ACSC/STAT 4720, Life Contingencies II
Fall 2015

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Homework Sheet 5

Due: Friday 20th November: 12:30 PM

Basic Questions

1. An insurance company sells a 5-year annual life insurance policy to a life aged 41, for whom the lifetable below is appropriate.

x	l_x	d_x
41	10000.00	9.53
42	9990.47	11.05
43	9979.42	12.87
44	9966.56	15.05
45	9951.51	17.66

The annual gross premium is \$385. Initial expenses are \$250 plus 25% of the first premium. The death benefits are \$230,000. Renewal costs are 3% of each subsequent premium. The interest rate is $i = 0.03$

(a) Calculate the expected net cash-flows associated with this policy (assuming no reserve). [This is the profit vector for the policy.]

(b) Calculate the expected profit margin of the policy using a risk discount rate $i = 0.06$.

2. An insurance company sells a 5-year annual life insurance policy to a life aged 56, for whom the lifetable below is appropriate.

x	l_x	d_x
56	10000.00	11.06
57	9988.94	11.98
58	9976.96	13.02
59	9963.94	14.20
60	9949.74	15.52

The annual gross premium is \$625. Initial expenses are \$130 plus 20% of the first premium. The death benefits are \$420,000. Renewal costs are 4% of each subsequent premium. The interest rate is $i = 0.03$. Reserves are calculated on the basis $i = 0.01$, with mortality following the table.

(a) Calculate the reserves.

(b) Calculate the profit signature.

(c) Calculate the Discounted payback period at a risk rate of $i = 0.10$.

3. For the policy in Question 2:

(a) Calculate the reserves and profit signature for a general premium.

(b) Calculate the premium that gives an internal rate of return of $i = 0.15$.

4. For the policy in Question 1, use profit testing to calculate the reserves needed to ensure that all cash flows are non-negative.

Standard Questions

5. A couple purchase a reversionary annuity. Annual Premiums of \$14,830 are payable while both are alive. If the husband dies first, an annual life annuity of \$50,000 is payable to the wife until her death. The husband and wife are both aged 69 and both have mortality following the lifetable below. Assume both lives are independent.

x	l_x	d_x
69	10000.00	99.59
70	9900.41	110.56
71	9789.85	122.59
72	9667.26	135.75
73	9531.51	150.11
74	9381.40	165.70
75	9215.70	182.57
76	9033.13	200.72
77	8832.41	220.14
78	8612.28	240.78
79	8371.50	262.54
80	8108.96	285.27
81	7823.69	308.76
82	7514.93	332.70
83	7182.23	356.71
84	6825.52	380.30
85	6445.22	402.88
86	6042.34	423.73
87	5618.61	442.05
88	5176.56	456.92
89	4719.64	467.38

x	l_x	d_x
90	4252.27	472.44
91	3779.83	471.15
92	3308.68	462.72
93	2845.96	446.54
94	2399.42	422.39
95	1977.03	390.48
96	1586.55	351.57
97	1234.97	307.05
98	927.93	258.85
99	669.08	209.41
100	459.68	161.42
101	298.26	117.51
102	180.75	79.90
103	100.85	50.02
104	50.83	28.29
105	22.55	14.08
106	8.47	5.93
107	2.54	1.99
108	0.54	0.48
109	0.06	0.06

Initial expenses are \$13,000, and renewal expenses are \$350 at the start of each subsequent year while the husband is alive, and \$20 at the start of each year while the husband is dead and the wife is alive. The interest rate is $i = 0.05$. Use a profit test without reserves to determine the NPV of this policy at a risk discount rate of $i = 0.15$.