

INFLATION-CRIME NEXUS: A PREDICTIVE ANALYSIS OF CRIME RATE USING INFLATIONARY INDICATOR IN MUNICIPALITIES OF NORTH COTABATO, PHILIPPINES

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ABSTRACT

Predicting the occurrence of robberies poses significant challenges, requiring valuable data to assist law enforcement personnel in crime prevention and solving efforts. This research paper introduces Crata, a tool that leverages linear regression to predict the robbery frequency in North Cotabato, Philippines. The development of Crata was driven by the analysis of historical data encompassing robbery incidents and inflation rates from 2010 to 2022. The research emphasizes the importance of utilizing the inflation rate as a crucial predictor in determining the robbery frequency. By incorporating this variable into the predictive model, Crata enables more accurate predictions, thus empowering law enforcement agencies with vital insights to address and mitigate crime problems proactively. The robustness and reliability of the tool were assessed through comprehensive evaluations, demonstrating its practical utility and effectiveness. This paper significantly contributes to crime prevention by providing a reliable and data-driven approach to anticipating robberies, enhancing proactive efforts to safeguard the community, and combat crimes. Further research and development are warranted to refine the tool and expand its applicability to other regions for strengthening crime prevention strategies on a broader scale.

KEYWORDS

crata; linear regression; predictors; crime analysis; probability

1. INTRODUCTION

Crime is one of the most disturbing social problems in the country, affecting public safety, children's development, and adult socioeconomic status. Owing to the rapid development of location technology and the widespread use of mobile devices, modern urban data has been collected, and these big data can provide new perspectives for understanding crime [1]. With this, data analysis is being utilized. Data analysis is the process of cleaning, changing, and processing raw data and extracting actionable, relevant information that helps make informed decisions [2]. Crime prediction has become crucial for public security agencies to prevent and combat crimes, which supports police operations more [3]. Most crime prediction methods consider historical crime data when estimating crimes retroactively [4].

A research that focuses on applying and assessing the Risk Terrain Modeling (RTM) technique, which identifies locations where there is a high likelihood that a crime event will occur, was conducted in Austria. Predictions for the crime occurrences of assault, auto theft, burglary, and

robbery for 2013 and 2014 are made using the city of Salzburg as an example. As a result, robberies and assaults, with respective PAI values of 31, 23, and 18, achieved the highest levels of prediction accuracy. Results for the season's spring and summer are also included. Overall, Austrian cities can benefit from the RTM technique. However, the predictions' precision varies [5].

The Philippines' rising population, poverty, and hunger were claimed to impact the country's crime rate. The urbanization of cities has generated slums with the highest levels of poverty and petty criminality. It was highlighted that determining the criminals' motivations led to the conclusion that small crimes were the norm because they cannot pay to buy the item, such as robbery, stealing, and theft. A BBC news segment hypothesizes that a 1% inflation rate will result in a 0.02% increase in crime [6].

In Culuan, Laguna, Philippines, effectively created a management information system to predict crime using predictive crime analytics. The software development life cycle was found to be effective. Multinomial logistic regression created a predictive model with a total accuracy and prediction confidence of 86.60%. Additionally, it demonstrates that regression is more accurate at predicting the occurrence of crimes than alternative classification techniques [7].

Based on the reports released by the Cotabato Provincial Police Office, there were 326 crime incidents reported in 2021 in the province, down from the recorded 485 crime incidents in 2020. According to the report, as of January 2022, the Midsayap, North Cotabato, eight specified offenders' peace and order index fell by 33% in 2021 compared to the previous year. Midsayap Police Station (MPS) promotes peace and order in the municipality and imposes [8] strict security measures following the crimes that happen in the municipality [9].

In this study, a tool was developed to analyze the crime data from 2010 to 2022 in the 18 municipalities of North Cotabato, Philippines. The tool utilized linear regression to forecast the probability of robbery. Moreover, the inflation rate was used as the predictor, which will be the basis of whether the inflation rate is effective in terms of predicting the crime rate frequency. Crata stands for Crime Rate Analysis, hence the name of the tool.

1.1. Theoretical Framework

This study is based on Linear Regression Analysis Theory. The regression analysis is a technique used to determine the relationship between the predictors (also known as independent variables, explanatory variables, control variables, or regressors, and typically denoted by x_1 , x_2 , ..., and x_p) and one or more response variables (also known as dependent variables, explained variables, predicted variables, or regressands, usually denoted by y) [10]. This paper developed a tool that uses linear regression analysis in data mining to analyze and give a probability of the forecasted robbery cases in North Cotabato, Philippines, using the inflation rate as the predictor.

