RISK DETERMINED OF MOTOR OWN DAMAGE INSURANCE BY POLICIES USING ARTIFICIAL INTELLIGENCE

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ABSTRACT: As a result of the increase of people's living standards, the number of vehicles has increased. The increasing number of vehicles has led to an increase in traffic density. Thus, an increased risk of accident and motor own damage insurance has led to their becoming mandatory. The insurance companies, taking into account the rate of profit, the race began to propose the most affordable prices for customers. At the same time, the companies must bid a fair price. The companies can achieve by making risk analysis of their customers. In this study, we aimed a model development to do customers risk analysis for insurance companies. Artificial neural network was used for this risk analysis by determining the167 policy data of an insurance company in Turkey. Neural network was used nearly 126 for the training and 41 for the testing of a total 167 policies. As the input of neural networks, 12 parameters were used related to driver and vehicle, the estimate gross premiums as an output parameter. Our model calculated with 93% accuracy for education when calculating with 92% accuracy for testing on gross premiums cost of the policy by using the Matlab Toolbox. These results have shown that developed system can be used to calculate the amount of gross premiums of insurance policies and to analyse the customers.

Key words: Artificial neuronal networks, policy, motor own damage insurance, gross premium.

JEL Format: C8, G22

YAPAY ZEKÂ KULLANILARAK KASKO SİGORTA POLİÇELERİNİN RİSK TESPİTİ

ÖZET: İnsanların yaşam standartlarının artması sonucu araç sayısı artmıştır. Araç sayısının artması da trafik yoğunluğunda artmaya neden olmuştur. Bu yoğunluk kaza riskinin artmasına ve araç kasko sigortalarının yaptırılmasını gereksinim haline getirmiştir. Bu gereksinim ile birlikte sigorta şirketleri, müşterilerine kendi kar oranlarını da hesaba katarak en uygun fiyatı sunma çabası içerisine girmişlerdir. Aynı zamanda da sigorta şirketleri müşterilere ucuz poliçe teklifi de sunmalıdırlar. Şirketler bu işlemi müşterilerinin risk analizini yaparak sağlayabileceklerdir. Çalışmamızda sigorta şirketlerinin müşteri risk analizini yapacak bir yazılım geliştirme hedeflenmiştir. Bu risk analizini belirlemek için Türkiye'deki bir sigorta şirketinin 167 poliçe bilgisi yapay sinir ağları yöntemi ile kullanılmıştır. 167 poliçenin, 126 âdeti sinir ağının eğitimi 41 tanesi test için seçilmiştir. Yapay sinir ağlarının girişi olarak, sürücü ve araç ile ilgili 12 parametre kullanılarak brüt prim tutarı tahmin ettirilmiştir. MatLab Toolbox kullanılarak, eğitim için %93 oranında doğruluk ile brüt poliçe primi hesaplanırken test için %92 oranında brüt poliçe primi hesaplanmıştır. Bu sonuçlar doğrultusunda geliştirmiş olduğumuz sistem, sigorta poliçelerinin brüt prim tutarlarının hesaplanarak müşteri analizinde kullanılabileceğini göstermiştir.

Anahtar Kelimeler: Yapay sinir ağı, police, kasko sigortası, brüt prim

JEL Kodu: C8, G22

1. Introduction

The raise in people's living standards have increased the ability to buy cars. This increase has raise the risk of accidents. The raise in the risk of accidents and the push up in the value of cars has maintained to encourage people buy on insurance. One of this insurance is comprehensive motor own damage insurance (Hazine Müsteşarlığı, 2014).

The number of motor own damage insurance policy with the exception of life insurance policies are up about 10% of the total number of insurance policies in Turkey in 2013. The income of motor own damage insurance policy exclusive of life insurance policies are approximately 25% of the total insurance policies. As of the end of 2013 in Turkey, 36 insurance companies have been on operation, where 31 of them are motor own damage insurance companies. These companies have made a draft 4 839 594 insurance policies (Hazine Müsteşarlığı, 2013). According to all indications, motor own damage insurance branch in the insurance industry is a market share and significant sector.

Motor own damage insurance policies are securing benefits of the insurers in the motorized and non-motorized on road vehicles such as heavy construction equipment, wheeled tractors, agricultural machinery, trailers and caravans, when in this situation (damage guarantee of property). Concretely, they insure:

- The vehicles collided with any other motorized and non-motorized vehicles which can be used on road or rail,
- The vehicle which the stop or non-stop is damaged in an accident cause of out of control of drivers,
- The vehicle is damaged because of malicious or foolish people,

- Burning of the vehicle,
- The vehicle or parts of the vehicle are theft or attempted to theft (Kara Araçları Sigortası Genel Şartları, 2014).

