Accident Rates and Contributing Factors

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Data 205

CRN :**22017**

Project goal and Tools

- The goal of this project is to identify valuable patterns by analyzing accident rates and contributing factors in Montgomery County using the provided datasets. The aim is to uncover insights that can help urban planners and policymakers improve road safety.
- **Tools**: R, Excel, ArcGIS Pro, Python , Tableau
- **Methods**: Logistic Regression, Chi-Square Test, Mapping and Visualization Analysis
-

Datasets

- **Crash Report Data**
- Source: Data Montgomery
- Key Info: Contains 39 variables on accidents, including driver details, accident circumstances, vehicle conditions, environmental context, and driver behavior.
- **Maryland Annual Average Daily Traffic (AADT)**
- Source: Maryland.gov Open Data
- Key Info: Focus on Average Vehicle Miles Traveled (AVMT) for assessing traffic patterns and accident rates.
- **Bikeways and Construction Activity**
- Source: Data Montgomery
- Purpose: Geographic data

Data cleaning

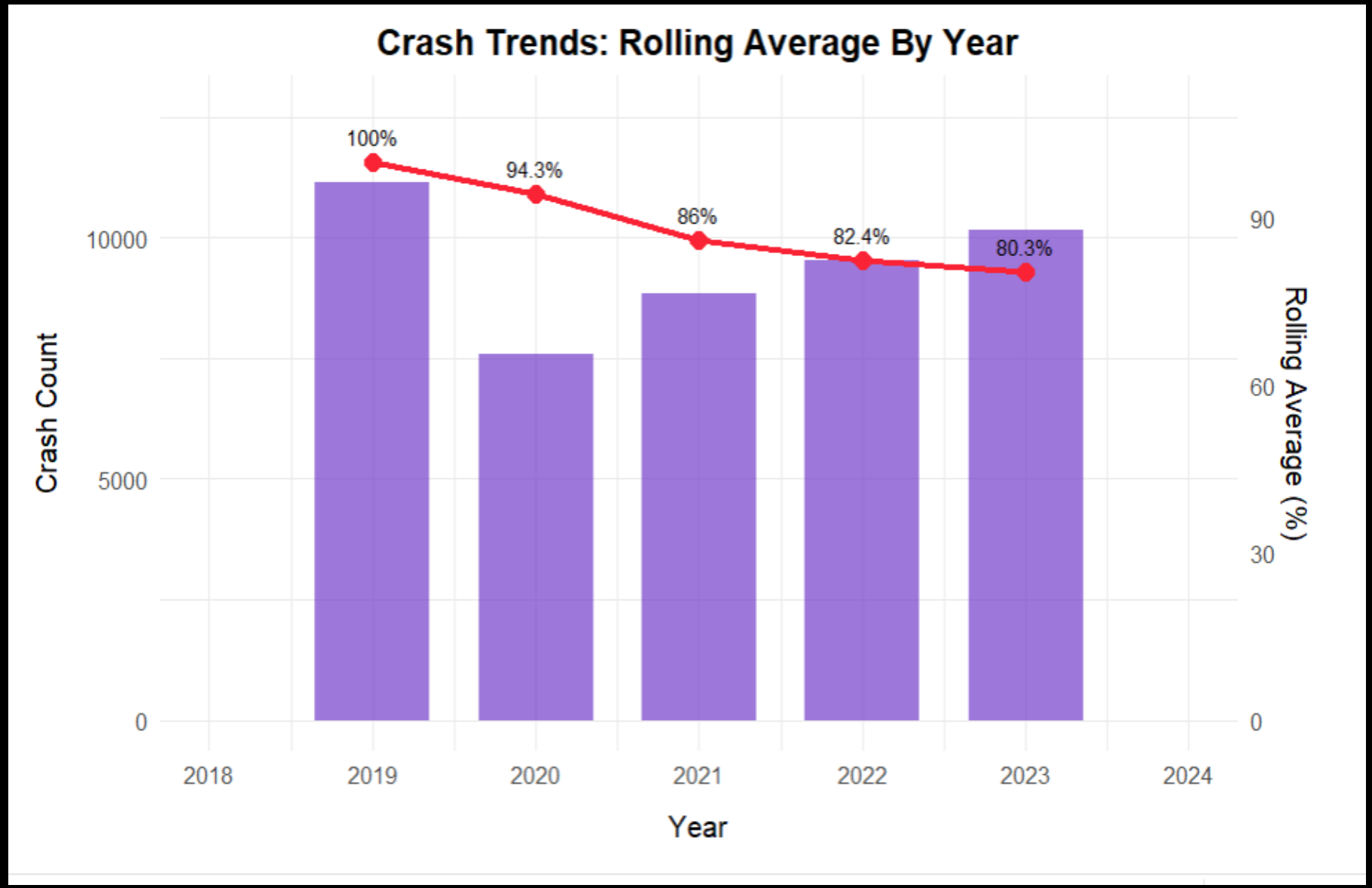
- **One-Hot Encoding:**
- Applied to categorical variables such as **Vehicle Model**, **Vehicle Make**, **Surface Condition**, etc.
- One-hot encoding transforms these categorical variables into binary columns representing each category (e.g., for **Vehicle Make**, columns like "Toyota", "Ford", etc., would be created).
- **Creating Binary Variables:**
- Converted variables like **Injury Severity** and **Substance Abuse** into binary variables.
  + **Injury Severity**: 0 (no injury) / 1 (injury occurred)
  + **Substance Abuse**: 0 (no substance abuse) / 1 (substance abuse detected)
  + **Electric Vehicle (EV) Indicator:**
- Created a new variable **EV** to indicate whether a vehicle is electric or not.
  + **EV** = 1 (electric vehicle) / 0 (non-electric vehicle)

