

# DETERMINING KEY FACTORS AFFECTING THE INJURY SEVERITY OF INTERSECTION RELATED CRASHES IN NEW JERSEY

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### Overview

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2015.

#### Introduction

✤ According to the Federal Highway Administration

(FHWA), more than 50 percent of combined fatal and injury crashes occur at or near the intersection.

✤ Furthermore, based on New Jersey State Police, a

total of 146 fatal crashes occurred at intersections in

New Jersey in 2019, indicating a 39% increase

(Source: Patel et al., 2023)

compared to the 105 fatal crashes that happened in



#### Introduction





#### Introduction

# THE DEADLIEST INTERSECTION IN THE COUNTRY IS IN NEW JERSEY (Surce New Jersey 10.5) (Surce New Jersey 1

STUDY: SIX OF THE TOP 30 DEADLIEST INTERSECTIONS IN AMERICA ARE IN NJ

Trenton, New Jersey intersection among the deadliest in the nation



# **Research Objectives**

- \* To identify significant contributors to the injury severity of intersection-related crashes
- \* To provide essential insights to professionals, and policymakers based on the research

findings



#### **Literature Review**

A total of **32** studies were reviewed to identify the primary **contributing factors to injury severity**, assess the utilization of **machine learning models**, and determine **limitations and research gaps** in prior investigations.





#### **Literature Review**





# **Collect/Analyze Relevant Data**

#### \* Five years (2015-2019) of crashes that

occurred at the intersection of the state of New Jersey

was gathered

injury.

✤ The final dataset includes 234,192 crash records,

including 2,180 fatal and serious injury; 70,013

possible and minor injury; and 161,999 no apparent





#### **Collect/Analyze Relevant Data**





# Methodology





#### Methodology

#### **Model Evaluation**





#### Methodology





# Results

#### **Model Performance Evaluation**

Models	Accuracy	Recalls	Precision	F-score
XGBoost	0.73	0.41	0.61	0.42
LightGBM	0.73	0.40	0.60	0.40
CatBoost	0.73	0.41	0.62	0.41
Random Forest	0.70	0.41	0.49	0.42
Ensemble Model	0.74	0.41	0.66	0.42



# Results

Co	onfusion Ma	trix	XGBoost					R	andom Fore	est
:	Fatal and Incapacitating Injury	19 (0.04%)	259 (0.55%)	148 (0.32%)			Fatal and Incapacitating Injury	15 (0.03%)	271 (0.58%)	140 (0.30%)
tual Class	Non-Incapacitating Injury	27 (0.06%)	3126 (6.67%)	10772 (23.00%)		tual Class	Non-Incapacitating Injury	34 (0.07%)	4414 (9.42%)	9477 (20.23%)
Act	Possible Injury	6 (0.01%)	1258 (2.96%)	31224 (66.66%)		Ac	Possible Injury	16 (0.03%)	4104 (8.76%)	28368 (60.56%)
		<ul> <li>Fatal and Incapacitating Injury</li> </ul>	Non-Incapacitating Injury	Possible Injury				Fatal and Incapacitating Injury	Non-Incapacitating Injury	Possible Injury
		Pro	edicted Clas	s	C	3.		Pro	edicted Clas	s



#### Results

#### **Confusion Matrix**





# Results

<b>Confusion Matrix</b>		Ensemble Model			
	Fatal and Incapacitating Injury	20 (0.04%)	254 (0.54%)	152 (0.32%)	
tual Class	Non-Incapacitating Injury	15 (0.03%)	3210 (6.85%)	10700 (22.84%)	
Act	Possible Injury	1 (0.00%)	1268 (2.71%)	31219 (66.65%)	
		Fatal and ncapacitating Injury	Non-Incapacitating Injury	Possible Injury	
	un te.dt	I Pre	edicted Clas	\$	



#### Results

#### **Shapley Additive Explanations (SHAP)**





#### Results

#### **Shapley Additive Explanations (SHAP) : Crash Type**





#### Results

#### **Shapley Additive Explanations (SHAP) : Traffic Control System**





# Conclusion

crash severity.

- The Ensemble Model achieved the highest accuracy of 0.74, demonstrating its effectiveness in predicting crash severity accurately
- SHAP analysis highlighted the importance of various factors, including angle crash type, higher speed limits, and temporal variables like seasons (summer and fall) and time of day (between 12:01 and 18:00 hours), in increasing the severity of injuries for the intersections related crashes
- These findings offer valuable guidance for transportation safety professionals, enabling the development of targeted strategies for education, enforcement, and engineering to reduce intersection



#### Recommendation





#### Recommendation





#### Recommendation

- Targeted Enforcement: Implement focused law enforcement efforts during specific crashprone months and hours, especially during summer and fall and between 12:01 and 18:00, to ensure smoother traffic flow and decrease crash rates.
- Educational Initiatives: Develop educational programs, particularly targeting older drivers, to provide updates on the latest intersection advancements and safety measures. Increasing awareness about the dangers of distracted driving near intersections should be a key component





needed.

#### Recommendation

- Exploring Advanced Models: Future research should explore the use of more advanced machine learning models, including deep learning techniques, to potentially achieve even higher accuracy rates in predicting intersection crash severity.
- Enhanced Data Collection: Collect more detailed data, including signal phase information, average cycle times for traffic lights, lane-specific location information, and real-time vehicle speeds before the time of the crash. This enhanced data can provide deeper insights into the factors contributing to intersection-related crash severity.
- Continuous Monitoring: Establish a system for continuous monitoring and evaluation of intersection safety measures to ensure their effectiveness over time and adapt them as





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