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Comparison of Premium Reserves with New Jersey Methods and Full Preliminary Term on Endowment Insurance

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Abstract— Life insurance companies often have difficulty getting fees at the beginning of the insurance year. It's noted that there are several life insurers who suffer losses caused by the inability to pay compensation to the insured, because the value of the claim insured submit exceeds the cliam estimated by the insurer. Those conditions can be anticipated if the insurance company has reserve funds. This study aims to find the right reserve value for insurance companies that have been adapted to endowment life insurance using the New Jersey and Full Preliminary Term method. Based on the data analysis carried out, it was concluded that the New Jersey reserve value for male from 1st year to 49th year is greater than that for females. Meanwhile, for Full Preliminary Term reserves, the value of male's reserves from the 1st year to the 49th year is relatively always greater than that of females. This research could be used as a reference for insurance company to consider the better method in calculating premium reserves based on its policyholder profile.

Keywords— Life Insurance; Endowment Life Insurance; New Jersey Method; Full Preliminary Term Method

I. INTRODUCTION

Insurance companies are one solution that can help the community in dealing with the risks that may occur due to this uncertainty. The community's obligation as insurance participants is to pay a premium that has been agreed with the insurance company. Premiums paid by insurance participants are in the form of gross premiums (net premiums plus fees). Those premiums will be allocated by the insurance company for compensation (benefits that will be returned to insurance participants), company operations and for reserve. In general there are several types of life insurance, including life insurance as a guarantee for life, life insurance for a certain period of time, pure endowment life insurance, and endowment life insurance which provides protection for only three parties who are still alive.

Life insurance companies frequently struggle to obtain funds at the beginning of the insurance year. These funds will be used for the creation of insurance participant policies, medical checks for insurance participants, agent commission payments, unexpected compensation, and other purposes. On the other hand, these costs are paid from their premium. The insurance company must be able to manage the funds for covering their business operations. One of the conditions for the establishment of an insurance company is to have a premium reserve. In other words, the premium reserve is the amount of the company's money in the coverage period. This premium reserve can be used at any time when an unexpected event occurs such as an unexpected claim. According to [1] the several life insurers who suffer losses caused by the inability to pay compensation to the insured, because the value of the claim insured submit exceeds the estimated claim by the insurer. Those conditions can be anticipated if the insurance company has reserve funds. Some previous researchers who discussed the calculation of premium reserves on endowment life insurance using different methods. In the study of premium reserves using the Zillmer method conducted by [2] concluded that "the smaller the interest rate used, the greater the premium reserve owned by the company". The premium reserve research using the New Jersey method conducted by [3] concluded that "endowment life insurance premium reserves using the New Jersey method at the end of the 5th year with policyholders aged 25, 30, 35, 40 and 45 years taking the policy for 20 years with a compensation of Rp. 10,000,000 has no significant difference". The study of premium reserves using the Full Preliminary Term method conducted by [4] concluded that "the value of the prospective benefit reserve from the first year to the 29th year is greater than the reserve of the Full Preliminary Term method". In the premium reserve research using the Premium Sufficiency method conducted by [5] concluded that "the value of the full preliminary term reserve is cheaper than the value of the premium sufficiency reserve".

Based on [6] life insurance companies often have difficulty getting fees at the beginning of the insurance year which will be used for making insurance participant policies, health checks for insurance participants, agent commission payments and others. In the New Jersey method, the reserve value at the end of the first year is zero. Premiums paid by insurance participants in the first year can be used by insurance companies in carrying out their duties such as financing medical examinations for people to be insured, paying agent commissions, policy administration, etc. The New Jersey method is part of the prospective reserve calculation. The prospective reserve value in year t is the reserve value based on the cash value of future benefits less the cash value of future premiums. However, according to [7] insurance companies avoid negative reserves because it causes losses to the company.

In the first year, the company Insurance costs quite a lot so reserves are needed to cover these costs. The Full Preliminary Term method is one of the reserve calculation methods which assumes the reserve at the end of the first year is zero (0). Thus, the insurance company is able to cover costs in the first year and fulfill obligations at the end of the insurance contract year. The calculation of reserves using the Full Preliminary Term method is obtained from the extension of the Zillmer method. The Zillmer method is a calculation method reserves using the prospective method as the basis for calculation.

