RowanUniversity
CENTER FOR RESEARCH & EDUCATION IN
ADVANCED TRANSPORTATION ENGINEERING SYSTEMS

Understanding Crash Factors in Disadvantaged Communities: An Examination of Socioeconomic Disparities and Road Safety

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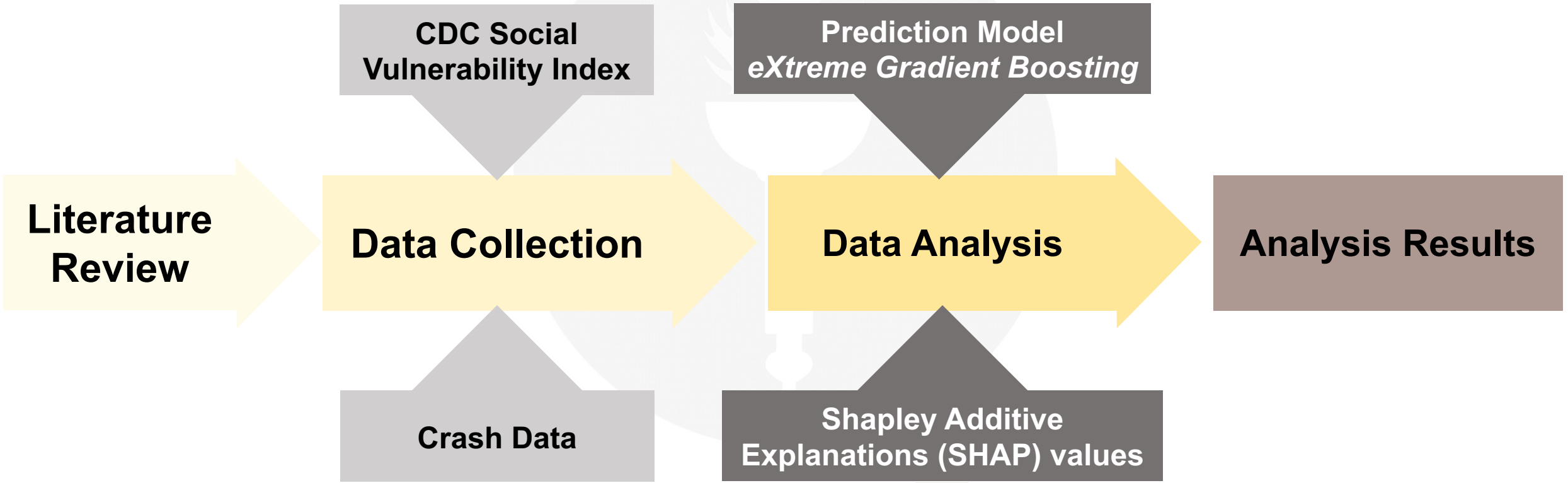
Introduction

- Traffic safety is a pressing public health concern that affects individuals across diverse demographic backgrounds
- The National Highway Traffic Safety Administration (NHTSA) reported a significant spike in traffic fatalities in 2021, marking the highest number since 2005
- Traffic crashes result in significant economic burdens, including medical expenses, property damage, lost productivity, and higher insurance premiums
- Traffic safety outcomes are not uniform across all communities, with disadvantaged communities often facing a disproportionate burden of traffic crashes and fatalities

Research Goals

- This research aims to explore the inequities in traffic safety and their outcomes in underserved communities
- Uncover and analyze the key contributing factors to traffic crashes in socially vulnerable areas
- Comprehend traffic safety disparities between vulnerable areas and more stable or secure communities
- Develop evidence-based recommendations to mitigate traffic safety disparities in socially vulnerable communities

