DEVELOPMENT OF SAFETY PERFORMANCE FUNCTIONS FOR TWO-LANE RURAL HIGHWAYS IN THE STATE OF OHIO

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Introduction

- For decades, Highway and Traffic Safety plays a vital role in traffic management strategy.

- As a result, AASHTO developed the Highway Safety Manual (HSM), (AASHTO, 2020).

- In particular, Part C of HSM represents the list of a variety of safety performance functions (SPFs) for various facility types such as a two-lane rural highway to predict the number of highway crashes (HSM, 2010).

Introduction

- Safety performance function (SPF) is a safety prediction model (HSM, 2010).
- Srinivasan and Bauer (2013) described the SPFs, which are "essentially mathematical equations that relate the number of crashes of different types to site characteristics" (R. Srinivasan & Bauer, 2013).
- The SPFs always utilize the given information about the characteristics of the geometric highway (such as lane width, shoulder width, median type), and the annual average daily traffic (AADT).

Problem Statement

- NHTSA reports that in 2017, there were 1,179 fatalities in the state of Ohio, which have increased 4 percent since 2016 (1,132) (NHTSA, 2019).

- the majority of fatality crashes occurred in the two-lane rural highway, as shown in the following Table 1.1 (OSHP Statistics, 2020).

- For this reason, the SPFs play an essential role in making better safety decisions by state departments of transportation and agencies through improving the precision of the crash prediction method and safety analysis.

Table 1-1: Traffic safety facts Rural/Urban for Ohio 2012-2018 (*OSHP Statistics*,2020)

Core Outcome Measures		Year						
		2012	2013	2014	2015	2016	2017	2018
Traffic Fatalities	Total (C-1)	1122	990	1008	1110	1133	1179	1068
	Rural	775	642	681	703	721	770	651
	Urban	347	348	327	407	412	409	417

Problem Statement

- HSM prediction models are not fit for all states or jurisdictions because each site and jurisdiction can embrace different characteristics, such as terrain, driver behaviors, crash type.

- the HSM recommendation, the calibration of HSM prediction models or develop jurisdiction-specific SPFs is necessary to make better and accurate predict safety performance for the state of Ohio.

The Objective Of The Study

- The principal objective of this study was to develop a prediction method for producing Ohio-specific SPFs model to use it for rural two-lane highways in the state of Ohio.

Literature Review

- The study of predicting the occurrence of crashes began with the study of how particular crash types related to geometric highway characteristics. Zeeger and Deacon (1987) created the first quantitative model to predict crashes using data from previous studies in Ohio and Kentucky

- (Miaou, 1993), (Mountain et al., 1996) have proposed new types of predictive models by using a variety of statistical approaches (such as Poisson regression, and negative binomial regression) to more accurately predicting accidents.

Literature Review

- to identify the best method to apply regression models to create the most accurate safety performance functions, Vogt, and Bared (1998) made the first move to develop the prediction model by creating SPFs base model used in HSM.

- they have created the base model for the two-lane rural highway, which presents the following equation:

$$N_{br} = (\mathrm{ADT})(L)(365)(10^{6})e^{-0.4865}$$

Literature Review

- the previous studies focused on Developing jurisdiction-specific SPFs for two-lane rural highways.

- the following states around the united states that developed their jurisdiction-specific SPFs for two-lane rural highways.
  - Illinois (Tegge et al., 2010).
  - Virginia (Garber et al., 2010).
  - North Carolina(R. Srinivasan & Carter, 2011)
  - Wisconsin (Martz, 2017)

