(New) Module 2 Section 4 Exercises:

For each of the following insurances in Numbers 1 through 10, draw an appropriate timeline and use ILT actuarial assumptions to determine the APV

1. a whole life insurance of 5000, issued to a 35 year old, with the death benefit payable at the end of the year of death
2. a 10-year pure endowment of 350 issued to (40)
3. a 17-year pure endowment of 10000 issued to (35)
4. a discrete 17-year deferred whole life insurance of 500 issued to (35)
5. a discrete 2-year term life insurance of 750 issued to (32)
6. a 17-year term insurance of 2500 issued to (35), with benefit payable at the end of the year of death
7. a 1-year endowment insurance of 25,000 issued to (35), with death benefit payable at the end of the year of death
8. a 17-year endowment insurance of 8000 issued to (35), with death benefit payable at the end of the year of death
9. a discrete whole life insurance of 1000 issued to independent lives aged 30 and 40, with benefit payable upon the first death
10. a discrete whole life insurance of 1000 issued to independent lives aged 30 and 40, with benefit payable upon the first death if it occurs within the next 10 years
11. a discrete whole life insurance of 500 issued to independent lives aged 30 and 40, with benefit payable upon the last death
12. a discrete whole life insurance of 500 issued to independent lives aged 30 and 40, with benefit payable upon the last death if it occurs within the next 10 years

For Numbers 13 through 15, assume $i = .08$ and CF mortality with $\mu = -\ln(0.9)$.

13. Determine the APV for a discrete whole life insurance of 3000 issued to (x).

14. Determine the APV of a 12-year pure endowment of 100 issued to (x).

15. Determine the APV of a 20-year term insurance of 1000 issued to (40), payable at the end of the year of death.

For Numbers 16 through 18, assume $i = .08$ and DML (global UDD) mortality with terminal age 110.

16. Determine the APV for a discrete whole life insurance of 3000 issued to (60).

17. Determine the APV of a 12-year pure endowment of 100 issued to (50).

18. Determine the APV of a 20-year term insurance of 1000 issued to (40), payable at the end of the year of death.

19. In a double decrement model, decrement 1 is death by non-accidental means and decrement 2 is death by accident. You are given:

x	$q_x^{(1)}$	$q_x^{(2)}$
60	0.010	0.005
61	0.014	0.008

A 2-year term insurance of 10,000 issued to (60), with benefit payable at the end of the year of death, has a double indemnity clause stating that an additional 10,000 will be paid if death occurs by accidental means. Using an annual effective interest rate of 5% determine the actuarial present value of the insurance.

20. You are given:

j	$1000A_x^{(\text{Dec } j)}$	$1000A_{x:\overline{n}|}^{(\text{Dec } j)}$
1	148.22	417.63
2	465.76	583.78

You are also given $1000\ {}_nE_x = 301.58$. A discrete whole life insurance issued to (x) pays 2000 if departure occurs within n years by decrement 1, pays 3000 if departure occurs after n years by decrement 2, and pays nothing otherwise. Determine the APV of the insurance.

21. A discrete 3-year term insurance issued to (35) pays 1000 if death occurs in the first year, 750 if death occurs in the second year, and 1250 if death occurs in the third year. Given $q_{35+k} = 0.02 + 0.005k$, for $k = 0, 1$, and 2, determine the actuarial present value for the insurance using $d = 0.05$.

22. Product A is a discrete 20-year term insurance issued to (30) paying a level benefit of 1000. Product B is a discrete 20-year term insurance offered to the same 30-year old and paying $1000(1.02)^n$ if death occurs in year n ($n = 1, 2, \ldots, 20$). Using $i = .03$, the APV of Product A is 585. Determine the APV of Product B using $i = 5.06\%$.

23. A discrete 30-year term insurance issued to (50) pays $1000(1.05)^{n-1}$ if death occurs in year n. Given ${}_{30}p_{50} = 0.4$ and $i = .05$, determine the APV of the insurance.

24. Draw the timeline, include the valuation date, that corresponds to the symbol $100(IA)_x$.

25. A discrete whole life insurance issued to (25) pays 5 if death occurs in the fist year, 7 if death occurs in the second year, and so on, where each year's sum insured is 2 more than the preceding year's benefit. Write an expression using actuarial notation for the APV of this insurance.

26. A 10-year term insurance issued to (50), with benefit paid at the end of the year of death, has a sum insured of 1500 for the first year. For subsequent years, the sum insured is 100 less than the previous year's benefit. Write an expression using actuarial notation for the APV of this insurance.

For Numbers 27 through 30, determine the APV of the insurance described, using
(a) ILT actuarial assumptions and the UDD assumption between integer ages
(b) ILT actuarial assumptions and the claims acceleration approach

27. A whole life insurance issued to (40) with a benefit of 1000 payable at the end of the quarter of death

28. A 20-year term insurance issued to (40) with a benefit of 1000 payable at the end of the month of death

29. A 20-year deferred whole life insurance issued to (40) with a benefit of 1000 payable at the end of the semiannual period of death

30. A 20-year endowment insurance issued to (40) with a benefit of 1000 payable at the end of the quarter of death