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Government Employees with Employment Agreements Pension Fund Valuation Across 17 Salary Grades Using Entry Age Normal and Projected Unit Credit

Khalil Rafif [1], Illuminata Wynnie [1*]

[1] *Actuarial Science, Mathematics Departement, Hasanuddin University, Makassar, Indonesia*

*Corresponding email: *illuminataw@unhas.ac.id*

Abstract

Accurate calculation of pension funds for Government Employees with Employment Agreements (PPPK) is crucial for the sustainability of the program. Variations in the age and age of entry used can result in significantly different pension cost projections, so a comprehensive analysis is needed to determine the right methods and assumptions. This study aims to analyze the differences in the calculation of present value future benefits, normal contributions, actuarial obligations, and lumpsum benefits by taking into account based on class and age of entry. This quantitative research uses actuarial simulations using the Entry Age Normal (EAN) and Projected Unit Credit (PUC) methods. The simulation was carried out at the age of 20 to 48 years and groups I to XVII. This calculation follows the 100% one-time pension benefit for a service period of 10 to 15 years and 20% at once for a service period of more than 15 years, with a normal retirement age of 58 years. The results of the study show that the EAN method produces constant normal contributions, while the PUC method produces contributions that increase every year, the normal monthly contributions increase monotonically based on the group and age of entry into work until retirement. In addition, the EAN method produces greater lumpsum benefits than the PUC method. The 17 PPPK groups take into account the projected pension fund present value future benefits, normal contributions, actuarial liabilities, and lumpsum benefits that are more realistic and sustainable.

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1. INTRODUCTION

The pension program is a long-term financial protection instrument that ensures the sustainability of employee welfare after the end of the employment period. The Republic of Indonesia (2023) declared that Government Employees with Work Agreements (PPPK) are equivalent to Civil Servants (PNS) in terms of social security rights, including pension guarantees. Civil servants have so far received protection through PPMP managed by PT Taspen (Persero), so it is appropriate for PPPK to receive equal treatment as mandated by law, considering that both are components of ASN with equal rights and obligations before the state. Furthermore, the Republic of Indonesia (2024) stipulates 17 PPPK salary groups with service periods as the determining variable for salary increases, making the PPPK staffing structure a relevant technical basis in pension actuarial valuation [3].

The selection of the actuarial valuation method in PPMP determines the amount of Normal Cost (NC) and retirement benefits at once (lumpsum benefits) which have a direct impact on the adequacy of funds in retirement. The two commonly used methods are Entry Age Normal (EAN) and Projected Unit Credit (PUC), as stipulated in [4]. The EAN method distributes the cost of retirement benefits evenly throughout the service period based on age of entry, while the PUC recognizes one unit of benefit each year based on the actual service period, resulting in a significantly different NC and Actuarial Liability (AL) pattern despite using identical actuarial assumptions [5]. With an interest rate of 8% per year as the average national pension fund based [6] and the assumption of a salary increase of 5% per year consistent with Indonesia's average economic growth of 5.03 - 5.31% in 2022 - 2024 [7], the difference between NC and AL between the two methods has the potential to create a material difference in fund accumulation at the normal retirement age of 58 years.

The urgency of this research is strengthened by the provisions of lump sum pension benefits in [8] and [9] must be able to pay contributions for at least 15 years. As for if the working period is less than 15 years, retirement benefits will be obtained at once. This is in line with the direction of the Constitutional Court (MK) regarding the indication of the payment of pension benefits as well as a financial instrument for social protection that can pose the risk of economic vulnerability and abuse in the future. Furthermore, there is a minimum requirement of 10 years to be able to receive pension benefits. In the [10] and [11], article 164 paragraph 2 that the first pension benefit is at most 20% at once. So that there is a pension benefit scheme at once and receive pension benefits on a monthly basis. This cluster dualism requires careful calculation of NC and AL, especially at the entry age of 20 years (e = 20) as the minimum age of Functional Position (JF) and the entry age of 48 years (e = 48) as the highest entry age limit that still receives 100% lumpsum benefits [12]. [13] show that in the last salary-based PPMP, the constant NC EAN produces a smaller NC than the progressively increasing NC PUC, so that the lumpsum benefits of the EAN method are consistently greater and more beneficial to participants.

The selection of female gender in this study is based on the demographic reality of PPPK in projecting the long-term obligations of PPMP PPPK. BKN data (2024) shows that women dominate the composition of PPPK nationally, especially in the education and health sectors. The mortality table used is the Group Annuity Mortality (GAM) 1971 [14]. Despite being an older mortality table, GAM 1971 is deliberately chosen because it remains the industry baseline and is more commonly implemented in practice; OJK data confirms its dominance, showing that 44% of Indonesian pension fund companies still rely on GAM 1971 for PPMP valuations due to historical consistency and regulatory precedents [15]. Methodologically, GAM 1971 is specifically designed for group annuity holders, different from the 2023 Indonesian Population Mortality Table (TMPI) published by BPJS Kesehatan and reflects the mortality of the general population. The difference in the probability of death value between the two tables has an impact on all actuarial components of PPMP. In the working age range (x = 20 - 57), the difference in q_x of the two tables affects the survival factors used in the PVFB, NC, and AL calculations. q_x TMPI 2023 female (x = 20 - 72) is smaller than q_x GAM 1971 female indicates that TMPI 2023 projects longer life expectancy during the working period to approximately 10 years after retirement. A table with a lower q_x over the service life results in a lower NC.