In this study, the authors are interested in comparing the results of the premium reserves calculation using the New Jersey method with the results of premium reserves calculation using the Full Preliminary Term method. The Full Preliminary Term method and the New Jersey method have the same equation, namely the reserve value at the end of the first year is zero. The most basic thing to be able to determine the value of the premium reserve using the New Jersey and Full Preliminary Term methods is to know the age of the policyholder (the insured) and payment terms. Then find out the probability of life and the probability of death of a person presented in the mortality table, the interest rate and the amount of compensation.

II. METHOD

A. Type of Research

The research uses Research and Development method is a method in research with the help of numbers that have been previously collected so that they can be presented and analyzed. While the type of writing uses literature study sourced from several previous literacies to find the connection. This research begins from taking the Indonesian Mortality Table 2019 obtained from AAJI. In this table there are survival rates for male and female. This survival rate is used to calculate premium reserves. The premium reserve calculates with New Jersey Method and Full Preliminary Term Method. Then, compare the result of both methods.

B. Data

The type of data used is quantitative data. The source of data used in this study is secondary data, namely the Indonesian Mortality Table (TMI) 2019 for male and female. Then, the variables used in this study are age x and interest rate *i*. The definition of operational variables is

a. Age *x* is the age of the policyholder or the insured at the time of the policy contract.
b. Interest rate *i* is the current interest rate in Indonesia based on the reference from the Central Bank of Indonesia, which is 3.50%.

C. Data Processing Flowchart

To compare the results of the calculation of premium reserves using the New Jersey Method and the Full Preliminary Term Method based on the problem formulation, the steps that must be taken are:

III. RESULTS AND DISCUSSION

In calculating premium reserves, it is necessary to have a mortality table and a predetermined interest rate. The mortality table used as a reference for calculating premiums and premium reserves is the Indonesia Mortality Table 2019 (TMI 2019), where the Indonesia Mortality Table 2019 is a new reference for the life insurance industry in Indonesia. The interest rate used refers to Bank Indonesia, which is 3.5%. It is assumed that someone who follows endowment life insurance is male (25) and female (25). The length of the insurance contract is 50 years with the benefits provided for all contracts are Rp. 100.000.000. Here are the following steps in evaluating benefit reserve using two methods. First, New Jersey Method Applied for male age 25 years. Second, New jersey method for female participant age 25 years. Third, using Full Preliminary Term Method for male and female participant age 25 years. The steps that can be taken to calculate premium reserve are:

1. Calculating the Value of Premium Reserves Using New Jersey Method (The cash value of payments for male)

a) Calculate the cash value of payments for male age 25 years with the number of insurance participants living at age *x* years (D_x). The value of $D_{25} = 41757{,}92$ represents the cash value of the *x*-year power payment with the number of insurance participants living at the age of *x* years.
b) Calculate the cash value of the payment for male the age of 25 years with the number of insurance participants who died at the age of *x* years (C_x). The value of $C_{25} = 20{,}97983$ represents the cash value of the *x*-year power payment with the number of insurance participants who died at the age of *x* years
c) Calculate the accumulated value of D_{x+k} with $k = 0$ years up to *w* (N_x). Suppose to calculate N_x, where $x = 25$. The value of $N_{25} = 1023805$ represents the value of accumulated D_{x+k} with $k = 0$ years up to *w*

