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Valuation of Pension Funds with Attained Age Normal and Projected Unit Credit Methods: Case Study of PT Taspen Samarinda

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Abstract

The pension fund serves as a guarantee of an individual's economic welfare after retirement, providing pension benefits. Civil Servants are among the workers entitled to pensions managed by PT. Taspen. However, Civil Servants are often perceived as a financial burden on society, as the government's pension scheme places a significant strain on the State Budget (APBN). Therefore, it is necessary to revise the scheme by conducting accurate actuarial calculations to reduce this burden. This research is intended to determine the normal contribution rates and actuarial obligations through the application of the Attained Age Normal and Projected Unit Credit methods at PT. Taspen (Persero) Samarinda Branch Office, with a 6% interest rate. The findings show that based on the Attained Age Normal approach, the normal contribution tends to rise as employees near retirement. In contrast, the Projected Unit Credit method provides a more consistent and evenly distributed contribution pattern throughout the working period. Regarding actuarial obligations, both methods demonstrate an upward trend; however, the Attained Age Normal method typically produces greater liabilities compared to the Projected Unit Credit method.

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1. INTRODUCTION

A pension fund is a legal entity that manages and runs a program that promises pension benefits for its participants [1]. Every employee should have a pension fund to support their independence and well-being in the future [2]. However, the pension system in Indonesia is often seen as a significant financial burden for the government, primarily due to its reliance on the pay-as-you-go scheme [3]. In this system, pension benefits are derived from the contributions of active workers. As a result, when the number of retirees increases and the ratio of active workers to retirees decreases, managing this system becomes increasingly difficult without imposing significant pressure on the state budget [4].

A well-established pension sector has the potential to drive economic growth, maintain financial stability, support the banking sector in channeling funds to the real sector, reduce poverty, and redistribute wealth. In this context, the government plans to shift the pension system for Civil Servants (*PNS*) to a fully funded scheme, where participants will finance their own pensions through contributions made during their active working years. This change is urgently needed due to the increasing fiscal pressure caused by the current pay-as-you-go pension system. As the number of pensioners rises and life expectancy increases, the burden on the state budget to fund pension benefits becomes even more substantial.

To ensure the success of this fully funded scheme, a precise and thorough actuarial approach is required to determine the appropriate contribution amounts and actuarial liabilities, ensuring that the accumulated funds will be sufficient to meet participants' pension entitlements in the future. Various actuarial methods—such as the Attained Age Normal method, which spreads the cost of benefits evenly over the remaining working life of participants, and the Projected Unit Credit method, which allocates benefits based on accrued service while accounting for future salary increases—have distinct characteristics and implications. Therefore, this study is essential for comparing these methods to identify the most effective, equitable, and sustainable approach. In

doing so, it contributes not only to the advancement of actuarial practice but also to the development of a more stable and independent pension system, which can help reduce future pressure on the state budget.

Based on a hearing between the Ministry of Finance and the House of Representatives (*DPR*) in February 2025, the Government of Indonesia plans to reform the pension scheme for *PNS* by transitioning from a pay-as-you-go system to a fully funded model. This reform is driven by the increasing fiscal burden on the state budget (*APBN*) caused by the current pension structure, which relies heavily on government funding. Under the proposed fully funded system, pension benefits will be determined by the contributions made by participants during their years of active service. Consequently, this new financing approach necessitates a rigorous actuarial framework to ensure that available assets are sufficient to meet long-term liabilities to pension recipients [5].

Previous research by [6], titled "Determining Pension Fund Financing Using the Attained Age Normal and Entry Age Normal Methods," analyzed 60 participants in the *ANTAM* pension program. The study found that the Entry Age Normal method produces higher normal contributions than the Attained Age Normal method and observed that actuarial liabilities increased annually, particularly under lower interest rate assumptions.

[7] A comparison between the Attained Age Normal and Entry Age Normal approaches in a public pension scheme found that while the Entry Age Normal method demands greater contributions, it offers more consistent long-term funding. [8] conducted an analysis of the Projected Unit Credit method relative to the Entry Age Normal approach and emphasized the influence of salary growth and service duration on funding requirements and liabilities. [9] conducted a broader comparison of several actuarial methods across various pension schemes and highlighted differences in funding sustainability and contribution levels depending on the selected method.

