Application of Projected Unit Credit Method and Entry Age Normal in Pension Fund Insurance of PT Pos Indonesia, South Aceh Regency

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Abstract

This study aims to analyze the application of the Projected Unit Credit (PUC) Method and the Entry Age Normal (EAN) Method in the context of pension fund insurance. The Projected Unit Credit Method and the Entry Age Normal Method are two actuarial approaches used to calculate liabilities and determine the required contributions in pension plans. The Projected Unit Credit Method calculates based on projected future salaries and benefits accumulated over the employee's working life, while the Entry Age Normal Method distributes the cost of retirement benefits evenly over the employee's working life. Data was collected from various pension plans that use both methods. Analysis was conducted to compare the accuracy of liability estimation, contribution stability, and the impact of each method on pension fund sustainability. The results show that the Projected Unit Credit Method provides a more realistic liability estimate by considering salary increases, while the Entry Age Normal Method offers better contribution stability from year to year. The selection of the appropriate actuarial method is highly dependent on the objectives and specific conditions of the pension program being managed. These findings are expected to help pension fund managers make more informed decisions to ensure the welfare of pension plan participants.

Keywords: Projected Unit Credit Method, Entry Age Normal Method, Pension Fund Insurance, Actuarial Liability, Pension Program.

1.   Introduction

Insurance is a financial mechanism designed to provide protection against unwanted financial risks. By paying a premium, individuals or entities can transfer risk to an insurance company, which will provide compensation in the event of an insured event. One of the most vital forms of insurance is life insurance, which provides financial benefits to beneficiaries or designated parties when the insured passes away.

The use of life insurance is often applied in the world of work, such as pension funds. This pension fund aims to improve employee welfare in old age to be more secure, so that it will create work peace and increase employee motivation. Pension funds are given to employees after entering retirement. The factors that cause an employee to enter retirement, namely due to normal retirement (age), self-retirement due to resignation, disability, and death (Utami, 2012).

In pension fund programs, an important concern is the actuarial valuation method (actuarial cost method). The actuarial valuation method is the valuation method used to determine the amount of normal contributions and actuarial liability of a pension fund program. Normal contributions are contributions from participants paid to the Pension Fund in accordance with the actuarial valuation method used, while the actuarial liability is a value that the Pension Fund must have so that the Pension Fund's obligations to participants can be fulfilled. In general, there are two groups of actuarial valuation methods, namely the Accrued Benefit Cost Method and the Projected Benefit Cost Method. The method included in the Accrued Benefit Cost Method is the Projected Unit Credit method, while the method included in the Projected Benefit Cost Method is the Entry Age Normal method.

The Projected Unit Credit method calculates the retirement benefit obligation based on the benefits that employees have earned to date, taking into account projected future salaries. This means that with each period of employment, the liability increases as salaries and benefits accumulate. This method is often considered more realistic as it reflects future expectations.

On the other hand, the Entry Age Normal Method calculates the retirement benefit obligation by spreading the benefit cost evenly over the employee's working life, from entry age to retirement age. In other words, the contributions required to fund the pension benefits are calculated based on the entry age and are paid consistently until

retirement age. This method emphasizes the stability of contributions from year to year, which can facilitate long-term financial planning for companies and employees.

This research will examine the application of both methods in the context of pension fund insurance with a focus on analyzing the advantages and disadvantages of each method. This analysis will cover aspects such as accuracy in liability estimation, contribution stability, and the impact on the continuation of the pension fund. With an in-depth understanding of the Projected Unit Credit Method and the Entry Age Normal Method, it is hoped that the most optimal approach can be found to ensure that the pension fund is able to fulfill its obligations to pension plan participants.

2.   Literature Review

2.1.   Retirement

Pension is a guarantee of old age and as a reward for Civil Servants and their families who have devoted themselves to the State for many years (Taspen, 2016). There are two types of pension programs, namely the Defined Contribution Pension Plan and the Defined Benefit Pension Plan (Taspen, 2016). The Defined Contribution Pension Program is a pension program in which the amount of contributions has been determined. The Defined Benefit Pension Program is a pension program whose pension benefits are stipulated in the Pension Fund Regulations.

