



# Risk theory insight into a zone-adaptive control strategy

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## Abstract

The main purpose of this paper is a risk theory insight into the problem of asset–liability and solvency adaptive management. In the multiperiodic insurance risk model composed of chained classical risk models, a zone-adaptive control strategy, essentially similar to that applied in Directives [Directive 2002/13/EC of the European Parliament and of the Council of 5 March 2002, Brussels, 5 March 2002], is introduced and its performance is examined analytically. That examination was initiated in [Malinovskii, V.K., 2006b. Adaptive control strategies and dependence of finite time ruin on the premium loading. *Insurance: Math. Econ.* (in press)] and is based on the application of the explicit expression for the finite-time ruin probability in the classical risk model. The result of independent interest in the paper is the representation of that finite-time ruin probability in terms of asymptotic series, as time increases.

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## 1. Introduction

Insurance regulation regards the insurance process as a series of successive insurance years. Each year starts with a manager's control intervention which fine-tunes tariffs, reserves and other operational characteristics of the probability mechanism of insurance in accordance with the fundamental principles of solvency and equity. The influence of that intervention remains in force throughout the whole insurance year, i.e., until the next financial report and the next-year control intervention.

It is believed that a control strategy directing the risk reserve process into a strip zone would make the development of the multiperiodic insurance process stationary or nearly stationary throughout a series of consecutive years. Article 16(a) of Directive (2002) specifies the algorithm of such a type.

Being an element of the insurance legislation rather than a research paper, Directive (2002) does not take care of the situations when the adaptive algorithm of this kind may work badly or even fail. But a strong theoretical background for Directive (2002) is necessary: if that algorithm was applied

without thorough theoretical analysis of its performance and of its scope of workability, insurance regulation and supervision would be acting blindfold.

This paper is devoted to a theoretical analysis of a zone-adaptive control strategy, essentially similar to that of Directive (2002). It is set up in the framework of the multiperiodic insurance process, where each single operating period is modelled by means of Lundberg's collective risk model. Besides keeping the risk reserve inside a zone by means of adjusting the initial capital, its idea is to smooth out deviations from a target capital value by adjusting the premium loading. The latter idea may be found in many sources. In particular, in Daykin et al. (1996), Chapter 5, Section 5.5, p. 151, a control is proposed where the premium loading “will be increased if the risk reserve ratio passes below a certain alarm barrier. On the other hand, if another barrier is exceeded, the loading will be reduced”.

Theoretical analysis of the multiperiodic-adaptive control strategies, when the risk model assumptions are more or less realistic, is known to be a difficult problem. By necessity, it is based mainly on simulation rather than on an analytical approach.

Regarding the balance of simulation and analytical methods accentuated in this paper, it is worthwhile to recall that “the

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