Trend Analysis

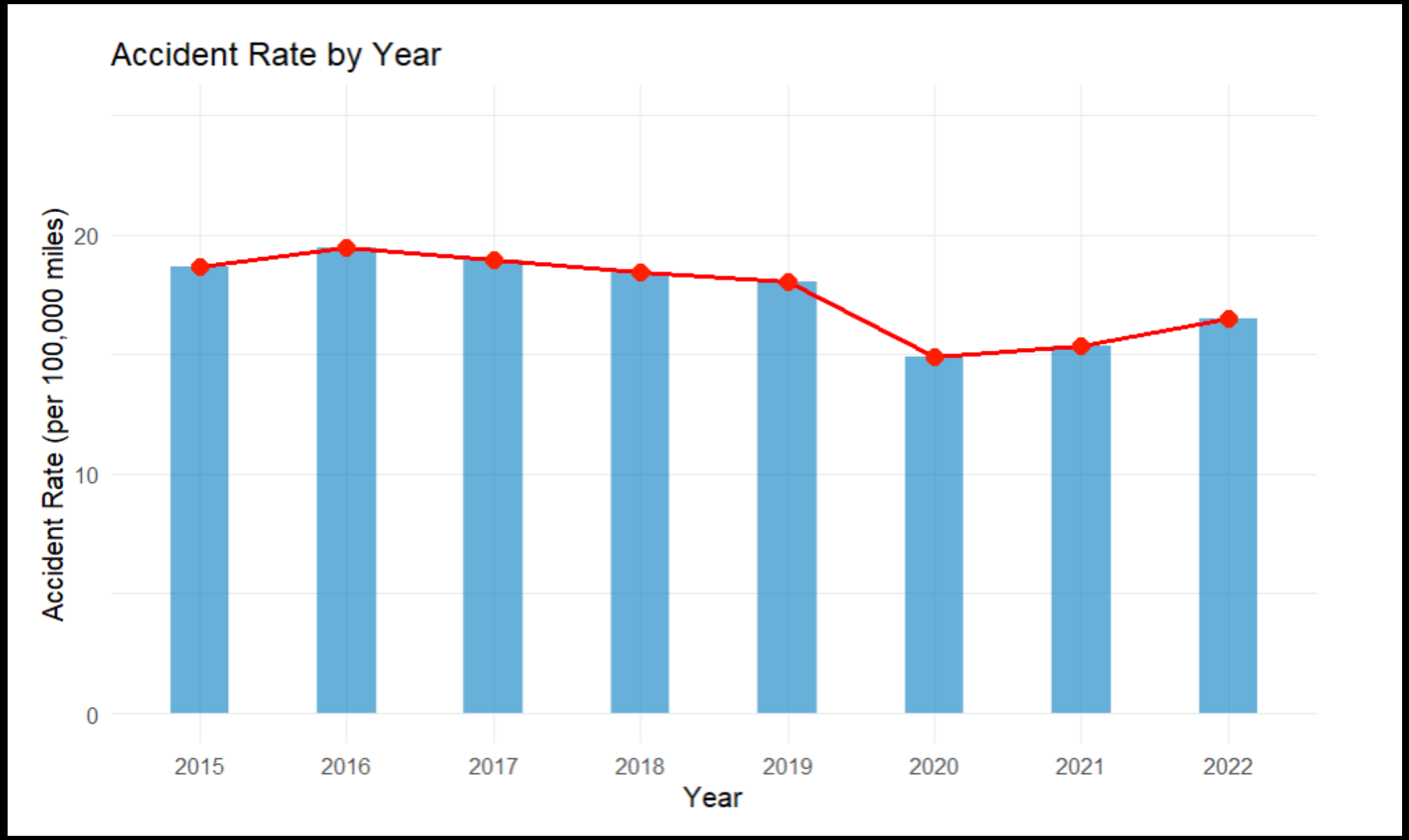
This plot shows

Crash Count for each year

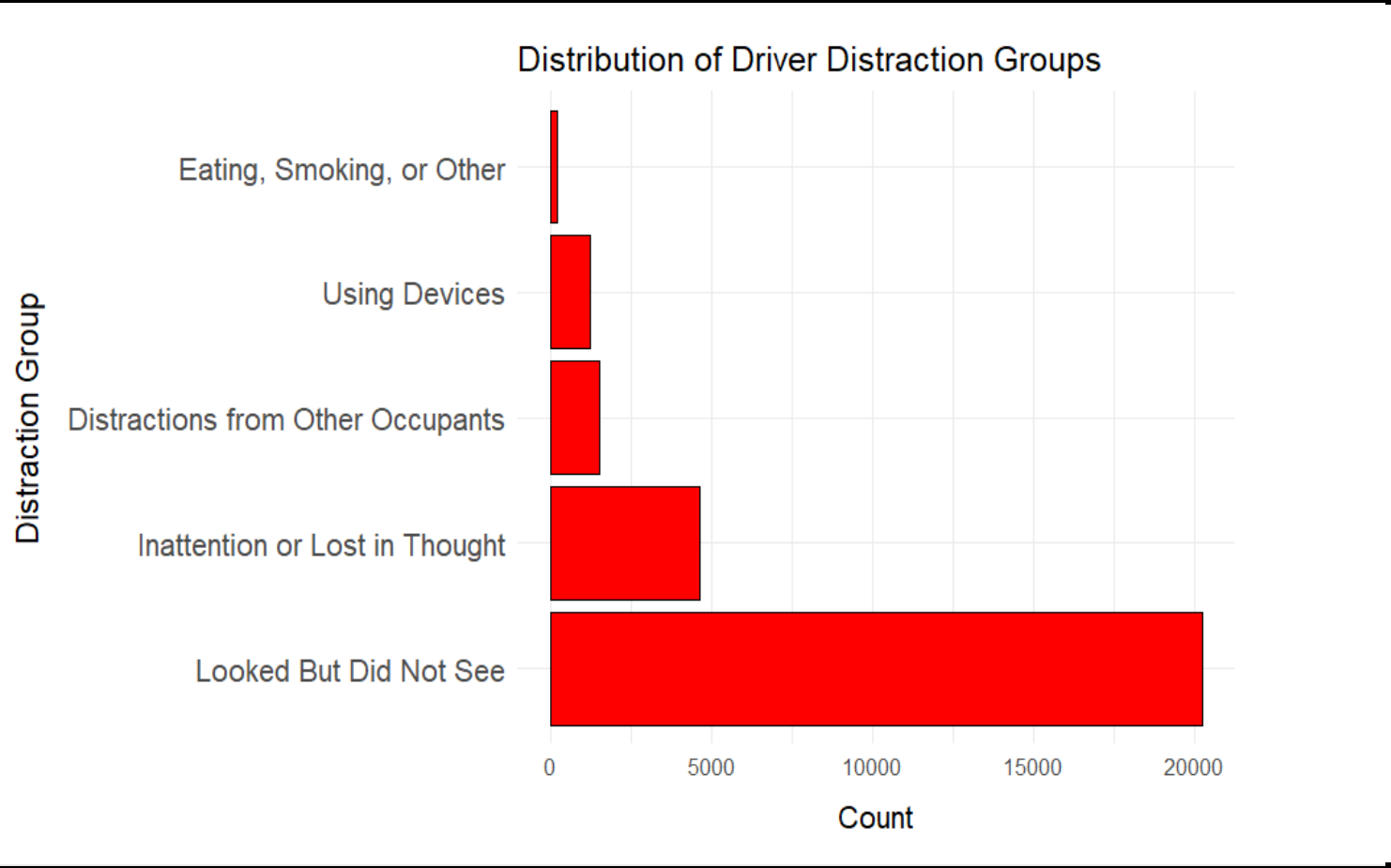
The trend line represents the 5-year rolling average, which smooths short-term fluctuations to highlight the overall trend in the analysis.

