Available online at http://www.iorajournal.org/index.php/ijgor/index

International Journal of Global Operations Research

e-ISSN: 2722-1016
p-ISSN: 2723-1739

Vol. 5, No. 3, pp. 153-163, 2024

Pension Fund Calculations for Regular Retirees Using the Projected Unit Credit Method and the Individual Level Premium Method in the Case Study PT Dynacast Indonesia.

Atha Hukama[1*], Rizcki Pangestu[2], Grida Saktian Laksito[3]

[1,2] *Undergraduate Program in Mathematics, Faculty of Mathematics and Natural Science, Padjadjaran University, Sumedang, Indonesia*

[3]*Faculty of Business, Economics and Social Development, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia*

**Corresponding author email: atha21001@mail.unpad.ac.id*

Abstract

The pension program provider requires actuarial valuation to estimate the necessary fund amount for pension payments. This research employs the projected unit credit and individual level premium methods. The findings indicate that the valuation of pension benefits, assuming a career average salary, is lower compared to other salary assumptions. Conversely, the final valuation of project unit credit using the individual level premium method is smaller than that of the projected unit credit method, which is more suitable for participants in the pension funding program. A pension fund program represents a form of future planning aimed at ensuring the well-being of employees during retirement. It embodies a company's responsibility towards employees who have dedicated themselves during their working years. Such a program offers a sense of security regarding an employee's financial future post-retirement and fosters peace of mind, knowing that their well-being in old age is assured.

Keywords: Projected unit credit method, individual level premium method, pension fund, salary.

1. Introduction

A pension fund program is one form of future planning aimed at ensuring the livelihood of employees during retirement. It represents a company's responsibility towards employees who have devoted themselves during their working years. Such a pension fund program can provide a sense of security regarding an employee's financial well-being after they are no longer active, creating peace of mind for employees as their welfare in old age is assured (Ubaidillah, 2020).

Several companies have ensured the well-being of their employees in old age by implementing pension fund programs (Aitken, 1994). Therefore, companies purchase pension insurance. The amount of premium each employee must pay in pension insurance is referred to as the normal contribution. Normal contributions are deducted from employees' salaries and then invested during their working years, allowing the accumulation of sufficient funds to pay pension benefits and maintain participants' income continuity in old age. Pension benefits are paid out when employees reach a certain retirement age according to the regulations of the pension fund (Von Nordheim, 2023).

Several reasons cause an employee to retire, such as death while still actively working, leading to the payment of widow/widower pension benefits, voluntary retirement before the official retirement age, leading to pension payments upon reaching retirement age based on their length of service, an active employee becoming disabled and unable to work, or an employee reaching retirement age and receiving immediate pension payments (Futami, 1993b).

The retirement of many employees in a company is often unpredictable, resulting in uncertain decreases in the workforce for the company. This necessitates the company to pay pension benefits to its employees. Therefore, if a company does not prepare for and calculate annuity payments for employees in the form of a pension fund program, it can lead to financial difficulties for the company resulting in unstable company finances. Based on this, it is necessary to conduct specific calculations to project the funds that the company will need to pay its employees' pensions. The

amount of pension benefits to be received and the normal contributions that employees must pay can be calculated using available actuarial calculation methods.

The actuarial calculation methods that can be used include the projected unit credit method and the individual level premium method. The projected unit credit method divides the total pension benefits, which are then allocated over the working period, while the individual level premium method evenly allocates total pension benefits from the actuarial valuation date (SR, 2024). Both methods use salary scale assumptions that will be estimated in the future (future value) and assume that salaries will increase. There are three types of salary scale usage in calculating pension benefits: final salary plan, average salary plan for the last n years, and average salary plan throughout employment. Pension benefits will be paid out equally each year during the retirement period (Lin, 2021).

Several studies on pension fund calculations have been conducted, including those by Pratiwi (2008) and Hapsari (2012). Pratiwi's research (2008) indicates that the normal contribution and pension benefits based on average salary throughout employment are smaller compared to formulations based on fixed income benefits, whereas based on the final average salary, the normal contribution and pension benefits are larger compared to fixed income benefits. Hapsari's study (2012) shows that the normal contribution size using the projected unit credit method continues to increase with the increase in received salaries, while if the entry age normal method is used, the size remains the same for each year for an employee.

