The Folly Of Using An Outcome To Predict The Future

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Abstract

If we are to reach the Vision Zero goal where no lives are lost on our roads, then a paradigm shift is required in the way we approach many aspects of road safety. This paper examines the predictive robustness of using historic crash to forecast future crash occurrence and compares it to a proactive risk approach. The findings provide compelling evidence that reactive approaches relying on crash history should be a secondary consideration to proactive risk-based approaches in both the identification of high-risk locations and the assessment of interventions.

Background

Crash data continues to be a key input to the way in which high-risk locations are identified and interventions prioritised and funded by many transport authorities. In large part, this is attributable to processes and procedures developed by transport authorities over many decades being slow to adjust to proactive approaches that adopt a more ethical standpoint to road safety; one where people do not need to be injured or killed before safety improvements can be justified. Whilst proactive approaches to measuring safety, such as crash prediction modelling, Star Rating and Infrastructure Risk Rating are becoming more widely accepted by transportation professionals, there remains a reluctance to fully embrace these proactive risk techniques in preference to reactive crash-based approaches.

Analysis

The predictive capability of different risk metrics has been evaluated from a national road safety dataset in New Zealand that covers approximately 100,000km of public roads. Reactive risk metrics in the dataset are based on crashes in the 2013 to 2017 period, and proactive metrics are based on infrastructure, operational and environmental factors contained in various data sources current to 2017. Crash data from 2018 has been analysed to determine the predictive capability and robustness of both reactive and proactive risk metrics.

The risk metrics described in the extended abstract are:

- Collective Risk – a measure of estimated fatal and serious crash density per km, using a severity index adjustment approach based on all injury crashes.
- Personal Risk – a measure of estimated fatal and serious crash density per vehicle km travelled, using a severity index adjustment approach based on all injury crashes.
- Infrastructure Risk Rating – a measure of the underlying level of safety of a road segment based on physical, operational and adjacent land use characteristics.

Each of the numerical risk metrics are classified into a five-tiered risk band.

Results

The proportion of fatal and serious crashes in 2018 occurring in each of the risk bands is shown in Table 1.

Table 1. Proportion of Fatal and Serious Crashes in 2018 by Risk Metric Rating

Risk Rating	Collective Risk	Personal Risk	Infrastructure Risk Rating (IRR)
Low	32%	24%	5%
Low Medium	29%	24%	20%
Medium	20%	38%	51%
Medium High	14%	10%	19%
High	6%	5%	6%

The results show that 61% of all fatal and serious crashes occurred on roads with a Collective Risk rating of Low or Low-Medium. In jurisdictions where crash data is used as the primary determinant of identifying high-risk locations and prioritising and funding safety improvements, these sites would almost certainly not be addressed. In contrast, only 25% of fatal and serious crashes occurred on roads with an IRR of Low or Low-Medium.

Analysis by vehicle km travelled demonstrated a similar predictive capability, as shown in Figure 1.

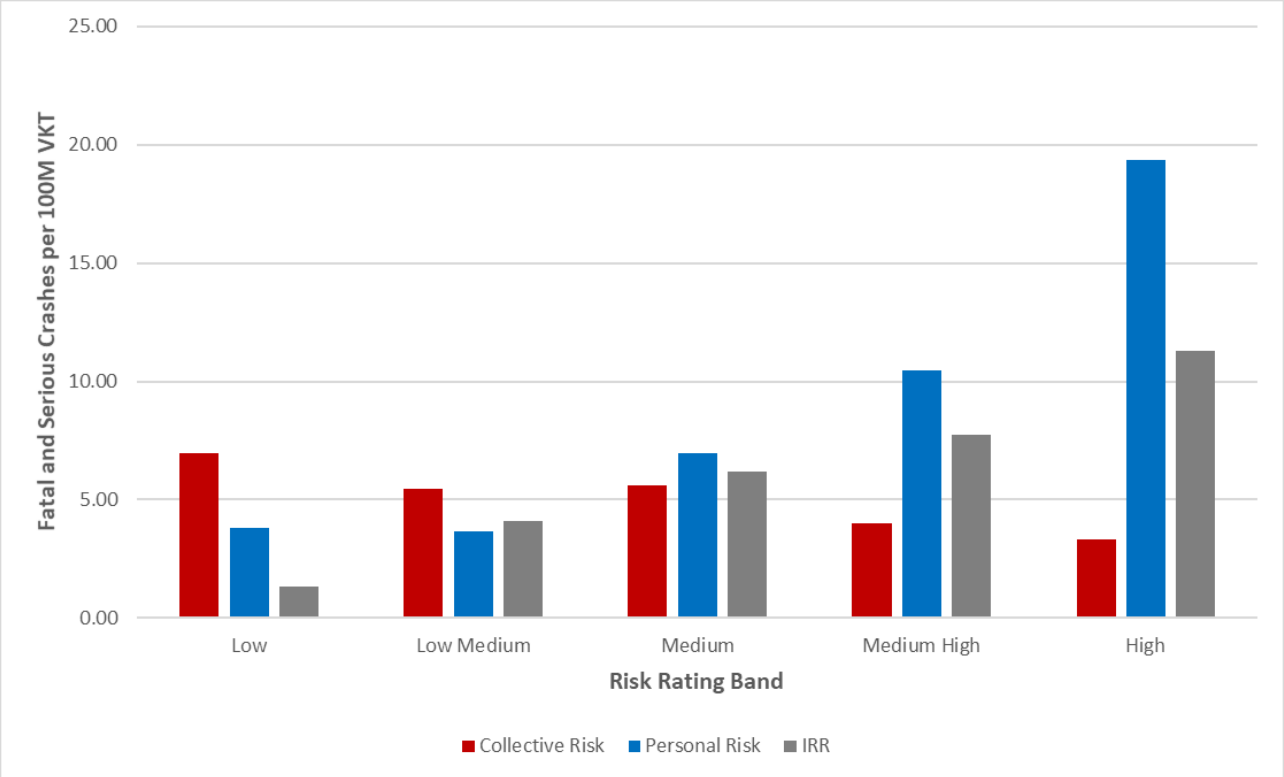

Figure 1. Fatal and Serious Crashes per 100 million vehicle km Travelled by Risk Metric Rating

The results show the actual fatal and serious crash rate in 2018 increased with increasing risk rating band for the Personal Risk and IRR risk metrics, but followed an inverse trend for Collective Risk.

Conclusions

The analysis provides compelling evidence to move away from identifying, prioritising and funding safety improvements solely on the basis of historic crash data. Predictive capability of reactive risk metrics can be enhanced by including a measure of exposure (Personal Risk), but even better predictive capability is achieved through the proactive IRR metric.