The gap in the national actuarial literature related to the comparison of EAN and PUC methods for 17 PPPK groups makes this study have a significant original contribution. [16] only reviewed the Taspen PNS without the context of PPPK, while [3] reviewed he PPPK AL without taking into account the components of lumpsum benefits in the latest P2SK regulatory framework. This study fills this gap by presenting a comprehensive valuation of PVFB, NC, AL, and lumpsum benefits using EAN and PUC methods for 17 PPPK groups based on the GAM 1971 table for women, an interest rate of 8%, and a salary increase of 5% per year, as a quantitative basis for the preparation of derivative implementing regulations of the 2023 ASN Law [17]. Therefore, this study is expected to examine the analysis of PPPK pension funds in the research title "Calculation of Pension Funds Normal Entry Age Method and Projected Unit Credit (Case Study: Government Employees with Employment Agreements)". Based on the formulation of the problem, this study aims to calculate the PVFB, NC, and AL that must be prepared if calculated using the EAN and PUC methods based on the difference in age of entry into the workforce and group variation, as well as to compare the lumpsum benefits obtained if calculated using the EAN and PUC methods based on the difference in age for work entry and group variation.

2. METHODS

This study evaluates the actuarial design of the pension fund for Government Employees with Work Agreements (PPPK). The methodology is structured as follows:

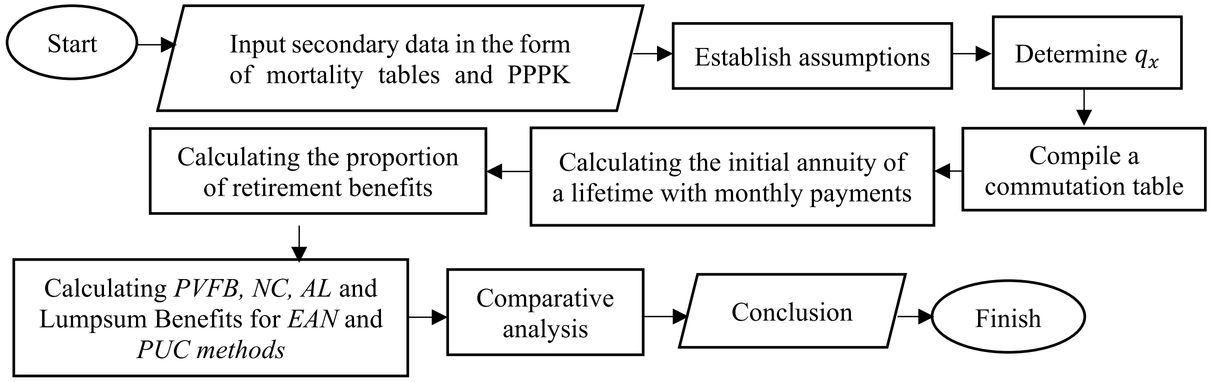

Figure 1. Flowchart of the Research Methodology

2.1 Basic Actuarial Functions

The function, interest rate function, and benefit function are basic actuarial functions to be able to calculate annuities [18]. This function is arranged according to the actuarial assumptions used. The three functions are expressed in the following equation.

$$q_x = 1 - p_x = \frac{l_x - l_{x+1}}{l_x} \tag{1}$$

$$v^n = (1+i)^{-n} \tag{2}$$

$$B_r = k(r-e)s_{r-1} \tag{3}$$

l_x denotes the number of individuals at a given age, p_x indicates the probability that an individual of a certain age will survive for an additional year, and d_x represents the number of individuals who die at a given.

2.2 Commutation Symbols

Commutation symbols are used to simplify the writing of actuarial equations [19]. These symbols can be arranged in a single commutation table. through the following equation.

$$D_x = v^x l_x \tag{4}$$

$$N_x = \sum_{i=0}^{w-x} D_{x+i} = D_x + D_{x+i} + \cdots + D_w \tag{5}$$

w is the highest age in the mortality table.

2.3 Annuity

An annuity is a series of periodic payments made within a certain time [20]. Annuities are divided into two, namely certain annuity and life annuity. Payments paid at the beginning of the period are called the initial annuity equation (6). Furthermore, the calculation of annuities can be done by payment in m-times with the following equation (7) [16].

$$\ddot{a}_x = \frac{N_x}{D_x} \tag{6}$$

$$\ddot{a}_x^{(m)} = \frac{N_x}{D_x} - \frac{(m-1)}{2m} \tag{7}$$

where m denotes the number of payment periods per annum, and x represents the retirement age (r).

2.4 Salary Function

Accumulated salary is obtained by first calculating the salary per month and annually every year of calculation. Determine the amount of salary obtained assuming an annual salary increase. If participants receive a salary increase every year, then the amount of the participant's salary at the age of the year is based on the wage at the age of the year [21]. The large calculation of the salary and its increase is expressed in the following equation.

$$S_{x+t} = S_x(1+s)^t \tag{8}$$

where s signifies the percentage of salary increment, whilst S_x denotes the salary at age x and t represents the future time.

2.5 Present Value of Future Benefit (PVFB)

The calculation of pension funds is calculated using the EAN and PUC methods. The EAN method is a method of calculating pension funds with a constant amount [22]. The PUC method is a method that divides the total retirement benefits at normal retirement age with the total service period into units of pension benefits which are then allocated to each year during the service period [23]. The calculation of the actuarial value of pension fund liabilities is calculated with the same Actuarial Present Value (APV) or Present Value of Future Benefit (PVFB) for both methods. PVFB is the present value of the pension benefits that will be paid to participants when they reach retirement age [24]. PVFB is expressed in Equation (9).

$$PVFB_x = B_r\, \ddot{a}_x^{(m)} \frac{D_r}{D_x} \tag{9}$$

Where the symbols in Equation (9) are defined as follows: B_r represents the pension benefit amount, D_r denotes the commutation symbol at the retirement age r, and D_x signifies the commutation symbol at the entry or current age x. These commutation symbols mathematically represent the multiplication between the discount rate factor and the corresponding survival population at each respective age.

