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**The Influence of Car Registration Year and Some Driver's Characteristics on the Number of
Car Accident**

The case of study Tehran and Isfahan Cities

Master of Science

In the subject of

Actuarial Science

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In The Name of GOD

The Compassionate, The Merciful

ABSTRACT

Road accidents represent the greatest social costs associated with insurance industry. This research presents a theoretical and empirical analysis of the accident rate that can be useful for insurance companies. The aim of this study is to analyze the number of accident and some factors that may influence on it. For this purpose, we selected some factors such as car production year, car application, as well as some driver's characteristics such as age, level of education, being right or left handed, etc. Based on these factors we assume people are divided into different risk groups .In other words, drivers risk levels and their value of precautionary efforts can be obtained by having information about these characteristics. For this purpose we distributed a questionnaire in two cities (Tehran and Isfahan) to gather data about those factors. The required sample size from these two cities was calculated 517 which applying Cochran and Proportional Allocation formula the number of required samples from Tehran and Isfahan were determined 434 and 83 respectively Then by means of software SPSS20 and applying related tools this research described gathered data by presenting a summary statistics and graphical displays. For analyzing the data and investigating the relationship between mentioned factors and number of accident some statistical tests were used, which the obtained results showed that all the factors had impact on the number of accident. Thus this research will be useful for insurance companies in order to determine price of their contracts precisely.

This research also presented appropriate statistical models in order to mathematically state the impact of mentioned factors upon the number of accident. For this analysis two suitable models (Poisson and Negative Binomial) were compared and finally Negative Binomial was selected as an appropriate model for stating this relationship. Obtained results of Paired – sample t-test indicated that this selected model can be fitted on the data as a valid and reliable model to estimate the frequency of accident based on the some characteristics of car and drivers in two cities Tehran and Isfahan.

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List of Abbreviations

LH	Left Handedness
RH	Right Handedness
AC0	Application of Car = Personal
AC1	Application of Car = Taxi
AC2	Application of Car = State Property
AC3	Application of Car = Conveyance
PYC3	Production Year of Car = (1385-1386)
PYC2	Production Year of Car = (1381-1384)
PYC1	Production Year of Car = (1377-1384)
PYC0	Production Year of Car = (1381-1384)
LOL3	Length of Obtained License= more Than 30 Years
LOL2	Length of Obtained License= (21-30) Years
LOL1	Length of Obtained License= (10-20) Years
LOL0	Length of Obtained License= (21-30) Years
DDT3	Daily Driving Time= More Than Five Hours
DDT2	Daily Driving Time= Three to Five Hours
DDT1	Daily Driving Time= One to Three Hours
DDT0	Daily Driving Time= an Hour or Less
LE5	Level of Education=Lower High School
LE4	Level of Education=High School Graduated
LE3	Level of Education=Upper High School
LE2	Level of education=Bachelor
LE1	Level of education=Master
LE0	Level of education=PhD and Higher

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CHAPTER 1: INTRODUCTION

1-1 Introduction:

Cars play a special role in everyday life. In fact, growth of automobile industry and the increasing need for humans to this device cause growth of traffic accident and make bodily and financial damages to owners, passengers and third parties. In our country like as most other countries third party insurance is compulsory and plays an important role in the number of accident and have influence on behavior of drivers. Despite of this fact there is no sufficient studies about this kind of insurance contracts and most of times having insurance makes sure drivers to be compensated about their losses and it causes they drive with high risk level and don't worried about the accident may occurred. In such a case most of advanced countries based on the conducted researches were aware of this fact that drivers characteristics such as age, marital status, level of education, driving experience, gender, economic status and some other factors had a direct relationship with the frequency of accidents in other words these factors can be representative of risk level of drivers. Thus decided to consider them in rate-making process of car insurance. This action is beneficial for insurance companies also reduces number of accidents which considerably reduced the cost of the insurance industry. In this research we're going to investigate effective factors on the number of accident and also the role of insurance in term of third party contracts to decrease the losses should be paid by insurance companies. For this aim our presented research includes six chapters :

Chapter one: Introduction

Chapter two: Literature Review

Chapter three: Methodology

Chapter four: Data Analyzing

Chapter five: Statistical Modeling

Chapter six: Conclusion and Recommendation

1-2 Importance of the thesis subject:

A research conducted in our country indicates that traffic accident is the most important factor of cause of death in Iran. This is evident in the fact that about 23,000 deaths-average of three per hour, as a result of traffic accident were recorded in 2009 and the road fatality rate for the same period was 30.96 Per 100,000 population. In addition, the rate of road injuries between 2007 and 2009 increased by 10%. Also, the total cost implication of accidents within the urban and suburban areas were put at about \$18 billion, this is equivalent to 1.39% of gross domestic product (GDP) of Iran in 2007 (Towhid Pour, 2011).

