ten years, from 2010 to 2019. The data contains the number of different crimes organized by the police units in different areas of Bangladesh. The aim of this work is to analyze the crimes committed in the last ten years, establish relationships between the different types of crimes, and identify patterns between them. In order to analyze the data, the dataset provided by Bangladesh Police is transformed into different forms, and then the correlation between different features is determined. The four most important features or crime types, namely murder, narcotics, smuggling, and dacoity, are analyzed in depth by analyzing the significance of the features. This study presents the overall scenario of the crime types and rates observed in the last decade and could be of great help to the law enforcement agencies to make future decisions based on the analysis presented in this paper.

CCS CONCEPTS

• **Information systems, Decision support systems, Data mining**;

KEYWORDS

Crime analysis, Data analysis, Information analysis, data visualization, Bangladesh police, Bangladesh crimes

ACM Reference Format:
Saima Sharleen Islam, Md. Samiul Haque, M. Saef Ullah Miah, Talha Bin Sarwar, and Abhijit Bhowmik. 2022. A Trend Analysis of crimes in Bangladesh. In *2nd International Conference on Computing Advancements (ICCA 2022), March 10–12, 2022, Dhaka, Bangladesh.* ACM, New York, NY, USA, 8 pages. https://doi.org/10.1145/3542954.3543026

ICCA 2022, March 10–12, 2022, Dhaka, Bangladesh

ACM ISBN 978-1-4503-9734-6/22/03…$15.00
https://doi.org/10.1145/3542954.3543026

1 INTRODUCTION

Criminal activity is a pervasive social problem that can have a negative impact on a country's quality of life and even economic growth. A crime is any intentional act that results in physical or psychological harm, property damage or loss, or other law violations. The term "crime" derives from the Old French crime, which was derived from the Latin crimen, which means an accusation. Oftentimes, crime victims sustain various psychological and social injuries that last long after their physical wounds heal. Common reactions include intense feelings of anger, fear, loneliness, low self-esteem, helplessness, and sadness. Oftentimes, crime victims sustain various psychological and social injuries that last long after their physical wounds heal. Common reactions include intense feelings of anger, fear, loneliness, low self-esteem, helplessness, and sadness. Bangladesh has a diverse range of criminal activities, including drug trafficking, money laundering, extortion, contract killing, fraud, human trafficking, robbery, corruption, black marketeering, political violence, terrorism and kidnapping, and wildlife trafficking. In this paper, different visualization techniques were utilized to analyze crime data within the different parts of Bangladesh. In this paper, different types of crime such as dacoity, robbery, murder, speedy trial, riot, police assault, women & child repression, kidnapping, burglary, theft, arms act, and others crime are considered. For the purpose of this research, the dataset is collected from the website of Bangladesh police [9]. The main contributions are:

- Explained and Visualized Bangladesh's crime data for 2010-2019.
- Conduct an analysis of crime data in order to gain a better understanding of crime trends.

This paper discusses various methods or proposed methods to analyze the crime data that were mentioned in previous research papers. This paper is organized in five sections. Section 1 is for the introduction which focused on the motivation and objectives for this research. In brief, Section 2 outlines other existing methods and experimental evaluation, Section 3 discusses about the dataset, Section 4 describes Experimental Results, Section 5 is all about the future work of this paper and concludes our work.

2 LITERATURE REVIEW

Bangladesh is one of the world's lower Medium Developed Countries (MDC) fifty years after independence, with an approximate

per capita GNI income of $3677 (2011 PPP$), ranking 136th out of 189 countries on the UNDP's 2017 Human Development Index (HDI) (UNDP, 2018) [10]. On average, 31.5 percent of the population of around 167.5 million (Worldometers, 2019) [15] lives below the absolute poverty line. Under such unfavorable circumstances, Bangladesh's crime rate has been steadily increasing, posing a serious threat to the people's social and economic security, as well as national development [5].

In 2016, Md. Abdul Awal et al. proposed an approach for forecasting future trends in crime in Bangladesh, and they used a crime dataset obtained from the Bangladesh Police website in their article. According to their study, the majority of crimes are on the rise in lockstep with population growth [2]. In the [7], a fuzzy association rule mining approach was used to discover patterns of community crime. The rules discovered were presented and discussed at regional and national levels in order to aid in the investigation of crime patterns.

Chicago city has conducted numerous studies to forecast crimes in light of the city's high crime rate, and the city has been effective in applying these systems [14]. Not just in the city of Chicago, according to the results of global research on crime prediction. The most difficult aspect of this crime is determining whether many crimes were perpetrated by the same individual or group. Criminals are also human beings. Then they frequently perform the same tasks in the same manner. According to surveys, 10% of offenders commit 50% of crimes. Machine Learning can be utilized in this circumstance to discover crime patterns. The data used to train this Machine Learning technique can come from a variety of sources, including criminal records, social media sentiment analysis, and weather data. There are five processes involved in applying Machine Learning to forecast crime. These include data gathering, classification, pattern recognition, event prediction, and visualization. Crime prediction tools can make good use of law enforcement authorities' limited resources.

