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Bonus-malus system in Armenia

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Introduction: Bonus-Malus system in the Armenian MTPL market

- *This paper examine the Bonus-Malus system in the Armenian MTPL market and propose a more relevant model that considers both the frequency and severity of claims*
- *Old Bonus-Malus system in Armenia has experienced disequilibrium, leading to significant financial losses for insurance companies*

BACKGROUND

- *Bonus-Malus system in Armenia operates on the principle that safe drivers/policyholders should pay lower premiums compared to high-risk drivers/policyholders.*
- *BM system utilized a scale of values ranging from 0 to 22, with a policyholder starting at the base level of 10.*
- *The system initially assigned 4 malus classes for each claim made by policyholder*
- *The Bonus-Malus system in Armenia has become imbalanced, over the last 4-5 years resulting in a 93.6% disequilibrium in 2021*

Propose of New Model

- *The new Bonus-Malus system has been modeled as a Markov chain with a finite state space from 1 to 25.*
- *For each claim, policyholders receive 3-8 malus classes based on the compensation amount*
- *In contrast to the old system, the new model's malus classes are also connected to the claim size*
- *Markov chain was utilized to test its equilibrium over a 10-year period.*

P probability matrix C class matrix

- *P probability matrix for different claim sizes over a 1-year period*
- *C class matrix for different claim sizes, indicating class changes for each claim*

Probability of claim in one year

	0-250$	250-500$	500-1000$	1000-2500$	2500-4000$	4500$ AND MORE
No claim	88.475%					
1 claim	5.597%	1.912%	1.795%	0.677%	0.309%	0.072%
2-nd claim	0.535%	0.203%	0.156%	0.060%	0.035%	0.007%
3-nd claim	0.075%	0.030%	0.018%	0.006%	0.003%	0.001%
4-nd claim	0.013%	0.006%	0.004%	0.001%	0.000%	0.000%
5-nd claim	0.003%	0.002%	0.001%	0.000%	0.000%	0.000%
6-nd claim	0.002%	0.000%	0.000%	0.000%	0.000%	0.000%
7-nd claim	0.001%	0.000%	0.000%	0.000%	0.000%	0.000%

Class changes for a claim

	0-250$	250-500$	500-1000$	1000-2500$	2500-4000$	4500$ AND MORE
No claim	-1					
1 claim	3	4	5	6	7	8
2-nd claim	3	4	5	6	7	8
3-nd claim	3	4	5	6	7	8
4-nd claim	3	4	5	6	7	8
5-nd claim	3	4	5	6	7	8
6-nd claim	3	4	5	6	7	8
7-nd claim	3	4	5	6	7	8

Probabilities for Policyholders in Class 1

- ***P probability matrix for different claim sizes over a 1-year period for Policyholders in Class 1***

Probability of claim in one year						
	0-250$	250-500$	500-1000$	1000-2500$	2500-4000$	4500$ AND MORE
No claim	99.14%					
1 claim	0.44%	0.21%	0.10%	0.07%	0.02%	0.00%
2-nd claim	0.012%	0.006%	0.006%	0.00%	0.00%	0.00%
3-nd claim	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4-nd claim	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
5-nd claim	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6-nd claim	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
7-nd claim	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

We can derive the following probabilities for policyholders in the 1st class transitioning to other classes.

1	99.1413 %
2	0.0000%
3	0.0000%
4	0.4440%
5	0.2045%
6	0.0993%
7	0.0763%
8	0.0235%
9	0.0059%
10	0.0031%
11	0.0014%
12	0.0006%
13	0.0001%
14	0.0000%
15	0.0000%
16	0.0000%
17	0.0000%
18	0.0000%
19	0.0000%
20	0.0000%
21	0.0000%
22	0.0000%

P probability matrix for other classes

- ***P probability matrix for different claim sizes over a 1-year period for Policyholders in Class 10***