Based on this, the author is interested in calculating the normal contributions paid annually by participants in the pension program and the amount of benefits obtained based on the three salary scale assumptions mentioned earlier, using both the projected unit credit method and the individual level premium method. Furthermore, a comparison of the calculation results between the two methods will also be conducted.

2. Literature Review

2.1 Pension Fund

The pension fund program is a form of government remuneration for civil servants who have dedicated themselves to the state for many years (Taspen, 2013). In the pension fund system, there are several benefits provided as additional benefits for death, early retirement (exit), retirement due to disability, and retirement at retirement age. The additional benefits are as follows (Futami, 1993b):

1. Widow/widower pension benefits paid in case of death.
2. Early retirement pension benefits paid to participants who stop working or exit.
3. Disability pension benefits paid to participants unable to work due to disability.
4. Retirement pension benefits paid to participants who have reached retirement age.

2.2 Multiple Depreciation Tables

Multiple Decrement Table contains the probabilities of employee retirement due to early retirement (exit), death, and retirement due to disability. The probabilities of employee retirement between ages x and x + 1 years in a company caused by early retirement (exit), death, and retirement due to disability, respectively, are (Futami, 1993b):

$$q_x^{(w)} = \frac{w_x}{l_x^{(T)}}, q_x^{(d)} = \frac{d_x^t}{l_x^{(T)}}, q_x^{(i)} = \frac{i_x}{l_x^{(T)}}$$

Therefore, the probability of employees still actively working between ages x and x + 1 years, denoted as $P_{x^{(T)}}$, is

$$p_x^{(T)} = 1 - q_x^{(d)} - q_x^{(w)} - q_x^{(i)}$$

2.3 Benefit Function

The benefit function is used to determine the amount of benefits paid upon early retirement (exit), death, retirement due to disability, or retirement at retirement age. If Br is the total benefit amount during the participant's active working years from age e to age r, while the annual benefit received by a participant aged x years is bx (Aitken, 1994):

$$b_x = \frac{b_r}{r - e}$$

The benefit obtained by participants in the pension program is a proportion of the salary, amounting to k percent, accumulated over the working period $(x - e)$ years based on three salary scales, namely:

1. Final salary assumption
   The final salary at age $r-1$, denoted as $sr{-}1$, is formulated as:

$$s_{r-1} = (1+s)^{r-1-x} s_x$$

Therefore, the pension benefit to be paid until age x years, denoted as Bx, is formulated as:

$$B_x = k s_{r-1}(x-e)$$

2. Average salary assumption for the last n years
   The expected average salary for the last n years (Final Average Salary) is:

$$FAS = \frac{1}{n}(1+s)^{r-x-1}[(1+s)^{1-n} + \cdots + 1]s_x$$

$$= \frac{1}{n}(1+s)^{r-x-1}\ddot{a}_{n|s}s_x$$

Therefore, the pension benefit that still needs to be paid until reaching age x years is:

$$B_x = k\ FAS\ (x-e)$$

3. Average salary assumption throughout employment
   The expected average salary throughout employment is:

$$\frac{1}{r-e}[s_e + \cdots + s_x + s_{x+1} + \cdots + s_{r-1}]$$

$$= \frac{1}{r-e}\left[\frac{s_x}{(1+s)^{x-e}} + \cdots + s_x + (1+s)s_x + \cdots + (1+s)^{r-x-1}s_x\right]$$

$$= \frac{1}{r-e}s_x(1+s)^{e-x}[1 + \cdots + (1+s)^{x-e} + (1+s)^{x-e+1} + \cdots + (1+s)^{r-e-1}$$

The final value of annuity carried out over $r-e$ years with an increase of s, denoted as

$$\frac{1}{r-e}s_x(1+s)^{e-x}s_{r-e|s}$$

Therefore, the benefit obtained by employees until reaching age x years is:

$$B_x = \frac{k}{r-e}[s_x(1+s)^{e-x}s_{r-e|s}](x-e)$$

The Present Value of Future Benefit (PVFB) is the present value of the pension benefits that a participant in the pension fund program will receive when the participant reaches retirement age, which is when the participant is r years old. Pension benefits are paid out annually until the participant passes away. Winklevoss (1993) cited in Oktiani (2013), states ${}^{r}(PVFB)_x$ formulated as follows:

$${}^{r}(PVFB)_x = B_r v^{r-x}\ddot{a}_{r\,r-x}p_x$$

2.4 Actuarial Calculation Method

The actuarial calculation methods used in this study are the projected unit credit method and the individual level premium method.