Tasmia et al. extracted data using a natural language processing tool, and a trigger word [1]. This article used machine learning techniques to classify a criminal incident based on its time and location of occurrence [11]. This paper can be effectively used by incorporating crime prediction techniques. Data collected from social media, in particular, demonstrates that a crime can be predicted using Machine Learning and that it provides a reasonable percentage of hits [14]. Various machine learning techniques could be used in this paper. Nonetheless, a Decision Tree was used to forecast Bangladesh's metropolitan area based on crime volume and then analyzed the result based on the algorithm's output [12]. They analyzed Twitter data from seven different locations (Ghaziabad, Chennai, Bangalore, Chandigarh, Jammu, Gujarat, and Hyderabad) from January 2014 to November 2018 in a case study of India, which was chosen to demonstrate the proposed work's efficacy [13].

3 METHODOLOGY

3.1 Dataset Overview

We analyzed crime information from the Bangladesh Police from 2010 to 2019. This dataset contains data on dacoity, robbery, murder, expedited prosecution, riot, repression of women and children, kidnapping, police assault, burglary, theft, other offenses, and the arms act, as well as explosives, narcotics, and smuggling. The dataset is divided into two sections based on Bangladesh's region: metropolitan and divisional areas. This page focused on Metropolitan Police Areas (MPAs) like DMP, CMP, KMP, RMP, BMP, SMP, and Railway, where D stands for Dhaka, C for Chittagong, and K for Khulna. Rajshahi is abbreviated as R, Barisal as B, Sylhet as S, and MP as Metropolitan Police. The website offers information on nineteen crimes, each with a date of commission. As a result, we must collect these data from beginning to end, using the years 2010 and 2019 as the starting and ending dates, respectively, by altering the year at the top of the web page URL [9].

3.2 Data preprocessing

This dataset contained no missing data. The dataset comprises many units like Dhaka, Chittagong, Rajshahi, Khulna, Barisal, Rangpur, Railway, and Mymensingh metropolitan areas. This information also covers railway zones. However, this dataset includes the newly constituted metropolitan areas and railway zones in recent years. That is why it lacks data in certain regions.

3.3 Feature Selection

The feature selection process entails isolating the most consistent, non-redundant, and relevant features for use in model construction. Methodologically reducing the size of datasets is critical as the size and diversity of datasets continue to increase. The primary objective of feature selection is to enhance the performance of a predictive model while minimizing its computational cost.

We used embedded methods in this research. Embedded feature selection methods incorporate the feature selection and machine learning algorithms into the learning algorithm, allowing for simultaneous classification and feature selection [8]. The features that will make the most significant contribution to each iteration of the model training process are extracted with care. For our research work, we used decision tree feature selection [4].

This study employs the scikit-learn [6] implementation of the decision tree to quantify this feature selection score. After fitting the model, the model includes a feature importance property that is used to retrieve the relative importance scores for each input function. Table 1 contains the feature importance scores for each feature in the dataset, and Figure 1 illustrates the visual representation. The feature importance scores are listed in ascending order, starting with the most necessary element and ending with the least core feature.

Inconsequential, duplicative, and noisy features can contaminate an algorithm, lowering its performance, accuracy, and computational cost. Selection of features becomes increasingly important as the average dataset's size and complexity continue to grow exponentially.

4 EXPERIMENTAL ANALYSIS

We attempted to analyze the crime rate in various locations and other relationships between various data types in this paper. In this case, we will use the data visualization technique to examine and comprehend the information. They exhibit the examined data in ways that are accessible for generalization, correlation, and

Table 1: Feature significance scores for different crime types.

Feature Name	Feature Importance Score
Murder	0.54874
Narcotics	0.33512
Smuggling	0.0422
Dacoity	0.04449
Explosive	0.00393
Speedy Trial	0.00358
Theft	0.00264
Police Assault	0.00264
Kidnapping	0.00267
Riot	0.00246
Other Cases	0.00246
Woman & Child Repression	0.00245
Robbery	0.00176
Arms Act	0.00106
Burglary	0.0038

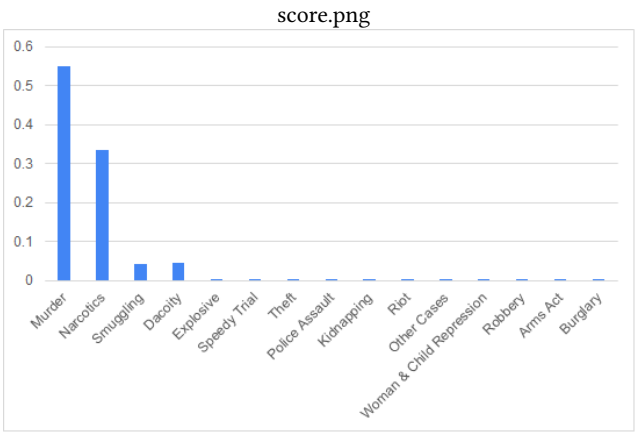

Figure 1: Correlation scores for every feature of the crime dataset is plotted in a bar chart. Each column represents the score for for relevant feature. The scores are sorted in descending order.

causality; they also serve as a means of answering critical learning questions regarding the crime data.

