AN ANALYSIS OF ROAD TRAFFIC ACCIDENTS IN TUNISIA USING CAR INSURANCE CLAIMS

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Abstract

In Tunisia, the motor insurance industry represents the most important category of damage insurance. In this branch, the fundamental problem is the evolution of the road accident phenomenon. The claim experience in motor insurance is measured in terms of accident frequency. Certainly, the determination of the factors that contribute to the explanation of the loss ratio allows for the improvement of the motor insurance sector. The objective of this study was to analyze the main determinants of claims reported by drivers to their Tunisian insurance companies, as well as the causes of satisfaction of the insured with their insurers. The results show that drivers' behavior is one of the key factors in the causes of claims and that the level of risk coverage helps define the relationship between an insured and his insurer.

Keywords: Auto insurance, Road accident, MCA, risk factors, satisfaction of policyholders, Tunisian insurance companies.

JEL Classification : L62, R41, C10, G32, J28, G22.

1. INTRODUCTION

The need for security arises naturally from the awareness of men to protect themselves against theft, illness, various accidents, and generally against the hazard. This has opened up a segment of economics and risk management where insurance companies primarily thrive.

According to Couilbault (1999), "Insurance can be defined as: a meeting of people, who are afraid of the coming of an event which is detrimental to them, to contribute to it, and to ensure that those who will be affected by this event deal with its consequences.

Similarly, we can define the insurance industry as an institution that transforms “uncertainty” into “certainty”. In this sense, insurers must take steps to keep their promises. It is therefore necessary for the latter to foresee the various risks insured, in particular to set around them a certain number of indicators in order to better measure the risks before pricing.

The automobile insurance branch occupies an increasingly interesting place in the overall structure of this sector, in the sense that the harmonization and securing of the various road risks have led governments to impose on users the subscription of a car insurance.

According to the World Health Organization (WHO), in 2020, road accidents lead to around 1.3 million deaths per year. Every year, more than 20 to 50 million injuries and more than half of road deaths are "vulnerable road users": pedestrians, cyclists and motorcyclists and more than 90% of road deaths occur in low-income countries. or intermediate and it is in the African region that the death rate from road accidents is the highest (OMS, 2020). Tunisia is one of the countries with the deadliest roads in the world. The National Road Safety Observatory (ONRS) announced 4,633 road accidents in Tunisia with 937 deaths on Tunisian roads in 2020.

The main problem with car insurance in Tunisia is the increase in road accidents. Generally, traffic accidents are complex, contingent and multifactorial phenomena. Thus, the solutions provided are not exclusive or complete. Better knowledge of the causal network of accidents should make it possible to design more effective prevention programs.

In order to achieve the objective of our study, which highlights the most significant factors of road accidents and the satisfaction of policyholders with their insurance companies, the most suitable method with the nature of the information to be collected is the survey. by questionnaire. Multiple correspondence analysis is used to study the grouping of categories of qualitative variables.

In this article, we will first start with a brief literature review on road accident risk factors. We then present the variables of the study and the MCA method. Finally, we discuss the main empirical results before concluding.

2. LITTERATURE REVIEW

2.1. ANALYSIS OF ROAD ACCIDENT RISK FACTORS

The analysis of the number of accidents incurred by drivers is acquiring an increasingly important part in the research work of the economic literature.

Based on road traffic forensic investigation of 25 serious traffic accidents in Thailand which resulted in 407 victims and 47 vehicles, Klinjun et al. (2021) used Haddon's matrix to identify pre- and post-accident risk factors. They showed that the main causes of road accidents are linked mainly to human errors such as speed and drowsiness and they are linked to vehicle risks such as overloaded vehicles, the absence of occupant safety equipment and the presence of unsecured seats and environmental hazards which include the absence of traffic lights, the absence of guardrails, the absence of traffic signs and fixed objects on the side of the road.

The results of a cross-sectional study on a sample of 376 participants were elaborated by Mekonnen et al. (2019) to identify the various factors affecting the occurrences of risky driving behavior among professional car drivers in the city of Bahirdar in the northwest of Ethiopia. They showed that more than 60% of the causes of road accidents are driving behavior such as drivers' compliance with traffic rules, drivers' average monthly salary, drink-driving, drivers' experience (drivers with less driving experience since their first license were more likely to engage in risky driving behaviors than those with long driving experience, number of kilometers driven per year and distance driven per year) .

In turn, Valent et al. (2002) launched a study in northern Italy on a sample of 10,320 road accidents that occurred during the period between 1991 and 1996, to identify the main risk factors for fatal accidents. The results showed that the risk of involvement in fatal rather than non-fatal accidents was lower in women than in men. Similarly, the accidents occurred from 1:00 a.m. to 5:00 a.m. Also, the risk of death is higher from 6:00 a.m. to 11:00 a.m. and the driver's injury increases with the non-wearing of the seat belt.

In the same context, Agarwal et al. (2020) carried out a study on 416 cases of road accidents reported to the emergency department of Muzaffarnager Medical College, from July 1, 2016 to June 30, 2017. The results indicate that human error is responsible for 78% in the occurrence of accidents. The human factors that are responsible for accidents are reckless driving, wrong passing, negligence, alcohol consumption and violation of traffic rules.

By looking at the study of Kumar et al. (2020), which was carried out on a sample of 654 victims of road accidents in India from a questionnaire. The results gave insight into the victims most susceptible to road accidents. In this paper, men are more at risk than women, most of the population is rural and the majority of victims are between 16 and 45 years old. In the same vein, they analyzed the temporal distribution of accident trend and that the highest number of accidents occurred on national roads and during monsoon[1] season.

[1]It is the rainy season during the period (June - September).

However, several researchers have agreed that speeding, alcohol and drug use, inattentiveness, cell phone use, smoking and failure to comply with safety measures such as seat belts (Sanyang et al., 2017; Rolison et al., 2018 and Talukder et al., 2022) are the most common risk factors associated with road accidents.

