Investigation of work zone crash casualty patterns using association rules

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ABSTRACT

Investigation of the casualty crash characteristics and contributory factors is one of the high-priority issues in traffic safety analysis. In this paper, we propose a method based on association rules to analyze the characteristics and contributory factors of work zone crash casualties. A case study is conducted using the Michigan M-94/I-94/I-94BL/I-94BR work zone crash data from 2004 to 2008. The obtained association rules are divided into two parts including rules with high-lift, and rules with high-support for the further analysis. The results show that almost all the high-lift rules contain either environmental or occupant characteristics. The majority of association rules are centered on specific characteristics, such as drinking driving, the highway with more than 4 lanes, speed-limit over 40 mph and not use of traffic control devices. It should be pointed out that some stronger associated rules were found in the high-support part. With the network visualization, the association rule method can provide more understandable results for investigating the patterns of work zone crash casualties.

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1. Introduction

Work zone safety analysis continues to be a hot topic in the traffic engineering field. The work zone lane closure increases traffic conflicts and reduces road capacity evidently. Moreover, the presence of work zone leads to increased traffic accident risk (Meng et al., 2010; Weng and Meng, 2011). It was further reported that the proportion of severe crashes is higher in work zones than in non-work zones (Ha and Nemeth, 1995; Bedard et al., 2002; Ullman et al., 2006; Meng et al., 2010; Meng and Weng, 2011). Both workers and motorists have higher probability of being killed or injured in severe crashes occurred in highway construction zones. Therefore, it is very meaningful to determine the associations among the characteristics and contributory factors before taking priority countermeasures to reduce the occurrence likelihood of fatal work zone crashes. It should be pointed out that numerous internal and external factors (e.g., occupant gender, vehicle age, roadway condition, etc) could influence the work zone crash casualty risk (Meng and Weng, 2011; Weng and Meng, 2012; Weng et al., 2013).

Although a number of studies have been conducted on the analysis of work zone crash accidents (e.g., Harb et al., 2008), their focus was mainly concentrated on the relationship between characteristics and contributory factors and work zone crash risk. As the public have shown great concern about the casualties resulting from work zone accidents, it is incumbent upon for traffic safety engineers to implement efficient safety enhancement strategies, with the objective of reducing the casualty risk once a work zone accident does occur. It is thus necessary to analyze the characteristics and contributory factors which can lead to work zone crash casualties. In reality, each contributory factor may not always exhibit effects on the work zone casualty risk under various circumstances. It only plays a role in increasing work zone casualty risk when some other factors are also presented. For example, the posted speed limit in rural roads may not take effects in reducing work zone casualty risk, as compared with that in highways/freeways. Hence, special attentions should be placed on the associations among the characteristics and contributory factors which have impacts on the work zone casualty risk simultaneously.

