

**ADTA 5940 Section 002**

**Analytics Capstone Experience (Fall 2024 1)**

**Complete Draft of Project Paper - Group Assignment**

**Crime Rate Analysis in Los Angeles**

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| **NO.** | **TITLE** |
| 1 | Introduction:   * Background * Research problem * Research significance * Research questions |
| 2 | Literaturereview |
| 3 | Methods   * Data collection * Data preparation * Data analysis techniques and tools |
| 4 | Results/ Interpretation |
| 5 | Summary |

1. **INTRODUCTION**

**1.1 Background**

Crime is rapid growing concern in most of the places in United States. If we consider Los Angeles, there are crimes like robbery, assault, human trafficking, kidnapping, and property crimes which affected people physically, emotionally and financially. All these crimes not only disturbed the individual or their family lives, but it did create fear in the communities.

Law enforcement and police forces collected crime data from a variety of sources, like victims, official documents, and journalists, to prevent and control crime. Understanding patterns of criminal activity and executing preventative measures, like increasing more police patrols and setting up CCTV surveillance systems, will require this data. However, certain events might remain unreported because only the reported cases have been recorded. This highlights the need for effective data collection and more police presence in remote areas.

We can predict future crimes and identify trends through looking at historical crime data. This helps law enforcement organizations make decisions that improve public safety and effectively manage resources. We can act on crime issues by using data-driven methods like predictive modeling, which provide helpful details about how and when crimes occur.

**1.2 Research problem**

Crime remains on increasing in many cities, including Los Angeles, despite the efforts of law enforcement. For crime prevention and efficiency of resources, it is necessary to understand the root cause trends, temporal patterns, and impacts of interventions. Still, it is difficult to create focused solutions as crime trends vary depending on the time of day, the type of crime, and the location.

The following requirements have been solved by this project:

1. Analyzing crime patterns in different categories.
2. Using predictive models for predicting future trends in crime.
3. Share facts that will help improve public safety services and government policies.

Also, this study will investigate major socioeconomic factors that contribute to increasing crime rates, like poverty, inequality, and unemployment. The study's conclusions will improve law enforcement tactics and help in focusing on solutions.

**1.3 Research significance**

This project is crucial as violent crimes will cause serious harm, including long-term disabilities, emotional trauma, and homelessness. Other crimes, like property theft, human trafficking, and cybercrimes, can disrupt both social life and the economy.

Using data-driven insights will help us:

* Prevent serious crimes by identifying patterns early.
* Allocate resources more effectively for law enforcement.
* Predict vulnerable locations and times to focus preventive efforts by the enforcement.

This Research highlights how modern analytics and predictive techniques can help improve public safety. By exploring new approaches, we aim to reduce the crime rates and strengthen community resilience.

**1.4 Research Questions:**

1. Which type of crime mostly takes place in Los Angeles?
2. Which age groups are more involved in crimes?
3. Find out the correlation between time of the day and occurrence of specific type of crime?
4. How much percentage of crimes occurring in a gender wise?
5. Which areas are struggling with high crimes rate?
6. Find out whether the crime is increased or decrease from 2020 to the present?
7. Which type of weapons are mostly used to make maximum crimes?
8. Does the racial or ethnic background of victims correlate with the type of crime and location?
9. What are the seasonal trends in crime rates, and do specific types of crimes increase during certain months?
10. How many cases are resolved based on the year?

**Hypothesis Statement:**  
**Hypothesis 1**  
"Violent crimes occur more frequently at night, while property crimes peak during the day."  
Model used for analyzing the correlation between time of day and specific crime types,  
particularly testing if violent crimes occur more frequently at night and property crimes during the day we will be using logistic regression model.

**Hypothesis 2**  
"Crimes within a city are spatially with time periods experiencing higher crime rates"  
We use K-means clustering technique to cluster the crime data based on location.

**Hypothesis 3**  
"Crime rates in Los Angeles can be accurately predicted based on historical trends, time of  
year, and type of crime."  
Using a Arima forecasting model to forecast future crime rates for specific time periods.