2.2.   Mortality Table

In the mortality table, the number of people aged x is expressed as simbol l_x. While the number of people who died between the ages of x and $x+1$ is expressed by the symbol d_x.

$$D_x = v^x l_x. \tag{1}$$

$$N_x = \sum_{i=0}^{w-x} D_{x+i}. \tag{2}$$

Description:
D : Commutation symbol between v^x and lx
N : Total of D_x
v : Discount factor
l : Number of people aged x year

2.3.   Annuities

An annuity is a payment of a certain amount made periodically over a certain period (Kellison, 1991). A life annuity is a periodic payment made as long as the insured is alive (Bowers, 1997).

$$\ddot{a}_x = \frac{N_x}{D_x} \tag{3}$$

Description:
$\ddot{a}$: Lifetime annuity

A term life annuity is a periodic payment made over a period of time, at most n years (Bowers, 1997).

$$\ddot{a}_{x:n|} = \frac{N_{x-1} - N_{x+n}}{D_x} \tag{4}$$

$\ddot{a}_{x:n|}$: Term life annuity

2.4.   Benefits by final salary

The amount of pension benefit of an aged person who enters the pension program at the age of and retires at the age of years is

$$B_r = k(r - e)s_{r-1} \tag{5}$$

Description:
k : Proportion of salary for pension benefits
r : Retirement age
e : Entry age
s_{r-1} : Last salary
B_r : Pension benefit amount

2.5.   Benefits according to last salary

From the pension benefits, the Present Value of Future Benefit (PVFB) can be calculated.

$$r(PVFB)_x = B_r \ddot{a}_r \, v^{r-x} \, {}_{r-x}P_x. \tag{6}$$

Description:

$n \, p_x$: The probability that a person aged x will live for r-x years.

$r(PVFB)_x$: Present value of retirement benefits

2.6.   Normal dues

The equation for calculating normal contributions using the Projected Unit Credit method is

$$PUC^r(NC)_x = \frac{r(PVFB)_x}{(r-e)}. \tag{7}$$

Description:

$PUC^r(NC)_x$: PUC method normal fee

The equation for calculating normal contributions using the Entry Age Normal method is

$$EAN^r(NC)_x = \frac{v^{x-e} \, {}_{x-e}P_e}{\ddot{a}_{\,e:r-e}} \, r(PVFB)_x \; . \tag{8}$$

Description:

$EAN^r(NC)_x$: EAN method normal dues

2.7.   Actuarial liability

The equation for calculating actuarial liabilities using the Projected Unit Credit method is

$$PUC^r(AL)_x = \frac{(x-e) \, r(PVFB)_x}{(r-e)}. \tag{9}$$

Description:

$PUC^r(AL)_x$: PUC method actuarial liability

The equation for calculating actuarial liabilities using the Entry Age Normal method is

$$EAN^r(AL)_x = \frac{\ddot{a}_{\,e:x-e} \, r(PVFB)_x}{\ddot{a}_{\,e:r-e}} \; . \tag{10}$$

Description:

$EAN^r(AL)_x$: EAN method actuarial liability

3.   Materials and Methods

3.1.   Materials

The salary data used is secondary data which is the basic salary of PT Pos Indonesia employees in South Aceh Regency. As for other data such as interest rates, the proportion of salary for pension benefits and others will use synthetic data and not original data. However, the synthetic data used has passed various considerations that can make the data used for the calculation of pension funds using the PUC method and the EAN method. The mortality table that will be used is the Indonesian Mortality Table in 2011 with an interest rate of 10%. This data will be processed with the help of Microsoft Excel application.

3.2.   Methods

The research steps to be used are as follows.
 (a) Develop a mortality table.
 (b) Determination of the amount of retirement benefits.
 (c) Determination of the present value of retirement benefits.
 (d) Determination of normal dues.
 (e) Determination of actuarial liabilities.
 (f) Draw conclusions.

4.   Results and Discussion

As an example of actuarial calculations on pension fund insurance, data will be used for a male employee

who starts participating in the pension fund program at the age of 25 (e=25), and is calculated to retire at the age of 55 (r=55). The last base salary received in a year is IDR14,400,000. The calculation is done when the participant is 35 years old (x=35).