Study Approach



Literature Review

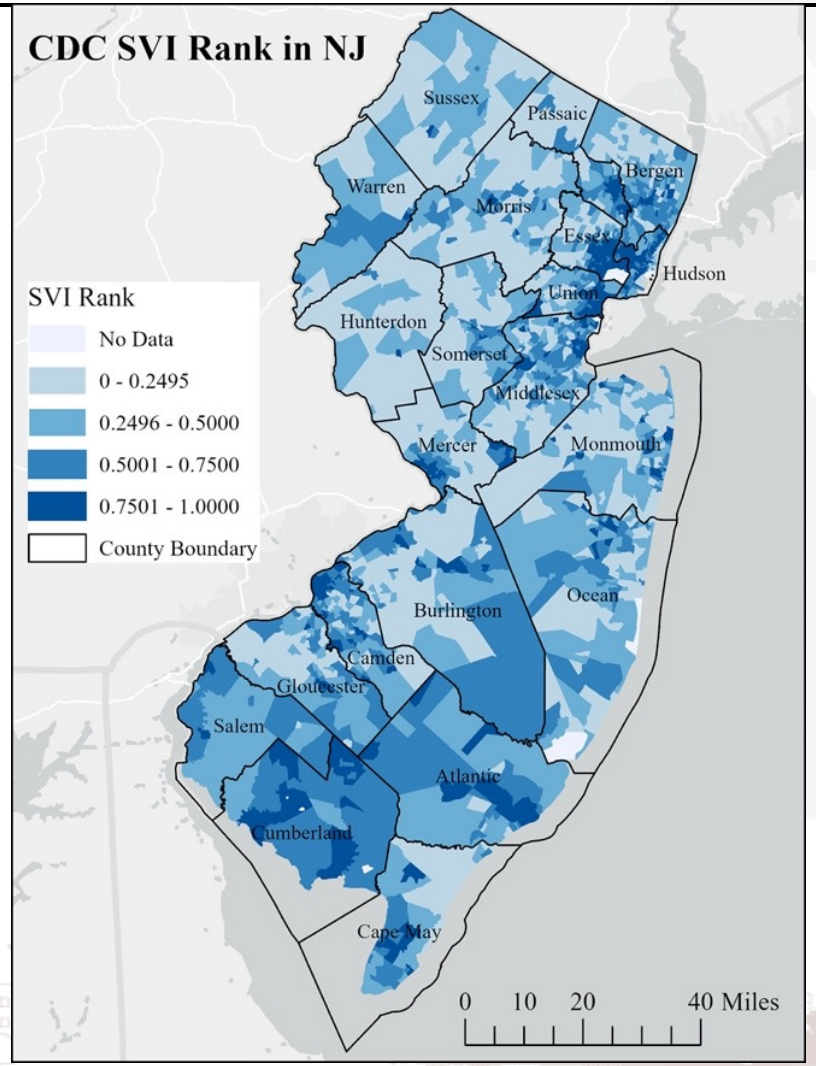
- Road geometry, traffic volumes, and human factors have been identified as major contributors to crash event
- The literature often neglects socio-demographic and economic influences on crash risk
- Recent studies examine contributing factors to traffic crashes in underserved communities, highlighting disparities in pedestrian and bicycle safety

CDC Social Vulnerability Index (SVI)

