Exploratory Data Analysis And Crime Prevention Using Machine Learning: The case of Ghana

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Abstract:- The objective of this work is to take advantage of machine learning to perform exploratory analysis of historical data and to forecast crime counts in a given month and year for a 4 year period between 2018 and 2021 and allow the evenly distribution and allocation of resources and logistics in the case of Ghana. The prediction was done using the Chicago crime dataset. The prediction was done using the Facebook prophet. The month February is the month with the least crime rate and this can be attributed to the fact that it has fewer days in the year. It was also discovered that crimes are committed between the hours of 5:00pm and 10:00 pm while most of the crimes are committed at 12:00 noon. With regard to District level crimes, it was observed that District 11 is the district with the highest crime between 2012 and 2017. This is followed by 7, 4, 25 and 6. This is an indication that more logistics and personnel will be required in those Districts to help prevent crimes from being committed.

The model predicted a decrease in the number of crimes that are likely to be committed with 2021 recording the least crimes. The model also predicted the least crimes to be in the period 1st to 30th January, 2021 as 10978 as compared to 1st to 30th January, 2021with the least crimes committed as 30 in the historical data. Most crimes happen on street and on sidewalks therefore extra police personnel needed on street patrolling. A lot of crimes are in residence and/or apartments therefore the Police Service will require more personnel to respond to destress 911 calls from people. The overall trend is that the crime rate keeps decreasing from the forecast in each year. The results indicate the importance of the application of Machine Learning for the prediction of crime data by the Ghana Police Service. In conclusion, this work provides the institution with much information and intuition on the use and application of machine learning to enhance the decision making process and the fight against crimes.

Keywords:- Ghana Police Service, Machine Learning, Artificial Nueral Network, Predictive Policing.

I. INTRODUCTION

Artificial intelligence has over the years become the subject of the day when issues of the future are brought to the table. It comprises machine learning and deep learning which all subset of the former. The application of Artificial intelligence can be observed in the security agencies, self-driving cars, chatbots, in the financial sector, the health and agriculture sector, among others. The increase in population contributed by migration and high birth rate has become one of the defining themes in the twenty-first century in Sub-Saharan Africa. Increasingly as populations explode and life-spans increase due to increased accessibility and availability to better health care, technology and education, there is pressure on the security agencies and the resources required sustaining the security of the country. Of great significance is how the security of the state and its citizens and other immigrants are managed optimally. This has also led to the forecasting of crimes and the ability to predict crimes using all forms of statistical methods and tools to identify hotspots in the fight against crime. The police administration is the institution in Ghana that is responsible for the security of the citizens. [1] The Ghana Police Service (GPS) is the main law enforcement agency of Ghana. The service is under the control of the Ghanaian Ministry of the Interior and employs over 30,000 officers across its 651 stations. [2] The primary functions of the Service are those stipulated in Section 1 of the Police Service Act, 1970 (Act 350). It states among others that: "It shall be the duties of the Police Service to prevent and detect crime, to apprehend offenders and to maintain public order and safety of persons and properties". Each year the police administration submits a budget to the ministry of finance and large sums of monies are appropriated to maintain law and order. It is also important to acknowledge that we live in a world of data that every activity we do generates some amount of data. And these data can be leveraged in the prediction of crime and their subsequent prevention. The efficiency of the security agents is their ability to quickly use the available data to investigate crime and also to take crime prevention actions by the leverage of machine learning algorithms which will be one of the efficient ways to boost the effectiveness of the police department through optimization of their operations. The purpose of this paper is to examine how machine learning algorithms can be used explore crime data and to predict crime seasons while identifying areas of high probability of crimes being committed.

II. SURVEY OF LITERATURE

A. Machine Learning

[3] *S.N.Sivanandam* et al, The term "machine learning" is today primarily associated with attempts to get computers to solve problems that use a particular small and somewhat arbitrarily chosen set of methodologies. It is a subset or branch of artificial intelligence performing actions without it being explicitly programmed or instructed by learning from a historical or previous data. Machine learning focuses on the development of algorithms that are able to solve problems through the process of learning by getting better over the task as they learn on the data over a period with experience given a certain number of epochs. These algorithms are able to learn to perform the task they are intended to do using developed models for predictions over unseen datasets using important data. [4]Machine Learning uses data mining techniques to extract the information from the huge size datasets. Machine learning can be classified into two broad classifications namely supervised learning and unsupervised learning. [5] There are five types of machine learning algorithms that are used on the datasets. These algorithms are; Classification Analysis Algorithm, Regression Analysis Algorithm, Segmentation Analysis Algorithm, Sequence Analysis Algorithm and Association Analysis Algorithm.