4.1. Compile a mortality table

In the pension fund calculation, the 2011 male mortality table will be used with an interest rate of 10%. The mortality table to be used is as follows.

Table 1: Male mortality table 2011

x	qx	px	lx
0	0.00802	0.99198	100000
1	0.00079	0.99921	99198
2	0.00063	0.99937	99119.634
3	0.00051	0.99949	99057.188
4	0.00043	0.99957	99006.669
5	0.00038	0.99962	98964.096
6	0.00034	0.99966	98926.49
7	0.00031	0.99969	98892.855
8	0.00029	0.99971	98862.198
:	:	:	:
109	0.67518	0.32482	0.1787704
110	0.71016	0.28984	0.0580682
111	1	0	0.0168305

4.2. Calculation of pension benefit amount

To calculate the amount of pension benefits, equation 5 will be used with a pension benefit salary proportion (k) of 2%, then:

$$B_{55} = 0.02(55 - 25)14400000 = \text{IDR}8,640,000.00$$

So the amount of pension benefits that participants will receive in a year is IDR 8,640,000.

4.3. Determination of the present value of pension benefits

To calculate the present value of pension benefits, equation 6 will be used. So if you want to know the present value of pension benefits at age 35, then:

$$55(PVFB)_{35} = 8640000(9.082034)(0.148644)(0.93320006) = IDR10,884,736.48$$

So the present value of pension benefits at age 35 is IDR10,884,736.

4.4. Determination of normal contribution

To calculate the normal contribution value, 2 methods will be used, namely the PUC method and the EAN method.

4.4.1. PUC Method

Based on equation 7, the calculation of normal contributions at the age of 35 with the PUC method is as follows.

$$PUC^{55}(NC)_{35} = \frac{10,884,736}{(55 - 25)} = IDR362,824.55$$

So the amount of normal contributions at age 35 based on the PUC method is IDR362,824.55.

4.4.2. EAN Method

Based on equation 8, the calculation of normal contributions at gae 35 using the EAN method is as follows.

$$EAN^{55}(NC)_{35} = \frac{(0.385543)(0.991979)}{10.27935}(10,884,736) = IDR404,974.69$$

So the amount of normal contributions at age 35 based on the EAN method is IDR404,974.69.

After the normal contributions of the two methods are calculated, Table 2 and Figure 1 will be produced. It can be seen that the amount of normal contributions in the Projected Unit Credit method continues to increase with age and salary received. While in the Entry Age Normal method the amount of normal contributions is always the same for

each year for an employee.

