



Discussion of Total Actuarial Liabilities and Normal Costs

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Abstract

Many company owners are still confused about calculating pensions for their employees so that company owners cannot prepare pensions properly. In this discussion, we will discuss the problem of calculating the total actuarial obligations and normal costs that are part of the pension fund. The purpose of this discussion is to show the solution to the problem of how to find total liabilities using the ordinary credit unit method and to find normal costs using the projected credit unit method. The calculation of total actuarial liabilities uses the credit unit method, while the normal cost calculation discussed uses the projected unit credit actuarial cost method. From the problems discussed, the total actuarial liability on 1/1/95 was IDR 405,335,428 and the normal cost for 1994 on 1/1/94 was IDR 1,071,429. The purpose of this discussion is to help readers better understand how to complete the calculation of total actuarial obligations and normal costs and can be a reference for readers in determining the amount of costs prepared for pensions.

1. Introduction

In this discussion, we will discuss the question of calculating the total actuarial obligations and normal costs that are part of the pension fund (Egli, et al., 2022; Gunadi, et al., 2021; Ridho, et al., 2021). The actuarial liability is the value of the pension benefit added from the entry age to the age at valuation (Felice, 2000). Based on the unit credit method, the total actuarial liabilities at time 0 (time of valuation) for all active participants in the pension program can be obtained by adding up the individual The normal cost (normal cost) at the beginning of each year x (NC_x) is the cost (contribution or premium) of the pension benefits received in year actuarial liabilities for each active participant. X (Awaludin & Rahman, 2021; Toharudin, 2021; Paryati, 2022). Normal cost calculations are discussed using the projected unit credit actuarial cost method. Projected Unit Credit is a cost method for adding the use of a unit credit plan with a pay scale to the payment method of a unit credit plan.

The discussion on the calculation of total actuarial liabilities and normal costs was made to increase knowledge and assist in problem solving. The discussion of this problem also aims to show the solution to the problem of how to find total liabilities using the ordinary credit unit method and to find normal costs using the projected credit unit method.

The discussion on the calculation of total actuarial obligations and normal costs can help readers to better understand how to solve these problems and can be a reference for readers in determining the amount of costs that are prepared for pensions, especially for readers who have employees who must be given a pension.

2. Materials and Methods

2.1. Materials

The data used in this report comes from the Exercise Questions contained in the handout for the Pension Funds Chapter 2 course on the Unit Credit Method. For questions regarding the calculation of total actuarial liabilities, it comes from Exercise Problems in Table 1. For questions regarding normal costs, come from practice problems, benefits with a salary scale, and projecting credit units.

2.2. Method

2.2.1. Total Actuarial Liability

To find the total actuarial liability, first, the actuarial liability for each participant is calculated. The actuarial obligations that will be discussed in this report are single-decrement because the decrement is only based on death. So the formula used to determine actuarial liabilities is

$$AL_x = NC_x (x - e) \quad (1)$$

Where,

AL_x : Actuarial liability at age x
 NC_x : Normal cost at age x
 x : age at the time of valuation
 e : age at entry as a participant in the pension fund

A formula is also used to determine the value of NC_x

$$NC_x = b_x v^t {}_t p_x \ddot{a}_r^{(12)} \quad (2)$$

The total actuarial obligations at time 0 (valuation time) can be determined by adding up the actuarial obligations of the participants participating in the pension fund. So it can be determined the formula is

$$TAL_0 = \sum AL_x \quad (3)$$

Where,

TAL_0 : Total actuarial liabilities at time 0
 AL_x : Actuarial liability at age x

2.2.2. Normal Fee

In the discussion of normal costs, the unit credit cost method will be used. To find the normal cost value, the formula used is

$$NC_0 = \sum b_x \frac{D_r^{(\tau)}}{D_x^{(\tau)}} \ddot{a}_r^{(12)} \quad (4)$$

where,

NC_0 : Normal cost at valuation (time 0)
 b_x : Retirement benefit at age x
 D_r : Decrement at age r (retirement age)
 D_x : Decrement at age x (age at the time of valuation)
 $\ddot{a}_r^{(12)}$: Annuity due

To find the value of the pension benefit needed when looking for normal costs, because in the problem to be used it is known that the retirement salary benefit is 1% of the last salary for each year, the formula can be used

$$b_x = 0.01 \left(\frac{s_{r-1}}{s_x} \right) S_x \quad (5)$$

where,

b_x : Retirement benefit at age x
 s_x : Total annual salary
 s_{r-1} : Last salary

$\frac{s_{r-1}}{s_x}$: Salary scale is bound by age

3. Results and Discussion

3.1. Question-1 and its Solution

Pension benefit: IDR 35 per month per year for services

Actuarial cost method : Credit Unit
 Actuarial assumptions : Interest : 6%
 Mortality : $q_{40} = 0.01, q_{41} = 0.02$
 Entry : age 35

Retirement : age 65
 Participants on 1/1/2018 : 50, all ages 40
 Normal fee on 1/1/2018 : IDR 50,000
 Deaths and newcomers : None in 12018 or 2019
 Compute the total actuarial liability at 1/1/2020.