A finding from the United States and Europe indicated that obesity was reported as a risk factor for road accidents and in southeastern regions of Asia, the type of roads (local roads, rural areas and highways) were the main causes of road-related risk (Razzaghi el al., 2019).

According to previous studies, risky driving is significantly higher in men than in women and that the category of young drivers is the most exposed to accidents (Shrestha et al., 2017; Singh et al., 2014; Kumar and Srinivasan, 2013; Jha et al., 2004).

2.2. FACTORS INFLUENCING POLICYHOLDER SATISFACTION

In general, the choice of an insurance company is linked to different criteria and also factors that determine customer preferences and affect their satisfaction.

Several researchers have stated that, in most cases, there is generally a positive relationship between these factors and consumer choice by insurance companies.

Graa et al. (2017) presented a quantitative survey to measure the different factors that affect the satisfaction of users of the Algerian social security fund. Observations showed that reliability, assurance, relationships and ethics have a significant effect on user satisfaction. On the other hand, transparency and tangibility have no significant effect on the satisfaction of social policyholders.

The results of a study developed by Getachew (2019) to assess the quality of motor insurance service in five branches of an Ethiopian insurance company using the SERVQUAL model indicate a positive correlation between the dimensions of service quality and customer satisfaction means that customer expectations exceeded perceptions. Based on a questionnaire, which was distributed to 285 respondents using a convenience sampling technique for EIC (Ethiopian Insurance Corporation) customers and the collected data was analyzed using SPSS version 20.

In the same context, during the period (2008-2009), Vazifehdust and Farokhian (2013) gave a first linked survey of customer satisfaction with 140 questionnaires distributed to statistical communities and a second survey which identified the factors affecting the insurance sector with 350 questionnaires were distributed among the insurers. This article analyzes the responses obtained by SPSS software and uses the SERVQUAL model. The results indicate that the

factors of customer satisfaction are customer response time, customer confidence in their insurance company, effective dealing with the insured and ability of insurance agents to convey information. precise. Understanding the customer, credit, insurance and the customer relationship can be identified as the indicators most involved in the success of the insurance sector.

Manoabe et al. (2020) examined the influence of each dimension of the perceived quality of service of car insurance companies on the attitude of policyholders. From a quantitative study on a sample of 210 motorists insured in the city of TOGO only the dimensions, relationship and insurance, have a positive and significant influence on the attitude and the criteria relationship between agents and insured, reliability, insurance and ethics have been identified as elements of the quality of service of insurance companies.

The objective of Maseke and Iipinge (2021) is to identify the factors influencing the preferences of policyholders in the choice of insurance companies. A study in Keetmanshoop Namibia, on a sample of 185 participants and they used the deductive approach to collect the data. The results showed that the majority of participants chose insurers because of agents' or brokers' persuasion, and participant feedback indicated that there is a positive relationship between the relative importance of customer insurance and factors (advertising, social and behavioral factors), most participants are very satisfied with their current insurers (87%) and have no intention of changing their insurance company as they are comfortable with the price range, services and benefits, etc.

Ramadhan and Soegoto (2020) initiated a questionnaire-based study at a health company, BPJS Bandug on a study sample (100 participants). To analyze the questionnaire data, they used the linear regression method, t-test and partial least squares structural equation modeling (SEM-PLS). They concluded that empathy, tangibility, assertiveness, responsiveness, and reliability influence customer satisfaction with their insurance company.

3. MATERIALS AND METHODS

3.1. DATA COLLECTION BY QUESTIONNAIRE

This study is based on qualitative variables. The data is collected during a survey by questionnaire from a sample of 300 people. These are traders, employees, students and retirees, etc., who have taken out an automobile insurance contract. Data collection was carried out by direct interview (face to face), over a period of three months, in insurance agencies.

The questionnaire (see appendix 1) includes twenty-eight questions relating to the factors that explain the number of accidents of the Tunisian policyholder. Likewise, it encompasses four parts. The first is devoted to the identification of the individual characteristics of the insured (gender, socio-professional category,

family situation, etc.). The second part concerns the characteristics of the insured vehicle (age, category of vehicle, fiscal power, etc.). The third deals with driving behavior. The last part represents the level of coverage of the insured's risk by his insurer and defines the relationship between the insurance company and his client in order to assess the satisfaction of the insured.

3.2. THE MULTIPLE CORRESPONDENCE ANALYSIS (MCA) METHOD

Multiple correspondence analysis (MCA) is a descriptive statistical method aimed at matching the modalities of qualitative variables. The goal of MCA is to graphically represent individuals by points in a subspace, so that the point cloud most closely resembles the point cloud of the original space. The first founders of multiple correspondence analysis are Benzécri, 1973 ; Escofier and Pagès, 1998.

4. RESULTS

In this work, we try to extract the factors that explain the number of accidents of the Tunisian insured, through the MCA method.

4.1. SELECTION OF ACTIVE VARIABLES AND ADDITIONAL VARIABLES BY THE MCA

Eigenvalue analysis is carried out according to the rule of the eigenvalue greater than the average of the eigenvalues.

In our case, 7 active variables are characterized by 32 associated modalities. Indeed, 25 eigenvalues are obtained, and which are relative to the difference between the number of modalities of the active variables and the latter (32-7=25 eigenvalues). In order to identify the number of axes that are significantly interpretable, we find that there are 11 eigenvalues greater than 0.1428 (= 1/V= 1/7). So, we have to interpret 11 axes. However, we limit ourselves to 4 axes since they provide most of the information sought (Table 1).

