US Road Safety: Analyzing Car Accidents in LA, California for Insights

March 12, 2024

Rachel Chong

INTRODUCTION AND OVERVIEW

- **Problem Statement:** How can we use machine learning to help address challenges in road safety at Los Angeles, California, including identifying and mitigating car accident hotspots and analyzing causative factors for effective prevention and intervention?
- **Goal:** By leveraging data science and machine learning, we aim to substantially reduce road accidents in Los Angeles, contributing to a safer and more economically efficient society.

$340 Billion in 2019[3]

That's a lot of money for traffic accidents

~19,937 crashes[2]

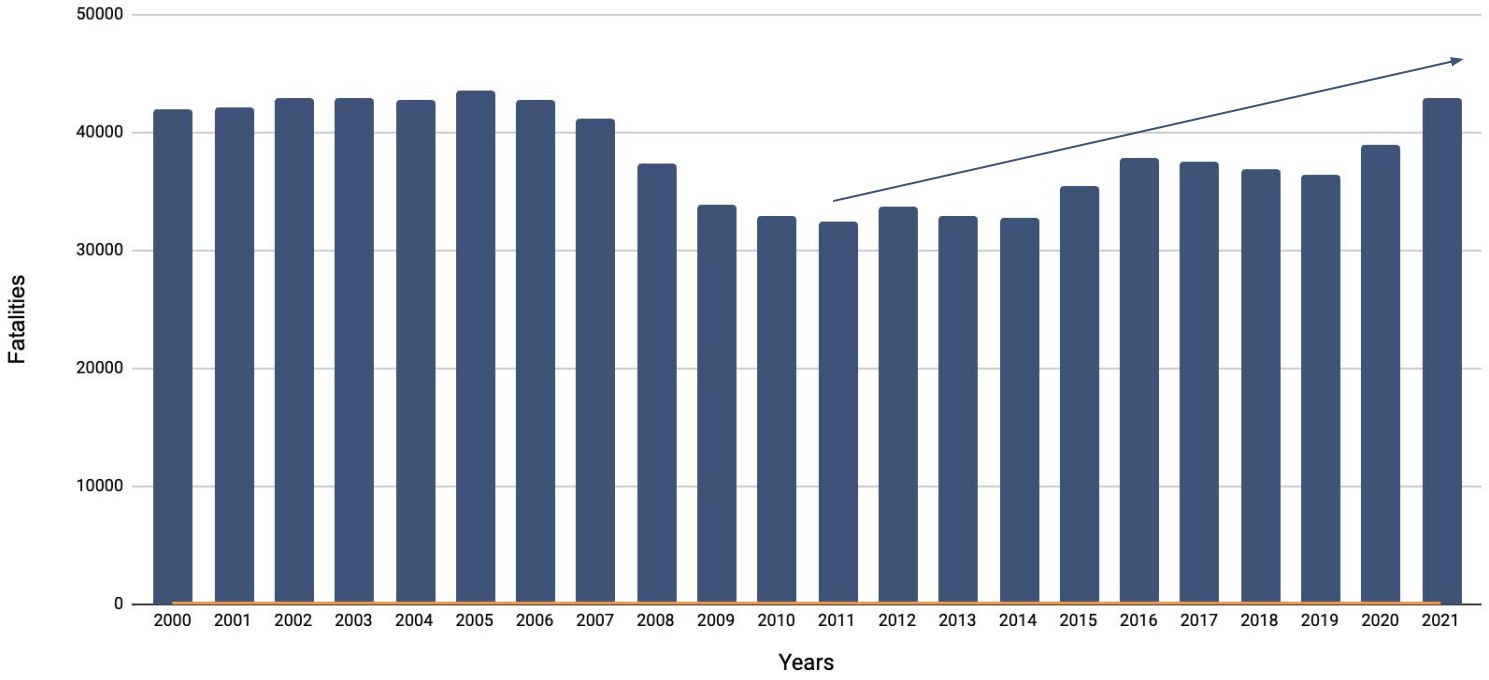
Each day

~118 deaths[2]

Each day

MOTOR VEHICLE SAFETY DATA

BUREAU OF TRANSPORTATION STATISTICS



BACKGROUND

Who is impacted?