B. Artificial Nueral Network

Artificial Neural Network is also called neural network. S. N. Sivanandam et al [6] an artificial neural network (ANN) may be defined as an information processing model that is inspired by the way biological nervous systems, such as the brain, process information. This model tries to replicate only the most basic functions of the brain. The key element of ANN is the novel structure of its information processing system. An ANN is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. The fundamental data structure in neural networks is the layer which is the data-processing module. This data processing module accepts one or more tensors as inputs. Some layers are stateless, but more frequently layers have a state: the layer's weights, one or several tensors learned with stochastic gradient descent, which together contain the network's knowledge. A neural network has its main responsibility of learning during the process of training and it is able to adapt to stimulus. This is through the [7] parameterization of the weight where the weight is consistently adjusted until it is able to produce the desired target or response. The main components of neural networks are the layers, networks, objective functions, and optimizers. [8] Proposed a dynamic programming based recursive algorithm to find the similarity between the training and test images. For ranking the images on the basis of highest similarity with the given object template a greedy multistate gradient descent method was used. The method proved robust to rotation and deformations but the method was not able to deal with extreme viewpoint changes.

C. Related Work

Propose a new way of analyzing crime patterns using the combination of Formal Concept Analysis and Geographical Information Science to discover patterns in crime data. It is able to visualize and present a graphical analysis of crime patterns in the society and categories crimes based on their distinct related types. It uses the Formal Concept Analysis which is a data analysis technique for considering the common and distinct attributes of crimes such that they have relations. The relationships between crimes, their location and occurrence were visualized using the formal concept analysis techniques. In their paper, crime types were considered and the relationship that a particular crime belonged to a particular geography and estimated however, the particular crime that could occur within that particular geography was not established.

Obubu Maxwell, et al [11] examined murder crimes in Nigeria using the Autoregressive integrated moving average model and also forecasted crimes using historical data. They used an exploration method to perform a prediction using a historical time series data. In their paper, the autoregressive integrated moving average was used to forecast the murder crime and the increasing murder crimes. However, other models or algorithms were not used in the crime forecast to determine the accuracy of the model. Their model will not be able to be use to perform a future occurrence of murder crimes. It also did not consider other important crimes which equally affects the livelihood of the people of the society

Luiz G.A Alves, et al [12] examined the crime dataset of Brazil. They performed predictive analysis of crimes dataset and tried to obtain the relationship between crime and urban indicators. They proposed that due to the non-Gaussian distribution and multicollinearity in the urban indicators, it makes it very easy to find conclusion about the influence if some urban indicators on crime. Random forest algorithm was used to predict crimes and the influence of urban indicators on crimes such as homicides. It also took into consideration the ranks of the various indicators and predicted that unemployment and illiteracy are the most important variables for homicide crimes in cities in Brazilian.

However they could not predict or forecast which crimes are most likely to be committed in a given period. It only took the accuracy of the model which it says can predict accurately at 97% of a crime based on some attributed and indicators that have effect on crime to guide crime control. It is also important to note that their model was able to perform prediction with accuracy between 38% and 39%.

Rizwan Iqbal, et al [13] used the classification algorithm to predict crime for different states in the United States of America using real data. An open source tool called WEKA developed in JAVA was used. The 'Crime and Community' dataset was used in their work. It performed the results of two machine learning algorithms namely Naïve Bayesian algorithm and Decision Tree algorithm to predict a particular category of crime. A 10 fold cross validation was applied to the dataset separately for Naïve Bayesian algorithm and Decision Tress algorithm. It then concluded that Naïve Bayesian algorithm is the best for performing an accurate prediction of crime category at 83.9519 %. The researchers could not evaluate the performance of their prediction. It did not consider other features to study their effects on crimes

and what effect the features will have on the prediction of crimes using other machine learning algorithms.

Suhong Kim, et al [14] created a predictive model that was able to accurately predict crime. Two main algorithms were used in their work. These are K-Nearest Neighbor and Decision tree algorithms. It also used the geographic information system to identify the location of crimes by the leverage of the co-ordinates which can easily be located on the map. However it is important to know that KNN algorithms cannot be applied to a large datasets since it will cost to be able to calculate the distance between the data points and also with sensitivity to noise and missing data in the dataset. The accuracy of the predictions using K-Nearest Neighbor is absolutely dependent on the number of neighbors while the speed of the algorithm is declines more quickly.