Table 1. *Diagram of eigenvalues*

Number	Eigenvalue	Percentage	Cumulative percentage
1	0.2855	7.99	7.99
2	0.2779	7.78	15.78
3	0.2129	5.96	21.74
4	0.1969	5.51	27.25
5	0.1907	5.34	32.59
6	0.1836	5.14	37.73
7	0.1796	5.03	42.76
8	0.1665	4.66	47.42
9	0.1610	4.51	51.93
10	0.1515	4.24	56.17
11	**0.1475**	**4.13**	**60.30**

12	0.1423	3.98	64.29
13	0.1364	3.82	68.11
14	0.1328	3.72	71.82
15	0.1302	3.65	75.47
16	0.1179	3.30	78.77
17	0.1128	3.16	81.93
18	0.1083	3.03	84.96
19	0.1062	2.97	87.94
20	0.0984	2.75	90.69
21	0.0911	2.55	93.25
22	0.0763	2.14	95.38
23	0.0670	1.87	97.26
24	0.0505	1.41	98.67
25	0.0475	1.33	100.00

We identified 47 modalities from this questionnaire.

After several trials of MCA, we selected seven relevant active variables and six additional variables. (Table 2 and 3).

Table 2. *Actives variables*

Actives variables	**Modalities**
X1 (socio-professional category SPC)	Employee
	free profession
	Trader
	Worker
	Farmer
	frame
	Professor or teacher
	Artisan
	Student
	Retired
X2 (driving experience DE)	DE1 (Less than 2 years)
	DE2 (Between 3 years and 10 years)
	DE3 (More than 10 years)
X3 (annual mileage AM)	AM1 (< 5000 km)
	AM2 (5000 km → 10000 km)
	AM3 (10000 km → 15000 km)
	AM4 (15000 km → 20000 km)
	AM5 (>20000 km)
X4 (Declared claim DC)	YDC (yes) : declaration of the claim to the insurer
	NDC (No) : failure to report the claim to the insurer
X5 (Number of Claims NC)	NC1 (A single disaster)
	NC2 (Two claims)
	NC3 (Three claims)
	NC4 (More than three claims)

	NC5 (Not sinister)
X6 (understanding of need U N)	UNVU (understanding of need Very Unsatisfactory)
	UUN (Unsatisfactory understanding of need)
	UNNSS (understanding of need Neither satisfactory nor unsatisfactory)
	SUN (Satisfactory understanding of need)
	UNVS (understanding of need Very Satisfactory)
X7 (change of insurer CI)	YCI (yes) : « policyholders who have changed their insurer»
	NCI (No) : « policyholders who have not changed their insurer »

***Table 3**. supplementary variables*

SUPPLEMENTARY VARIABLES	Modalities
X1 (age category «AC»)	AC1 (less than 25 years old)
	AC2 (between 25 and 35 years old)
	AC3 (between 35 and 60 years old)
	AC4 (more than 60 years old)
X2 (frequency of use FU)	FUD (daily)
	FUAD(almost daily)
	FULF (less frequently)
	FUOW (only on weekends)
	FURU(rarely used)
X3(category of vehicle CV)	TV (Tourism vehicle)
	UV (utility vehicle)
	PTV (public transportation vehicle)
	IV (Industrial vehicle: pick-up truck)
X4 (annual bonus AB)	AB1 (200d → 600d)
	AB2 (600d → 1000d)
	AB3 (1000 → 2000d)
	AB4 (more)
X5 (traffic offenses TO)	TO1 (once)
	TO2 (Many times)
	TO3 (never)
X6 (causes of claims CC)	CCES (Excess speed)
	CCVR (Violation of the rules of the road)
	CCLC (Lack of concentration (fatigue and drowsiness…))
	CCEA (Driving under the influence of alcohol)
	CCPD (Phone use while driving)
	CCAD (Aggressive driving)

4.2. INTERPRETATION OF THE FIRST FACTORIAL PLANE

Table 4 summarizes the contributions of the active modalities on the foreground (high CTR contribution).

***Table 4**. Summary of contributions of active modalities on plan 1*[2]

Axis	Modality with high CTR	CTR(%)		Modality with high CTR	CTR(%)	
		Sign	Value		Sign	Value
Axis 1	NC4	-	8,62	NC5	+	8,50
Axis 2	UUN	-	16,73	SUN	+	3,05

Reading the contributions of the active modalities on the foreground allows us to draw the following interpretations. Axis 1 discriminates between drivers who suffer several automobile claims (CTR= 8.62%) and drivers who have never suffered an accident (CTR=8.50%). Axis 2 opposes satisfaction (CTR= 3.05%) and non-satisfaction (CTR = 16.37%) of the insured. We can interpret it as being the axis of opposition between the satisfaction and the non-satisfaction of the understandings of the needs of the insured of their insurer.

The MCA makes it possible to highlight the variables or methods correlated with the risk of an automobile accident and to study the relationship between the insured and his insurance company. By way of illustration, we represent the foreground (appendix 2). The latter gives the projection of the variables in the first factorial plane generated by axis 1 and 2 contributing respectively for 7.99% and 7.78% of the total variability. Thus, the interpretation of each axis is done according to the variables or modalities that contribute more to the formation of the axes.

Axis 1 highlights the opposition that exists between the 5 modalities of the active variables (AREA 2) and the 5 modalities (AREA 4).This distribution shows a strong opposition between the categories of drivers who recorded fewer accidents, compared to the other category of insured who committed serious claims. This opposition presents the first factorial axis. In addition, the 1st axis highlights the oppositions which are summarized in Table 5.

***Table 5**. Representation of active and additional modalities on axis 1*[3]

Axis 1	
Negative side of axis 1 (AREA 4)	**Positive side of axis 1 (AREA 2)**
High annual mileage (AM4, AM5)	Low annual mileage (AM1, AM2)
Daily use of the vehicle	Non-intensive use of the vehicle
Driving experience (>10 years): (DE3)	Average driving experience (DE1 (<2 years); (DE2: [3.10[years)
The most serious traffic offenses	The least serious traffic offenses
Utility vehicle (UV)	Tourism vehicle
Drivers had at least 2 or more accidents (NC2, NC3, NC4)	The drivers had only one accident (NC1)
YDC : Reporting the claim to the insurer	NDC : failure to report the claim to the insurer

[2]For more details see appendix 4.
[3]For more details, see appendix 4.