While these studies provided valuable insights, they shared several limitations. Most focused on either corporate or general state pension schemes and did not offer a direct comparison between the Attained Age Normal and Projected Unit Credit methods. Notably, the Projected Unit Credit method—a widely recognized international standard—was often omitted from comparisons involving the Attained Age Normal method. Furthermore, many studies used hypothetical models or lacked real-world data from public sector institutions, reducing the applicability of their findings to current government pension reforms in Indonesia.

This study distinguishes itself by addressing this research gap through a direct, empirical comparison of the Attained Age Normal and Projected Unit Credit methods using actual participant data from *PT. Taspen (Persero)*, Samarinda Branch—a state-owned institution managing pensions for civil servants. By applying both methods to a realistic case study within the Indonesian public sector, the research provides unique insights into how each method impacts normal contributions and actuarial liabilities.

The novelty of this study lies in three key aspects: (1) it is the first to compare the AAN and PUC methods using real data from a government pension provider in Indonesia; (2) it focuses specifically on the Indonesian civil servant context, which has received limited attention in prior literature; and (3) it offers practical, data-driven recommendations for selecting actuarial methods that align with Indonesia's transition toward a fully funded pension system.

Through this approach, the study makes both a theoretical and practical contribution to actuarial science and public pension policy. It helps bridge the gap between abstract actuarial models and the practical realities faced by policymakers and pension administrators. The findings are expected to inform ongoing reforms by providing evidence-based support for choosing the most sustainable and equitable funding model. Ultimately, this research enhances the understanding of pension financing in Indonesia and offers guidance for ensuring long-term fiscal stability and fairness in the country's evolving pension landscape.

2. METHODS

This study is a quantitative research with a descriptive approach, focusing on numerical calculations related to pension fund financing, normal contributions, and actuarial liabilities. The data used in this study consists of figures such as age, salary, interest rates, mortality, and others, with the addition of a hypothetical case study to complement real data. The secondary data used includes salary data of *PNS*, starting work age, retirement age, and gender, provided by *PT. Taspen (Persero)* Samarinda Branch Office, as well as the 2023 Indonesian Mortality Table. The data collection techniques used include documentation study, which involves obtaining secondary data from *PT. Taspen (Persero)* and the 2023 Indonesian Mortality Table, as well as literature study to collect theories, actuarial methods, and other references from books, scientific articles, and research reports. The data analysis techniques include calculations of various actuarial functions, such as survival functions, interest rate functions, and salary functions. The calculation of pension benefits, present value of benefits, normal contributions, and actuarial liabilities is conducted using the Attained Age Normal and Projected Unit Credit methods. The analysis results are presented through visualizations, such as graphs of accumulated contributions and normal liabilities.

2.1 Pension Fund

A pension fund is a program designed to plan for the future by ensuring a continuous income for employees upon retirement, in accordance with the terms of the employment agreement. Law No. 11 of 1992 affirms that pension programs are accessible to both private employees and the self-employed seeking financial protection in retirement, showing that such benefits are not restricted solely to *ASN*, *TNI*, or *Polri* personnel [10].

2.2 PT. Taspen (Persero)

PT. Taspen (Persero) is an institution engaged in the savings and insurance programs for PNS, managed by a State-Owned Enterprise (*BUMN*). *PT. Taspen* is affiliated with the National Civil Service Agency, which is responsible for the management and disbursement of government employee salaries. Additionally, *PT. Taspen* is connected with the Ministry of Finance, which oversees the disbursement of contributions, pension payments, and benefits. *PT. Taspen (Persero)* offers various programs, including pension schemes, work accident insurance, and death benefits [11].

2.3 Pension Fund Programs

2.3.1 Defined Benefit Pension Program (PPMP)

A pension program where the amount of the pension benefits is predetermined based on the pension benefit formula outlined in pension fund regulations, influenced by the length of service, compensation factors during one year of service, and the basic pension income [12]. The advantage of a defined benefit program is that the pension benefits, which are determined in advance, can be adjusted according to the participant's length of service, even if the pension program is established after the company has started operations. However, the drawback of this program lies in the company bearing the risk of insufficient funds due to inadequate investment returns, as well as the generally complex management of the program [13].

