

Comprehensive Safety Analysis on Crash Modification Factors at Intersections

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Abstract

A crash modification factor (CMF) is a multiplicative factor that represents potential changes in the expected number of crashes as a result of implementing a specific safety countermeasure. The key objective is to improve the accuracy and reliability of the estimated CMFs at intersections. As each treatment has different characteristics, there is a need to assess the variation of CMFs among the treated sites with different intersection characteristics. Besides, using a fixed single value of CMF is not suitable when safety effects change over time. In order to identify the CMFs by intersection features, the CMFs were estimated under different traffic volume using the Empirical Bayes (EB) method. On the other hand, time series ARIMA model was also utilized to estimate the CMFs over time. After screening the CMFs based on traffic volume and time, a program was developed to further examine the stability of the CMFs using bootstrap to ensure the quality of the CMFs. The results showed that the CMF values vary by different traffic volume when signaling an intersection. Furthermore, based on the developed ARIMA model, the predicted crashes regain after red-light running cameras were installed. These results indicate that the stability of CMFs needs to be further analyzed. For this reason, resamples are generated from the sample to estimate CMFs with the confidence interval for each resamples, it is clearly revealed that the CMFs for signalization are different for each crash category. Therefore, it is recommended to set up a threshold to determine the reliability of CMFs when the resampled CMFs show a large variance. In conclusion, a road crash is a rare, random, and multifactorial event and this makes it hard to screen out the systematic change when calculating the CMFs for the target treatment. Therefore, after a CMF is calculated, it is suggested to screen it by identifying its reliability. Further screening is needed if the CMF is not reliable, in order to yield a stable CMF.

Keywords: intersection, CMF, ARIMA, Empirical Bayes, resampling, bootstrap

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