An application of symbolic computation techniques to risk theory

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We introduce an algebraic operator framework to study discounted penalty functions in renewal risk models. For inter-arrival and claim size distributions with rational Laplace transform, the usual integral equation is transformed into a boundary value problem, which is solved by symbolic techniques. The factorization of the differential operator can be lifted to the level of boundary value problems, amounting to iteratively solving first-order problems. This leads to an explicit expression for the expected discounted penalty function in terms of the chosen penalty.