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

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## 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:

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

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

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

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

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