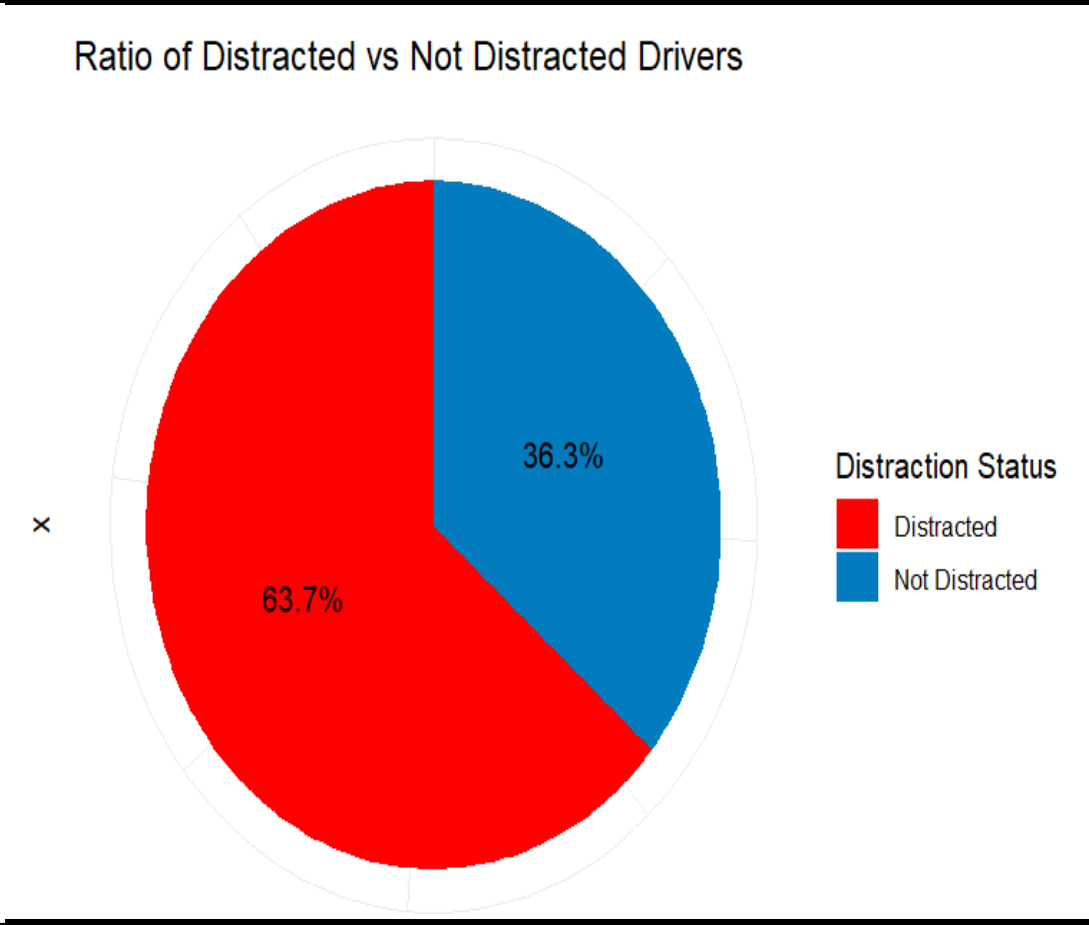


What is the road accident traffic rate in Montgomery County?



What are drivers mostly distracted by?

