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Ordinary Credit Units, Benefit with Salary Scale, and Projecting Credit Units

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Abstract:

In determining the benefits of a pension fund, proper calculations are needed so as not to provide a pension that is too small or too large for someone. The importance of discussing the problems in pension funds is to understand the various problems that exist in determining pension funds. The purpose of making the solution to the selected questions is because the author feels that a discussion about these questions is needed. The problems that exist are sought to be solved using the Traditional Unit Credit (TUC) method and the Projected Unit Credit (PUC) method. The result obtained from the problem under discussion is that if only changes in the age part are entered, it means that it is only necessary to multiply the previously obtained normal cost by the difference from the age in the specified year with the entered age. For those who survive, the normal fee is IDR 33,125, if there are 92 participants who are still alive, the normal fee is IDR. 3,047,490, if there are 96 participants who are still alive, the normal fee is IDR 3,180,000, and if all participants are still alive, the normal fee is IDR 3,312,510. It is hoped that the discussion of the selected questions will help readers understand how to solve problems in determining pension funds.

Keywords: pension fund, traditional unit credit, projected unit credit

1. Introduction

In determining the benefits of a pension fund, proper calculations are needed so as not to provide a pension that is too small or too large for someone. (Benartzi and Thaler, 2007; Gollier, 2008; Wahyudi et al., 2020) The importance of discussing the problems in pension funds is to understand the various problems that exist in determining pension funds.

The purpose of making the solution to the selected questions is because the author feels that a discussion about these questions is needed. The questions are discussed using the methods that have been studied in the Pension Fund Mathematics course. It is hoped that the discussion of the selected questions will help readers understand how to solve problems in determining pension funds.

2. Method

2.1. Traditional Unit Credit (TUC)

For example, the valuation of pension funds is carried out at time 0, for participants aged x at time 0. The annual pension benefits received from age e to age x are usually IDR per month for each year of service. The annual benefit received at age x is denoted by B_x, and the benefit received at age x is denoted by B_r. For more details, consider the number line in Figure 1. (Hardy et al., 2014; Chen, 2018)

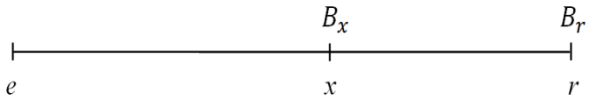

Figure 1. Number line of entry age e to pension e

Actuarial liability is the value of the pension benefit increasing from age e to age x, (Donnely, 2014; Giang and Pfau, 2008) given by equation (1).

$$AL_x = B_x \cdot \frac{D_r^{(\tau)}}{D_x^{(\tau)}} \cdot \ddot{a}_r^{(12)} \quad (1)$$

Where τ represents multiple decrement, and $D_r^{(\tau)}/D_x^{(\tau)}$ is calculated based on the service table (murtalita table). This calculation includes interest, death, discharge, disability, and dismissal. Based on the unit credit method, total actuarial liabilities (TAL) can be obtained at time 0 for all active participants in the pension program, by adding up the individual actuarial obligations for each active participant, so that equation (2) is obtained.

$$TAL_0 = \sum AL_x = \sum B_x \cdot \frac{D_r^{(\tau)}}{D_x^{(\tau)}} \cdot \ddot{a}_r^{(12)} \quad (2)$$

The actuarial obligations for each participant increase with age. Therefore, if no participant leaves the group, and no new participant enters the group, the total actuarial liability will also increase over time.

The TUC method is most often used in retirement plans that provide flat pension benefits. Let B_x represent the share of the total pension benefit earned at age x years. The simplest example is where the same pension benefit is obtained every year, so as given in equation (3).

$$b_x = \frac{B_r}{r - e}. \quad (3)$$

Normal cost (normal cost) at the beginning of each year x (NC_x), is the cost (contribution or premium) of the pension benefits received (recorded) in year x, which is expressed by equation (4).

$$NC_x = b_x \cdot \frac{D_r^{(\tau)}}{D_x^{(\tau)}} \cdot \ddot{a}_r^{(12)} . \quad (4)$$

Normal costs for younger participants are lower because of the larger effect of the discount rate $D_r^{(\tau)}/D_x^{(\tau)}$. The total normal cost for the plan each year is the sum of the normal costs for all participants who receive the benefits they should have received (accrued). Normal total costs in future years will be affected by aging, unit benefit size, withdrawals (withdraws), pensions, deaths, and new arrivals (newly entered participants).