Young drivers (<25 years and between [25 to 35 years]) recorded fewer accidents than adult drivers aged between (35 and 60 years). In addition, we can see that the probability of loss increases with the length of driving experience (DE3). So, the age of the drivers is strongly correlated with the seniority of the driving experience.

Also, the socio-professional categories "SPC" (for example: traders, free professions, etc.) who use "utility vehicles (seen)" are the most subject to claims compared to the use of "passenger vehicles (student, executive, etc.).

In fact, the probability of observing a claim for “Tourism vehicles (TV)” is lower than for “utility vehicles (UV)”. This analysis asserts that the SPC is an indicator of the level and type of travel of the insured. This information completes the “use of the vehicle” criterion. We find that the increase in the number of times a driver uses his car, increases the chance of suffering a claim. All of this gives us an illustrative explanation of the measurement of the frequency of claims, which is essentially linked to the categories that cover significant mileage (>20,000 km). Thus, the first axis makes it possible to highlight the opposition between low mileage and high mileage.

The number of traffic offenses accumulated in AREA 4 gives us an idea of the classification of drivers according to the degree of their driving behavior. Indeed, the more the driver commits violations several times, the more the probability of a claim increases. Furthermore, “NC3” and “NC4” drivers are those who have suffered three or more non-fatal claims. Thus, policyholders with serious claims where their liability is engaged and who have caused an accident by committing serious offenses such as: poor evaluation of speeds and distances and the most frequent offense with dangerous driving behavior (driving under the effect of alcohol, drowsiness, inattention, fatigue and aggressive driving, medication, illness, emotional stress, etc.).

Therefore, the occurrence of accidents is linked to the behavior of drivers and with the declaration of the number of accidents, which is linked especially to drivers who have suffered a lot of claims. For this, the least careful drivers must improve their driving behavior to reduce their accidents.

The second axis marks an opposition between the two modalities of the active variables (AREA 1) with the three modalities (AREA 3). Moreover, we can interpret axis 2 as being the axis of opposition between the category of policyholders who are the most satisfied with their insurers, compared to the others who are not satisfied. Consequently, axis 2 highlights the oppositions between “AREA 1” and “AREA 3”. (Table 6)

Table 6 *. Representation of active and additional modalities on axis 2*[4]

[4]For more details, see appendix 4.

Axis 2	
Negative side of axis 2 (AREA 3)	**Positive side of axis 2 (AREA 1)**
UNNSS : understanding of needs (neither satisfactory nor unsatisfactory)	UUN : understanding of needs (unsatisfactory)
SUN : understanding of needs (satisfactory)	UNVU : understanding of needs (very unsatisfactory)
NCI : policyholders who have not changed their insurer	YCI : policyholders who have changed their insurer.
Retired	
AC4 : over 60 years old	

Thus, retired represent the category that does not suffer claims. In the category of people over 60 years old, designate experienced drivers, they have fewer accidents.

The level of risk coverage is an important element that defines the relationship between the insurance company and its client. Indeed, AREA 1 gives us an idea of the categories of people who are more likely to change their insurance company (YCI). Moreover, the causes of this decision are mainly related to the lack of satisfaction of their needs. On the other hand, AREA 3 contains the categories of customers most loyal to their insurer (NCI).

In what follows, we proceed to the analysis of the projections of the active variables on the second plan to know the displacements of the modalities of the active variables.

4.3. INTERPRETATION OF THE SECOND FACTORIAL PLANE

We start with Table 7, which illustrates the strongest contributions of the active modalities, which are responsible for the construction of axis 3 and 4.

Table 7*. summary of contributions of active modalities on plan 2*[5]

Axis	Modalities with high CTR	CTR(%)		Modalities with high CTR	CTR(%)	
		Sign	Value		Sign	Value
Axis 3	YCI	-	7,20	NCI	+	1,24
Axis 4	DE1	+	5,97	DE3	-	4,25

A visualization of the contributions of the active modalities on the second plane allows us to identify the following interpretations:

- The third axis opposes two decisions. One is related to the change of the insurance company (CTR= 7.20%) and the other decision is related to the non-change of the insurer (CTR= 1.24%).

- Axis 4 puts the opposition of two modalities. One is the short drive experience (CTR=5.97%) and the other is the long drive experience (CTR=4.25%).

[5]For more details, see appendix 4.

In particular, appendix 3 represents the projections of the active and additional modalities, which are close to the origin.

From appendix 3, we find that most of the active modalities are close to the origin of the axes, i.e. a juxtaposition of most of the modalities. In addition, note that there is an association between these two modalities “Driving experience (>10 years)” and “TO3: category of traffic offences: never”. This shows that experienced and safe drivers on the road are less likely to have a traffic violation. In addition, we note from appendix 3 the connection between (DE2 (Average driving experience ([3.10] (years)) and CCVR. Indeed, the " CCVR " drivers have committed several offenses simultaneously and do not respect the highway code.

Similarly, a rapprochement between “free profession” and (“CCPD”: the use of telephones while driving). Thus, the risk of accident increases with the use of mobile phones while driving, for example (telephone conversation, listening to music, sending SMS and consulting emails, etc.). Moreover, these practices require more driver attention and contribute to the loss of driver attention.

And yet another comparison between “NC2” (the number of claims which is equal to 2) and “IV” (industrial van vehicle).

This makes it easier for us to observe the most significant factors in automobile accidents and also gives us an idea of the degree of severity of the driver's behavior at the wheel. In conclusion, lack of driving experience, lack of driving instruction, bad decision, speeding and excessive use of the telephone lead to non-respect of the road and therefore a great risk of disaster.

5. DISCUSSION

This article has studied the most significant factors of road accidents reported by policyholders. Similarly, we have developed a study on the behavior of drivers on the road. Finally, we underlined the level of their satisfaction with the coverage of the disaster carried out by their insurance companies in Tunisia.

