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Comparative Analysis of Normal Pension Benefits Using the Attained Age Normal Method and the Individual Level Premium Method

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Abstract

Pension programs are among the most important forms of employee compensation, offering financial security after retirement. This study aims to calculate the company's initial payroll contributions to determine regular contributions, actuarial liabilities, and pension benefits using two actuarial projection methods: the Attained Age Normal (AAN) and Individual Level Premium (ILP) methods. The analysis is based on employee data from Puskesmas Binjai Estate, including age, salary, and years of service. It includes computations of pension benefits, normal costs, actuarial liabilities, and net benefits received by employees under each method. The results reveal that the length of service significantly affects both the value of contributions and the actuarial liabilities. Employees with longer service periods result in higher contribution requirements and greater liabilities. Moreover, the Attained Age Normal method produces higher pension benefits compared to the Individual Level Premium method for long-serving employees. However, both methods present financial challenges for employers, as they require higher contributions relative to the benefits promised. Consequently, companies must allocate substantial funding to meet their pension obligations. This study provides a comparative perspective that can assist decision-makers in selecting an actuarial method that balances benefit adequacy and financial sustainability.

Keywords: pension funding, Individual Level Premium (ILP), Attained Age Normal (AAN), normal cost, actuarial liability, normal retirement benefit.

1. Introduction

The pension system is a fundamental component of social welfare, ensuring financial security for individuals once they retire from the workforce. In Indonesia, the pension system for Civil Servants or also known as PNS in Indonesian, is carefully regulated to safeguard financial stability for employees during their retirement years. Actuarial calculations are central to pension program planning, as they determine the benefits participants will receive and the required contributions they must make during their working years.

The Indonesian government has established Law No. 11 of 1992 on Pension Funds to address the need for providing financial support to workers in their old age. According to the Indonesian Actuaries Association (2019), pension funds represent a company's responsibility to its employees, ensuring their financial well-being after they retire. These funds accumulate money from regular contributions, which are deducted from the salaries of participants and invested throughout their careers.

The calculation methods for pension contributions and benefits can significantly affect the final retirement payouts. One such distinction is the method used to calculate the normal contributions and the pension benefits to be received upon retirement. Various methods, such as Attained Age Normal, Entry Age Normal, and Individual Level Premium, offer different approaches to these calculations, each influencing the financial outcome for the participants.

Previous studies, including research by Putri et al. (2024) and Afifah (2021), have explored various pension calculation methods. While these studies provide valuable insights, further investigation is needed to understand how the Attained Age Normal and Individual Level Premium methods compare in terms of their effectiveness in determining pension benefits.

This study seeks to investigate the actuarial calculations of pension contributions and benefits, specifically comparing the Attained Age Normal and Individual Level Premium methods. The primary objective of this research is to determine

which method is more efficient and accurate in calculating the normal contributions and pension benefits for participants.

This research distinguishes itself from previous studies by employing the Attained Age Normal and Individual Level Premium methods to calculate normal pensions for the Civil Servants pension fund, aiming to identify the optimal method from the company's perspective. The study utilizes the Indonesian Mortality Table IV 2019 for mortality rates and relies on secondary data from Civil Servants collected from Puskemas Binjai Estate in North Sumatra.

2. Literature Review

2.1 Actuarial

Actuarial science is a scientific method that integrates mathematical and statistical concepts to predict financial risk management in the future. This discipline is commonly used by insurance companies, pension funds, and human resource management to achieve goals related to the total amount of liabilities to be paid over a specific period. Factors such as the number of participants, salary increases over time, mortality rates, life expectancy, interest rates, claims, coverage, and other factors must be accurately calculated (Soetiono, 2016). An expert in actuarial methods for financial matters is called an actuary. In Indonesia, actuaries fall under the competence of the Indonesian Actuarial Association or also known as PAI in Indonesian, which was established and recognized by the government in 1964 and became a member of the International Actuarial Association in 2007.

2.2 Salary Function

Salary Function in pension programs where the benefits are based on an employee's salary, it is necessary to use specific notation to represent the salary and methods to project future salaries. The total cumulative salary of an employee from the starting age y to the age $x-1$, with $x > y$, is denoted as S_x and is defined as :

$$S_x = \sum_{t=y}^{x-1} s_{t.} \tag{1}$$

The salary amount of a pension fund participant calculated at age x, with the salary at the entry age y, can be formulated as follows:

$$s_x = s_y \frac{(SS)_x}{(SS)_y} [(1+I)]^{(x-y)}. \tag{2}$$

Explanation of Notations:

x ıe participant's age at the time of calculation,

y ıe participant's age upon entering the pension program,

I ıe annual salary growth rate,

s_x ıe total annual salary from age y until x

s_y ıe initial salary of an employee at age y

$(SS)_x$ ıe salary scale at age x

$(SS)_y$ ıe salary scale at age y

2.3 The function of pension benefits

Pension benefits calculated based on the average salary throughout the employment period is a method in which the annual benefits that a participant will receive are determined as a fixed percentage of the employee's average annual income during their working years. This method is formulated as follows:

$$B_x = kS_x,$$
$$B_r = kS_{r-1}. \tag{3}$$

2.4 Annuity

A life annuity due is a type of annuity where the payments continue as long as the insured person is alive. Annuity is the value of the annuity given is 1 unit, then the life annuity due $\ddot{a}_x$ refers to the total annual payment of 1 unit made at the beginning of the year. A person aged x will purchase a life annuity by paying a cash amount of $\ddot{a}_x$, with the expectation of receiving 1 unit at the end of each year, plus interest of $v^1\ {}_1p_x$. If the person lives for two more years, the probability is ${}_2p_x$. After reaching age $x+1$, they will receive 1 unit plus interest of $v^2\ {}_2p_x$, and so on. Therefore, the value of the life annuity due for someone aged x can be calculated as follows.

$$\ddot{a}_x = \frac{N_x}{D_x}. \tag{4}$$

2.5 Present Value of Future Benefit

The Present Value of Future Benefit is the current value of the pension benefits that a participant will receive after reaching retirement age. PVFB can be calculated using the result of the benefit function. The PVFB for an individual aged x years, who started working at age y and will retire at age r, can be denoted as ${}^{r}(PVFB)_x$ and is defined as follows.

$$ {}^{r}(PVFB)_x = B_r v^{r-x}\, {}_{(r-x)}p_x \ddot{a}_r. \tag{5}$$

2.6 Normal Cost with Attained Age Normal Method

The normal cost is the annual contribution amount that must be paid by a participant to fund a portion of the present value of the pension benefits to be received upon retirement, while the participant is still actively working. This contribution amount is calculated in accordance with the provisions set out in the pension fund regulations. The equation used to calculate the normal cost under the Attained Age Normal method for an individual currently aged x and who enrolled in the pension plan at age y is as follows:

$$ {}^{AAN\ r}(NC)_x = \frac{(B_r - B_a)\ddot{a}_r^{(12)} \dfrac{D_r^{(T)}}{D_a^{(T)}}}{\dfrac{N_x - N_r}{D_x}}. \tag{6}$$

2.7 Normal Cost with Individual Level Premium Method

The normal cost is defined when a participant makes regular contributions from age x until age r to fund the pension benefits that will be received upon retirement. Therefore, the value of the normal cost at age x should be equivalent to the present value of the pension benefits to be received at retirement. The participant pays pension contributions from age x up to age $r-1$, and the present value of the pension contributions at age x represents the accumulation of contributions made during that period.

$$ {}^{ILP\ \ r}(NC)_x = B_x \ddot{a}_r^{(12)} \left(\frac{{D_r}^{T}}{N_x^T - N_r^T} \right). \tag{7}$$

2.8 Actuarial Liability with Attained Age Normal Method

Actuarial liability is defined as the present value of pension benefit payments that a pension fund is obligated to provide to both active and retired participants, based on the service they have rendered. The amount of actuarial liability depends on the present value of future benefits and the present value of future normal contributions. For a pension plan participant aged *x*, the actuarial liability is calculated as the difference between the present value of future benefits and the present value of future contributions.

$$ AAN^{r}(AL)_x = (B_r - B_x)\frac{D_r^{(T)}}{D_x^{(T)}} \ddot{a}_r^{(12)} - {}^{AAN}(NC)_x \frac{N_x^T - N_r^T}{D_x^{(T)}}. \tag{8}$$

2.9 Actuarial Liability with Individual Level Premium Method

Actuarial liability refers to the current value of the pension benefits that a pension fund is required to pay to both current employees and retirees, in accordance with the services they have already provided. This liability is determined by the difference between the present value of the expected future benefits (PVFB) and the present value of the expected future normal contributions (PVFNC). For a participant aged *x*, the actuarial liability is obtained by subtracting the present value of future contributions from the present value of future benefits.

$$ {}^{ILP\ \ r}(AL)_x = {}^{r}(PVFB)_x - {}^{ILPr}(NC)_x v^{r-x}\, {}_{r-x}p_x\, {}^{(T)}. \tag{9}$$

2.10 Pension Benefit Amount with Attained Age Normal Method

The pension benefit amount refers to the total retirement income that a participant is entitled to receive upon reaching retirement age. Under the Attained Age Normal method, the benefit is calculated based on the participant's current age (attained age), salary, and years of service up to that point. The Attained Age Normal method is a funding method commonly used in pension actuarial valuation. It assumes that the cost of the benefit is spread uniformly over the future working lifetime of the participant from the valuation age until retirement. The key idea is to calculate a normal cost, which is the annual contribution required to fund the benefit, and the actuarial liability, which is the present value of accrued benefits to date. The pension benefits will be provided as 20% in a lump sum when the worker reaches retirement age, and the remaining 80% will be allocated monthly as a pension salary. The amount of pension benefits using the Attained Age Normal method is as follows:

$$ {}^{AAN}B = 20\% \left[{}^{AAN\ r}(AL)_{r-1} - \sum_{x}^{r-1} {}^{AAN\ r}(NC)_x \right]. \tag{10}$$