2.6 Normal Cost of Pension Funds (NC)

Normal Cost (NC) is the contribution that must be paid by participants and/or employers every period [25]. The normal calculation of contributions by the EAN method results in the same amount of contributions for each year. This calculation is expressed in equations (10) and (11) below.

$$^{EAN}(NC)_x = \frac{D_x}{N_e - N_r} PVFB_x \tag{10}$$

$$^{PUC}(NC)_x = \frac{PVFB_x}{r-e} \tag{11}$$

where $PVFB_x$ yielding identical values for both the *EAN* and *PUC,* r denoting the retirement age, and e representing the participant's age at entry.

2.7 Actuarial Liability of Pension Funds (AL)

Actuarial liability (AL) is the present value of pension obligations that has accrued up to a certain valuation age [21]. The calculation of the size of actuarial liabilities uses equations (12) and (13).

$$^{EAN}(AL)_x = \frac{N_e - N_x}{N_e - N_r} PVFB_x \tag{12}$$

$$^{PUC}(AL)_x = \frac{x-e}{r-e}\, PVFB_x \tag{13}$$

where $^{EAN}(AL)_x$ denotes AL under the EAN method at age x, $^{PUC}(AL)_x$ represents the AL under the PUC method at age x, r signifies the retirement age, x corresponds to the participant's age in the year of calculation, and e denotes the participant's age at entry.

2.8 Lumpsum Pension Benefits

The implementation of the lumpsum pension benefit scheme is governed by the applicable national regulatory framework. Under Government Regulation, the pension scheme for this employee category transitions from a partial payout to a full payout depending on specific entry age brackets. Specifically, individuals entering the scheme between the ages of 20 and 42 are eligible for a 20% partial lumpsum, whereas a policy shift mandates a 100% full lumpsum benefit for those with entry ages ranging from 43 to 48 years. This statutory mandate dictates the payout percentages (P) applied at retirement. Retirement benefits are also the amount of retirement benefits that a person receives after entering retirement age [26]. The calculation of the size of retirement benefits at the same time uses equation (14) as follows.

$$B = \%[(AL)_{r-1} - \sum_{x=e}^{r-1} (NC)_x] \tag{14}$$

where B constitutes the lumpsum pension benefit, $(AL)_{r-1}$ corresponds to the accrued liability (AL) at the final age prior to retirement, and $\sum_{x=e}^{r-1}(NC)_x$ denotes the total contributions remitted throughout the period of employment.

3. RESULT AND DISCUSSION

The calculation of pension funds is carried out using the EAN and PUC methods. The calculation was made to obtain: (1) accumulated salary and projected retirement benefits, (2) Present Value of Future Benefit (PVFB), (3) Normal Cost (NC), (4) Actuarial Liability (AL), and (5) lumpsum pension benefits. All calculations were carried out for 17 groups and 29 variations in age for entering work. For the purposes of illustration in the manuscript, Groups I and XVII are presented with detailed examples at entry age e = 43 years, as well as a summary of 4 representative ages (20, 42, 43, 48). This selective presentation is methodologically justified as Groups I and XVII represent the boundary extremes (the minimum and maximum brackets) of the employment classification, which efficiently captures the overall data behavior. Furthermore, the selected entry ages (20, 42, 43, and 48) encapsulate the critical threshold points of the institutional policy shift, specifically highlighting the transition from a 20% partial lumpsum payout scheme to a 100% full lumpsum scheme.

3.1 Computational Symbol Calculation

Table 1. presents the calculated mortality and commutation values from the entry age of 43 to the mandatory retirement age of 58. The table is constructed using an initial radix value (l_5) of 100,000 as the baseline population size. A constant annual interest rate of 8% ($i = 8\%$) is applied as the discount factor to calculate the commutation values D_x and N_x. Ultimately, these values serve as the mathematical foundation for subsequent calculations; by combining the results from Equations (1), (2), (4), and (5), they are directly substituted into Equation (7) to obtain the life annuity values discussed in Section 3.2.

Table 1. Service table GAM 1971 (female)

x	q_x	p_x	l_x	D_x	N_x
43	0.001186	0.998814	98446	3597	45029
44	0.001286	0.998714	98329	3327	41432
45	0.001397	0.998603	98203	3076	38105
46	0.001519	0.998481	98066	2845	35028
47	0.001654	0.998346	97917	2630	32184
48	0.001802	0.998198	97755	2431	29554
49	0.001967	0.998033	97579	2247	27123
50	0.002151	0.997849	97387	2076	24876
51	0.002324	0.997676	97177	1918	22799
52	0.002520	0.997480	96952	1772	20881
53	0.002738	0.997262	96707	1637	19109
54	0.002982	0.997018	96442	1511	17472

x	q_x	p_x	l_x	D_x	N_x
55	0.003256	0.996744	96155	1395	15961
56	0.003574	0.996426	95842	1288	14565
57	0.003948	0.996052	95499	1188	13278
58	0.004388	0.995612	95122	1096	12089

3.2 Annuity Calculation

The annuity used in the calculation is a lifetime annuity calculated by equations (6) and (7) as follows. So that the results of the calculation are obtained as $r = 58$ follows.

$$\ddot{a}_{58} = \frac{N_{58}}{D_{58}} = \frac{12098}{1096} = 11.033247$$

Furthermore, the annuities paid every month are as follows.

$$\ddot{a}_{58}{}^{(12)} = 11.033247 + \frac{(12 - 1)}{2(12)} = 11.033247 - \frac{11}{24} = 10.574914$$

The value of $\ddot{a}_x$ is derived from the commutation table, assuming r = 58 years, alongside the GAM 1971 female mortality table. This yields $\ddot{a}_{58} = 11.033247$, resulting in a monthly annuity value of $\ddot{a}_{58}{}^{(12)} = 10.574914$. This figure is subsequently utilised as a multiplier across all PVFB calculations for the 17 distinct classifications and 29 entry age scenarios.