Probability of claim in one year for policyholders in 10-th class						
	0-250$	250-500$	500-1000$	1000-2500$	2500-4000$	4500$ AND MORE
No claim	82.660%					
1 claim	8.4174%	2.9290%	2.7049%	1.0334%	0.5781%	0.0000%
2-nd claim	0.7779%	0.2940%	0.2070%	0.0942%	0.0614%	0.0000%
3-nd claim	0.1199%	0.0385%	0.0271%	0.0071%	0.0043%	0.0000%
4-nd claim	0.0257%	0.0029%	0.0029%	0.0014%	0.0014%	0.0000%
5-nd claim	0.0043%	0.0014%	0.0014%	0.0014%	0.0000%	0.0000%
6-nd claim	0.0014%	0.0000%	0.0014%	0.0000%	0.0000%	0.0000%
7-nd claim	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%

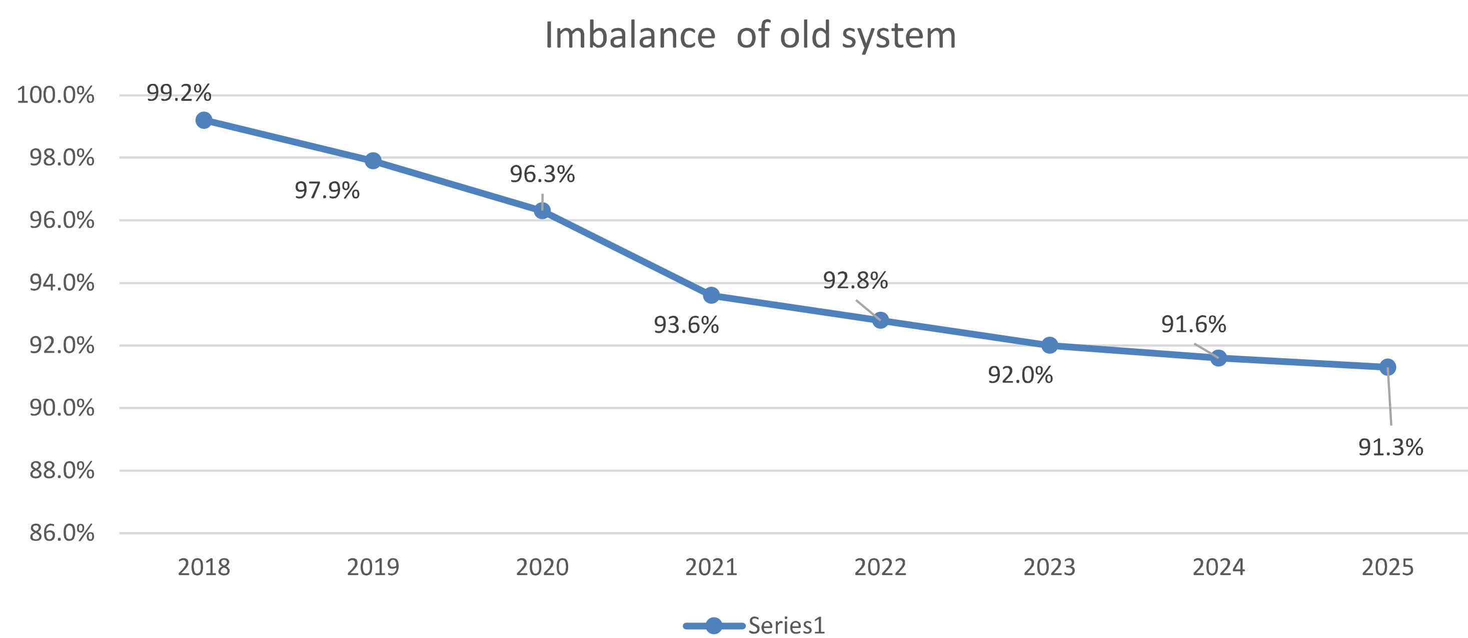
- ***P probability matrix for different claim sizes over a 1-year period for Policyholders in Class 22***