The name and type of the motor own damage insurance in Turkey are given by;

- Under the narrower scope motor own damage policy: partially secured damage guarantee of property.
- Motor own damage policy: fully secured damage guarantee of property.
- Extended motor own damage policy: fully secured damage guarantee of property and some special guarantees.
- Full motor own damage policy: fully secured damage guarantee of property and special guarantees (Kara Araçları Sigortası Genel Şartları, 2014).

The motor own damage insurance policy cost begin to be determined independently by the company beginning from April 2013 in Turkey (Hazine Müsteşarlığı, 2014).

The insurance companies consider to get maximum profit. The race began to propose the most affordable prices for customers. At the same time, the companies should bid a fair price. The companies can achieve by making risk analysis of their customers.

There are also various studies in recent years for risk analysis on the insurance industry. Lin proposes the back propagation neural network (BPNN) model as a tool for the underwriter to determine the proper premium rate of in-between risks (Lin, 2009). Shapiro presented an overview include the advantages and disadvantages of the merging of NNs, fuzzy logic and genetic algorithm (Shapiro, 2002). Dalkilic, Sevim and Gulbandilar (2013), suggested to use a fuzzy logic method for risk assessment modelling in life insurance. Fragiadakis, Tsoukalas and Papazoglou (2014) has been applied to study the effect of working conditions on occupational injury using data of professional accidents assembled by ship repair yards by an adaptive neuro-fuzzy inference system (ANFIS).

To the best our knowledge, there has not been carried out any study dealing with the assessment of motor own damage insurance risks through artificial neuronal networks (ANN) in the literature. The present study will give effective decision-making based on risk factors in the motor own damage insurance. Thus, insurance companies will be able to distinguish between risk policies and calculate premiums according to the risk. The insurance companies may demand lower premiums for policies with a low risk, higher premiums for policies with a high risk. This work will also help insurance companies to decide if the policies are renewable.

2. Material, Methods and Study Design

We investigated the 167 subject's policies from the special insurance companies in Kutahya, Turkey for 2014. We used the extended motor own damage policy type. In this ANN, the input variables are taken to be city name, the purpose of usage (such as private or commercial), model (year of the car), number of potential passenger, claims discount, non-claims discount, defects rate in accident, claims number, cost of damage, age of the driver, sex of the driver and market value of the vehicle (Türkiye Sigorta Birliği, 2014).

Hence, Gross net premium is the output variable as shown in Figure 1. According to the damage guarantee of property, the gross net premium may include current value of coverage shock-collision insurance, coverage burning insurance, water-damage insurance coverage, terror attack insurance coverage, auto-glass broken insurance coverage, auto-keys stolen and theft insurance coverage, earthquake insurance coverage, car-assistant insurance coverage, third party liability insurance coverage, personal liability insurance coverage and driver's and passenger liability insurance coverage and judicial courts insurance. The 126 of totally 167 policies are used for training data. The input and output variables are normalized between 0 and 1.

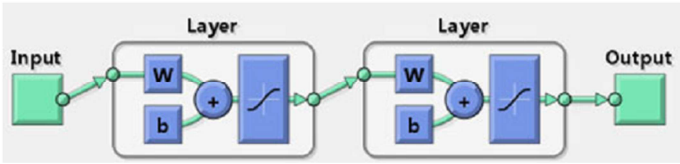

Figure 1. The ANN block diagram

The system diagnosed the gross net premium has been designed using MATLAB 2009 Toolbox. The designed ANN consisted of feed-forward back propagation, two hidden layers, training function (Levenberg-Marquardt), adaptation learning function (learngdm) and performance function (MSE-mean squared error). The neurons used in the system are 10 and 1, in the first and the second layers, respectively.

The data used in this research referred to 167 automobile motor own damage insurance policies. The data consisted of 126 automobile motor own damage insurance policies were used to form the ANN training set. Performance of the ANN training set and R value are $\times 10^{-6}$ and 0.933, respectively (Figure 2). After training, the ability of the neural network to classify test patterns not in the training set was investigated. The data consisted of 41 automobile motor own damage insurance policies were used to form the ANN test set.