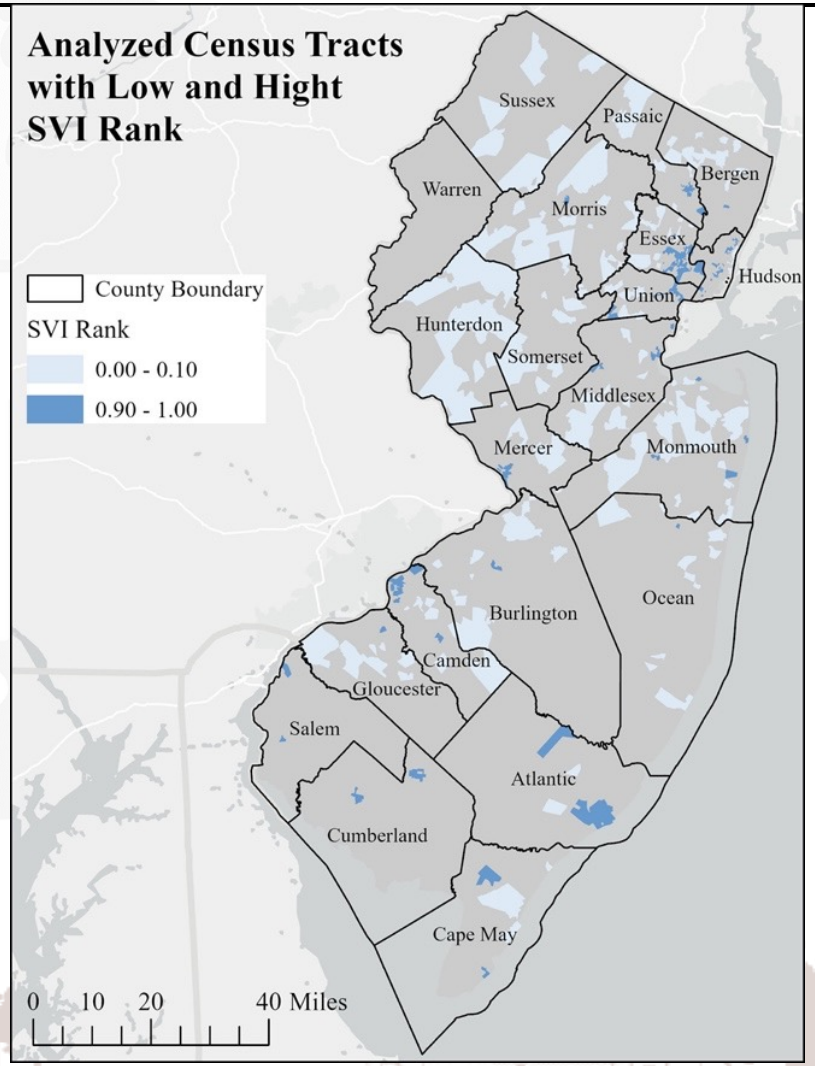
- For each tract, CDC SVI generates its percentile rank among all census tracts in New Jersey for all 15 selected variables
- The value of percentile rankings ranges from 0 to 1
- The higher the value, the greater the vulnerability

SVI Theme	Associated Variable
Socioeconomic	People below poverty
	Unemployment rate
	Per capita income
	People with no high school (age 25 +)
Household composition & disability	People aged 65 and older
	People aged 17 and younger
	Civilian with disability
	Single parent households with children under 18
Minority status & language barrier	Minority (all persons except white, non-Hispanic)
	People (age 5 +) who speak English “less than well”
Housing type & transportation	Housing in structures with 10 or more units
	Mobile houses
	Occupied housing units with more people than rooms
	Households with no vehicle available
	People in group quarters

CDC Social Vulnerability Index (SVI)



