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RESEARCH ARTICLE

ESTIMATION OF OUTSTANDING CLAIMS RESERVES OF TURKISH INSURANCE COMPANIES USING CHAIN LADDER METHOD

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ABSTRACT

Estimating the outstanding claims and funding appropriate reserves are among the most important obligations of insurance companies in order to compensate any possible damages. Outstanding claim reserves are calculated with potential estimations based on the historical data obtained from an insurance company. The estimation of outstanding claim payments is significant with regards to maintaining the financial balance of insurance companies. Literature covers several reserve methods and Chain Ladder method is the most commonly used and recognized method among them. This study aims to estimate the outstanding claim reserves using the Chain Ladder method on the claims payments of insurance companies operating in Turkey for a period between 2009 and 2014.

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INTRODUCTION

Outstanding claim stands for the approximate claim amount which most probably will be payable related to damages occurred and reported to the insurance company yet still not settled. Insurance companies determine a specific balance using several methods at the end of each fiscal year based on the total outstanding claims. This amount reserved for potential payments is called outstanding claims reserve. It is a must for insurance companies to properly assign the amount of claims reserve in order to reduce potential risks and to protect companies against unexpected damages. Insurance companies which focus on fields other than life insurance need to determine their future outstanding claims reserves in order to be able to assess their solvency (Verdonck and Wouwe, 2011). Insurance companies which focus on fields other than life insurance use several methods to estimate their outstanding claims reserves. These methods involve numerous options from stochastic models to deterministic techniques (Alba, 2008). The Cahin Ladder method is one of the most commonly used methods among insurance companies. This study used stochastic Chain Ladder method in order to estimate the outstanding claims reserves of Insurance companies which focus on fields other than life insurance.

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Data includes the claims payments of insurance companies operating in Turkey for a period between 2009 and 2014. Claims payments of Turkish insurance industry were addressed collectively. The data obtained was then used in the Chain Ladder method in order to estimate the future claims payments collectively.

Literature Survey

The Chain Ladder method is the most common method used in the estimation of outstanding claims. It is possible to see many studies using the Chain Ladder method in the literature. Kremer (1982) investigated the relationship between the linear method and the Chain Ladder method developing normal equations for the linear method. Furthermore, this study reported that the Chain Ladder method works in a log-linear cross-categorized structure. It was proved that the Chain Ladder and Multiplicative models are equivalents. Kremer (1985) reported that estimations of Maximum Possibility and the Chain Ladder methods were the same. Mack (1993) developed a method independent of the distribution in order to find the standard error of the Chain Ladder reserve estimates. This study proved the univariate Chain Ladder method. Schmidt and Schnaus (1996) built on Mack's model. Schmidt (1997, 1999) investigated the optimality of the estimators of the Chain Ladder for the accumulative claims size of the unobservable consecutive beginning years.

Verrall (2000) defined relationships between the Chain Ladder method and some stochastic models. This study suggested Poisson distribution for the claims amounts. Hess and Schmidt (2002) compared different models systematically for the Chain Ladder method. Braun (2004) investigated multivariate versions of the Chain Ladder model which is independent of the distribution. This study utilized classic (univariate) estimators. Schmidt (2006) used multivariate estimators in his study. Buchwalder *et al*. (2006) suggested different approaches to the estimation derivation for parameter standard error of estimate for the distribution-free Chain Ladder method.

MerzandWüthrich (2008) obtained mean squared error of estimators for portfolios with different correlations. Peters *et al*. (2010) estimated outstanding claims reserves using distribution-free Chain Ladder method. Zhang (2010) compared univariate stochastic reserve model with multi-variate Chain Ladder model. This study proved that multivariate stochastic reserve models allowed for structural connections between triangles and the superiority of multivariate Chain Ladder method. Verdonck and Wouwe (2011) developed univariate Chain Ladder method as an addition to the multi-variate Chain Ladder method of Merz and Wüthrich (2008). Riegel (2014) estimated the outstanding claims reserves in Germany using stochastic Chain Ladder method. Heberle and Thomas (2014) developed the Chain Ladder method using fuzzy methods.

MATERIALS AND METHODS

The Chain Ladder method is a popular method used in outstanding claim reserves estimation (Verdonck and Debruyne, 2011). The Chain Ladder method is globally recognized and is widely used. As it offers easy application, researchers commonly use this method. This method utilizes any data available in the balance triangle and offers estimations for future accumulative claims amounts (Schmidt and Wünsche, 1998). Table 1 shows the balance triangle table with the cumulative claims amounts.

Table 1. Balance Triangle

Accident Period (*i*)	Development Periods (*j*)							
	0	1	2	3	4	.... *j*	....	J
0								
1								
.								
.								
.								
I+1-J	Observation values of $C_{i,j}$ *and* $X_{i,j}$ stochastic variables							
.	*i* +*j* ≤*I*							
.								
.								
i								
.								
.								
.								
I-2								
I-1								
I	Estimations of $C_{i,j}$ *and* $X_{i,j}$							

$X_{i,j}$, represents the claims arising from accidents occurred in *i* accident year which are paid in the *j* development year.

