



Determination of Monthly Term Health Insurance Premiums for Individuals Based on Gender

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Abstract

Health is one of the important aspects of human life, and protection against health risks is a necessity for every society. Health insurance is a solution in providing protection against financial risks from health. In its implementation, determining premiums is an important factor for insurance companies in order to cover claims from policyholders. Premiums are money paid by policyholders to insurance companies in order to receive benefits in the future. This study aims to determine the monthly premium for term health insurance which adjusted for each gender using actuarial approach. The premium is determined using the 2023 Indonesian Mortality Table and the Indonesian Morbidity Table I "Critical Illness". Based on this study, it was found that the value of the monthly term health insurance premium will increase if the policyholder's entry age and the insurance contract period increase. This study also found that the premium values for men were greater than the premium and reserve values for women if the policy entry age of the man or woman was over 30 years, in addition, the premium and reserve values for women were greater.

Keywords: Term Health insurance, Monthly Premium, Gender, Mortality Table, Morbidity Table.

1. Introduction

Health is an important aspect of life especially for a good social economy life (Asenso-Okyere et al., 2011). All human want to have a healthy life and not get sick in the way. When somebody get sick, they are going to spend a lot of money to pay for the treatment. Nowadays, treatment of a sickness keeps getting increased and more expensive. That's where health insurance come to cover the cost of a treatment.

To overcome the increasing treatment cost, health insurance is needed as a solution for it. Health insurance covers every medical costs that caused by sickness or injury (Priya, A. & Srinivasan, 2015). One kind of health insurance is term health insurance which covers every medical cost for a term that agreed by both of the policy holder and health insurance company.

In the practice, premiums is important for health insurance company. Premium is payment that paid by the policy holders for every period of time to health insurance company. These premiums paid with the hope of the coverage from the health insurance company in the future.

Research related to the determination of health insurance premiums has been conducted previously. First, Lahallo et al. (2013) conducted a study on the calculation of monthly premiums for hospital care health insurance for individuals, using an actuarial approach. Second, Pradipta et al. (2013) conducted a study related to the effect of interest rate changes on the calculation of annual net premiums for individual health insurance, where the premium was determined based on different interest rates, then its influence was analyzed. Third, there was a study conducted by Espinoza (2016) which contained the determination of monthly premiums for term health insurance for hospital care for individuals, where the monthly premium to be paid was calculated using the average cost of hospital care and with the actuarial method.

In this research, the calculation of premium is researched. The calculation used in this research is using actuarial approach with the expected claim got from the actual data using morbidity and mortality table.

2. Literature Review

2.1. Health Insurance

Insurance is a policy between the insurance company and the policy holders that give protection to policy holders with the premium that paid by policy holders so that the insurance company can cover the unexpected risk of the policy holders (Wetmen Sinaga, 2022). Health insurance is one kind of insurance that paid by premium, so that the medical and costs treatment covered by the health insurance company (Espinoza, 2016).

2.2. Mortality Table

Mortality table is a table that used to know the expected claim that caused by death, and a table that predicted how long can someone live. There are some important aspect of mortality table that written in equation (1) until equation (3).

$$l_x = l_{x-1} p_{x-1}, \quad (1)$$

$$p_x = \frac{l_{x+1}}{l_x}, \quad (2)$$

$${}_t p_x = \frac{l_{x+t}}{l_x}, \quad (3)$$

where,

l_x : the sum of people that lives aged x years,

p_x : the probabily of someone lives from age x to $x + 1$,

${}_t p_x$: the probabily of someone lives from age x to $x + t$.

There is also something important that comes derived from l_x which is force of mortality. Force of mortality is a instantaneous relative death rate (London, 1997). Force of mortality can be determinated by equation (4).

$$\mu_x = \frac{\frac{d}{dx} l_x}{l_x}, \quad (4)$$

where,

μ_x : force of mortality for age x .

2.3. Morbidity table

Morbidity table is a table that contains of morbidity rate of a population for a period of time. Usually, morbidity table gives morbidity rate for every age of the population. Every morbidity table can have a population of 1000, 10000, or more. The number of population is customized based on the researchers.