2.11 Pension Benefit Amount with Individual Level Premium Method

The pension benefit amount refers to the total retirement income a participant will receive upon reaching retirement. Under the Individual Level Premium method, the goal is to calculate a fixed annual contribution (premium) from each participant that remains level throughout their working life. This contribution is designed to fully fund the pension benefit by the time the participant reaches retirement age. The pension benefits will be provided as 20% in a lump sum when the worker reaches retirement age, and the remaining 80% will be allocated monthly as a pension salary. The amount of pension benefits using the Individual Level Premium method is as follows:

$$^{ILP}\ B = 20\%\left[{}^{ILP\,r}(AL)_{r-1} - \sum_{x}^{r-1} {}^{ILP\,r}(NC)_x \right]. \tag{11}$$

3. Materials and Methods

3.1. Materials

This study uses secondary data obtained from Civil Servants registered as participants in the pension program at Puskesmas Binjai Estate 2023. The data used includes information about the participants' gender, age at the time of appointment as a civil servant, retirement age, years of service, last basic salary, grade at the time of appointment, initial salary, year of civil servant appointment, and retirement date. In this study, pension benefits, present value of pension benefits, normal contributions, and actuarial liabilities will be calculated using the Attained Age Normal method and the Individual Level Premium method.

3.2. Methods

This study discusses the actuarial calculation of normal pension benefits using the Attained Age Normal and Individual Level Premium methods. The focus of this research is to determine the amount of normal contributions and actuarial liabilities.

Afterward, the results from both methods will be analyzed to determine which method is more beneficial for pension program participants at Puskesmas Binjai Estate, North Sumatera.This research is conducted through the following steps:

1) Calculate the total salary each year throughout the years of service with a 3% annual salary increase. The percentage of salary allocated for pension benefits at Puskesmas Binjai Estate is 4.75% of the basic salary, and the normal retirement age for Civil Servants is set at 58 years with the following equation 1,
2) Calculate the percentage of salary allocated for pension benefits using equation 3,
3) Calculate the annuity using equation (2.4).
4) Calculate the Present Value of Future Benefits using equation 4,
5) Calculate the normal pension contribution using the Attained Age Normal method with equation 6,
6) Calculate the normal pension contribution using the Individual Level Premium method with equation 7,
7) Calculate the actuarial liability using the Attained Age Normal method with equation 8,
8) Calculate the actuarial liability using the Individual Level Premium method with equation 9,
9) Calculate the amount of pension benefits received by participants using the Attained Age Normal method with equation (10,
10) Calculate the amount of pension benefits received by participants using the Individual Level Premium method with equation 11,
11) Analysis of result.

4. Results and Discussion

In this study, the data used is secondary data from Civil Servants who are participants of the normal pension program at the Puskesmas Binjai Estate, North Sumatra. The obtained data contains the participant's gender, age when appointed as a Civil Servant, the participant's retirement age, length of service, initial salary, year of becoming a Civil Servant, and the retirement date, as shown in the following Table 1.

Table 1: Data of participants in the Puskesmas Binjai Estate pension program.

No	Gender	Age when became Civil Servant (years)	Participant's Retirement Age (years)	Length of Service (years)	Initial Basic Salary (IDR)	Year of Becoming Civil Servant	Retirement Date
1	Female	30	58	28	117,300	1993	01/06/2021
2	Female	26	58	32	58,200	1992	01/03/2023
3	Male	24	58	34	58,200	1990	01/02/2023
4	Female	22	58	36	58,200	1988	01/05/2023
5	Female	21	58	37	58,200	1987	01/09/2023

Calculation pension for a civil servant selected randomly is carried out. The sample used is the participant with number 1. The accumulated salary is obtained by summing the salary per year during the work period, from the first year until just before retirement. The pension program for the participant starts at the age of 30 (y = 30), with calculations done at the age of 32 (valuation age), and retirement at the age of 58. The participant's initial salary is IDR 117,300.00 (s_y = IDR 117,300.00) with a salary increase of 3% per year. The calculation process is carried out as follows.