Another research shows that over 30,000 people die annually in Iran from road traffic crashes, amounting to a death rate of 44 per 100,000. Similarly, the annual mortality of road traffic crashes is substantially higher than the number of deaths from the 2003 Bam earthquake, one of the worst natural disasters of recent decades (Towhid Pour, 2011). These statistical records show that accidents increase requires serious action to reduce it. According to the statistical records in 1389, automobile insurance produced about 31356 billion Rials of total insurance revenue (about 59162 billion Rials). Also about 53% of the Insurance industry paid losses is related to automobile insurance contracts which is a considerable amount (calendar of Central Insurance of Iran,).

Thus not only this action help economy of society to preserve life and property of individuals but benefit insurance companies to reduce their costs.

More than a million people are killed on the world's roads each year. The total is expected to increase steeply as the number of motor vehicles increases rapidly in many formerly less-motorized countries, and will likely exceed 2 million by the year 2020. Traffic crashes are one of the world's largest public health problems. The problem is all the more acute because the victims are overwhelmingly young and healthy prior to their crashes (1389 Naghavi, 2007).

The problem of deaths and injury as a result of road accidents is now acknowledged to be a global phenomenon with authorities in virtually all countries of the world concerned about the growth in the number of people killed and seriously injured on their roads. In recent years there have been two major studies of causes of death worldwide which have been published in the 'Global Burden of Disease' (1996, World Health Organisation, World Bank and Harvard University)

and in the 'World Health Report –Making a Difference' (WHO 1999).These publications show that in 1990 road accidents as a cause of death or disability were by no means insignificant, lying in ninth place out of a total of over 100 separately identified causes. However, by the year 2020 forecasts suggest that as a cause of death, road accidents will move up to sixth place and in terms of years of life lost (YLL) and 'disability adjusted life years' (DALYs)¹ will be in second and third place respectively(Jacobs & Thomas,2000). Following table indicates this fact.

Table 1.1: Disease Burden (DALYs lost) for 10 Leading Causes

1998 Disease or Injury	2020 Disease or Injury
1 - Lower respiratory infections	1- Ischaemic heart disease
2 - HIV/AIDS	2 - Unipolar major depression
3 - Perinatal conditions	3 - Road traffic injuries
4 - Diarrhoeal diseases	4 - Cerebrovascular disease
5 - Unipolar major depression	5 - Chronic obstructive pulmonary disease
6 - Ischaemic heart disease	6 - Lower respiratory infections
7 - Cerebrovascular disease	7 - Tuberculosis
8 - Malaria	8 - War
9 - Road traffic injuries	9 - Diarrhoeal diseases
10 - Chronic obstructive pulmonary disease	10 - HIV/AIDS

Source: WHO, Evidence, Information and Policy, 2001

Another study in Thailand states that road accidents have not caused only death and disability to Thailand citizens but also substantial damage to the country's economy. It was estimated that the economic losses due to road accidents in Thailand are over 100,000 million Baht (approximately 2,500 million US\$ or 300,000 million Yen) per year, which means over 12 million Baht per hour or about 3.4% of the country's GNP(Evans,2004).

Each year 127000 people die from road crashes in the WHO European Region (Peden et al.,2004).The nonfatal consequences are also sever: more than 2 million injured people require hospital admission and millions more require medical attention, with a large proportion permanently disabled (UNECE,2006).Road traffic injuries in the Region result in an annual loss of 3.6 million of healthy life due to premature death or disability (disability-adjusted life-years).The loss of national productivity is an economic threat, resulting in high societal costs equivalent to 2% of gross domestic product. For the European Region,this

translates into hundred of billions of euros, including health service costs to treat and rehabilitate injured people(Tanaboriboon & Satiennam,2004).