2.4.1 Projected Unit Credit Method

The projected unit credit method involves dividing the total pension benefits at normal retirement age by the total service period to obtain units of pension benefits, which are then allocated to each year during the service period (Bowers, et al. 1997). Normal contributions under the projected unit credit method ${}^{PUC}(NC_x)$ formulated as:

$${}^{PUC}(NC_x) = b_x\frac{D_r^{(T)}}{D_x^{(T)}}\ddot{a}_r$$

Based on the definition of normal contributions using the projected unit credit method, we obtain:

$$^{PUC}(NC_x) = \frac{1}{r-e}\ddot{a}_r \ {}^r(PVFB)_x$$

$$= \frac{1}{r-e} B_r \ddot{a}_r v^{r-x}\, {}_{r-x}p_x{}^{(T)}$$

$$\text{Because } {}_{r-x}p_x{}^{(T)} = \frac{l_r^{(T)}}{l_x^{(T)}}$$

$$= \frac{1}{r-e} B_r \ddot{a}_r \frac{v^r}{v^x} \frac{l_r^{(T)}}{l_x^{(T)}}$$

(Based on the commutation function)

$$= \frac{1}{r-e} B_r \ddot{a}_r \frac{D_r^{(T)}}{D_x^{(T)}}$$

2.4.2 Individual Level Premium Method

The individual level premium method is a method that falls under the projected benefit cost method group. This method entails the present value on the actuarial valuation date of the total pension benefits allocated evenly over each year of service, from the actuarial valuation date to the normal retirement age. The method utilizes assumptions about salary escalation with a predetermined annuity amount based on past and future work periods (Jonatan, 2006).

The normal contribution amount using the individual level premium method is formulated as follows (Aitken, 1994):

$$NC\left(\frac{N_e^{(T)} - N_r^{(T)}}{D_e^{(T)}}\right) = B_r \ddot{a}_r \frac{D_r^{(T)}}{D_e^{(T)}}$$

Essentially, the normal contributions paid by participants periodically (PVFNC) from when the participant is e years old until r years old are used to pay the benefits (PVFB) the participant will receive upon retirement. Therefore, the present value of the normal contributions when the participant is e years its value will be the ${}^r(PVFNC)_e$ same as the present value of the pension benefits when the participant is e years ${}^r(PVFNC)_e$

Therefore, we obtain the equation:

$$^r(PVFB)_e = {}^r(PVNC)_e$$

The Present Value of Future Normal Cost (PVFNC) is the present value of the normal contributions paid periodically by participants, starting from when the participant is e years old until reaching retirement age at $r-1$ years old, ${}^r(PVFNC)_e$ denoted as The regular payment amount of normal contributions made at the beginning of each year, denoted as NC, starts from when participants enter the pension program (at age a years) until reaching retirement age (at age $r-1$ years), can be illustrated by the payment scheme as shown in the diagram below.

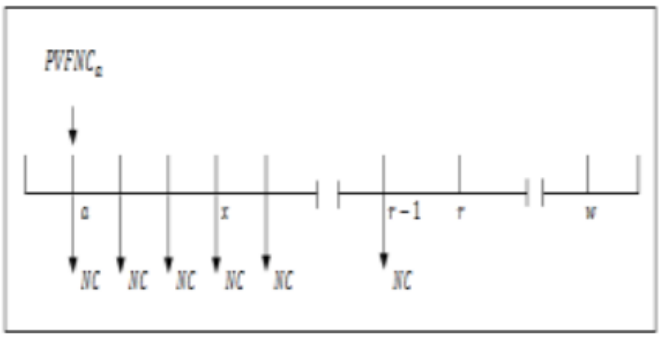

Figure 1: Scheme of Normal Contribution Payments During Employment

Based on the payment scheme in Figure 2, the regular payment of normal contributions during the participant's working period from age a years to age $r-1$ years is:

$$1 + vp_a + v^2\,{}_2p_a \ + \cdots + v^{r-1-a}\,{}_{r-1-a}p_a$$

$$= \ddot{a}_{a:r-a}$$

Therefore, the present value of normal contributions when the participant is a years old, denoted ${}^{r}(PVNC)_e$ as

$${}^{r}(PVNC)_e = NC(\ddot{a}_{a:r-a})$$

Assuming that the participant's age upon entering the pension program is the same as the participant's age upon starting work ($a = e$). Therefore, we obtain the equation:

$${}^{r}(PVNC)_e = NC(\ddot{a}_{a:r-a}) = NC\left(\frac{N_e^{(T)} - N_r^{(T)}}{D_e^{(T)}}\right)$$

Based on that, the equation becomes

$$NC\left(\frac{N_e^{(T)} - N_r^{(T)}}{D_e^{(T)}}\right) = B_r \ddot{a}_r \frac{D_r^{(T)}}{D_e^{(T)}}$$

$$N = B_r \ddot{a}_r \frac{D_r^{(T)}}{N_e^{(T)} - N_r^{(T)}}$$

Therefore, the calculation of normal contributions using the individual level premium method when the participant is x years ${}^{ILP}NC_x$ can be formulated as:

$${}^{ILP}NC_x = B_r \ddot{a}_r \frac{D_r^{(T)}}{N_e^{(T)} - N_r^{(T)}}$$

3. Materials and Methods

3.1. Projected Unit Credit Method and Individual Level Premium

The Projected Unit Credit method involves dividing the total pension benefits at normal retirement age by the total service period to obtain units of pension benefits, which are then allocated to each year during the service period (Bowers, et al. 1997). The normal contribution under the projected unit credit ${}^{PUC}(NC_x) = b_x \frac{D_r^{(T)}}{D_x^{(T)}} \ddot{a}_r$ method is formulated with equation (1.13) (Aitken, 1994).

The projected unit credit method involves dividing the total pension benefits at normal retirement age by the total service period to obtain units of pension benefits, which are then allocated to each year during the service period (Bowers, 1997). Normal pension benefits at age x are defined as follows:

$$B_x = \frac{(x-e)}{(r-e)} B_r$$

Pension Individual Level Premium contributions are obligations paid by participants of a pension fund program to the company according to the regulations of the pension fund. Pension contributions paid by participants of the pension fund program from the time they join the pension fund program until they enter retirement can be calculated using the equation:

$$(NC)_x = \frac{B_r}{r - y_{x-y}} \, p_x^{(T)} v^{r-x} d_r$$

With benefit :

$$b_x = \frac{B_r}{r-y}$$

3.2. Methods

The type of data used in this study is quantitative data, namely the salaries of employees at PT Dynacast Indonesia, in the form of participant data in the pension program, consisting of employee salaries and the proportion of salaries allocated for pension benefits. In this research, employee data taken randomly are used for pension fund calculations.

4. Results and Discussion

The following is a case example applied to PT Dynacast Indonesia. A female private sector employee in the barrel industry began participating at the age of 27 (e = 26) and will start counting retirement from January 1, 2030, at the age of 57 (r = 57). The basic salary in the first year (S_e) received annually is Rp20,000,000. According to the regulations of PT Dynacast Indonesia, the calculation of pension financing will commence when the participant reaches the age of 36 (x = 36).