4.1 Calculating the total salary each year

1. Salary when the participant is 30 years old ($x = 30$)

$$
\begin{aligned}
s_x &= s_y \frac{(SS)_x}{(SS)_y}[(1+I)]^{(x-y)} \\
&= s_y \frac{(SS)_{30}}{(SS)_{30}}[(1+I)]^{(30-30)} \\
&= \text{IDR } 117{,}300.00 \frac{(1)}{(1)}[(1+0{,}03)]^{(0)} \\
&= \text{IDR } 117{,}300.00
\end{aligned}
$$

Thus, the salary for one year can be calculated as follows

$$12s_{30} = 12(\text{IDR } 117{,}300.00) = \text{IDR } 1{,}407{,}600.00$$

The calculation is carried out up to the age of $(r-1)$ years, then the salary for each year is accumulated until the retirement age, calculated using the equation 1.

$$S_x = \sum_{t=y}^{x-1} s_t$$

$$S_{58} = s_{30} + s_{31} + s_{32} + \cdots + s_{57}$$

$$S_{58} = \text{IDR } 106{,}796{,}955.56$$

Table 2: Calculation of total annual salary

Age (x)	Years of Service	Monthly Salary Scale	Percentage	Starting Salary (IDR)	Annual Salary (IDR)
30	0	1	1.03	117,300	1,407,600.00
31	1	1.045	1.03	117,300	1,515,070.26
32	2	1.091	1.03	117,300	1,629,215.22
33	3	1.138	1.03	117,300	1,750,383.43
34	4	1.186	1.03	117,300	1,878,939.71
35	5	1.234	1.03	117,300	2,013,634.03
36	6	1.284	1.03	117,300	2,158,080.45
37	7	1.334	1.03	117,300	2,309,381.38
38	8	1.384	1.03	117,300	2,467,818.10
39	9	1.436	1.03	117,300	2,637,355.78
40	10	1.487	1.03	117,300	2,812,952.99
41	11	1.539	1.03	117,300	2,998,660.85
42	12	1.592	1.03	117,300	3,194,986.43
43	13	1.644	1.03	117,300	3,398,325.64
44	14	1.697	1.03	117,300	3,613,118.84
45	15	1.749	1.03	117,300	3,835,548.14
46	16	1.802	1.03	117,300	4,070,330.18
47	17	1.854	1.03	117,300	4,313,420.60
48	18	1.906	1.03	117,300	4,567,433.15
49	19	1.958	1.03	117,300	4,832,804.37
50	20	2.008	1.03	117,300	5,104,902.61
51	21	2.059	1.03	117,300	5,391,595.77
52	22	2.108	1.03	117,300	5,685,501.89

53	23	2.157	1.03	117,300	5,992,189.95
54	24	2.204	1.03	117,300	6,306,439.61
55	25	2.250	1.03	117,300	6,631,204.08
56	26	2.295	1.03	117,300	6,966,743.10
57	27	2.339	1.03	117,300	7,313,319.50
		Accumulated Salary			106,796,955.56

4.2 Calculating the Salary Percentage for Pension Benefits

To calculate the salary percentage for pension benefits, Equation 3 can be used, which is:

1. The percentage of salary at age 30 (x = 30)

$$B_x = kS_x$$
$$B_{30} = kS_{30}$$
$$B_{30} = 4{,}75\%(\text{IDR } 1{,}407{,}600.00)$$
$$B_{30} = \text{IDR } 66{,}861.00.$$

Table 3: Calculation the Salary Percentage

Age (x)	S_x	k	B_x
30	1,407,600.00	4.75%	66,861.00
31	1,515,070.26	4.75%	71,965.84
32	1,629,215.22	4.75%	77,387.72
33	1,750,383.43	4.75%	83,143.21
34	1,878,939.71	4.75%	89,249.64
35	2,013,634.03	4.75%	95,647.62
36	2,158,080.45	4.75%	102,508.82
37	2,309,381.38	4.75%	109,695.62
38	2,467,818.10	4.75%	117,221.36
39	2,637,355.78	4.75%	125,274.40
40	2,812,952.99	4.75%	133,615.27
41	2,998,660.85	4.75%	142,436.39
42	3,194,986.43	4.75%	151,761.86
43	3,398,325.64	4.75%	161,420.47
44	3,613,118.84	4.75%	171,623.14
45	3,835,548.14	4.75%	182,188.54
46	4,070,330.18	4.75%	193,340.68
47	4,313,420.60	4.75%	204,887.48
48	4,567,433.15	4.75%	216,953.07
49	4,832,804.37	4.75%	229,558.21
50	5,104,902.61	4.75%	242,482.87
51	5,391,595.77	4.75%	256,100.80
52	5,685,501.89	4.75%	270,061.34
53	5,992,189.95	4.75%	284,629.02
54	6,306,439.61	4.75%	299,555.88
55	6,631,204.08	4.75%	314,982.19
56	6,966,743.10	4.75%	330,920.30
57	7,313,319.50	4.75%	347,382.68
Calculating the Salary			5,072,855.41

4.3 Calculating Annuity

Calculate the annuity using equation 4. The mortality table used is Mortality Table IV (2019) for females with an interest rate of $i = 10\%$.

$$\ddot{a}_x = \frac{N_x}{D_x}$$

$$\ddot{a}_{58} = \frac{N_{58}}{D_{58}} = \frac{35{,}923.19341}{3{,}698.55268} = 9.71277$$

The annuity paid annually is :

$$\ddot{a}_r^{(m)} = \ddot{a}_r + \frac{(m-1)}{2m}$$

$$\ddot{a}_{58}^{(12)} = \ddot{a}_{58} + \frac{(12-1)}{2(12)} = 9.71277 + \frac{11}{24} = 10.1711$$

