Amity Journal of Computational Sciences
ISSN 2456-6616 (Online)
Volume 7, Issue 1, 2023

Crime Rate Prediction Using Machine Learning

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Abstract: ***The criminal cases are increasing rapidly in our country due to which number of pending cases are also piling up. The continuous increase in the criminal cases is proving that it would be very difficult to be classified and to be solved. Recognizing the criminal activity patterns of a place is very important in order to prevent it from happening any other case. The crime solving agencies are doing a better work and can do a better work if they have a good knowledge of the pattern of criminal activities that are happening in a particular area or region. The most difficult task will most likely be "proving" to legislators that it works. It's tough to establish the negative when a system is meant to prevent something from happening. A positive feedback loop would certainly benefit companies who are directly involved in providing governments with ML capabilities to monitor areas or predict crime. Improvements in crime prevention technology will almost certainly lead to an increase in overall spending on this technology. The proposed system leverages historical crime data, demographic information, socioeconomic factors, and other relevant features to train and fine-tune machine learning algorithms. Various algorithms such as decision trees, random forests, and support vector machines are employed to analyze and predict crime rates for specific geographical areas. The project aims to provide law enforcement agencies with a valuable tool for proactive crime prevention and resource allocation, allowing them to allocate personnel and resources more efficiently in areas with a higher predicted crime rate. Additionally, the insights gained from this project can aid policymakers in making informed decisions to address the underlying socioeconomic factors contributing to crime in different regions.***

I. INTRODUCTION

Crime is a persistent and complex societal issue that affects communities worldwide, posing significant challenges for law enforcement agencies and policymakers. Accurate prediction of crime rates is crucial for effective resource allocation and proactive crime prevention. In recent years, the integration of machine learning (ML) techniques into the field of criminology has shown promise in enhancing our ability to forecast crime rates, providing valuable insights for law enforcement agencies and policymakers. The significance of this project lies in its potential to revolutionize the way we approach crime prevention and public safety. By accurately predicting crime rates at different spatial and temporal scales, law enforcement agencies can make informed decisions about resource allocation, personnel deployment, and targeted intervention strategies. Moreover, policymakers can utilize the insights derived from this predictive model to address underlying socio-economic factors contributing to crime and implement evidence-based policies to reduce crime rates. In this project, we will employ a range of ML techniques, including decision trees, random forests, and support vector machines, to create and evaluate our predictive model. Data preprocessing methods will be applied to ensure data quality, handle missing values, and feature engineering to extract relevant information. In conclusion, the crime rate prediction system using ML holds great promise as a valuable tool in the field of criminology and law enforcement. This project aims to contribute to the ongoing efforts to improve public safety and reduce crime rates by harnessing the capabilities of machine learning to make accurate predictions and inform evidence-based decision-making in this critical domain.

1.1 PROBLEM STATEMENT

The models for the crime prediction methods will be used to search through data found in the police archives for data on specific types of crimes as well as the records on different details of their occurrences, with variables that influence the probability of occurrence studied to get better.

II. PROPOSED ALGORITHM

(a). K-Nearest Neighbours

The K-Nearest neighbours (KNN) algorithm can be utilised for both regression predictive and classification problems. This algorithm suits all considerable parameters. It is usually utilised for its lower calculation time and ease of interpretation. There is no need to make additional assumptions. It works easily on multi-class problems. The KNN algorithm predicts that alike things subsist near each other. We can also say, alike things are nearby. For distance calculation, it uses Euclidean, Manhattan, and Minkowski distance functions. The process is to run the KNN algorithm several times with diverse K-value sand select the value of K that decreases the error number. Using a cross-validation method and by measuring accuracy or validation error, we get the optimal value of K.

(b) Decision tree algorithm

A decision tree is a tree structure where an internal node depicts a property, the branch refers to a decision rule, and each leaf node refers to the outcome. The topmost node learns to partition depending on the attribute value. It partitions the tree in a recursive manner called recursive partitioning. This

algorithm aids in decision making. The decision tree algorithm works in the following way:

a) Select the best feature utilising the Gini index or cross-entropy to divide the records.
b) Makes that feature decision node and splits the set of data into smaller subsets.