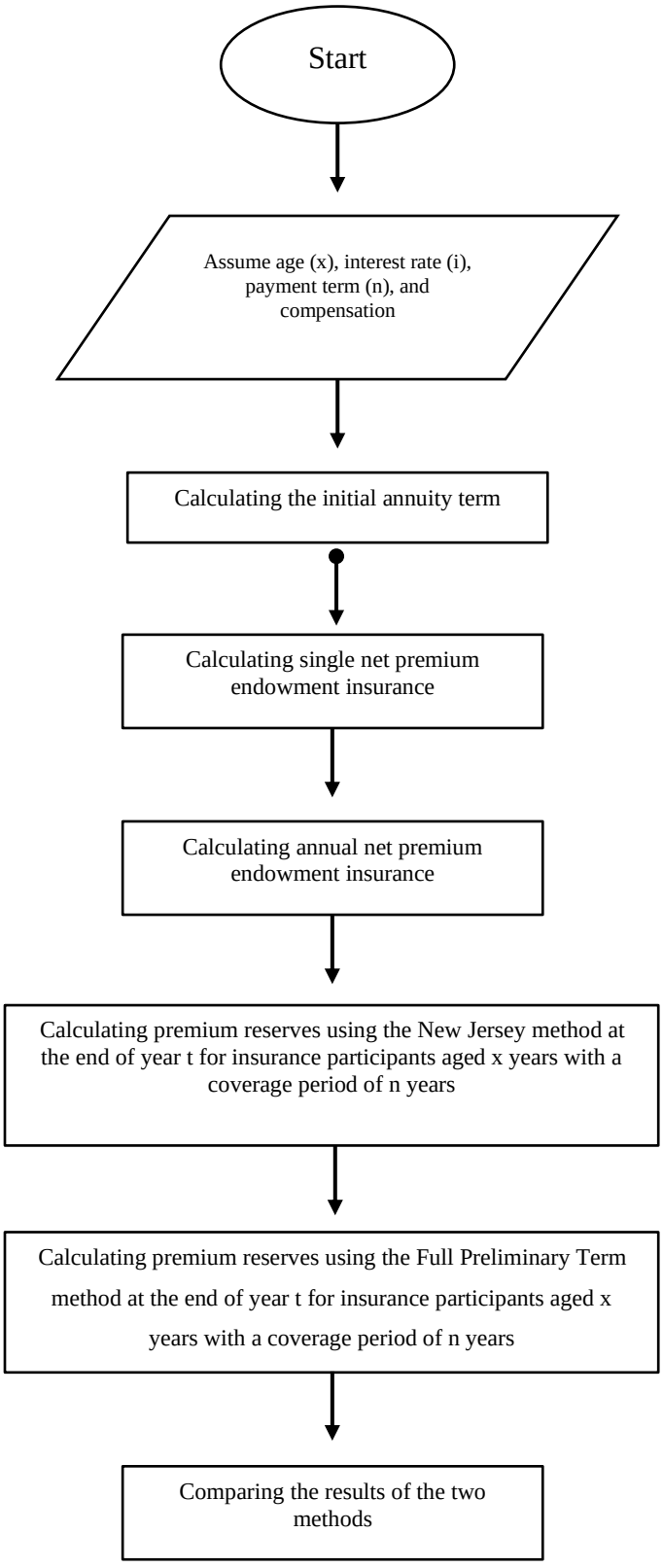

Figure 1. Research Flowchart

d) Calculate the accumulated value of C_{x+k} with $k=0$ years up to w (M_x). Suppose to calculate M_x, where $x=25$, The value of $M_{25}=7136{,}513$ represents the value of the accumulation of C_{x+k} with $k=0$ years up to *w*.
e) Calculating the modified premium reserve for male using the New Jersey method at the end of year t for participants aged *x* years with a coverage period of n years. The amount of the premium reserve using the New Jersey method is paid by a male policyholder who is 25 years old with 50 years of coverage at the end of the 2nd year with compensation of Rp. 100.000.000 is Rp. 22.893.647.

2. Calculating the Value of Premium Reserves Using New Jersey Method (The cash value of payments for female)
a) Calculate the cash value of payments for female age 25 years with the number of insurance participants living at age *x* years (D_x). The value of $D_{25}=41949{,}65$ represents the cash value of the *x*-year power payment with the number of insurance participants living at the age of *x* years.
b) Calculate the cash value of the payment for females at the age of 25 years with the number of insurance participants who died at the age of x years (C_x). The value of $C_{25}=15{,}40181$ represents the cash value of the *x*-year power payment with the number of insurance participants who died at the age of *x* years
c) Calculate the accumulated value of D_{x+k} with $k=0$ years up to w (N_x). Suppose to calculate N_x, where $x=25$. The value of $N_{25}=1054780$ represents the value of accumulated D_{x+k} with $k=0$ years up to *w*
d) Calculate the accumulated value of C_{x+k} with $k=0$ years up to w (M_x). Suppose to calculate M_x, where $x=25$, The value of $M_{25}=6280{,}761$ represents the value of the accumulation of C_{x+k} with $k=0$ years up to *w*.
e) Calculating the modified premium reserve for females using the New Jersey method at the end of year t for participants aged *x* years with a coverage period of n years. The amount of the premium reserve using the New Jersey method is paid by a female policyholder who is 25 years old with 50 years of coverage at the end of the 2nd year with compensation of Rp. 100,000,000 is Rp. 21.737.958.

