

Pension

Actuarial liability for pension benefits

1. Projected unit method: the approach considers future salary increases.
2. Traditional unit (current unit) method: the approach that does not project future salaries when calculating the actuarial liability.
3. A career average plan pays a proportion of career average earnings for each year of service. Let α be the proportion, and let TPE be total pensionable earnings, the sum of salaries for all years of service. Let n be the number of years of service. Then the annual pension is αTPE .

Funding the benefits

We usually assume the benefits paid during the year are paid in the middle of the year, in other words, all exits from the plan occur in the middle of the year.

1. ${}_tV$: the actuarial liability.
2. C_t : the contribution the employer must make to the plan, normal contribution, or normal cost.
$$C_t = v {}_1p_x^{00} {}_{t+1}V - {}_tV + EPV \text{ (benefits paid for mid year exits)}$$
3. ${}_1p_x^{00}$: the probability of not exiting the active state during the year.
4. TUC: traditional unit credit (if the actuarial liability is calculated with the traditional unit method)
Then the normal contribution = ${}_0V \left(\frac{S_{x+1}}{S_x} \frac{n+1}{n} - 1 \right)$
5. PUC: projected unit credit (if the actuarial liability is calculated with the projected unit method)
Then the normal contribution = ${}_0V \left(\frac{1}{n} \right)$

Retiree Health Benefits

Expected present value

1. Suppose retirement is at age x and time t .
2. $B(y, t)$: the premium for health insurance at time t for a person age y .
3. The annuity:

$$\ddot{a}_B(x, t) = \sum_{k=0}^{\infty} v^k {}_k p_x \left(\frac{B(x+k, t+k)}{B(x, t)} \right)$$

4. $a_B(x, t)$: the benefit premium annuity
5. The expected present value of health benefits for someone retiring at age x and time t is $B(x, t) \ddot{a}_B(x, t)$.

6. If assume $\frac{B(x+1, t)}{B(x, t)} = c$ for all x and t , and $\frac{B(x, t+1)}{B(x, t)} = 1 + j$, (j is the inflation rate).

$$\ddot{a}_B(x, t) = \sum_{k=0}^{\infty} v^k {}_k p_x c^k (1 + j)^k$$

7. Combine $v = \frac{1}{1+i}$, c and $1+j$. Let $1 + i^* = \frac{1+i}{c(1+j)}$. Then, the health cost annuity can be evaluated as a whole life annuity at a modified interest rate i^* ,

$$\begin{aligned} \ddot{a}_B(x, t) &= \ddot{a}_{x|i^*} \\ \ddot{a}_{x|i^*} &= \frac{1 + i^*}{q + i^*} \end{aligned}$$

8. AVTHB: actuarial value of total health benefits.

- If we assume retirement must occur no later than age 65, and all retirements occur at the beginning of the year, then