1. **Literature review**

**2.1 Crime patterns and statistics over time**

As stated by Vivint (n.d.), the number of property crimes that occur during the summer months have increased. Most of the crimes like Burglary, rape/sexual assault, and murder occur in the same time of the year and according to the research the perfect time for criminal activity is in between 8 pm in the night till 2 am in the morning. Whereas Criminal activity was at its lowest from 1 a.m. to 7 a.m. As mentioned in a 2014 study conducted in Stockholm, Sweden by Ceccato and Uittenbogaard on the reflection of criminal activity over time and geography, various forms of criminal behavior take place at various periods. The weekends and evening times are most popular for violent crimes taking place.

As per the study by the Los Angeles Mayor's office(2024), there was a fall in property crimes and violence in 2023 when compared to the previous years. Shootings decreased by 10% while a few other occurrences, such killings, decreased by around 17%. Not all of this is a decrease, though; car theft was nearly 2.2 times higher.

**2.2 Patterns of location and the corresponding primary regions**

One of the main areas of attention for criminology researchers has been the perception of criminal conduct depending on place. Because a thorough grasp of this "law of crime concentration" is essential for allocating resources and creating tactics in law enforcement. Areas with low income have many off-premise alcohol shops so according to Gorman’s research one of the reason for increased crime rates is selling alcohol. The Los Angeles Police Department (LAPD) has applied data-driven approaches to traffic safety and crime which is known as DDACTS in short, this has shown impact in the city's context. In order to optimize police patrol routes, Kuo et al. (2013) examined the use of GIS to categorize crime and crash hotspots. Their results showed that using DDACTS principles to adjust for travel time to the most popular hotspots might cut dispatch times by 13–17%.

**2.3 Disparities in Race and Demographics**

A study conducted by Losstrom et al. (2023) from the Public Policy Institute of California revealed that the number of stops done by law enforcement officers was wildly inaccurate. The former shows that persons of African origin are stopped in disproportionately high numbers compared to their percentage of the overall population, while the latter is contrasted with the reality that police stop American people infrequently. As per the findings of a 2009 research by Dunn regarding racial profiling in the issue of traffic tickets in large cities. This implies that the study statement shows that, even after looking into the background of the increase in population, it is still true that African Americans continue to earn a high number of traffic fines in comparison to American drivers.

**2.4 The intricate network of influences on crime rates**

Crime in places like Los Angeles is rarely triggered by a single issue. It is frequently caused by a mixture of unemployment, financial hardship, uneven incomes, educational disparities, and race conflicts (World Population Review, 2024). These factors combine in complicated ways, altering depending on the unique conditions of each city. Braga et al. (2019) found that focusing on high-crime regions through "hot spots policing" resulted in a considerable drop-in criminal activity.

**2.5 What is the hierarchy of usefulness of law enforcement?**

Crime clearance rates, which display the proportion of reported crimes that are resolved by arrests or other illegal means, are one approach to assess the effectiveness of law enforcement. Standards for these percentages are provided by FBI data from 2017, highlighting areas where law enforcement efforts could fall short. By carefully analyzing clearance rates to find weaknesses in their investigation procedures, police agencies can enhance their case resolution tactics.

**2.6 Crime rates according to the type of crime**

The relationship between medicinal marijuana shops and crime rates in Los Angeles is further examined in research by Contreras. Their findings tells us that marijuana businesses are being considered as criminal attackers. Valasik et al. examined the environmental risk variables that geographically affect gang violence and assaults in East Los Angeles . By highlighting anti-gang initiatives in high-risk locations, RTM (risk terrain modeling) was used as an analytical tool

**3. Methods**

**Data Collection:**

The dataset was collected from data.gov, covering crime incidents in Los Angeles from 2020 to the present. The link is given below for reference.

<https://catalog.data.gov/dataset/crime-data-from-2020-to-present>

Initially, the dataset includes 974,478 observations and 28 variables that fulfill the project requirements of at least 21 variables and 10,000 rows. This dataset contains the crime data of Los Angeles.

**Key variables include:**

* The variables covered to represent below data
  + Date Rptd - Date reported
  + DATE OCC - Date occurred
  + TIME OCC – Time occurred
  + AREA – Place name
  + Vict Age – Victim age
  + Vict Sex – Victim sex
  + Crm Cd – Crime code
  + Crm Cd Desc – Crime code description
  + Weapon Used Cd – Code of weapon used
  + LAT – Latitiude
  + LON - Longitude

**Data Preparation:**

As we collected the dataset from website, there were several issues with the data such as missing values, irregular format, unwanted columns, duplicate entries. Data preparation is very crucial, in achieving correct results, better analysis and accurate results.