Commuters, law enforcement agencies, emergency services, city planners, and insurance companies located in LA, California

Anticipated impact:

- Enhance commuter safety
- Optimized emergency responses
- City planning for safer infrastructure
- Insurance risk assessment improvement
- Economic impact mitigation

DATASET OVERVIEW

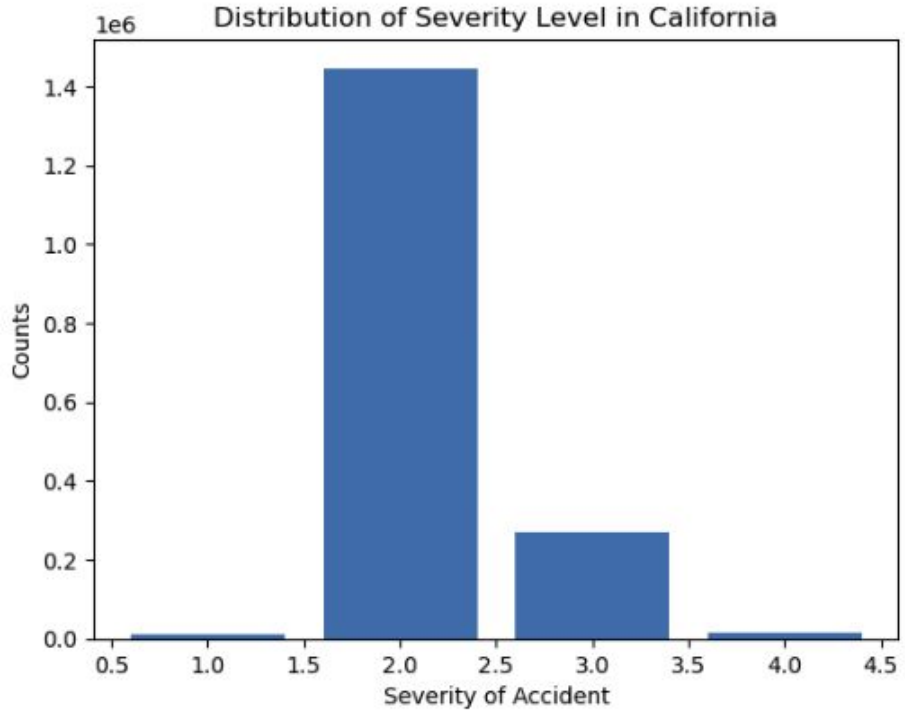
- Kaggle Dataset: comprehensive dataset of car accidents across the USA spanning from February 2016 to March 2023
- 7.7 million rows x 46 columns
  - Accident severity, timestamps, geographical coordinates, weather conditions, and various Points of Interest annotations

EDA AND DATA PREPROCESSING

- Out of the 45 columns, 22 columns had null values
  - End latitude, end longitude, precipitation, wind chill, and wind speed are the top 5 columns with most null values
- No duplicate rows
- Data types include: bool(13), float64(12), int64(1), object(20)