3.3 Calculation of Salary

The accumulated salary of group I employees is obtained when the employee is 43 years old (e = 43 years) and reaches retirement age (r = 58 years). The initial salary of PPPK is adjusted based on the salary table presented based on group I and adjusted to the annual salary increase of 5%. If the employee receives an annual salary increase, then the amount of the employee's salary at the age is based on the wage at $x + 1$ the age of the year with Equation (8) as follows.

Furthermore, PVFB obtained the following results.

$$S_{44} = S_{43}(1 + 5\%)^1$$

$$S_{44} = 23{,}262{,}000(1.05)$$

$$S_{44} = 24{,}425{,}100$$

The calculation of acumulated salary of group I employees with a working age of 43 years is presented in **Table 2.** as follows.

Table 2. Accumulated PPPK salary group I (e = 43 years) (IDR)

x	MKG	I	S_x
43	0	1,938,500	23,262,000
44	1	2,035,425	24,425,100
45	2	2,204,449	26,453,385
46	3	2,314,671	27,776,054
47	4	2,506,982	30,083,780
48	5	2,632,331	31,587,969
49	6	2,851,053	34,212,642
50	7	2,993,606	35,923,274
51	8	3,242,276	38,907,312

x	MKG	I	S_x
52	9	3,404,390	40,852,677
53	10	3,687,166	44,245,991
54	11	3,871,524	46,458,290
55	12	4,193,145	50,317,739
56	13	4,402,802	52,833,626
57	14	4,768,467	57,221,607

3.4 Calculation of Retirement Benefits

The proportion of salary for retirement benefits can be expressed in equation (3) with k = 4.75%. The proportion of salary for PPPK group I pension benefits when (e = 43 years) is obtained as follows.

$$B_r = 4{,}75\%\ (58 - 43)57{,}221{,}607$$

$$B_r = 40{,}770{,}395$$

Furthermore, the amount of retirement benefits is determined based on the valuation age and employee group. **Table 3.** presents these projected retirement benefits (B_r), expressed in Indonesian Rupiah (IDR). The data indicates that B_r at the entry age of $e = 20$ years is significantly larger than at $e = 48$ years, as a longer service period yields a greater accumulation of salary. In addition, B_r increases monotonically from Group I to XVII, corresponding directly to the higher basic salary of each respective group.

Table 3. Amount of retirement benefits (IDR)

Group	B_r			
	e = 20	e = 42	e = 43	e = 48
I	382,116,047	45,662,843	40,770,395	19,405,022
II	404,548,520	48,343,762	41,847,042	20,543,945
III	421,672,546	50,389,527	43,616,062	21,413,170
IV	439,507,877	52,520,611	45,461,259	22,318,649
V	551,907,347	60,093,165	52,017,634	25,537,345
VI	575,248,712	62,635,678	54,216,635	26,617,022
VII	599,578,000	65,286,261	56,510,436	27,743,566
VIII	624,947,903	68,046,812	58,900,728	28,916,975
IX	693,062,008	75,463,895	67,378,478	32,068,467
X	722,370,437	78,654,834	70,227,530	33,424,918
XI	752,930,236	81,982,283	73,198,467	34,838,845
XII	784,780,924	85,450,035	76,294,674	36,312,901
XIII	817,975,189	89,065,674	79,522,923	37,848,856
XIV	852,578,893	92,832,991	82,886,599	39,449,361
XV	888,631,554	96,759,571	86,392,474	41,117,954
XVI	926,225,376	100,852,997	90,047,319	42,857,288
XVII	965,399,878	105,118,958	93,856,212	44,670,899

3.5. Calculation of Present Value of Future Benefit

The Present Value of Future Benefits ($PVFB$) represents the current actuarial value of the projected pension benefits that participants are eligible to receive upon reaching their mandatory retirement age. This value is determined by applying the actuarial formulation outlined in Equation (9). Consequently, the computations yield the following result.

$$^{58}(PVFB)_{43} = B_{58}\, \ddot{a}_{58}{}^{(12)} \frac{D_{58}}{D_{43}}$$

$$^{58}(PVFB)_{43} = 40{,}770{,}395(10.574914)\left(\frac{1{,}096}{3{,}597}\right)$$

$$^{58}(PVFB)_{43} = 131{,}325{,}195$$

The calculation of PVFB for employees in groups I and XVII is based on the difference in annual pension benefits and those with a working age of 43 years arepresented in **Table 4.** with a different PVFB value each year.