In this paper, we will examine various types of crime and the crime rates in each zone. This will assist law enforcement by increasing the likelihood of deterring and preventing crime through early identification of crime problems by crime analysts combined with improved communication within and between law enforcement agencies. This research's primary objective is to identify crime trends and patterns.

4.1 Dacoity

Dacoity refers to an armed gang's violent robbery. The total number of cases of dacoity (Fig.2) varies over time; we can see that the number of instances of dacoity has decreased over time.

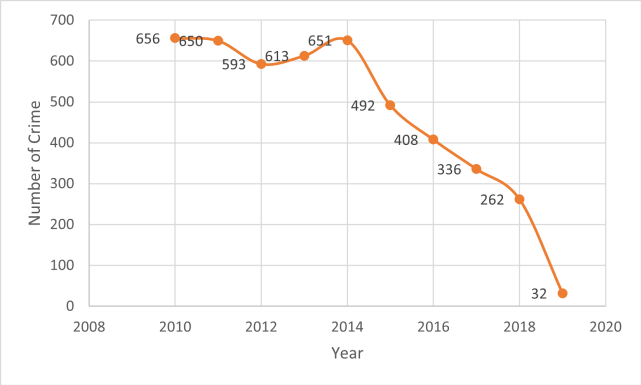

Figure 2: Total cases of dacoity from 2010-2019.

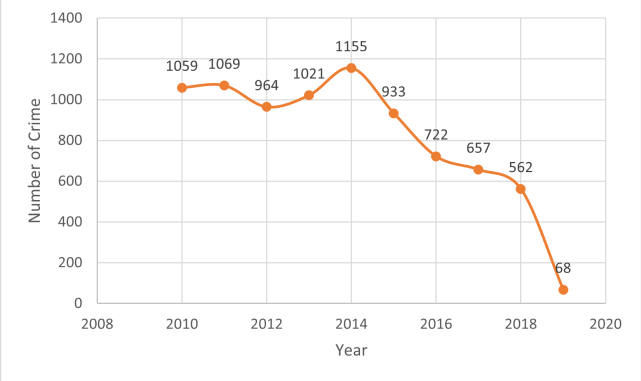

Figure 3: Total cases of robbery from 2010-2019.

In 2010, the total number of cases of dacoity was approximately 656. The following year, it was slightly reduced to around 650.The following year, it decreased further, reaching approximately 593 cases in 2012. The number of cases then steadily increased over the next few years, reaching 651 in 2014. Following that, it continued to decline steadily until it reached just over 32 cases in 2019.

4.2 Robbery

Robbery is defined as the unauthorized, forcible removal of a victim's property from his or her person. The total number of cases of robbery (Fig.3) varies over time; we can see that the number of instances of robbery has decreased over time.

The line graph depicts the number of robberies committed in Bangladesh, and the data also indicates how this rate has evolved over the last decade. Crimes climbed from 1,059 in 2010 to 1,069 in 2011. Apart from that, crime rates decreased somewhat in 2012. (964 cases). The number of offenses climbed gradually over the next two years, reaching approximately 1,155 in 2014. However, the static growth ceased between 2015 and 2019, when it fell to roughly 68 cases.

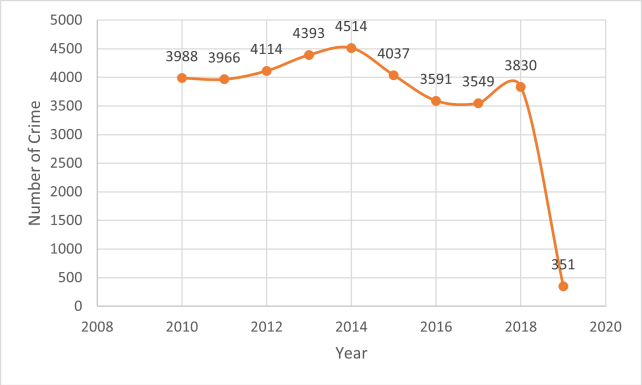

Figure 4: Total cases of murder from 2010-2019.

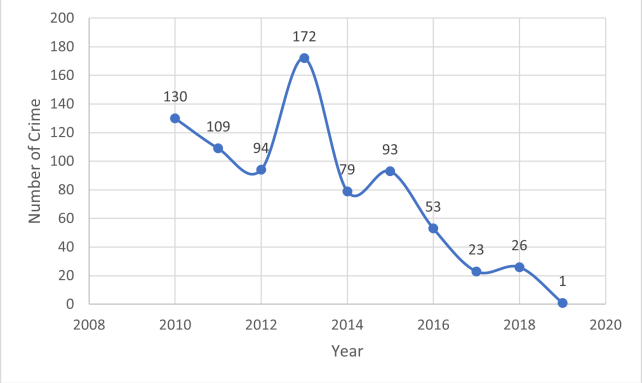

Figure 5: Total cases of riot from 2010-2019.