Automobile insurance among the other types of insurance fields,has a special features.May be surprised to know that people are more sensitive to the increase in car insurance premiums in compared with other insurance fields.Car insurance actually is considered as a political–social problem and in advanced industrial countries specially America,in order to solve technical and political problems,relevant organizations must work together.(karimi,1386)

Statistical reports of occurred accident during these recent years indicates that the number of accident increases rapidly that it makes big loss for insurance companies,This fact express the necessity of some serious actions in order to decline the number of accident in our country.

In our country only a few parameters of vehicle and driver affect insurance contract price. Risk level of each policyholder is solely determined based on the characteristic of vehicle,while conducted researches during last years indicated that there are many factors that have positive or negative influence on the risk level of individuals. They also suggested insurance companies to consider these factors in rate-making process.According to the results of these studies,Most advanced countries changed their policies and the method of determining their premiums,in fact they decided to determine risk level of each policyholder based on their characteristics and then considered different premium for each risk level.

1-3 Risk

1-3-1 Definition of Risk

Risk is a condition in which is a possibility of an adverse deviation from a desired outcome that is expected or hoped for.

1-3-2 Classification of Risk

Risks may be classified in many ways such as: (J. Vaughan & M.Vaughan,2007)

❖ Financial and Nonfinancial:

The term of risk is referred to exposure to adversity. In some cases this adversity involves financial loss ,while in others it doesn't .

❖ **Static and Dynamic**

Dynamic risks are those resulting from changes in the economy such as changes in technology and consumer tastes and etc. Static risks arise from causes other than the changes in the economy such as perils of nature.

❖ **Fundamental and Particular**

Fundamental risks involve losses that are impersonal in origin and consequence for instance: inflation, floods ,That are grouped risks .Particular risks involve losses that are out of individual events such as robbery of a bank.

❖ **Pure and Speculative Risks**

Pure risk is referred to those situation that involve only the chance of loss or no loss ,While speculative risks describes a situation where there is a possibility of loss, but also a possibility of gain for example gambling .

1-3-3 Risk Management

Risk management is a scientific approach to the problem of risk that has as its objective the reduction and elimination of risks facing the business firm.

1-3-4 The Five Step of Managing Risk

1) Risk Identification and Measurement

The two-fold process of (1) examining business, from property holdings to operational processes, and identifying all risks that potentially threaten your organization's assets; and (2) estimating each risk's potential financial impact on the organization's asset base. Broadly speaking, the treatment options available range from avoiding the risk completely, accepting the risk and controlling it, through to transferring the risk to another party.

2)Risk Avoidance and Reduction

Technically, avoidance takes place when decisions are made that prevent a risk from even coming into existence. Risk avoidance should be used in those instances

in which the exposure has catastrophic potential and the risk cannot be reduced or transferred. Risk reduction consists of all techniques that are designed to reduce the likelihood of loss, or the potential severity of those losses that do occur

3)Risk Retention

Self-funding certain types and amounts of risk.

4)Risk Transfer

The deflection of risk away from the organization and onto others. Transferring the risk to another party either in full or sharing the risk may be an option in some scenarios.

5)Risk Monitoring and Adjustment

The periodic process of re-examining chosen risk management strategies and adjusting them to fit the organization's financial and other objectives (Webster, 2011) & (J. Vaughan & M. Vaughan, 2007).

1-4 Insurance:

As mentioned before Insurance can be used as a tool for transferring the risk in order to deal with risk. Insurance is a contract in which one party undertakes to indemnify the loss sustained by the other party caused by the occurrence of specific events, in consideration of receipt of a certain sum or sums of money from the other party. The undertaking party is named the Insurer, the other party the Insured, the money paid by the insured to insurer is termed premium and the subject of insurance is termed interest (Iran Insurance co).