Table 2: Normalized dues comparison table between PUC method and EAN method

| Age	PUC	EAN
25	IDR138,762.57	IDR404,974.69
26	IDR152,768.68	IDR404,974.69
27	IDR168,185.14	IDR404,974.69
28	IDR185,149.92	IDR404,974.69
29	IDR203,817.78	IDR404,974.69
30	IDR224,365.59	IDR404,974.69
31	IDR246,989.86	IDR404,974.69
32	IDR271,906.37	IDR404,974.69
33	IDR299,345.46	IDR404,974.69
34	IDR329,556.84	IDR404,974.69
35	IDR362,824.55	IDR404,974.69
36	IDR399,470.52	IDR404,974.69
37	IDR439,853.03	IDR404,974.69
38	IDR484,366.29	IDR404,974.69
39	IDR533,443.05	IDR404,974.69
40	IDR587,580.59	IDR404,974.69
41	IDR647,329.06	IDR404,974.69
42	IDR713,310.26	IDR404,974.69
43	IDR786,182.21	IDR404,974.69
44	IDR866,698.50	IDR404,974.69
45	IDR955,719.42	IDR404,974.69
46	IDR1,054,232.67	IDR404,974.69
47	IDR1,163,355.40	IDR404,974.69
48	IDR1,284,353.15	IDR404,974.69
49	IDR1,418,661.72	IDR404,974.69
50	IDR1,567,912.76	IDR404,974.69
51	IDR1,734,033.14	IDR404,974.69
52	IDR1,919,239.77	IDR404,974.69
53	IDR2,126,024.66	IDR404,974.69
54	IDR2,357,106.85	IDR404,974.69
55	IDR2,615,625.79	IDR404,974.69
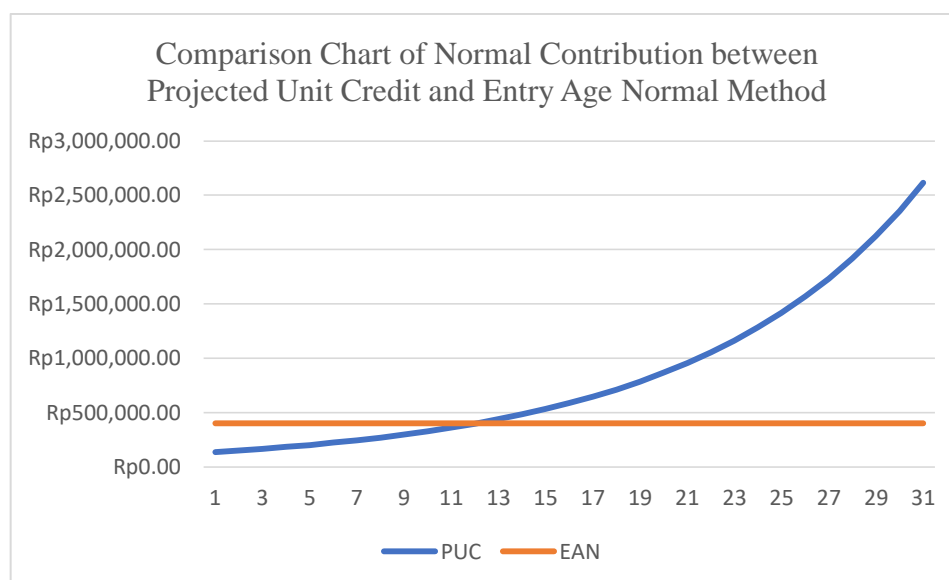
Figure 1: Normalized dues comparison chart between PUC method and EAN method

4.5. Determination of actuarial liability

To calculate the normal contribution value, 2 methods will be used, namely the PUC method and the EAN method.

4.5.1. PUC Method

Based on equation 9, the calculation of actuarial liabilities at age 35 using the PUC method is as follows.

$$PUC^{55}(AL)_{35} = \frac{(35-25)}{(55-25)}(10{,}884{,}736.48) = IDR3{,}628{,}245.49$$

So the amount of actuarial liabilities at age 35 based on the PUC method is IDR3,628,245.49.

4.5.2. EAN Method

Based on equation 10, the calculation of actuarial liabilities at age 35 using the EAN method is as follows.

$$EAN^{55}(AL)_{35} = \frac{(6.738878736)}{10.27935115}(10{,}884{,}736.48) = IDR7{,}135{,}753.81$$

So the amount of actuarial liabilities at age 35 based on the EAN method is IDR7,135,753.81.

After the actuarial liabilities of the two methods are calculated, Table 3 and Figure 2 will be produced. It can be seen that the amount of actuarial liabilities between the Projected Unit Credit and Entry Age Normal methods at entry age and retirement age is the same. However, the amount of actuarial liabilities from year to year using the Projected Unit Credit method is smaller than the Entry Age Normal method.

Table 3: Comparison table of actuarial liabilities between PUC method and EAN method

Age	PUC	EAN
25	IDR0.00	IDR0.00
26	IDR152,768.68	IDR445,851.13
27	IDR336,370.28	IDR936,685.86
28	IDR555,449.77	IDR1,476,993.43
29	IDR815,271.11	IDR2,071,718.72
30	IDR1,121,827.93	IDR2,726,380.27
31	IDR1,481,939.15	IDR3,447,110.27
32	IDR1,903,344.58	IDR4,240,686.00
33	IDR2,394,763.70	IDR5,114,471.77
34	IDR2,966,011.53	IDR6,076,495.37
35	IDR3,628,245.49	IDR7,135,753.81
36	IDR4,394,175.75	IDR8,302,356.50
37	IDR5,278,236.35	IDR9,587,555.99
38	IDR6,296,761.79	IDR11,003,777.87