III. LITERATURE SURVEY

A literature survey is used to give a succinct but thorough review of the studies and research articles that have been done on a particular topic. The data was/is presented as Crime research is a tool used to define criminal activities and study them. If the research conducted so far can be seen to be more specifically useful, it is mostly because it indicates which criminal types are useful in controlling crime, then, mostly they would it be places where violent crimes are reduced. It is an excellent method for measuring the crime rate because of each region can be broken down by procedure and the data is collected for any of each process to be examined. Through the rapid increase in information technology, crime analysts will be able to continue to enhance the investigations and help them interpret the evidence. on the sample clustering and preprocessing to get unstructured evidence, and then look for crimes inside it. Thus, persons formerly investigated and then arrested or identified as having committed the same criminal behaviour may often be looked at at for patterns such as criminal history, or incident reports, rather than only offences themselves. This is simply intended to direct law enforcement resources to where crimes can occur, without attention to identifying who is responsible. Bayesian classifiers were used as the current scheme was in use in place. In the current methodology, the fuzzy C-Means algorithm will be used to group the crime data for all items that are apprehensible, apprehension of, physical assault, larceny-theft, and crime of women, as well as all criminal offences such as kidnapping, in the dataset.

Nafiz Mahmud, Khalid Ibn Zinna, “CRIMECAST: A Crime Prediction and Strategy Direction Service [4], The data was/is presented as the wide variety of studies on criminology is valuable in providing us with a new information on criminal psychology. Criminals don't live in uncertain territory; they wait before they have an easy target to commit offences, in which case there are clustered areas like hotspots of people or strangers. It is possible to simulate a crime forecasting model using evidence that can be checked in the fact of past crimes, as long as it has been publicly available, there is enough time enough to verify. This paper intends to show how the CCRIMBA's artificial Neural Network has been broadened to include the CRIMAST, a crime prediction and threat management service which assists law enforcement in training and testing criminologists to work with Neural models. the CriMA employs spatial techniques, which concentrate on legitimate crime patterns of crime and generate defence strategies, designates areas vulnerable to criminal action, and then broadcasts security warnings. Our simulation with a large dataset shows that CRIEC can be much more effective than other models in terms of predicting crime. Mary Shermila A, “Crime Data Analysis and Prediction of Perpetrator Identity using Machine Learning Approach [5], The data was/is presented as Prevention is one of the most prominent and important tasks we have in the realm of civilization. In addition to being a means of identifying and researching the usual patterns and developments of violence, it is also a systemic, scientific approach. the aim of this model is to make systems more effective at detecting and apprehending criminals This statistical model can be employed at the crime scenes to discover crime dynamics and to forecast the description of the criminal most probable perpetrator to be present based on inferences drawn from the site. This is a long, involved process of both physically expanding and philosophically advancing. Predictions on who is likely to commit crimes and how serious such crimes are the phase includes determining the number of open offences, which gauges the importance of different variables, such as the year, month, the weapons used, and the social class or demographics of the perpetrators. The prediction process is able to deduce how old, whether the suspect is male, female, and/how many years they've known the victim There are several theories from the investigation based on the information gathered on this area. The method uses multilinomial regression, k-neigh regression, and neural networks for classifiers like Multilearate Regression, kNeighbors, and KNeighbors for static entity definition. The machine learning algorithm was developed and thoroughly tested using the San Francisco homicide dataset (1981-2014) and then deployed using Python.

IV. IMPLEMENTATION

4.1. Data Collection

The Crime data set used in this project is in the CSV(Comma separated values) format.

4.2. Data Preprocessing

The dataset has 10000 entries. df=dropna( ),where df is the data frame,is used to remove null values. Label Encoder is used to translate category attributes(Location,Block,crime types,Community Area)into numeric values. The date attribute has been separated into additional characteristics such as month and hour, which can be utilized as model features.

4.3 Feature Selection

The features that will be utilized to build the model are chosen. Block, Location, District, Community area, X coordinate, Y coordinate, Latitude, Longitude, Hour and month are the attributes used to pick features.

4.4 Building and Training Model

The location and month attributes are used for training after feature selection. The dataset is split into xtrain ,ytrain and x

test and y test pairs. Sklearn is used to import the algorithm model. Models are used to create models a good fit(xtrain,ytrain).

4.5 Prediction Model

predict is used to make predictions after the model has been developed using the above process(xtest). The accuracy is determined by importing accuracy score from metrics-metrics. accuracy score (y test, predicted).

V. RESULTS AND DISCUSSION

Different classification methods such as decision tree, K-Nearest Neighbour (KNN), and random forest algorithm have been utilised to forecast different characteristics of crime data. In this paper, two types of attributes are used to predict crime. One is crime type and the other is the number of arrests. The following section discusses the two types of attributes in detail.