2.4. Interest

Interest is amount of payment that done by the user of the capital and the capital owner that the amount of the interest already decided by both parties (Futami, 1993). There are some important aspect such as interest rate (i), discount factor and force of interest. Discount factor is a present value of a payment of 1 that done one period after. Force of interest is used for continous payment. These aspects can be calculated using equation (5) and equation (6).

$$v = \frac{1}{1 + i}, \quad (5)$$

$$\delta = \log(1 + i), \quad (6)$$

where,

v : discount factor,

δ : force of interest

2.5. Monthly Term Life Annuities

Term life annuities is life annuities that paid for a certain term of time (Futami, 1993). There are two type of life annuities. Those are being life annuities that paid in every beginning period of time, and life annuities that paid in every of the end of a period of time. Monthly term life annuities that paid in the beginning can be calculated using equation (7) and the one that paid in the end of each period of time can be calculated using equation (8).

$$\ddot{a}_{\overline{x:\overline{n}|}}^{(12)} = \frac{1}{12} \sum_{t=1}^{12n-1} v^{\frac{t}{12}} {}_t p_x, \quad (7)$$

$$a_{\overline{x:\overline{n}|}}^{(12)} = \frac{1}{12} \sum_{t=1}^{12n} v^{\frac{t}{12}} {}_t p_x, \quad (8)$$

where,

$\ddot{a}_{\overline{x:\overline{n}|}}^{(12)}$: Monthly n -term life annuities that paid in the beginning from period x ,

$a_{\overline{x:\overline{n}|}}^{(12)}$: Monthly n -term life annuities that paid in the end from period x .

There is one approach that can approximate the monthly n -term life annuities, which is, Woolhouse Method. Using Woolhouse method, Monthly n -term life annuities that paid in the beginning from period x can be calculated using equation (9).

$$\begin{aligned} \ddot{a}_{s,\overline{x:\overline{n}|}}^{(m)} = & \sum_{i=0}^{n-1} v^i {}_i p_x - \frac{m-1}{2m} (1 + v^{n-1} {}_{n-1} p_x) \\ & + \frac{m^2-1}{12m^2} (-(\delta + \mu_x) + {}_{n-1} p_x \delta e^{-\delta(n-1)} + v^{n-1} {}_{n-1} p_x \mu_{x+(n-1)}). \end{aligned} \quad (9)$$

Using this method, force of mortality can be approximated using equation (10).

$$\mu_x \approx -\frac{1}{2} (\log({}_{x-1} p_x) + \log(p_x)). \quad (10)$$

2.6. Monthly Term Health Insurance Premium and The Reserve

Monthly term health insurance premium is a premium for health insurance that being paid monthly for a term period of time. Michael Cichon (1999) said that in the determination of health insurance premium can be calculated using per capita claim as the risk and actuarial method. The calculation of the premium uses equation (11) until equation (14).

$$\overline{KP}_{s,x,sickness} = P_{s,x,sickness}^{sh} \cdot \frac{TP_{sickness}}{L_{sickness}}, \quad (11)$$

$$\overline{K}_{s,x} = \sum_{sickness} \overline{KP}_{s,x,sickness}, \quad (12)$$

$$B_{s,\overline{x:\overline{n}|}} = \sum_{t=0}^{n-1} {}_t p_{s,x} \overline{K}_{s,x+t} v^t, \quad (13)$$

$$P_{s,\overline{x:\overline{n}|}}^{(12)} = \frac{B_{s,\overline{x:\overline{n}|}}}{12 \ddot{a}_{s,\overline{x:\overline{n}|}}^{(12)}}, \quad (14)$$

Where,

$\overline{KP}_{s,x,sickness}$: Average per capita claim for age x with gender s for sickness,

$P_{s,x,sickness}^{sh}$: Probability of someone age x with gender s get sickness ,

$TP_{sickness}$: Total amount of claim costs for a sickness,

$L_{sickness}$: The amount of sickness cases for a sickness,

$B_{s,\overline{x:\overline{n}|}}$: Benefit for n term health insurance for policy holders age x and gender s .

