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Project Title

Motorcycle Safety Assessment in Wyoming and Utah: Crash Characteristics and Contributing Factors

University

University of Wyoming

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Research Needs

Even though motorcycle fatalities comprise a large percentage of traffic fatalities in the U.S. (in excess of 15%) (1), comprehensive studies on motorcycle safety on the national level are lacking. According to the NHTSA, the mean fatality crash rate for motorcycles is about five times higher than that for passenger cars (2). From 2015 onwards, the 5-year rolling average of fatal motorcycle crashes per million population in Wyoming has been increasing, from 26 in 2015, to 32 in 2018 (1). In 2018, there were 15 motorcycle fatalities in Wyoming. In Utah, the average motorcycle fatalities between 2015 and 2020 were 41 per year, which constituted about 15.1% of all highway fatalities, even though the motorcycle VMTs represent less than 1% of all VMTs (3). Most fatal and serious injury motorcycle crashes happen between April and September, with the peak occurring in August. However, after April of 2019 the number of fatal motorcycle crashes reduced between 25% and 60% depending on the month (3). The new law allowing lane filtering came into effect in May of 2019, with Utah becoming the second state in the US to allow this, after California. The safety effects of the Utah lane filtering law are still unknown. In addition, neither Wyoming nor California have a comprehensive helmet requirement law. Wyoming requires helmets for riders/passengers aged 17 or younger, with the exception for mopeds, while Utah requires helmets for riders/passengers 20 or younger, regardless of motorcycle type (5).

This research will perform a comprehensive motorcycle safety assessment for Wyoming and Utah, using five to ten years of detailed crash data. It will analyze crash characteristics, severities, types and contributing factors for different facilities and area types, and assess the countermeasures which have the potential to reduce the frequency and severity of motorcycle crashes. The study will develop statistical models to be used for a detailed assessment. There aren't any recent studies on motorcycle safety in Wyoming and Utah, however fatal and serious

motorcycle crashes represent a significant percentage of all crashes. A comprehensive study is needed to determine motorcycle crash characteristics, contributing factors and potential countermeasures.

Research Objectives

The main research objectives of this study are as follows:

- Summarize motorcycle crash characteristics for Wyoming and Utah.
- Develop statistical models for motorcycle safety assessment, using 5-10 years of crash data. The measure of success will be the calibration of the models.
- Determine the major contributing factors for severe and fatal motorcycle crashes.
- Develop recommendations for countermeasures. The success of these recommendations will be assessed using data from other states with implemented measures.

The study will first perform a detailed assessment of motorcycle crash characteristics using 5-10 years of safety data from Wyoming and Utah. The assessment will show crash characteristics such as crash types, severities, locations, contributing factors, and other elements of importance. These descriptive statistics will show the current state of motorcycle safety and needs for improvements.

Five to ten years of crash data from Wyoming and Utah will be used to develop statistical safety models for motorcycle crashes. The data will be organized by selected variables (crash characteristics, traffic, environmental conditions and roadway characteristics) and imported into statistical software. First, statistically significant variables for injury and fatal motorcycle crashes will be determined. Then, statistical models will be developed to create locally applicable Safety Performance Functions (SPFs) for these types of crashes. In addition to modeling frequencies and rates for motorcycle crashes, the SPFs will be able to predict safety performance for future changes in traffic patterns, as well as the implemented countermeasures and other updates. The measure of success will be the calibration of these models, to ensure realistic representations of safety characteristics.

Through both data analysis and statistical modeling, the study will determine the major contributing factors for motorcycle crashes, with a focus on severe injury and fatal crashes. The contributing factors will show the direction for needed improvements in the motorcycle safety area for the two states.

Finally, the study will recommend potential countermeasures for the reduction of severe and fatal motorcycle crashes and assess their effectiveness, using the previously developed statistical models. Some of the effectiveness of the countermeasures will be determined using available Crash Modification Factors (CMFs) and experiences from other states.

Research Methods

The study will use reviews of literature and practice, collection and analysis of safety data, and statistical safety models to assess the current state of motorcycle safety in Wyoming and Utah, and test the effectiveness of recommended countermeasures. The safety data will be collected from the crash databases from Wyoming and Utah DOTs, for a period of five to ten years. These databases contain detailed crash data (crash characteristics, traffic, environmental conditions and

roadway characteristics) which can be used for descriptive analysis and statistical modeling. Statistical software, such as R and/or SAS will be used to develop statistical models and determine the significance of different crash contributing factors. These models will be used to determine the locally-applicable SPFs for motorcycle crashes in Wyoming and Utah. Our research team has previous experience in developing and using statistical safety models for both Wyoming and Utah. Through a review of literature and practice, as well as the safety data analysis, the research team will narrow down potential countermeasures to be installed in certain locations to reduce the frequency and/or severity of motorcycle-related crashes. The effectiveness of these countermeasures will be assessed based on available CMFs, or through the analysis of sites where these measures are installed.

Expected Outcomes

The first outcome of the study will be a synthesis of existing literature and practice on motorcycle safety, with a focus on Wyoming and Utah. The reviews will help identify the major problems and gaps that exist in the motorcycle safety research. Furthermore, the reviews will produce recommendations for analysis methods, potential countermeasures and existing CMFs.

The second outcome will be a set of motorcycle safety data and descriptive statistics for Wyoming and Utah. The data will be redacted, organized, analyzed and presented to show the current state of motorcycle safety, crash characteristics and contributing factors, which will be used in further research.