By providing recent and detailed evidence on the factors of road accidents and on the satisfaction of their insurer's customers. A total of 300 policyholders were sampled using the Multiple Correspondence Analysis method.

The data from our study show that the occurrence of accidents is linked to driver behavior (compliance with road rules, lack of concentration, fatigue and drowsiness, aggressive driving and driving under the influence of alcohol, etc.). This is in line with previous studies (Klinjun et al., 2021; Sanyang et al., 2017; Rolison et al., 2018; Talukder et al., 2022) which also found that the main factors of road accidents are mainly related to human errors.

The distribution of policyholders according to their driving experience implies that the majority of respondents have driving experience, more than 10

years; they represent almost 50% of the total. The other predominant segment is that made up of people whose experience is between 3 and 10 years. This segment covers (35.66%) of the sample and lastly come people whose driving experience is less than 2 years. Thus, in our study, the probability of loss increases with the length of driving experience. This observation coincides with the study of Mekonnen et al. (2019). This author confirmed that drivers with less driving experience since their first driving license were more likely to engage in risky driving behaviors than those with long driving experience.

We note that almost half of the respondents (45%) recorded traffic offenses several times. Even more, we find (26%) who recorded just one traffic violation. On the other hand, the rest of the policyholders questioned (29%) did not record any offence. This analysis allows us to see that the level of traffic violations is too high. So, the accumulation of even minor offenses reveals dangerous behavior. This result is consistent with the authors' study (Agarwal et al., 2020).

The number of kilometers traveled is one of the most important characteristics of the vehicle. It appears that the first intervals of annual mileage are the least declared according to the interviewers (8.66%), while the other 4 intervals are similar (20.33%, 21% and 29%). This observation is similar to that of Mekonnen et al. (2019).

The results of our study revealed that the probability of observing a loss for passenger vehicles is lower than for utility vehicles. This result is consistent with the authors' previous work. (Graa et al., 2017)

Majorities of respondents confirmed that they have no intention of changing their current insurance company. Indeed, (85.33%) of policyholders refuse to change their insurer. While (14.66%) of customers accept the change of their insurer. In the same context, the study of Maseke and Iipinge (2021) discovers that various participants were satisfied with their insurers and that they had never intended to change their insurance companies.

Overall, (46%) and (4.66%) of policyholders say they are very satisfied or satisfied with the quality of understanding of their needs, while just (7.33%) and (3.33%) of policyholders are not satisfied with the quality of services provided by these agencies. The rest of the sample (38.66%) clearly states that they are neither satisfied nor dissatisfied with their insurance company.

We have observed that the sources of satisfaction for policyholders are essentially linked to the management of claims, the damage of which is quickly assessed and quickly repaired, as well as the speed, the time taken to obtain the payment of indemnities, the professionalism, the reliability and the quality of service offered from the assurance. Hence, the primary cause of satisfaction for the insured is the coverage of risk and damage. Similarly, Graa et al. (2017); Getachew

(2019) ; Vazifehdust and Farokhian (2013) and Manoabe et al.(2020) confirmed these different criteria of customer satisfaction towards their insurance company.

6. CONCLUSION

This descriptive analysis of the Tunisian car insurance market has shown us that traffic accidents pose a great threat to this branch. Indeed, we have found that this scourge is one of the main causes of auto insurance deficit and also it has a negative impact on the cost of insurance and on insurers. Thus, the loss experience in automobile insurance is measured according to the frequency of accidents. Certainly, the determination of the factors that contribute to explaining the loss experience makes it possible to improve the automobile insurance sector.

For insurers, these factors allow them to construct risk classes, segment their portfolio and prioritize these classes using loss indicators, such as the pure premium. Indeed, after several tests of Multiple Correspondence Analysis on our database, we identified seven relevant active variables and six additional variables.

Thus, on the one hand, the probability of loss increases with characteristics linked to drivers or with vehicle characteristics, for example: driving experience, the category of vehicle and its use and therefore the probability of accidents increases with the class of insured.

On the other hand, the level of risk coverage, which is based on the amount of the premium paid, is an important element that defines the relationship between the insurance company and its client.

In future work, we propose to generate successive surveys on all insurance companies in Tunisia in order to observe the behavior of the insured, by implementing new control techniques to reduce the risk of claims.

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***APPENDIX 1**: QUESTIONNAIRE*

Q1 : Are you?

A man	1
A woman	2

Q2 : What is your age?

Under 25	1
Between 25 and 35 years old	2
Between 35 and 60 years old	3
over 60 years old	4

Q3 : What is your marital status?

Single	1
Married	2

Q4 : What is your socio-professional category?

Employee	1
free profession	2
Trader	3
Worker	4
Farmer	5
frame	6
Professor or teacher	7
Artisan	8
student	.9
Retired	10

Q 5 : Where do you live (region) ?

Internal region	1
coastal region	2
northern region	3
Southern region	4

Q 6 : How can you rate your driving experience?

Less than 2 years old	1
Between 3 years and 10 years	2

If YES: answer the questions (Q16 → Q 24).
If NO: go directly to the questions (25 → Q 28).

Q16 : Give us the number of claims

1	1
2	2
3	3
More	4
Not sinister	5

Q17 : When did the disaster occur?

Morning	1
midday	2
Evening	3

Q 18: Can you specify the day of the accident?

During the week	1
In Week-end	2

Q 19: Can you specify the place of the accident?

local road	1
Regional road	2
National road	3

Q 20: What do you think is (are) the cause(s) of the accident??

Excess speed	1
Violation of the rules of the road	2
Lack of concentration (fatigue and drowsiness…))	3
Driving under the influence of alcohol	4
Phone use while driving	5
Aggressive driving	6

Q21: What type of damage is most often reported?

Materials	1
corporal	2

More than 10 years	3

Q 7: How old is your vehicle?

