

ACSC/STAT 4720, Life Contingencies II

Fall 2016

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Homework Sheet 6

Due: Friday 25th November: 12:30 PM

Basic Questions

1. A policyholder aged 58 buys a 5-year type A universal life insurance policy. The death benefit is \$450,000. The policyholder pays a premium of \$6,400 at the start of each year. The lifetable for the policyholder is:

x	l_x	d_x
58	10000.00	137.45
59	9862.55	149.49
60	9713.06	162.35
61	9550.71	176.05
62	9374.66	190.57
63	9184.09	205.89

The cost of insurance is based on 105% of mortality in the above table and $i = 0.04$. Expense charges are 2% of the account value (after each premium is paid). Assume the credited interest rate is $i = 0.05$.

- (a) Calculate the projected account value for the next 5 years.
- (b) Suppose the insurer earns an interest rate, $i = 0.06$, and mortality follows the above table, initial expenses are \$1,300 and renewal expenses are 1% of account value each year after the first. Suppose there are no surrenders. Calculate the profit margin of this policy at a risk discount rate of $i = 0.10$.
2. A life aged 37 buys a 5-year type B universal life insurance policy with additional death benefit \$350,000. The annual premium is \$7,400. Mortality is as shown in the following table:

x	l_x	d_x
37	10000.00	11.86
38	9988.14	12.77
39	9975.37	13.75
40	9961.62	14.80
41	9946.82	15.93
42	9930.88	17.15
43	9913.73	18.47

The credited interest rate is $i = 0.04$. Cost of insurance is based on mortality in the above table and $i = 0.02$. Expense charges are 1.5% of account value.

- (a) Project the account value for the next 5 years.
- (b) Assume that the insurance company earns interest $i = 0.08$; Mortality is 105% of the mortality in the lifetable. Initial expenses are \$3,700; renewal expenses are 1% of premiums paid. The surrender charges and surrender rates are:

Year	Charge	rate
1	\$4,200	1%
2	\$3,200	2%
3	\$1,400	3%
4	\$400	3%
5	\$0	100%

Which of the following is the internal rate of return of the policy:

- (i) $i = 0.09903$
- (ii) $i = 0.10320$
- (iii) $i = 0.11382$
- (iv) $i = 0.12034$

3. A life aged 52 has an annual type A Universal life insurance policy that has been in effect for 12 years.

- The current account value is \$112,483.
- The annual premium is \$6,500.
- The expense charge is 1% of account value.
- The credited interest rate is $i = 0.05$.
- The total death benefit is \$300,000.
- The corridor factor requirement is 2.5.
- The insurance is priced using mortality rate $q_{52} = 0.000412$ and interest $i = 0.03$.

Calculate the cost of insurance charge for the year.

Standard Questions

4. Consider an annual type A universal life insurance policy with annual premiums of \$6,000, death benefit \$400,000 with no corridor factor requirement.

Surrender charges and rates are

Year	Charge	rate
1	\$2,200	2%
2	\$1,300	2%
3	\$800	2%
4	\$0	2%
5	\$0	100%

Initial expenses are \$1,100, and renewal expenses are \$90. Cost of insurance is based on mortality $q_x = 0.000702$ and $i = 0.05$. The insurance company makes an annual rate of return equal to $i = 0.08$. A competitor offers a comparable policy with expense charge 1% and credited interest rate $i = 0.05$. If the company wants to charge an expense charge of 2% and base Cost of Insurance on $q_x = 0.00066$ and $i = 0.04$, what credited interest rate should it charge so that the NPV of its policy at a risk discount rate of $i = 0.12$ is the same as the competitor's policy?

- (i) $i = 0.007917$
- (ii) $i = 0.011423$
- (iii) $i = 0.014042$
- (iv) $i = 0.017162$