2.3.2 Defined Contribution Pension Program (PPIP)

A defined contribution program is one where the regulations of the pension fund stipulate contributions, and the development results and contributions are recorded in the employee’s account as part of the pension program benefits [14]. The advantage of a defined contribution program is that funding from the company can be more easily calculated and forecasted, enabling employees to more easily calculate their annual contributions, which simplifies administration. However, the disadvantage of this program is that the pension benefits at retirement age are difficult to predict, and participants bear the risk in case of investment instability [15].

2.4 Pension Benefits

In theory, pension benefits are the product of insurance funds, monthly contributions from participants that must be paid by employers, employees, and other parties, with the contribution period starting from when the employee is enrolled in the pension program until the end of their employment. For pension fund managers, pension benefits are considered obligations or debts categorized as short-term liabilities and are recorded in pension liability accounts [16].

2.5 Mortality Table

A table compiled based on data obtained from a group of individuals who are insurance participants with similar conditions is called a mortality table. The mortality table contains the probability of an individual dying at a certain age, denoted as q_x [17]. The mortality table also includes the number of individuals alive at age *x*, symbolized as l_x, and the number of individuals who die after reaching age *x*, symbolized as d_x. The calculation for the mortality table is as follows.

$$d_x = l_x - l_{x+1} . \tag{1}$$

Explanation:

d_x : The number of individuals who die between ages *x* and *x* + 1 years

l_x : The number of individuals alive at exactly age *x* years

l_{x+1} : The number of individuals alive at exactly age *x* + 1 years

The probability that an individual aged *x* will survive for 1 more year is as follows [18]:

$$p_x = \frac{l_{x+1}}{l_x}. \tag{2}$$

The probability that someone aged *x* will not survive to age *x* + 1 is denoted as q_x, with the following equation [18]:

$$q_x = 1 - p_x . \tag{3}$$

The probability of death within n years for an individual aged n years is denoted as ${}_nq_x$, with the following equation:

$${}_nq_x = 1 - {}_np_x . \tag{4}$$

Commutation symbols are often used to simplify mortality table calculations. Some commutation symbols used are as follows:

1. The notation D_x is expressed as:

$$D_x = v^x l_x . \tag{5}$$

Where v can be calculated using the interest rate as $v = \frac{1}{(1+i)}$.

2. The notation N_x is expressed as:

$$N_x = D_x + D_{x+1} + D_{x+2} + \ldots + D_w = \sum_{i=0}^{w-x} D_{x+i} . \tag{6}$$

2.6 Annuities

An annuity is a fixed payment made at regular intervals over a specific period of time. Based on the payment duration, annuities are categorized into life annuities, which include pure endowment, term annuities, deferred annuities, and lifetime annuities. A lifetime annuity is one in which payments are made as long as the insured person is alive, and it is further divided into two types: immediate annuities and annuities due [19]. In the pension annuity calculations used in this study, the discrete life annuity calculation is applied using the equation below [20]:

$$\ddot{a}_r = \frac{N_r}{D_r}. \tag{7}$$

2.7 Basic Actuarial Functions

2.7.1 Survival Probability Function

The survival probability function is the probability that a worker will remain employed during the active employment period until retirement. The survival probability function is expressed by the equation below [21].

$$_np_x = \frac{l_{x+n}}{l_x}. \tag{8}$$

2.7.2 Discount Factor as a Function of Interest Rate

The discount factor, which is derived from the interest rate function, is based on the concept that interest arises due to the time value of money [22]. In this study, the interest rate is used to discount a future payment to its present value. This process, known as discounting, determines the present worth of a future amount. The mathematical expression of the discount factor is as follows [21]:

$$v^n = \frac{1}{(1+i)^n} \tag{9}$$

Where v^n is the discount factor for n years factor.