SVI rank in NJ census tracts



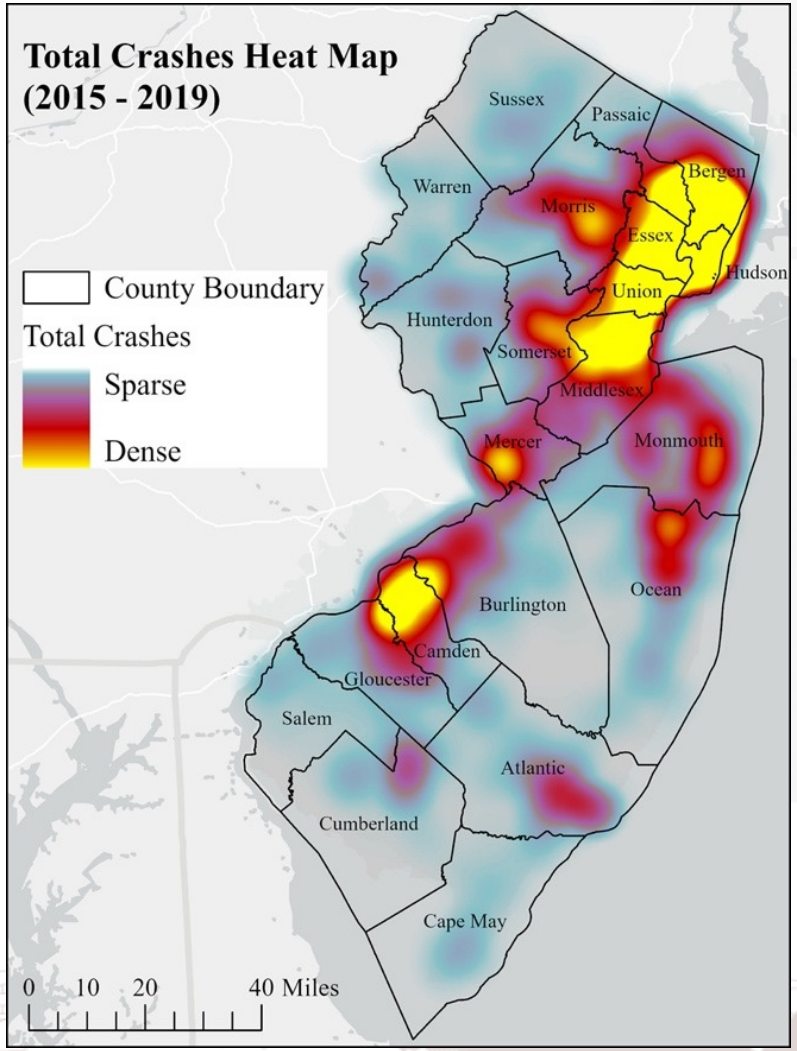
Selected census tracts

Crash Data

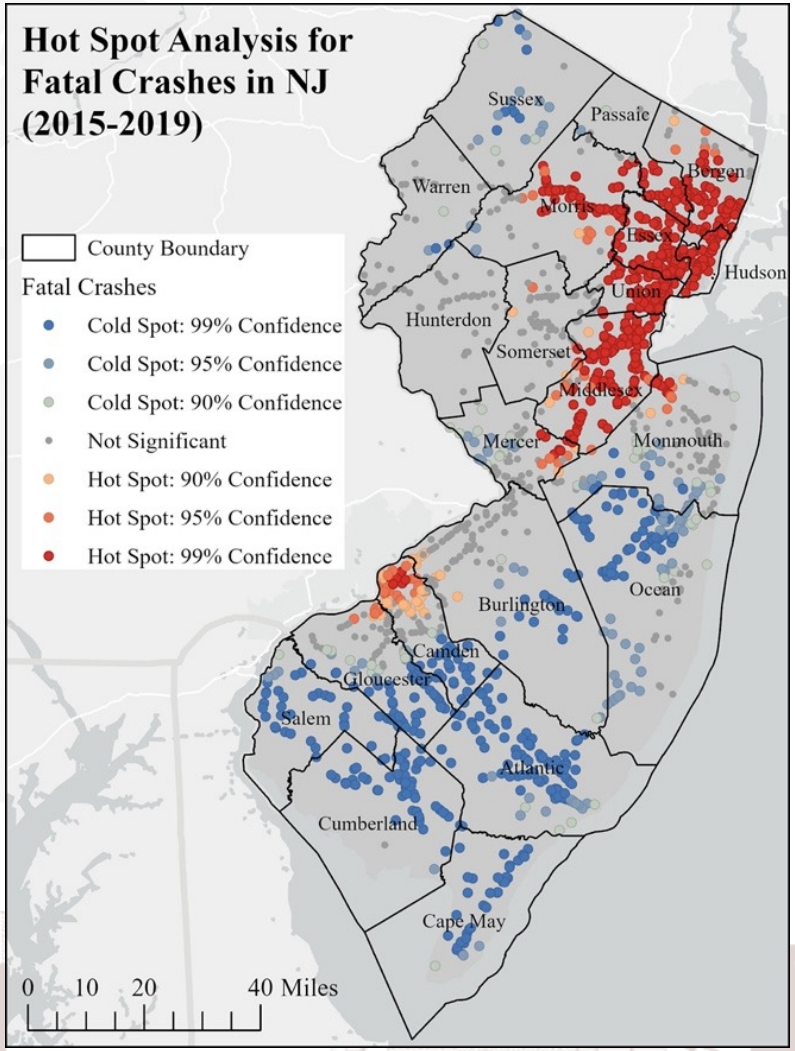
- Five years of crash data **2015 – 2019**, from the Crash Analysis Tool (CAT) provided by the New Jersey Division of Highway Traffic Safety (NJDHTS)
- Final dataset included **906,637** crash records, including **7,275** fatal injuries and suspected serious injuries
- Crash data in the selected census tracts:

Crash Severity Level	Fatal and Serious Injury	Possible and Minor Injury	No Apparent Injury
Total Crashes Census Tracts with Low SVI (0.00 – 0.10)	583	18,677	50,601
Total Crashes in Census Tracts with High SVI (0.90 – 1.00)	582	15,022	53,126

Crash Data



Heat map of the total crashes in NJ



Fatal crashes in NJ – Hot spot analysis

Data Analysis

Included Variables within the Model (XGBoost)

Temporal Variables

- Season
- Day of the Week

Roadway Features

- Road System
- Intersection
- Area
- Median Type
- Posted Speed Limit
- Road divided by

Crash Characteristics

- Crash Type
- Alcohol Involved
- Curve Related
- Distracted Driver Involved
- Drugged Driver Involved
- Head On Collision Involved
- Pedestrian Involved
- Older Driver Involved
- Motorcycle Involved

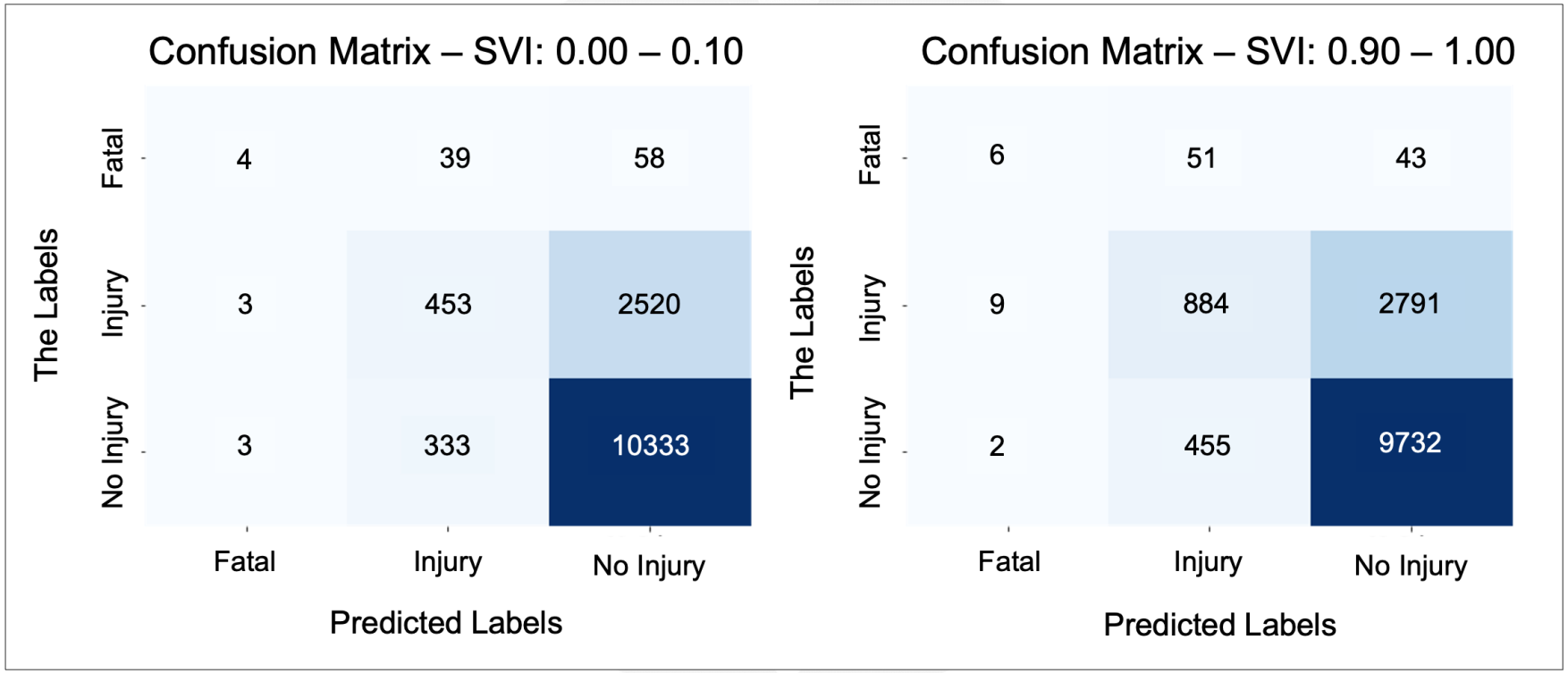
Crash Characteristics, cont.