$P_{s,\overline{x:\overline{n}|}}^{(12)}$: Monthly-term Premium for n term health insurance for policy holders age x and gender s .

3. Materials and Methods

3.1. Materials

Object that will be used in this paper is the sample that created with the sickness coverage include Heart disease, Cancer, Stroke, Kidney Failure. The detail of the research object can be seen in Table 3.1.

Table 1: Research Object

No	Name	x	n	Sickness
1	Sample 1	20	5	Heart disease, Cancer, Stroke, Kidney Failure
2	Sample 2	30	5	Heart disease, Cancer, Stroke, Kidney Failure
3	Sample 3	40	5	Heart disease, Cancer, Stroke, Kidney Failure
4	Sample 4	50	5	Heart disease, Cancer, Stroke, Kidney Failure
5	Sample 5	60	5	Heart disease, Cancer, Stroke, Kidney Failure
6	Sample 6	20	10	Heart disease, Cancer, Stroke, Kidney Failure
7	Sample 7	30	10	Heart disease, Cancer, Stroke, Kidney Failure
8	Sample 8	40	10	Heart disease, Cancer, Stroke, Kidney Failure
9	Sample 9	50	10	Heart disease, Cancer, Stroke, Kidney Failure
10	Sample 10	60	10	Heart disease, Cancer, Stroke, Kidney Failure

The expected claim of every sickness is calculated using the catastrophic cost from “Profil Kesehatan Indonesia 2023” book (2024). The data collected from the book can be seen within Table 2.

Table 2: Catastrophic Cost

No	Sickness	Amount of Case	Cost (IDR)
1	Heart Disease	20,037,280	17,629,046,950,030.00
2	Cancer	3,864,086	5,979,918,075,905.00
3	Stroke	3,461,563	5,209,327,023,563.00
4	Kidney Failure	1,501,016	2,919,190,263,610.00

3.2. Methods

Methods that used in this research is the actuarial approach in calculate the premium and reserve using Tabel Mortalitas Indonesia tahun 2023 and Tabel Morbiditas Indonesia I “Penyakit Kritis”. The steps of the research are:

1. Determine the insurance policy contract that will be the object of this research.
2. Calculate the cash value of monthly term health insurance premiums for policyholders for each gender.
3. Calculate the cash value of monthly term health insurance premium reserves for each year for policyholders for each gender.

4. Results and Discussion

In this research, the interest rate that used is the Bank Indonesia rate on 18 December 2024 which is 0,06. So we can calculate the discount factor using this interest rate.

$$v = (1 + 0.06)^{-1}$$

$$v = 1.06^{-1}$$

The force of interest can be calculated using equation (2.6) and the discount factor that already been calculated.

$$\delta = \log(1 + i)$$

$$= \log(1.06)$$

$$\delta = 0.058268908123975824$$

So for the male sample of Sampel 1, we can calculate the benefit as follow.

$$\begin{aligned}
B_{male, \overline{20:5}|} &= \sum_{t=0}^{5-1} {}_t p_{male, x} \bar{K}_{male, x+t} v^t \\
&= {}_0 p_{male, 20} \bar{K}_{male, 20+0} v^0 + {}_1 p_{male, 20} \bar{K}_{male, 20+1} v^1 + {}_2 p_{male, 20} \bar{K}_{male, 20+2} v^2 + {}_3 p_{male, 20} \bar{K}_{male, 20+3} v^3 \\
&\quad + {}_4 p_{male, 20} \bar{K}_{male, 20+4} v^4 \\
&= 881.563530593183 + 897.4584869818099 + 919.0313570273723 + 940.0446277181367 \\
&\quad + 964.8335757637642 \\
&= 4602.931578084266
\end{aligned}$$

And then we can calculate the monthly term life annuities for male sample of sampel 1 using equation (2.9) as follow.

