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Common Credit Units, and Projected Unit Cost of Credit Methods

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Abstract

Pension funds are funds collected by the company as the rights of a retiree from the company. Pension funds are usually in the form of money that can be taken every month or taken all at once when someone enters retirement, and the amount of pension funds must be calculated carefully. This paper aims to be able to perform actuarial calculations on traditional credit units, and perform calculations on several methods of calculating the projected salary scale. The calculation results obtained total actuarial liabilities, and total normal costs for pension fund program participants, so that it can be used as an illustration for pension plan participants to estimate how much pension benefits will be received at retirement.

Keywords: Pension funds, traditional credit units, projected salary scale, total actuarial liabilities, and total normal costs

1. Introduction

Unit Credit Method, is the most basic method in the discussion of pension funds. Aims to be able to perform actuarial calculations on traditional unit credit and be able to perform calculations on several methods of calculating the projected salary scale. The method used is Traditional Unit Credit (TUC) as a starting point for calculating pension costs and Projected Unit Credit is a cost method for adding the use of a unit credit plan with a salary scale to the payment method of a unit credit plan. Traditional Unit Credit (TUC) is a starting point for calculating pension costs. The actuarial liability of TUC is the present value at the valuation date, the pension benefits increase from the date entered into the plan until the valuation date. This method is often called unit credit. 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 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.

The first question asks how much the total actuarial liability is and the second question asks how much is the total normal cost (Zwaan, & Taylor, 2006; Valsiner, et al., 2005; Liu, et al., 2012). For the first question, Traditional Unit Credit (TUC) is used as a starting point for calculating pension costs (Chen, & Hardy, 2009; Gold, 2005; Pang, & Warshawsky, 2013). The actuarial liability of TUC is the present value at the valuation date, the pension benefits increase from the date entered into the plan until the valuation date (Hardy, et al., 2014;. Peng, 2004; Gold, & Latter, 2009). This method is often called unit credit.

And for the second question, the Projected Unit Credit method is used, which is a cost method to add the use of a unit credit plan with a salary scale to the payment method of a unit credit plan (Angkasa, et al., 2021). 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.

2. Material and Methods

2.1 Material

For the first question, it is known that the pension benefit is IDR 35 per month per year for services, carried out using the credit unit method. Assuming actuarial assumptions as follows, interest is 6%, mortality is $q_{40} = 0.01, q_{41} = 0.02$, enters at age 35 and retires at age 65. Participants at 1/1/2017 : 50, all age 40. With normal fees at 1/ 1/2017 is IDR 50,000.00. Asked how much is the total actuarial liability at 1/1/2019. Then by calculating the normal cost each year and then calculating NC_{41}, NC_{42}.Followed by looking for AL_{42} and then the total actuarial liability on 1/1/2019 is IDR 405,339,095.00

Furthermore, for the second question, it is known that the pension benefit is 1% of the last salary per year from service. The actuarial cost method used is to project Credit Units. Assuming retirement age is 65, the annuity factor is $\ddot{a}_{65}^{(12)} = 10$. There is no

discontinuation before age 65 other than death. The participant data was on 1/1/2018 and the change of function was chosen based on the attached table in the discussion section of the question. asked what the normal cost for 192018 on 1/1/2018.

2.2 Method

The first thing to do is to do a calculation using the formula

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

So the total normal cost on 1/1/2018 is IDR 1,071,42,-

For question-1

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

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

Normal costs for younger participants are lower due to the larger effect of the discount rate on $D_r^{(\tau)}/D_x^{(\tau)}$, 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 a simple variation such as the following equation

$NC_x = b_x \, . \, \frac{N_r^{(12)}}{D_x} = b_x \, . \, v^t \, {}_tP_x \, . \, \ddot{a}_r^{(12)}$ where $t = r - x$, and $AL_x = NC_x \, (x - e)$

For question-2

The normal cost for PUC is $NC_0 = \sum b_x (1+i)^{-(r-x)} \, {}_{r-x}p_x \ddot{a}_r^{(12)}$

3. Results and Discussion

3.1. Solution for Question-1

Pension benefit: IDR 35 per month per year for services
Actuarial cost method: Credit Unit
Actuarial assumptions:
- Interest : 6%
- Mortality : q_40=.01,q_41=.02
- Entry : age 35
- Retirement : age 65

Participants on 1/1/2017 : 50, all ages 40
Normal fee on 1/1/2017 : IDR 50,000
Deaths and newcomers : None in 2017 or 2018
Compute the total actuarial liability at 1/1/2019.