2.7.3 Salary Function

The salary of a participant at age *x* is denoted as S_x, representing the amount of salary received at a certain time, under the assumption that the participant experiences an annual salary increase rate of *s%*, using the following equation:

$$S_{x+t} = S_x(1+s)^t \tag{10}$$

2.7.4 Benefit Function

There are three types of benefit equations used in the calculation of defined benefit pension plans, where the retirement age is denoted as *r*, the initial age of registration as a pension fund participant is denoted as e, and the benefit amount at retirement is denoted as B_r [23]. The benefit function can be calculated based on three assumptions: the final salary, the average salary during the entire employment period, or the average salary over the last *n* years [24]. In this study, the final salary assumption is used, with the equation as follows:

$$B_r = k(r-e)S_{r-1}. \tag{11}$$

Where:

k : The proportion of salary allocated to pension benefits (%)

S_{r-1} : The cumulative final salary before retirement at age $r-1$

The cumulative final salary before retirement at age $r-1$ can be calculated with the following equation:

$$S_{r-1} = (1+s)^{r-e-1}S_x. \tag{12}$$

2.8 Present Value of Future Benefit (PVFB)

The Present Value of Future Benefit represents the estimated value, at present, of the pension payments that a participant is entitled to receive once they attain retirement age (r). The equation used is as follows [25]:

$$^r(PVFB)_x = B_r\ddot{a}_r v^{r-x}{}_{r-x}p_x. \tag{13}$$

2.9 Normal Cost

Normal cost represents the annual contribution required to finance the value of pension benefits accrued for the current year, based on the actuarial approach applied. The equation is as follows [3]:

$$^{r}(NC)_x = B_r \ddot{a}_r v^{r-x}{}_{r-x}p_x \,. \tag{14}$$

The relationship between the present value of future benefits and the present value of future normal contributions is given by:

$$^{r}(PVFB)_e = {}^{r}(PVFNC)_e \,. \tag{15}$$

The calculation of the accumulation of normal costs or the total normal cost contributions to be paid by a participant from the entry age (e) until retirement age (r) is as follows [21]:

$$^{r}(NA)_e = \sum_{x=e}^{r-1} \frac{^{r}(NC)_x}{v^{r-x}} . \tag{16}$$

2.10 Actuarial Liability

Actuarial liability represents the mathematical reserve provision in life insurance. Following the normal cost payments, during the program or when the participant is aged x, there may be a difference between $^{r}(PVFB)_e$ and $^{r}(PVFNC)_e$, resulting in the actuarial liability, calculated as:

$$^{r}(AL)_x = {}^{r}(PVFB)_x - {}^{r}(PVFNC)_x . \tag{17}$$

2.11 Attained Age Normal

The Attained Age Normal method calculates the present value of pension benefits allocated from the participant's current age (x) up to the normal retirement age (r). According to 2015 statistics from the Financial Services Authority (OJK), this method is widely used by pension funds and benefits pension fund institutions by producing lower actuarial liabilities and distributing pension benefits more evenly through annual contributions [22]. The normal pension cost using the Attained Age Normal method is calculated as:

$$AAN\ ^{r}(NC)_x = \frac{^{r}(PVFB)_e}{\frac{N_x - N_r}{D_x}} . \tag{18}$$

The actuarial liability using the Attained Age Normal method is calculated as:

$$AAN\ ^{r}(AL)_x = {}^{r}(PVFB)_x - AAN\ ^{r}(NC)_x \frac{N_x - N_r}{D_x} . \tag{19}$$

2.12 Project Unit Credit

The Projected Unit Credit method is an actuarial calculation that pension benefits expected at the normal retirement age (r) are distributed proportionally across the total years of service, with each year accruing a specific portion of the benefit. [17]. The normal pension cost using the Projected Unit Credit method is calculated as [3]:

$$PUC\ ^{r}(NC)_x = \frac{1}{(r-e)}\ {}^{r}(PVFB)_x . \tag{20}$$

The actuarial liability using the Projected Unit Credit method is calculated as [3]:

$$PUC\ ^{r}(AL)_x = \frac{(x-e)}{(r-e)}\, ^{r}(PVFB)_x \,. \tag{21}$$

3. RESULT AND DISCUSSION

3.1 Research Data Description

This study uses data on the basic salary of *PNS*, gender, age at the time of joining employment or registering as a pension plan participant (e), and the employee's retirement age (r), based on data obtained from *PT. Taspen (Persero)* Samarinda Branch Office. In addition, this study constructs a hypothetical case using

assumptions similar to real-world cases, which include the age at the time of calculation (x), interest rate (i), salary increase rate (s), length of service (n), and the proportion of salary allocated for pension benefits (k).