4.1 Calculation of Pension Benefit

Based on the assumption of 3 salary scales is as follows:

4.1.1 The assumption of the final salary

$$s_{56} = (1 + 5\%)^{57-1-26} s_{26}$$
$$= (1{,}05)^{30}\ 20.000.000$$
$$= \text{Rp } 86.438.847$$

The retirement benefits that the participant will receive upon retirement are as follows:

$$B_{57}^{(1)} = 2{,}25\%(57 - 26)s_{56}$$
$$= (0{,}0{,}6975)\ 86.438.847$$
$$= 60.291.095{,}78$$

So the total amount of pension benefits that will received by participants is $Rp60.291.095{,}78$

4.1.2 Assumed average salary for the last 5 years

We will do the calculation for $\ddot{a}_{5|0{,}05}$ first, follows:

$$\ddot{a}_{5|0{,}05} = (1 + 0{,}05)^{-4} + \cdots + (1 + 0{,}05)^{0}$$
$$= 0{,}822702 + \cdots + 1$$
$$= 4{,}545951$$

The calculation of the salary scale assuming the average salary for the last 5 years is:

$$FAS = \frac{1}{5}\ (1 + 5\%)^{57-26-1} \ddot{a}_{5|0{,}05} s_{26}$$
$$= \frac{1}{5}(1{,}05)^{30}(4{,}545951)(20.000.000)$$
$$= 78.589.353{,}05$$

The pension benefits that participants will receive at the time of retirement are

$$B_{57}^{(2)} = 2{,}25\%\ (FAS)(57 - 26)$$
$$= 2{,}25\%\ (78.589.353{,}05)(57 - 26)$$
$$= 54.816.073{,}75$$

So the total amount of pension benefits that will received by participants is $Rp54.816.073{,}75$

4.1.3 Assumed average salary during employment:

In this case it is known that the salary in the first year s_e, then:

$$\frac{1}{r-e}[s_e + \cdots + s_{r-1}]$$
$$= \frac{1}{r-e}[s_e + \cdots + s_e(1 + s)^{r-1-e}]$$

$$= \frac{1}{r-e} s_e[1 + \cdots + (1+s)^{r-1-e}]$$

$$= \frac{1}{r-e} s_e s_{r-1|s}$$

The calculation for $s_{57-26|0,05}$ is:

$$s_{31|0,05} = 1 + \cdots + (1+s)^{57-1-26}$$

$$= 1 + \cdots + 4{,}321942$$

$$= 70{,}760790$$

Calculation of the salary scale assuming the average salary during employment is:

$$= \frac{1}{57-26} s_{26} s_{31|0,05}$$

$$= \frac{1}{31}(20.000.000)(70{,}760790)$$

$$= 45.652.122{,}58$$

The pension benefits that participants will receive at the time of retirement are

$$B_{57}^{(3)} = 2{,}25\%\ (45.652.122{,}58)(57-26)$$

$$= 31.842.355{,}5$$

So the total amount of pension benefits that will received by participants is $Rp31.842.355{,}5$

4.2 Calculation of Present Value of Future Benefit

4.2.1 The assumption of the final salary

$$^{57}(PVFB)_{34}\ ^{1} = B_{57}^{(1)} \ddot{a}_{57} v^{57-36}\ {}_{57-36}p_{36}^{(T)}$$

$$= B_{57}^{(1)} \frac{N_{57}}{D_{57}}\ v^{57-36}\ {}_{57-36}p_{36}^{(T)}$$

$$= 47.802.017{,}06$$

So the present value of total pension benefits at the age of 34 years is $Rp47.802.017{,}06$

4.2.2 Assumed average salary for the last 5 years last

$$^{57}(PVFB)_{34}\ ^{2} = B_{57}^{(2)} \ddot{a}_{57} v^{57-36}\ {}_{57-36}p_{36}^{(T)}$$

$$= B_{57}^{(2)} \frac{N_{57}}{D_{57}}\ v^{57-36}\ {}_{57-36}p_{36}^{(T)}$$

$$= 43.461.125{,}71$$

So the present value of total pension benefits at the age of 34 years is $Rp43.461.125{,}71$

4.2.3 Assumed average salary during employment

$$^{57}(PVFB)_{34}\ ^{3} = B_{57}^{(3)} \ddot{a}_{57} v^{57-36}\ {}_{57-36}p_{36}^{(T)}$$

$$= B_{57}^{(3)} \frac{N_{57}}{D_{57}}\ v^{57-36}\ {}_{57-36}p_{36}^{(T)}$$

$$= 25.246.328{,}69$$

So the present value of total pension benefits at the age of 34 years is $Rp25.246.328{,}69$

