

Pension

Pension basic

Replacement ratio and salary scale

1. Final salary is defined as the salary earned in the 12 months preceding the retirement date.
2. Career average salary is the average salary earned over the entire period that the employee is in the pension plan.
3. 2 major categories of pensions:
 1. Defined benefit (DB): which pays a monthly amount to retirees determined by formula. They pay a percentage of final average salary, but they also may pay a percentage of career average salary.
Annual pension benefit = final average (or career average salary) x accrual rate x number of years of service
 2. Defined contribution (DC): which specifies the amount contributed to the pension fund each year of service. The fund grows with interest and is distributed to the employee at retirement. The amount that is contributed to the fund is a percentage of salary. The amount in the fund at retirement is not known in advance and depends on investment performance. The employee bears the investment risk.
4. Replacement ratio (R): is the ratio of the pension scheduled to be paid in the first year of retirement to the final salary.
5. Rate of salary function: $\bar{s}_x$, for $x \geq x_0$. The rate of salary function is defined so that if the annual salary rate at age x is $S(x)$ and the annual salary rate at age y is $S(y)$. Then, $\frac{S(y)}{S(x)} = \frac{\bar{s}_y}{\bar{s}_x}$. A rate of salary function of the form $\bar{s}_x = c^x$, representing a salary rate that increases continuously.
6. K-year final average salary: the average of the salaries earned in the last k years before retirement.
7. Salary scale: s_x is defined an index of the salary earned during the year of age $(x, x+1]$, so that if $S(x)$ is the salary earned between age x and $(x+1)$ and $S(y)$ is the salary earned between age y and $(y+1)$, then $\frac{S(y)}{S(x)} = \frac{s_y}{s_x}$.
8. To go from a rate of salary function to the corresponding salary scale, we need to integrate the rate of salary function over one year.

$$s_x = \int_0^1 \bar{s}_{x+t} dt$$

As an approximation, the rate of salary function at age x is assumed to be the same as the salary scale half a year earlier: $\bar{s}_x = s_{x-0.5}$

Actuarial present value of benefits

1. α : benefit accrual rate
2. n : the number of years of service
3. TPE : total pensionable earnings, the sum of salaries for all years of service.
4. The annual benefit upon retirement is $n * \alpha$ times final or career average salary, possibly reduced for early retirement.
5. Do not compound the reduction factor.
6. $\text{annual pension} = \alpha TPE$
7. COLA: cost of living adjustments (in Britain).