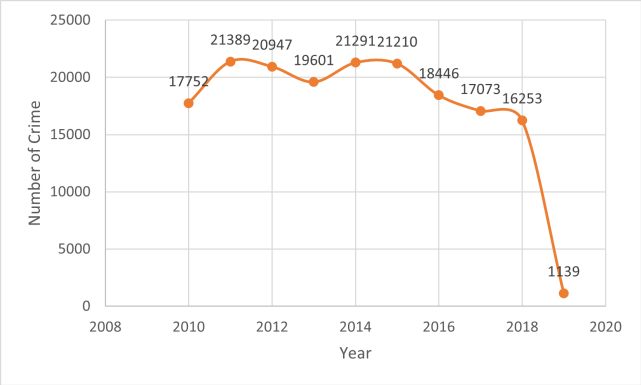

Figure 6: Total cases of woman & child repression from 2010-2019.

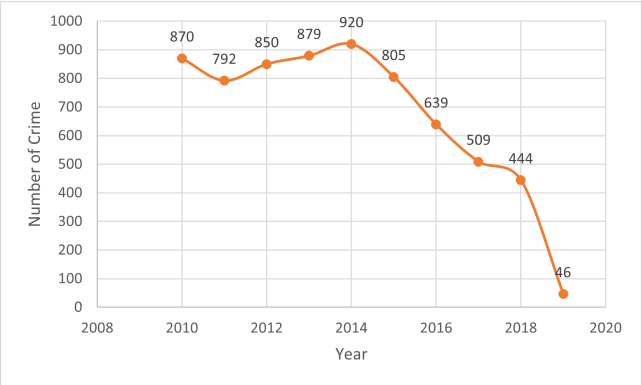

Figure 7: Total cases of kidnapping from 2010-2019.

4.3 Murder

Murder is the intentional death of another human being without reason or legitimate justification.

According to the data presented in the line graph (Fig.4), the number of murders committed in Bangladesh has increased significantly over the last decade. The number of crimes fell from 3,988 in 2010 to 3,966 in 2011. Aside from that, crime rates increased in 2012, but only slightly. (4,114 cases). A steady increase in the number of reported offenses occurred over the next two years, reaching roughly 4,514 in 2014. In contrast, the static rise ended between 2015 and 2019, when the number of cases plummeted to approximately 351 cases.

4.4 Riot

A riot is a type of civil disruption that is frequently defined by a group lashing out violently against authority, properties, or persons.

The line graph (Fig.5) represents the number of riots that have occurred in Bangladesh during the last decade, and the data also shows how this rate has changed over time. The number of cases decreased from 130 in 2010 to 109 in 2011. Apart from that, 2012 saw a slight decline in crime rates. (94 cases). The subsequent year saw a modest increase in the number of cases, reaching roughly 172 in 2013. However, static growth ended between 2014 and 2019, when it decreased to only one case in 2019.

4.5 Woman & Child Repression

Woman & Child Repression refers to acts of violence conducted primarily or exclusively against women or children.

The line graph (Fig.6) depicts the number of cases of violence against women and child repression in Bangladesh during the last decade, as well as the pace of change over time. From 17,752 in 2010 to 21,389 in 2011, the number of cases increased. Apart from that, crime rates decreased somewhat in 2012 (20,947 cases). The next year, the number of cases decreased somewhat, reaching approximately 19,601 in 2013. The following two years saw an increase in cases, which peaked at roughly 21,210 in 2105. However, static growth ceased between 2016 and 2019, with the number of cases falling to 1,139 in 2019.

4.6 Kidnapping

Kidnapping is a criminal offense that involves the unlawful seizing and transportation of a person by force or trickery, as well as the illegal seizure and detention of a person against his will.

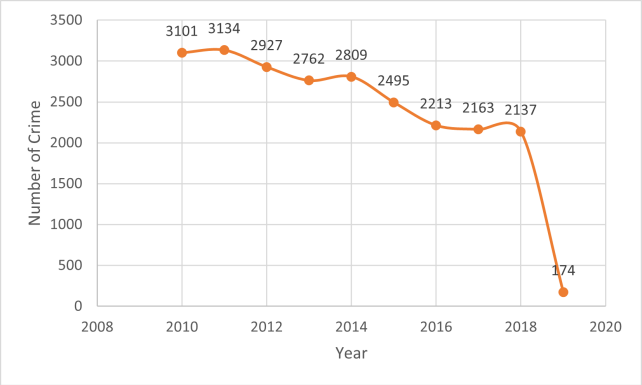

Figure 8: Total cases of burglary from 2010-2019.

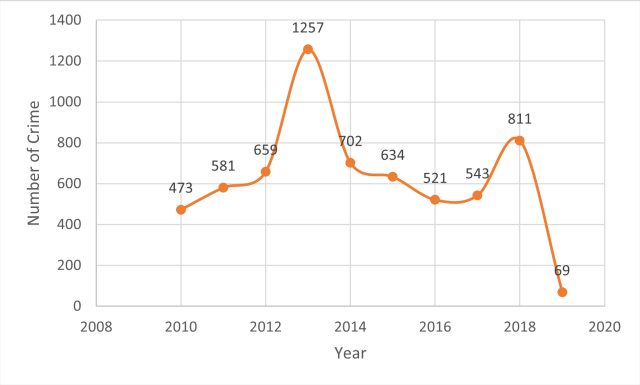

Figure 9: Total cases of police assault from 2010-2019.

