



**NUMERICAL SOLUTION OF RUIN PROBABILITY IN THE
CLASSICAL RISK PROCESS USING HEUN'S METHOD**

UNDERGRADUATE THESIS

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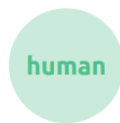
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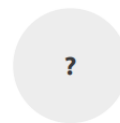
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ABSTRACT

Ruin probability is the likelihood that the insurer's surplus will go below zero at some time in the future, or the total claim exceed the sum of initial surplus and the total premium at some time t in the future. Several methods can be used in order to calculate the probability of ruin. In the classical risk model, the ruin probability can be calculated via the integro-differential equation. With analytical method, Laplace transform can be used but the calculation is done manually in order to solve the survival probability. Using numerical method like Euler's method, it produces a good approximation with some limitations. In this research, the ruin probability is calculated through survival probability using integro-differential equation with two different approaches. In case where the value of claim is followed by the Gamma and Exponential distribution, Laplace transform and Heun's method is used to compare the performance of both methods. From the result of the simulation, it shows that the ruin probability will decrease as the initial surplus increases, while the survival probability will increase alongside. It can be said that the Heun's method is resulting to a good approximation with the maximum error value at the order of 10^{-4} when u is $[0,60]$ for the first case and when u is $[0,30]$ for the second case, also at the order of 10^{-6} when u is $[0,100]$ for the third case. With note that when the value of initial surplus u is bigger, the error value can be greater.

Keywords: *Ruin probability, Survival probability, Integro-differential equation, Laplace transform, Heun's method, Gamma distribution, Exponential distribution*

ABSTRAK

Probabilitas kebangkrutan adalah kemungkinan surplus dari perusahaan asuransi jatuh di bawah nol pada suatu waktu di masa depan, atau total klaim melebihi jumlah surplus awal dan total premi pada suatu waktu t di masa depan. Beberapa metode dapat digunakan untuk menghitung probabilitas kebangkrutan. Dalam model risiko klasik, probabilitas kebangkrutan dapat dihitung melalui persamaan integro-diferensial. Dengan metode analitik, transformasi Laplace dapat digunakan tetapi perhitungan dilakukan secara manual untuk mengetahui probabilitas *survival*. Menggunakan metode numerik seperti metode Euler, didapatkan pendekatan yang baik dengan beberapa batasan. Dalam penelitian ini, probabilitas kebangkrutan dihitung melalui probabilitas survival menggunakan persamaan integro-diferensial dengan dua pendekatan berbeda. Dalam kasus di mana nilai klaim diikuti oleh distribusi Gamma dan Eksponensial, transformasi Laplace dan metode Heun digunakan untuk membandingkan kinerja kedua metode. Dari hasil simulasi, terlihat bahwa probabilitas kebangkrutan akan menurun seiring dengan peningkatan surplus awal, sementara probabilitas *survival* akan meningkat. Dapat dikatakan bahwa metode Heun menghasilkan pendekatan yang baik dengan nilai eror maksimum di skala 10^{-4} dengan u dalam $[0,60]$ untuk kasus pertama dan u dalam $[0,30]$ untuk kasus kedua, dan juga pada skala 10^{-6} dengan u dalam $[0,100]$ pada kasus ketiga. Dengan catatan jika jumlah surplus awal lebih besar, maka nilai eror juga dapat bertambah.

Kata kunci: *Probabilitas kebangkrutan, Probabilitas survival, Persamaan integro-diferensial, Transformasi Laplace, Metode Heun, Distribusi gamma, Distribusi eksponensial*

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