| 39	IDR7,468,202.73	IDR12,564,705.46
40	IDR8,813,708.86	IDR14,285,934.18
41	IDR10,357,265.02	IDR16,184,762.44
42	IDR12,126,274.47	IDR18,280,702.07
43	IDR14,151,279.71	IDR20,594,609.88
44	IDR16,467,271.44	IDR23,150,242.06
45	IDR19,114,388.32	IDR25,974,636.03
46	IDR22,138,886.00	IDR29,098,757.32
47	IDR25,593,818.88	IDR32,557,638.50
48	IDR29,540,122.36	IDR36,390,973.75
49	IDR34,047,881.28	IDR40,643,808.65
50	IDR39,197,819.03	IDR45,367,341.86
51	IDR45,084,861.52	IDR50,621,893.99
52	IDR51,819,473.89	IDR56,476,888.42
53	IDR59,528,690.57	IDR63,010,492.77
54	IDR68,356,098.57	IDR70,308,230.73
55	IDR78,468,773.67	IDR78,468,773.67
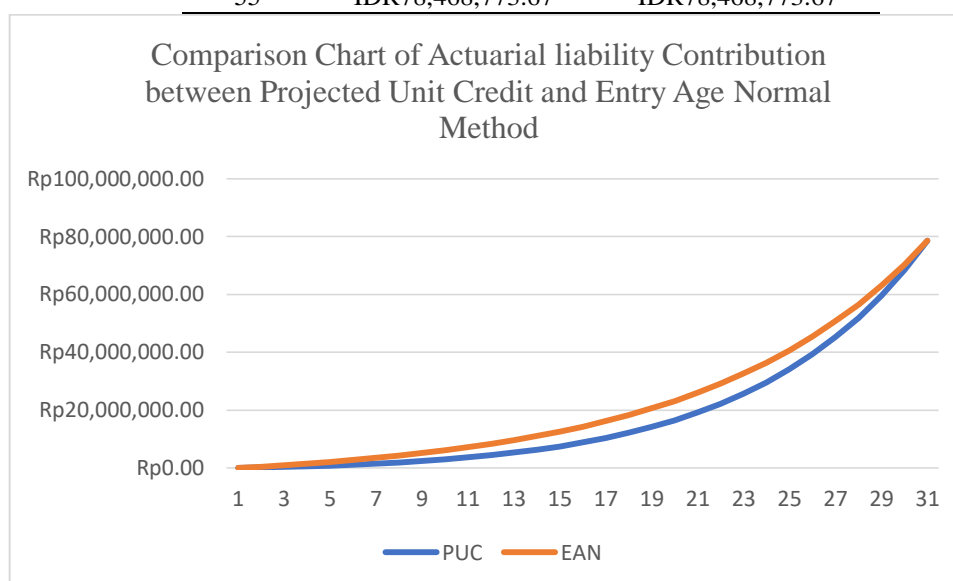
Figure 2: Comparison chart of actuarial liabilities between PUC method and EAN method

5.   Conclussion

Based on the results of the analysis and discussion carried out on the calculation of the Projected Unit Credit and Entry Age Normal methods in determining pension funding, it can be concluded that:

(a) Although the normal contribution in the Projected Unit Credit method in the early years tends to be lower than the Entry Age Normal method, the amount of normal contribution in the Projected Unit Credit method will be higher than the Entry Age Normal method when starting to enter the middle years of participation.
(b) The amount of actuarial liabilities from both methods starts with the same value, but as the years increase the value of actuarial liabilities from the Projected Unit Credit method becomes smaller than the value of actuarial liabilities from the Entry Age Normal method.
(c) For pension fund insurance participants, the Entry Age Normal method is more profitable when compared to the Projected Unit Credit method. Because in the Entry Age Normal method, the normal contributions paid by participants are more stable when compared to the Projected Unit Credit method which continues to increase from year to year. As for pension fund insurance providers, the Projected Unit Credit method is more profitable than the Entry Age Normal method. Because in the Projected Unit Credit method, the actuarial liabilities that must be allocated by the organizer to participants are smaller.

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