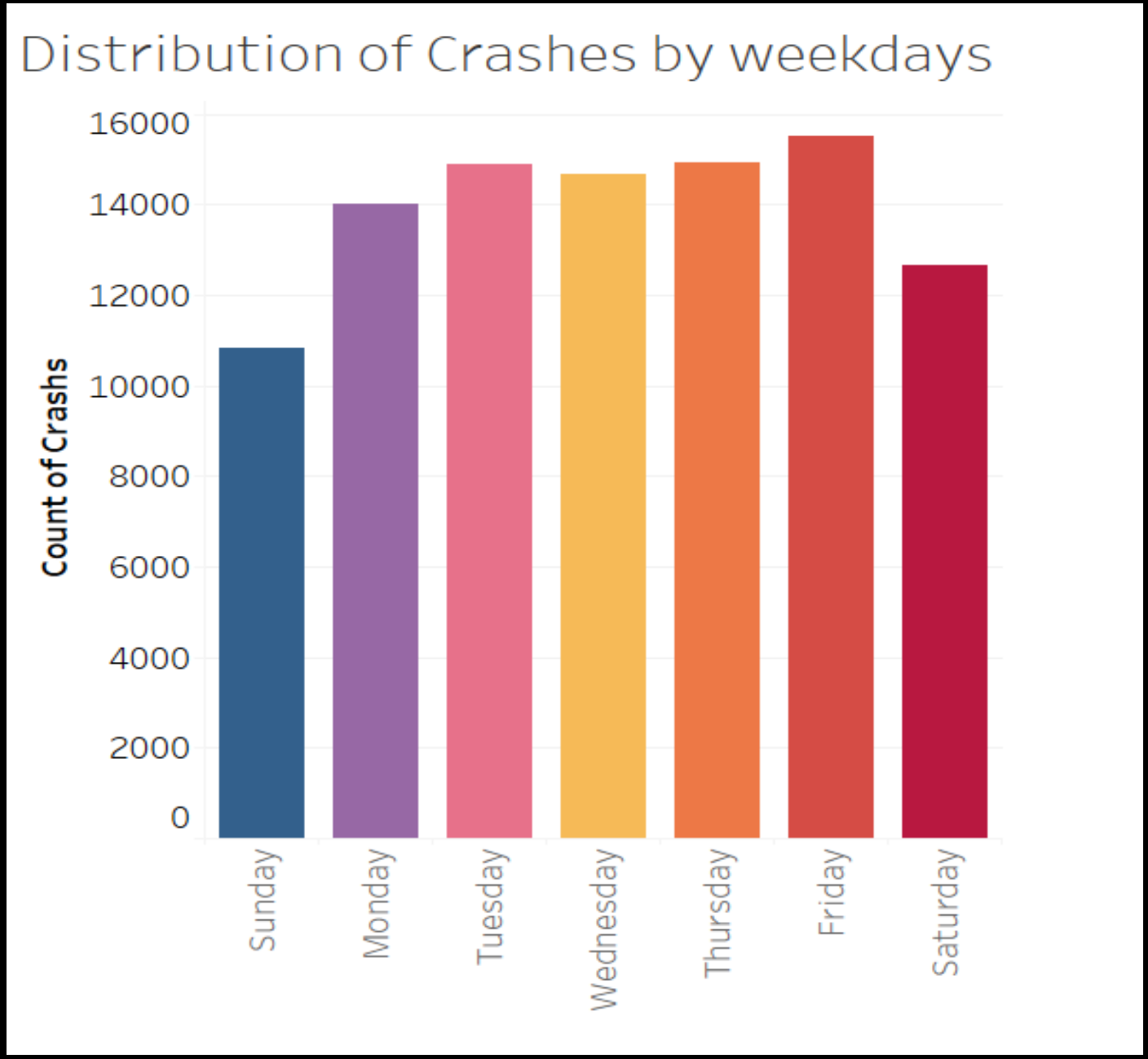




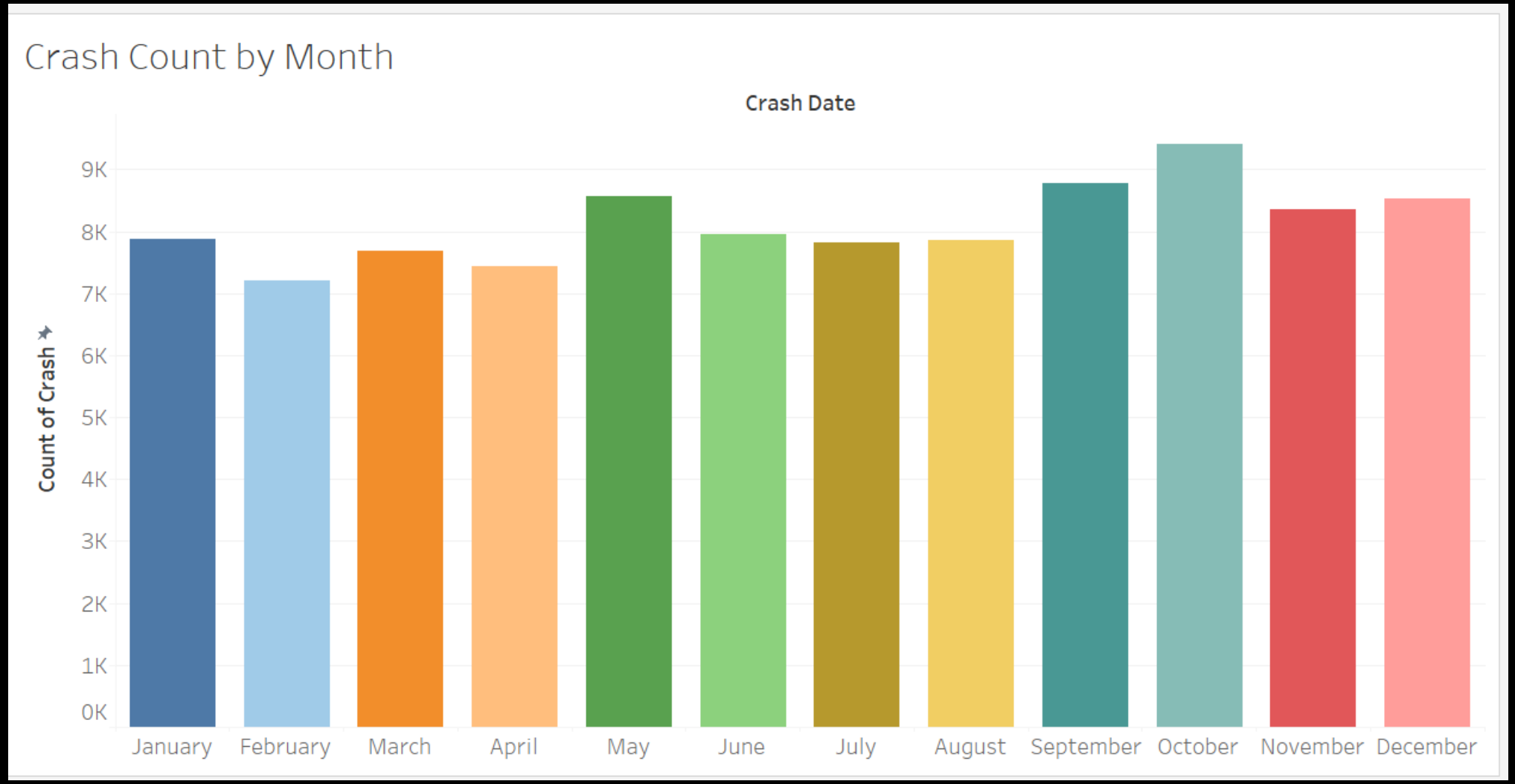
What day Most Crashes Happen?

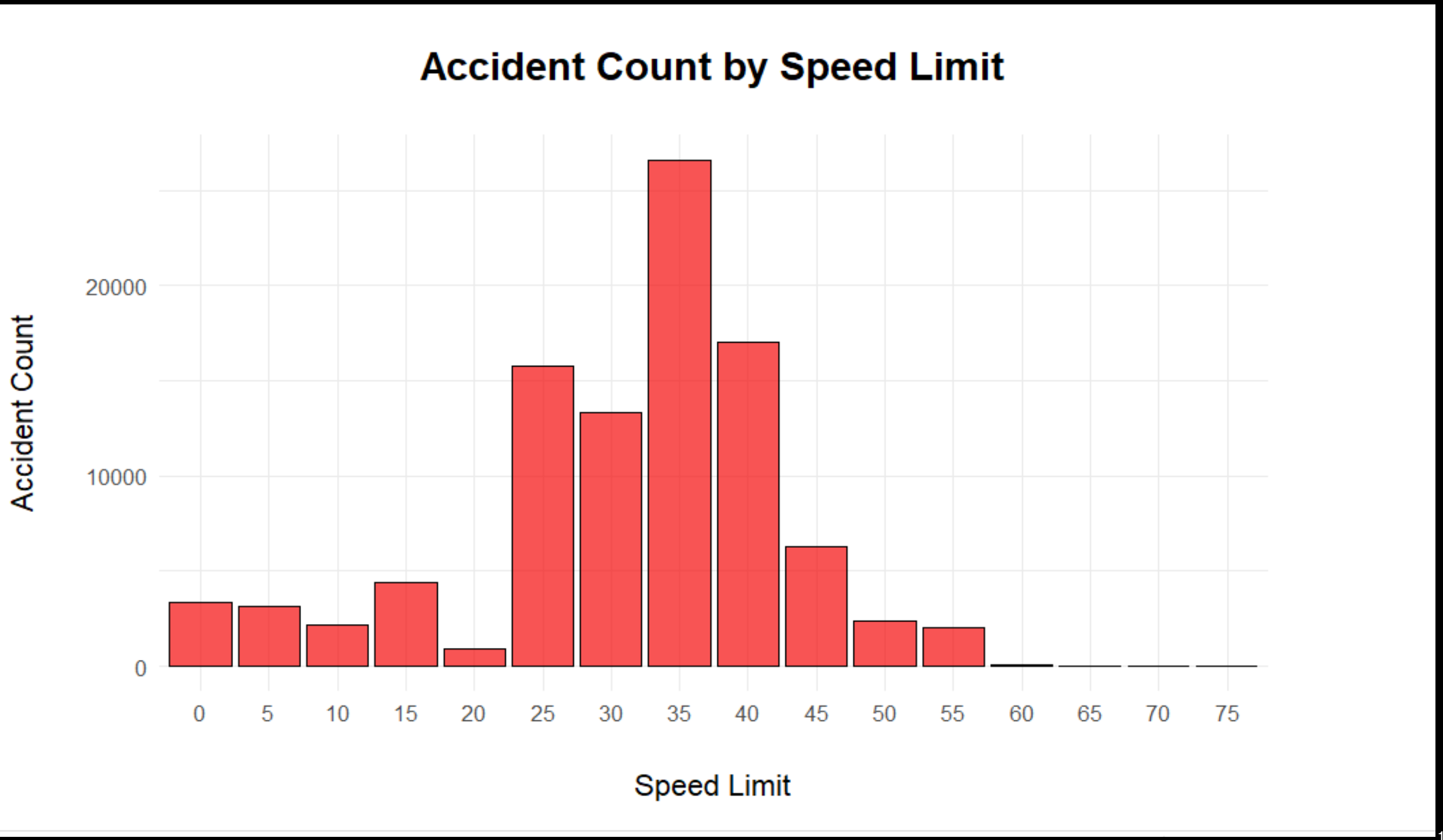
- Friday
- Thursday
- Tuesday
- Wednesday
- Monday

There are fewer accidents reported on weekends.