Association rules have a unique advantage in discovering such associations with a large database (Pande and Abdel-Aty, 2008). Based on the association rules among the characteristics and contributory factors, we can take more effective countermeasures to
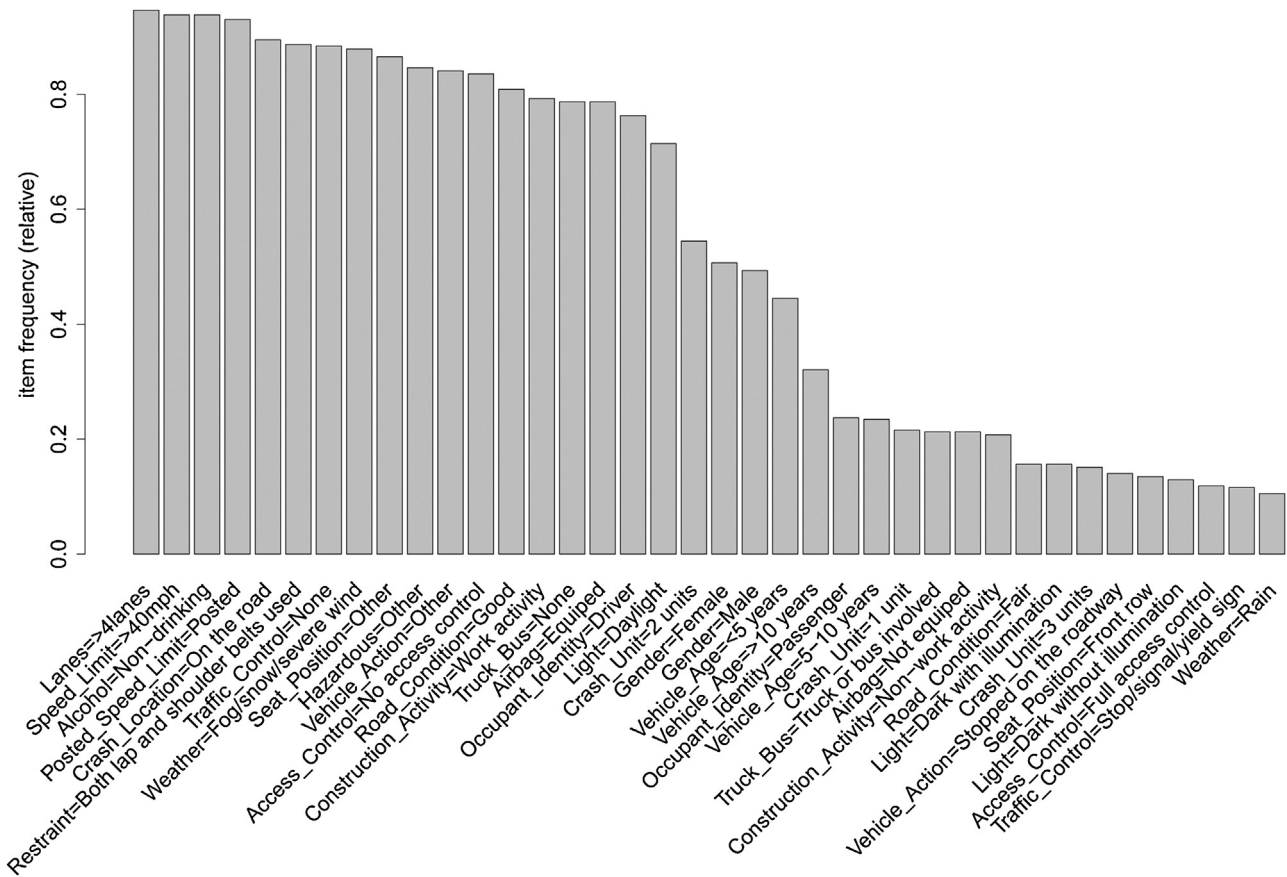
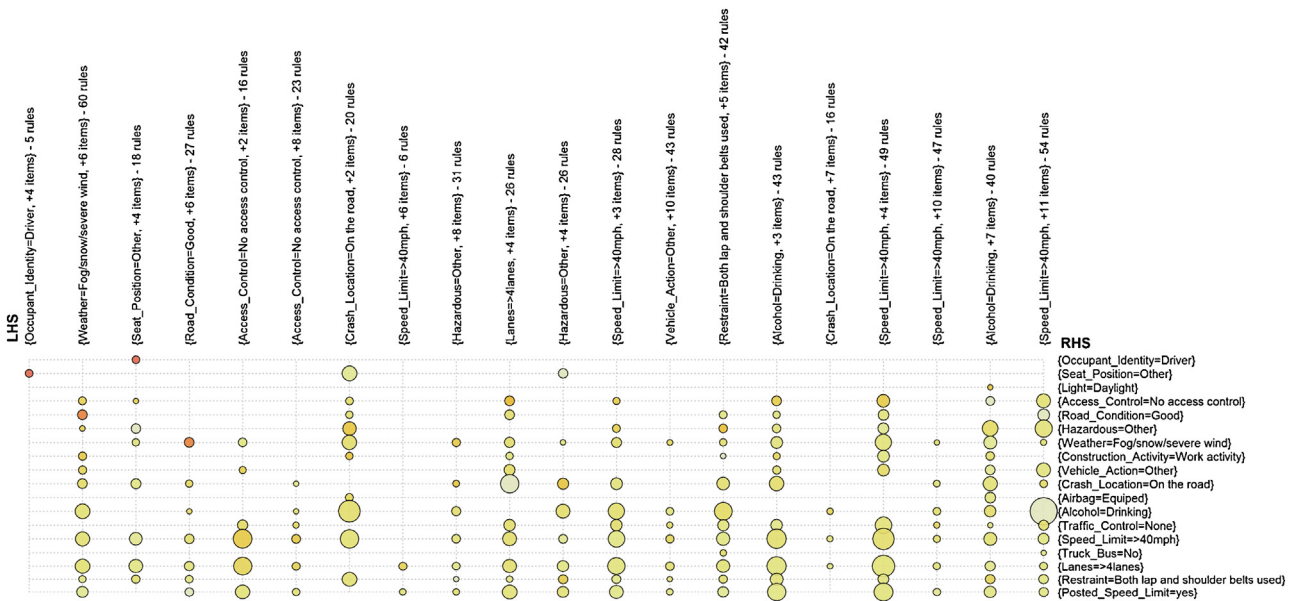**Fig. 1.** Item frequency for serious work zone crashes.

Fig. 2. Grouped balloon plot of 620 rules.

reduce the fatalities caused by work zone crashes. Therefore, the association rule approach has been employed to explore these associations among characteristics and contributory factors in order to understand the patterns of the work zone crash casualty in this study.

2. Literature review

To date, a number of models have been developed for the crash casualty risk analysis. The majority of these models are parametric models. For example, Bedard et al. (2002) employed a multivariate logistic regression model to identify the independent contribu-