III. POBLEM FOMULATION

Companies and organizations are collecting data on their customers, employees, etc. which are stored in a digital form. The metrological department of Ghana collects data about the weather. These weather data collected are cleaned, stored, and processed to make decisions on the weather and crimes. They are able to forecast the weather condition for the coming days using predictive algorithms and other statistical tools and technologies. These enable a timely and efficient decision and also speed up the decision making process. The Ghana Police Service as well gather data on criminal activities across the country about the committed crimes, location of the crime, the type of crime, the names of victims and criminals if any, whether arrests were made or not, etc. Huge sums of monies are allocated to the Ghana Police Service by the central government yearly in the annual budget of the country to enable the police administration perform their functions effectively. Monies are spent by the police administration to forecast crime and determined hotspots. Crime has become one of the major threats that are facing all countries of which Ghana is no exception. The perpetrators of crimes have made it a necessary evil for various scholars to research into crime and the behaviour of criminals in the society in which we find ourselves. It has also warranted the study of the application of predictive algorithms to enable the security service predict the occurrence of crimes.

It is no doubt to know that crime prevention and prediction manually has become a very complex activity by the Ghana Police Service and other security agencies leading to the large volume of crime data that is generated each year. Time and resources are daily spent at a high rate to make the police service combat the high rates of crimes and to accurately predict the amount of crimes to occurred in a given period and crime scenes through the studying of historical data. The trends and the correlation in the historical data are used to estimate the amount of crimes to be committed in a given period of time, what type of crimes are likely to be committed within a particular period, the prevailing crimes, the time and the day for a particular crime to be committed through the application of statistical knowledge. This method of estimating crimes and crime scene using historical data and the statistical tools and analytics tools and knowledge by

domain experts has helped the Ghana Police Service however; it will not be able to determine some deviations that are more likely to occur than machine learning can. As Ghana is getting prepared to go to the polls on 7th December, 2020, crimes relating to elections which are commonly referred to as electoral violence or political violence are highly anticipated to go on the rise. Electoral violence or political violence is a pervasive trait of the electoral period or election year in the county. These actions demand that the Ghana Police Service become very proactive by predicting such crimes and where it would occur often by the use of a model that has a proactive power to be able to perform accurate or high predictions. With Ghana gradually becoming more industrialized partly due to the recent oil found and the industrialized approach taken by the government, an anticipated pressure on the security services to provide security to citizens and investors is very necessary. It is the responsibility of the Ghana Police Service to be proactive as well as their ability to allocate resources where necessary. According to [15], Predictive analysis is a complex process that uses large volumes of data to forecast and formulate potential outcomes of an event. In a criminal jurisprudence, the work of estimating and combating crimes rests mainly with police, probation practitioners, and other professionals, who must gain expertise in the subject area over many years and it is time-consuming and subject to bias and error. [16] The causes of crimes differ from country to country due to different culture, economic and social characteristics and have therefore divided causes of the crimes primarily relating to economic situation, social environment and family structure. [17] In Ghana, crime is not limited to poor areas and this is where the relationship becomes unclear. [18] We urgently need a robust crime database that will complement our increasing use of intelligence to fight crime. Predictive policing and Prompt identification of suspected criminals through the application of artificial neural networks will increase the efficiency of police operations in order to better protect citizens against both internal and external threats. Given that many individuals and organizations and institutions are being established, the number of crime rate increases, researching into the use of machine learning and deep neural networks in combating crime is paramount. Crimes are committed on a daily basis and the security service has over the years been reactive and has relied on people for information on where, when and how crimes are being perpetuated. The security agency has over the years in the fight against crime use hotspots based on knowledge obtained from previous data. The hotspots are used by the Ghana Police Service to deploy their men-in-uniform where it has been established based on the historical data that the likelihood of crimes being perpetrated at these areas is high. According to [14], a hotspot is an area that has the highest rate of crime during the forecast which is regarded as the most dangerous area. This method is employed by the Ghana Police Service which does not help in the fight against crime, making the service reactive rather than proactive. It is important to know that as the crime rate in the country increases, the Ghana Police Service will need to adopt artificial neural network and machine learning techniques by developing a predictive model to help in the fight against crime.

Predictive policing applying artificial neural networks and machine learning are currently not utilized by the GPS. The method of forecasting based on historical data is used to forecast the likelihood of a crime being committed at a particular place.

How can the security agency leverage machine learning to predict crime? How can the security agency leverage machine learning to fully allocate resources to fight crime?

How can the security agency use machine learning to discover crime pattern in the society?