3. Calculating the Value of Premium Reserve Using Full Preliminary Term Method
a) Calculating the premium reserve for male using Full Preliminary Term method at the end of year t for participants aged *x* years with a coverage period of n years. The amount of the premium reserve using Full Preliminary Term method is paid by a male policyholder who is 25 years old with 50 years of coverage at the end of the 2nd year with compensation of Rp. 100,000,000 is Rp. 941.947,9.
b) Calculating the premium reserve for male using Full Preliminary Term method at the end of year t for participants aged *x* years with a coverage period of n years. The amount of the premium reserve using Full Preliminary Term method is paid by a male policyholder who is 25 years old with 50 years of coverage at the end of the 2nd year with compensation of Rp. 100,000,000 is Rp. 890.696.

In this study, it is assumed that the case example is a simulation for evaluating premium reserves using the New Jersey method and the Full Preliminary Term method for endowment life insurance with a contract length of 50 years for a male and a female with constant premiums at the beginning of each year. Before calculating the reserve, it is necessary to know the age of the prospective policy holder or the insured, the length of the insurance contract, the interest rate, and the compensation that will be given when the insured dies. And determine the value of the annual constant single premium.

The profile of the policy owner or the insured is a male (25) and a female (25) with a contract length of 50 years. For an interest rate of 3.5% (as determined by Bank Indonesia) [8] with a compensation benefit given at the end of the year of death or at the end of the contract with the insured is still alive in the amount of IDR 100,000,000. The data used is the 2019 Mortality Table data issued by the Indonesian Life Insurance Association (AAJI) in 2019 [9]. Using those data, the commutation value, annuity value, and annual premium value were computed which can be seen in Appendix 1. It can be concluded that a female's annual constant premium (25) is smaller than a male (25).

The difference in reserve value using the New Jersey method and the Full Preliminary Term method for male (25) with a 50-year insurance contract can be seen on Figure 2. It shows a very significant difference in the early years of premium reserve payments for male (25) between the New Jersey method and the Full Preliminary Term method. New jersey method has a higher reserve value for male for year 2 to 49. As for year 50, both method are in the same value.