According to the line graph (Fig.7), kidnappings have climbed dramatically in Bangladesh during the last decade. Crimes decreased from 870 in 2010 to 792 in 2011. Apart from that, crime rates increased marginally in 2012 (850 cases). Over the next two years, reported offenses increased steadily, reaching over 920 in 2014. By comparison, the static increase ceased between 2015 and 2019, when the number of cases fell to just 46.

4.7 Burglary

Burglary is commonly described as the unlawful entrance or trespass into the property of another person.

The line graph(Fig.8) depicts the number of burglaries that occurred in Bangladesh over the last decade, as well as how this rate has changed over time. From 3,101 in 2010 to 3,134 in 2011, the number of cases increased. Apart from that, crime rates decreased somewhat in 2012(2,927 cases). Following that, the number of cases fluctuated, peaking at approximately 2,809 in 2014. However, static growth ceased between 2015 and 2019, when the number of cases reduced to 174.

4.8 Police Assault

Police assault is defined as the crime or tort of threatening or attempting to inflict imminent offensive physical contact or bodily harm on the victim that the police have the authority to impose at the time and that places the victim in dread of such injury or contact. According to the line graph (Fig.9), the number of police attacks has climbed dramatically in Bangladesh during the last decade. Crimes increased from 473 in 2010 to 581 in 2011. Apart from that, crime rates increased marginally in 2012 (659 cases). It is plain to see that reported offenses increased significantly over the next year, reaching approximately 1,257 in 2013. In comparison, the static increase ceased between 2014 and 2019, when the number of cases fell to around 69.

4.9 Theft

Whoever moves property with the intent of dishonestly removing it from the custody of another without that person's agreement is said to commit theft.

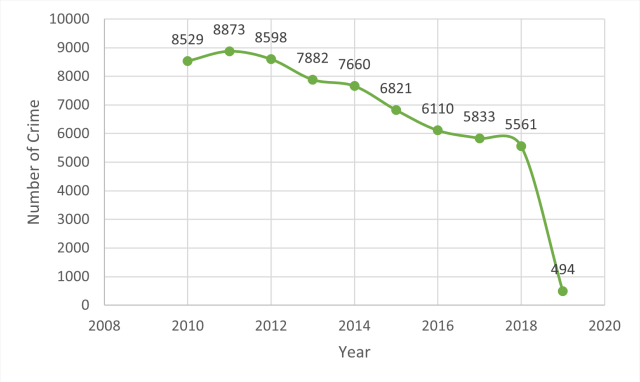

Figure 10: Total cases of theft from 2010-2019.

In 2010 (Fig.10), there were around 8,529 theft cases reported. The next year, it was increased slightly to around 8,873 instances. Following that, it decreased progressively until it reached little more than 494 cases in 2019.

4.10 Narcotics

A substance that dulls the senses, relieves pain, and induces sleep in small amounts but has dangerous side effects in greater levels, including those used in medicine (such as morphine) and those taken illegally (such as heroin), which frequently results in addiction.

The line graph (Fig.11)illustrates the number of narcotics-related deaths in Bangladesh during the last decade, as well as the pace of the increase over time. Since 2010, drugs cases have steadily climbed, reaching roughly 29,344 in 2010. After that, it gradually grew each year until 2017(98,984 cases). The number of cases thereafter skyrocketed to 1,12,549 instances. Following that, it declined precipitously to 9,069 cases in 2019.

4.11 Smuggling

Smuggling is the unlawful act of bringing into or withdrawing from country products that are either forbidden or for which customs or excise fees have not been paid.

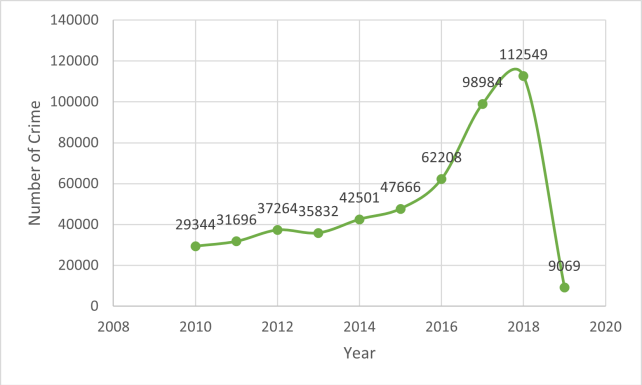

Figure 11: Total cases of narcotics from 2010-2019.

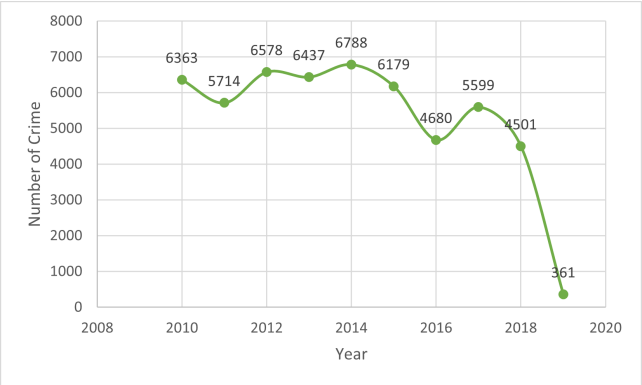

Figure 12: Total cases of smuggling from 2010-2019.

