



31 May - 03 June 2016  
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ISEG- Lisbon School of Economics  
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## SUBMISSION FORM

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Title of Paper / Presentation / Session to appear in program: Optimizing transition rules of bonus-malus system under different criteria

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What will your final submission be? Presentation and Paper  Presentation Only

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No prior knowledge  General industry knowledge assumed  Technical/specific industry knowledge assumed

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## ABSTRACT

### Optimizing transition rules of bonus-malus system under different criteria

*Marcin Topolewski, Michał Bernardelli*

**Key words:** Bonus-malus system, transition rules, optimization, premium elasticity, automobile insurance.

#### Purpose of your paper:

We try to determine if optimization of the transition rules of bonus-malus system can improve and objectify the process of building a system, and if the aim to obtain a bonus-malus system of good statistical properties goes hand in hand with the desired market utility performance of the system. Therefore for each presented solution, measures of system characteristics are calculated and analyzed to assess possibility of system market application. We show that optimization with respect to different criteria leads to a different results, and reconciliation of different characteristics of systems can be difficult to achieve.

#### Abstract:

Bonus-malus systems are used for posterior premiums differentiation in the risk assessment process in automobile insurance. The key feature of a system are transition rules which determine the eligibility of insured to particular premium class and decide about properties of the system. In the literature relatively little space is devoted to the optimization of transition rules. The problem appears to be particularly interesting from the viewpoint of design of the system with desired characteristics.

Technically transition rules optimization constitutes a nonlinear nonconvex discrete optimization problem. To solve this problem we engage improved greedy optimization algorithm, similar to the one used by Marlock (1984).

In this work we summarise our research and consider optimization with respect to various criteria, namely: minimizing the error of assessment (using Norberg premium criterion), achieving the best system elasticity (as defined by Loimaranta and later generalized by De Prill) and finally obtain adequate system toughens (issue addressed by Lemaire). We analyse large variety of insured portfolios characterized by the different risk structures described by inverse Gaussian risk structure function with realistic parameters. Thus we draw applicable conclusions. We also show that in some cases the well-grounded measures of system performance fail to reflect adequate system properties, so we propose alternative measures, which allow for better monitoring of system characteristics.

We try to determine if optimization of the transition rules can improve the process of building a bonus-malus system, and if the aim to obtain a bonus-malus system of good statistical properties goes hand in hand with the desired market utility performance of the system. Therefore for each solution, measures of system characteristics are calculated and analysed to assess possibility of system market application. We show that optimization with respect to different criteria leads to a different results, and reconciliation of different characteristics of systems can be difficult to achieve.

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