The case study used in this research involves data of a male *PNS* who entered employment and registered as a pension fund participant at the age of 22 (e = 22) and is set to retire at the age of 60 (r = 60). The calculations are performed when the employee is 35 years old (x = 35), with the latest monthly basic salary of IDR 4,074,000, amounting to IDR 48,888,000 annually. The assumed salary increase rate is 8%, the proportion of salary for pension benefits is 2.5%, and the interest rate is 6%.

3.2 Discussion

The actuarial calculation of the pension fund is carried out using the Attained Age Normal and Project Unit Credit methods. It includes the calculation of cumulative final salary before retirement, pension benefits to be received, Present Value of Future Benefit (PVFB), normal cost, accumulated normal cost, actuarial liability, and a comparison of the normal cost and actuarial liability under both methods.

3.2.1 Pension Benefit

The pension benefit is calculated assuming a salary increase rate (s) of 8% and an annual basic salary (S_x) of IDR 48,888,000. Before calculating the pension benefit, the cumulative final salary before retirement at age r - 1 is calculated as follows:

$$\begin{aligned} S_{r-1} &= (1+s)^{r-e-1} S_x \\ S_{60-1} &= (1+0.08)^{60-22-1} 48{,}888{,}000 \\ S_{59} &= (1+0.08)^{37} 48{,}888{,}000 \\ S_{59} &= 843{,}104{,}143.594 \end{aligned} \tag{22}$$

Thus, the cumulative final salary before retirement at age 59 is IDR 843,104,143.594. The pension benefit to be received by the employee is calculated as:

$$\begin{aligned} B_r &= k(r-e) S_{r-1} \\ B_{60} &= 2{,}5\% \ (60-22) S_{59} \\ B_{60} &= 2{,}5\% \ (38) \ 843{,}104{,}143.594 \\ B_{60} &= 800{,}948{,}936.414 \end{aligned} \tag{23}$$

3.2.2 Present Value of Future Benefit (PVFB)

The present value of the pension benefit at the calculation age of 35 (x = 35) is calculated as:

$$\begin{aligned} {}^{r}(PVFB)_x &= B_r \ddot{a}_r v^{r-x} {}_{r-x}p_x \\ {}^{60}(PVFB)_{35} &= B_{60} \ddot{a}_{60} v^{60-35} {}_{60-35}p_{35} \\ {}^{60}(PVFB)_{35} &= 800{,}948{,}936.414 \left(\frac{N_{60}}{D_{60}}\right)\left(\frac{1}{1+0.06}\right)^{25}\left(\frac{l_{35+25}}{l_{35}}\right) \\ {}^{60}(PVFB)_{35} &= 800{,}948{,}936.414 \left(\frac{24{,}518.27}{24{,}518.27}\right)\left(\frac{1}{1+0.06}\right)^{25}\left(\frac{808{,}801.237}{966{,}522.760}\right) \\ {}^{60}(PVFB)_{35} &= 800{,}948{,}936.414 \left(\frac{24{,}518.27}{24{,}518.27}\right).2329986\left(\frac{808{,}801.237}{966{,}522.760}\right) \\ {}^{60}(PVFB)_{35} &= 156{,}166{,}494.584 \end{aligned} \tag{24}$$

Thus, the present value of the pension benefit at age 35 is IDR 156,166,494.584.

3.2.3 Normal Cost

The calculation of the normal cost using the Attained Age Normal method requires calculating the present value of future benefits at the age of enrollment (e = 22):

$$
\begin{aligned}
{}^{r}(PVFB)_e &= B_r \ddot{a}_r v^{r-e}{}_{r-e}p_e \\
{}^{60}(PVFB)_{22} &= B_{60}\ddot{a}_{60}v^{60-22}{}_{60-22}p_{22} \\
{}^{60}(PVFB)_{22} &= 800{,}948{,}936.414\left(\frac{N_{60}}{D_{60}}\right)\left(\frac{1}{1+0{,}06}\right)^{38}\left(\frac{l_{22+38}}{l_{22}}\right) \\
{}^{60}(PVFB)_{22} &= 800{,}948{,}936.414\left(\frac{24{,}518.27}{24{,}518.27}\right)\left(\frac{1}{1+0.06}\right)^{38}\left(\frac{808{,}801.237}{983{,}696.327}\right) \\
{}^{60}(PVFB)_{22} &= 800{,}948{,}936.414\left(\frac{24{,}518.27}{24{,}518.27}\right)0.1092388\left(\frac{808{,}801.237}{983{,}696.327}\right) \\
{}^{60}(PVFB)_{22} &= 71{,}938{,}719.916 \qquad (25)
\end{aligned}
$$