4.3 Calculation of normal contributions using the actuarial method

4.3.1 Projected unit credit method

Calculation of normal contributions using the projected unit credit method is:

$$^{PUC}NC_{36} = \frac{B_{57}^{(3)}}{(r-e)} \frac{D_{57}^{(T)}}{D_{36}^{(T)}} \ddot{a}_{57}$$

$$= \frac{B_{57}^{(3)}}{(r-e)} \frac{l_{57}^{(T)} v^{56}}{l_{36}^{(T)} v^{36}} \ddot{a}_{57}$$

$$= \frac{31.842.355,5}{(57-26)} \frac{126,805}{1.323,722} (8,276628)$$

$$= 814.397,666$$

So the normal contribution that must be paid participants when they are 34 years old is $Rp814.397,666$

4.3.2 individual level premium method

The calculation of normal contributions using the individual level premium method is:

$$^{ILP}NC_{36} = \frac{B_{57}^{(3)} D_{57}^{(T)}}{N_{26}^{(T)} - N_{57}^{(T)}} \ddot{a}_{57}$$

$$= \frac{B_{57}^{(3)} (l_{57}^{(T)} v^{57})}{D_{26}^{(T)} + D_{27}^{(T)} + \cdots + D_{56}^{(T)}} \frac{N_{57}}{D_{57}}$$

$$= \frac{31.842.355,5\ (126,805)}{36.752,72962} (8,276628)$$

$$= 909.296,2528$$

So the normal contribution payment made each year by the participant when 34 years old is equal to

$$Rp909.296,2528$$

In the same way, the calculation of the present value of total pension benefits, financing normal contribution each year, and the final value of normal contribution financing can be calculated for

$$x = 26\ until\ x = 57.$$

4.4 Calculation of the final value of financing contributions with the actuarial method is:

4.4.1 projected unit credit method

Calculation of the final value of financing contributions with the projected unit credit method is:

$$^{PUC}NA = \sum_{x=26}^{x=56} {}^{PUC}(NC)_x (1+i)^{57-x}$$

$$= {}^{PUC}(NC)_{26}(1,1)^{31} + \cdots + {}^{PUC}(NC)_{57}(1,1)^{1}$$

$$= (4.258.876) + \cdots + (9.861.251)$$

$$= 347.287.345$$

So, the total final value of normal contribution financing normal contribution financing with the projected unit credit method is $Rp347,287,345, -$

4.4.2 individual level premium method

Calculation of the final value of contribution financing with the individual level method premium method is:

$$^{ILP}NA = \sum_{x=26}^{x=56} {}^{ILP}(NC)_x (1+i)^{57-x}$$

$$= {}^{ILP}(NC)_{26}(1,1)^{31} + \cdots + {}^{ILP}(NC)_{57}(1,1)^{1}$$

$$= (909.296,2528)(19,194342) + \cdots + (814.397,666)(1,1)$$

$$= (17.453.25) + \cdots + (895.837,43)$$

$$= 332.875,86.$$

So, the total final value of normal contribution financing normal contribution financing with the individual level