Steps:

1. Initially, we imported python basic libraries such as pandas, numpy for cleaning the data and handling missing values. Also imported Matplotlib and seaborn for data visualizations.
2. After analysing the dataset, we noticed that few columns are not useful for our research work. They are Part 1-2, Mocodes, Premis Cd, Premis Desc, Crm Cd 1, Crm Cd 2, Crm Cd 3, Crm Cd 4. Initially there were 28 variables in the dataset, after removing above columns the count is 19.

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1. Then we converted time and date, assigned these values to newly created fields time\_converted and date\_occurred respectively.

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1. Two new columns named Year and Month are extracted from the ‘DATE OCC’ field.

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1. After adding new fields, we have now 23 variables in total.

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1. Deleted some rows where victim age is less than ‘1’ and considered rows only with victim age greater or equal to 1.

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1. As a next step, removed rows where “Vict Sex” is equal to value ‘X’ or ‘H’ or ‘- ‘or blanks.

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**Data Analysis Techniques and Tools:**

* We used Python as a primary tool to deal with the project.
* In this study paper, we worked on exploratory data analysis (known as EDA), Machine learning models, Time series analysis. These tests can help in investigating the relationships between different variables of Los Angeles crime data.
* In EDA, we used python libraries such as Pandas for data cleaning, NumPy for numerical and Matplotlib for finding patterns and visualizations
* We used Scikit learn models, train\_test\_split function to split our dataset into 2 parts train and test. Also, linear model named logistic regression is used to do regression analysis. Functions like classification report, accuracy score are executed to identify the accuracy or precision of the model.
* The relationship between crime type and Count of crime is shown with a Bar Graph to identify the top 10 crime types.
* Machine learning models, like logistic regression to find whether violent crimes occur frequently on night times. Also, random forest model is used to compare the accuracy with regression model.
* K-means clustering technique is used to segment the data based on regions with similar crime patters.
* Autoregressive integrated moving average (ARIMA) model is used to predict or forecast the crime rate.

**4. Results/ Interpretation:**

**RQ 1. Which type of crime mostly takes place in Los Angeles?**

Variables Used: “Crm Cd Desc“

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* In the above we can see overview of the types of crimes and the number of crimes occurring in the Los Angeles’ overall 122 types of crimes are there like battery simple assault, threats, thefts etc,. Here, we analysed top 10 crimes because of the more data so we worked on top most crimes happening takes place in the Los Angeles’.

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* This bar chart shows the frequency of the top 10 crimes and the count of that crime taking place in the Los Angeles’ and provides the clear visualization of the crimes. The following are the interpretation of results and recommendation of each research question.

**Interpretation:**

* We can see Battery-Simple Assault are the highest crimes occurred which is approximately above 70,000.
* Assault with Deadly Weapon takes place the second most crimes around 53,000 cases.
* Intimate Partner-Simple Assault is placed in the third which is around 47,000 crimes.
* Coming into the next crimes it got decreased in other categories like Robbery, Criminal Threats, Intimate Partner and brandish weapon.
* Attempted Robbery has the lowest crime rate which is around 5,000 cases.

**Key Findings:**

* Simple Assaults are that are both normal and intimate assault come under these crimes which occurring most of the incidents.
* Most of the incidents involve by usage of weapons.
* Domestic violence plays a major role in the high number of assaults by the intimate partners.
* Property crimes like robbery and the attempted robbery occurs very less while compared with the violent crimes.

**Recommendations of the Crimes:**

* Right law enforcement can make the community safe and take charge on high crime areas. Better responses from the domestic violence, police presence can reduce the crime rates.
* Should conduct the prevention programs by teaching the groups how to resolving the struggles. Also, develop the domestic violence find in early stage.
* Conduct the rehabilitation centres to develop the criminal justice and also increase the sources to help the victims.

**RQ 2. Which age groups are more involved in crimes?**

Variables Used: “Vict Age”

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* In the above we can see that age groups who involved in the crimes those are adult, child, teen and senior aged people and the number of crimes. In the data we don’t have any adult, child separately we divided Vict Age into different age groups based on their age so we can clearly identify which age groups are more involved in the crimes.