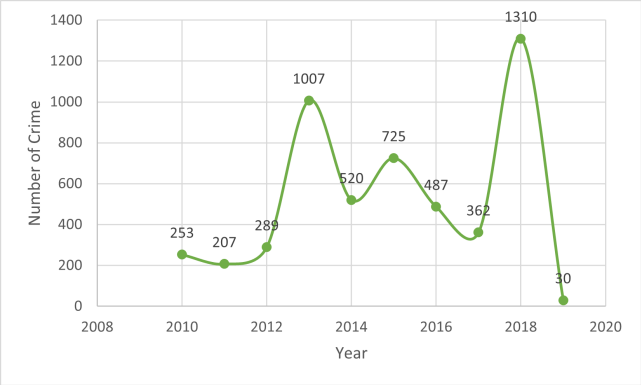

Figure 13: Total cases of explosive from 2010-2019.

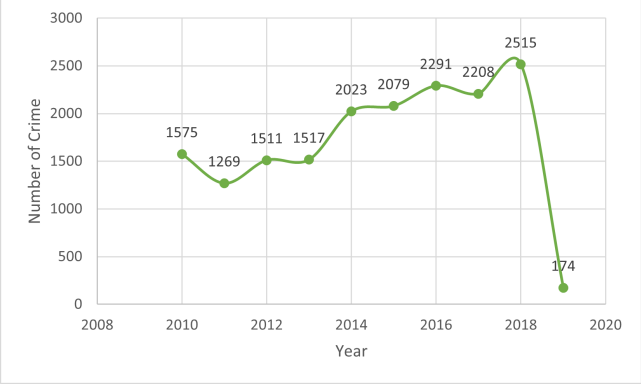

Figure 14: Total cases of arms act from 2010-2019.

The line graph (Fig.12) illustrates the number of cases of smuggling in Bangladesh during the last decade, as well as the rate of change over time. Cases declined from 6,363 in 2010 to 5,714 in 2011. Apart from that, 2012 saw a slight uptick in crime rates (6,578 cases). The next year, the case count declined somewhat, reaching roughly 6,437 in 2013. The next year, the number of cases increased, reaching a peak of approximately 6,788 in 2014. Between 2015 and 2019, however, static growth ended, with instances declining to 361 in 2019.

4.12 Explosive

Explosive refers to any chemical or instrument capable of producing a large amount of rapidly expanding gas in a very short period of time.

The line graph (Fig.13) depicts the number of explosive cases in Bangladesh during the last decade, as well as the pace of change. The number of reported cases decreased from 253 in 2010 to 207 in 2011. Apart from that, crime rates increased slightly in 2012 (289 cases). The next year, the case count grew significantly, reaching approximately 1,007 in 2013. Cases declined the following year, reaching roughly 520 in 2014. In 2015, the number of reported cases grew to approximately 725. The following two years saw a decline in the number of cases, reaching roughly 362 in 2017. Following that, the number of cases increased to 1310 in 2018, which was greater than in previous years. In 2019, explosive cases decreased substantially to only 30.

4.13 Arms Act

Under the Arms Act, it is illegal to acquire, possess, or carry restricted ammunition without a license.

The line graph (Fig.14) illustrates the number of weapons act violations in Bangladesh during the last decade, as well as the pace of change over time. The number of reported cases decreased from 1,575 in 2010 to 1,269 in 2011. Apart from that, crime rates increased slightly in 2012 (1,511 cases). The next year, the case count grew slightly, reaching approximately 1,517 in 2013. The number of cases climbed steadily over the next few years, reaching a peak of roughly 2,515 in 2018. After that, static growth ceased, and the number of cases decreased to 174 in 2019.

4.14 Overview of Bangladesh

A heat map visualizes the values of the primary variable of interest as a grid of colored squares across two axis variables [3]. As with a bar chart or histogram, the axis variables are separated into ranges, and the color of each cell represents the value of the primary variable in the corresponding cell range. Heat maps illustrate the

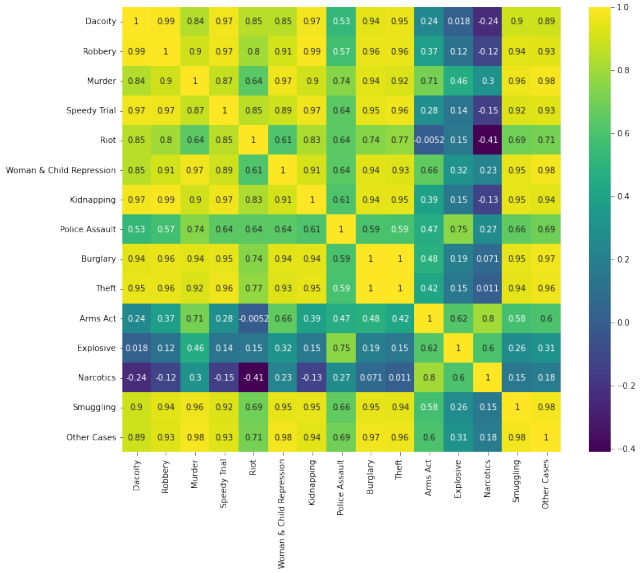

Figure 15: Correlation heat-map for all the crimes occurred from year 2010-2019 in Bangladesh.

