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Article
Interest Rate in Pension Plan Premium Calculation

Khafsah Joebaedi[*1], Kankan Parmikanti[1], Agus Supriatna[1], Fauzi Akhmad[1] , Badrulfalah[1], Nendi Suhendi Syafei[2]

[1]Department of Mathematics, Faculty of Mathematics and Natural Science, Universitas Padjadjaran, Bandung, Indonesia
[2]Department of Electrical Engineering, Faculty of Mathematics and Natural Science, Universitas Padjadjaran, Bandung1, Indonesia

Abstract. The defined benefit pension plan and premium payment (normal dues) are determined by life annuities as life insurance instruments in the face of life risks. This research aims to analyze the relationship between the interest rate relationship is inversely proportional to the amount of the premium on the pension plan. The method used is to measure several variables, among others FSL (Future Service Liability), PVFSAL (Present Value Future Salary), PR (Pension Rate) and Premiums. Calculation, life annuity uses actuarial assumptions, one of which is the interest rate assumption, if the assumptions used are not in accordance with the actual conditions, then what happens is excessive payments or deficient payments. The interest rate has an influence in the process of calculating the defined benefit pension plan premium. Using the assumption of different interest rates (11%, 12 % and 13%), it is found that the interest rate relationship is inversely proportional to the amount of the premium. The results of this study are FSL, PVFSAL, PR and Premiums for the interest of 11%, 12% and 13% (participants aged 25 years) as follows 720,187.97; 554,000,24; 430,570.07 (FSL in Rupiah); 27,155,187.70; 24,922,770,59; 23,002,699.40 (PVFSAL in Rupiah); 2.6521; 2.2229; 1.8718 (PR in%) and 55,535.38; 46,546.85; 39,196.00 (Premiums in Rupiah)The higher the interest rate, the smaller the pension premium and vice versa.
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Corresponding Author :
Khafsah Joebaedi
Department of Mathematics, Faculty of Mathematics and Natural Science (FMIPA)

Universitas Padjadjaran, Bandung, Indonesia
Email : khafsah.joebaedi@unpad.ac.id

1. Introduction

Pension fund funding either in order to meet the requirements or for the purpose of managing financial management will cause the occurrence of wealth which will later be used to pay pension benefits and administrative costs(1-3). In practice, the urgency of the pension program is applied with the precautionary principle because pension funds must also pay attention to wealth for funding. This means that the wealth of the pension fund is calculated to determine the quality of the Pension Fund funding and the existence of solvency obligations and actuary obligations that must be fulfilled in the program. But in reality, there are still not many optimal studies to examine this issue in depth(4-13).

A Pension Fund formed by a person or entity that employs employees, as the founder, to hold a pension program. In a pension program, the amount of pension benefits received by participants at retirement is determined in advance based on a formulation of pension benefits in accordance with the applicable pension fund regulations, then the contribution fee / premium is calculated. To estimate the amount of actuarial liabilities, it is based on applicable actuarial assumptions[14]. Actuarial assumptions are calculations of future changes, which apply to actuarial valuations. So that in each assessment period, adjustments can arise that arise from differences between assumptions and reality, including because changes in the assumptions themselves, referred to as Actuarial Advantages and Disadvantages[15]. Or if the actual situation is not in accordance with the prevailing assumptions, then there is excessive or under-financing (payments that are actuarially unfair)[14].

This paper aims to analyze mathematically the relationship between pension plans implemented by various parties, and their relationship with the pension benefits received later. The analysis will consider the assumptions about the premiums issued by participants by mathematical modeling and the value of the benefits to be obtained later for participants of the pension fund program. With this study, it will be seen how the relevance of the pension fund premiums and other actuarial obligations related to the pension fund program so that the relationship between the pension fund program and the pension premiums can be identified as well as the benefits obtained by participants in the future.

2. Experimental Section

This research approach uses a quantitative method, which uses a framework of thought and theory to be developed into a data analysis, where this approach is based more on data calculated for a strong quantitative estimation. In this research, the approach was made in the form of mathematical assumptions and interpreted in groups based on the aims, benefits and time of the study. This type of research based on its purpose is an explanatory research because this study presents an overview and exposes it in research, and is carried out to find an explanation of why an event or event occurred. The final result of this research is a description of the causal relationship.