1-4-1 History of Insurance in Iran

Historical background of insurance in Iran goes back to 80 years ago when two Russian companies ventured to open their branch offices, and following that Iran Insurance Company was established as the first independent and state owned insurance market. In the early 1970s many new insurance companies were established and at the same time the Law establishing BimehMarkazi Iran (Central Insurance of Iran) was passed in the Parliament. After the Islamic Revolution in 1979, the work permission of foreign insurance agencies in Iran has been withdrawn and ten of the insurance

companies were merged in Dana Insurance Co. BimehMarkazi Iran, while having the responsibility of regulating, supervising and promoting insurance business in Iran, is also the sole reinsure of the market and has a very reputable stand in the Middle East and various markets of the world. (karimi Ayat,1386)

1-4-2 Types of Automobile Insurance in Iran :

I –Vehicle(Body) Insurance:

Compensating damages incurred on the insured vehicle.

II -Third Party Insurance:

Compensating damages incurred on persons, including:

1 – Financial Damages

2 – Physical Damages (death, physical defect or disability and medical expenses)

III -Passenger Coverage:

Compensating damages incurred on passengers of the insured vehicle (death, physical defect, medical expenses)(Iran Insurance co).

According to the Provisions of the Article one of the Law of Compulsory Third Party Liability Insurance, all the owners of land transport motor vehicles and all kinds of tuggers and trailers attached to the said vehicles and railway trains are liable for damages to persons and properties incurred by third parties as a result of the accidents of such vehicles of consignments thereof and are obligated to insure their liability in this respect with one of the Iranian insurance companies. Therefore, the damages resulting from the aforesaid vehicles are classified into the two following groups(Center Insurance of Iran):

1- Damages to persons

Compensation of damage to persons, means indemnification of third parties for the treatment expenses of physical damage or injuries resulting from traffic accidents as well as indemnities for failure and deficiency of body members, permanent, absolute or relative disablement or death resulting from accidents covered by insurance.

Therefore, the insurer indemnifies damages to persons under the three following titles:

A- Expenses for treatment of physical damage or injury.

B- Indemnity for failure and deficiency of body members, permanent, absolute or relative disablement.

C- Indemnity for death.

The amount of damages to persons shall be determined on the basis of the court judgment having due regard to the Islamic Penal Law.

2- Damages to properties.

“Indemnity for damages to properties consists of the provision and compensation for direct losses resulting from accidents covered by insurance, to the objects and properties under the ownership or legal possession of individuals.”

1-5 Methodology

1-5-1 Classifying Factors

The stages of research can be summarized as following:

First Identifying factors that may affect accident rate (year of production and application of car, Driver's age, level of education, being right or left handed, daily driving time, date of achieving driving license). Then eliminating cars manufactured after 1386 And classifying mentioned factors into some specific groups as following:

Application of cars in to: personal, taxi, state property, conveyance.

Level of education into 6 groups: PHD and higher, Master, Bachelor, upper high school, high school graduated and lower high school.

Daily driving time into 4 categories: An hour or less, one to three hours, three to five hours, More than five hours.

Age of drivers into: (18-30), (31-40), (41-50), older than 50.

In chapter four data collected were analyzed by mathematical and statistical software and using appropriate statistical test and graphs to test some hypothesis.

1-5-2 Main Hypothesis

- 1-Car production year affects positively on the number of accident.
- 2- Old drivers have lower number of accident rather than young drivers.
- 3- Level of education of drivers has negative effect on the risk levels.
- 4-Driving period in a day affects positively the accident rate.
- 5-Left handedness of drivers increases the risk level of drivers.
- 6- The length of obtained license has negative impact on the risk level of drivers .
- 7-The accident rate is affected by the manner of usage of cars.

After testing mentioned hypothesis ,Then the results will be expressed by presenting two mathematical model :Poisson and Negative Binomial.And also by comparing this two models and finally based on the relative statistical tests presented most appropriate model.

1-6 Data Requirement

Data needed for this study are collected through questionnaires that will be answered by at least 500 drivers in Tehran and Isfahan. The number of questionnaires distributed in each of the two cities is calculated using the proportional allocation.This study utilizes the simple random sampling method. It should be noted that the questionnaires are distributed in different parts of cities to make sure that sampling process is completely random. This research includes both male and female drivers of all ages. The questionnaires are distributed in Tehran and Isfahan. The records related to cars manufactured before 1387 are taken into account .We solely consider accidents occurred during 1387-1390.Finally about 900 questionnaires were answered by people which about 517 of them were usable.