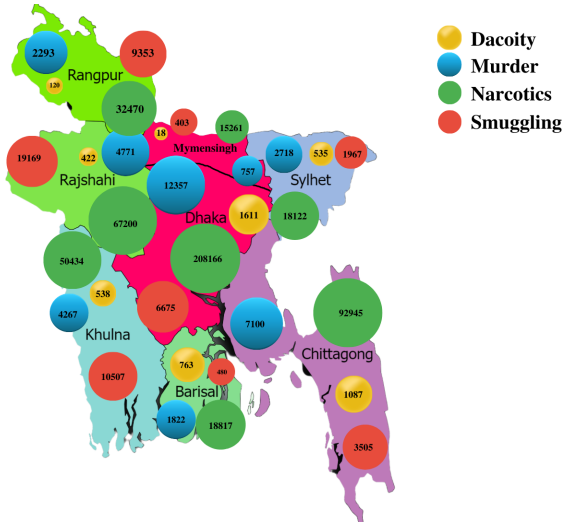

Figure 16: Division wise top four crimes of Bangladesh for year 2010-2019.

correlations between variables. On both axes, these variables are plotted. By observing the color shift, we look for patterns in the cell. It receives solely numeric data and presents it on a grid, indicating different data values by shifting color intensity.

Each square represents the correlation between the variables on the corresponding axes. Correlation coefficients range from -1 to +1. Closer to zero values indicate that there is no linear relationship between the two variables. The closer the correlation is to one, the more positively associated they are; that is, if one increases, the other increases as well, and the closer the correlation is to one, the stronger the association. Correlations closer to -1 are similar, except one variable will continue to decline rather than both increases. The diagonals are all 1/dark green since they perfectly correlate each variable with itself. The greater the number and the more saturated the hue, the stronger the correlation between the two variables. Additionally, the plot is symmetrical along the diagonal, as the same two variables are paired in those squares.

According to the heat map (Fig.15) and correlation score in Fig.1, the top four crimes are murder, narcotics, smuggling, and dacoity. We visualized these four crimes by plotting their data from 2010 to 2019 in a bubble chart.

As can be seen from the Bangladesh bubble chart (Fig.16), the number of narcotics cases was rising in every region of the country. In Bangladesh's capital, Dhaka, the biggest number of cases (2,08,166) involved narcotics. Murder was the next case, which was more prevalent in Dhaka (around 12,357 cases). Following that, the third most prevalent crime in Dhaka was smuggling (6,675 cases). The most heinous crime committed here was dacoity (1,611 cases).

When we look at Chittagong, the major coastal city and financial center in southeastern Bangladesh, we notice that the majority of cases (92,945) involved narcotics. Murder was the next case, which was more prevalent in Chittagong (around 7,100 cases). Following that, smuggling (3,505 cases) was the third most common crime in Chittagong. The lowest crime committed here was dacoity (1,087 cases).

Khulna is Bangladesh's third-largest city, after Dhaka and Chittagong, and the majority of cases (50,434) involved narcotics. The next case involved smuggling, which was particularly frequent in Khulna (around 10,507 cases). Following that, murder was the third most common crime in Khulna (4,267 cases). The least serious crime perpetrated here was dacoity (538 cases).

When we analyze Barisal, the largest city and administrative center of Barisal District and Barisal Division, we find that the majority of cases (18,817) involved narcotics. The following case was murder, which was more prevalent in Barisal (around 1,822 cases). Following that, dacoity was the third most prevalent crime in Barisal (763 cases). Smuggling was the least serious crime perpetrated here (480 cases).

Rajshahi is the major urban, commercial, and educational center of Bangladesh; most cases (67,200) involved narcotics. Smuggling was the next case, more prevalent in Rajshahi (around 19,169 cases). Following that, murder(4,771 cases) was the third most common crime in Rajshahi. The lowest crime committed here was dacoity (422 cases)

Mymensingh is the major financial center and educational hub of north-central Bangladesh; the majority of cases (15,261) included narcotics. Murder was the next case, which was more common in Mymensingh (around 757 cases). Smuggling (403 cases) was the third most prevalent crime in Mymensingh. The lowest crime committed here was dacoity (Only 18 cases).

The majority of cases (32,470) in Rangpur involved narcotics. Smuggling was the following case, which was particularly widespread in Rangpur (around 9,353 cases). Following that, murder was the third most common crime in Rangpur (2293 cases). The lowest crime committed here was dacoity (120 cases).

