

A New Risk Management Model for Auto Insurance in Serbia

Ivan Radojković, Branislav Randjelović

Dunav Voluntary Pension Fund, Karadžićeva 8, Niš, Serbia
University of Niš, Faculty of Electrical Engineering, A.Medvedeva 14, Niš, Serbia
ivan.radojkovic@dunavpenzije.com, branislav.randjelovic@elfak.ni.ac.rs

Abstract — The importance of the automotive industry is significant in every country and economy. It affects the economic development of the country, and in the last decade, the number of vehicles has been increasing every day, and hundreds and millions of vehicles are now traveling around the world. As a consequence, motor vehicle insurance is one of the most important branches of insurance. In this paper, we consider a general risk management model of motor vehicle insurance that is actually in Serbia. We propose a change of this model and a modification in order to reduce the risk in car insurance, as well as to provide insurance to users with better service, in accordance with characteristics of vehicles. Modification of risk management model is based on the mathematical approach and appropriate data analysis.

Keywords— motor vehicles, car insurance, risk management

I. INTRODUCTION

For motor vehicle insurance in Serbia, only the cubic capacity of the vehicle is taken into account. However, as the amount paid by the insured when concluding a vehicle insurance contract should be directly proportional to the probability of collecting the insurance premium, ie to the probability of vehicle damage (ie the probability of an accident), it is desirable to consider whether there are more some factors that significantly affect the possible occurrence of a traffic accident. The following question naturally arises: Can driving style be one of the key factors?

Let's consider two different types of drivers, the first - a driver who drives in accordance with the regulations and the second who drives arrogantly. It happens that the second one often exceeds the speed limit, does not respect traffic regulations and/or drives under the influence of alcohol. It is clear that the other driver endangers the traffic with his behavior and thus increases the probability of a traffic accident, while the number one driver is a conscientious participant in traffic.

However, when concluding the insurance contract, the driving history of the insured is not taken into account, ie the number of penalty points in the driving card of the insured. The number of penalty points is currently the only quantitative measure of the behavior of the observed traffic participant. It is logical that drivers without penalty points represent exemplary participants in traffic, while drivers

with a large number of penalty points most likely belong to the class of arrogant and reckless drivers. Therefore, it is desirable to make several classes of drivers in relation to the number of penalty points.

Risk management is a management approach aimed at preserving the assets and profit power of the company while preventing the risk of loss, especially accidental and unforeseen losses.

II. PENALTY POINTS AS A KEY FACTOR IN THE PROBABILITY OF A TRAFFIC INCIDENT

It is not possible to do a statistical analysis that would confirm that there is a significant difference in the percentage of accidents in persons with a higher number of penalty points, compared to persons who do not have (or have significantly less) penalty points, because data on the number of penalty points of the insured does not exist in the table submitted by AS non/life insurance, the joint-stock insurance company, for 2011.

However, in order to show that in the general case there is a statistically significant difference in the prevalence of accidents between these two categories, the Nis SUP was asked for data on the number of traffic accidents in 2013, as well as the number of penalty points from the same year. The following data were obtained:

TABLE I NUMBER OF PENALTY POINTS

Registered motor vehicles in 2013	Drivers who had a car accident in 2013	Drivers with penalty points in 2013	Drivers with penalty points before the traffic accident in 2013
97248	2348	2084	314

Based on the statistical analysis of the data, the following was obtained: there is a statistically highly significant difference in the percentage of accidents between the group of drivers who had previous penalty points and those who did not have it $\chi^2 = 1441.53$; OR = 8.12 (7.13 <OR <9.25) 95% confidence interval.

TABLE III RESULTS OF χ^2 TEST, WHICH COMPARES THE PREVALENCE OF ACCIDENTS IN THE GROUP OF DRIVERS WHO ALREADY HAD PENALTY POINTS COMPARED TO THOSE WHO DID NOT

	χ^2 -test	p
uncorrected	1447.05	<0.001
Mantel – Haenszel	1446.99	<0.001
Yates corrected	1441.53	<0.001

It is concluded that if penalty points were recorded during the conclusion of the contract, there would actually be multiple benefits. Namely, if the number of penalty points was introduced as an additional coefficient in the proposed logit model (or in an existing one), the price paid by a conscientious traffic participant would be significantly lower than that paid by an arrogant driver. This would not only reward a conscientious driver, but would also motivate other categories of drivers to behave in accordance with the regulations.

III. MODEL TESTING

In this section, we will compare the new model, with existing models that are currently in Serbia, Germany, the USA and the world. Since we have already presented all the above current models, we immediately start the analysis.

Models for assessing insurance risk in the automotive industry will be studied. As there are currently no developed methods for risk assessment in the domestic car insurance market, ie when insuring vehicles in Serbia, engine power is taken into account as the only risk factor, vehicle insurance in developed countries will be considered here. Germany will be considered as the representative of the largest European economic power. Then, the world economic giant of the United States of America will be considered, and finally the model of Pay-As-You-Drive motor vehicle insurance.