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* This bar plot which shows the which age groups are more involved in the crimes and following are the interpretation of results and recommendation of each research question.

**Interpretation:**

* Adults has the massive crime rate compared to the other age groups which is approximately 250,000.
* Children have the second place in the crime rate rather than the teens which is very sad to hear.
* In the last teens and the senior have the almost same crime rate around 20,000-30,000 each. So, totally 75% total population adults have the more crime rate.

**Key Findings:**

* While comparing all other age groups the adult population there is huge gap in the crime rate.
* In terms of the population size there is no clear difference between children and the teens.
* Among all the categories the senior population have the smallest crime rate.

**Recommendations:**

* Make the particular plans for the different age groups and make sure there is an enough healthcare facilities for the senior people.
* Even though there is less people conduct the youth development programs and develop adult services for handling the large volumes.
* Develop the long-term plans for the future purpose and also the track the changes in the population .
* Prepare for the possible changes in the age distribution, provide the family support services.

**RQ 3. Find out the correlation between time of the day and occurrence of specific type of crime?**

Variables Used: “Crm Cd Desc”, “TIME OCC”

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* In the above we can see that which time and the specific type of crime have been occurred. In the data we don’t have clear Time format so we divided them into morning, afternoon, evening and night according to this we can easily identify when crimes are happening mostly and type of crimes occurring. We analyzed the top 5 crimes because of the more data in the Los Angeles’.

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* In the bar chart we can see the time occurrence of the crime and the type of crime. Here, blue bar represents morning, orange indicates afternoon, green shows evening and red represents the night time. The following are the interpretation of results and recommendation of this research question.

**Interpretation:**

1. Temporal crime patterns:

* Mostly, the morning hours shows the constantly like 35-37% and the night time changes according to the crime type like 20-27%.
* Afternoon and the evening times it shows the normal levels like 15-24%.

2. Crime-types:

* Intimate Partner simple assault:
* Highest morning crime rate (37%)
* Night crime rate (27%)
* Have the lowest in the afternoon (16%)

3. Assault with deadly weapon:

* Most crime rate in morning time (34%)
* Afternoon, night and in the evening have almost same (20-23%)

4. Battery/simple assault:

* Morning (32%)
* Night lowest (20%)
* Normal in both afternoon and in evening.

5. Robbery:

* Morning (34%)
* Consistent in other times like afternoon and evening.
* little bit decrease in the night.

**Key Findings:**

* “Generally we think that most of the crimes occurring in the night times but while we analyzing mostly crimes happening in the morning times only”.
* Domestic violence (Intimate assault) highly takes place in the morning and night. Violent crimes are constant in the daylight hours.
* Property crimes (Robbery) are occurring in all the times common in the Los Angeles’.

**Recommendations:**

* Need to increase the police presence in the morning hours like 6AM-12PM and maintain the police patrolling for the domestic violence.
* In the night make sure there is an enough security and make the programs for proper understanding of the high-risk times in a day.
* Also, develop the quick response groups during the morning hours because it has more crime rate.
* Communicate with the community resources and increase the patrolling schedules.

**RQ 4. How much percentage of crimes occurring in a gender wise?**

Variables Used: “Vict Sex”

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* In the above we can see the bar chart which represents the gender wise crime rate in the Los Angeles’ sky-blue represents the crimes occurring in the male and the pink color represents the crimes taking place in the female.

**Interpretation:**

* This shows the crimes between the male(M) and the female(F) and it represents in blue and pink respectively.
* The data is presented in both the numbers and the percentage of the total crimes occurred.

**Key Findings:**

* We can clearly see that male has 52.92% of crimes has been reported and for the female 47.08% of crimes are recorded.
* The difference between both male and female is very small 5.84%. So, the male has the highest record of crimes occurred compared with the female.

**Recommendations:**

* Prevention and the recovery programs should be conduct which makes the gender differences and the necessary needs.
* By carefully observing the data we can see that which type of crimes each gender is related with.
* Examine whether this type is constant in different areas and the different times.

**RQ 5. Which areas are struggling with high crimes rate?**

Variables Used: “AREA NAME”

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* This bar graph shows the top 10 areas with the highest crime rates in the Los Angeles’. We analyzed only 10 because of the large data.