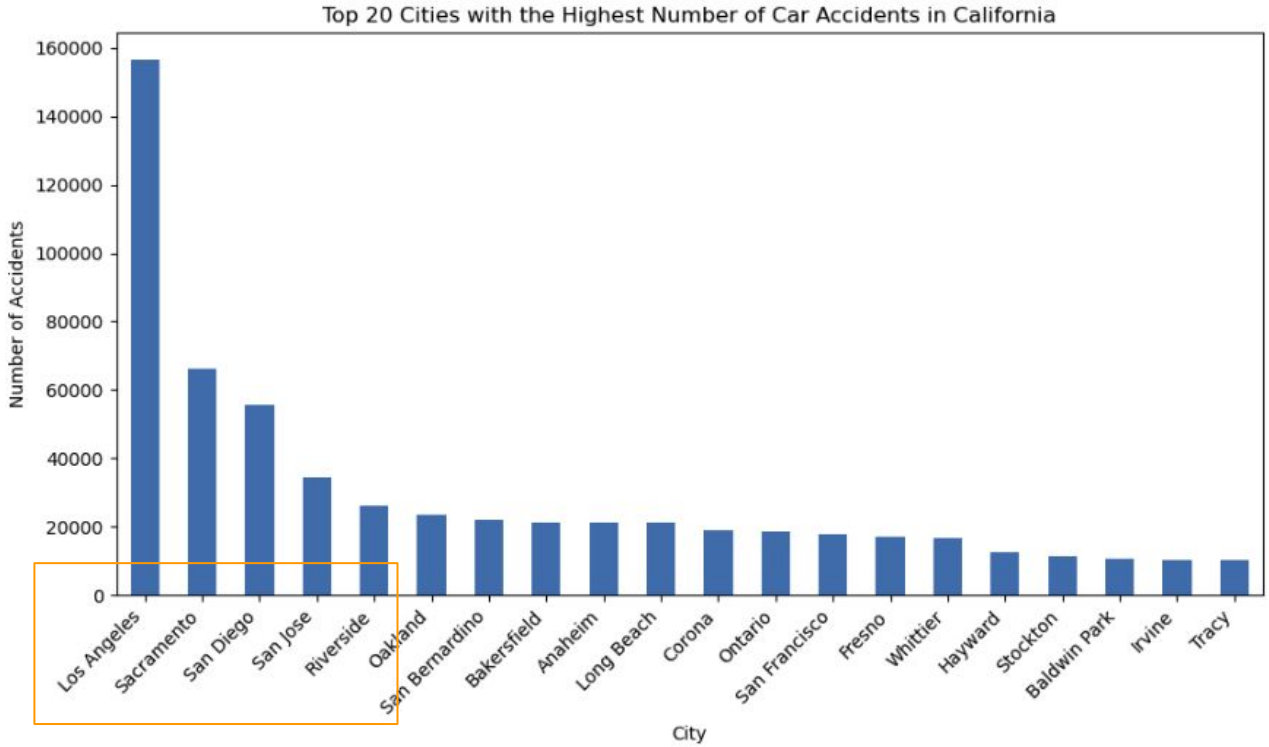
Columns	Null Values
End_Lat	3402762
End_Lng	3402762
Precipitation(in)	2203586
Wind_Chill(F)	1999019
Wind_Speed(mph)	571233
Visibility(mi)	177098
Wind_Direction	175206
Humidity(%)	174144
Weather_Condition	173459
Temperature(F)	163853
Pressure(in)	140679
Weather_Timestamp	120228
Sunrise_Sunset	23246
Civil_Twilight	23246
Nautical_Twilight	23246
Astronomical_Twilight	23246
Airport_Code	22635
Street	10869
Timezone	7808
Zipcode	1915
City	253
Description	5