4.4. Calculating Present Value of Future Benefit

1. Present value of Future Benefit at 30 year (x = 30)

$$^{r}(PVFB)_x = B_r \ddot{a}_r{}^{(12)} v^{r-x}{}_{r-x}p_x{}^{(T)}$$

$$^{58}(PVFB)_{30} = B_{58} \ddot{a}_{58}{}^{(12)} v^{58-30}{}_{58-30}p_{30}{}^{(T)}$$

$$^{58}(PVFB)_{30} = (5{,}072{,}855.41)(10.1711)(0.06934)(0.20100)$$

$$^{58}(PVFB)_{30} = \text{IDR } 719{,}118.2.$$

The calculation will be carried out up to age $r-1$. Then, the results will be calculated until the retirement age is reached. The table used is the Service Table for determining ${}_{r-x}p_x{}^{(T)}$ and the Table $D_x{}^{T}$ and $N_x{}^{T}$ for determining v^{r-x}. The Present Value of Future Benefit calculation is shown in Table 4 below.

Table 4: Calculation Present Value of Future Benefit

Age (x)	B_r	$\ddot{a}_r{}^{(12)}$	v^{r-x}	${}_{r-x}p_x{}^{(T)}$	$^{r}(PVFB)_x$
30	5,072,855.41	10.1711	0.06934	0.20100	719,118.2
31	5,072,855.41	10.1711	0.07628	0.22508	885,865.9
32	5,072,855.41	10.1711	0.08391	0.24968	1,080,980.6
33	5,072,855.41	10.1711	0.09230	0.27461	1,307,791.3
34	5,072,855.41	10.1711	0.10153	0.29978	1,570,425.9
35	5,072,855.41	10.1711	0.11168	0.32505	1,873,035.4
36	5,072,855.41	10.1711	0.12285	0.35035	2,220,739.9
37	5,072,855.41	10.1711	0.13513	0.37567	2,619,260.5
38	5,072,855.41	10.1711	0.14864	0.40100	3,075,392.0
39	5,072,855.41	10.1711	0.16351	0.42636	3,597,006.2
40	5,072,855.41	10.1711	0.17986	0.45179	4,192,679.0
41	5,072,855.41	10.1711	0.19784	0.47738	4,873,026.0
42	5,072,855.41	10.1711	0.21763	0.50322	5,650,632.5
43	5,072,855.41	10.1711	0.23939	0.52951	6,540,343.8
44	5,072,855.41	10.1711	0.26333	0.55637	7,559,350.0
45	5,072,855.41	10.1711	0.28966	0.58399	8,727,992.1
46	5,072,855.41	10.1711	0.31863	0.61255	10,070,443.9
47	5,072,855.41	10.1711	0.35049	0.64214	11,612,501.0
48	5,072,855.41	10.1711	0.38554	0.67303	13,388,264.2
49	5,072,855.41	10.1711	0.42410	0.70539	15,435,403.2
50	5,072,855.41	10.1711	0.46651	0.73942	17,798,055.6
51	5,072,855.41	10.1711	0.51316	0.77528	20,527,297.9
52	5,072,855.41	10.1711	0.56447	0.81310	23,681,283.4
53	5,072,855.41	10.1711	0.62092	0.85308	27,330,389.3
54	5,072,855.41	10.1711	0.68301	0.89524	31,549,098.2
55	5,072,855.41	10.1711	0.75131	0.93971	36,427,840.5
56	5,072,855.41	10.1711	0,82645	0.95255	40,618,583.5
57	5,072,855.41	10.1711	0,90909	0.96666	45,342,038.0

4.5. Normal Pension Cost with Attained Age Normal Method

The pension contribution is calculated when the participant reaches the valuation age, which is 32 years old (x =32). The use of the valuation age in the Attained Age Normal method is necessary because this method calculates the normal contribution based on the participant's condition at the time the actuarial valuation is conducted, not from the time they initially joined the program.

$$^{AAN\ r}(NC = \frac{(B_r - B_a)\ddot{a}_r^{(12)} \frac{D_r^{(T)}}{D_a^{(T)}}}{\frac{N_a - N_r}{D_a}}$$

$$^{AAN\ 58}(NC)_{32} = \frac{(B_{58} - B_{32})\ddot{a}_{58}{}^{(12)} \frac{D_{58}{}^{(T)}}{D_{32}{}^{(T)}}}{\frac{N_{32} - N_{58}}{D_{32}}}$$

$$^{AAN\ 58}(NC)_{32} = \frac{(4{,}995{,}467.72)\ (10.1711)(0.02095)}{6.41046}$$

$$^{AAN\ 58}(NC)_{32} = \text{IDR } 166{,}050.0129$$

Thus, the total normal contribution that must be paid by the participant from the age of 32 until retirement using the Attained Age Normal method is:

$$26\ x\ ^{AAN\ 58}(NC)_{32} = \text{IDR } 4{,}317{,}300.26$$

4.6. Normal Pension Cost with Individual Level Premium Method

Unlike the Attained Age Normal method, the Individual Level Premium method does not require a valuation age in calculating the normal contribution. This is because this method calculates the contribution evenly from the time the participant enters the pension program until reaching the retirement age.