5.1. Prediction Of Crime Types

Using the KNN, decision tree, and random forest algorithms, we have predicted different sorts of crimes. Assault, burglary, theft, robbery, weapons violation, car theft, and public peace violation are among the several criminal kinds that exist. 632 instances and 9 attributes have been used in our study. For measuring results, a 10-fold cross-validation method has been used. Examining for both training and testing is a benefit of the cross-validation technique. And for the test set, each observation was used exactly once. In every instance, 25% of the data set was split for testing and 75% for training. Precision, recall, F1 score, and MCC were measured with the help of the confusion matrix. Table 2, Table 3, and Table 4 show the outcomes for KNN and decision tree, and random forest respectively.

We can observe from Tables 2, 3, and 4 that the majority of examples have precision values between 0.93 and 1.00, with 1.00 being the best. It holds true for recall as well; the majority of recall values fall between 0.94 and 1.00. Recall has a best value of 1.00. The F1 score ranges from 0.92 to 1.00, with 1.00 being the ideal number. The range of the MCC score is 0.92 to 0.99. We can therefore conclude that our experimental findings are extremely close to the best values for precision, recall, F1 score, and MCC. We use K (number of nearest neighbors) = 7 for the KNN method. Using a confidence factor (CF), the decision tree method has been developed. CF is used for pruning. Larger CF gives more specific rules to predict the target class. In this paper, we applied CF = 0.45. For the random forest algorithm, batch size and number of iterations have been used. For this paper, both the batch size and the number of iterations are 100. For all the cases, we used different types of numbers in these parameters (K, CF, or batch size). But we chose the number with which we get the best result.

5.2. Prediction of the arrest record

With the use of the KNN, Decision Tree, and Random Forest algorithms, we were able to forecast the arrest attribute, which indicates whether or not criminals will be apprehended. The two goal classifications here are arrest and not arrest. We used the Chicago crime dataset from 2001 to the present for this prediction [16]. The input data include primary kind, local description, beat, district, domestic, ward, neighborhood, and FBI code. The 10-fold cross-validation technique has been used for analysis, hence removing the possibility of overfitting the data. Accuracy, precision, recall, F1 score, and MCC have all been used to gauge performance. In each example, the split of the data sets was 25% for testing and 75% for training. Tables 5, 6, and 7 display the precision, recall, and F1 data.

We can observe from Tables 5, 6, and 7 that the majority of the examples have precision values between 0.79 and 0.89, with 1.00 being the best. It holds true for recollection as well; the majority of recall values fall between 0.44 and 0.58. Recall has a best value of 1.00. The F1 score ranges from 0.56 to 0.64, with 1.00 being the ideal value. The score for MCC ranges from 0.55 to 0.61. Most of the time, the precision, recall, F1 score, and MCC values in our trial findings are not even near to the best values.We used K (number of nearest neighbors) = 7 for the KNN algorithm. The Minkowski distance computation has been applied here in order to measure distances.

Using a confidence factor (CF), the decision tree method has been applied. When pruning the decision tree, the confidence factor serves as a threshold for permitted inherent inaccuracy in the data. We choose attributes based on the Gini index criterion. We used CF = 0.45 for all the tests in this research. Batch size and iterations have both been employed with the random forest technique. The batch size (the number of samples obtained at a time) and iterations for this experiment are both fixed at 100. We employed several types of numbers (K, CF, or batch size) in these parameters, just as we did with crime types. However, we went with the number that gives us the best outcome.

VII. CONCLUSION

In conclusion, this minor project on crime rate prediction using machine learning has provided valuable insights into the potential of ML techniques in addressing the complex issue of crime rates in our society. Through a comprehensive exploration of historical crime data, socio-demographic factors, and geographic features, we have developed and evaluated predictive models that offer the promise of enhancing law enforcement strategies and public safety measures. While this minor project has made significant progress in the field of crime rate prediction using ML, it is essential to acknowledge that crime prediction is a multifaceted issue. Continued research and collaboration with law enforcement agencies and policymakers are necessary to refine and deploy these models effectively in real-world scenarios. As we move forward, it is clear that the integration of machine learning into crime prevention efforts has the potential to make a meaningful impact on public safety. By leveraging the power of data-driven insights and predictive modeling, we can work toward reducing crime rates, improving resource allocation, and ultimately creating safer communities.

VIII. FUTURE ENHANCEMENT

From the encouraging results, we believe that crime data mining has a promising future for adding the effectiveness and effectiveness of felonious and intelligence analysis. Visual and intuitive felonious and intelligence disquisition ways can be developed for crime pattern. As we've applied clustering fashion of data mining for crime- analysis we can also perform other ways of data booby-trapping similar as bracket. Also, we can perform analysis on colorful dataset similar as enterprise check dataset, poverty dataset, aid effectiveness dataset, etc.

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