Methodology

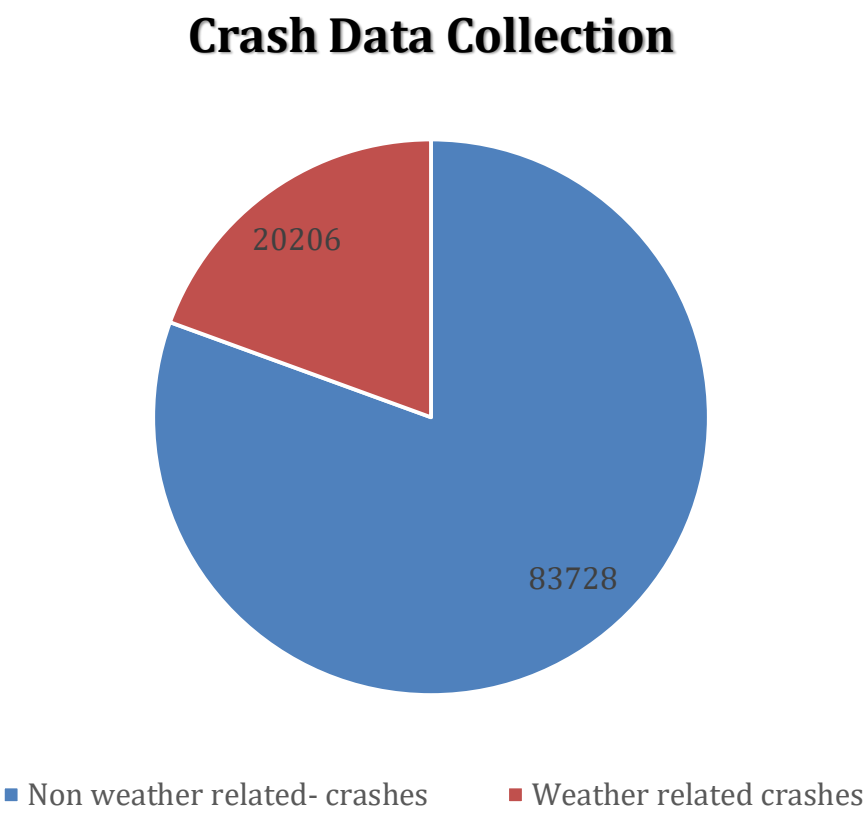
- the proposed model form for the methodology of this study was the negative binomial regression model because it accounts for the overdispersion, which is "the existence of variability in a dataset.", and HSM recommends it

- The following equation presents the basic negative binomial regression model that shows the relationship between crash frequency and the independent variables, and it might be used in this study .

$$N_{SPF} = N \times L \times AADT^{\alpha_0} \times e^{\alpha_1 + (\alpha_2 X_1 + \alpha_3 X_2 + \cdots + \alpha_m X_n)} \quad (1)$$

Where the variable α0 is the coefficient of AADT and α1 through α(m) are coefficients for each of the influencing factors (X1 through Xn), L represents segment length (miles), *NSPF* represents the predicted number of crashes per year, and N is the number of total years of crash data.

Data Description Analysis



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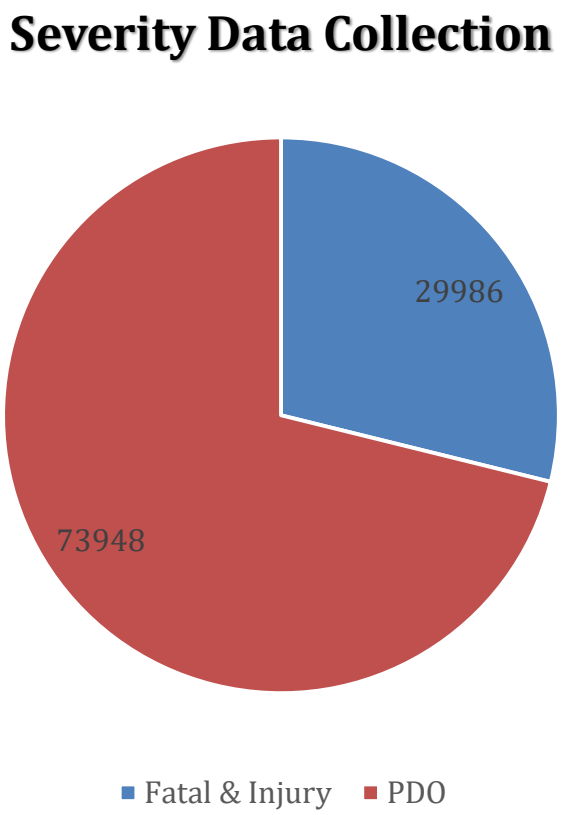