Data collection in this research is to reduce mathematical equations and conduct a literature study based on articles, scientific papers and journals related to interest rates and retirement planning. The problems to be discussed are Changes in actuarial assumptions at the interest rate and the impact of actuarial assumption changes in the pension program premium calculation process, as well as knowing the benefits or losses for participants due to changes in these assumptions. The assumptions used are 11%, 12% and 13% interest. The age of the participants used was 25 years. Measurement variables in this research are others FSL (Future Service Liability), PVFSAL (Present Value Future Salary), PR (Pension Rate) and Premiums.

3. Results and Discussion
3.1 Calculation of the Pension Program
Pension fund calculation requires supporting data from pension program participants, among others [5]; current age (at valuation), age when starting work and current monthly salary. These three variables will be the determining factor for calculating how the FSL and PSVSAL values will be measured. In this measurement the following formula is used;

3.1.2. Calculating *FSL (Future Service Liability)*
Future Service Liability use equations

Amount of FSL = PPNC$_{FSL}$ + PPJDP$_{FSL}$

where:

$$\text{PPNC}_{FSL} = 2{,}5\%.PhDP.mkd.(a\ell)_x^{ra,ia}$$

$$\text{PPJDP}_{FSL} = 60\%.2{,}5\%.PhDP.mkd(x).^{z,zr}(a\ell)_x^{d(wa)}$$

$$(a\ell)_x^{ra,ia} = (^z\overline{M}_x^{ra}/{_sD_x}) + (^z\overline{M}_x^{ia}/{_sD_x})$$

$$^{z,zr}(a\ell)_x^{d(wa)} = (^z\overline{M}_x^{d(wa)}/{_sD_x}) + (^{zr}\overline{M}_x^{d(wa)}/{_sD_x})$$

3.1.2. Calculating *PVFSAL (Present Value Future Salary)*
Present Value Future Salary use equations

$$(PVFSAL)_x = \frac{PhDP}{{^sD_x}}\,{^s\overline{N}_x}$$

To calculate the Normal Fee in the form of a percentage (*PR*), that is

$$PR = \frac{\dfrac{FSL}{PVFSAL}}{}\times 100\%$$

Normal contributions in rupiah have a formula: Amount PhDP $\times PR$

Measurements made with the formula above produce FSL, PVFSAL, PR and premium with i = 12% and i = 13% are presented in table 1

Table 1 Results of the calculation of the *FSL* amount, *PVFSAL* amount, and premiums with *i*=11%, *i*=12%, dan *i*=13%

Interest Rate (*i*)	*FSL* amount (Rp)	*PVFSAL* amount (Rp)	*PR* (%)	Normal Fee (Rp)
11%	27.333.109,19	828.037.630,13	3,3	2.896.844,51
12%	22.771.063,92	777.461.394,73	2,9	2.570.340,81
13%	19.176.892,93	732.771.326,93	2,6	2.296.656,26

3.2 Calculation of Pension Fund for a person with *x*-years old
The pension fund calculation is illustrated in a retired participant at 25 years with changes in assumptions at the interest rate of 11%, 12%, and 13% as follows:

FSL calculations of 25 years are as follows:

$$FSL = 2{,}5\%.PhDP.mkd(x).(a\ell)_x^{ra,ia} + 60\%.2{,}5\%.PhDP.mkd(x).^{z,zr}(a\ell)_x^{d(wa)}$$

Will be calculated $(a\ell)_x^{ra,ia} = (^z\overline{M}_x^{ra}/_sD_x) + (^z\overline{M}_x^{ia}/_sD_x)$

for normal retirement participants with $x = 25$, $i= 11\%$ obtained

$$^z\overline{M}_{25}^{ra}/_sD_{25} = \frac{(^zM_{25}^{ra} + {}^zM_{25+1}^{ra})1/2}{l_{25}.v^{25+1/2}.s_{25}}$$

for pensioners with disabilities with $x = 25$, $i = 11\%$ obtained

$$^z\overline{M}_{25}^{ia}/_sD_{25} = \frac{(^zM_{25}^{ia} + {}^zM_{25+1}^{ia})1/2}{l_{25}.v^{25+1/2}.s_{25}}$$