**Interpretation:**

* We could clearly notice highest crime rates are occurring in 77th street in Los Angeles’ with highest crime rate.
* Then the next area goes to central where the highest crime rates are occurring.
* In this way we could notice that there is slight decreasing trend in the occurrence of crime rate for first three areas till southwest and for Hollywood and newton and rampart there is very slight difference in occurrence of crime rate with almost equal crime rates occurring for newton and Hollywood and with slight difference of crime rate occurring for newton and rampart.
* From the area Olympics again, we could notice that decrease trend in the crime rates occurring in pacific and harbour.

**Key Findings:**

* So, I could observe most of the crime rates are occurring in 77th street followed by other areas with slight difference of crime rates occurring.

**Recommendations:**

* Teach the children and adults in the schools and organization about the impact of the crimes and the strict rules imposed by the government if the crime is done.
* I would also recommend providing the teams everywhere in such a way that they could respond immediately addressing the most happening crime happening now a days.

**Hypothesis Statement:**

**1.Hypothesis**

"Violent crimes occur more frequently at night, while property crimes peak during the day."  
**Reason for choosing the hypothesis**

We chose this hypothesis based on Research Question 3 which was focused on the correlation between type of the crime and the time of day. If we look at the historical trends and the common opinion tells us that violent crimes occur at night and the property crimes take place during the daytime. The main reason of this hypothesis was to test this assumption methodically.

**Null Hypothesis(H0)**

There is no significant difference in the frequency of Violent and property crimes between night and day

**Alternative Hypothesis(H1)**

There is a significant difference in the frequency of Violent and property crimes between night and day.

Logistic regression model used for analyzing the relation between time of day and specific crime types, particularly testing if violent crimes occur more frequently at night and property crimes during the day.

**Logistic Regression Model:**

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**Results/Findings:**

* Overall accuracy of the model is 81.29%
* Class 0 which is property crimes have 1,487 samples and class 1 which is violent crimes has 6462.
* For class 1 precision is 0.81, F1-score is 0.9.
* We obtained the p-value of 0.000 from the summary of the model as this value is less than the critical value (0.05). Therefore, we can reject the null hypothesis. This indicates that there is a statistically significant relationship between time of day and crime type. This proves that violent crimes frequency is more during night times whereas the property crimes are recorded at high rate during daytime.

**Random Forest Model:**

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**Results/Findings for random forest model:**

* The accuracy of the random forest model is 82.15%
* Class 0 which is property crimes have 2,280 samples and class 1 which is violent crimes has 10492.
* For class 1 precision is 0.82, F1-score is 0.9.
* Based on the model results, P-value is 0.00, as this value is statistically significant we reject the null hypothesis and accept the alternate hypothesis. This proves that violent crimes frequency is more during night times whereas the property crimes are recorded at high rate during daytime.

**Comparison between logistic regression and random forest models:**

Both the models are resulting in identical pattern with minor difference in accuracy. The random forest model precision is 82% and P-values resulted in the same in two models. Based on these models we reject null hypothesis.

**2.Hypothesis**

"Crime within a city are varying by location with certain time periods experiencing higher crime rates"

**Reason for choosing this hypothesis**

We chose this hypothesis based on Research Question 5, By looking into criminology we can say that geographical and temporal patterns are well documented. Which leads us to think about this hypothesis which explains why crime rates vary on both location and time. And testing this hypothesis will give us high crime rate zones and the factors which are paying major role in it.

**Null Hypothesis(H0):**

Crime rates within a city are not significantly influenced by location or time of day.

**Alternate Hypothesis(H1):**

Crime rates within a city are significantly influenced by location or time of day.

We used K-means clustering technique to cluster the crime data based on location. Here we are using elbow method to find the optimal K- value.

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**Elbow Method:**

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From the above elbow method, we can observe that optimal k value is 3. Now executing K-means clustering technique.

**K-means clustering:**

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**Anova Test results**

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**Results/Findings:**

The p-values from Anova test results indicate 0 which is less than the typical significance level of 0.05. Hence, we can reject the null hypothesis. We can conclude that crime rates are influenced by location.

**3.Hypothesis**

"Crime rates in Los Angeles can be accurately predicted based on historical trends, time of year, and type of crime."