How can the security agency apply machine learning to optimize their operations in crime combat?

How can the Ghana Police Service also utilize the biometric data from the NIA to extract the full data about a criminal through the use of an image recognition model?

Hence the use of machine learning algorithms and artificial neural network techniques will be applied in this work to the Chicago crime datasets comprising of criminal activities to determine various what crimes are likely to be committed, the various months in which crimes are committed, the years that crime rate are likely to either increase and reduce, and the various clusters of crimes and factors that could cause the decreased or increase in crime rate at a particular time period.

IV. SOURCES OF DATA

A secondary data is the type of data that has already been collected by means of a primary source and it's been made available for researchers to use for their own research. This data may be collected for general use with absolutely no specific research purpose. Sources of data which are classified as secondary data sources include books, personal sources, journal website, government record, non-governmental organizations, and newspapers among others. The prevalence of the internet and the electronic media has made access to secondary sources of data easy without any difficulties. It saves time without spending much time in collecting data, providing cost efficiencies. It serves as the baseline for the primary research helping in research design and is associated with a quantitative database serving as a legitimate avenue for quantitative research.

In this research work, a secondary source of data will be the basis. Secondary sources will be used to collect all data relevant for the study. This secondary data for the research work will be the Chicago Crime datasets. The Chicago Crime datasets will be the primary focus of this work however if possible data on crime activities on rural and farming households and their accessibility to state security in the event of a commitment of a crime may be considered and shall be stated wherever applicable

V. DATA COLLECTION AND PREPARATIONS

Data collection is the process by which data is gathered or collected through relevant sources to find solutions to a research problem, to test a hypothesis of the research and evaluate the outcomes. Data collection is an important part of quantitative research which captures quality evidence allowing analysis to lead to the formulation of a credible solution to a problem.

A dataset is a container for our data storage which is mostly presented in a two dimensional array form. It is made up of series consisting of some rows and columns. The dataset for this work involve 22 attributes. The data is preprocessed using data mining techniques to transform the raw data into an efficient, useful and meaningful format.

VI. DATA VISUALIZATION

Data visualization is the means of conveying information to users in a graphical view. This can be in the form of graph, maps, etc. I can be said to be a graphical representation of information for easy understanding and interpretations. The important information in the dataset is exploited to obtain good information about the Chicago crime dataset. This is done through the process of Exploratory Data Analysis (EDA). This enables us to see some useful trends in the dataset.

VII. TRAINING OF THE ALGORITHMS

After the data has been cleaned, exploited and visualized, it is time to select the machine learning model. Selecting or choosing a machine learning model enables us to perform the work easily and also to obtain the right predictions we expect. Some of the machine learning models includes Classification, Regression, Dimensionality Reduction and Clustering. The choice of the model to use shall depend on the amount of data available for the purpose of the training and testing and prediction. It is also very paramount to note that the choice of model selection also depends highly on the problem to be solved. In machine learning a model is created in order to predict the outcome of the event such as predicting the crime rate, the price of a house among others. After the model is created, the performance of the model is calculated using the method called Train and Test.

VIII. EVALUATION OF THE MODEL

The important part of performing a predictive modeling is evaluating the model. A machine learning model is always evaluated to determine how good the model is at predicting the target of the new and future data. Model evaluation aims at estimating the general accuracy of a model on future data. The methods for evaluating a model's performance are divided into two main categories namely, holdout and Cross-validation methods. Cross-validation is also called out-of-sample testing used to determine how well the result of model generalizes well to an unseen dataset. It involve partitioning the original observation into training set which is used for training purpose and an independent set which is used to evaluate the performance of the model. The most common cross validation technique is called k-fold cross validation. The holdout validation is to test the model on a different data than the data it was trained on to provide an unbiased estimate of the learning performance. It involves the random division into three subset namely Training set, validation set and the

test set. Both methods use a test set to evaluate model performance. It's not recommended to use the data used to build the model to evaluate it. The reason being that the model will simply remember the whole training set, and will therefore always predict the correct label for any point in the training set which will result in overfitting of the model.