Next calculation: $^{z,zr}(a\ell)_x^{d(wa)} = (^z\overline{M}_x^{d(wa)}/_sD_x) + (^{zr}\overline{M}_x^{d(wa)}/_sD_x)$

for widow / widower retirement participants because they died with $x = 25$, $i = 11\%$

$$^z\overline{M}_{25}^{d(wa)}/_sD_{25} = \frac{(^zM_{25}^{d(wa)} + {}^zM_{25+1}^{d(wa)})1/2}{l_{25}.v^{25+1/2}.s_{25}}$$

for retired widow / widower retirement participants with $x = 25$, $i= 11\%$

$$^{zr}\overline{M}_{25}^{d(wa)}/_sD_{25} = \frac{(^{zr}M_{25}^{d(wa)} + {}^{zr}M_{25+1}^{d(wa)})1/2}{l_{25}.v^{25+1/2}.s_{25}}$$

PVFSAL calculation of 25 years are as follows:

$$(PVFSAL)_{25} = \frac{PhDP}{^sD_{25}}\,{}^s\overline{N}_{25}$$

Calculation of pension contributions and benefits

Contributions to participants of defined benefit pension plans at 25 years are:

Annual contribution $= \dfrac{FSL}{PVFSAL} \times 100\% \times PhDP$

Benefits per year $= 12 \times PhDP \times$ work period $\times 2{,}5\%$

With the same formulation, it is also calculated for $i =12\%$ and $i =13\%$ with the results presented in the table 2

Table 2 The results of FSL, PVFSAL and Premium participants retirement aged 25 years with i =11%, i = 12%, and i = 13%

Interest Rate (*i*)	0,11	0,12	0,13
FSL (Rp)	720.187,97	554.000,24	430.570,07
PVFSAL (Rp)	27.155.187,70	24.922.770,59	23.002.699,40
PR (%)	2,6521	2,2229	1,8718
Premiums (Rp)	55.535,38	46.546,85	39.196,00
Benefits per year (Rp)	18.846.000,00	18.846.000,00	18.846.000,00

From the above calculation it can be seen that the pension program with attractive interest variations, 11%, 12% and 13%, gives a difference in the benefits obtained by participants. At the 11% interest offered, the interest charged to the participants reached 2.6% and the premium charged was IDR 55,535.38 with greater liability. Liability charged to participants reaches Rp. 720,187.97 and the value of assets to come to Rp 27,155,187.70 (the highest compared to i 12% and i 13%).

In the higher interest rates, which are 12% and 13%, it turns out that the pension interest is also low, which is 2.2229% and 1.8718% for i = 12% and i = 13%. This decrease is also in line with the decline in the value of FSL and PVFSAL, namely Rp. 24,922,770.59 (PVFSAL for i = 12%) and Rp. 23,002,699.40 (PVFSAL for i = 13%), while for the FSL respectively at i = 12 % is Rp.554,000.24 and at i = 13% is Rp. 430,570.07. The value obtained from this measurement can reflect the benefits obtained by participants in the pension plan based on the interest given.

Based on the results of this study it appears that there is a tendency for an increase in the value of the benefits obtained by participants if the interest offered is small in the same time frame. Pension fund participants should choose a program that has a small pension fund interest rate, in order to get more benefits and benefits. Conversely, the higher the interest of the pension fund program offered, the smaller the benefits obtained by participants of the pension fund program[16].

4. Conclusion

After completing the authors get several conclusions, including In calculating the pension plan, the assumption factors used greatly influence the results of the calculation. From the results of the discussion it can be shown that the impact of changes in interest rate assumptions is very influential in the valuation of the retirement program so that the relationship between changes in interest rate assumptions is inversely proportional to the amount of premiums generated. The higher the interest rate will cause the premium to decrease and vice versa. With higher interest rates, the participants of the Pension Program will benefit because with the same pension benefits, the higher the interest rate, the lower the premiums issued by participants and vice versa. Of the three offered interest variables (11%, 12% and 13%), then to get more benefits, the interest on the pension program is 11%.

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