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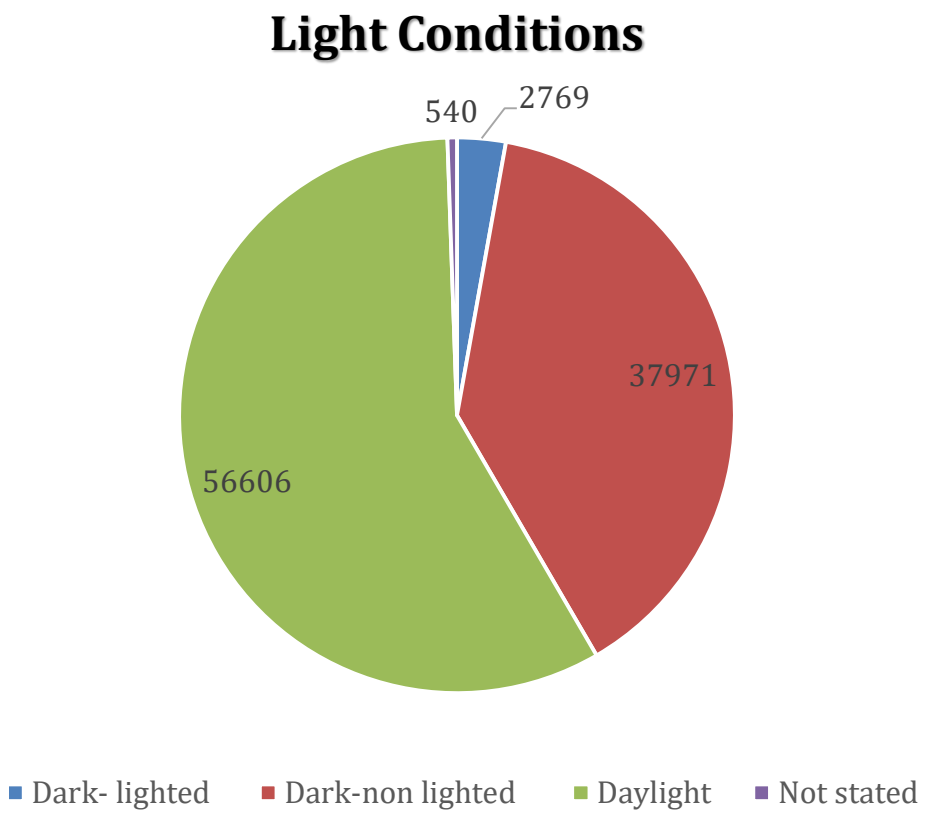

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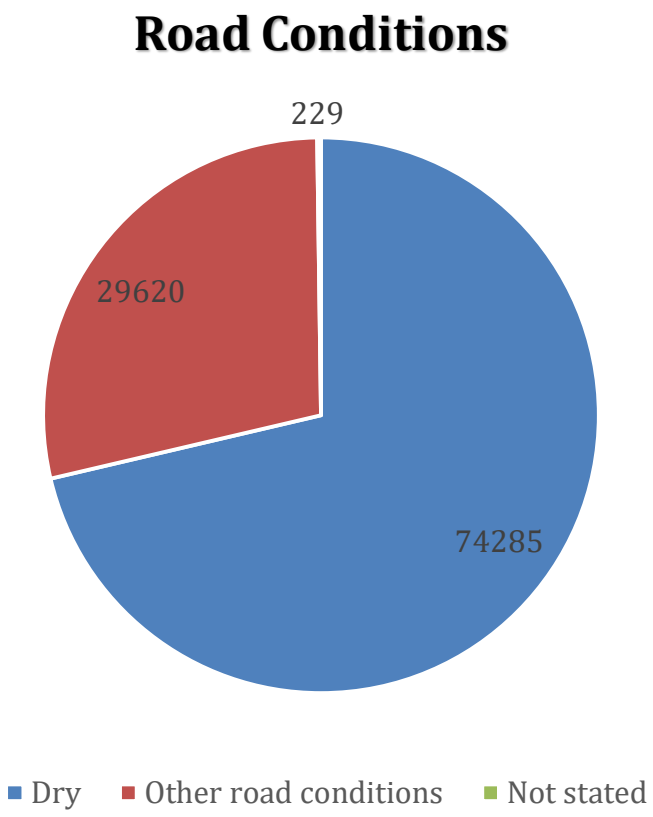