IX. EXPLORATORY DATA ANALYSIS

The entire dataset is visualized and analyzed. And missing values were all dropped from the dataset before prediction. Seaborn and matplotlib were used for the purpose of visualization.
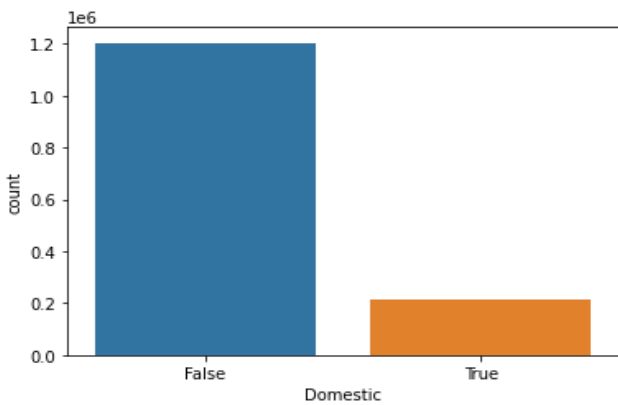
Figure 1

From the dataset between 2012 and 2017, the number of domestic crimes committed were 12000000 and 200000 represents the total number of other crimes.

A total number of 110000 offenders could not be arrested while about 40000 arrests were made by the police department. This is represented graphically below.
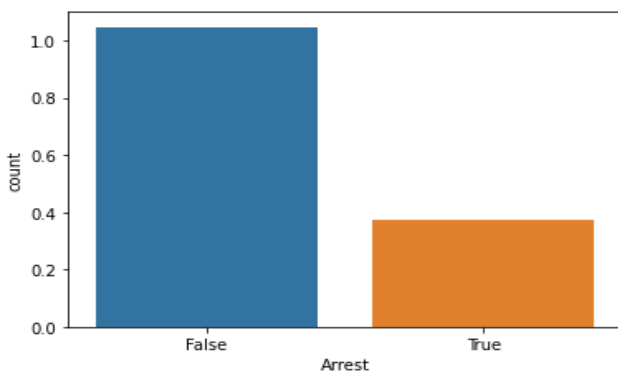
Figure 2

The data was studied to observe the top ten (10) crimes that are committed with theft being the most crimes to robbery in the topmost crimes. A little over 300000 thefts were committed in the between 2012 and 2017 with robbery of a little over 50000 crimes in the years as the least crime among the top 10 crimes between 2012 and 2017.

A top 10 crimes that were committed is shown below in the graph
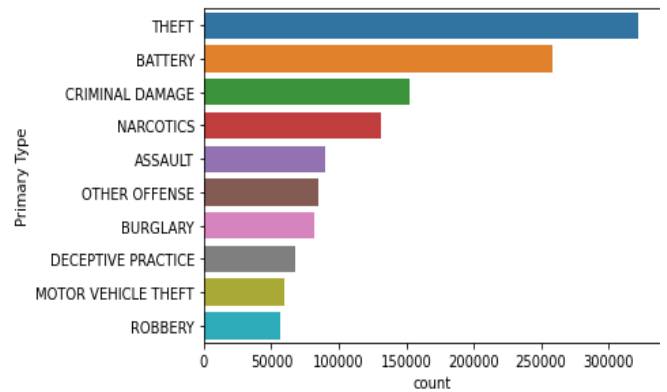
Figure 1

From the analysis from the below figure 4, the number of crimes committed appears evenly distributed across days of the week. We cannot therefore say that crimes are more likely to be committed on a particular day of the week however, it is imperative to assume Thursday to be the day which crimes are committed most since it has the highest number of crimes committed and Saturday has the least.
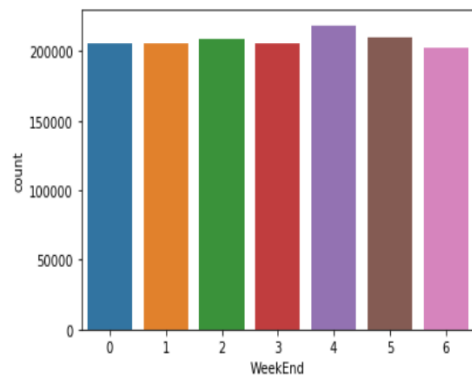