Table 4. Amount PVFB PPPK groups I and XVII (IDR)

x	MKG	$(PVFB)_x$	
		Group I	**Group XVII**
43	0	131,325,195	302,319,498
44	1	141,999,622	326,892,753
45	2	153,557,066	353,498,772
46	3	166,073,636	382,312,765
47	4	179,632,389	413,525,932
48	5	194,324,393	447,347,920
49	6	210,249,213	484,007,936
50	7	227,516,676	523,758,804
51	8	246,247,688	566,878,865
52	9	266,567,005	613,655,309
53	10	288,619,687	664,422,078
54	11	312,565,065	719,545,961
55	12	338,579,916	779,433,909
56	13	366,860,808	844,538,439
57	14	397,630,805	915,373,058

Table 5. Pension benefits based on group I - 4 representative age (IDR)

e	MKG	$(PVFB)_e$	Lumpsum Benefits Scheme
20	38	206,937,441	20% (starting point)
42	16	136,040,100	20% (upper limit)
43	15	131,325,195	100% (lower limit)
48	10	92,490,373	100% (endpoint)

Based on **Table 4.,** the size of PVFB PPPK group I is smaller than group XVII, where the MKG is group's work period. This proves that the higher the class, the greater the PVFB. It should be emphasized that the value of PVFB is identical between the EAN and PUC methods because PVFB is a function of demographic and financial assumptions. PVFB is not a function of the chosen cost allocation method.

3.6 Comparison of Normal Cost

The normal amount of contributions with the EAN method for group I employees is the same every year, while the PUC method has different contributions. Pension contributions are calculated when the employee enters the valuation age when he is first appointed and starts working, which is 43 years old calculated by equations (10) and (11).

Furthermore, the calculation of normal contributions using the EAN method obtained the following results.

$$^{EAN}(NC)_{43} = \frac{D_e}{N_e - N_r} PVFB_e$$

$$^{EAN}(NC)_{43} = \frac{3{,}597}{45{,}029 - 12{,}089}(131{,}325{,}195)$$

$$^{EAN}(NC)_{43} = 14{,}341{,}896$$

The calculation of normal contributions using the PUC method obtained the following results.

$$^{PUC}(NC)_{43} = \frac{PVFB_{43}}{58 - 43}$$

$$^{PUC}(NC)_{43} = \frac{131{,}325{,}195}{15}$$

$$^{PUC}(NC)_{43} = 8{,}755{,}013$$

The total amount of normal contributions with the EAN method is IDR 14,341,896 for a full year, so the monthly contribution amount is IDR 1,195,158. The total amount of normal contributions with the PUC method is IDR 8,755,013 for the first full year so that the monthly contribution amount is IDR 729,584. In the same way, other normal contribution amounts are obtained which can be seen in **Table 6.** as follows.

Table 6. Normal amount of PPPK contributions groups I and XVII (IDR)

x	**Group I**		**Group XVII**	
	$^{EAN}(NC)_x$	$^{PUC}(NC)_x$	$^{EAN}(NC)_x$	$^{PUC}(NC)_x$
43	1,195,158	729,584	3,428,758	1,679,553
44	1,195,158	788,887	3,428,758	1,816,071
45	1,195,158	853,095	3,428,758	1,963,882
46	1,195,158	922,631	3,428,758	2,123,960
47	1,195,158	997,958	3,428,758	2,297,366
48	1,195,158	1,079,580	3,428,758	2,485,266
49	1,195,158	1,168,051	3,428,758	2,688,933
50	1,195,158	1,263,982	3,428,758	2,909,771
51	1,195,158	1,368,043	3,428,758	3,149,327
52	1,195,158	1,480,928	3,428,758	3,409,196
53	1,195,158	1,603,443	3,428,758	3,691,234
54	1,195,158	1,736,473	3,428,758	3,997,478
55	1,195,158	1,881,000	3,428,758	4,330,188
56	1,195,158	2,038,116	3,428,758	4,691,880
57	1,195,158	2,209,060	3,428,758	5,085,406

Based on **Table 6.**, it is found that the higher the class, the greater the contribution. In addition, the normal contribution of the EAN method is constant throughout the working life and the normal contribution of the PUC method increases from the age of entry to work until reaching retirement age. **Figure 2.** is a visualization of the comparison of normal monthly contributions.

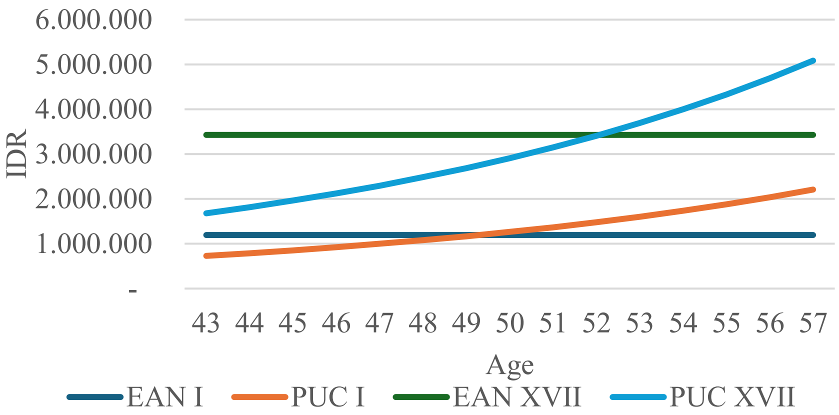

Figure 2. Comparison of monthly NC PPPK groups I and XVII

Table 7. presents the monthly NC EAN for 17 groups of 4 representative ages. **Table 8.** is the amount of the normal monthly contribution of the EAN method which is constant throughout the working period of all groups and ages of entry. The table shows that NC EAN increased from the age of 20 to 48 because the shorter service period forced the accumulation of the same benefits to be done in a shorter period. This is consistent for all 17 groups.

