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

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Motivation

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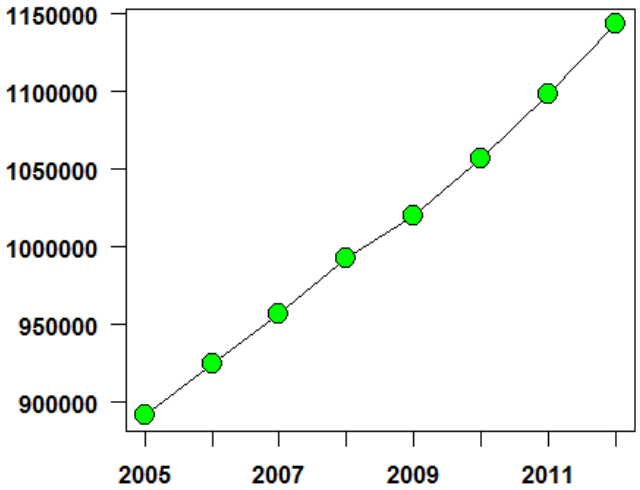
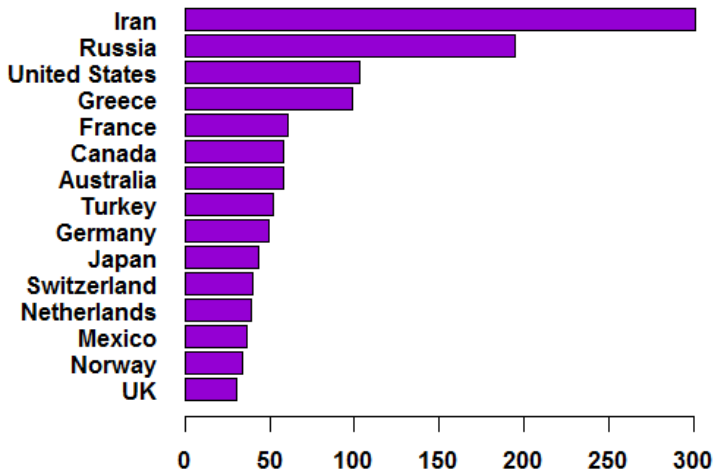


Number of car in use in thousand unit (Total world)[1]



Number of road death per 1,000,000 population (2011)[2]

Source of data:

[1] http://www.destatis.de/EN/InternationalStatistics

[2] http://www.internationaltransportforum.org/statistics

[2] http://data.worldbank.org/indicator/SP.POP.TOTL

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- **Bonus-Malus System (BMS) is a common posterior ratemaking in the field of automobile insurance**

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- **Bonus** usually is a discount in the premium which is given on the renewal of the policy if no claim is made in the previous year.
- **Malus** is an increase in the premium if there is a claim in the previous year.

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- Adjusting the prior premiums,
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- Improving the behaviour of drivers,
- Homogenization of the portfolio by attraction of good risk and excluding bad risk.

How does it works?

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  Here, we only talk about the BMS based on frequency of claims.

Main components

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- Starting level
- Transition rules
- Relativities

An example of BMS based on frequency of claims

Table 1: A Sample BMS (Starting level: 6)

level	Relativities%	level after ... claim					
		0	1	2	3	4	4+
10	200	5	6	7	8	9	10
9	160	5	10	10	10	10	10
8	140	5	10	10	10	10	10
7	120	5	9	10	10	10	10
*6	100	5	8	10	10	10	10
5	95	4	7	9	10	10	10
4	90	3	6	8	10	10	10
3	85	2	5	7	9	10	10
2	75	1	4	6	8	10	10
1	65	0	3	5	7	9	10
0	50	0	2	4	6	8	10

Note: Such this system is called $-1/+2$ system.

A general BMS structure

Table 2: A general BMS structure

level	Relativities	level after ... claim			
		0	1	2	...
s	r_s	$L_0(s)$	$L_1(s)$	$L_2(s)$	...
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	...
1	r_1	$L_0(1)$	$L_1(1)$	$L_2(1)$	...
0	r_0	$L_0(0)$	$L_1(0)$	$L_2(0)$	...

Where, $s+1$ is the number of levels, r_j is the relativity of level j, for $j = 0, \ldots, s$ and $L_k(j)$ shows the results of transition rule or next level of policyholder that currently is in level j and reported k claims.

The problem

Consider two policyholders who have an accidents in a year:

- policyholder A has an accident in the first day of his insurance period;
- policyholder B has an accident in the last day of his insurance period;
- All conditions of A and B as well as the loss of their accidents are the same.

The current BMS's penalize A and B equally. The problem is adjusting current BMS's to consider this difference.

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- Relativities

Structure of the new proposed BMS

Table 3: A New BMS, with varying relativities by timing claims

level	level after ... claim			Relativity when first claim is 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	$L_0(0)$	$L_1(0)$	...	$r_{0.1}$	$r_{0.2}$	...	$r_{0.m}$	$r_{0.m+1}$

where: $r_{j.t}$ is the relativity for the policyholder who is in level j and has the first claim in sub-period t.

Relativities in new BMS

As a first attempt we introduce a linear relativity in the set-up of Gilde & Sundt (1989):

$$r_{l.t} = \alpha + \beta(l + 1 - \frac{t-1}{m}),$$

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

Table 4: A New -1/+3 system, with varying relativities by timing claims

level	level after ... claim			Relativity when first claim is in time period:				
	0	1	≥ 2	1	2	3	4	No claim
6	5	6	6	2.49	2.42	2.36	2.29	2.23
5	4	6	6	2.16	2.10	2.03	1.97	1.90
4	3	6	6	1.84	1.77	1.71	1.64	1.58
3	2	6	6	1.52	1.45	1.39	1.32	1.26
2	1	5	6	n.a	n.a	n.a	n.a	0.93
1	0	4	6	n.a	n.a	n.a	n.a	0.61
0	0	3	6	n.a	n.a	n.a	n.a	0.29

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  (1) extend their contract and
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- This system will increase the satisfaction of both policyholders and insurers.

Thank you