Figure 2

X. LOCATION OF CRIMES

The history data was visualized to present the description of crimes that are committed and the frequency. From the diagram below, it is observed that the top four crimes are committed on STREET, RESIDENCE, APARTMENT and SIDEWALK. Other crimes are committed on OTHER, PARKING LOT/GARAGE, ALLEY, RESIDENTIAL YARD, SMALL RETAIL STORE and SCHOOL, PUBLIC and BUILDING. Street crimes are the most committed crimes which records 330471 incidents. The least crime is committed in School, Public and Building.
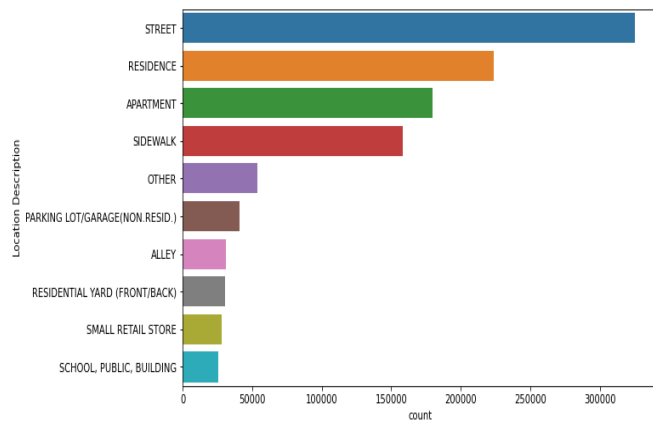
Figure 1

From the exploratory analysis being done on the historical data, the location of crimes is exploited to determine the District with the highest crimes. From the diagram below, the lowest amount of crime is committed in the District 13. District 11 recorded the highest crime between the year 2012 and 2017.
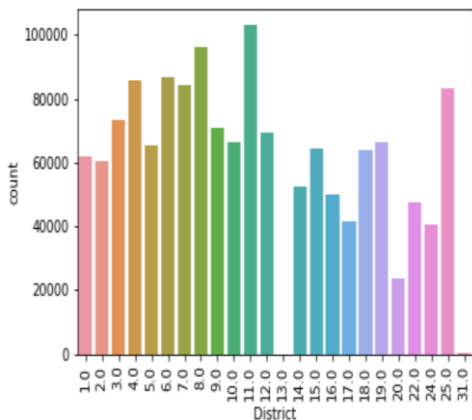

Figure 2

From the below plot in figure 7, it can be inferred that more crimes were committed between May and August of which July has the highest number of crimes. The month of February has the lowest number of crimes which can be as a result of the fact that it has lesser days in the year. Figure 5.8 and figure 9 also indicates crimes that are committed per day graphically from the year 2012 to 2017.
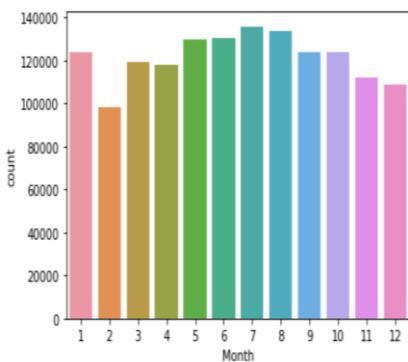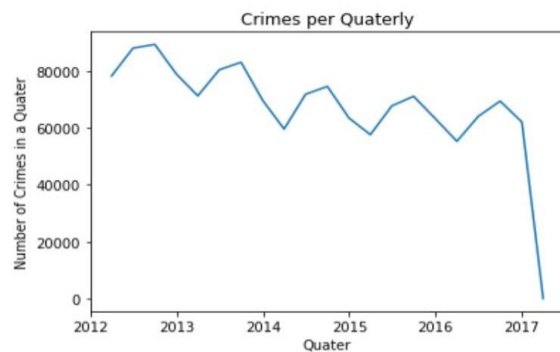

Figure 3
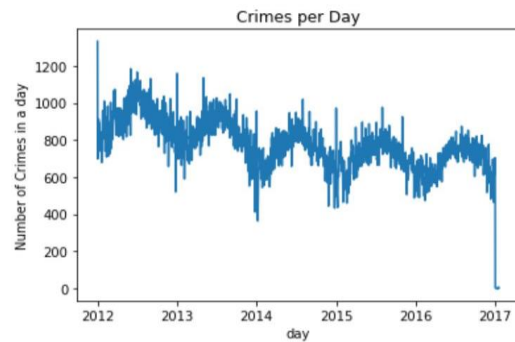
Figure 4

Figure 5

XI. THE PROPET

The Prophet is a tool developed by Facebook for the purpose of time series forecasting. It is one of the tools that are capable of predicting at a reasonable quality. It is an open-source tool based on an additive model where nonlinear trends are fit with yearly, weekly and daily seasonality. It also has holiday effects. It is used in many applications for the production of reliable predictions.

In this work, the Prophet is used for the purpose of modeling the dynamics of crimes. This is done to enable the generation of daily, weekly, monthly and quarterly crime predictions.

In application of the Prophet, it is very important that at least a 24 month of the historical data is made available for the efficient and reliable estimation of the various trends. A quality prediction is very important after the model evaluation. Making predictions or estimations on historical data of the likelihoods about future events is what is called predictive analysis. It gives us more knowledge into the future based on probability and machine learning and artificial intelligence. Machine learning focuses on predictive analysis through the combination of historical data to make inferences.

