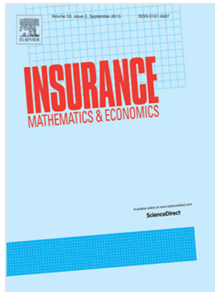
Accepted Manuscript



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PII: S0167-6687(15)30312-7
DOI: http://dx.doi.org/10.1016/j.insmatheco.2016.04.003
Reference: INSUMA 2200

To appear in: *Insurance: Mathematics and Economics*

Received date: December 2015
Revised date: March 2016
Accepted date: 4 April 2016

Asymptotic Ruin Probabilities for a Multidimensional Renewal Risk Model with Multivariate Regularly Varying Claims

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March 16, 2016

Abstract

This paper studies a continuous-time multidimensional risk model with constant force of interest and dependence structures among random factors involved. The model allows a general dependence among the claim-number processes from different insurance businesses. Moreover, we utilize the framework of multivariate regular variation to describe the dependence and heavy-tailed nature of the claim sizes. Some precise asymptotic expansions are derived for both finite-time and infinite-time ruin probabilities.

Keywords: asymptotics; multidimensional renewal risk model; multivariate regular variation; ruin probability

Mathematics Subject Classification: Primary 62P05; Secondary 62E10, 91B30

1 Introduction

Consider an insurance company which simultaneously operates d kinds of businesses. Its surplus process can be described by the following multidimensional risk model:

$$\begin{pmatrix} U_1(t) \\ \vdots \\ U_d(t) \end{pmatrix} = \begin{pmatrix} \rho_1 x \mathrm{e}^{rt} \\ \vdots \\ \rho_d x \mathrm{e}^{rt} \end{pmatrix} + \begin{pmatrix} c_1 \int_0^t \mathrm{e}^{r(t-s)} \mathrm{d}s \\ \vdots \\ c_d \int_0^t \mathrm{e}^{r(t-s)} \mathrm{d}s \end{pmatrix} - \begin{pmatrix} \sum_{i=1}^{N_1(t)} X_{1i} \mathrm{e}^{r(t-\tau_{1i})} \\ \vdots \\ \sum_{i=1}^{N_d(t)} X_{di} \mathrm{e}^{r(t-\tau_{di})} \end{pmatrix}, \qquad t \geq 0, \tag{1.1}$$

where $\{(U_1(t), \ldots, U_d(t))\,; t \geq 0\}$ denotes the multidimensional surplus process, $r \geq 0$ the constant force of interest, $(\rho_1 x, \ldots, \rho_d x)$ the vector of initial surpluses assigned to different businesses with positive $\rho_1, \ldots, \rho_d$ such that $\sum_{k=1}^d \rho_k = 1$, $(c_1, \ldots, c_d)$ the vector of constant premium rates, $\{(X_{1i}, \ldots, X_{di}); i \geq 1\}$ the sequence of claim-size vectors, and $\tau_{k1}, \tau_{k2}, \ldots$ the claim-arrival times of the kth business with the corresponding claim-number process $\{N_k(t); t \geq 0\}$ for $k = 1, \ldots, d$.

Define the finite-time and infinite-time ruin probabilities corresponding to risk model (1.1) as

$$\psi(x; T) = \mathbb{P}\left(T_{\max} \leq T \middle| (U_1(0), \ldots, U_d(0)) = (\rho_1 x, \ldots, \rho_d x) \right),$$

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