premium method is $Rp332.875{,}86,-$

4.4 Comparison of Calculation Results

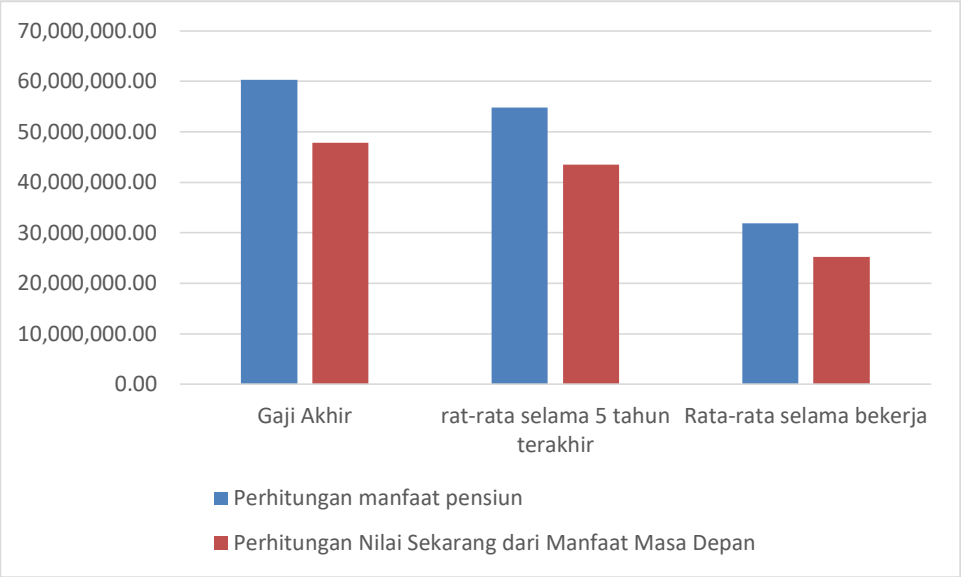

Figure 1: Comparison of Calculation

The graph depicts two calculations related to retirement benefits using three different methods for calculating salary: final salary, average over the last 5 years, and average over the working life. On the y-axis, the values are represented in rupiah, while the x-axis shows the salary calculation method.

The calculation of retirement benefits shown by the blue bars shows that the highest value of retirement benefits is obtained using final salary, which is around Rp60,291,095.78. Using the average salary over the last 5 years gives a slightly lower value of Rp54,816,073.75. Meanwhile, using the average salary over the working life results in the lowest pension benefit value, around Rp31,842,355.5.

The calculation of the present value of future benefits represented by the red bars shows a similar pattern. Based on final salary, the present value of future benefits is approximately Rp47,802,017.06, which is lower than the calculation of retirement benefits using final salary. Using the average salary over the past 5 years, this value becomes approximately Rp43,461,125.71. Using the average salary over the working life r/esults in the lowest value, which is around Rp25,246,328.69.

Overall, this graph shows that the salary calculation method used greatly affects the value of retirement benefits and the present value of future benefits. The final salary method provides the highest value, followed by the average salary over the last 5 years, and the lowest is the average salary over the working life.

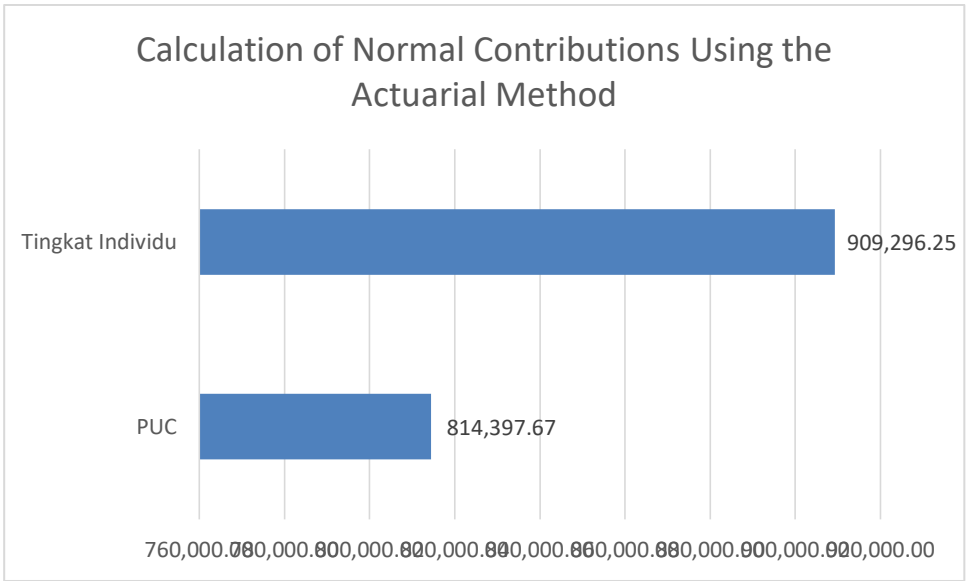

Figure 2: Calculation of Normal Contributions Using the Actuarial Method

From the graph, it can be seen that the Individual Level category has a higher value compared to the PUC.