New	1
Between 1 or 2 years of age	2
Between 3.4 or 5 years old	3
Between 6, 7.8 or 9 years old	4
10 years or older	5

Q 8 : How often do you use your vehicle ?

Daily	1
almost daily	2
less frequently	3
only on weekends	4
rarely used	5

Q 9 : What category does your vehicle belong to?

Tourism vehicle	1
utility vehicle	2
public transportation vehicle	3
Industrial vehicle: pick-up truck	4

Q 10 : What mileage do you probably do per year?

< 5000 km	1
5000 km → 10000 km	2
10000 km → 15000 km	3
15000 km → 20000 km	4
>20000 km	5

Q 11 : What is the power of your vehicle?

<= 9 horses	1
>9 horses	2

Q 12 : What is the risk coverage you have chosen?

Q 22: Were you responsible for the accident?

at fault	1
Not at fault	2
Shared responsibility	3

Q 23 : What was the amount of compensation you received?

Equal to the amounts of damage declared	1
Lower than the declared damage amounts	2
No compensation	3

Q 24: What do you think of the compensation you received?

Very insufficient	1
insufficient	2
Neither satisfactory, nor unsatisfactory	3
Satisfactory	4
Very Satisfactory	5

Q25: How many times have you renewed your insurance contract?

once	1
Manny times	2
Never	3

Q 26: Did you change your insurer?

yes	1
No	2

Q 27 : How can you qualify the understanding of your needs by the insurance company to which you belong? :

Very Satisfactory	1
Unsatisfactory	2
Neither satisfactory, nor unsatisfactory	3
Satisfactory	4
Very Satisfactory	5

Defense and appeals	1
Complete third	2
Fire	3
robbery	4
Damage and collision	5
icebreaker	6

Q13 : How much do you pay as annual premium amount?

200d → 600d	1
600d → 1000d	2
1000 → 2000d	3
more	4

Q 14 : How many times you have committed a traffic offense?

once	1
Many times	2
never	3

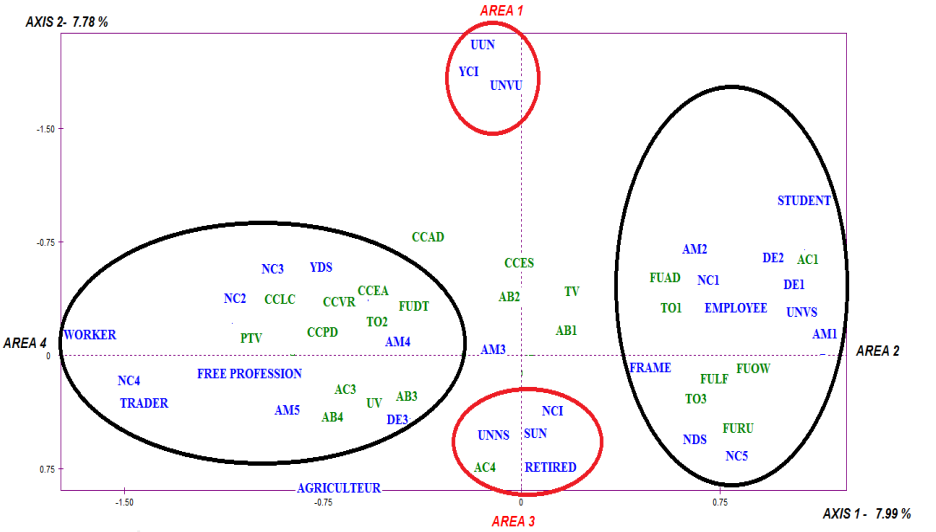
Q15: Have you had any previously declared claims?

yes	1
No	2

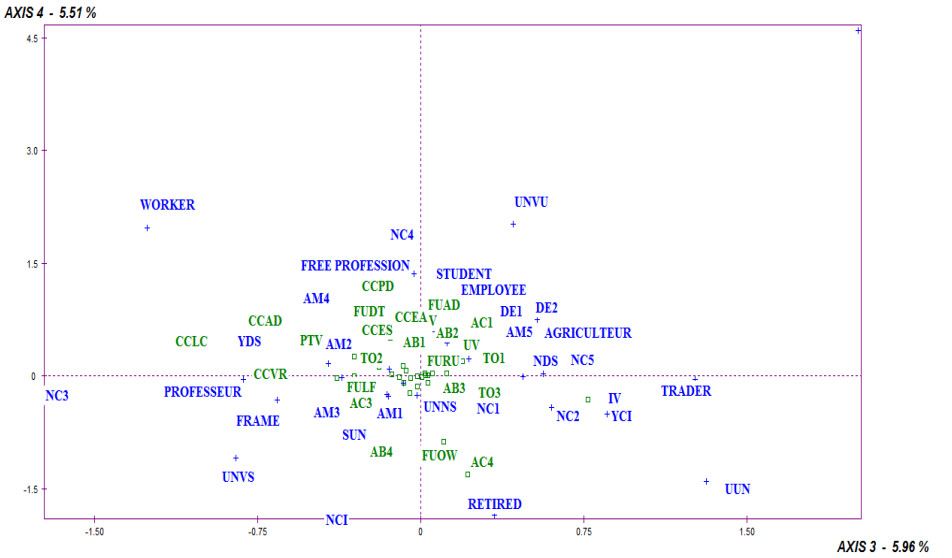
Q 28: Do you plan to change your insurer??