1. Normal cost at age 30 years ($x = 30$)

$$^{ILP\ r}(NC)_x = B_x\ddot{a}_r{}^{(12)}\left(\frac{D_r{}^T}{N_x{}^T - N_r{}^T}\right)$$

$$^{ILP\ 58}(NC)_{30} = B_{30}\ddot{a}_{58}{}^{(12)}\left(\frac{D_{58}{}^T}{N_{30}{}^T - N_{58}{}^T}\right)$$

$$= 66{,}861(10.1711)(0.00229)$$

$$= \text{IDR } 1{,}557.31.$$

Table 5: Normal Pension Cost with Individual Level Premium Method

Age (x)	B_x	$\ddot{a}_r{}^{(12)}$	$\frac{D_r{}^T}{N_x{}^T - N_r{}^T}$	$^{ILP\ r}(NC)_x$
30	66,861.00	10.1711	0.00229	1,557.31
31	71,965.84	10.1711	0.00275	2,012.92
32	77,387.72	10.1711	0.00327	2,573.88
33	83,143.21	10.1711	0.00387	3,272.70
34	89,249.64	10.1711	0.00457	4,148.50
35	95,647.62	10.1711	0.00538	5,233.89
36	102,508.82	10.1711	0.00631	6,578.98
37	109,695.62	10.1711	0.00742	8,256.37
38	117,221.36	10.1711	0.00866	10,325.06
39	125,274.40	10.1711	0.01013	12,907.43
40	133,615.27	10.1711	0.01185	16,104.32
41	142,436.39	10.1711	0.01388	20,108.44
42	151,761.86	10.1711	0.01627	25,114.13
43	161,420.47	10.1711	0.01911	31,375.25
44	171,623.14	10.1711	0.02253	39,275.91
45	182,188.54	10.1711	0.02659	49,272.81
46	193,340.68	10.1711	0.03154	62,023.01

47	204,887.48	10.1711	0.03762	78,397.49
48	216,953.07	10.1711	0.04518	99,696.51
49	229,558.21	10.1711	0.05472	127,716.81
50	242,482.87	10.1711	0.06694	165,095.30
51	256,100.80	10.1711	0.08305	216,330.87
52	270,061.34	10.1711	0.10497	288,333.79
53	284,629.02	10.1711	0.13609	393,979.22
54	299,555.88	10.1711	0.18315	558,023.77
55	314,982.19	10.1711	0.26147	837,675.46
56	330,920.30	10.1711	0.41525	1,397,658.18
57	347,382.68	10.1711	0.87879	3,104,997.02
Total Normal Pension Cost				7,568,045.32

4.7. Actuarial Liability with Attained Age Normal Method

The actuarial liability at age 32 ($x = 32$) refers to the present value of the pension benefits that a participant is entitled to receive, calculated as of the valuation age (32 years old in this case). It includes the expected future benefits, adjusted for mortality, interest, and other relevant factors.

$$AAN^{r}(AL)_x = (B_r - B_x)\frac{D_r^{(T)}}{D_x^{(T)}}\ddot{a}_r^{(12)} - {}^{AAN}(NC)_x\frac{N_x^T - N_r^T}{D_x^{(T)}}$$

$$AAN\ ^{58}(AL)_{32} = (B_{58} - B_{32})\frac{D_{58}^{(T)}}{D_{32}^{(T)}}\ddot{a}_{58}^{(12)} - {}^{AAN}(NC)_{32}\frac{N_{32}^T - N_{58}^T}{D_{32}^{(T)}}$$

$$AAN\ ^{58}(AL)_{32} = (4{,}995{,}467.69)(0.02095)(10.1711)\ (166{,}050.01)(6.41054)$$

$$AAN\ ^{58}(AL)_{32} = 1{,}064{,}470.23 - 1{,}064{,}470.23$$

$$AAN\ ^{58}(AL)_{32} = \text{IDR } 0.00.$$

Calculations are performed until the age of $r - 1$. The results are then calculated until the retirement age is reached. The tables used are the ${D_x}^T$ and ${N_x}^T$ tables to determine $\frac{D_r^{(T)}}{D_x^{(T)}}$ dan $\frac{{D_r}^T}{{N_x}^T - {N_r}^T}$. The actuarial liability calculation using the Attained Age Normal Method is shown in Table 6 below.