Then, the normal cost is calculated as:

$$
\begin{aligned}
AAN\ {}^{r}(NC)_x &= \frac{{}^{r}(PVFB)_e}{\frac{N_x - N_r}{D_x}} \\
AAN\ {}^{60}(NC)_{35} &= \frac{{}^{60}(PVFB)_{22}}{\frac{N_{35} - N_{60}}{D_{35}}} \\
AAN\ {}^{60}(NC)_{35} &= \frac{71{,}938{,}719.916}{\frac{1{,}668{,}902.08 - 24{,}518.27}{125{,}749.65}} \\
AAN\ {}^{60}(NC)_{35} &= 5{,}501{,}312.504 \qquad (26)
\end{aligned}
$$

Thus, the annual normal cost for the participant aged 35 up to retirement at age 60 is IDR 5,501,312.504. Next, the calculation of the normal cost is carried out using the Projected Unit Credit method.

$$
\begin{aligned}
PUC\ {}^{r}(NC)_x &= \frac{1}{(r-e)}\ {}^{r}(PVFB)_x \\
PUC\ {}^{60}(NC)_{35} &= \frac{1}{(60-22)}\ {}^{60}(PVFB)_{35} \\
PUC\ {}^{60}(NC)_{35} &= \frac{1}{(38)}\ {}^{60}(PVFB)_{35} \\
PUC\ {}^{60}(NC)_{35} &= \frac{1}{(38)}\ 156{,}166{,}494.584 \\
PUC\ {}^{60}(NC)_{35} &= 4{,}109{,}645.131 \qquad (27)
\end{aligned}
$$

Based on the calculation of the normal cost using the Projected Unit Credit method, it is determined that the normal cost that must be paid by a participant aged 35 until the retirement age of 60 is IDR 4,109,645.131.

3.2.4 Final Value of Normal Contributions

The calculation of the final value of contributions that must be paid by the participant using the Attained Age Normal method is as follows:

$$AAN\ NA = \sum_{x=22}^{59} AAN(NC)_x(1+i)^{60-x}$$

$$AAN\ NA = AAN(NC)_{22}(1+0.06)^{60-22} + AAN(NC)_{23}(1+0.06)^{60-23} + \ldots + AAN(NC)_{59}(1+0.06)^{60-59}$$

$$AAN\ NA = AAN(NC)_{35}(1.06)^{38} + AAN(NC)_{36}(1.06)^{37} + \ldots + AAN(NC)_{59}(1.06)^{1}$$
$$AAN\ NA = 42{,}686{,}305.133 + 40{,}801{,}522.520 + \ldots + 76{,}255{,}043.111$$
$$AAN\ NA = 1{,}001{,}981{,}567.013 \quad (28)$$

Based on the calculation above, the participant's required total contribution using the Attained Age Normal method is IDR 1,001,981,567.013. Subsequently, the calculation of the final value of contributions that must be paid by the participant using the Project Unit Credit method is performed as follows:

$$PUC\ NA = \sum_{x=22}^{59} PUC(NC)_x(1+i)^{60-x}$$
$$PUC\ NA = PUC(1+0.06)^{60-22} + PUC(NC)_{23}(1+0.06)^{60-23} + \ldots + PUC(NC)_{59}(1+0.06)^{60-59}$$
$$PUC\ NA = PUC(NC)_{35}(1.06)^{38} + PUC(NC)_{36}(1.06)^{37} + \ldots + PUC(NC)_{59}(1.06)^{1}$$
$$PUC\ NA = 17{,}330{,}136.727 + 17{,}346{,}911.190 + \ldots + 20{,}727{,}631.060$$
$$PUC\ NA = 692{,}765{,}213.086 \quad (29)$$

From the above calculation, it is obtained that the total final value of contributions that must be paid by the participant using the Project Unit Credit method is IDR 692,765,213.086.