Probability of claim in one year for policyholders in 22-th class						
	0-250$	250-500$	500-1000$	1000-2500$	2500-4000$	4500$ AND MORE
No claim	55.061%					
1 claim	16.478%	5.6612%	4.5239%	1.2384%	0.8593%	0.0000%
2-nd claim	5.4085%	2.0471%	1.3142%	0.4044%	0.2275%	0.0000%
3-nd claim	1.6175%	0.5307%	0.4296%	0.1769%	0.0253%	0.0000%
4-nd claim	0.4549%	0.2527%	0.1769%	0.0505%	0.0253%	0.0000%
5-nd claim	0.1516%	0.1011%	0.0253%	0.0000%	0.0253%	0.0000%
6-nd claim	0.1011%	0.0505%	0.0000%	0.0000%	0.0000%	0.0000%
7-nd claim	2.5805%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%

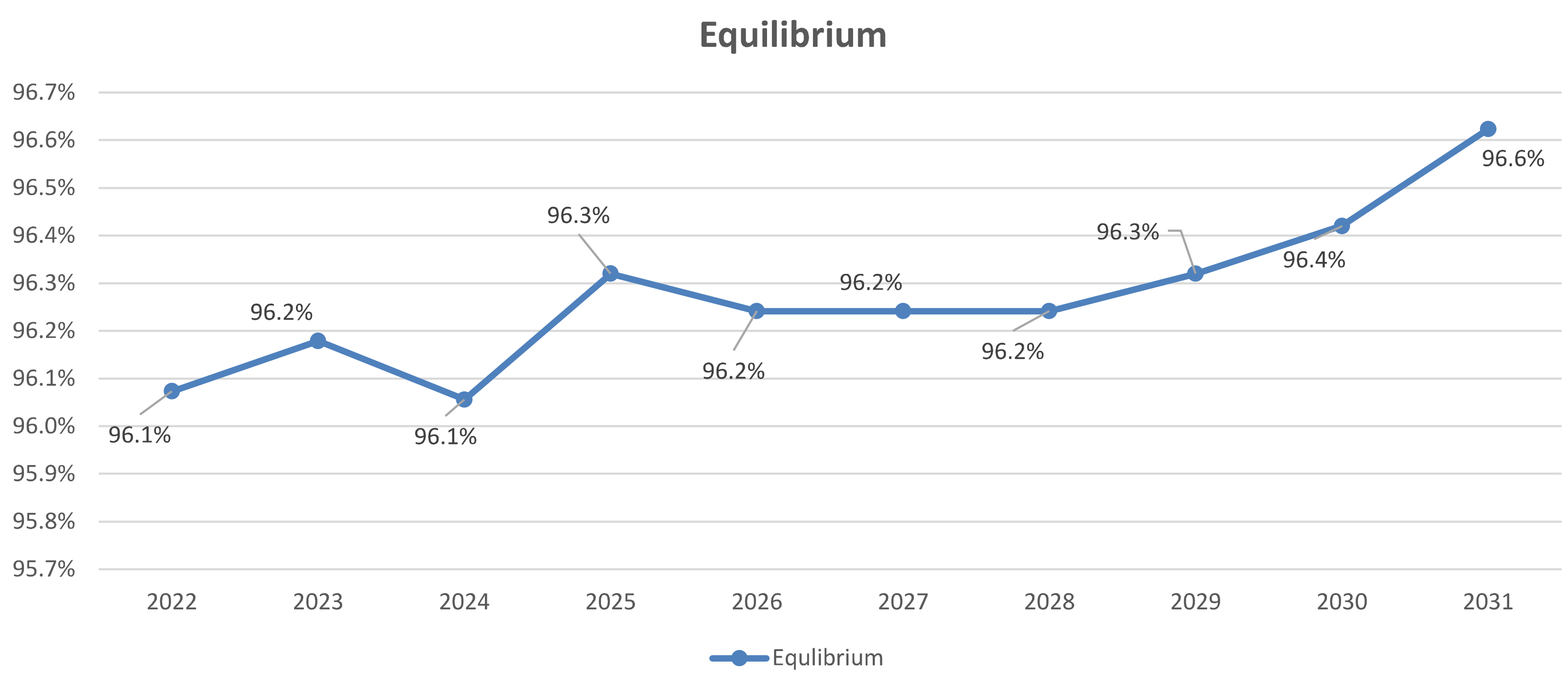
Ph_{ij} matrix, transition probabilities

