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Approximations for finite-time ruin probability in a dependent discrete-time risk model with CMC simulations

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Abstract

Consider a discrete-time risk model in which the insurer is allowed to invest its wealth into a risk-free or a risky portfolio under a certain regulation. Then the insurer is said to be exposed to a stochastic economic environment that contains two kinds of risks, the insurance risk and financial risk. Within period i , the net insurance loss is denoted by X_i and the stochastic discount factor from time i to zero is denoted by θ_i . For any integer n, assume that $X_1, \ldots, X_n$ form a sequence of pairwise asymptotically independent but not necessarily identically distributed real-valued random variables with distributions $F_1, \ldots, F_n$, respectively; $\theta_1, \theta_2, \ldots, \theta_n$ are another sequence of arbitrarily dependent nonnegative random variables; and the two sequences are mutually independent. Under the assumption that the average distribution $n^{-1}\sum_{i=1}^{n} F_i$ is dominatedly varying tailed and some moment conditions on $\theta_i,\ i = 1, \ldots, n$, we derive a weakly equivalent formula for the finite-time ruin probability. We demonstrate our obtained results through a Crude Monte-Carlo simulation with asymptotics.

Keywords: Discrete-time risk model with insurance and financial risks; Pairwise asymptotical independence; Dominated variation; Ruin probability; Crude Monte-Carlo simulation

AMS Subject Classification: 62P05; 62E10; 91B30

1 Introduction

Consider a discrete-time risk model, in which within period $i \geq 1$, an insurer's net loss (the aggregate claim amount minus the total premium income) is denoted by a real-valued random variable (r.v.) X_i with distribution F_i; the stochastic discount factor (the reciprocal of the stochastic return rate) from time i to zero is denoted by a nonnegative r.v. θ_i; and assume that $\{X_i,\ i \geq 1\}$ obey some certain dependence structure, $\{\theta_i,\ i \geq 1\}$ are arbitrarily dependent, but $\{X_i,\ i \geq 1\}$ and $\{\theta_i,\ i \geq 1\}$ are mutually independent. In particular, the stochastic discount factors can be specialized to a product of some independent and identically distributed (i.i.d.) nonnegative r.v.s,

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