yes	1
No	2

***APPENDIX 2**. REPRESENTATION OF ACTIVE MODALITIES AND ADDITIONAL ON PLAN 1*



***APPENDIX 3.** SIMULTANEOUS REPRESENTATION OF ACTIVE AND ADDITIONAL MODALITIES ON PLAN 2*



APPENDIX 4

Coordinates of Active Modalities								
Label	**Relative weight**	**Origin distance**	**Axis 1**	**Axis 2**	**Axis 3**	**Axis 4**	**Axis 5**	**Axis 6**
SOCIO-PROFESSIONAL CATEGORY								
Employee	2,095	5,81818	0,75	-0,19	0,22	0,22	-0,45	-0,71
free profession	3,952	2,61446	-0,43	0,16	-0,08	-0,09	0,52	-0,44
Trader	1,429	9,00000	-0,99	0,23	1,26	-0,05	-0,18	-0,25
Worker	0,190	74,00000	-1,73	-0,12	-1,26	1,97	-1,25	-0,35
Farmer	0,619	22,07690	-0,72	0,87	0,75	0,24	1,17	0,39
frame	2,238	5,38298	0,19	0,07	-0,66	-0,33	-0,64	-0,23
Professor or teacher	1,571	8,09091	0,09	-0,06	-0,82	-0,04	-0,76	1,30
artisan	0,143	99,00000	0,07	-0,98	2,01	4,60	-2,11	1,74
student	1,381	9,34483	1,21	-1,09	0,06	0,59	1,00	0,49
Retired	0,667	20,42860	0,09	0,76	0,34	-1,86	0,32	1,44
DRIVING EXPERIENCE								
(DE1) less than 2 years old	2,095	5,81818	1,07	-0,68	0,54	0,75	0,68	0,20
(DE2) between 3 and 10 years	5,095	1,80374	0,16	-0,30	-0,43	0,17	-0,47	-0,24
(DE3) More than 10 years	7,095	1,01342	-0,43	0,42	0,15	-0,34	0,14	0,11
ANNUAL MILEAGE								
AM1 (< 5000 km)	1,238	10,53850	1,14	-0,01	-0,15	-0,27	0,67	-1,46
AM2 (5000 km → 10000 km)	3,000	3,76190	0,83	-0,29	-0,02	-0,26	0,34	0,77
AM3 (10000 km → 15000 km)	4,143	2,44828	-0,12	-0,02	-0,16	-0,25	-0,56	0,42
AM4 (15000 km → 20000 km)	3,000	3,76190	-0,44	-0,05	-0,40	0,49	-0,65	-0,45
AM5 (>20000 km)	2,905	3,91803	-0,72	0,40	0,72	0,22	0,83	-0,32
DECLARED CLAIM								
Declared claim yes (YDS (yes)	8,667	0,64835	-0,42	-0,36	-0,36	-0,02	0,21	0,08
Declared claim no (NDS (No)	5,619	1,54237	0,65	0,56	0,56	0,03	-0,32	-0,12
NUMBER OF CLAIMS								
NC1 (A single disaster)	6,333	1,25564	0,17	-0,46	-0,33	-0,07	0,35	0,05
NC2 (Two claims)	2,048	5,97674	-1,09	-0,23	0,60	-0,42	-0,42	0,46
NC3 (Three claims)	0,619	22,07690	-0,58	-0,38	-1,72	-0,24	-0,02	-1,40
NC4 (More than	1,095	12,04350	-	0,17	-0,03	1,36	0,46	-0,04

three claims)			1,50					
NC5 (Not sinister)	4,190	2,40909	0,76	0,81	0,47	-0,01	-0,44	-0,09
UNDERSTANDING OF NEED								
UNVU (very Unsatisfactory)	0,476	29,00000	-0,12	-1,65	0,43	2,02	0,18	1,36
UUN (Unsatisfactory)	1,048	12,63640	-0,26	-2,11	1,31	-1,40	-0,73	-0,60
UNNSS (Neither satisfactory, nor unsatisfactory)	5,524	1,58621	-0,08	0,14	0,12	0,44	-0,19	-0,24
SUN (Satisfactory)	6,571	1,17391	0,02	0,36	-0,25	-0,18	0,17	0,31
UNVS (Very Satisfactory)	0,667	20,42860	0,99	-0,20	-0,85	-1,09	0,85	-1,08
CHANGE OF INSURER								
YCI (yes)	2,095	5,81818	-0,28	-1,74	0,86	-0,50	-0,30	-0,20
NCI (No)	12,191	0,17188	0,05	0,30	-0,15	0,09	0,05	0,03