An example of using Facebook's Prophet Tool to forecast the future crime for the crime dataset per month is shown below in table 2.

Table 1

S/N	Dates	Actual Crimes(y)	Predicted Crimes(yhat)
1	2014-02-28	17684	17892
2	2014-03-31	19155	22005
3	2014-04-30	20949	22519
4	2014-05-31	22619	24413
5	2014-05-31	20203	24867

According to the historical data, the highest crime was committed in the year 2012 with a total number of crimes as 334397 and the year 2017 recorded the lowest in terms of the crimes committed. This is shown in the figure below.
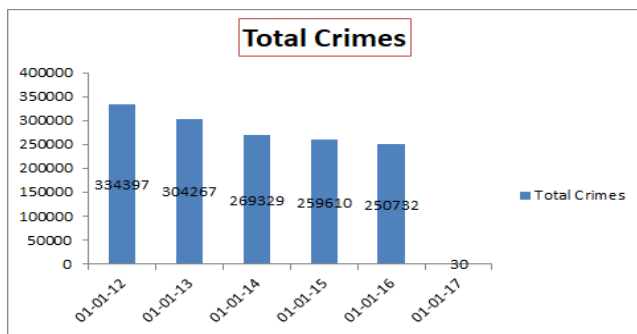
Figure 1

The model was able to predict the total number of crimes that could be committed in months for 1460 days representing 4 years based on the historical data that was obtained. This is from the year 2018 to 2021. The model predicted a decrease in the number of crimes that are likely to be committed with 2021 expected to record the least crimes. It is important to note that the number of crimes keeps declining each year since 2012.

The model also predicted the least crimes to be in the period 1st to 30th January, 2021 as 10978 as compared to 1st to 30th January, 2017with the least crimes committed as 30 in the historical data. The table below is the forecast components which plot the trend, yearly and weekly seasonality of the Chicago crime datasets between 2012 and 2021. We therefore visualize the prediction of the crime from the year 2018 to the year 2021.
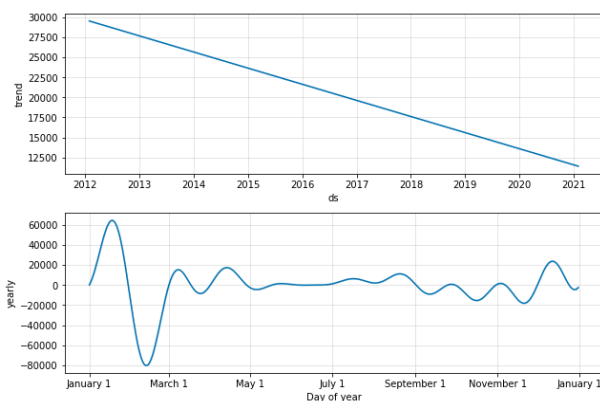

Figure 2

From the diagram below, the blue line in the graph represents the predicted values which are the prediction and the black dots represent the data in the historical dataset.
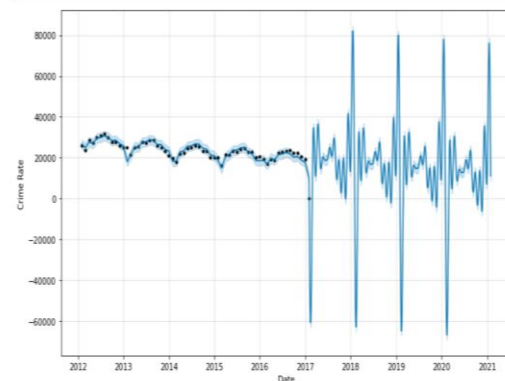

Figure 3

XII.   MODEL PERFORMANCE METRICS

The performance metrics utility can is used to compute useful statistics of the prediction performance as a function of the distance of how far into the future the prediction was.

Three main performance metrics are computed in this work namely Mean Squared Error (MSE), Root Mean Squared Error (RMSE) and Mean Absolute Error (MAE).