In single-decrement situations, it will often be done using simple variations such as equations (5) and (6).

$$NC_x = b_x \cdot \frac{N_r^{(12)}}{D_x} = b_x \cdot v^t \; {}_tP_x \cdot \ddot{a}_r^{(12)} \quad (5)$$

Where $t = r - x$, and

$$AL_x = NC_x\,(x - e\,) \quad (6)$$

2.2. Projected Unit Credit 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.(Lim, 2020) The current salary is projected for the retirement date using a salary scale, and the benefits of projecting a pension are evenly distributed among the recipients, if the benefits are the same for each year. (Maloletko et al., 2016; Peek et al., 2008)

Assume that the retirement salary recipient of age x is Sx. With 5% interest annually, and his retirement salary benefit is 2% of his last salary for each year. The last salary is the retirement salary in the previous year, if the normal retirement age is r, the last salary is likened to S_{r-1}. Planning for retirement benefits can be expressed as

$$\begin{aligned} B_r &= .02S_{r-1}(r - e) \\ &= .02(s_{r-1}/s_x).Sx(r - e) \\ &= .02(1.05)^{r-1-x}S_x(r - e). \end{aligned} \quad (7)$$

Where $\frac{S_{r-1}}{S_x}$ is the age-bound salary scale, where in this example, $(1.05)^{r-1-x}$. It is usually used for simple salary scales or one of them depends on age, or neither.

Planned benefits can be divided equally in direct distribution, so the value of the pension benefit allocation for the previous year by Projected Unit Credit (PUC).

$$B_x = .02S_{r-1}(x - e)$$

$$= .02(s_{r-1}/s_x)S_x(x-e)$$
$$= .02(1.05)^{r-1-x}S_x(x-e) \quad (8)$$

The pension benefits where the annual increase follows the age of x is:

$$b_x = \frac{.02(S_{r-1}/S_x)S_x(r-e)}{r-e} = .02S_{r-1} \quad (9)$$

PUC's actuarial liability for a person of age x is

$$AL_x = .02(S_{r-1}/S_x)S_x(x-e)\frac{D_r^{(T)}}{D_x^{(T)}}\ddot{a}_r^{(12)}$$
$$= .02(1.05)^{r-1}S_x(x-e)\frac{D_r^{(T)}}{D_x^{(T)}}\ddot{a}_r^{(12)} \quad (10)$$

and the normal cost of PUC is

$$NC_x = .02(S_{r-1}/S_x)S_x\frac{D_r^{(T)}}{D_x^{(T)}}\ddot{a}_r^{(12)}$$
$$= .02(1.05)^{r-1-x}S_x\frac{D_r^{(T)}}{D_x^{(T)}}\ddot{a}_r^{(12)} \quad (11)$$

3. Results and Discussion

3.1. Question-1 and its Solution

Calculate the four actuarial liability credit units from Example (2) if age 31 is entered.
Example:

Normal pension benefit: IDR 10 (unit) per month for each year of service.
Actuarial Cost Method: Unit Credit
Actuarial assumptions:
Interest: 6%
Termination of pre-retirement other than death: None
Retirement age: 65
Participants on 1/1/2013: 100 active participants, all age 60.
Normal fee for 2013 from 1/1/2013: IDR 100,000
Mortalita table selected
Calculate normal cost for 2014 from 1/1/2014

a) surviving (not yet dead),
b) if 92 participants are still alive on 1/1/2014,
c) if 96 participants are still alive, and
d) if all participants are still alive.

Answer:

Age entered: 31

Length of employment until year 2014: 61-31=30

a) $30 \times NC_{61} = 30 \times \frac{1060}{0.96} = 33{,}125$
b) $30 \times TNC_{61} = 30 \times 101{,}583 = 3{,}047{,}490$
c) $30 \times TNC_{61} = 30 \times 106{,}000 = 3{,}180{,}000$
d) $30 \times TNC_{61} = 30 \times 110{,}417 = 3{,}312{,}510$

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.
Participant data on 1/1/2014 and a change of function was selected:

Age at Rent	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 2014 on 1/1/2014?

Answer:

Assume 1/1/2014 is time 0.

For $x = 30$; $NC_0 = S_{30} \times \frac{S_{64}}{S_{30}} \times 0.01 \times 10 \times \frac{10}{140} = 571$

For $x = 50$; $NC_0 = S_{50} \times \frac{S_{64}}{S_{50}} \times 0.01 \times 10 \times \frac{10}{120} = 500$

$$TNC_0 = 500 + 571 = 1071$$

4. Conclusion

In the first problem, if only changes in the age part are entered, it means that it is only necessary to multiply the previously obtained normal cost by the difference from the age in the specified year by the entered age. For the second question, normal costs are calculated at age x, namely 30 and 50. After that, the total is calculated.

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