Table 7. Normal amount of PPPK contributions based on group I - 4 representative age (IDR)

e	MKG	$^{EAN}(NC)_x$	$^{PUC}(NC)_e$	Lumpsum Benefits Scheme
20	38	1,357,141	453,810	20% (starting point)
42	16	1,197,215	708,542	20% (upper limit)
43	15	1,195,158	729,584	100% (lower limit)
48	10	1,072,899	770,753	100% (endpoint)

Table 8. Normal amount of PPPK contributions based on group - 4 representative age (IDR)

Group	$^{EAN}(NC)_e$			
	$^{EAN}(NC)_{20}$	$^{EAN}(NC)_{42}$	$^{EAN}(NC)_{43}$	$^{EAN}(NC)_{48}$
I	1,357,141	1,197,215	1,195,158	1,072,899
II	1,436,813	1,267,505	1,226,719	1,135,870
III	1,497,632	1,321,142	1,278,576	1,183,929
IV	1,560,976	1,377,016	1,332,667	1,233,993
V	1,960,179	1,575,558	1,524,863	1,411,954
VI	2,043,080	1,642,219	1,589,325	1,471,649
VII	2,129,489	1,711,714	1,656,567	1,533,935
VIII	2,219,594	1,784,092	1,726,636	1,598,813
IX	2,461,511	1,978,557	1,975,156	1,773,058
X	2,565,604	2,062,219	2,058,674	1,848,056
XI	2,674,141	2,149,460	2,145,765	1,926,231
XII	2,787,264	2,240,380	2,236,529	2,007,732
XIII	2,905,158	2,335,177	2,331,163	2,092,654
XIV	3,028,058	2,433,950	2,429,767	2,181,146
XV	3,156,104	2,536,900	2,532,539	2,273,402
XVI	3,289,624	2,644,224	2,639,678	2,369,569
XVII	3,428,758	2,756,071	2,751,334	2,469,843

Based on **Table 7.** and **Table 8.**, the calculation of normal monthly contributions using the EAN method increases based on the group. In addition, the contribution also increases if the working period until reaching retirement age is getting smaller. **Figure 3.** is a visualization of the comparison of normal contributions of the EAN method based on work entry and group.

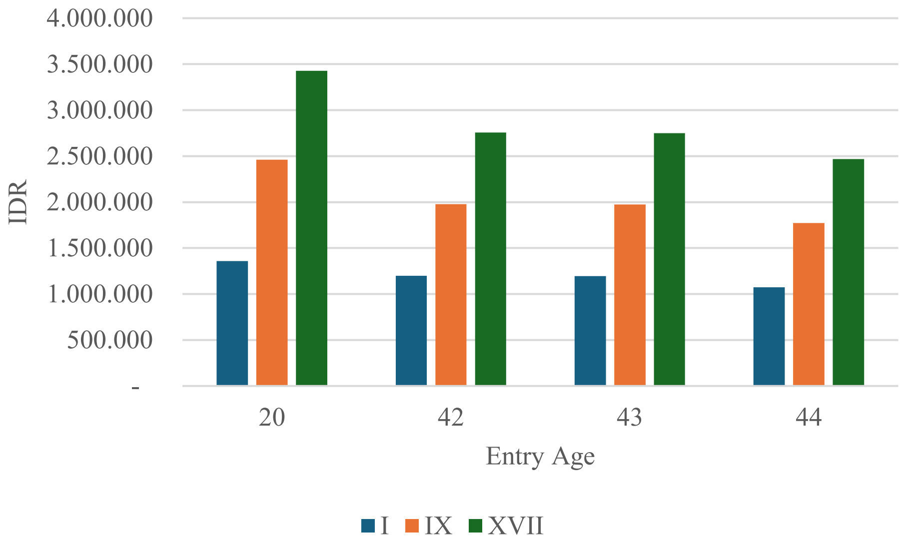

Figure 3. NC comparison of EAN methods based on group and age of entry.

3.7 Determination of Actuarial Liability

Actuarial liabilities can be calculated using equations (12) and (13). Furthermore, the calculation of the AL of the EAN method for group I obtained the following results.

$$^{\text{EAN}}(\text{AL})_{44} = \frac{\text{N}_{43} - \text{N}_{44}}{\text{N}_{43} - \text{N}_{58}} \text{PVFB}_{44}$$

$$^{\text{EAN}}(\text{AL})_{44} = \frac{(45{,}029 - 41{,}432)(141{,}999{,}622)}{45{,}029 - 12{,}089} = 15{,}507{,}634$$

Furthermore, the calculation of the PUC method for group I obtained the following results.

$$^{\text{PUC}}(\text{AL})_{44} = \frac{44 - 43}{58 - 43} \text{PVFB}_{44}$$

$$^{\text{PUC}}(\text{AL})_{44} = 0{,}0667(141{,}999{,}622) = 9{,}466{,}641.$$

Calculations for other years on the EAN and PUC methods can be seen in **Table 9**. Furthermore, the visualization of the comparison of PPPK Groups I and XVII with the age of entry into service is 43 years old can be seen in **Figure 4.** The results indicate that higher salary groups are associated with larger actuarial liabilities.