**Reason to choose this hypothesis**

We chose this hypothesis based on Research Question 6 and 9 which involved crime trends over time and seasonal crime patterns. If we analyze the historical trends, seasonal crime variations and the crime type, it will aim to see if we can predict the future crime rates much more effectively.

**Null hypothesis:**

There is no significant relationship between historical trends, time of year in predicting crime rates in Los Angeles.

**Alternative Hypothesis:**

There is significant relationship between historical trends, time of year in predicting crime rates in Los Angeles.

By utilizing the Arima forecast model we could predict the crime pattern for specific time periods.

**Arima Model:**

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**Results/Findings:**

The graph shows crime count from year 2020 – 2026, including historical data and forecasting trends.

Crime rate is fluctuating without any specific pattern ranging average daily crime from 20 to 300.

From 2024 to 2026 downtrend has been identified in the crime rate.

We noticed regular peaks over the time and seasonal variations in the pattern. Hence, we can reject the null hypothesis and conclude that there is a significant relationship between historical trends, time of year in predicting crime rates in Los Angeles.

**Findings from the techniques:**

* After executing the Logistic regression model, we got an accuracy of 82% on the model and the results prove that violent crimes occur at nights more frequently.
* Got clustering based on Longitudinal and latitudinal.
* Forecasted crime rates are displayed in red colour.

**5. Summary**

For this research we used a dataset from 2020 to present that included 28 variables, including demographic and crime-specific data, and roughly a million records to assess Los Angeles' crime statistics. Following data cleaning, which included removing duplicates and missing information, the study employed exploratory data analysis (EDA) to find trends by region, age group, crime type, and time of day. With over 70,000 incidents, Battery-Simple Assault was the most common crime, according to visualizations. Assault with a Deadly Weapon came in second with over 53,000 cases, and Intimate Partner-Simple Assault came in third with about 47,000 cases. Based on age research, the bulk of crimes were carried out by adults (more than 250,000 events), followed by children (a shocking 20,000–30,000 instances), which is almost equivalent to that of teenagers and seniors. In contrast to popular belief, crimes, especially domestic violence, peaked in the morning (35–37%), whereas, depending on the kind of crime, nighttime accounted for around 20–27%.

More complicated methods, such as logistic regression, K-means clustering, and ARIMA forecasting, investigated these patterns in greater detail, finding spatial regions of high crime, associations between crime kinds and times, and anticipated future trends in crime. According to a research of Los Angeles's gender-based crime rates, crimes committed by women is 47.08% and by men is 52.92% . The study's research of high-crime zones tells us that the 77th Street area has the greatest crime rate, followed by Central and Southwest, where incidences are trending significantly lower.

Differences were found by racial and socioeconomic studies, including greater rates of interactions with law enforcement for African people and higher crime rates in economically poor regions. In consideration of these findings, the report offers practical suggestions, such as stepping up patrols in high-crime areas, implementing preventative initiatives for vulnerable populations, and changing laws to address injustices in society. This data-driven strategy helps community organizations and law enforcement prioritize resources, build community resilience, and eventually reduce crime in Los Angeles.

**Limitations:**

Although the research gives us insightful information, it must be noted that it has several limitations. First, there may be biases in crime rate analysis since the information only covers recorded crimes, thereby ignoring unreported instances. Furthermore, the study's reliance on data unique to Los Angeles could restrict the findings' applicability to other areas with distinct socioeconomic circumstances and criminal activity patterns. Even if cutting-edge methods like logistic regression and ARIMA models provide insights into the future, their precision is reliant on past data trends and might not take into consideration unexpected shifts in crime patterns brought on by outside variables like policy changes or economic disturbances. By adding data from different areas and sources, future research might overcome these constraints and improve the model's resilience and the conclusions generally.

**Conclusion:**

While we mainly focus on crime categories, historical trends, demographics, and geographic hotspots, the study's conclusion offers important insights into Los Angeles' crime patterns. According to commonly held assumptions that nighttime crime peaks, the results show that various crimes happen more frequently during hours and among age groups. This suggests that specific treatments based on complex crime timing and location patterns are required. The study also emphasizes how socioeconomic variables affect crime rates, since racial and economic demographics are connected to differences in interactions with law enforcement. In the end, these data-driven insights

contribute to improved public safety and strategic planning in Los Angeles by offering insightful recommendations for efficient resource allocation, law enforcement tactics, and community-based crime prevention initiatives.

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