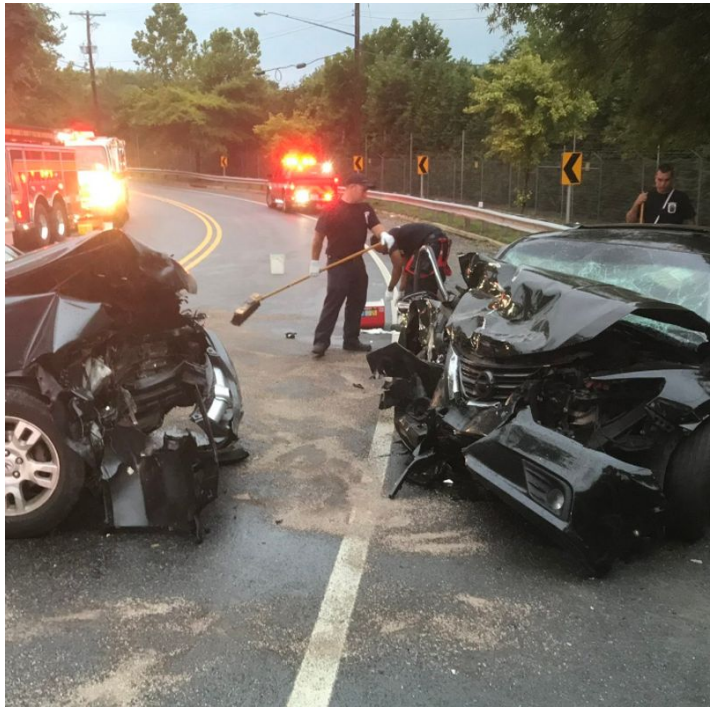
Traffic Collisions Analysis in Maryland State

Stanislav Liashkov
University Of Colorado Boulder, Master's of Science in Data Science Program

Agenda

1. Abstract
2. Intro
3. Related Work
4. Proposed Work
5. Project Timeline



Abstract

This project analyzes Maryland's traffic collision data **(2015–2024)** using time-series and geospatial analysis to identify key risk factors, such as distracted driving, and pinpoint high-risk hotspots. *The findings aim to guide targeted safety interventions and data-driven policies to reduce traffic-related injuries and fatalities.*

- **Research Method:** This study uses time-series analysis to identify temporal risk patterns and geospatial techniques like *Moran's I* and *LISA* clustering to pinpoint high-risk collision hotspots. Statistical tests, including *ANOVA* and *Kruskal-Wallis*, assess the impact of factors like road conditions, weather, and distractions.

- **Potential Value:** The analysis provides actionable insights for targeted traffic safety interventions, such as redesigning hazardous intersections, implementing stricter enforcement of traffic laws, and optimizing resource allocation to reduce injuries and fatalities.

Intro

- **Scope:** Analyzes Maryland traffic collision data (2015–2024) from the Automated Crash Reporting System (ACRS).
- **Dataset:** ~107,000 records detailing incidents, drivers, and non-motorists, sourced from local and state police.
- **Limitations:** Data includes preliminary reports that may be incomplete or unverified.
- **Accessibility:** Fully open dataset available on data.gov.
- **Objective:** Identify patterns, causes, geographical hotspots and risk factors of serious injuries and fatalities to guide actions for reducing damage from collisions in Maryland.

Related Work

Dezman et al. (2016) analyzed Baltimore (the largest city in Maryland) traffic collisions from 2009 to 2013 using ARIMA modeling and spatial analysis. They identified hotspots in high-density urban areas, with 31% of crashes linked to distracted driving. Our study extends their work to Maryland's 2015–2024 data, aiming to validate their findings and reproduce their observations over a new time span while uncovering additional insights.