The German car insurance market is characterized by high competitive pressure, and therefore low profitability. In Germany, insurance risks in the automotive industry are traditionally classified on the basis of a large number of risk factors, such as, for example, the occupation of the driver, the type of car and the region. In addition, there are different bonus-malus classes, depending on the previous history of compensation. The bonus-malus system is considered to determine the amount of motor third party liability insurance premium by applying the appropriate premium system, depending on whether the insured had previously reported damage under this insurance for that vehicle, for which he is responsible. The bonus represents a reduction of the basic car liability insurance premium, if there was no damage during the insurance period of at least one year. It is calculated annually, when paying the premium, in a certain percentage. The bonus adjusts the premium to individual risk, because it has been proven that policyholders, who are granted this discount in advance by the insurer, have a significantly lower number of claims than other policyholders. Malus represents an increase in the basic premium if there were reported claims in the previously observed period. So, it is a loss of bonus or a premium supplement paid by the insured, if at least one damage for which the insured is responsible has been reported.

Therefore, risks are determined on the basis of several thousand different tariff classes. The problem that arises within this approach is the difficult fragmentation of data from many classes, which contains only a few risks and often shows little or no data on damage, which makes it difficult to calculate an adequate risk price based on damage history for these tariffs classes. So far, several methods have been used to overcome this problem. For example, cluster analysis identifies tariff classes with similar expected claims, in order to achieve a better basis for calculation [1]. Other methods include interpolation [2] or the use of a larger database [3].

On the other hand, the US insurance market uses an approach called "scoring insurance" [4]. Insurers derive one "insurance score" for each potential that is secured by weighting, ie searching for the mean values of certain characteristics of the applicant's credit history, for example, the number of arrears of loan payments [5]. The basic credit record was obtained from a major national credit information provider. The insurance company uses such a score in combination with other factors, in order to assess the risk of insuring the applicant's car. The main reason for using credit history data is to obtain information, which will facilitate the assessment of inconspicuous factors, such as driving caution [5].

Motor vehicle insurance is usually considered a fixed cost in relation to the use of vehicles, ie. drivers do not see insurance savings if they reduce mileage. Distance-based or Pay-As-You-Drive or Per-Mile motor insurance converts the cost of insurance into variable costs so that the insurance premium is directly related to the annual mileage [26]. Many organizations are exploring ways to implement Pay-As-You-Drive insurance to achieve a variety of planned goals, including increasing accessibility, saving savings, traffic safety, and reducing exhaust emissions [6].

Several insurance companies offer this insurance [7]: Aioi Insurance (www.ioi-sonpo.co.jp), Japan; Aryeh (www.aryeh.co.il), Israel; Holland PAYD Coverage (www.payasyoudrive.co.za), South Africa; MileMeter (www.milemeter.com), US; MiDriveStyle (www.miway.co.za/midrivestyle), South Africa; Pago Por Uso (www.jovenesdesiguales.com), Spain; MyRate (www.progressive.com/MyRate/myrate-default.aspx), USA; PAY PER K Coverage (www.nedbank.co.za), South Africa, Polis Vor Mij ("Policy for me") (www.PolisVoorMij.nl), The Netherlands, Polis Direct Kilometre Policy (www.kilometerpolis.nl), The Netherlands, Progressive, Real Insurance PAYD (www.payasyoudrive.com.au), Australia.

As a starting point for the theoretical testing of all models, we will take the SWOT analysis and use a matrix of four elements.

TABLE IVVVI GERMAN MODEL BASED ON CHARACTERISTICS-TARIFF CLASSES

Model power A large number of tariff classes	Weakness of the model Poor definition of tariff classes
Chances of the Model An analysis of many tariff classes can look at a wide range of insurance	Model threats It works if there is a sufficient amount of data across the considered tariff class

TABLE VIIV US MODEL BASED ON CREDIT HISTORY

Model power One criterion	Weakness of the model Inaccuracy of criteria
Chances of the Model Combination with another criterion	Model threats Combination with another criterion

TABLE V MODEL USED IN SEVERAL COUNTRIES BASED ON MILEAGE

Model power One criterion	Weakness of the model Expensive ancillary equipment and maintenance
Chances of the Model Combination with another criterion	Model threats Non-acceptance of criteria by the insured

TABLE VVIII CURRENT SERBIAN MODEL ON COMPULSORY CAR LIABILITY INSURANCE

Model power Two criteria	Weakness of the model Inaccuracy of criteria
Chances of the model Combination with another criterion	Model threats Dissatisfied policyholders

TABLE VIXX NEW PROPOSED MODEL

Model power Three criteria	Weakness of the model Legal incoherence of criteria
Chances of the model It gives a more realistic price of compulsory car insurance	Model threats Dissatisfied policyholders

If we compare the elements from the matrix, we conclude that the application of the first, second and third models in Serbia is not possible for several reasons. The first model has the disadvantage that it has many tariff classes and that a large amount of data is needed to be applicable in Serbia. The second model, which is based on the credit indebtedness of the insured, is inapplicable for several reasons, the first to insure insured persons who do not have credit indebtedness, the second, information on credit indebtedness is a personal matter of the individual, the third, 7.3% of the population is late (May 2016, UBS, www.ubs-asb.com), whereby these citizen insured persons are automatically penalized for buying more expensive insurance.