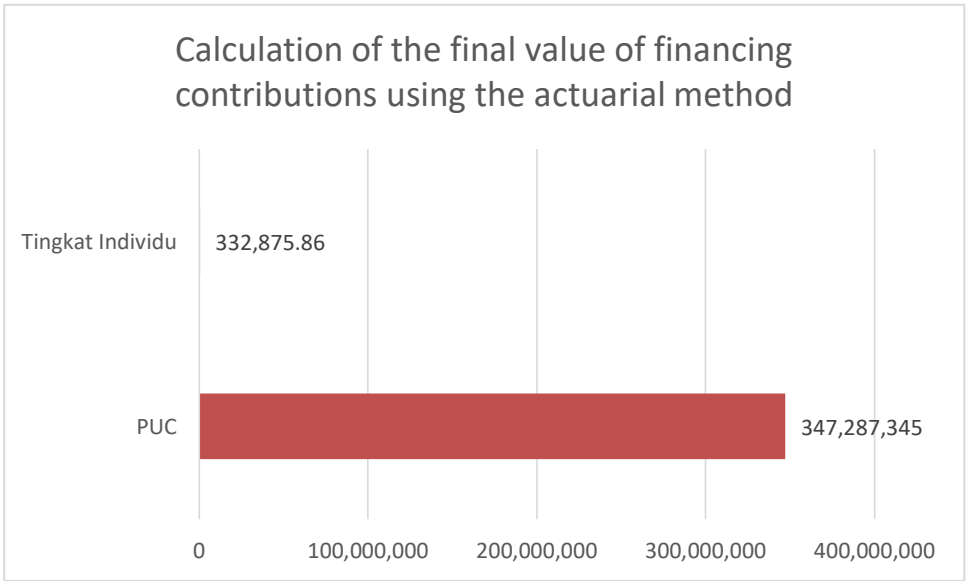

Figure 3: Calculation of the final value of financing contributions using the actuarial method

In this graph, the PUC has a higher value compared to the Individual Rate

5. Conclusion

Based on the discussion, the conclusions that can be drawn are::

a) The use of the average salary assumption during employment results in relatively stable pension benefits each year, allowing the company to avoid the obligation of normal contribution funding due to salary increases in certain years.
b) The final calculation of normal contribution funding using the individual level premium method shows that the individual level premium method is better from the perspective of pension fund program participants compared to the projected unit credit method.

References

Bowers, Newton. L. et al. 1997. Actuarial Mathematics. 2 nd edition. IPC Publishing

Futami, T. 1993a. Matematika Asuransi Jiwa Bagian I. Herliyanto, Gatot, penerjemah. Tokyo: Oriental Life Insurance Cultural Development Center. Terjemahan dari : Seimei Hoken Sugaku, Jokan ("92 Revision). Alligood, K. T., Sauer, T. D. and Yorke, J. A. (1996). *Chaos: An Introduction to Dynamical Systems*. New York: Springer-Verlag.

Hapsari, Ayu. 2012. Penggunaan Metode Projected Unit Credit dan Entry Age Normal dalam Pembiayaan Pensiun. Jurnal Gaussian, Volume 1, Nomor 1, Halaman 47-54.

Lin, H. C., Tanaka, A., & Wu, P. S. (2021). Shifting from pay-as-you-go to individual retirement accounts: A path to a sustainable pension system. *Journal of Macroeconomics*, *69*, 103329.

SR, A. A. P., Susanti, D., & Riaman, R. (2024). Comparison of Projected Unit Credit, Entry Age Normal, and Individual Level Premium Methods in Calculation of Normal Retirement on PNS Pension Funds. *International Journal of Quantitative Research and Modeling*, *5*(2), 184-191.

Ubaidillah, M., Ismail, M. A., & Noor, M. A. M. (2020). The waqf integrated financial instrument of pension model in Malaysian social security: A conceptual proposition. *The Journal of Muamalat and Islamic Finance Research*, 33-55.

Von Nordheim, F., & Kvist, J. (2023). Regulating the retirement age—Lessons from Nordic pension policy approaches. *Regulation & Governance*, *17*(3), 644-657.