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On a two-dimensional risk model with time-dependent claim sizes and risky investments*

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Abstract: Consider a two-dimensional risk model, in which two insurance companies divide between them the claims in some specified proportions. Suppose that the claim sizes and inter-arrival times form a sequence of independent and identically distributed random pairs, with each pair obeying a dependence structure, and the surpluses of the two companies are invested into portfolios whose returns follow two different geometric Lévy processes. When the claim-size distribution is extended-regularly-varying tailed, asymptotic expressions for the ruin probability of this two-dimensional risk model is exhibited. Some numerical results are also presented to illustrate the accuracy of our asymptotic formulae.

Keywords: Extended regular variation; Lévy process; Ruin probability; Time-dependent risk model

AMS Mathematics Subject Classification: 62P05; 60F99

1. Introduction

In this paper, we consider a particular two-dimensional risk model, in which two insurance companies (or two branches of the same company) split the amount they pay out of each claim in positive proportions δ_1 and δ_2, respectively, where $\delta_1 + \delta_2 = 1$. The surplus of the i-th $(i = 1, 2,)$ company up to time $t \geq 0$ is given by

$$U_i(t) = e^{R_i(t)}\Big(x_i + c_i \int_0^t e^{-R_i(s)}\mathrm{d}s - \delta_i \sum_{k=1}^{N(t)} X_k e^{-R_i(\tau_k)}\Big), \quad i = 1, 2, , \tag{1.1}$$

where $(R_1(t), R_2(t))$ is the vector of investment return processes, $\vec{x} = (x_1, x_2)$ is the initial surplus vector, (c_1, c_2) is the vector of rate of premium payments, and $\{X_i; i \geq 1\}$ is the sequence of claim sizes whose common arrival times $\tau_1, \tau_2, \cdots$ constitute a renewal claim-number process $\{N(t); t \geq 0\}$ with finite renewal function $\lambda_t = \mathsf{E}N(t) = \sum_{i=1}^{\infty} \mathsf{P}(\tau_i \leq t)$. Note that a similar risk model was first

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