1.2. Conceptual Framework

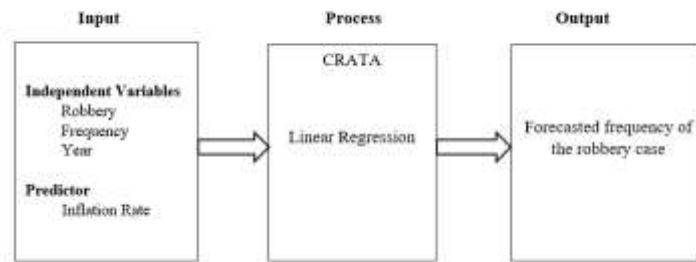


Fig. 1 Conceptual Framework of the Study

Fig.1 shows the conceptual framework of the study. Crime Type, Frequency, and Year were the study's independent variables, while the Inflation Rate was used as the predictor. The data were analyzed using Crata, and a Linear Regression Model was used to predict the robbery case frequency.

2. RELATED WORKS

2.1. Data Mining

A course recommender system was developed to predict which courses the incoming college students at Notre Dame of Midsayap College will find most valuable. The study uses multiple regression, a data mining approach, to forecast the Cumulative Semestral Grade Point Average (CSGPA) using Entrance Exam (EE) and High School Grade Point Average (HSGPA). The study highlights that Educational Data Mining (EDM) is crucial to the study's course recommender system. Educational data analysis, particularly student achievement, is crucial [11]. The academic area known as Educational Data Mining (EDM) focuses on analyzing educational data to uncover intriguing trends and information in educational institutions. The study investigates several variables theorized to impact students' success in higher education. It identifies a qualitative model that best categorizes and forecasts the students' performance based on pertinent personal and societal variables [12]. EDM focuses on creating and applying data mining techniques to make analyzing huge volumes of data from various educational contexts easier. One of the most crucial jobs in the EDM sector is to predict students' development and learning outcomes, such as dropout, performance, and course grades. The study examines the effectiveness of automated Machine Learning (autoML) for predicting students' learning outcomes based on their participation in online learning platforms [13].

A study [14] used data mining to analyze the Indian e-commerce business and forecast the demand for reconditioned gadgets. Based on the findings of their investigation, the suggested technique may produce extremely accurate forecasts despite the effects of variable customer behavior and market circumstances. In another study [15], the researcher provided a methodological analysis of data mining, concentrating on its data analysis procedure and emphasizing some of the most important concerns associated with its use in clinical practice. They restrict the paper's focus to predictive data mining, whose approaches are methodologically mature, often accessible, and perhaps appropriate for the issues resulting from clinical data analysis and decision support. Most scientific disciplines, including the medical sciences, employ data mining. Data mining methods have been used to diagnose illnesses like heart disease, diabetes, neurology, depression, and breast cancer. The project's major goal is to develop a more effective data mining algorithm, which will subsequently be used to extract rules for potential illness prediction [16].

The abovementioned pieces of literature highlighted the uses and benefits of data mining in different fields such as education, commerce, and health. In this study, the usefulness of data mining was also highlighted in crime prevention, especially in predicting the frequency of robbery cases.

2.2. Predictor and Crime Analysis

A study shows that people under 21 are accountable for around 28% of all offenses. However, the fact that they are just poorer than other age groups may cause their higher crime rates. Additionally, it is recognized that unemployment increases the likelihood of joining a group with dangerous relationships[17]. In a group of 35 untreated child abusers, the study looked at a few demographics, criminal history, and deviant sexual arousal factors as potential indicators of re-offense. Three components were identified using factor analysis of the predictor variables: Sexual Deviance, Social Status, and Offender Age. Over 20% of the variance in recidivism was explained by using the sets of three-factor scores as predictors in multiple correlation analysis. However, the component of Sexual Deviance was the only significant predictor for the study [18].

In another study [19], regression analysis's findings highlight the significance of socioeconomic factors, including unemployment, poverty, race, and family reliance on government aid in predicting both violent and property crimes. According to the findings, empirical measurements of the independent factors are more likely to predict rural property crimes than violent crimes accurately. The predictors' ability to accurately forecast the main forms of property crimes in American society may be credited largely for their efficacy in explaining property crime rates.