Fig 1. Baltimore Map

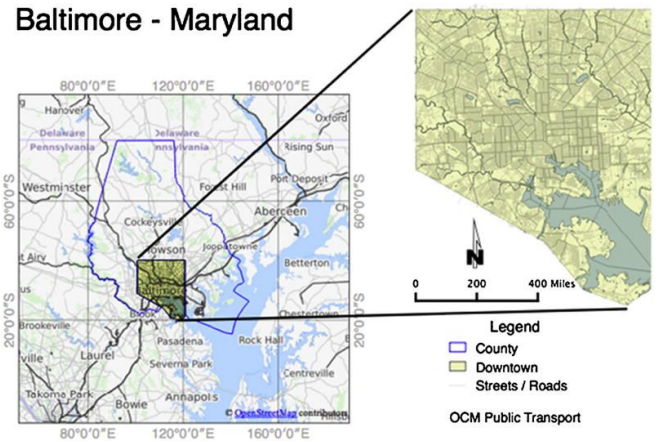


Fig 2. Seasonality of crashes (2009-2013)

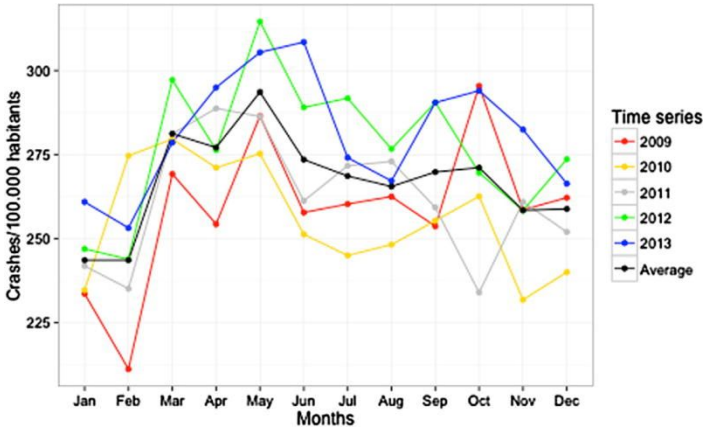
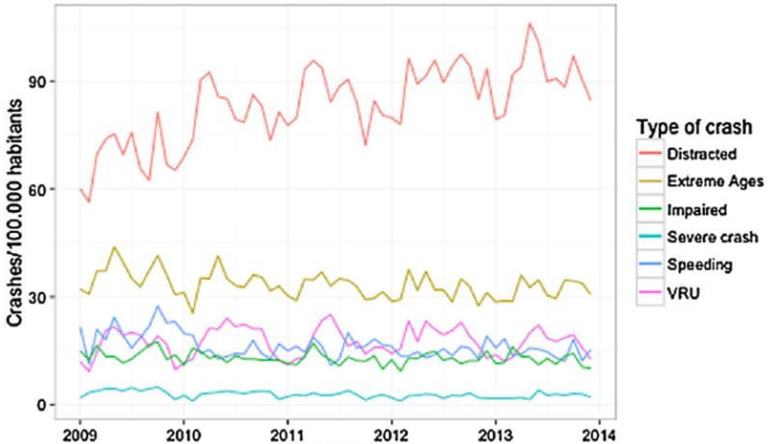