Contributions from active modalities								
Label	**Relative weight**	**Origin distance**	**Axis 1**	**Axis 2**	**Axis 3**	**Axis 4**	**Axis 5**	**Axe 6**
SOCIO-PROFESSIONAL CATEGORY								
Employee	2,095	5,81818	4,13	0,27	0,47	0,53	2,26	5,68
free profession	3,952	2,61446	2,59	0,37	0,12	0,17	5,53	4,22
Trader	1,429	9,00000	4,87	0,26	10,63	0,02	0,24	0,49
Worker	0,190	74,00000	1,99	0,01	1,42	3,77	1,55	0,13
Farmer	0,619	22,07690	1,13	1,68	1,62	0,17	4,45	0,51
frame	2,238	5,38298	0,29	0,04	4,61	1,21	4,74	0,63
Professor or teacher	1,571	8,09091	0,05	0,02	4,92	0,01	4,71	14,46
artisan	0,143	99,00000	0,00	0,49	2,71	15,36	3,32	2,34
student	1,381	9,34483	7,14	5,91	0,03	2,44	7,21	1,79
Retired	0,667	20,42860	0,02	1,37	0,36	11,67	0,35	7,52
DRIVING EXPERIENCE								
DE1 (less than 2 years old)	2,095	5,81818	8,37	3,52	2,82	5,97	5,01	0,44
DE2 (between 3 and 10 years)	5,095	1,80374	0,44	1,68	4,36	0,75	5,82	1,57
DE3 (More than 10 years)	7,095	1,01342	4,57	4,48	0,73	4,25	0,69	0,49
ANNUAL MILEAGE								
AM1 (< 5000 km)	1,238	10,53850	5,61	0,00	0,13	0,45	2,92	14,39
AM2 (5000 km → 10000 km)	3,000	3,76190	7,18	0,92	0,01	1,02	1,84	9,81
AM3 (10000 km → 15000 km)	4,143	2,44828	0,20	0,01	0,47	1,26	6,91	4,01
AM4 (15000 km → 20000 km)	3,000	3,76190	2,01	0,03	2,26	3,70	6,60	3,28
AM5 (>20000 km)	2,905	3,91803	5,28	1,63	7,06	0,73	10,60	1,59
DECLARED CLAIM								
Declared claim yes (YDS (yes)	8,667	0,64835	5,39	4,04	5,39	0,02	1,96	28
Declared claim no (NDS (No)	5,619	1,54237	8,31	6,23	8,31	0,03	3,02	43
NUMBER OF CLAIMS								
NC1 (A single disaster)	6,333	1,25564	0,61	4,72	3,26	0,15	4,10	09
NC2 (Two claims)	2,048	5,97674	8,57	0,39	3,47	1,81	1,90	41
NC3 (Three claims)	0,619	22,07690	0,73	0,32	8,56	0,18	0,00	65
NC4 (More than three claims)	1,095	12,04350	8,62	0,12	0,01	10,35	1,23	01
NC5 (Not sinister)	4,190	2,40909	8,50	9,94	4,33	0,00	4,32	17
UNDERSTANDING OF NEED								
UNVU (very Unsatisfactory)	0,476	29,00000	0,03	4,67	0,41	9,86	0,08	30
UUN (Unsatisfactory)	1,048	12,63640	0,25	16,73	8,49	10,38	2,89	03
UNNSS (Neither satisfactory, nor unsatisfactory)	5,524	1,58621	0,12	0,38	0,37	5,44	1,01	69
SUN (Satisfactory)	6,571	1,17391	0,01	3,05	2,00	1,12	1,04	33
UNVS (Very Satisfactory)	0,667	20,42860	2,30	0,10	2,27	4,02	2,54	22
CHANGE OF INSURER								
YCI (yes)	2,095	5,81818	0,58	22,70	7,20	2,68	0,97	47
NCI (No)	12,191	0,17188	0,10	3,90	1,24	0,46	0,17	08

Squared cosines of the active modalities

Label	Relative weight	Origin distance	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6
SOCIO-PROFESSIONAL CATEGORY								
Employee	2,095	5,81818	0,10	0,01	0,01	0,01	0,04	0,09
free profession	3,952	2,61446	0,07	0,01	0,00	0,00	0,10	0,07
Trader	1,429	9,00000	0,11	0,01	0,18	0,00	0,00	0,01
Worker	0,190	74,00000	0,04	0,00	0,02	0,05	0,02	0,00
Farmer	0,619	22,07690	0,02	0,03	0,03	0,00	0,06	0,01
frame	2,238	5,38298	0,01	0,00	0,08	0,02	0,08	0,01
Professor or teacher	1,571	8,09091	0,00	0,00	0,08	0,00	0,07	0,21
artisan	0,143	99,00000	0,00	0,01	0,04	0,21	0,04	0,03
student	1,381	9,34483	0,16	0,13	0,00	0,04	0,11	0,03
Retired	0,667	20,42860	0,00	0,03	0,01	0,17	0,00	0,10
DRIVING EXPERIENCE								
(DE1) less than 2 years old	2,095	5,81818	0,20	0,08	0,05	0,10	0,08	0,01
(DE2) between 3 and 10 years	5,095	1,80374	0,01	0,05	0,10	0,02	0,12	0,03
(DE3) More than 10 years	7,095	1,01342	0,18	0,17	0,02	0,12	0,02	0,01
ANNUAL MILEAGE								
AM1 (< 5000 km)	1,238	10,53850	0,12	0,00	0,00	0,01	0,04	0,20
AM2 (5000 km → 10000 km)	3,000	3,76190	0,18	0,02	0,00	0,02	0,03	0,16
AM3 (10000 km → 15000 km)	4,143	2,44828	0,01	0,00	0,01	0,02	0,13	0,07
AM4 (15000 km → 20000 km)	3,000	3,76190	0,05	0,00	0,04	0,06	0,11	0,05
AM5 (>20000 km)	2,905	3,91803	0,13	0,04	0,13	0,01	0,18	0,03
DECLARED CLAIM								
Declared claim yes (YDS (yes)	8,667	0,64835	0,27	0,20	0,20	0,00	0,07	0,01
Declared claim no (NDS (No)	5,619	1,54237	0,27	0,20	0,20	0,00	0,07	0,01
NUMBER OF CLAIMS								
NC1 (A single disaster)	6,333	1,25564	0,02	0,17	0,09	0,00	0,10	0,00
NC2 (Two claims)	2,048	5,97674	0,20	0,01	0,06	0,03	0,03	0,04
NC3 (Three claims)	0,619	22,07690	0,02	0,01	0,13	0,00	0,00	0,09
NC4 (More than three claims)	1,095	12,04350	0,19	0,00	0,00	0,15	0,02	0,00
NC5 (Not sinister)	4,190	2,40909	0,24	0,27	0,09	0,00	0,08	0,00
UNDERSTANDING OF NEED								
UNVU (very Unsatisfactory)	0,476	29,00000	0,00	0,09	0,01	0,14	0,00	0,06
UUN (Unsatisfactory)	1,048	12,63640	0,01	0,35	0,14	0,15	0,04	0,03
UNNSS (Neither satisfactory, nor unsatisfactory)	5,524	1,58621	0,00	0,01	0,01	0,12	0,02	0,04
SUN (Satisfactory)	6,571	1,17391	0,00	0,11	0,06	0,03	0,03	0,08
UNVS (Very Satisfactory)	0,667	20,42860	0,05	0,00	0,04	0,06	0,04	0,06
CHANGE OF INSURER								
YCI (yes)	2,095	5,81818	0,01	0,52	0,13	0,04	0,02	0,01
NCI (No)	12,191	0,17188	0,01	0,52	0,13	0,04	0,02	0,01