Answer:
Calculate the normal cost of each year:

$$\frac{NC_{40}}{NC_{41}} = \frac{420 . v^{25} \cdot {}_{25}p_{40} . \ddot{a}_{65}^{(12)}}{420 . v^{24} \cdot {}_{24}p_{41} . \ddot{a}_{65}^{(12)}}$$

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

$$\frac{1000}{NC_{41}} = \left(\frac{1}{1.06}\right)(1 - q_{40})$$

$$\frac{1000}{NC_{41}} = (0.9434)(0.99)$$

$$NC_{41} = 1{,}070.7071$$

Next calculated NC_{41}

$$\frac{NC_{40}}{NC_{41}} = \frac{420.v^{25}.{}_{25}p_{40}.\ddot{a}_{65}^{(12)}}{420.v^{24}.{}_{24}p_{41}.\ddot{a}_{65}^{(12)}}$$

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

$$\frac{1000}{NC_{41}} = \left(\frac{1}{1.06}\right)(1-q_{40})$$

$$\frac{1000}{NC_{41}} = (0.9434)(0.99)$$

$$NC_{41} = 1{,}070.7071$$

Next calculated NC_{42}

$$\frac{NC_{41}}{NC_{42}} = \frac{420.v^{24}.{}_{24}p_{41}.\ddot{a}_{65}^{(12)}}{420.v^{23}.{}_{23}p_{42}.\ddot{a}_{65}^{(12)}}$$

$$\frac{NC_{41}}{NC_{42}} = v.p_{41}$$

$$\frac{1{,}070.7071}{NC_{42}} = \left(\frac{1}{1.06}\right)(1-q_{41})$$

$$\frac{1{,}070.7071}{NC_{42}} = (0.9434)(0.98)$$

$$NC_{42} = 1{,}158.1117$$

Then you can search for AL_{42}

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

$$= 1{,}158.1117(7)$$

$$= 8{,}106.7819$$

Obtained total actuarial liabilities:

$$TAL_0 = 50(8{,}106.7819)$$

$$= 405{,}339.095$$

So, the total actuarial liability on 1/1/2019 is IDR 405,339,095,-

3.2. Solution for Question-2

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 1/1/94 and a change of function was selected:

What is the normal cost for 2018 on 1/1/2018?

Answer:

$NC_0 = \sum b_x \,.\, \frac{D_r^{(\tau)}}{D_x^{(\tau)}} \,.\ddot{a}_r^{(12)}$ With $b_x = B_r \,.\left(\frac{S_{r-1}}{S_x}\right).S_x$

Information:

B_r = retirement benefit

$\left(\frac{s_{r-1}}{s_x}\right)$ = salary increase at time r-1 and at age x.

S_x = yearly salary

So, the calculation that occurs is:

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

$$NC_0 = \left[(0.01 \, . \, (4{,}0) . \, 20000 \, . \frac{10}{140} \, . 10\right] + \left[(0.01 \, . \, (2.0) \, . \, 30000) \, . \, \frac{10}{120} \, . \, 10\right]$$

$$NC_0 = \left[800 \, . \frac{1}{14} \, . \, 10\right] + \left[600 \, . \frac{1}{12} \, . \, 10\right]$$

$$NC_0 = (571{,}42) + (500)$$

$$NC_0 = 1{,}071.42$$

So the total normal cost on $1/1/2018$ is IDR 1,071.42

4. Conclusion

Thus, we are able to perform actuarial calculations on traditional unit credits with the above discussion regarding the calculation of total actuarial obligations with the normal cost formula (normal cost) and in the second problem we are able to perform calculations on several methods of calculating the projected salary scale with the above discussion regarding normal cost calculations. With the normal cost formula for PUC.

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