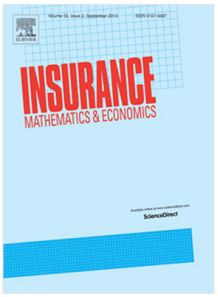
Accepted Manuscript



Ruin probability via Quantum Mechanics Approach

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PII: S0167-6687(16)30206-2
DOI: https://doi.org/10.1016/j.insmatheco.2017.12.009
Reference: INSUMA 2433

To appear in: *Insurance: Mathematics and Economics*

Received date : May 2016
Revised date : August 2017
Accepted date : 19 December 2017

Please cite this article as: Tamturk M., Utev S., Ruin probability via Quantum Mechanics Approach. *Insurance: Mathematics and Economics* (2017), https://doi.org/10.1016/j.insmatheco.2017.12.009

Ruin Probability via Quantum Mechanics Approach

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Abstract

The finite time ruin probability in the classical surplus process setup with additional capital injections and withdrawals is investigated via the Quantum Mechanics Approach. The results are compared with the Picard-Lefevre Appell Polynomial approach and the traditional Markov Chain approach. In addition, several optimization problems in the insurance market are numerically solved by applying the Quantum Mechanics Approach.

Keywords: Ruin probability, Hamiltonian, Path integral, Quantum mechanics, Capital injection, Appell Polynomials.

1 Introduction

Numerical analysis plays an important role in Actuarial Sciences. Although a number of numerical methods were developed to estimate the ruin probability [2, 10, 13], there are challenges to compute the finite time ruin probability and to incorporate financial interferences such as Capital Allocations, Capital Injections and Capital Withdrawals [11, 15, 16, 21].
The Quantum Mechanics Approach provides an alternative powerful tool to the traditional probability calculations [3, 4, 9, 12, 14]. In this article, we apply the Quantum Mechanics Approach to derive numerical methods for the finite time non-ruin probability with or without Capital Injections and Withdrawals.
Numerical results on the non-ruin probability derived via the Quantum Mechanics Approach are compared with the Appell Polynomials approach as introduced in Picard-Lefevre [18]and traditional Markov chain approach [5, 6].
Moreover, we apply the Quantum Mechanics Approach to solve numerically Capital Allocation type problems in Actuarial Sciences such as how to maximize the proportion of the total claim amount paid with the prescribed ruin level; how to minimize the ruin probability via the Optimization of the time and amounts of Capital Allocation of Investments and Withdrawals and how to minimize the ruin probability via Optimization of Allocation of Initial Capitals.
In addition, we show that the Quantum Mechanics Approach is applicable to ruin models generated by non-Levy processes.