$C_{i,j}$ represents the cumulative denotation of the paid claims for each *i* accident year (Buchwalder *et al.,* 2006).

Parameters

İ: Based on the date the damage occurred i:0,.....,n
j:The time period following the basal date
j:0,.....,n
n:Period of observation (month, year..)
S_{ij}= The paid amount of claims in the $(i+j)^{th}$ period which was occurred in the i^{th} period (noncumulative)
C_{ij} = Cumulative claims amount which occurred in the i^{th} period and observed after a period of j

Transition coefficients are required in order to estimate the values shown in the right bottom part of the balance triangle using the Chain Ladder method. These transition coefficients are calculated using the formula below (England and Verrall, 1999).

Transition Coefficient

$$f_j = \frac{C_{0,j+1} + C_{1,j+1} + \cdots + C_{n-j-1,j+1}}{C_{0,j} + C_{1,j} + \cdots + C_{n-j-1,j}} = \frac{\sum_{i=0}^{n-j-1} X_{i,j+1}}{\sum_{i=0}^{n-j-1} X_{i,j}}$$

$$\boldsymbol{f}_{i,j} = \frac{\boldsymbol{C}_{i,j+1}}{\boldsymbol{C}_{i,j}}$$

f_i= amount of total cumulative claims in the period of *j*+1 / amount of cumulative paid claims for the period *j*

It is possible to estimate future claims using transition coefficients. The Chain Ladder method contributes to the insurance companies in monitoring if reserves are adequately funded for the outstanding claims. Advantages and disadvantages of the Chain Ladder method are as follows;

Advantages

- It is an objective method
- It does not utilize subjective expected claims ratios
- Regulators and tax authorities may prefer methods involving fewer actuarial assessments.

Disadvantages

- It may not always be possible to include amounts of claims for different periods into the process;
- It may provide inconsistent results due to changes in claims payment performance. For example, estimations of claims amounts will be higher when claims payment performance is increased;
- When no claims payments are made for that accounting year, then the payments are taken “zero”.

The claims amounts used in this study are obtained from loss reports of the Insurance Information Center of Turkey. Information which was not readily available in the loss reports were obtained from balance sheet annotations of the insurance companies operating in Turkey.

The total amount of claims insurance companies operating in fields other than life insurance face were found for a period between 2009 and 2014. The claim amounts were then converted into USD from TL. The conversion was based on the foreign exchange rate issued by the Central Bank of Turkey. Claims payments were converted into USD based on the year of transaction and the USD/TL exchange rate for that year. Table 2 shows the noncumulative claims payments between 2009 and 2014.

Table 2. Noncumulative Claims Payments (000 USD)

Accident Periods	Development Years					
	0	1	2	3	4	5
2009/1	295.098	585.409	105.963	28.127	18.775	12.892
2010/1	357.700	529.408	140.639	32.857	21.487	
2011/1	359.997	675.067	140.818	64.463		
2012/1	421.917	657.153	94.546			
2013/1	375.516	687.610				
2014/1	378.185					

As seen in Table 2, the amount of claims realized and paid in 2009 is $295.098.000. On the other hand, this number adds up to $12.892.000 in 2014. Other values are calculated similarly.

Table 3 shows the cumulative claims payments.

Table 3. Cumulative Claims Payments (000 USD)

Accident Periods	Development Years					
	0	1	2	3	4	5
2009/1	295.098	880.507	986.470	1.014.597	1.033.372	1.046.264
2010/1	357.700	887.108	1.027.747	1.060.604	1.082.091	
2011/1	359.997	1.035.064	1.175.882	1.240.345		
2012/1	421.917	1.079.070	1.173.616			
2013/1	375.516	1.063.126				
2014/1	378.185					

Cumulative claims amounts are calculated as follows (Table 2). For example;

For the accident period 2009/1 and for the development year 1: 880.507 $ = 295.098$ + 585.409$

For the accident period 2010/1 and for the development year 4: 1.082.091$ = 357.700$ + 529.408$ + 140.639$ + 32.857$ + 21.487$

Claims payments for the years after 2014 will be estimated using the Chain Ladder method based on the amounts of claims payments included in this study.

Empirical Findings

Necessary reserve amounts insurance companies will need to reserve for the following years were estimated based on the claims ratios obtained from a period between 2009 and 2014. Table 4 shows paid claims amounts and observed claims amounts. It was found that the observed claims amounts decreased when Table 4 is investigated for paid claims amounts and observed claims amounts for the years in question.

Table 5 shows the estimated noncumulative claims payments for future periods.