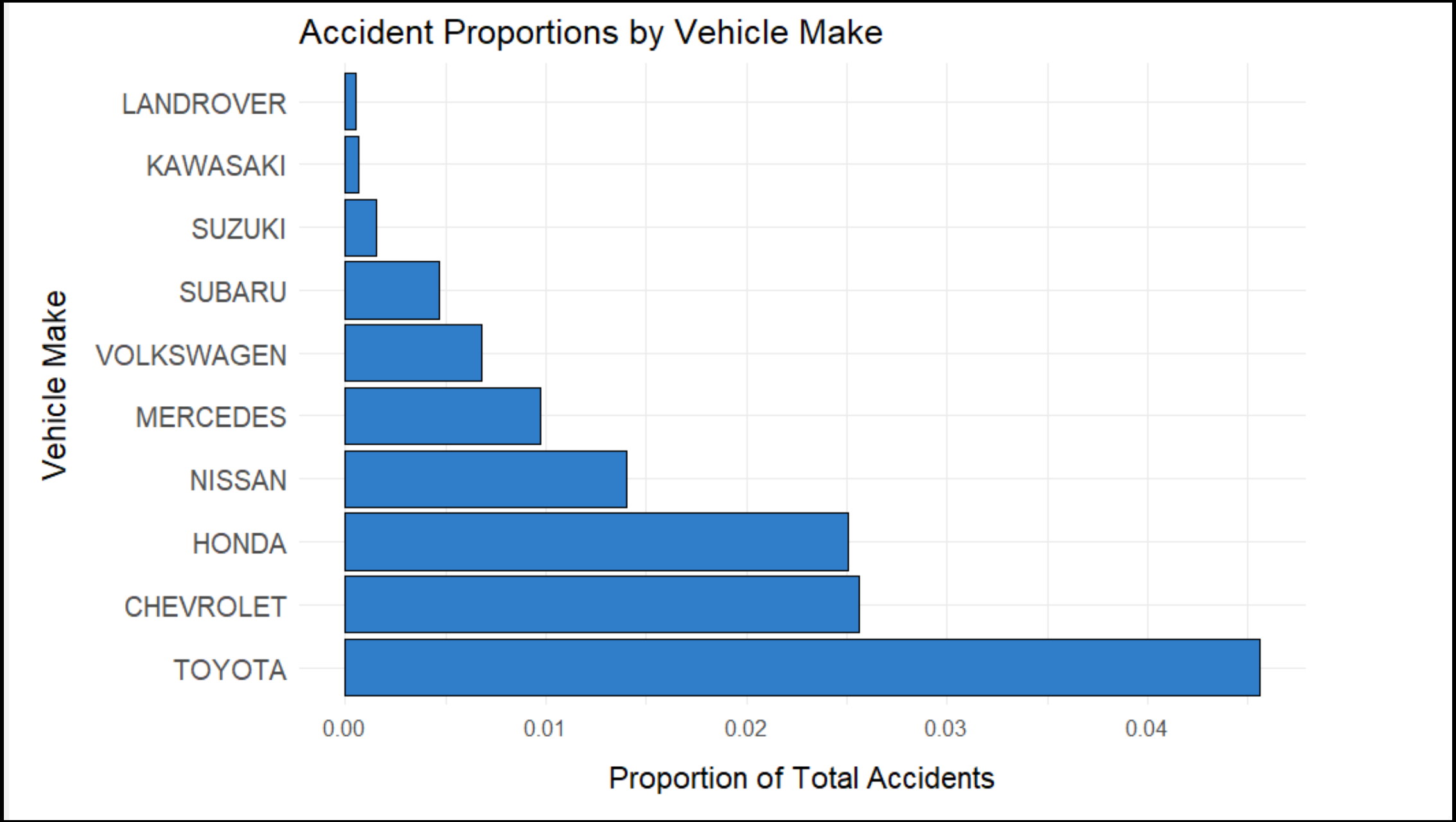


Which months have the highest accident counts?



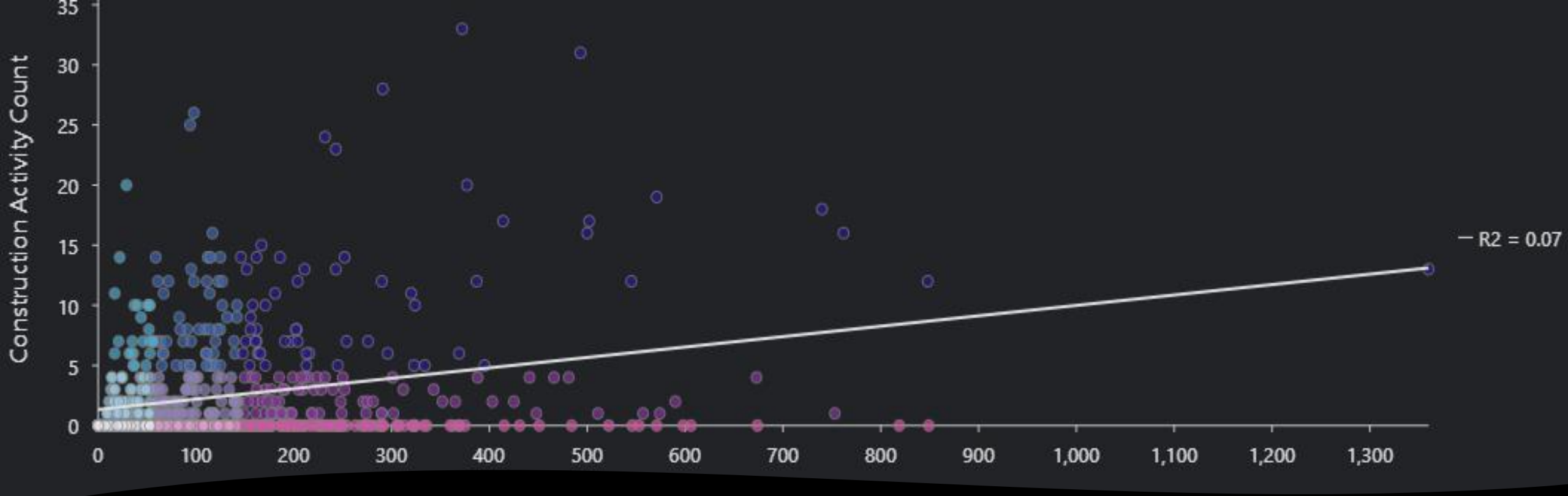

Accident Count by Speed Limit
Accident Count
20000
10000
0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
Speed Limit