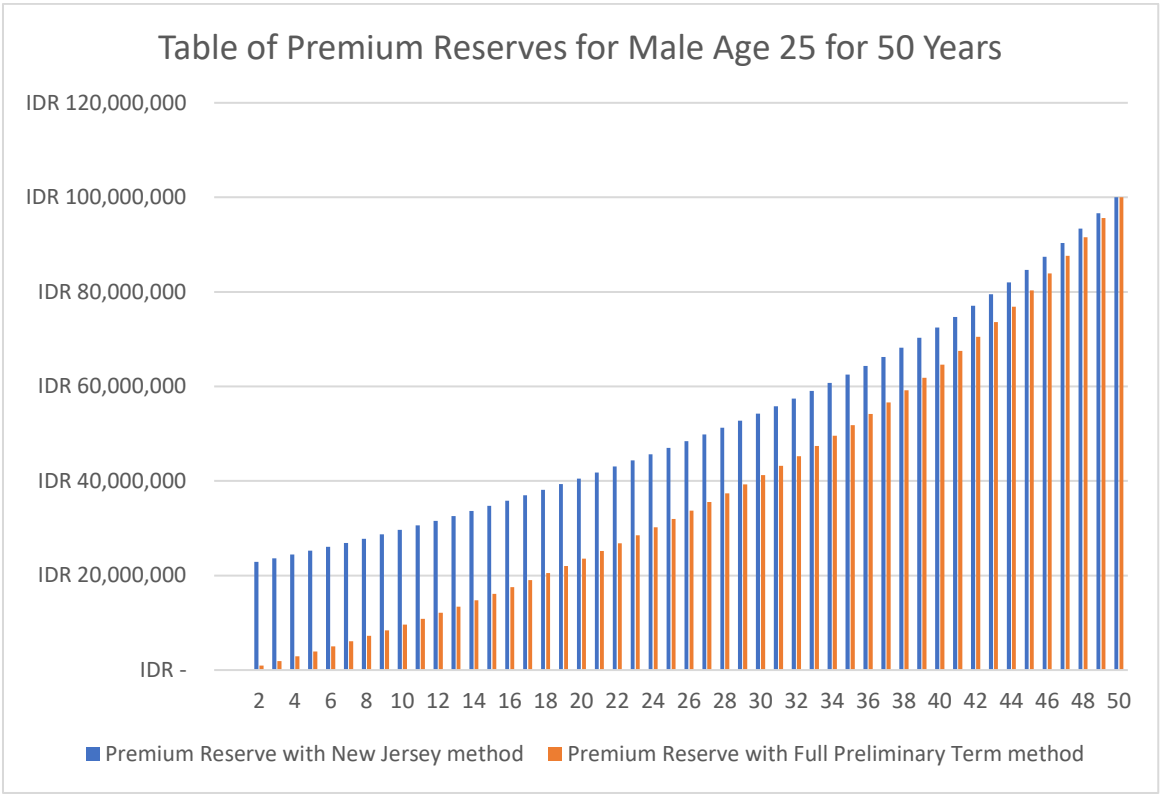

Figure 2. Premium Reserve for Male

For the difference in payment of premium reserves with the New Jersey method and premium reserves with the Full Preliminary Term method for female (25) can be seen in Figure 3. It shows a significant difference as well in the early years of premium reserve payments for female (25). In this case, New Jersey still produced higher reserve than Full Preliminary Term for period 2 until 49. However, in the year of 50, both reserve are equivalent. The performance of the benefit reserve evaluation using the New Jersey method and the Full Preliminary Term method with a contract duration of 50 years can be seen in appendix 5 and appendix 6.

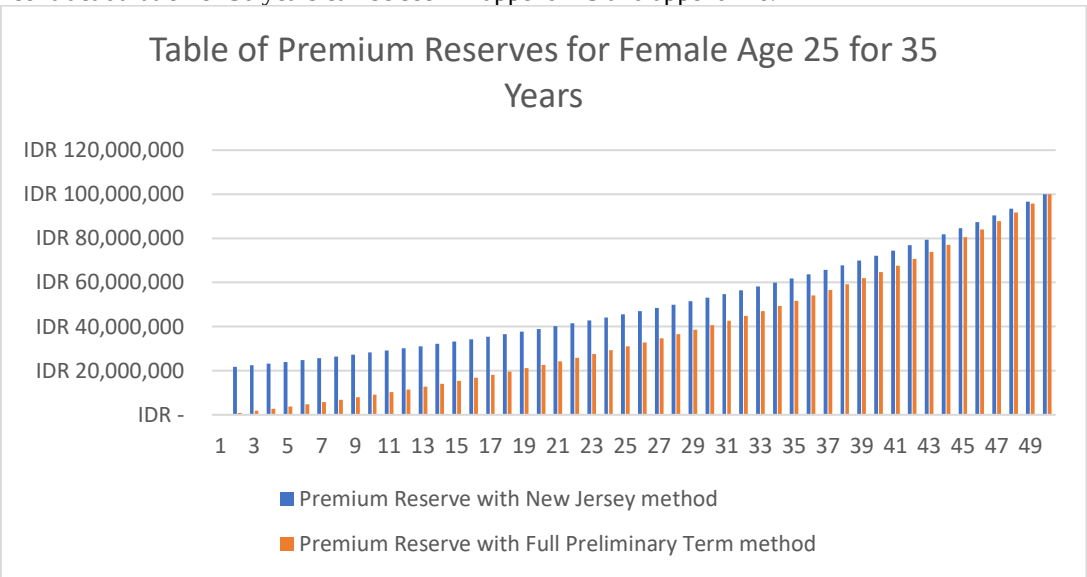

Figure 3. Premium Reserve for Female

For the comparison of premium reserves with the New Jersey method and premium reserves with the Full Preliminary Term method for male (25) and female (25) can be seen in Figure 4. At the end of the insurance term, the New Jersey method reserve value and the Full Preliminary Term method reserve value are the same as the benefit provided. This indicates that at the end of the insurance coverage period, the insurance company is ready to provide the promised compensation to the policyholder or the insured.