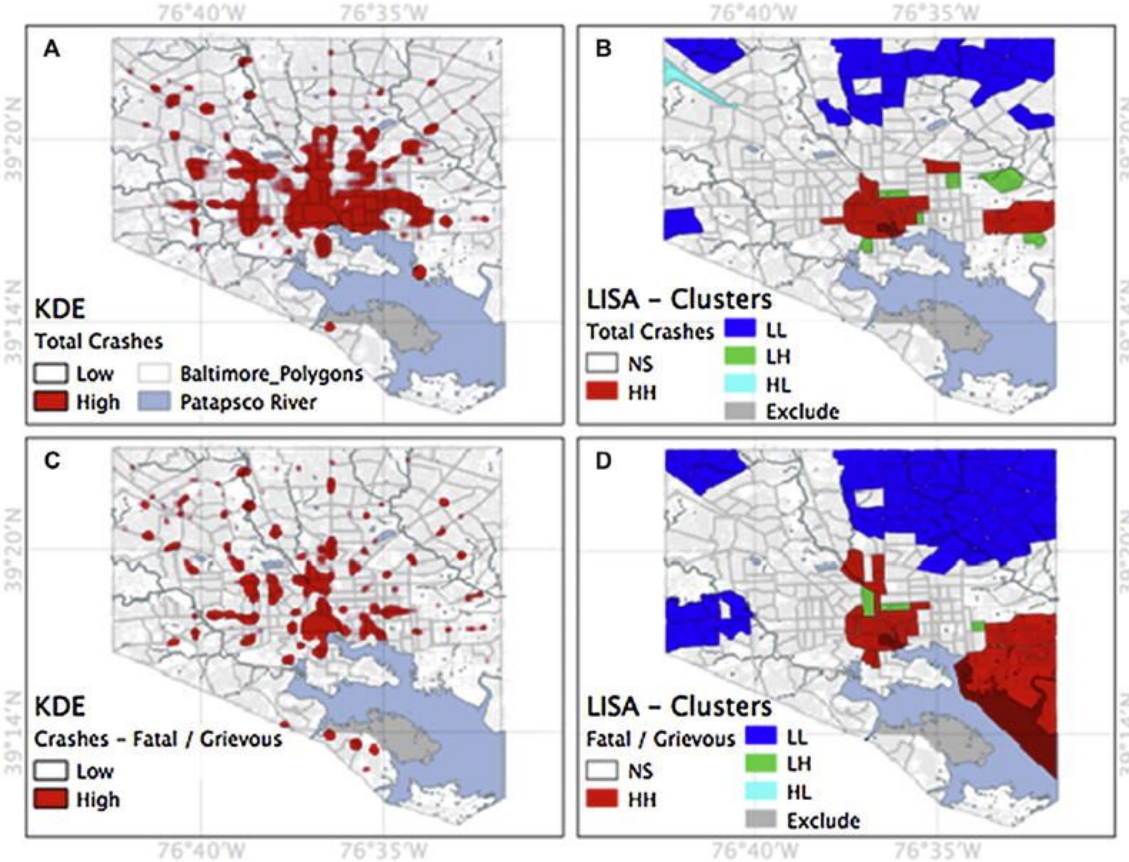
Fig 3. Seasonality of crashes by type of crash (2009-2013)



Related Work

- The most dense area of all traffic collisions is center of Baltimore as expected.
- Severe crashes has their own hotspots that are not clearly seen on non-severe crashes plot
- There is moderate spatial dependence for crashes.
  More distant areas classified as low risk areas for crashes

Fig 4. Hotspots and spatial correlation clusters for (a) all crashes and (b) severe crashes.



Proposed Work - Part I

1. **Data Collection and Preprocessing**
   Collect Maryland's traffic data (2015–2024) and preprocess it using **DuckDB** for efficient handling of incidents, drivers, and non-motorists data. Prepare clean and normalized datasets for analysis.

2. **Basic EDA (Exploratory Data Analysis)**
   Explore data distributions, relationships, and trends using visualizations to uncover patterns and address potential data quality issues.

3. **Time-Series Analysis**
   Use **ARIMA** modeling to analyze temporal trends in collisions, identifying seasonal patterns and high-risk periods.

Proposed Work - Part II

4. **Risk Factor Analysis**
   Apply statistical tests like **ANOVA** to assess how factors like distractions, weather, and road types contribute to collision severity.
5. **Spatial Analysis and Hotspots**
   Perform geospatial analysis to identify collision hotspots and assess spatial correlations with road layouts and urban density.
6. **Conclusions**
   Synthesize insights to recommend targeted safety interventions, such as urban planning improvements and policy changes.
7. **Report and Deliverables**
   Compile findings into a detailed report with maps, visualizations, and actionable strategies to improve road safety in Maryland.

Project Timeline

Project proposal date: 08.12.2024
Project ETA: 15.01.2025