- **Spearman's Rank Correlation Analysis:**
- **Variables**: Speed Limit and Accident Count
- **Spearman's ρ (rho)**: **-0.5294**
  + A moderate to strong **negative** correlation
  + As speed limits increase, accident counts tend to decrease.
- **p-value**: **0.03728**
  + Statistically significant (**$p < 0.05$**)


Accident Proportions by Vehicle Make
Vehicle Make
LANDROVER
KAWASAKI
SUZUKI
SUBARU
VOLKSWAGEN
MERCEDES
NISSAN
HONDA
CHEVROLET
TOYOTA
0.00
0.01
0.02
0.03
0.04
Proportion of Total Accidents

Do EV get Involved in less Accidents compere to None -EV?

Non-EVs show significantly higher accident counts per vehicle compared to EVs (with a p-value < 2e-16).



Are accidents more frequent around i Construction areas?

Weak Association:

- R2=0.07R^2 = 0.07R2=0.07 (only 7% of the variation in crash counts can be attributed to construction activity).

Are accidents more frequent around Construction areas?

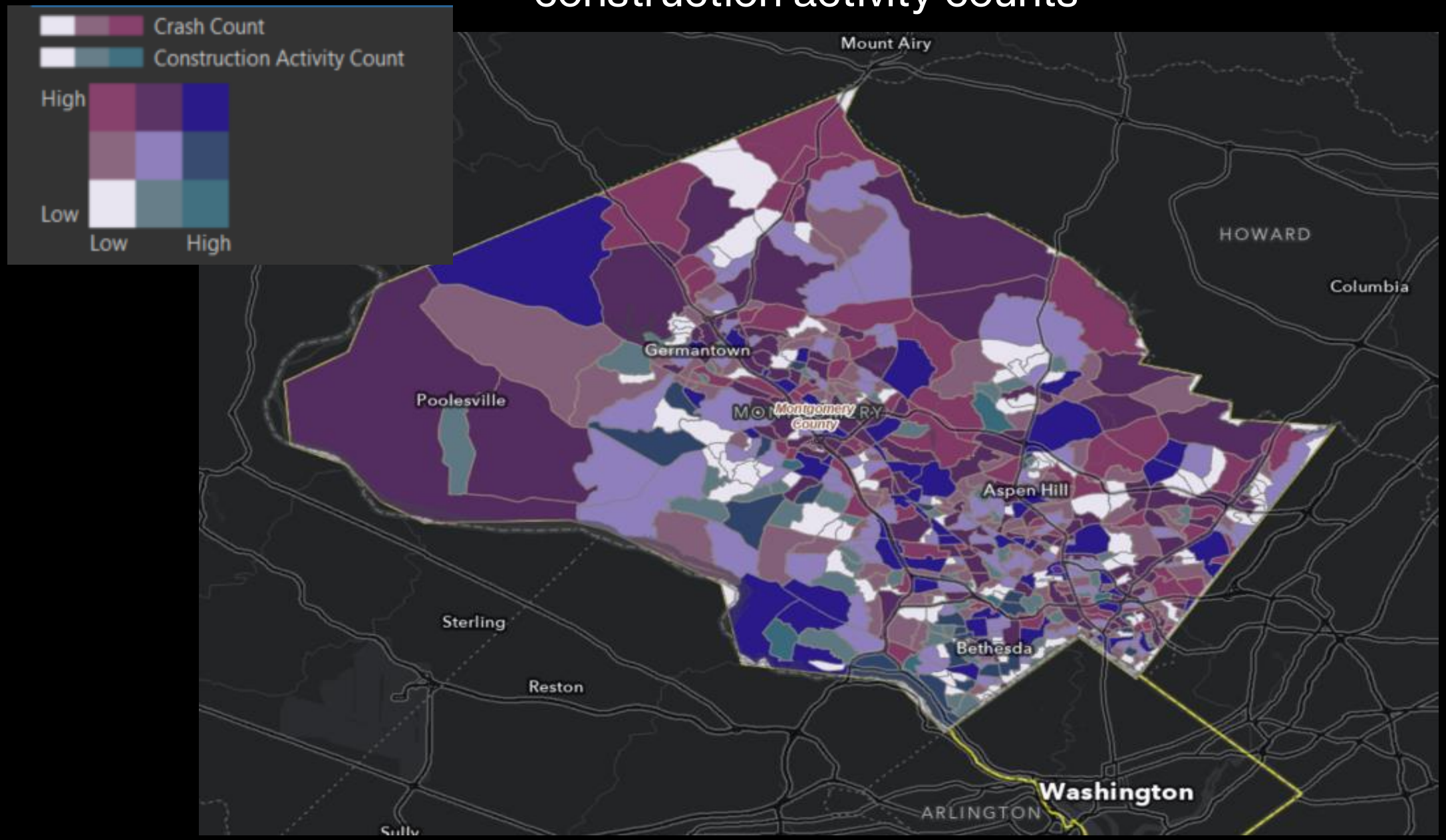
Spatial Analysis:

- Analyzed accidents and infrastructure within **Census Blocks**
- Counted the number of accidents and infrastructure features per block

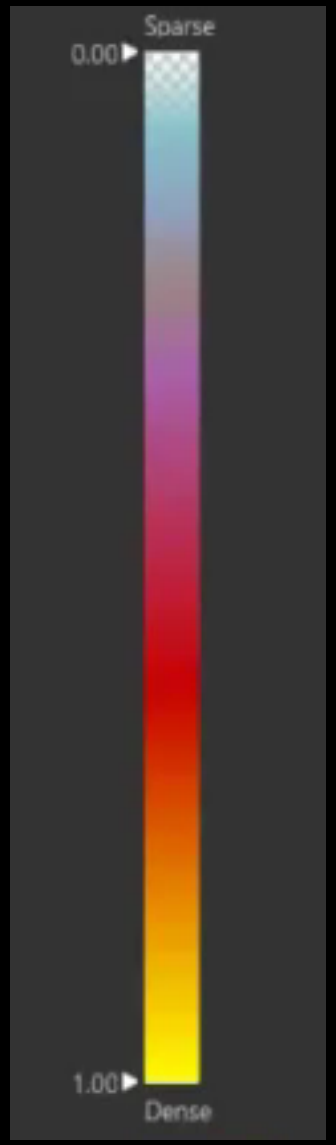
Correlation Calculation:

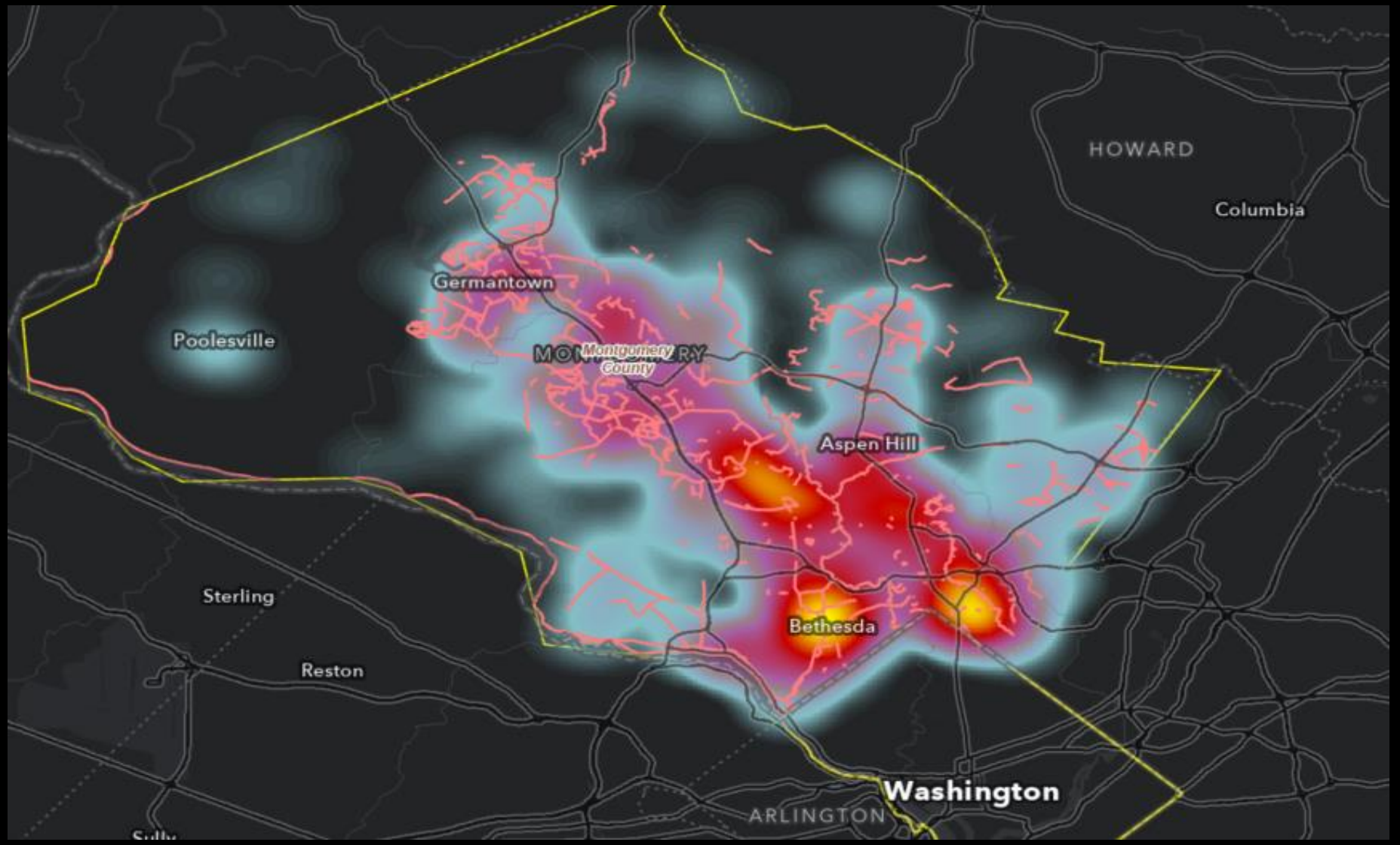
- Calculated the correlation between accident frequency and infrastructure density (using Pearson's correlation)

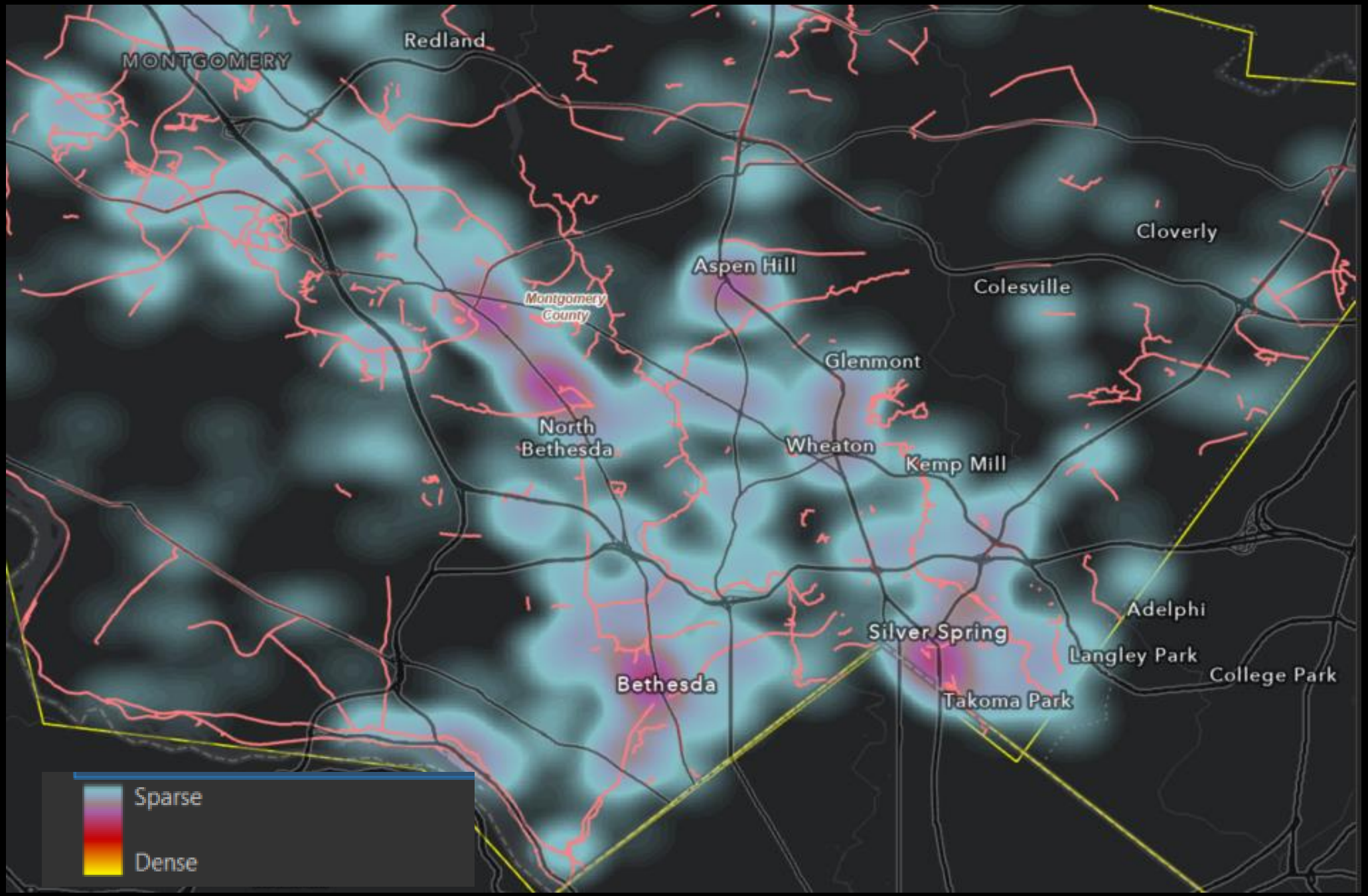
Map of correlation between the number of traffic crashes and construction activity counts