Table 9. AL PPPK groups I and XVII (e = 43 years) (IDR)

x	**Group I**		**Group XVII**	
	$^{\mathrm{PUC}}(\mathrm{AL})_x$	$^{\mathrm{EAN}}(\mathrm{AL})_x$	$^{\mathrm{PUC}}(\mathrm{AL})_x$	$^{\mathrm{EAN}}(\mathrm{AL})_x$
43	-	-	-	-
44	9,466,641	15,507,634	21,792,850	35,706,238
45	20,474,276	32,278,997	47,133,170	74,322,206
46	33,214,727	50,420,997	76,462,553	116,094,057
47	47,901,970	70,050,326	110,273,582	161,290,472
48	64,774,798	91,294,595	149,115,973	210,205,280
49	84,099,685	114,293,361	193,603,174	263,159,807
50	106,174,449	139,199,878	244,420,775	320,506,920
51	131,332,100	166,182,569	302,335,395	382,634,410
52	159,940,203	195,420,574	368,193,185	449,954,749
53	192,413,125	227,115,793	442,948,052	522,931,126
54	229,214,381	261,490,259	527,667,038	602,071,973
55	270,863,933	298,789,713	623,547,127	687,938,897
56	317,946,033	339,286,850	731,933,314	781,153,984
57	371,122,085	383,288,914	854,348,187	882,417,473

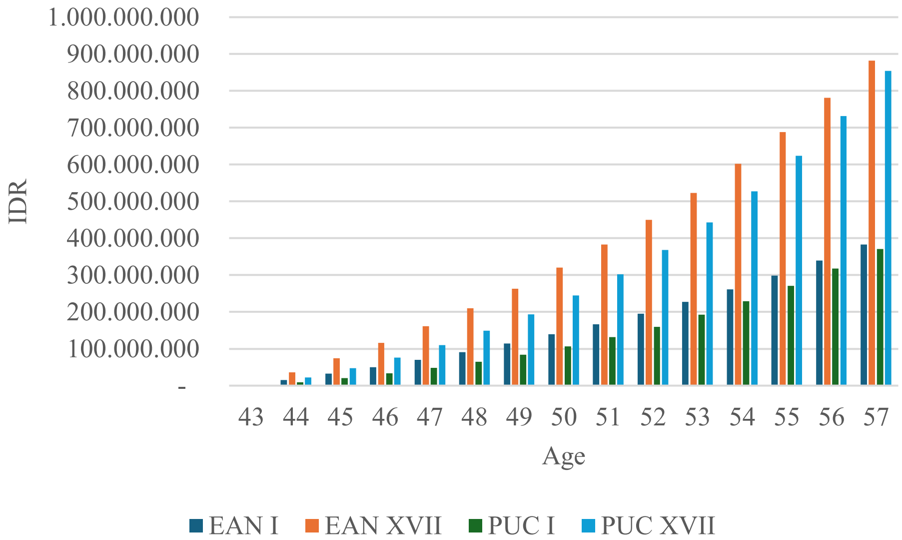

Figure 4. Comparison of AL PPPK groups I and XVII

3.8 Comparison of Lumpsum Retirement Benefits

The large calculation of lumpsum benefits is carried out with two approaches based on the length of service, namely 1) pension benefits will be given 100% at once when the employee enters retirement age when he starts working at the age of 43; and 2) pension benefits will be given 20% at once when the employee enters retirement age and the remaining 80% is allocated to each month as a retirement salary when starting work at the age of 20. The calculation of the large amount of retirement benefits at once can be calculated using the equation (14).

Furthermore, lumpsum benefit of the scheme 100% with e = 43 the EAN method can be obtained as follows.

$$B = 100\% \left[{}^{\mathrm{EAN}}(\mathrm{AL})_{57} - \sum_{43}^{57} {}^{\mathrm{EAN}}(\mathrm{NC})_{43} \right]$$

$$B = 100\%[383{,}288{,}914 - 215{,}128{,}361]$$
$$B = 168{,}160{,}554$$

Furthermore, lumpsum benefit of the scheme 100% with $e = 43$ the PUC method can be obtained as follows.

$$B = 100\%\left[{}^{\mathrm{PUC}}(\mathrm{AL})_{57} - \sum_{43}^{57} {}^{\mathrm{PUC}}(\mathrm{NC})_{43}\right]$$
$$B = 100\%[371{,}122{,}085 - 241{,}449{,}944]$$
$$B = 129{,}672{,}140$$

Table 10. Lumpsum benefit of the 20% scheme by group (representative age e = 20 and e = 42 years) (IDR)

Group	e = 20		e = 42	
	PUC	***EAN***	***PUC***	***EAN***
I	480,336,423	618,321,820	31,097,479	40,222,912
II	508,535,014	654,620,971	32,923,249	42,584,446
III	530,060,656	682,330,246	34,316,464	44,386,494
IV	552,480,441	711,190,522	35,767,783	46,263,697
V	693,771,443	893,069,942	40,924,872	52,934,113
VI	723,112,549	930,839,816	42,656,383	55,173,730
VII	753,695,519	970,208,302	44,461,493	57,508,543
VIII	785,586,586	1,011,260,659	46,341,494	59,940,222
IX	871,208,967	1,121,479,630	51,392,704	66,473,689
X	908,050,931	1,168,905,120	53,565,809	69,284,483
XI	946,465,923	1,218,355,519	55,831,881	72,215,525
XII	986,503,617	1,269,894,771	58,193,502	75,270,155
XIII	1,028,230,246	1,323,608,135	60,655,838	78,455,053
XIV	1,071,728,601	1,379,602,186	63,221,470	81,773,560
XV	1,117,048,357	1,437,940,868	65,895,564	85,232,357
XVI	1,164,305,421	1,498,773,385	68,683,285	88,838,122
XVII	1,213,549,466	1,562,163,681	71,588,505	92,595,868

Table 11. Lumpsum benefit of the scheme 100% by group (representative age e = 43 and e = 48 years) (IDR)