$$\begin{aligned}
\ddot{a}_{s, \overline{x:n}|}^{(12)} &= \sum_{i=0}^{n-1} v^i {}_i p_x - \frac{m-1}{2m} (1 + v^{n-1} {}_{n-1} p_x) + \frac{m^2-1}{12m^2} (-(\delta + \mu_x) + {}_{n-1} p_x \delta e^{-\delta(n-1)} + v^{n-1} {}_{n-1} p_x \mu_{x+(n-1)}). \\
\ddot{a}_{male, \overline{20:5}|}^{(12)} &= \sum_{i=0}^{5-1} v^i {}_i p_{40} - \frac{12-1}{2(12)} (1 + v^4 {}_4 p_{20}) + \frac{12^2-1}{12(12)^2} (-(\delta + \mu_{20}) + {}_4 p_x \delta e^{-\delta(4)} + v^4 {}_4 p_{20} \mu_{24}). \\
&= \sum_{i=0}^5 v^i {}_i p_{40} - \frac{11}{24} (1 + 0.7892720375946404) + \frac{143}{1728} (-0.012277991516929841) \\
&= {}_0 p_{pria, 20} v^0 + {}_1 p_{pria, 20} v^1 + {}_2 p_{pria, 20} v^2 + {}_3 p_{pria, 20} v^3 + {}_4 p_{pria, 20} v^4 - \frac{11}{24} (1.709895264222754) \\
&\quad + \frac{143}{1728} (-0.012277991516929841) \\
&= 1 + 0.942620754716981 + 0.8884956488341045 + 0.8374381625535083 + 0.7892720375946404 \\
&\quad - \frac{11}{24} (1.709895264222754) + \frac{143}{1728} (-0.012277991516929841) \\
&= 3.56236178121454
\end{aligned}$$

The monthly premium for male sample of sampel 1 can be calculated using equation (14) as follow.

$$\begin{aligned}
P_{s, \overline{x:n}|}^{(12)} &= \frac{B_{s, \overline{x:n}|}}{12 \ddot{a}_{s, \overline{x:n}|}^{(12)}} \\
P_{male, \overline{20:5}|}^{(12)} &= \frac{B_{male, \overline{20:5}|}}{12 \ddot{a}_{male, \overline{20:5}|}^{(12)}} \\
&= \frac{IDR4.602,93}{12(3.56236178121454)} \\
&= IDR107,68
\end{aligned}$$

With the same way as before, the monthly premium for each sample can be calculated.

Table 3: Monthly Premium

No	Name	x	n	$P_{male, \overline{x:n} }^{(12)}$	$P_{female, \overline{x:n} }^{(12)}$
1	Sample 1	20	5	IDR107,68	IDR120,03
2	Sample 2	30	5	IDR281,78	IDR328.70
3	Sample 3	40	5	IDR1,026.17	IDR1,050.49
4	Sample 4	50	5	IDR3,559.55	IDR2,153.68
5	Sample 5	60	5	IDR7,073.84	IDR4,330.68
6	Sample 6	20	10	IDR118,16	IDR131,81
7	Sample 7	30	10	IDR342,10	IDR380,66
8	Sample 8	40	10	IDR1,283.37	IDR1,149.86
9	Sample 9	50	10	IDR3,845.40	IDR2,246.00
10	Sample 10	60	10	IDR6,968.30	IDR4,333.71

According Table 3, The monthly premium value of term health insurance increases as the policyholder's age increases when entering the policy (x) and also increases as the insurance period increases. It can be seen that for the policy entry age (x) of 20 years, 30 years, 40 years, and 50 years, the monthly premium for term health insurance with the largest value is the premium for male policyholders with an insurance contract period (n) of 10 years. This is because the benefits provided are greater for male policyholders, and because a longer insurance contract period causes the benefits provided to also increase.

5. Conclusion

Based on the calculation results, it can be seen that the premium is more expensive for male policyholders than for female policyholders, this is because the chances of men getting critical illnesses are greater than for women, resulting in larger per capita claims and greater benefits for men. It also can be seen that the more the insurance contract period, the more the premium will be. The premium also increases as the age increase. This happens because the probability of somebody got sickness increases as the ages increase too.

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