3.2.5 Actuarial Liability

The calculation of the actuarial liability using the Attained Age Normal method is as follows:

$$AAN\ {}^{r}(AL)_x = {}^{r}(PVFB)_x - AAN\ {}^{r}(NC)_x \frac{N_x - N_r}{D_x}$$
$$AAN\ {}^{60}(AL)_{35} = {}^{60}(PVFB)_{35} - AAN\ {}^{60}(NC)_{35} \frac{N_{35} - N_{60}}{D_{35}}$$
$$AAN\ {}^{60}(AL)_{35} = 156{,}166{,}494.584 - 5{,}501{,}312.504 \frac{1{,}668{,}902.08 - 24{,}518.27}{125{,}749.65}$$
$$AAN\ {}^{60}(AL)_{35} = 84{,}227{,}795.059 \quad (30)$$

From the calculation above, the actuarial liability using the Attained Age Normal method from age 35 up to retirement at age 60 is IDR 84,227,795.059. Next, the actuarial liability is calculated using the Project Unit Credit method:

$$PUC\ {}^{r}(AL)_x = \frac{(x-e)}{(r-e)}\ {}^{r}(PVFB)_x$$
$$PUC\ {}^{60}(AL)_{35} = \frac{(35-22)}{(60-22)}\ {}^{60}(PVFB)_{35}$$
$$PUC\ {}^{60}(AL)_{35} = \frac{(13)}{(38)} 156{,}166{,}494.584$$
$$PUC\ {}^{60}(AL)_{35} = 53{,}425{,}386.70 \quad (31)$$

From the above calculation, the actuarial liability using the Project Unit Credit method from age 35 up to retirement at age 60 is IDR 53,425,386.70.

3.2.6 Comparison of Calculation Results

A comparison is conducted to determine the most suitable method for both the participants of the pension fund program and the pension fund organizer, PT. Taspen. The comparison is based on the normal contribution values, and the results of the comparison between the two methods are as follows:

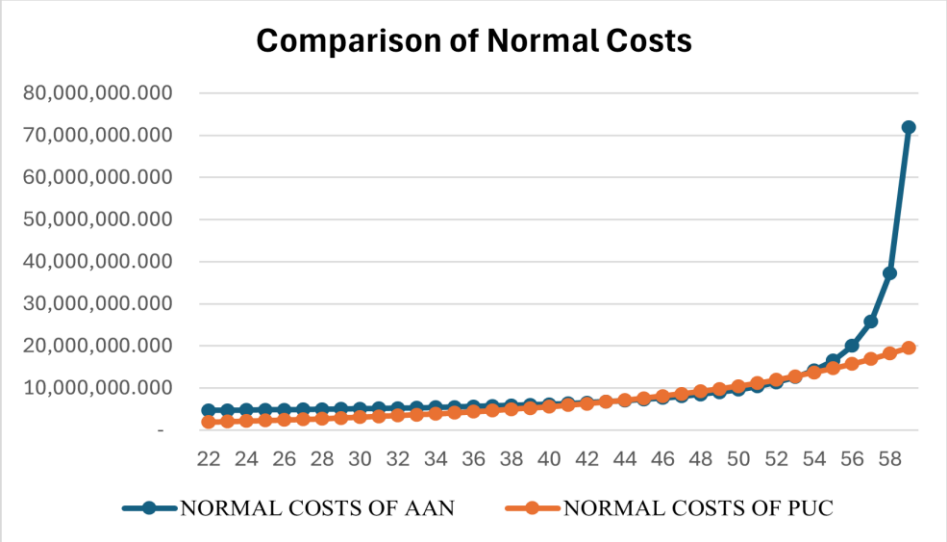

Figure 1. Comparison of normal contribution values between the Attained Age Normal and the Projected Unit Credit method

Based on Figure 1, it can be observed that the normal contribution value using the Attained Age Normal method, represented in blue, follows an increasing pattern from the initial age of registration as a participant up to retirement age. This increase becomes significant in the years approaching retirement, indicating that the contribution burden becomes heavier toward the end of the working period, with the value reaching IDR 71,938,719.916 at age 59 or r - 1. On the other hand, the Projected Unit Credit method, shown in orange, displays a more stable growth pattern throughout the participant's career. This method distributes pension benefits proportionally over the completed service years, resulting in relatively stable contributions, with a value of IDR 19,554,368.924 at the end of the working period (age 59 or r - 1). The comparison of actuarial liabilities under both methods is presented below.

