Road Accident Analysis of Addis Ababa Sub cities Traffic Data

Data Visualization and Exploration (DS6151)

Final Project

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**Accident Analysis in Addis Ababa: Insights and Observations**

# Abstract

This study explores patterns, trends, and factors contributing to road accidents in Addis Ababa based on a comprehensive analysis of accident data. Using exploratory data analysis (EDA) techniques, the study identifies critical factors influencing accident severity, including time of occurrence, road conditions, driver demographics, and collision types. The findings highlight significant patterns such as peak accident times, demographic risks, and the impact of environmental and behavioral factors, offering actionable insights for road safety improvements.

# Introduction

Road accidents are a major concern globally, particularly in urban areas with high traffic volumes. Addis Ababa, as the capital city of Ethiopia, experiences a significant number of road accidents, leading to fatalities, injuries, and property damage. Understanding the underlying factors contributing to these accidents is essential for implementing effective safety measures. This study utilizes accident data to identify trends, risk factors, and potential interventions to reduce accident severity.

# Methodology

This research is based on a detailed analysis of accident data from Addis Ababa. The methodology includes:

1. **Data Collection:** A dataset containing records of road accidents in Addis Ababa was used.
2. **Exploratory Data Analysis (EDA):** Various techniques, including univariate, bivariate, and multivariate analysis, were employed to examine the relationships between accident severity and contributing factors.
3. **Data Preprocessing:** The data was cleaned by handling missing values, encoding categorical variables, and removing duplicates. Outliers were addressed, and relevant transformations were applied.
4. **Visualization:** Graphs and charts were used to highlight key trends and patterns in the data.

# Structure

\* Step 1 | Import Libraries

\* Step 2 | Loading the Dataset

\* Step 3 | EDA

- Step 3.1 | Dataset basic Information

- Step 3.2 | Missing Values

- Step 3.3 | Duplicated Values

- Step 3.4 | Univariate Analysis

- Step 3.5 | Bivariate Analysis

- Step 3.6 | Multivariate Analysis

\* Step 4 | Data Preprocessing

- Step 4.1 | Features Encoding

- Step 4.2 | Missing Value Handling

- Step 4.3 | Data Transformation

- Step 4.4 | Data Reduction

- Step 4.5 | Outlier Treatment

- Step 4.5 | Insights and Recommendations

# Results and Analysis

**1. Accident Trends**

* **Number of Vehicles:** As the number of vehicles involved in an accident increases, the fatality rate decreases. No fatalities were observed for accidents involving four or more vehicles.
* **Time of Day:** Most accidents occur during three critical periods:
  + **8:00 AM**: Start of work hours.
  + **1:00 PM**: Lunch hour.
  + **5:00 PM**: End of work hours.
* **Daylight:** A majority (71.4%) of accidents happen during daylight.
* **Day of the Week:** Fridays are the most accident-prone, with accidents decreasing from Friday to Thursday.

**2. Demographics and Severity**

* **Gender:** Male drivers are involved in more accidents, though the severity of accidents involving females is comparable.
* **Age:** Underage drivers have the highest percentage of serious accidents (20.5%). Drivers aged 31–50 have the lowest serious accident rate (13.2%) and fatalities (1.3%).
* **Experience:** Accident frequency increases with driving experience up to 10 years and declines thereafter.

**3. Road and Environmental Conditions**

* **Junctions:** “No Junction” points have the highest fatality proportion (1.9%). Serious accidents are most common in “O Shape” and “No Junction” areas.
* **Weather:** Rain accounts for the highest fatality percentage (1.7%), despite 81.7% of accidents occurring in clear weather. Windy conditions lead to the highest serious injury rate (16.3%).

**4. Collision Types**

* **Vehicle-to-Vehicle Collisions:** Represent 71.2% of all accidents.
* **Train Collisions:** Lead to the highest percentage of serious injuries (22.3%).
* **Pedestrian Collisions:** Account for the highest fatality percentage (2.5%).

**5. Causes of Accidents**

* **Over speeding:** While less frequent, it results in the highest proportion of serious accidents.
* **Improper Parking:** Causes the highest proportion of fatalities (4%).
* **Changing Lanes:** The most prominent cause, followed by no distancing and careless driving.

**6. Feature Importance**

* **Mutual Information Scores:** Features with MI scores below 0.01, such as “Casualty Sex,” were deemed insignificant and recommended for exclusion.

# Discussion

The analysis highlights significant patterns in road accidents in Addis Ababa. Key insights include the influence of driver behavior, time, and environmental conditions on accident severity. The findings suggest targeted interventions, such as:

* **Time-Based Measures:** Enhanced traffic management during peak hours.
* **Driver Training:** Focused programs for underage and inexperienced drivers.
* **Infrastructure Improvements:** Upgrades at high-risk junctions and better drainage systems for rainy conditions.
* **Policy Interventions:** Stricter enforcement of speed limits and parking regulations.

# Conclusion and Recommendations

This study provides a data-driven foundation for improving road safety in Addis Ababa. Key recommendations include:

1. **Education Campaigns:** Targeting drivers about risks associated with overspeeding and improper parking.
2. **Improved Traffic Management:** Addressing peak-hour congestion and enhancing road infrastructure.
3. **Technology Integration:** Using AI and real-time monitoring to identify and address high-risk scenarios.
4. **Policy Reforms:** Strengthening laws on underage driving and enforcing penalties for violations.

By implementing these measures, Addis Ababa can reduce accident severity and enhance road safety for all users.