The third outcome will be a set of advanced statistical models describing the interdependency among motorcycle crash characteristics, traffic and environmental conditions, and roadway characteristics. These models will be used to develop specific SPFs for motorcycle crashes in Wyoming and Utah, and assess the effectiveness of potential countermeasures.

The fourth outcome will be a set of location-specific countermeasures aimed at reducing the frequency and/or severity of motorcycle-related crashes. The effectiveness of these countermeasures will be assessed through the previously developed SPFs, estimated CMFs using the available data, and the CMFs obtained from the literature and practice, as applicable.

The final outcome of the study will be a set of journal publications, reports and presentations describing the research and its results.

Relevance to Strategic Goals

This research will directly address the ***Safety*** strategic goal. Compared to the safety research for other highway modes, motorcycle research is lagging on the national level. However, motorcycles are frequently involved in severe and fatal crashes, due to the nature of the mode. This study will shed more light on the motorcycle crash characteristics, contributing factors and countermeasures in Wyoming and Utah, but can also be applicable to other states.

To some degree, the study will address the ***Environmental Sustainability*** goal, since motorcycle can be considered a more sustainable transportation mode compared to solo-driving.

Educational Benefits

Graduate students will be involved in all aspects of this study, and it will provide material for transportation courses in traffic engineering, safety and control. The students will perform main tasks in literature review, data collection and analysis, statistical models development and countermeasure assessment. They will also author publications and present the results of the research. The material developed throughout the study will be used to update the course syllabi and class lectures and assignment in related transportation courses. Students in these courses will have the opportunity to work with real-world data and models related to motorcycle safety.

Technology Transfer

The research team will reach out to the transportation community to discuss and present the methodologies and results of the study, where the practitioners and researchers will be the target audience. This will be done through personal communication, web sites, social media, conferences and journal publications. The research team will seek input from other interested parties to improve upon the study design and methodology. Wyoming and Utah DOTs have a great interest in this type of study, so their personnel will be invited to participate in certain aspects of the study.

Work Plan

The work plan is divided in five tasks and developed for a one-year performance period. The tasks are as follows:

Task 1: Review of literature and practice related to motorcycle safety, crash characteristics and countermeasures (NTP – Month 2, and updated throughout the study)

The research team will review the existing research studies, guidelines and best practices from different agencies related to the motorcycle safety assessment. The literature review will also provide recommendations for the selection of data, analysis and modeling methodologies, results interpretation, and potential countermeasures and their effectiveness. The research team will also review all relevant safety studies in Wyoming and Utah to identify locally specific conditions which have an impact on motorcycle safety. Current state and local laws will be reviewed to better understand the governing principles of motorcycle licensing, enforcement and contributions to safety.

Task 2: Data collection, analysis and descriptive statistics (Month 2 – Month 6)

The research team will identify the safety data needed for this research, and the existing data sources primarily with Wyoming and Utah DOTs, as well as national databases (such as FARS, National Motorcycle Institute Fatality Reporting System and similar). The data will be collected for a period of five to ten years, and will include detailed crash, traffic, environmental and roadway characteristics needed for a comprehensive assessment, with the focus on severe and fatal motorcycle crashes. Data analysis will show the most relevant descriptive statistics needed for a better understanding of the current state of motorcycle safety and crash characteristics in Wyoming and Utah. It will determine the major crash contributing factors, and identify potential locations which have a higher tendency for motorcycle crashes. The data will then be used for the development of statistical safety models.

Task 3: Statistical safety modeling (Month 4 – Month 8)

Through data analysis from Task 3, statistically significant variables for serious injury and fatal motorcycle crashes will be determined. Then, statistical models will be developed to create locally applicable SPFs for these types of crashes. In addition to modeling frequencies and rates for motorcycle crashes, the SPFs will be able to predict safety performance for future changes in traffic patterns, as well as the implemented countermeasures and other updates. Statistical software, such as R and/or SAS will be used in this task. Our research team has previous experience in developing and using statistical safety models for both Wyoming and Utah.

Task 4: Recommendation and analysis of potential countermeasures (Month 7 – Month 10)

Through the review of literature and practice, as well as by assessing the local conditions and querying the CMF Clearinghouse, the research team will identify potential countermeasures for each location previously defined as a hotspot for motorcycle crashes. Some CMFs will be developed for local conditions using the available safety data, as applicable. The countermeasures will be implemented in the previously developed statistical models to predict the safety performance after a potential improvement.

Task 5: Final report (Month 10 – Month 12)

The research team will summarize the study in a formal final report. Technical reports and memos will be developed throughout the study, as applicable. The final report will be a complex document that will include the review of literature and practice, data analysis, statistical models, description of countermeasures and their effectiveness, and the final results.

Project Cost

Total Project Costs:	$95,031
MPC Funds Requested:	$45,838
Matching Funds:	$49,193
Source of Matching Funds:	University of Wyoming

References

1. National Motorcycle Institute Fatality Reporting System, National Motorcycle Institute. https://motorcyclefatalities.org/
2. National Highway Traffic Safety Administration (NHTSA). *Traffic Safety Facts: 2007 Data: Motorcycles* (DOT HS 810 990). Washington, DC: US Department of Transportation; 2008.
3. Fatalities Crash Statistics, Utah Department of Public Safety's Highway Safety Office. https://udps.numetric.net/fatalities-data#/
4. UDOT. *March 2020 Traffic Fatality Comparison Summary*.
5. Insurance Institute for Highway Safety (IIHS). *Motorcycle helmet use laws by state*. https://www.iihs.org/topics/motorcycles/motorcycle-helmet-laws-table. Accessed Feb 22, 2021.