DATA EXPLORATION
DISTRIBUTION OF SEVERITY LEVEL IN CALIFORNIA

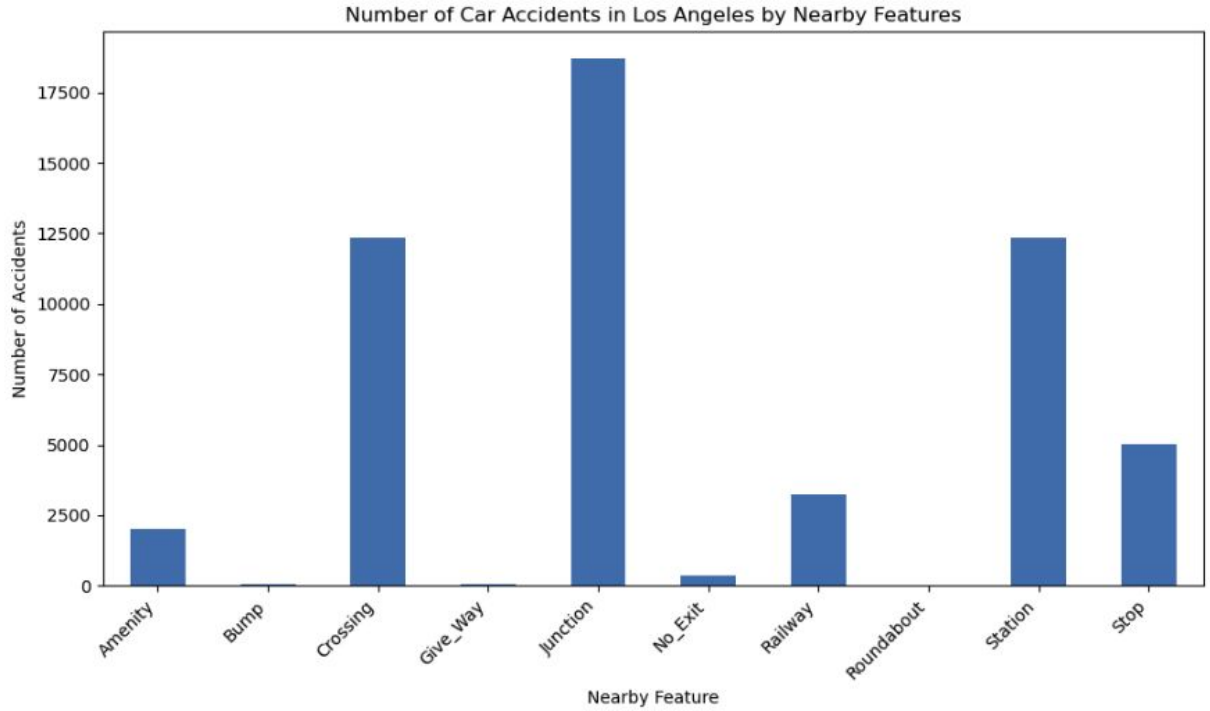


- Severity of the accident on a scale of 1 to 4 where 1 indicates minimal impact and 4 significant

DATA EXPLORATION
NUMBER OF ACCIDENTS BY CITY IN LA



DATA EXPLORATION
NUMBER OF ACCIDENTS BY NEARBY FEATURES



BASELINE MODELS AND EVALUATION METRICS

- **Data Filtering:** Focuses on car accidents in Los Angeles.
- **Severity Classification:** Categorizes accident severity into low and high.
- **Binary Variable Creation:** Generates a binary variable for severity groups.

```
# Filter data for Los Angeles
df_la = df[df['City'] == 'Los Angeles'].copy()  # Make a copy to avoid modifying the original DataFrame

# Define a function to map severity levels to low or high severity
def map_severity_binary(severity):
    if severity in [1, 2]:
        return 0  # Low Severity
    elif severity in [3, 4]:
        return 1  # High Severity
    else:
        return -1  # Unknown or error

# Apply the function to create a new column 'Severity_Group_Binary' for Los Angeles data
df_la.loc[:, 'Severity_Group_Binary'] = df_la['Severity'].apply(map_severity_binary)

# Display the first few rows of the filtered DataFrame to verify the changes
print(df_la.head())
```

BASELINE MODELS AND EVALUATION METRICS CONTINUED

- Selected numeric features and target variable for training a logistic regression model
- **Model Training and Evaluation:**
  - Split the data into training and testing sets.
  - Train a logistic regression model to predict severity of car accidents.
  - Evaluate the model's accuracy in predicting severity on unseen data.
- **Feature Imputation:** Impute missing values in numeric features using mean column values.
- **Model Performance Assessment:** Calculated accuracy score to measure the model's effectiveness in predicting car accident severity and received **100% accuracy**

NEXT STEPS

- As you can see, accuracy is 100%, which raise concerns about the model's performance such as class imbalance for severity levels.
  - Conduct a sampling balance for severity levels (e.g., undersampling or oversampling)
- Continue with more granular EDA
- Exploration of additional models such as decision tree or random forest

THANK YOU!

Any questions?

GENERAL REFERENCES

1. CDC. (2020, December 14). Road Traffic Injuries and Deaths—A Global Problem. Centers for Disease Control and Prevention. https://www.cdc.gov/injury/features/global-road-safety/index.html#:~:text=Road%20traffic%20crashes%20are%20a

2. How Many Car Accidents Occur Each Hour, Day & Year? (n.d.). Https://Amarolawfirm.com/. Retrieved January 11, 2024, from https://amarolawfirm.com/how-many-car-accidents-occur-each-hour-day-year-in-the-u-s/#

3. NHTSA: Traffic Crashes Cost America $340 Billion in 2019 | NHTSA. (2023, January 10). Www.nhtsa.gov. https://www.nhtsa.gov/press-releases/traffic-crashes-cost-america-billions-2019

DATASET REFERENCES

- Moosavi, Sobhan, Mohammad Hossein Samavatian, Srinivasan Parthasarathy, and Rajiv Ramnath. “A Countrywide Traffic Accident Dataset.”, 2019.
- Moosavi, Sobhan, Mohammad Hossein Samavatian, Srinivasan Parthasarathy, Radu Teodorescu, and Rajiv Ramnath. "Accident Risk Prediction based on Heterogeneous Sparse Data: New Dataset and Insights." In proceedings of the 27th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems, ACM, 2019.