Group	e = 43		e = 48	
	PUC	EAN	PUC	EAN
I	129,672,140	168,160,554	34,721,944	47,633,146
II	133,096,467	172,601,266	36,759,850	50,428,840
III	138,722,915	179,897,719	38,315,178	52,562,509
IV	144,591,651	187,508,374	39,935,377	54,785,173
V	165,444,508	214,550,635	45,694,679	62,686,045
VI	172,438,533	223,620,580	47,626,577	65,336,311
VII	179,734,072	233,081,532	49,642,332	68,101,616
VIII	187,336,508	242,940,471	51,741,946	70,981,962
IX	214,300,387	277,907,589	57,380,998	78,717,871
X	223,361,931	289,658,718	59,808,132	82,047,525
XI	232,811,134	301,912,570	62,338,111	85,518,265
XII	242,658,765	314,683,109	64,975,682	89,136,604
XIII	252,926,360	327,998,263	67,724,008	92,906,883
XIV	263,624,689	341,871,998	70,587,836	96,835,614
XV	274,775,287	356,332,241	73,573,496	100,931,479
XVI	286,399,691	371,406,923	76,685,734	105,200,989
XVII	298,514,054	387,116,990	79,930,879	109,652,827

The calculation is carried out in the same way so that the results of the calculation of the lumpsum benefits of employees in groups I to XVII are obtained, as presented in **Table 10.** and **Table 11.**, with all monetary values expressed in Indonesian Rupiah (IDR). The EAN method consistently yields larger lumpsum benefits than the PUC method across all entry ages and groups. While the benefit generally decreases as the entry age increases due to a shorter service period, a significant surge occurs at entry age 43. This jump is explicitly driven by a policy shift in the payment scheme, which transitions from a 20% partial lumpsum (for entry ages 20–42) to a 100% full lumpsum (for entry ages 43–48). Despite the shorter accumulation phase for those entering at age 43 compared to age 42, the five-fold increase in the lumpsum payout percentage (from 20% to 100%) mathematically overrides the effect of a shorter service period, resulting in a sharp spike in the received benefits. The visual comparison of these two schemes is illustrated in **Figure 5.**

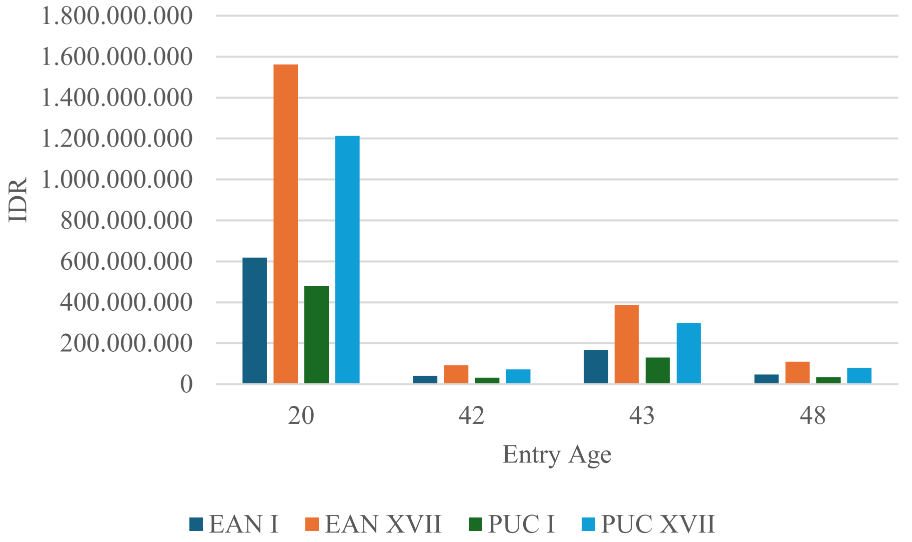

Figure 5. Comparison of lumpsum benefits of PPPK groups I and XVII based on age to enter the workforce.

According to [1], the PPPK population is structured into 17 salary grades with 29 variations of entry age (e = 20-48 years), generating 493 distinct valuation scenarios. Each scenario subsequently outputs specific values for the PVFB, NC, AL, and lumpsum benefits. This study constructs an interdependent actuarial system, wherein the selection between the EAN or PUC exerts a systemic impact on all funding elements. The policy implications of these findings suggest the necessity of adopting a pension model for PPPK that aligns with the PNS scheme, such as Taspen, with a strong preference for the EAN method. The EAN approach is highly recommended as it generates a stable NC that can be projected within the medium term State Budget (APBN), yields a prudent AL to ensure early reserve availability, and better protects the adequacy of participants benefits [17]. Furthermore, harmonization with the existing Old Age Benefit (JHT) scheme of Employment Social Security Agency must be carefully designed to prevent overlapping liabilities. Pension fund managers must prioritize the strengthening of technical reserves as an actuarial obligation to anticipate future claims. Ultimately, it is crucial to optimize funding and investment strategies to ensure long-term program sustainability, maintaining affordable monthly normal contributions for PPPK without compromising the future solvency of the pension fund.

4. CONCLUSIONS

This study demonstrates that both the Entry Age Normal (EAN) and Projected Unit Credit (PUC) methods yield identical Present Value of Future Benefits (PVFB) for PPPK pension designs, but differ significantly in funding cash flows. The EAN method offers a stable and constant Normal Cost (NC) with a higher Actuarial Liability (AL) throughout the service period. In contrast, the PUC method exhibits a progressive, back-loaded NC that increases sharply toward retirement. Furthermore, the EAN method consistently generates higher lumpsum benefits across all group and entry-age scenarios compared to the PUC method.

Consequently, the EAN method is highly recommended for the PPPK pension framework as it provides predictable, affordable monthly contributions and superior post-retirement welfare. However, a major limitation of this study is its reliance on the GAM 1971 mortality table, which reflects historical mortality rates and may understate current life expectancy, potentially leading to long-term underfunding risks. Future policy designs should consider transitioning to updated tables like TMPI 2023 to ensure fiscal sustainability.

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