Development of Safety Performance Functions (SPFs) for Motorcycle Crashes in Florida for Pre- and Post- Pandemic Conditions

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Introduction

- Florida has the highest number of motorcycle fatalities in the United States.
- Motorcyclists represent 3.4% of Florida's registered vehicles
- Motorcycle crashes account for about 20% of traffic fatalities, represent less than 1% of total vehicle miles traveled.
- The number of annual motorcycle fatalities observed in Florida has more than doubled over the past twenty years.

In recent years, the Federal Highway Administration (FHWA) has developed safety performance functions (SPFs), or mathematical models for identifying locations and predicting the number of crashes over a highway segment. Existing SPFs are not currently used solely for motorcycle crash prediction; this study aims to develop SPFs for different degrees of severity in motorcycle crashes in Florida. Crash data from 2020 is used throughout the model formulation and preliminary results.

The purpose of this study is to compare pre- and post- pandemic crash predictions using Safety Performance Functions.

Methodology

Safety Performance Functions are used to enhance traffic safety and determine which roadway elements contribute to crashes along certain segments of roadway. These specific roadway geometric characteristics and external factors, such as weather and lighting, are implemented into the SPF equation to predict the number of crashes based on certain criteria. The standard SPFs described within the HSM can be modified and calibrated to a specific roadway or jurisdiction using the following equation:

$$N_{predicted} = N_{SPF} * \left(CMF_{1x} * CMF_{2x} * \cdots * CMF_{yz}\right) * C_x$$

Where: $N_{predicted}$ = predicted average crash frequency for a specific year for site type x;

N_{SPF} = predicted average crash frequency determined for base conditions of the SPF developed for site type x;

CMF_{nx} = crash modification factors specific to SPF for site type x;

And C_x = calibration factor to adjust SPF for local conditions for site type x.

References

1. CRASHES OVER TIME – Ride Smart Florida. (n.d.-b). https://ridesmartflorida.com/crashes- over-time/

2. Lee, C., Wang, Z., Yang, R., Understanding Florida Motorcycle Crashes and Injury Outcomes Using the Motorcycle Crash Causation Study (MCCS) Dataset 2021-10-01 URL : https://rosap.ntl.bts.gov/view/dot/62748

3. Srinivasan, R., Carter, D., Bauer, K., Safety Performance Function Decision Guide: SPF Calibration vs SPF Development 2013-09-01 Report Number : FHWA-SA-14-004 URL : https://rosap.ntl.bts.gov/view/dot/49504

4. Federal Highway Administration. (2016). The Calibrator: An SPF Calibration and Assessment Tool User Guide. United States Department of Transportation

Data Collection

Data Sources:

FDOT SSOGis website are maintained by FDOT Safety Office. The database provides crash data within the state of Florida from 2011 to June 2022.

Some of the data provided includes:

- Crash types
- Roadway conditions
- Weather
- Injury severity levels
- Lighting conditions
- Moving status
- Geographical coordinates, etc

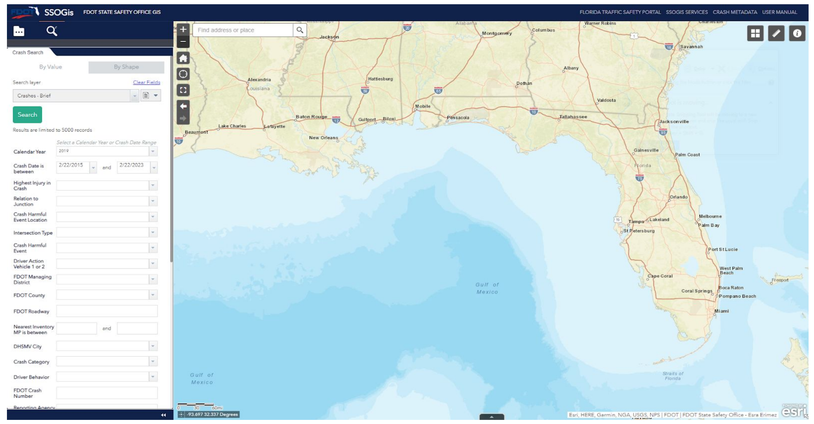

Figure 1: FDOT SSOGis System

Future Work

- Develop SPFs for pre-COVID-19 years (2018, 2019).
- Combine 2020 (existing) data and 2021 data for during COVID-19 condition.
- Develop SPFs for during COVID-19 condition (2020, 2021).
- Collect data for post-COVID-19 condition (2022, 2023).
- Develop SPFs for post-COVID-19 condition (2022, 2023).
- Compare SPFs from pre-, during, and post COVID-19 years.

