

Module 5 Section 6 Exercises:

1. Sue's company has only a DC plan with a company match of \$0.50 for each dollar of employee contribution, up to 6% of employee contributions. You are given:
 - (i) Sue is hired at exact age 25.
 - (ii) Sue's initial salary is 40,000 and he receives annual raises of 3% per year.
 - (iii) Sue deposits 7% of his salary into his DC account at the end of each year and earns 6% annual effective interest on all contributions into the account.
 - (iv) Actuarial assumptions follow ILT

Determine

- (a) Sue's replacement ratio if he retires at age 60.
 - (b) Sue's replacement ratio if he retires at age 65.
 - (c) Sue's replacement ratio if he retires at age 65, assuming that instead of depositing 7% of his salary each year, he only deposits 5% of his salary each year.
2. Tom's company has only a DC plan with a dollar per dollar company match up to \$2500 of employee contributions. You are given:
 - (i) Tom is hired at exact age 45 and retires at exact age 65.
 - (ii) Tom's initial salary is 50,000 and he receives annual raises of 4% per year.
 - (iii) Tom makes level deposits into his DC account at the end of each year and earns 9% annual effective interest on all contributions into the account.
 - (iv) $\ddot{a}_{65} = 10$

Determine the amount of Tom's deposits in order to achieve a replacement ratio of 35% from this plan.

3. Repeat the previous problem if the company match is \$0.50 per dollar of employee contribution, up to a maximum company deposit of 2500.

4. Omar has accrued a normal retirement benefit of 50000 per year for life, payable annually starting at age 65. As an optional form of payment, he elects to receive a benefit payable monthly starting at age 65. The optional form of payment is actuarially equivalent to the normal retirement benefit using ILT actuarial assumptions. Determine the amount of Omar's monthly benefit using

- (a) the UDD assumption
- (b) a 2-term Woolhouse assumption
- (c) a 3-term Woolhouse assumption

5. You are given the following DB plan provisions:

- (i) Annual benefit equals 1800 for each complete year of service
- (ii) Normal retirement age is 65
- (iii) Normal form of payment is annual payment life annuity due paid for participant's lifetime only
- (iv) Optional forms of payment are:
 - (a) lump sum
 - (b) 10-year certain and life
 - (c) joint and 100% survivor; upon either death, the survivor continues to receive the same amount
 - (d) joint and 50% survivor; upon death of participant, benefit to spouse is reduced to 50% of original amount, whereas if spouse dies first, there is no reduction of original benefit
 - (e) joint and 50% contingent; upon first death, benefit is reduced to 50% of original amount
- (v) Optional forms of payment (b) through (e) are payable annually, and all optional forms of payment are actuarially equivalent to the normal retirement benefit using ILT actuarial assumptions

Kim began work on October 15, 1980. She has requested a benefit calculation based on retiring on December 31, 2015. Both Kim and her spouse, David, will be exact age 65 on December 31, 2015. Determine

- (a) Kim's normal retirement benefit
- (b) Kim's benefit if she chooses the lump sum option
- (c) Kim's annual benefit if she chooses each of the other forms of payment

6. Jim and Tim both began work at exact age 40 for companies that sponsor identical defined benefit pension plans, except for the vesting requirements.

Jim's plan has 5-year cliff vesting; that is, Jim is 0% vested in his accrued benefit until he earns 5 years of service, at which time he becomes 100% vested.

Tim's plan has graded vesting, whereby he becomes 20% vested in his accrued benefit for each year of service. After 5 years of service he is 100% vested.

At exact age 43, both Jim and Tim terminate employment with their respective companies. Each has an accrued benefit of 5000, payable annually for life starting at age 65.

Determine the actuarial present value at the termination date for each of their vested benefits, using ILT actuarial assumptions.

7. William participates in a career average pension plan whereby he accrues a benefit of 2% of each year's salary, payable at the beginning of each year for life, starting at his normal retirement age.

At his normal retirement age, the total salary earned over the 30 years William worked is 1,500,000.

Determine William's annual benefit amount.

8. Cindy belongs to a career average pension plan whereby she accrues an annual retirement benefit of 1.5% of each year's salary, payable at the beginning of each month for life, starting at age 65. Cindy is exact age 45 now, and began work at exact age 25. You are given:

- (i) Cindy has earned 600,000 in total past salary
- (ii) Cindy's current salary, while she is age 45, is 70,000
- (iii) Cindy will receive 3% salary increases each year until retirement
- (iv) $\ddot{a}_{65}^{(12)} = 11.4$
- (v) $i = .04$
- (vi) ${}_{20}p_{45} = 0.9$

Determine

- (a) Cindy's annual retirement benefit if she terminates employment today. (This is her accrued benefit, and she receives it as the normal form of payment at her normal retirement age.)
 - (b) the actuarial present value at Cindy's current age of her accrued benefit.
 - (c) the actuarial present value at Cindy's current age of her annual retirement benefit, i.e as though she retires at exact age 65.
 - (d) Cindy's replacement ratio, given she retires at exact age 65.
9. Jamie joined a defined benefit pension plan at exact age 35. His age 35 salary is 40,000 and will increase by 5% each year. The plan provides an annual retirement benefit at age 65 equal to 1.5% of final year's salary for each year of service. Determine Jamie's annual benefit upon retirement at age 65.
10. Donna joined a defined benefit pension plan at exact age 35. Her age 35 salary is Y and will increase by $x\%$ each year. The plan provides an annual retirement benefit at age 65 equal to 1.5% of final year's salary for each year of service. Determine Donna's replacement ratio at retirement age, 65.

11. Lou belongs to a final average pension plan whereby he receives an annual retirement benefit of 2% of the final 3-year average salary up to 100,000 multiplied by years of service, plus 3% of the final 3-year average salary over 100,000 multiplied by years of service. The benefit is paid monthly starting at age 65. You are given:

(i) Lou joined the plan at exact age 45 with a salary of 80,000

(ii) Lou's salary increases by 3% each year

(iii) $\ddot{a}_{65}^{(12)} = 12.2$

Determine

(a) Lou's accrued monthly benefit if he terminates employment at age 60.

(b) Lou's monthly benefit if he retires at age 65.

(c) the actuarial present value, at age 65, of Lou's retirement benefit.

12. See the previous problem. In addition to the provisions of the plan stated in that problem, participants are allowed to retire early as long as they are at least 60 with at least 10 years of service. You are also given:

(i) Early retirement benefits are determined by actuarial equivalence

(ii) $i = 0.04$

(iii) ${}_5p_{60} = 0.95$

(iv) $\ddot{a}_{60}^{(12)} = 13.6$

Lou retires early at age 60. Determine his monthly benefit, starting at age 60.

13. Ron and Don, twins, belong to a final average pension plan whereby they receive an annual retirement benefit of 2% of final 5-year average salary for each year of service. The benefit is paid monthly starting at age 65. You are given:

- (i) They joined the plan at exact age 35, each with a salary of 60,000
- (ii) Their salaries increases by 4% each year
- (iii) $\ddot{a}_{65}^{(12)} = 12.2$ and $\ddot{a}_{60}^{(12)} = 13.6$
- (iv) Early retirement is allowed starting at age 60 with a pension reduction factor of 6% per year.

Ron retired at age 60 and Don retired at age 65. Determine

- (a) Ron's monthly retirement benefit.
- (b) Don's monthly retirement benefit.
- (c) the actuarial present value of Ron's retirement benefit at the time he retires.
- (d) the actuarial present value of Don's retirement benefit at the time he retires.