A New Modification on the Bonus-Malus System in Automobile Insurance

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Extended Abstract

Bonus-malus systems are the most applicable method of posterior ratemaking in the area of automobile insurance, which mainly designed to motivate drivers to drive better. These systems are applied extensively and adjusted by different researchers through the years. Lemaire (1995), Dionne and Vanase (1989), Frangos and Vrontos (2001), Denuit et al, (2007) and Mahmoudvand and Hassani (2009) and references therein are the most related studies on these types of BMS's. Here, we focus on BMS based on frequency components and would like to make the BMS penalty depending on the timing of the claim in the year.

Generally speaking, BMS based on frequency component can be designed by determining the Number of bonus-malus (BM) classes, Transition rules among class and Relativity for each class. A good reference for finding the way of determining these components is Dennuit, et al (2007). In this paper, we introduce a new adjusted form of BMS, which add a new component into the current systems based on the time of claims. According to this system, both insurer and policyholders can have more satisfactions. This system will increase the incentive of policyholders to (1) extend their contract and (2) drive better to receive no claim discount. On the other hand, the business model for insurers is to collect more in premium and investment income than is paid out in losses. Therefore, paying out losses soon for insurers is not okay. The designed system of this paper covers this issue and therefore it can be accepted by insurers, too.

Let, insurance period $[0, 1]$ has divided into m sub-period (for example we use $m = 4$ for seasonal sub-period). Moreover, assume $r_{c.t}$ denotes the relativities of sub-period t in BM class c for policyholders who have positive claims; where $t = 1, ..., m$ and $c = 0, ..., s$. Moreover, for consistency let $r_{c,m+1}$ denotes the relativity for no claim policyholders in class c. Finally suppose that random variable T_1 show the time of first claim in the current insurance period for a policyholder. We assume that

BMS is designed and executed normally, without any discussion about the time of claims; except the next relativities for policyholders who have positive claims will be adjusted by their occurrences time in the insurance periods if there is any. A general structure for such these BMS is illustrated in Table 1. Note that, in this table we have to consider restrictions $r_{c-1} \leq r_{c.m+1} \leq r_{c.m} \leq r_{c.m-1} \leq \ldots \leq r_{c.1} \leq r_{c+1}$; where $r_{-1} = 0$ and $r_{s+1} = \infty$. Moreover, note that the transition rules are like as standard BMS and will be determined without considering time of claims.

Table 1: A New BMS, with varying relativities by timing claims

Current BM Class	Next BM Class after ... claim			Relativity if first claim occurred in time period:				
	0	1	...	1	2	...	m	No claim
s	$L_0(s)$	$L_1(s)$	...	$r_{s.1}$	$r_{s.2}$	...	$r_{s.m}$	$r_{s.m+1}$
$\vdots$	$\vdots$	$\vdots$	...	$\vdots$	$\vdots$	...	$\vdots$	$\vdots$
1	$L_0(1)$	$L_1(1)$	...	$r_{1.1}$	$r_{1.2}$	...	$r_{1.m}$	$r_{1.m+1}$
0	$L_0(0)$	$L_1(0)$	...	$r_{0.1}$	$r_{0.2}$	...	$r_{0.m}$	$r_{0.m+1}$

The main problem with this system is the way of finding relativities. As a first attempt we introduce a linear relativity in the set-up of Gilde & Sundt (1989). Let a policyholder whom picked randomly is in class c. This policyholder had the first claim over the time period t, where $t \in \{1, \ldots, m\}$. Under these assumption we proposed the new linear relativity for the policyholder as bellow:

$$r_{c.t} = \alpha + \beta(c + 1 - \frac{t-1}{m}),\ c = 0, 1, ..., S,\ t = 1, 2, ..., m + 1. \qquad (1)$$

where, $\beta = \frac{Cov(\Theta, C+T)}{Var(C)}$ and $\alpha = E(\Theta) - \beta E(C + T)$.

References

[1] Denuit, M., Marechal, X., Pitrebois, S., and Walhin, J. F. (2007). *Actuarial Modelling of Claim Counts.*, John Wiley and Sons, Ltd.

[2] Gilde, V., Sundt, B. (1989). On bonus systems with credibility scales. *Scandinavian Actuarial Journal*, 13-22.

[3] Frangos, N.E. and Vrontos, S.D. (2001). Design of Optimal Bonus-malus Systems with a Frequency and Severity Component on an Individual base in Automobile Insurance.*Astin Bulletin*,**31**, No.1,1-2.

[4] Lemaire, J. (1995). *Bonus Malus Systems in Automobile Insurance.* Kluwer Academic Publisher, Bostn.

[5] Mahmoudvand, R. and Hassani, H. (2009). Generalized Bonus-malus systems with a frequence and severity component on an individual basis in automobile insurance. *ASTIN Bulletin*,**39**, 307-315.