Table 4. Paid and Observed Claims Amounts

Accident periods	Development Years	S_{ij}	C_{ij}
0	0	295.098	12.595
0	1	585.409	13.280
0	2	105.963	11.571
0	3	28.127	10.244
0	4	18.775	9.840
0	5	12.892	9.464
1	0	357.700	12.787
1	1	529.408	13.180
1	2	140.639	11.854
1	3	32.857	10.400
1	4	21.487	9.975
2	0	359.997	12.794
2	1	675.067	13.423
2	2	140.818	11.855
2	3	64.463	11.074
3	0	421.917	12.953
3	1	657.153	13.396
3	2	94.546	11.457
4	0	375.516	12.836
4	1	687.610	13.441
5	0	378.185	12.843

Table 5. Noncumulative Claims Payments for Future Periods (000 USD)

Accident Periods	Development Years					
	0	1	2	3	4	5
2009/1						
2010/1						14.754
2011/1					42.592	29.246
2012/1				30.155	19.924	13.681
2013/1			135.430	43.852	28.951	19.879
2014/1		654.876	128.983	41.765	27.573	18.933

According to Table 5, the amount of claims incurred in 2010 and which are due to be paid until 2015 is $14.754.000. The claims amount of $42.592.000 and $29.246.000 incurred in 2011 are due to be paid until 2015 and 2016, respectively. The claims amount of $30.155.000 which is incurred in 2012 needs to be paid until 2015, claims amount of $19.924.000 needs to be paid until 2016 and claims amount of $13.681.000 needs to be paid until 2017.

The claims amount of $135.430.000 which is incurred in 2013 needs to be paid until 2015, claims amount of $43.852.000 needs to be paid until 2016 and claims amount of $28.951.000 needs to be paid until 2017. The claims amount of $654.876.000 which is incurred in 2014 needs to be paid until 2015, claims amount of $128.983.000 needs to be paid until 2016, claims amount of $41.765.000 needs to be paid until 2017, claims amount of $27.573.000 needs to be paid until 2018, and claims amount of $18.933.000 needs to be paid until 2019.

Table 6 shows the outstanding claims reserves estimations of insurance companies for a period between 2015 and 2019.

Table 6. Estimated Outstanding Claims Reserves

Accident Periods	2015	2016	2017	2018	2019
	14.754				
Calculated Amount of	42.592	29.246			
Reserves	30.155	19.924	13.681		
	135.430	43.852	28.951	19.879	
	654.876	128.983	41.765	27.573	18.933
Total	877.807	222.005	84.397	47.452	18.933

Insurance companies need to pay a sum of $877.807.000 until 2015. They need to pay a sum of $222.005.000 until 2016. They need to pay a sum of $84.397.000 until 2017. They need to pay a sum of $47.452.000 until 2018 and a sum of $18.933.000 until 2019. A sum of $1.250.594.000 should be funded as outstanding claims reserves in order for insurance companies to be able to pay the total claim amounts after 2014. Table 7 shows the cumulative claims payments calculated for the future periods.

Table 7. Cumulative Claims Payments for Future Periods (000 USD)

Accident Periods	Development Years					
	0	1	2	3	4	5
2009/1						
2010/1						1.095.590
2011/1					1.264.409	1.280.183
2012/1				1.219.767	1.243.432	1.258.945
2013/1			1.195.125	1.242.122	1.266.221	1.282.018
2014/1		1.033.061	1.161.328	1.206.996	1.230.414	1.245.764

According to Table 7, the sum of $1.033.061.000 represents the cumulative claims incurred in 2014 and due to be paid until 2015.The outstanding claims payment of $1.245.764.000 needs to be paid until 2019. This amount is significantly similar to the amount calculated for noncumulative payments ($1.250. 594.000). Insurance companies will need to fund their outstanding claims reserves in accordance with this number.

Conclusion

Insurance contracts are written agreements signed between the insurance company and the insured. One who purchases an insurance policy as a result of such a contract transfers part of its risks to the insurance company. The insurer is obliged to protect the insured while the insured is obliged to pay a specified premium to the insurance company. The funds reserved against possible claims payments which may incur in the future are called claims reserves and it is of utmost importance for the insurance company to be able to determine the amount of claims reserves. Among the most challenging questions asked in practice, one of them comes into prominence which is the question of which dataset and which method is to be use in order to accurately estimate the future liabilities, i.e. reserves. Literature offers several methods for outstanding claims reserves estimations. The Chain Ladder method is most commonly preferred by insurance companies as it is easy to understand and apply. As some losses are now being processed based on statements in Turkey, a significant claim increase has occurred in Traffic Insurance segment. This study focused on the estimated amount of reserves insurance companies need to fund for future claims and outstanding claims amounts based on any policy year. Outstanding claims reserves were estimated prospectively based on the claims payments insurance companies operating in Turkey have made. The data used in this study involved the claims amounts paid between 2009 and 2014. It is a must for insurance companies to maintain their outstanding claims reserves at an adequate level based on the amounts calculated in this study. According to the outstanding claims reserves calculated using the claims payments insurance companies operating in Turkey has made, the total sum which needs to be paid by 2019 is $1.250.594.000.

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