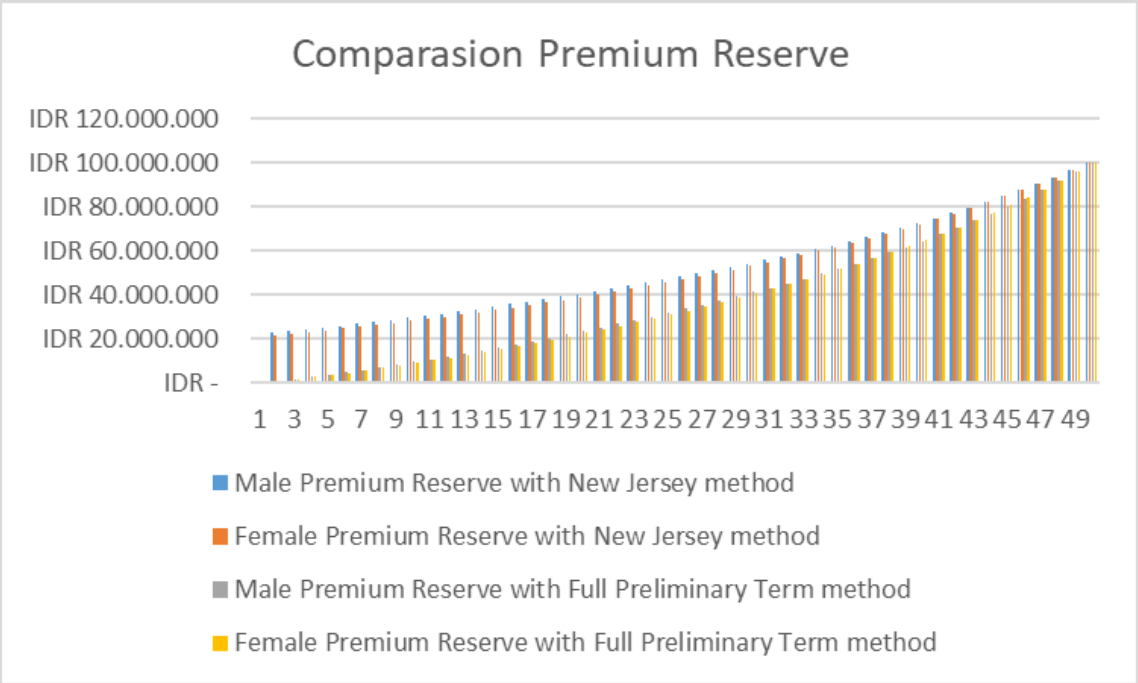

Figure 4. Premium Reserve for Male and Female

IV. CONCLUSION

Based on the results and discussion, it can be concluded that the calculation of premium reserves, either by the New Jersey method or the Full Preliminary Term method, is determined by the length of the insurance contract and the age of the insured at the time of insurance. From the simulation results that have been carried out, it can be seen that the premium reserve value for the New Jersey method is greater than the premium reserve value for the Full Preliminary Term method.

The results of the calculation of premium reserves using the New Jersey method show that in the 2nd year to the 49th year, the value of male's (25) premium reserves is greater than the value of female's (25) premium reserves. Meanwhile, in the 50th year, the premium reserves for male and female are of the same value.

The results of the calculation of premium reserves using the Full Preliminary Term method show that in the 2nd year to the 37th year, the value of male's (25) premium reserves is greater than the value of female's (25) premium reserves. Meanwhile, in the 38th year to the 49th year, the value of female's premium reserves is greater than the value of male's premium reserves, and in the 50th year, male's and female's premium reserves have the same value.

From all cases, it can be concluded that the New Jersey reserve value for male from 1st year to 49th year is greater than that for female. Meanwhile, for Full Preliminary Term reserves, the value of male's reserves from the 1st year to the 49th year is relatively always greater than that of female.

Based on the results above, it could be seen that the period of this research is 30 years longer than the previous research with a greater benefit of 90 million. This research could be used as a reference for insurance company to consider the better method in calculating premium reserves based on its policyholder profile. In further research, the premium calculation can be replaced by calculating continuous insurance premiums with non-constant interest rates and for premium reserves one can use the retrospective method, Zillmer, Canadian, Premium Sufficiency, or other methods. In addition, it can also examine premium reserves using the types of whole life insurance, term life insurance, and pure endowment life insurance.

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