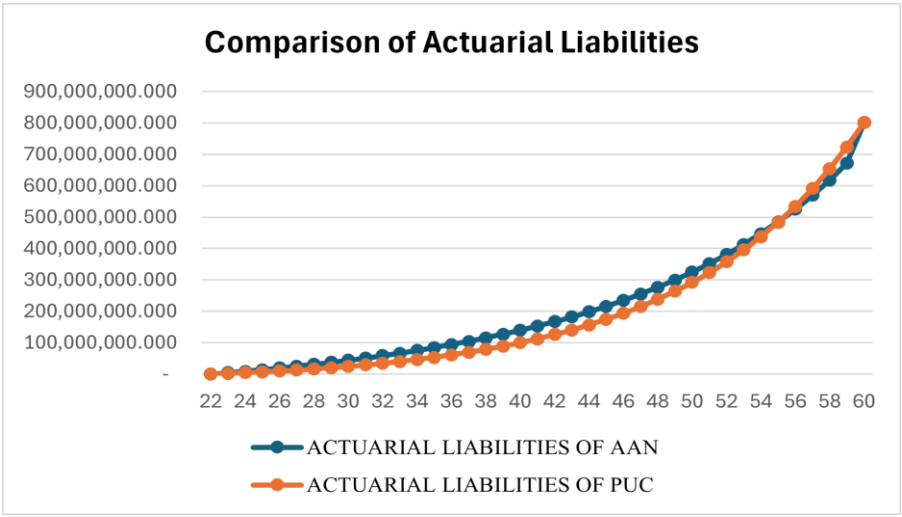

Figure 2. Comparison of actuarial liabilities between the Attained Age Normal and the Projected Unit Credit method

Based on Figure 2, it can be observed that the actuarial liabilities under both the Attained Age Normal method, indicated in blue, and the Projected Unit Credit method, indicated in orange, increase with age. Nevertheless, the liabilities determined through the Attained Age Normal method tend to be marginally greater than those calculated using the Projected Unit Credit method. This is because the Projected Unit Credit method tends to show more stable and evenly distributed liability growth by allocating liabilities proportionally to the

participant's years of service. In contrast, the Attained Age Normal method tends to accumulate larger liabilities as retirement approaches.

4. CONCLUSIONS

This study has demonstrated notable differences in pension fund financing between the Attained Age Normal (AAN) and Projected Unit Credit (PUC) methods, based on a 6% interest rate and real-world data from *PT. Taspen*. The AAN method features lower normal contributions in the early employment years but significantly higher contributions as retirement approaches. In contrast, the PUC method ensures a more stable and evenly distributed contribution pattern across the employee's service period.

While both methods show increasing actuarial liabilities over time, the AAN method results in higher liabilities near retirement due to its deferred funding approach. The PUC method, on the other hand, promotes a more gradual and consistent accumulation of liabilities, reflecting its proportional allocation structure.

The key contribution of this research lies in its practical comparison of two actuarial methods using actual civil servant data from a state pension institution—an approach rarely explored in Indonesian actuarial literature. These findings offer valuable insights for pension policymakers and fund administrators seeking a more sustainable and equitable pension system. Specifically, the Projected Unit Credit method is recommended for public pension participants due to its stability and fairness, while the Attained Age Normal method may benefit pension providers by enabling greater accumulation in later years. This analysis contributes to the body of knowledge in actuarial science and offers timely support for Indonesia's transition from a pay-as-you-go scheme to a fully funded pension model.

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We also acknowledge *PT. Taspen*'s continued commitment to transparency and knowledge-sharing, which supports the advancement of actuarial research in Indonesia. We hope that the insights and outcomes presented in this study will make a meaningful contribution to the development of a more robust, equitable, and sustainable pension system, particularly for civil servants and government institutions undergoing pension reform.

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