Tabel 6: Actuarial Liability with Attained Age Normal Method

Age (x)	$B_r - B_x$	$\frac{D_r^{(T)}}{D_x^{(T)}}$	$\ddot{a}_r^{(12)}$	${}^{AAN}(NC)_x$	$\frac{N_x^T - N_r^T}{D_x^{(T)}}$	$AAN^r(AL)_x$
32	4,995,467.69	0.02095	10.1711	166,050.01	6.41054	0.00
33	4,989,712.20	0.02535	10.1711	166,050.01	6.54591	199,585.92
34	4,983,605.78	0.03044	10.1711	166,050.01	6.65967	437,127.36
35	4,977,207.80	0.03632	10.1711	166,050.01	6.75043	716,730.55
36	4,970,346.59	0.04304	10.1711	166,050.01	6.81776	1,043,750.40
37	4,963,159.80	0.05076	10.1711	166,050.01	6.86199	1,422,971.63
38	4,955,634.05	0.05961	10.1711	166,050.01	6.88308	1,861,661.81
39	4,947,581.01	0.06971	10.1711	166,050.01	6.88062	2,365,443.39
40	4,939,240.15	0.08126	10.1711	166,050.01	6.85446	2,944,116.54
41	4,930,419.02	0.09445	10.1711	166,050.01	6.80466	3,606,544.42
42	4,921,093.56	0.10951	10.1711	166,050.01	6.73072	4,363,660.75
43	4,911,434.94	0.12676	10.1711	166,050.01	6.63316	5,230,820.98
44	4,901,232.27	0.14651	10.1711	166,050.01	6.51083	6,222,535.42
45	4,890,666.88	0.16916	10.1711	166,050.01	6.36285	7,358,052.70
46	4,879,514.73	0.19518	10.1711	166,050.01	6.18757	8,659,343.64
47	4,867,967.93	0.22507	10.1711	166,050.01	5.98204	10,150,480.53
48	4,855,902.34	0.25948	10.1711	166,050.01	5.74388	11,861,911.69

49	4,843,297.21	0,29915	10.1711	166,050.01	5.46915	13,828,473.24
50	4,830,372.54	0.34494	10.1711	166,050.01	5.15321	16,091,281.35
51	4,816,754.61	0.39784	10.1711	166,050.01	4.79012	18,695,455.61
52	4,802,794.07	0.45897	10.1711	166,050.01	4.37248	21,694,495.91
53	4,788,226.39	0.52974	10.1711	166,050.01	3.89215	25,150,908.60
54	4,773,299.53	0.61146	10.1711	166,050.01	3.33859	29,131,830.86
55	4,757,873.22	0.70602	10.1711	166,050.01	2.70024	33,717,912.81
56	4,741,935.12	0.78723	10.1711	166,050.01	1.89582	37,653,850.08
57	4,725,472.74	0.87879	10.1711	166,050.01	1.00000	42,071,458.51
Total Actuarial Liabilty with Attained Age Normal Method						306,480,404.70

4.8. Actuarial Liability with Individual Level Premium Method

The actuarial liability at age 30 ($x = 30$)is calculated using the specific actuarial formulas and mortality tables as referenced in the methodology for the Attained Age Normal (AAN) method. Typically, actuarial liability at this age involves the present value of future pension benefits, taking into account factors such as life expectancy, the participant's salary, and the applicable interest rate**.**

$$^{ILP\ r}(AL)_x = {}^{r}(PVFB)_x - {}^{ILPr}(NC)_x v^{r-x}\ {}_{r-x}p_x{}^{(T)}$$

$$^{ILP\ 58}(AL)_{30} = {}^{r}(PVFB)_{30} - {}^{ILP\ 58}(NC)_{30}\ v^{58-30}\ {}_{58-30}p_x{}^{(T)}$$

$$^{ILP\ 58}(AL)_{30} = 719{,}118.2 - (1{,}555.31)(0.06934)(0.20100)$$

$$^{ILP\ 58}(AL)_{30} = 719{,}118{,}2 - 21.6768$$

$$^{ILP\ 58}(AL)_{30} = \text{IDR } 719{,}096.52.$$

The calculation of actuarial liability using the Individual Level Premium Method is shown in Table 7.