Solution

Calculating actuarial liabilities can use formula (1). Because the value of $x = 42$ (age at 1/1/2018 is 40, then age at 1/1/2020 is 42) and age at entry $e = 35$ then

$$AL_{42} = NC_{42} (42 - 35)$$

First, the normal cost is determined by the formula

$$NC_x = b_x v^t {}_t p_x \ddot{a}_r^{(12)}$$

Normal cost of employee at 40

it is known that the retirement age is $r=65$ and the employee's age at that time is 40, then $t=65-40=25$

$$NC_{40} = 420 v^{25} {}_{25} p_{40} \ddot{a}_{65}^{(12)}$$

Normal cost of employee at 41

it is known that the retirement age is $r=65$ and the employee's age at that time is 41, then $t=65-41=24$

$$NC_{41} = 420 v^{24} {}_{24} p_{40} \ddot{a}_{65}^{(12)}$$

By dividing between NC_{40} and NC_{41} we get

$$\frac{NC_{40}}{NC_{41}} = v p_{40}$$

Is known

NC_{40} is IDR 50,000 and the number of participants is 50 people

$i = 0.06$, so we get $v = (1 + i)^{-1} = (1 + 0.06)^{-1} = (1.06)^{-1}$

$q_{41}=0.01$, so we get $p_{41}=1-q_{41}=1-0.01=0.99$

So it can be calculated

$$NC_{42} = \frac{NC_{41}}{v p_{41}} = \frac{1177.7}{\frac{0.98}{1.06}} = \text{IDR } 1,158.10$$

Then it can be calculated actuarial liability

$$AL_{42} = NC_{42} (42 - 35) = 1158.10 \times 7 = \text{IDR } 8,106.72856$$

The total actuarial liability can be determined with the number of participants as much as 50

$$TAL_0 = \sum AL_{42} = 50 \times 8106.72856 = \text{Rp}405,335.428$$

So for Question-1 it can be determined that the total actuarial liability on 1/1/95 is IDR 405,335,428

3.2. Problem-2 and its Solution

Retirement benefits : 1% of last salary per year from service

Actuarial cost method : Projecting Credit Units

Assumed retirement age : 65

Annuity factor : $\ddot{a}_{65}^{(12)} = 10$

There is no discontinuation before age 65 other than death.

Table 1. Participant data on 1/1/2019 and a change of function was selected

Age When Renting	Reaching Age x	Number of Employees	Total Annual Salary	s_{64}/s_x	D_x
30	30	1	IDR 20,000	4.0	140
-	31	0	IDR 0	3.9	138
40	50	1	IDR 30,000	2.0	120
-	51	0	IDR 0	1.9	116
-	65	0	IDR 0	1.0	10

What is the normal cost for 2019 on 1/1/2019?

Solution

Let 1/1/2019 be time 0. The total normal cost of planning is given by

$$NC_0 = \sum b_x \frac{D_r^{(\tau)}}{D_x^{(\tau)}} \ddot{a}_r^{(12)}$$

Since there is no decrement other than death, an appropriate single-decrement table (i.e. mortality table) can be used for using D_x , instead of $D_x^{(\tau)}$.

$$NC_0 = \sum b_x \frac{D_r}{D_x} \ddot{a}_r^{(12)}$$

where ${}_{r-x}p_x = 1$ because the probability of dying before retirement is assumed to be zero. The 1% pension benefit received the following year at 0 time is

$$b_x = 0.01 \left(\frac{S_{r-1}}{S_x} \right) S_x$$

Where $r = 65$, $x = 30$, $x = 50$, $\frac{S_{64}}{S_{30}} = 4$, $\frac{S_{64}}{S_{50}} = 2$, $S_{30} = 20000$, $S_{50} = 30000$

$$b_{30} = 0.01 \times 4 \times 20000 = 800$$

$$b_{50} = 0.01 \times 2 \times 30000 = 600$$

Then the total normal cost can be calculated

$$C_0 = b_{30} \frac{D_{65}}{D_{30}} \ddot{a}_{65}^{(12)} + b_{50} \frac{D_{65}}{D_{50}} \ddot{a}_{65}^{(12)}$$

Where $D_{65} = 10$, $D_{30} = 140$, $D_{50} = 120$, $\ddot{a}_{65}^{(12)} = 10$. So

$$NC_0 = 800 \times \frac{10}{140} \times 10 + 600 \times \frac{10}{120} \times 10$$

$$NC_0 = 571.429 + 500 = Rp1,071.429$$

So for Problem-2 it can be determined that the normal cost for 1994 at 1/1/94 is IDR 1,071,429

3.3. Discussion

Based on the calculation in Problem-1, the total actuarial liability on 1/1/95 is IDR 405,335,428, meaning that the obligation that must be paid by a pension fund company on 1/1/95 is Rp.405,335,428.

Based on the calculation in Problem-2, the normal cost for 1994 on 1/1/94 is IDR 1,071,429, meaning that the payment received from participants for 2019 on 1/1/2019 is IDR 1,071,429

4. Conclusion

From the report on the calculation of the total actuarial liability and normal costs, the total actuarial liability on 1/1/95 using the ordinary credit unit method is IDR 405,335,428 and the normal cost for 1994 is 1/1/2019 using the projected credit unit method is IDR 1,071,429

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