

ACSC/STAT 4720, Life Contingencies II

Fall 2015

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Homework Sheet 6

Due: Friday 2nd October: 12:30 PM

Basic Questions

1. A policyholder aged 54 buys a 10-year type B universal life insurance policy. The additional death benefit is \$150,000. The policyholder pays a premium of \$4,200 at the start of each year. The lifetable for the policyholder is:

x	l_x	d_x
54	10000.00	8.33
55	9991.67	8.90
56	9982.77	9.54
57	9973.23	10.24
58	9962.99	11.01
59	9951.99	11.85
60	9940.14	12.78
61	9927.36	13.80
62	9913.56	14.91
63	9898.65	16.14

The cost of insurance is based on 105% of mortality in the above table and $i = 0.03$. 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 10 years.

(b) Suppose the insurer earns an interest rate, $i = 0.04$, and mortality follows the above table, initial expenses are \$700 and renewal expenses are 0.5% 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 $i = 0.12$.

2. A life aged 42 buys a 10-year type A universal life insurance policy with death benefit \$350,000. The annual premium is \$5,900. Mortality is as shown in the following table:

x	l_x	d_x
42	10000.00	7.60
43	9992.40	7.87
44	9984.54	8.17
45	9976.37	8.51
46	9967.86	8.89
47	9958.97	9.31
48	9949.66	9.79
49	9939.87	10.32
50	9929.56	10.91
51	9918.65	11.58

The credited interest rate is $i = 0.06$. Cost of insurance is based on mortality in the above table and $i = 0.04$. Expense charges are 2% of account value.

(a) Project the account value for the next 10 years.

(b) Assume that the insurance company earns interest $i = 0.075$; Mortality is 105% of the mortality in the lifetable. Initial expenses are \$3,750; renewal expenses are 2% of premiums paid. The surrender charges and surrender rates are:

Year	Charge	rate
1	\$4,200	4%
2	\$3,500	5%
3	\$3,200	4%
4	\$2,800	3%
5	\$2,200	3%
6	\$1,400	4%
7	\$900	4%
8	\$400	5%
9	\$0	7%
10	\$0	100%

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

- (i) $i = 0.0944$
- (ii) $i = 0.1218$
- (iii) $i = 0.1524$
- (iv) $i = 0.1760$

3. A life aged 39 has an annual type A Universal life insurance policy that has been in effect for 4 years.
- The current account value is \$32,418.
 - The annual premium is \$6,300.
 - The expense charge is 1.5% of account value.
 - The credited interest rate is $i = 0.04$.
 - The total death benefit is \$100,000.
 - The corridor factor requirement is 2.6.
 - The insurance is priced using mortality rate $q_{39} = 0.000192$ and interest $i = 0.03$.

Calculate the cost of insurance charge for the year.

Standard Questions

4. Consider an annual type B universal life insurance policy with annual premiums of \$3,000, additional death benefit \$80,000 with no corridor factor requirement. The expense charge is 1.5% of account value. Surrender charges and rates are

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

Initial expenses are \$800, and renewal expenses are \$30. Cost of insurance is based on mortality $q_x = 0.000402$ and $i = 0.04$. The insurance company makes an annual rate of return equal to prime+1 (where the prime rate is set each year by the central bank). It offers credited interest as prime + a for some a . Calculate the value of a so that whatever the value of prime, the insurance company's profit margin on the policy at a risk discount rate of 10% is at least 5%. [Assume prime is always in the range 0–10%.]