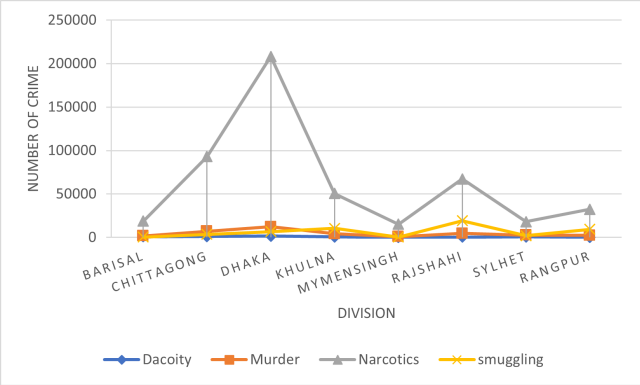

Figure 17: Overview of top four crimes based on divisions in Bangladesh from 2010-2019.

Sylhet most cases (18,122) involved narcotics. Murder was the next case, more prevalent in Sylhet(around 2,718 cases). Following that, smuggling(1,967 cases) was the third most common crime in Sylhet. The lowest crime committed here was dacoity (120 cases).

The line curve indicates Bangladesh's top four crimes: dacoity, murder, narcotics, and smuggling. As can be seen, the majority of recorded offenses involve narcotics. When compared to the other three offences, narcotics charges are substantially more prevalent. Though reported crimes were higher in previous years, the number of recorded offenses decreased later in 2019.

5 CONCLUSION

Following an analysis of crimes committed over the last decade, it is clear that the majority of reported offenses include narcotics. The number of narcotics-related incidents was increasing in every region, which was cause for concern. Comparing the eight divisions of our country: Dhaka, Chittagong, Sylhet, Rangpur, Mymensingh, Rajshahi, Barisal, and Khulna, it is clear that Dhaka and Chittagong have a greater number of recorded drug cases. The in-depth research of crime statistics in each of our country's eight divisions will assist law enforcement in making future judgments based on the analysis. Apart from relegating historical crime data to criminal records, this data can be used to improve our understanding of crimes and criminals.

REFERENCES

[1] Tasmia Ishrat Alam, Imtiaz Mamun, Iftakhar Ali Khandokar, and Zubair Ahmed Anas. 2018. *Event Detection and Violence Recognition from Textual News through Multilayer Perceptron and Supervised Learning.* Ph.D. Dissertation.
[2] Md Abdul Awal, Jakaria Rabbi, Sk Imran Hossain, and MMA Hashem. 2016. Using linear regression to forecast future trends in crime of Bangladesh. In *2016 5th International Conference on Informatics, Electronics and Vision (ICIEV).* IEEE, 333–338.
[3] Mike DeBoer. 2015. Understanding the heat map. *Cartographic perspectives* 80 (2015), 39–43.
[4] Krzysztof Grabczewski and Norbert Jankowski. 2005. Feature selection with decision tree criterion. In *Fifth International Conference on Hybrid Intelligent Systems (HIS'05).* IEEE, 6–pp.
[5] Mst Nurjahan Khatun and Mohammed Jahirul Islam. 2018. Crime in Bangladesh: A Historical Overview. *Social Science Review* 35 (2018), 1–33.
[6] Scikit learn developers. [n.d.]. scikit-learn 0.24.2 documentation. https://scikit-learn.org/stable/modules/ensemble.html#forest
[7] Ned Levine et al. 2000. Crimestat: A spatial statistics program for the analysis of crime incident locations (version 1.1). *Washington, DC: National Institute of Justice* (2000).
[8] Haoyue Liu, MengChu Zhou, and Qing Liu. 2019. An embedded feature selection method for imbalanced data classification. *IEEE/CAA Journal of Automatica Sinica* 6, 3 (2019), 703–715.
[9] Bangladesh Police. 2022. bangladesh police. https://www.police.gov.bd
[10] UNITED NATIONS DEVELOPMENT PROGRAMME. 2021. Human development reports. http://www.hdr.undp.org/en/countries/profiles/BGD
[11] Nishat Shama. 2017. *A machine learning approach to predict crime using time and location data.* Ph.D. Dissertation. BRAC University.
[12] Debasish Bhattacharjee Victor and Subhenur Latif. 2021. Bangladesh Metropolitan Crime Area Prediction Using Decision Tree. In *2021 6th International Conference on Communication and Electronics Systems (ICCES).* IEEE, 1226–1233.
[13] Thanh Vo, Rohit Sharma, Raghvendra Kumar, Le Hoang Son, Binh Thai Pham, Dieu Tien Bui, Ishaani Priyadarshini, Manash Sarkar, and Tuong Le. 2020. Crime rate detection using social media of different crime locations and Twitter part-of-speech tagger with Brown clustering. *Journal of Intelligent & Fuzzy Systems* 38, 4 (2020), 4287–4299.
[14] ND Waduge and L Ranathunga. 2017. Machine Learning Approaches For Detect Crime Patterns. *Sri Lanka* (2017).
[15] Worldometers.info. 2021. Bangladesh demographics. https://www.worldometers.info/demographics/bangladesh-demographics/