The literature that has been mentioned above uses demographic profiles and socioeconomics as the predictor to predict crime. However, this paper used the inflation rate to predict robbery cases in North Cotabato, Philippines. Also, this paper wanted to highlight if there is a significant relationship between the robbery rate and the inflation rate.

2.3. Algorithm

A pattern was analyzed in a study using a crime dataset from the Chicago Police Department. The major aim of the paper is to predict which crime category will take place at a detailed time and place in Chicago. The study used two algorithms, the random forest, and the decision tree, to evaluate the prediction's accuracy [20]. Another research uses an improved Decision Tree Algorithm to identify emails that appear to be concerning illegal activity. An upgraded ID3 algorithm was used with an improved feature selection approach and attribute-importance factor to identify and prevent suspicious criminal activity. The study aims to demonstrate the value of data mining technologies in creating preventative apps to identify shady criminal activity [21].

The KNN (K-Nearest Neighbor) and ANN (Artificial Neural Network) algorithms were used in the discovered Crime mapping analysis to streamline the procedure. Crime mapping is a crucial study subject to concentrate on for public safety. The researcher uses data mining techniques to identify the areas where crimes occur most frequently. To lower the crime rate, the researcher uses Crime Analysis Mapping, which involves gathering crime data, grouping data, clustering the data, and forecasting the data. To assist police and reduce and prevent crimes and criminal disorders, crime analysis using crime mapping helps understand the theory and practice of crime analysis [22].

The presented pieces of literature above used different data mining algorithms such as random forest, decision tree, K-Nearest Neighbor, and Artificial Neural Networks. However, this paper

uses a linear regression algorithm to predict the frequency of robbery cases from 2023-2027 in North Cotabato, Philippines. The variables used in this study are the robbery, year, and frequency; the predictor is the inflation rate.

Linear Regression can be written as:

$$y = b_0 + b_1 x$$

where;

b_0 = y-intercept for the population

b_1 = slope for the problem

y = the predicted value of y

x = explanatory variable

(1)

3. METHODS

This study utilized a descriptive-correlation research design. It focused on predicting the frequency of the robbery rate, using the inflation rate as the predictor utilizing the linear regression technique. This method aims to determine the relationship between the frequency of robbery cases and the inflation rate. The study was conducted at Notre Dame of Midsayap College, Midsayap North, Cotabato, Philippines. Data collection is done by getting the historical data on a robbery in terms of its frequency and what year the crime happened from the Freedom of Information Philippines [23]. The extracted data are from the robbery case and inflation rate in North Cotabato Province from 2010-2022 [24].

Descriptive statistics were used to get the mean and standard deviation of the variables. For the significant relationship of the variables, Pearson's R correlation was used to determine the relationship between the inflation rate and frequency of robbery. For the predictive model, the regression output formula was formulated by the coefficient of the variables.

The study used an adapted questionnaire to evaluate the tool's effectiveness. The survey questionnaire was composed of three parts: efficiency, convenience, and accuracy. A Likert scale was used to determine the answers of the respondents whether they agreed or disagreed with the statement provided [11]. The respondents of this study were five faculty and 40 students from the College of Criminal Justice Education, 55 students from the College of Information Technology and Engineering from the same institution, and 10 Police officers from the Midsayap Police Station, a total of 110 respondents.

4. RESULTS

4.1. Data Set

Table 1. The Mean and the SD of the Variables

Variables	Mean	Standard Deviation
Inflation Rate	1.17	2.04
Frequency of Robbery	92.53	4.96

Table 1 shows the inflation rate and frequency of robbery cases from 2010-2022. The mean for the inflation rate is 1.17 with a standard deviation of 2.04, which implies that the higher the value of the standard deviation, the greater the variability or dispersion of the inflation rate around the mean value, and there may be a period of higher or lower inflation rates compared to the mean.

Table 1 also presents the mean of the frequency of robbery cases, which is 92.53 with a standard deviation of 4.96, which suggests that the frequency of robberies may be higher than the mean or lower than the mean. To simplify, the frequency of the robbery could go higher from the mean of 92.53 or lower than 92.53.

Table 2. The Significant Relationship Between the Variables

Variables	Inflation Rate	
	r-value	p-value
Frequency of Robbery	-0.633	0.0203

Table 2 shows that the r-value of the frequency of robbery to the inflation rate is -0.633. It shows a strong relationship between the frequency of robbery and the inflation rate. Table 2 also presents the p-value, which is 0.0203, and is less than the alpha, which is $\alpha=0.05$. This means that the relationship between the Frequency of Robbery and the Inflation Rate is also significant for predicting the frequency of robbery cases.

