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Review Of Highway Incident Management System

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Abstract

This thesis is concerned with the causal relationship between traffic interventions and road safety. It focuses on two issues that have been overlooked in the existing empirical literature: the establishment of a causal link between traffic interventions and road traffic accidents, and the application and development of formal causal approaches, which have not yet been applied in the field of road safety.

In the past decades substantial studies have been conducted to investigate the risk factors contributing to road accidents. It has been shown that the frequency and severity of road accidents are associated with various factors, including traffic characteristics, road environment and demographic characteristics. However, the existence of a causal link between traffic interventions and road accidents remains unclear due to the complex character of traffic interventions. Meanwhile, the lack of formal causal models makes it difficult fully to address issues such as confounding effects and regression to the mean bias.

This thesis begins by reviewing and discussing different types of traffic interventions in order to demonstrate the chains through which traffic interventions are related to road safety. To address the shortcomings in empirical literature, three models for causal inferences are discussed: the difference-in-difference method, the propensity score matching method and Bayesian methods.

These formal causal approaches are then applied to three empirical studies: the London congestion charging scheme, speed limit enforcement cameras, and the road network design. The conventional models are also employed and compared with formal causal models.

Introduction

Over the last two decades there has been a small but growing body of research seeking to determine the effects of traffic interventions on road safety. This thesis contributes to the literature on this theme by focusing on the issue of establishing a causal link between traffic interventions and road traffic accidents and by addressing some of the methodological limitations of previous work. This introductory chapter presents the background, motivation and objectives of the thesis. The first section provides a brief review of evaluation studies of traffic interventions and explains why the estimation results are inconsistent and have been questioned. Section 1.2 explains the motivation and objectives of the thesis, while the research contributions are presented in section 1.3. An outline of the thesis is provided in the last section.

Background

Road accidents place a great burden on individuals, property and society. During the last few decades, considerable research has been conducted to identify important factors related to the occurrence of road accidents,

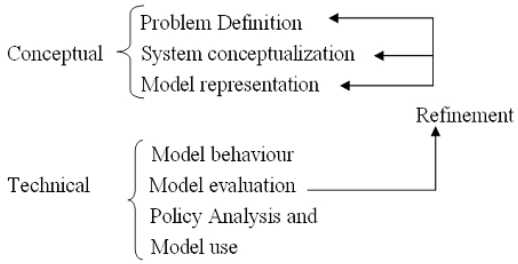
including traffic characteristics, road characteristics, socio-economic and environmental factors (Baruya, 1998; Ossiander and Cummings, 2002; Taylor et al., 2002; Martin, 2002; Golob et al., 2004; Lord et al., 2005; Kononov et al., 2008; Noland and Quddus, 2005; Abdel-Aty and Radwan, 2000; Noland and Quddus, 2004; Graham and Glaister, 2003; Wedagama et al., 2006; Dissanayake et al., 2009; Graham et al., 2008; Quddus, 2008; Wier et al., 2009). In recent years, some researchers have paid close attention to the impact of road safety measures on the incidence of road accidents (Pau and Angius, 2001; Galante et al., 2010; Allpress and Leland Jr, 2009; Elvik, 2001; Goldenbeld and van Schagen, 2005; Hess and Polak, 2003; Newstead and Cameron, 2003; Chen et al., 2002; Christie et al., 2003; Mountain et al., 2005; Shin et al., 2009; Keall et al., 2001; Gains et al., 2004, 2005; Jones et al., 2008). Most of these studies, however, make associational inferences instead of causal inferences. That is to say that, association, or correlation, is a relationship between two or more variables, while causation implies that the change in one thing directly causes a change in the other. In other words, causal relationships between one variable and another cannot be obtained only from the observed association between them.

Need for Study

In India 94968 persons were killed and 465282 were injured by motor vehicles. In Tamilnadu level 9468 and 12036 were killed, 63008 and 71099 were injured by motor vehicles according to 2005 and 2007 statistics respectively. The use of any service depends on the safety, reliability and convenience offered by the service. The accidents occur due to various reasons and playing a hand in the causative is the road geometric. The road geometry though designed as per standards undergoes changes with time in terms of widening, encroachments etc. the road design may then become inefficient for maneuvering especially for heavy vehicles like buses. Hence it becomes necessary to evaluate the causes of accidents with respect to the human factors.

Methodology

On reviewing the literatures major reasons for accidents and accident pattern has to be identified. The objective of the study is then formulated based on the previous studies. The cause of accidents is an important aspect considered in this study. Data relating to it has been collected from the Chennai City Traffic Police (CCTP). The factors (human, environment, road, vehicle and other) which are main cause of accidents are to be studied and identified based on the data collected. Then few stretches in city is taken and its geometrics (carriage way width, median, etc) and road characteristics (roughness, potholes, etc) are studied. Now the collected data has to be analyzed and using RADMS the accident prone locations will be identified and appropriate remedial measures will be given.