Table 7: Actuarial Liability with Individual Level Premium Method

Age (x)	${}^{r}(PVFB)_x$	${}^{ILP\ r}(NC)_x$	v^{r-x}	${}_{r-x}p_x{}^{(T)}$	${}^{ILP\ r}(AL)_x$
30	719,118.2	1,557.31	0.06934	0.20100	719,096.53
31	885,865.9	2,012.92	0.07628	0.22508	885,831.37
32	1,080,980.6	2,573.88	0.08391	0.24968	1,080,926.64
33	1,307,791.3	3,272.70	0.09230	0.27461	1,307,708.39
34	1,570,425.9	4,148.50	0.10153	0.29978	1,570,299.64
35	1,873,035.4	5,233.89	0.11168	0.32505	1,872,845.40
36	2,220,739.9	6,578.98	0.12285	0.35035	2,220,456.71
37	2,619,260.5	8,256.37	0.13513	0.37567	2,618,841.41
38	3,075,392.0	10,325.06	0.14864	0.40100	3,074,776.56
39	3,597,006.2	12,907.43	0.16351	0.42636	3,596,106.32
40	4,192,679.0	16,104.32	0.17986	0.45179	4,191,370.36
41	4,873,026.0	20,108.44	0.19784	0.47738	4,871,126.90
42	5,650,632.5	25,114.13	0.21763	0.50322	5,647,882.12
43	6,540,343.8	31,375.25	0.23939	0.52951	6,536,366.71
44	7,559,350.0	39,275.91	0.26333	0.55637	7,553,595.70
45	8,727,992.1	49,272.81	0.28966	0.58399	8,719,657.20
46	10,070,443.9	62,023.01	0.31863	0.61255	10,058,338.49
47	11,612,501.0	78,397.49	0.35049	0.64214	11,594,856.55
48	13,388,264.2	99,696.51	0.38554	0.67303	13,362,394.97
49	15,435,403.2	127,716.81	0.42410	0.70539	15,397,195.99
50	17,798,055.6	165,095.30	0.46651	0.73942	17,741,106.51
51	20,527,297.9	216,330.87	0.51316	0.77528	20,441,232.27
52	23,681,283.4	288,333.79	0.56447	0.81310	23,548,946.66
53	27,330,389.3	393,979.22	0.62092	0.85308	27,121,700.67

54	31,549,098.2	558,023.77	0.68301	0.89524	31,207,890.13
55	36,427,840.5	837,675.46	0.75131	0.93971	35,836,430.29
56	40,618,583.5	1,397,658.18	0,82645	0.95255	39,518,298.10
57	45,342,038.0	3,104,997.02	0,90909	0.96666	42,613,425.85
Total Actuarial Liability with Individual Level Premium Method					344,908,704.43

4.9. Calculating Amount Pension Benefit with Attained Age Normal Method

$$^{AAN}B = 20\%\left[{}^{AAN\,r}(AL)_{r-1} - \sum_{x}^{r-1} {}^{AAN\,r}(NC)_x\right]$$

$$^{AAN}B = 20\%\left[{}^{AAN\,58}(AL)_{57} - \sum_{x=32}^{57} {}^{AAN\,58}(NC)_{32}\right]$$

$$^{AAN}B = 20\%[42{,}071{,}458.51 - 4{,}317{,}300.26\,]$$

$$^{AAN}B = 20\%[37{,}754{,}158.25\,]$$

$$^{AAN}B = \text{IDR } 7{,}750{,}831.65.$$

4.10. Calculating Amount Pension Benefit with Individual Level Premium Method

$$^{ILP}\ B = 20\%\left[{}^{ILP\,r}(AL)_{r-1} - \sum_{x}^{r-1} {}^{ILP\,r}(NC)_x\right]$$

$$^{ILP}\ B = 20\%\left[{}^{ILP\,58}(AL)_{57} - \sum_{x=30}^{57} {}^{ILP\,58}(NC)_{30}\right]$$

$$^{ILP}\ B = 20\%[42{,}613{,}425.85\ - 7{,}568{,}045.32]$$

$$^{ILP}\ B = 20\%[35{,}045{,}380.53]$$

$$^{ILP}\ B = \text{IDR } 7{,}009{,}076.11.$$

4.11. Analysis of Result

Based on the actuarial calculations conducted on a sample pension participant using the Attained Age Normal method and the Individual Level Premium method, differences in normal contributions, actuarial liabilities, and pension benefits were obtained. The results showed that the Attained Age Normal method generated lower annual normal contributions compared to the Individual Level Premium method because the contribution payment period was shorter (starting from the valuation age of 32 years until retirement). However, the pension benefits received by the participant were higher. This indicates that the Attained Age Normal method focuses more on the efficiency of allocating contributions as the participant approaches retirement, with a more concentrated burden but more optimal benefits. In contrast, the Individual Level Premium method spreads contributions from the start of the program (age 30) until retirement. Although the total contributions are higher, the pension benefits calculated using the Individual Level Premium method are lower compared to Attained Age Normal in this case. This is because the Individual Level Premium method takes into account a longer projection period, and the more evenly distributed contributions tend to result in more stable liabilities.

In general, the Attained Age Normal method is more beneficial for participants in terms of the pension benefits they receive, especially for participants with long service periods. However, from the perspective of the pension fund management institution, the Individual Level Premium method provides stability in collecting contributions and managing actuarial liabilities, as contributions are made from the beginning of the service period. Therefore, the choice of method depends on the policy orientation, whether it prioritizes optimal benefits for participants (Attained Age Normal) or long-term financial stability of the pension program (Individual Level Premium).

5. Conclusion

Based on the analysis between the Attained Age Normal method and the Individual Level Premium method, it can be concluded that the Attained Age Normal method generally offers more favorable outcomes for participants. Although both methods provide similar actuarial liabilities at retirement age, the Attained Age Normal method results in higher pension benefits. This makes it a more advantageous choice for participants in terms of retirement income security, despite requiring a relatively lower normal contribution compared to the Individual Level Premium method.

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