Table 3. The Prediction Model

Variables	Coefficients	Std. error	t (df=11)	p-value	95% lower	95% upper
Robbery	268.1163	65.8182	4.074	.0018	123.2514	412.9812
Inflation Rate	-50.1657	18.5151	-2.709	.0203	-90.9173	-9.4142

Table 3 shows that the coefficient of robbery is 268.1163 with a p-value of 0.0018. Also, the inflation rate coefficient is -50.1657 with a p-value of 0.0203, which implies a significant relationship in predicting the frequency of robbery cases with the predictive model $Y = 268.12 + (-50.166)X$.

Crata Predictive Model

$$Y = -50.166 + 268.12 X \quad (2)$$

where;

- Y = Predicted value
- B0 = Y-intercept for the population
- B1 = slope of the problem
- X = predictor

Example: If the Inflation Rate is 3.03, the expected forecasted frequency of the robbery is:

$$Y = 268.12 + (-50.166) X$$

$$Y = 268.12 + (50.166) (3.03)$$

$$Y = 166.11$$

Table 4. Summary Results of the Crata Survey Questionnaire

CATEGORY	Verbal	
	Mean	Analogy
1. Efficiency	3.08	Agree
2. Convenience	3.09	Agree
3. Accuracy	3.08	Agree
Overall:	3.08	Agree

Table 4 shows the summary results of the survey questionnaire for Crata’s efficiency, convenience, and accuracy. The overall results show a mean of 3.08 with the verbal analogy of agree, which implies that Crata is efficient, convenient, and accurate in predicting the frequency of robbery in the 18 municipalities of North Cotabato, Philippines.

5. DISCUSSION

The proponents developed a predictive model after using linear regression analysis in the extracted data of the robbery from the year 2010-2022. The identified intercept coefficient is from the y-intercept value, while the inflation rate coefficient is from the slope. The data sets of the frequency of robbery cases and the inflation rate have shown a result of a mean and a standard deviation to be used for future prediction. The result of the study presented a p-value for the inflation rate, which implies that the relationship between the variables has significance since the p-value is less than the alpha. Therefore, the greater the inflation rate, the higher chance of predicting the frequency of robbery.

Moreover, the survey questionnaire yielded a positive result due to the respondents' feedback highlighting the tool's efficiency, convenience, and accuracy. Most respondents expressed satisfaction with the tool, citing its effectiveness in providing reliable and timely results.

6. CONCLUSION AND RECOMMENDATIONS

Based on the results, this paper concluded that there is a significant relationship between the inflation rate and the frequency of robbery. Using data mining and linear regression techniques, Crata is an effective tool in predicting the frequency of robbery in the municipalities of North Cotabato, Philippines. Also, the study’s predictive model for the prediction is $Y = 268.12 + -50.166 X$, whereas the Y-intercept is 268.12 and the slope is -50.166, and X is the predictor. The model demonstrates promising accuracy and reliability, highlighting the potential utility of inflation as a predictive tool for law enforcement agencies and policymakers in crime prevention and resource allocation.

Furthermore, the implications of this research are far-reaching, as it sheds light on an underexplored dimension of crime prediction. By considering the impact of inflation rates, law enforcement agencies can enhance their strategies and allocate resources more effectively, particularly during economic instability. Moreover, policymakers can utilize these findings to

design targeted interventions and policies to mitigate the potential adverse effects of inflation on crime rates.

This paper recommends incorporating the monthly rate of robbery cases alongside the inflation rate to investigate their relationship further. Additionally, future researchers should consider including other potential predictors that significantly influence crime rate prediction. Doing so can give a more comprehensive understanding of the factors contributing to crime rates. Furthermore, this study can serve as a valuable resource for future researchers, aiding them in identifying and employing additional regression techniques that can enhance the accuracy and effectiveness of crime rate prediction models utilizing the inflation rate as a key predictor.

In conclusion, this research paper contributes to the literature on crime prediction by emphasizing the relevance of inflation rates as a potential predictor. The study's findings and predictive model offer valuable insights for law enforcement agencies, policymakers, and researchers alike, facilitating evidence-based decision-making and interventions in crime prevention.

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