The third model is based on the kilometers traveled, if we assume that the average premium of compulsory car insurance in 2015 was 11,935.00 dinars (Association of Insurers of Serbia, Review of achieved results in motor third party liability insurance in 2015, www.uos.rs), and the price for GPS tracking of kilometers traveled by cars (www.gpspracenje.co.rs) is 85 € plus 20 € fines and a monthly subscription for the service of using the vehicle

tracking system is 7 €, annual overpayment 84 €, which is a total of 189 € or RSD 23.323,36, it is concluded that the model is economically unprofitable.

The fourth model is the current model of compulsory car insurance - car liability in Serbia, which is based on two criteria of engine power of the insured vehicle and bonus malus system, the current bonus-malus system adjusts tariffs according to previous experience, sanctioning compensation with higher premiums compensation by reducing premiums. In other words, if there is compensation, the insured pays it, at least in part, through a higher premium, which should create an incentive to drive more carefully. A simple model that allows careful drivers a lower premium of compulsory car insurance, but does not consider drivers who have or do not have penalty points.

The proposed model is essentially an upgrade of the existing model of compulsory car insurance, which includes the third criterion, which is the criterion of penalty points. By including this criterion, the level of insurance is raised to a higher level, where risky drivers with penalty points are penalized, and drivers without penalty points are rewarded. This model would surely make drivers be even more careful in the driving process itself.

IV. CONCLUSION

Risk is a multifaceted, multidimensional concept that is present in human life on a daily basis. In the broadest sense, the risk is uncertainty about the outcome, ie the probability that the outcome will be unfavorable. Wherever there is human activity related to facilities, machines, technologies, and above all traffic, there are also risks. Therefore, risk management has always attracted great attention, both from researchers and scientists, as well as economists and engineers. The main task of this paper was to propose a new model for risk management in auto insurance, which would be more optimal compared to the current model. The proposed model aims, first of all, to directly connect the probability of accidents for a certain category with the price of insurance premiums, which would result in a reduction in the number of casualties in traffic accidents, and thus to reduce the number of paid damages. In order to create such a model, it is necessary to recognize the criteria that affect the occurrence of the risk, many of which have not been taken into account so far when concluding contracts on compulsory car insurance.

Risk management is an integral part of the successful business of an insurance company and its market positioning. So far, not many characteristics of drivers or vehicles have been recorded in Serbia, but some basic data are still available. Using currently available data: vehicle age, driver age, driver gender and vehicle cubic capacity, a new insurance premium model was proposed. Namely, using logistic regression, based on the factors listed, the probability of accidents for the appropriate class was calculated. Based on this probability, an insurance premium could be determined, e.g. by multiplying the probability by some fixed value. In this way, the price of insurance would be obtained, which is directly proportional to the probability of an accident, which

further results in a suitable model for determining the premium. Unfortunately, due to the small amount of data available to insurance companies, an ideal model cannot be obtained. For example, it has been assumed that the number of driver penalty points is directly related to the probability of an accident, which means that more careful drivers cause far fewer traffic accidents than violent and careless drivers. Until now, this data was not available to insurance companies. Therefore, the main proposal when defining the new model was that the number of penalty points for drivers must be taken into consideration. This new model would not only be more suitable for both insurance companies and insurance users, but would also motivate drivers to behave in accordance with regulations, to adapt their driving to environmental conditions, which would reduce the number of traffic accidents.

The conclusion is that, if penalty points were recorded when concluding the contract, there would actually be multiple benefits. Namely, if the number of penalty points was introduced as an additional coefficient in the proposed logit model (or in an existing one), the price paid by a conscientious traffic participant would be significantly lower than that paid by an arrogant driver. This would not only reward a conscientious driver, but would also motivate other categories of drivers to behave in accordance with the regulations.

The authors are of the opinion that the current system of compulsory motor vehicle insurance in Serbia needs to be modified, the only question is whether this is waiting for better times.

REFERENCES

- [1] C. A. Williams, R. M. Heins, "Risk Management and Insurance". McGraw-Hill Book Company, New York, 1976.
- [2] C. Dugas, Y. Bengio, N. Chapados, P. Vincent, G. Denoncourt, J. Fournier, "Statistical Learning Algorithms Applied to Automobile Insurance. Singapore", World Scientific Publishing Company, 2003.
- [3] B. Matijević, "Osiguranje Management-Ekonomija-Pravo", Naklada Zadar, 2010.
- [4] R. P. Hartwig, C. Wilkinson, "The Use of Credit Information in Personal", Insurance Issues Series, 2003.
- [5] U. Mayer, "Third Party Motor Insurance in Europe", Bamberg, University of Bamberg, 2002.
- [6] I. Kovačević, "**Verovatnoća i statistika sa zbirkom zadataka**" Beograd, Univerzitet Singidunum, 2011 (in Serbian)
- [7] I. D. Radojković, "**Model upravljanja rizikom u auto osiguranju**", Doktorska disertacija, Univerzitetu Nišu, Mašinski fakultet, 2016 (in Serbian).