Module 4 Section 6 Exercises:

1. For a fully discrete whole life insurance of 1000 issued to (30) that has annual premiums of 7, use ILT actuarial assumptions to determine

   (a) the reserve at times 0, 1, and 2, using the definition of reserve

   (b) verify the results from part (a) using recursion

2. For a fully discrete 2-year endowment insurance on (x), you are given

   (i) the death benefit is 3000 in year 1 and 2000 in year 2

   (ii) the maturity benefit is 1000

   (iii) expenses, payable at the beginning of the year are:
   - (a) taxes are 2% of the gross premium
   - (b) commissions are 3% of the gross premium
   - (c) other expenses are 15 in the first year and 2 in the second year

   (iv) $i = 0.04$, $p_x = 0.9$, and $p_{x+1} = 0.8$

   (v) using the equivalence principle, the annual gross premium is 735.68

   (vi) the annual net premium is 689.93

   Determine each of the following (see #1 from last section):

   (a) the gross premium reserve at time 1 using recursion from time 0 to time 1, and noting that ${}_0V^g = 0$ since the annual gross premium is determined by the equivalence principle

   (b) the gross premium reserve at time 1 using recursion from time 1 to time 2 and noting that ${}_2V^g$ is easy to determine for a 2-year endowment insurance

   (c) the net premium reserve at time 1 using recursion from time 0 to time 1 and noting that ${}_0V^n = 0$ since the annual net premium is determined by the equivalence principle

   (d) the net premium reserve at time 1 using recursion from time 1 to time 2 and noting that ${}_2V^n$ is easy to determine for a 2-year endowment insurance

3. For a fully discrete insurance issued to (x) you are given:

(i) the death benefit in year 7 is 10000 and the death benefit in year 8 is 8000

(ii) the premium in year 7 is 250 and the premium in year 8 is 260

(ii) $p_{x+6} = 0.9$ and $p_{x+7} = 0.8$

(iii) $i_7 = 4\%$ and $i_8 = 5\%$ (i.e. the annual effective interest rate for year 7 is 4% and for year 8 is 5%)

(iii) ${}_6V = 3000$

Determine ${}_8V$

4. For a deferred whole life annuity due on (25) with annual payment of X commencing at age 60, you are given:

(i) level annual net premiums of 1 are paid at the beginning of each year during the deferral period

(ii) during the deferral period, a death benefit equal to the return of premiums with interest is paid at the end of the year of death

(iii) $i = .06$

Determine

(a) the net premium reserve at the end of the 20th year

(b) the net premium reserve at age 60 in two ways;
first recursively as in part (a), and then prospectively, which is always the case

(c) use your answers from part (b) and ILT mortality to determine X

5. For a deferred whole life annuity due on (25) with annual payment of 1 commencing at age 60, you are given:

   (i) level annual net premiums of π are paid at the beginning of each year during the deferral period

   (ii) during the deferral period, a death benefit equal to the net premium reserve is payable at the end of the year of death

   By setting the net premium reserve determined recursively at age 60 equal to the net premium reserve determined using the prospective method at age 60, show that $\pi = \frac{\ddot{a}_{60}}{\ddot{s}_{\overline{35}|}}$

6. For a whole life insurance issued to (25), you are given:

   (i) the death benefit is paid at the end of the year of death

   (ii) the death benefit for year 6 is 8000, and the death benefit for year 7 is 10000

   (iii) premiums are paid at the beginning of each semiannual period

   (iv) semiannual premiums for year 6 equal 20, and semiannual premiums for year 7 equal 25

   (v) mortality follows the ILT

   (vi) Assume a uniform distribution of deaths between integer ages

   (vii) the annual discount factor is 0.9025 for years 6 and 7

   (viii) ${}_7V = 320$

   Determine

   (a) ${}_{6.5}V$

   (b) ${}_{5.5}V$