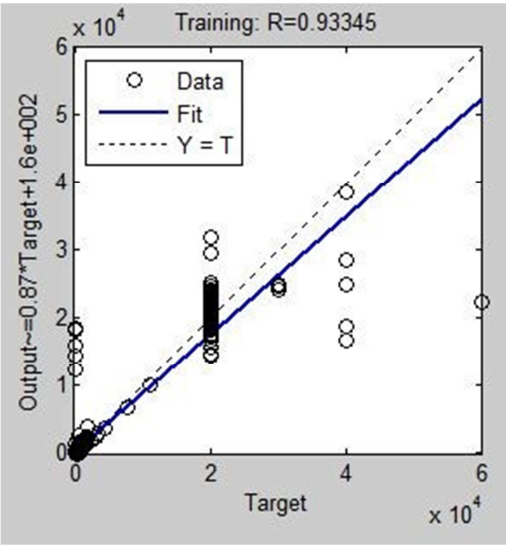

Figure 2. ANN training performance

3. Results and Discussions

The expert systems behave very similar to real data as seen in Figure 3 (R^2 =0.92 for the ANN). The net gross for policies (real data) and the net gross for policies predicted using the ANN values (computed with expert systems) have been compared as seen in Figure 3. According to the results, between the real data and ANN value is seen statistically significant correlation.

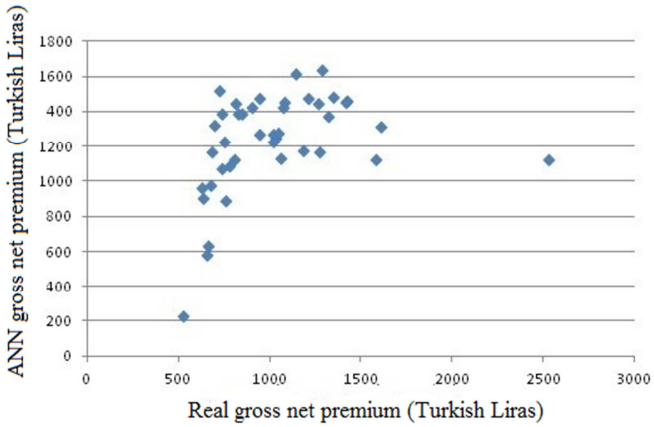

Figure 3. A comparisons between the ANFIS results and real gross net premium data

As pointed out by Forsstrom (1995), ANNs have been shown to be superior to both conventional statistical methods and manual/specialist-based analysis in many studies. There are many benefits by using neural networks compared to conventional statistical methods. For the details of the discussion to interested readers are referred to the corresponding reference.

Zhao and Cen (2014) showed how an insurance company can use its current customers' data for modelling target customer profiles aimed at cross-selling of caravan policies as well as targeting new customers. They use different technics such as reviewing current customers' data and pre-processing, following by linear regression analysis to gain an understanding of the nature of data. Different modelling methods were considered before it was decided to develop classifier models of a target customer profile. Models derived with four different classifier methods are presented with comparative results of their explanatory and predictive power as well as computational efficiency. Although all four models of target customer profile share a number of similarities, they also differ in interesting ways.

Guelman, Guillénb and Pérez-Marín (2014) said that they have considered a model for price calculations based on three components: a fair premium; price loadings reflecting general expenses and solvency requirements; and profit. The first two components were typically evaluated on a yearly basis, while the third was viewed from a longer perspective. When considering the value of customers over a period of several years, and examining policy renewals and cross-selling in relation to price adjustments, many insurers may prefer to reduce their short-term benefits so as to focus on their most profitable customers and the long-term value. They showed how models of personalized treatment learning can be used to select the policy holders that should be targeted in a company's marketing strategies. An empirical application of the causal conditional inference tree method illustrated how best to implement a personalized cross-sell marketing campaign in their framework.

By using neural networks, more complex tasks can be learned from examples than by using conventional statistical techniques. Another benefit is that both qualitative and quantitative data can easily be included in the same model. Neural networks perform well in analysis of nonlinear multivariate data. The disadvantages related to the use of neural networks include difficulties of expressing their function in a simple way.

As a result of these outcomes, usage of the developed expert systems can be used to successfully making risk analysis of their customers on the motor own damage policy. Therefore optimum gross net premiums can be easily calculated by this expert system. Hence, labor cost and working load of insurance company may be decreased. When the insurance companies take into account the rate of profit, the race began to propose the most affordable prices for customers. At the same time, the companies must bid a fair price.

The limitation of this study due to consideration of only passenger cars. In future studies, we plan to extend this study by adding further vehicle data such as trucks, buses and minibus.

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