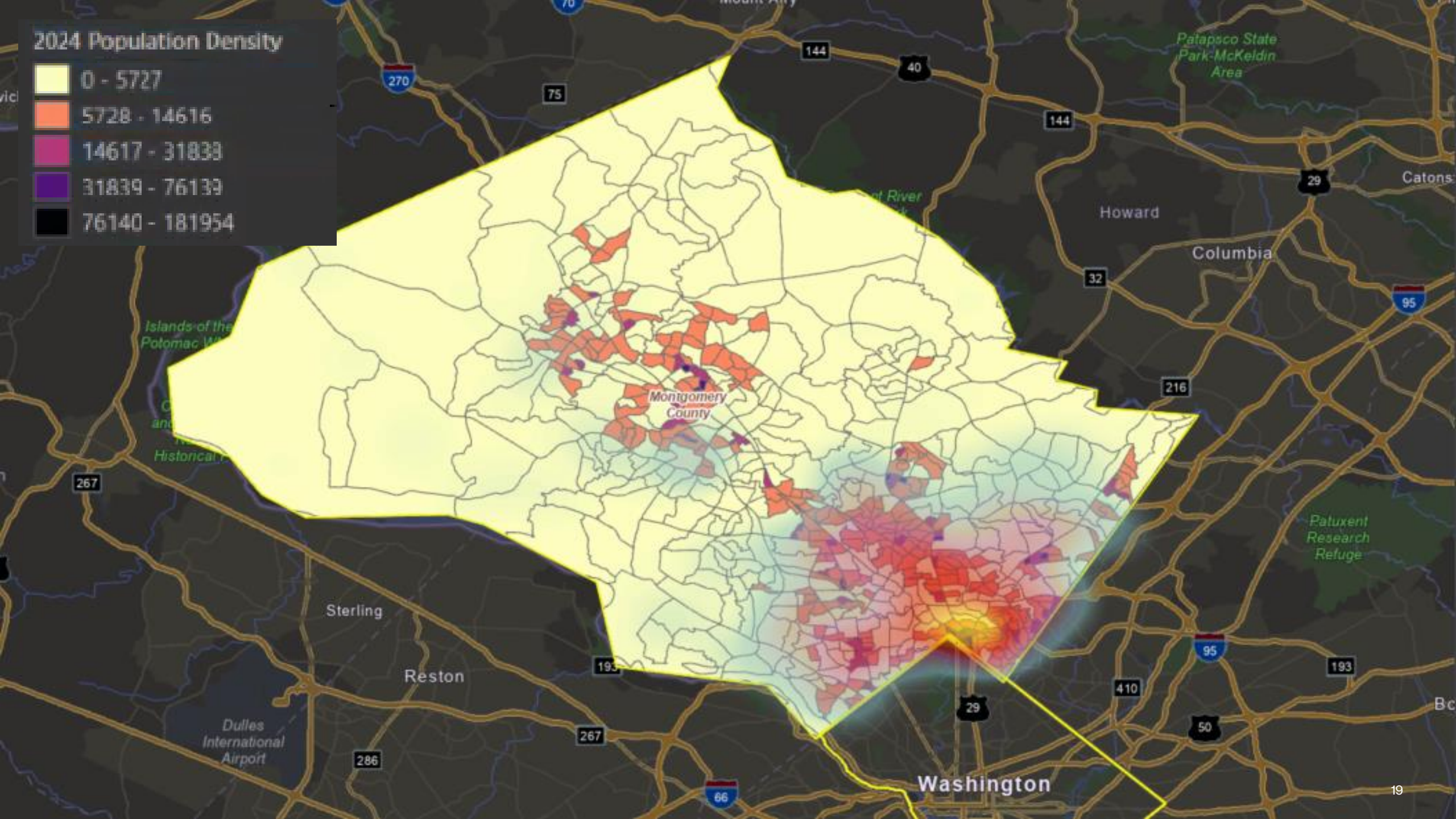


Map of hotspots of accident crashes involving vehicles & bikes






MONTGOMERY
Redland
Aspen Hill
Montgomery County
Cloverly
Colesville
Glenmont
North Bethesda
Wheaton
Kemp Mill
Adelphi
Silver Spring
Langley Park
College Park
Bethesda
Takoma Park
Sparse
Dense


2024 Population Density
0 - 5727
5728 - 14616
14617 - 31833
31839 - 76139
76140 - 181954
Montgomery County
Howard
Columbia
Sterling
Reston
Dulles International Airport
Washington
Patapsco State Park-McKeldin Area
Patuxent Research Refuge
Catons
Islands of the Potomac
Historical
70
270
75
144
40
29
32
95
216
267
193
410
50
66
286

Key Accident Patterns

- **Trends:** Crash rates dropped during the pandemic but rebounded post-pandemic.
- **High-Risk Days/Months:** Most crashes occur on weekdays, especially Fridays, and peak in October and May.
- **Speed Limits:** Higher speed limits are linked to fewer crashes ($\rho = -0.5294$, $p < 0.05$).
- **Vehicle Impact:** Non-EVs have significantly more accidents than EVs ($p < 2e\text{-}16$).
- **Infrastructure:** Weak correlation between crash counts and infrastructure.

References

。*T SHA Annual Average Daily Traffic (AADT)*. (n.d.). https://data.imap.maryland.gov/maps/77010abe7558425997b4fcdab02e2b64/about

- *MDOT/MVA Electric and Plug-in Hybrid Vehicle Registrations by County as of each month end from July 2020 to September 2024 | Open Data | opendata.maryland.gov*. (2024, October 18). https://opendata.maryland.gov/Transportation/MDOT-MVA-Electric-and-Plug-in-Hybrid-Vehicle-Regis/qtcv-n3tc/about_data

- *MVA Vehicle Registrations by County as of Each Month End from January 2023 to September 2024 | Open Data | opendata.maryland.gov*. (2024, October 24). https://opendata.maryland.gov/Transportation/MVA-Vehicle-Registrations-by-County-as-of-Each-Mon/db8v-9ewn/about_data

- *Roadway safety information Analysis - Safety | Federal Highway Administration*. (n.d.). https://safety.fhwa.dot.gov/local_rural/training/fhwasa1210/s3.cfm

Thank You !