	New class after one year																								
Initial class	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	99.1%	0.0%	0.0%	0.4%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2	97.1%	0.0%	0.0%	0.0%	1.4%	0.5%	0.5%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
3	0.0%	95.8%	0.0%	0.0%	0.0%	2.2%	0.7%	0.7%	0.3%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
4	0.0%	0.0%	94.9%	0.0%	0.0%	0.0%	2.7%	0.9%	0.8%	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5	0.0%	0.0%	0.0%	91.4%	0.0%	0.0%	0.0%	4.6%	1.5%	1.4%	0.7%	0.3%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
6	0.0%	0.0%	0.0%	0.0%	89.7%	0.0%	0.0%	0.0%	5.3%	1.6%	1.7%	0.8%	0.5%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
7	0.0%	0.0%	0.0%	0.0%	0.0%	90.6%	0.0%	0.0%	0.0%	4.9%	1.6%	1.5%	0.7%	0.4%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
8	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	89.7%	0.0%	0.0%	0.0%	5.3%	1.7%	1.6%	0.9%	0.5%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
9	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	88.9%	0.0%	0.0%	0.0%	5.6%	1.8%	1.7%	0.9%	0.5%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	82.7%	0.0%	0.0%	0.0%	8.4%	2.9%	2.7%	1.5%	0.9%	0.3%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%
11	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	84.3%	0.0%	0.0%	0.0%	6.9%	2.6%	2.7%	1.3%	0.9%	0.4%	0.3%	0.2%	0.1%	0.1%	0.0%	0.0%
12	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	84.5%	0.0%	0.0%	0.0%	7.4%	2.4%	2.3%	1.3%	0.8%	0.4%	0.3%	0.2%	0.1%	0.1%	0.1%
13	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	83.6%	0.0%	0.0%	0.0%	7.4%	2.7%	2.3%	1.5%	1.1%	0.4%	0.8%	0.2%	0.1%	0.1%
14	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	79.3%	0.0%	0.0%	0.0%	8.7%	3.1%	2.8%	2.1%	1.5%	2.5%	0.6%	0.5%	0.6%
15	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	82.4%	0.0%	0.0%	0.0%	7.0%	3.5%	2.7%	1.5%	1.1%	0.5%	0.4%	0.8%
16	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	81.7%	0.0%	0.0%	0.0%	7.6%	2.7%	3.1%	4.8%	1.0%	0.6%	1.3%
17	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	78.8%	0.0%	0.0%	0.0%	8.4%	3.0%	9.8%	2.2%	1.6%	2.9%
18	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	73.3%	0.0%	0.0%	0.0%	10.3%	16.3%	3.6%	2.4%	6.2%
19	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	77.8%	0.0%	0.0%	0.0%	22.2%	3.7%	3.9%	6.7%
20	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	69.6%	0.0%	0.0%	30.4%	13.4%	6.1%	10.5%
21	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	71.9%	0.0%	28.1%	0.0%	11.0%	16.9%
22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	55.1%	0.0%	0.0%	0.0%	44.9%
23	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
24	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Imbalance of old system



Equilibrium of new system



Discussion

- *This balance will be achieved by appropriately aligning premiums with individual driving behaviors and the level of risk*
- *drivers who consistently demonstrate safe driving habits will be rewarded with lower premiums, while those who engage in risky behaviors will face the appropriate financial consequences.*
- *The new model will have positive implications for insurance companies. By encouraging safer driving practices, insurance companies can expect a reduction in the frequency and severity of claims, leading to improved profitability and sustainability in the long run.*
- *It promotes fairer sentences by linking premiums to individual driving behaviors, encourages safer driving practices, and provides a practical solution for addressing small damages.*

Conclusion

- *The paper has proposed a more relevant Bonus-Malus system for the Armenian MTPL market by considering both the frequency and severity of claims.*
- *The results demonstrate that the new model maintains equilibrium over a 10-year period.*
- *The implementation of this new system is expected to address the disequilibrium issue and provide a fair and balanced system for both insurance companies and policyholders in Armenia.*

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Thank you