

# REPORT OF RESEARCH RESULTS

## A. Title :

Pricing the Usage-Based Insurance for Tour Bus in Taiwan

## B. Researchers

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## C. Summary:

With the progress of technology, insurance company starts to apply technology to improve pricing accuracy to attract low risk. Among those innovations, the automobile usage-based insurance (UBI) is especially important. By issuing UBI products, insurance companies want to price the insureds more accurately and thus provide the insureds the incentives to decrease the usage of automobile.

In the auto insurance market, if premium is not based on the usage of automobiles, drivers with lower mileage are thus treated unfairly and have lower incentives to purchase insurance. On the contrary, drivers with higher mileage will have higher incentives to purchase insurance. Therefore, insurance company suffers from adverse selection. Although usage-based insurance (UBI) products exist for personal automobile owners, the relationship between loss and mileage for personal auto insurance may not apply to insurance for tour buses.

However, one of the major challenges facing insurers to develop such products is to establish the relationship between mileage and loss since local property-liability insurers didn't collect mileage data. Although some insurers later issued their own UBI products for personal auto insurance, its premium rating structure may not apply to tour bus. Therefore, it's important to provide more understanding on the between loss and mileage for tour buses.

As far as we know, no study has examined the determinants of loss for tour bus in Taiwan. In this study, we focus on examining the relationship between loss and mileage for tour buses by applying Generalized Linear Model (GLM). Our data is from the Tour Bus Business Survey conducted by the Ministry of Transportation and Communication. Firstly, we build econometric models for the relationship between loss and mileage, which could be the first step for insurance companies to develop UBI products for tour buses. Our preliminary results can show that higher mileage is positively associated with loss probability and loss frequency of traffic accidents, which indicate that the mileage is positively correlated with exposure to risk.

Besides, tour buses, with routine or non-routine routes, play an important role for transporting commuters and tourists in this country. Although tour buses industry operates in various market segments with diverse mileages, the relationship between mileages and loss conditions is not examined. In addition, insurers don't use mileage to differentiate the riskiness of tour bus drivers. Our results can offer policy recommendations to insurers and the authorities.

#### **D. Aim of Research:**

This paper can make several contributions to the extant literature. Firstly, the main purpose of this study is to investigate the relationship between loss and mileage for tour buses. To the best of our knowledge, our study is the first to build an econometric model and comprehensively examine the relationship between the mileage and the probability/frequency for tour buses involving in traffic accidents. Secondly, by using actual survey data on Taiwan, our results can provide precise evidence to support the development of UBI products for tour buses. We further provide the practical policy recommendations to the insurers and the government.

### **E. Method of Research & Progression:**

The purpose of this study is to investigate the relationship between loss and mileage for tour buses by applying Generalized Linear Model (GLM). For insurers, the aggregate losses over a fixed time period incurred can be expressed as

$$L = \sum_{i=1}^N X_i$$

where  $N$  is the number of claims incurred and  $X_i$  is the amount of  $i$ th claim incurred.

In order to price the insurance contract, GLM method is useful to estimate the expected loss. The frequency and severity processes can be expressed as linear combinations of rating variables such as gender, age, driving record or other characteristics of the insureds (Renshaw, 1994). In this study, we further consider the mileage into the econometric model.

Using the Tour Bus Business Survey data in 2013, 2015 and 2017, we can build model of the probability and frequency for tour buses. This Survey is conducted biannually by the Ministry of Transportation and Communication. Although the latest survey is conducted 2019, the mileage and accident information are not included in this survey. Therefore, the 2019 data is not incorporated in this study. Since mileage is positively correlated with exposure to risk, we expect higher mileage is positively associated with the probability and the frequency associated with traffic accidents. The detailed information in Tour Bus Business Survey data allow us to provide an in-depth investigation for automobile insurance of tour buses drivers.

Our data doesn't have loss amount for each traffic accident. However, if driving mileage is independent to loss amount, which is likely the case since prior studies, such as Hsu (2019, 2020) indicate that loss amount is subject to greater random effect, then insurers can apply existing average loss amount data to our empirical results to derive the relationship between driving mileages and expected losses and price tour bus drivers accordingly.

## **F. Results of Research:**

Improving the insurance market for tour buses can better protect the interests of tour buses industry, consumers and other drivers, which can provide public welfare and positive externalities. Based upon actual data on tour bus drivers, our results provide new evidence on the relationship between loss frequency/ loss severity and driving kilometers. Our results also reveal that insurance with mileage is an important risk factor for tour buses. We further examine different types of tour bus in the final report of this research project. We provide the more robustness results in the final report and provide the conclusion of the results.

## **G. Future Areas to Take Note of, and Going Forward:**

In this study, we show the relationship between mileage and loss probability and loss frequency for tour buses. We further provide the preliminary suggestion on product design on UBI product design for tour buses. The insurers and government may also need more information on the clauses design of insurance policy. It may be worthwhile to conduct subsequent research and analysis on clause design or related legal studies.

For the data limitation, we can only use Tour Bus Business Survey data to carry out analysis. Thus, it is also worth collecting more data, and conducting further examination on the actual loss amount. Therefore, subsequent studies can collect more data on claims and driving mileages for further analysis.

## **H. Means of Official Announcement of Research Results:**

We expect to submit the results of this project to an academic journal in insurance field in 2023.