Phases in Model Building Process

RADMS

RADMS is a fully integrated, comprehensive solution that can be used for scientific road safety management. The application is completely web-based, facilitating
complete end-to-end accident data management system with built-in intelligent analysis

and road safety program management functions. RADMS is backed by a powerful Geographical Information System (GIS) engine that supports multiple GIS standards. This facility helps to plot accident data on digital maps and enables in-depth GIS-based spatial analysis like corridor analysis, cluster analysis for accident black spot identification and grid analysis. RADMS is a web-based accident analysis system is the real time monitoring system. It involves public bodies like Police, transport division, Highway division etc in uploading the data which is collected on the spot. RADMS was developed by TNRSP Highways departments and maintained by Police department. Accident analysis is carried out in order to determine the cause or causes of an accident or series of accidents so as to prevent further accidents of a similar kind. It is also known as accident investigation. The analysis like strip analysis, spot
intersection analysis, corridor analysis, cluster analysis etc are carried out to identify black spots, black route, black area in the major corridor of Chennai city in this study It was found that most of the accidents occurred at those junctions. Many subway roads join to this road, since this road runs parallel to rail crossings. Due to poor lighting most of the accidents occurred during night time. Pedestrian facilities should be planned in an integrated manner so as to ensure a continuous pedestrian flow. It should be useful therefore to look at pedestrian needs for an area as a whole and prepare an overall strategic plan.

Bayesian Approaches for Evaluation Studies

Another widely used approach for the before-after evaluation of road safety treatments is the Bayesian method. The Bayesian approach combines prior and observed data to derive an estimate for the outcomes of interest. In this section, two related Bayesian approaches are discussed, Empirical Bayes (EB) and full Bayes (FB), and their application in road safety studies is reviewed. Finally, to address the issue of selecting proper control groups, an EB method is developed by combining it with the propensity score.

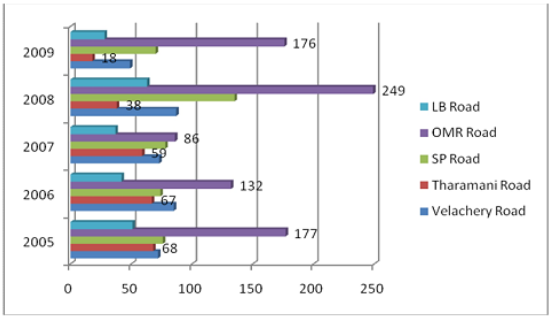
Review of Bayesian Methods
The EB and FB are two related approaches to combining prior information and current information in order to derive an estimate for the expected safety of treated sites. In the application to road safety, the prior information is obtained from a group of similar sites and the observed information is the accident frequency for the specific site. Although the EB and FB have a similar conceptual basis, there are differences in these two approaches. In the EB method, the prior information is obtained from a group of similar sites to estimate a sample mean and variance. A safety performance function can be also applied to establish the relationship between the accident frequency of the reference sites and various factors. An improved estimate of the long-term accident frequency can be obtained by combining the point estimates of the expected mean and the variance with the accident number of treated sites. In the FB approach, instead of a point estimate of the expected mean and variance, distributions for these statistics are estimated from a model of a reference population, and combined with the accident frequency of treated sites to estimate the long-term expected accident frequency. The estimated variance can be more accurate by using a prior distribution instead of a point estimate.

Bayesian methods have been widely used in traffic safety studies over the last two decades, especially in before-after evaluations (Hauer, 1997; Hauer et al., 2002; Li et al., 2008; Miaou and Lord, 2003; Park and Lord, 2007; Persaud et al., 1997, 2004, 2010; Persaud and Lyon, 2007; Quddus, 2008;

Aquero-Valverde and Jovanis, 2009; ElBasyouny and Sayed, 2009). EB methods, in particular, have become popular as statistically defensible methods that can cope with several key issues in observational before-after studies, such as the regression to mean bias. A recent study by Persaud and Lyon (2007) reviews the use of EB in before-after safety studies, including the basics of EB evaluation and the need for and validity of the EB approach, and addresses the critical issues in the interpretation of EB evaluations.

Empirical Bayes

The idea behind the Bayes approaches is that "accident counts are not the only clue to the safety of an entity. Another clue is in what is known about the safety of similar entities" (Hauer, 1997). In the EB approach, prior information is obtained from a roup of sites similar to the treated group and used to calculate point estimates of sample mean and variance. Alternatively, information is acquired from a calibrated safety performance function that relates the accident frequency of the reference group to their characteristics.



Year wise accidents in study stretches

Year	Total Accidents				
	Do Minimum	Partial Efforts	20 % Reduction	Desirable	Ideal
2005	4,543	4,543	4,543	4,543	4,543
2006	5,043	4,770	4,413	4,311	3,452
2007	5,598	5,008	4,286	4,092	2,623
2008	6,214	5,258	4,164	3,884	1,993
2009	6,899	5,521	4,045	3,688	1,515
2010	7,658	5,796	3,930	3,501	1,151
2011	8,501	6,086	3,818	3,324	875
2012	9,437	6,390	3,710	3,157	665
2013	**10,476**	**6,709**	**3,605**	**2,998**	**505**
2014	11,629	7,044	3,502	2,847	384
2015	12,909	7,396	3,403	2,703	292
2016	14,330	7,765	3,307	2,568	222
2017	15,908	8,153	3,214	2,439	168
2018	17,659	8,560	3,123	2,316	128
2019	19,603	8,988	3,035	2,200	97
Final	**21,761**	**9,437**	**2,949**	**2,089**	**74**

Source: Model Results

Results of all Scenarios

Conclusions

The following are the conclusions for the study:

- To reduce the accidents, equal importance must be given for training the public, transport, highways and police officials. Then only appropriate reduction in accidents will be achieved.
- To achieve target of Tamil Nadu Road Safety policy to reduce 20% of accidents around 65 lakhs rupees needed for training the police, transport and highway officials.
- If 65 lakhs rupees is spent per year the accident trend will reduce from 4543 to 3605 by the year 2013 which is the target of the Tamilnadu road safety policy.
- Desirable and Ideal scenario gives best results more than the Road Safety Policy of Tamil Nadu.

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