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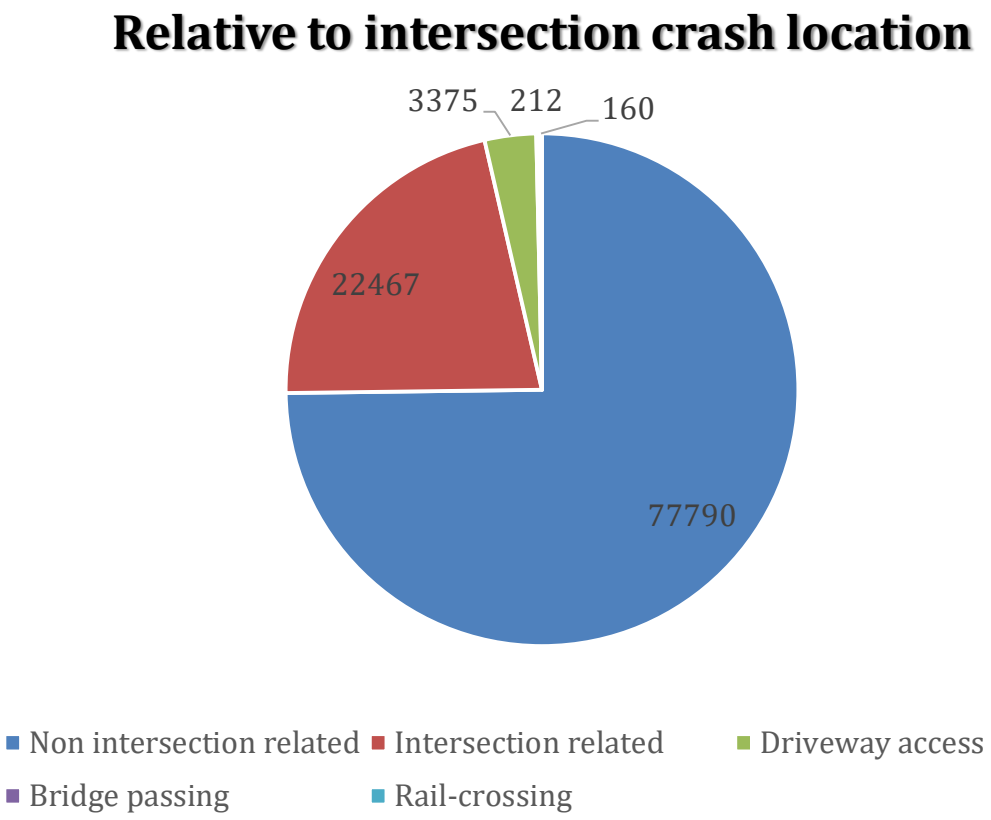
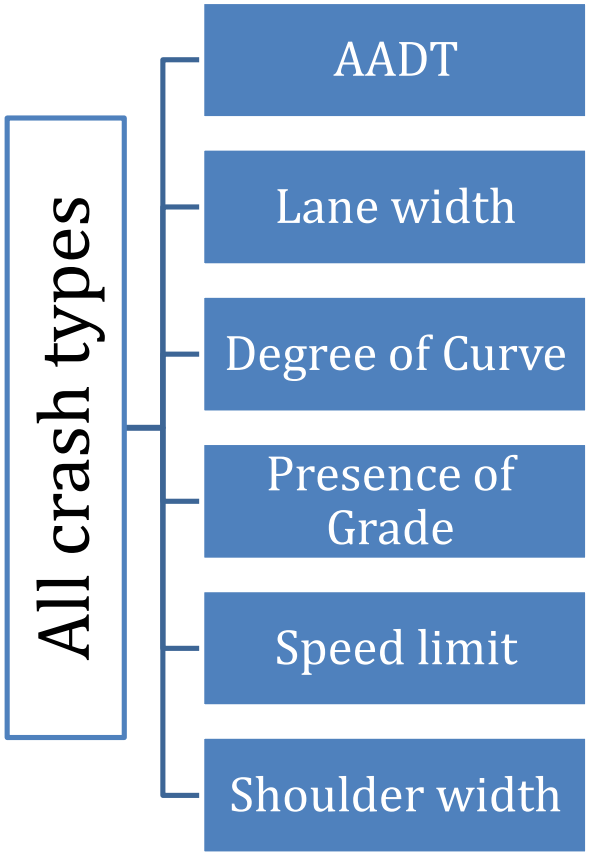


Data Description Analysis

BY using SPSS, all crash types correlated to the following variables except Segment length



Recommendation

1- the datasets should be filtered, and the outlier analysis is a crucial step because a single outlier or a few outliers will seriously affect the estimate of the parameter in the SPF.

2- We should create 3 SPF models for tow-lane rural highways in the state of Ohio, which are the following:

- All crash type model
- Fatal & Injury crash model
- Weather related crash model

3. Validate these model by utilizing Goodness of Fit measures.