- Live Animal Involved
- Single Vehicle Crash

Environmental Conditions

- Light Conditions
- Weather
- Surface Condition

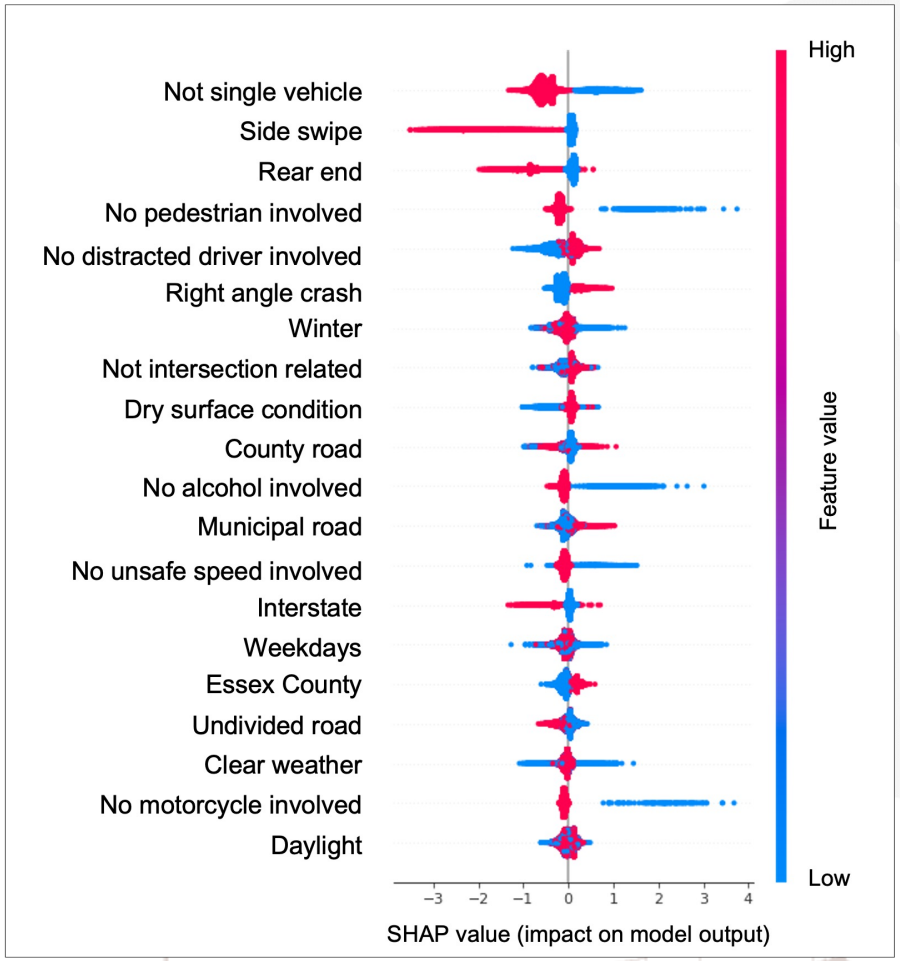
Model Performance



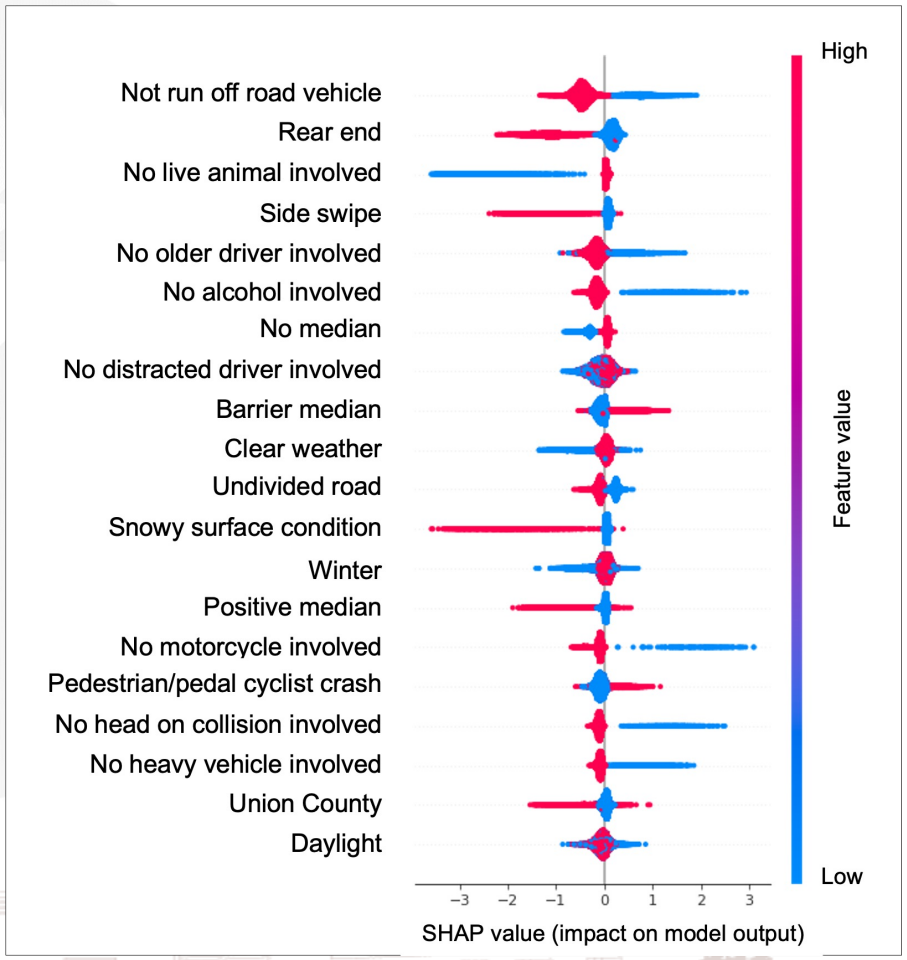
Confusion matrix of model performance

Dataset	Accuracy	Recall	Precision	F-score
Crashes in Low SVI	0.78	0.39	0.58	0.39
Crashes in High SVI	0.76	0.42	0.59	0.44

SHAP Results



SHAP summary plot for the key contributing factors influencing fatal and serious injury severity in tracts with SVI ranges between 0.90 and 1.00



SHAP summary plot for the key contributing factors influencing fatal and serious injury severity in tracts with SVI ranges between 0.00 and 0.10

SHAP Results

- In socially vulnerable areas, single-vehicle crashes were the most contributing factor to increased crash severity. Pedestrian involvement was the fourth most important variable, with their presence leading to higher crash severity
- Several variables, such as specific crash types (angle), and road systems (municipal), were associated with lower crash severity levels in vulnerable communities
- In less vulnerable areas, run-off road crashes, rear-end and side-wipe crash types, and the absence of live animal crashes were the most significant factors contributing to lower crash severity

Conclusion

- To address disparities in traffic safety, some systematic interventions can create more equitable and safer transportation environments, such as, prioritizing infrastructure improvements, improving access to public transportation, promoting alternative modes of travel, developing tailored traffic safety education programs, and fostering collaboration among stakeholders
- Communities should empower their residents with the knowledge, skills, and resources needed to make safer transportation choices

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Thank You!

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