-Mean Squared Error is the average of the square of the distance between the actual values and the predicted values. This is defined mathematically as;

$$MeanSquaredError = \frac{1}{N} \sum_{j=1}^{N} (y_j - \hat{y}_j)^2 \tag{1}$$

-Mean Absolute Error is the average of the difference between the Original Values and the Predicted Values. It gives us the measure of how far the predictions were from the actual output. However, they don't give us any idea of the direction of the error i.e. whether we are under predicting the data or over predicting the data. Mathematically, it is represented as

$$MeanAbsoluteError = \frac{1}{N} \sum_{j=1}^{N} |y_j - \hat{y}_j| \tag{2}$$

-Root Mean Squared Error is another very good performance metric which is the variation of the Mean Squared Error. It determines the mean deviation that is in the predicted values from the actual values. It is based on the assumption that error is unbiased following a normal distribution. It is defined mathematically as:

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N} (Predicted_i - Actual_i)^2}{N}} \tag{3}$$

The table below is the metrics of our model for a given period or horizon using the facbook prophet.

Table 1

Horizon	MSE	RMSE	MAE
48	1.606	12.67	8.35
51	1.600	12.65	8.17
53	1.74	13.22	9.45
56	1.64	12.81	8.52
59	1.90	13.79	10.49

XIII. EVALUATING OUR MODEL

This includes the selection of the measure as well as the actual evaluation; seemingly a smaller step than others, but important to our end result. It is as important as the quality of our predictions since it helps to know how well the models perform in real world situations.

The model evaluation is done after the training of the model using a cross validation. In machine learning, our dataset is trained and the model is generated which is compiled. After the training, the model is then evaluated to see its performance on the training data and the test data. The validation is the process by which a part of the training data is aside for the validation of the model accuracy. Cross validation procedure is used to validate the model. This cross validation procedure is done automatically for a range of historical cutoffs using the cross validation function provided in the Facebook prophet module. The horizons, the initial period and the spacing between the periods are specified.

A data frame as output is provided by the cross validation process. This presents us with the true values represented, 'y' and the predicted values, 'yhat' each for a predicted date and the cutoff date. The prediction is made for each of the observed data points between cutoff and the cutoff horizon. The 'y' and 'yhat' is used to calculate the error or the difference between the actual values and the predicted values to enable us obtain the residual values of our model. The cross validation was performed to compute the performance of the prediction for a period of 365 days. The cross validation began with 730 days of training data in the initial cutoff and predictions are performed after every 30 days. The figure below depicts the cross validation process for a period of 30 days.

After the cross validation process, an output is obtained. The content of the cross validation is the dates, the actual values (y), the predicted or forecast values (yhat), the uncertainty intervals namely the yhat_lower and yhat_upper and the cutoff point.

XIV. RESULTS

The forecast or prediction is evaluated on real-world data. More resources should be allocated to the police department to fight crime. It can be concluded that most crimes occur on the street, residence followed by school, public and building and therefore, most police personnel must be deployed to these areas. Much resources and logistics must be allocated to fight crimes in these locations. According to the exploratory data analysis on the historical data, it can be concluded that most offenders are not arrested of crimes that they have committed. Much as 110000 offenders were not arrested while only 40000 offenders of various crimes were arrested. This could be due to the wrongly allocation of logistics to places with less crimes. On the average, more crimes are committed between the month of May and August each year. The month February is the month with the least crime rate and this can be attributed to the fact that it has fewer days in the year.

It was also discovered that crimes are committed between the hours of 5:00pm and 10:00 pm. However it is very imperative to understand from the data that most of the crimes are committed at 12:00 noon during the day.

With regard to District level crimes, it was observed that District 11 is the district with the highest crime between 2012 and 2017. This is followed by 7, 4, 25 and 6. This is an indication that more logistics and personnel will be required in those Districts to help prevent crimes from being committed.

The overall trend is that the crime rate keeps decreasing from the forecast in each year. We now know that most crimes happen on street and on sidewalks therefore we need extra police personnel on street patrolling. A lot of crimes are in residence and/or apartments therefore the Police Service will require more personnel to respond to destress 911 calls from people.

XV. CONCLUSION

In this paper, Facebook Prophet was used by applying machine learning. The model used Facebook prophet to predict or forecast crime. It is recommended for the Ghana Police Service and other security agencies to apply machine Learning and artificial Intelligence in the combat of crimes in the country. The Police Service can use this method to forecast crimes in the country. The amount of crime to be committed in the year and month. It is hereby concluded that, it is very necessary to ensure that Ghana Police service and other security agencies apply Machine Learning in crime predictions and also apply it in detecting crimes, its occurrence, where there is high probability of crime to be committed. This will also enable the service to be able to allocate more resources to place where much resource will likely be needed. In conclusion, this work provides the institution with much information and intuition on the use and application of machine learning to enhance the decision making process and the fight against crimes.

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