Table 1: Explanatory Variables

No Unknown Information					
Type	**Variable**	**Value**	**Description**	**Count**	**Percent**
Categorical	Highest Level Injury	5	Fatal (Within 30 Days) Injury	212	8.018%
		4	Incapacitating Injury	548	20.726%
		3	Non-Incapacitating Injury	684	25.870%
		2	Possible Injury	866	32.753%
		1	No Injury	334	12.632%
Dummy	Area	1	Urban	2480	93.797%
		0	Rural	164	6.203%
	Alcohol/Drugs	1	Present	136	5.144%
		0	Not Present	2508	94.856%
	Daytime	1	Yes	1708	64.599%
		0	No	936	35.401%
	Dusk	1	Yes	113	4.274%
		0	No	2531	95.726%
	Dawn	1	Yes	33	1.248%
		0	No	2611	98.752%
	Dark-Lighted	1	Yes	642	24.281%
		0	No	2002	75.719%
	Dark-Not Lighted	1	Yes	144	5.446%
		0	No	2500	94.554%
	Dark-Unknown Lighting	1	Yes	4	0.151%
		0	No	2640	99.849%
	Speeding	1	Yes	119	4.501%
		0	No	2525	95.499%
	Aggressive Driving	1	Yes	112	4.236%
		0	No	2532	95.764%
	Distracted Driving	1	Yes	406	15.356%
		0	No	2238	84.644%
	Rear-End	1	Yes	1054	39.864%
		0	No	1590	60.136%
	Head-On	1	Yes	122	4.614%
		0	No	2522	95.386%
	Angle	1	Yes	1005	38.011%
		0	No	1639	61.989%
	Sideswipe	1	Yes	447	16.906%
		0	No	2197	83.094%
	Rear to Side	1	Yes	12	0.454%
		0	No	2632	99.546%
	Rear to Rear	1	Yes	4	0.151%
		0	No	2640	99.849%
	Clear Weather	1	Yes	2294	86.762%
		0	No	350	13.238%
	Cloudy Weather	1	Yes	262	9.909%
		0	No	2382	90.091%
	Rainy Weather	1	Yes	77	2.912%
		0	No	2567	97.088%
	Fog, Smog, Smoke	1	Yes	11	0.416%
		0	No	2633	99.584%
	Road Wet	1	Yes	142	5.371%
		0	No	2502	94.629%
	Posted Speed >30 mph	1	Yes	2502	94.629%
		0	No	142	5.371%
Continuous	AADT	Annual Average Daily Traffic (in Thousands)		1300 ~ 269000	
	Posted Speed	Posted Speed Limit (in mph)		25 ~ 70	

Preliminary Model Results

Tables 2 and 3 list the model results obtained from SPSS and the Goodness of Fit of the results, respectively. All selected variables are significant at a 95% confidence level.

Table 2: Significant Variables for Motorcycle Crash Injury Level

Parameter	Coefficients	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
Constant	5.080	.1655	4.756	5.405	941.724	1	0.000
Functional Class	.558	.0860	.389	.726	42.046	1	.000
Posted Speed >30mph	-.557	.0916	-.737	-.377	36.959	1	.000
Alcohol/Drugs Involved	-1.026	.0946	-1.212	-.841	117.610	1	0.000
Daylight	.100	.0438	.014	.185	5.180	1	.023
Clear Weather	.166	.0611	.046	.285	7.355	1	.007
Head-On Collision	-.420	.1003	-.616	-.223	17.499	1	.000
Angle Collision	-.503	.0431	-.587	-.418	136.061	1	0.000
Speeding	-.700	.1001	-.897	-.504	48.950	1	.000

Table 3: Goodness of Fit of SPSS Model

Goodness of Fit			
Likelihood Ratio Chi-Square	df	Sig.	
427.572	8	0.000	
	Value	df	Value/df
Deviance	2959.142	2635	1.123
Scaled Deviance	2644.000	2635	
Pearson Chi-Square	2959.142	2635	1.123
Scaled Pearson Chi-Square	2644.000	2635	
Log Likelihood[b]	-3900.539		
Akaike's Information Criterion (AIC)	7821.079		
Finite Sample Corrected AIC (AICC)	7821.162		
Bayesian Information Criterion (BIC)	7879.879		
Consistent AIC (CAIC)	7889.879		