On the time and number of claims until ruin in a two-barrier risk model perturbed by diffusion

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Abstract

In this presentation we consider a surplus process perturbed by a diffusion,

$$U(t) = u + ct + \sigma B(t) - \sum_{i=1}^{N(t)} X_i, \; t \geq 0,$$

where $\{N(t), t \geq 0\}$ is a renewal process that denotes the total number of claims from an insurance portfolio. The claim amounts $X_1, X_2, ...$ are non-negative i.i.d. r.v.s with c.d.f. F, while the claim inter-arrival times $T_1, T_2, ...$ are non-negative i.i.d. r.v.s, independent also of X_i's, with c.d.f. K. $\{B(t), t \geq 0\}$ is a standard Wiener process that is independent of the claim amounts and the process $\{N(t), t \geq 0\}$. In this model, $u \geq 0$ is the initial surplus, $c > 0$ denotes the premium income rate (per unit of time) and $\sigma > 0$ is the dispersion parameter. We are interested in the distributions of the number ν of claims, the total amount C of claims and the time τ until the first time that the insurer's surplus process falls below zero (ruin) or exceeds a predefined upper barrier $b > u$ (safety level), *immediately after the payment of a claim*. By using exponentially tilted measures we derive an expression for the joint generating function of the distributions of interest which is built upon the generating functions of the overshoot and undershoot of the surplus process. We offer explicit results for the case where the claim amounts and the claim inter-arrival times belong to the class of mixed Erlang distributions which is dense in the class of all non-negative distributions. We finally implement appropriate algorithms for the numerical calculation of the aforementioned distributions of ν, C and τ via computer algebra software.

Keywords and phrases: Two-sided first exit time; Number of claims to ruin; Exponentially tilted probability measures; Overshoot; Undershoot; Mixed Erlang class of distributions.

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