

ACSC/STAT 3720, Life Contingencies I

Winter 2015

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Homework Sheet 6

Modified version to deal with changes in schedule

Due: Monday 28th March: 12:30 PM

Basic Questions

- Using the lifetable in Table 1, and interest rate $i = 0.05$, calculate the net annual premium for a 5-year endowment insurance policy with benefit \$350,000, sold to a standard life aged 44, if:
 - The life works in a hazardous environment, and has mortality 0.008 higher than normal.
 - The life is an impaired life, and has mortality 1.06 times the usual mortality for a life of the same age.
- An insurance company has a whole life insurance policy for an individual aged 52. The death benefit of this policy is \$800,000, and the interest rate is $i = 0.06$. Premiums are payable until age 80. The insurance company calculates $A_{52} = 0.118287$, and $A_{80} = 0.400802$. Therefore, the net annual premium for the policy is \$6,852.85. What is the policy value if the life survives to age 65? [Use the lifetable in Table 1. $A_{65} = 0.218135$.]
- An insurance company sells 600 whole life insurance policies with annual net premiums to lives aged 53. The death benefit on these policies is \$400,000. The interest rate is $i = 0.06$. In the first year of the policies:
 - One policyholder dies.
 - The company earns interest $i = 0.07$.

The company still uses $i = 0.06$ as its basis for calculating the policy values. What is the company's annual profit on these policies? [Using the lifetable in Table 1, we have $A_{53} = 0.124241$ and $A_{54} = 0.130456$.]

- An insurance company sells 300 whole-life insurance policies to lives aged 45. The death benefit of these policies is \$800,000. The interest rate is $i = 0.045$ and net premiums are payable annually in advance. At this interest rate, $A_{45} = 0.142031$. In the first two years of the policy:
 - two policyholders die in the first year of the policy.
 - The company earns interest $i = 0.06$ in the first year of the policy, and $i = 0.05$ in the second year.

Calculate the asset share of the remaining policies after the second year.

- A select life aged 37 purchases a whole-life insurance policy with a death benefit of \$600,000. The interest rate is $i = 0.05$. From the lifetable in Table 1, we have $A_{37} = 0.0827855$ and $A_{43} = 0.108129$. Using Woolhouse's formula:
 - calculate the monthly premium.

- (b) calculate the policy value after 6 years and 4 months. [You may use the UDD assumption for the distribution of deaths in Year 7, but use Woolhouse's formula to calculate $\ddot{a}_{43}^{(12)}$.]
- (c) calculate the policy value after 6 years 3.6 months.

Standard Questions

6. A select life aged 39 takes out a whole life insurance with benefit \$600,000. The initial cost of this insurance is \$1000 plus 30% of the first annual premium. The renewal cost is 2% of each subsequent premium. The interest rate is $i = 0.05$. Using the lifetable in Table 1, we can calculate $A_{42} = 0.103456$.
- (a) Calculate the gross premium for this policy.
- (b) Calculate the gross policy value after 2 years.
7. An insurance company wants to design a 10-year term policy with continuous premiums so that the policy value is given by ${}_tV = 150t(t - 10)(t - 15)$. The death benefits at time t are $100000(3 + t)$. The policy is sold to a life aged 52, with mortality given by $\mu_x = 0.0000012(1.106)^x$. Calculate the premiums as a function of time if force of interest is $\delta = 0.051$.

Table 1: Select lifetable to be used for questions on this assignment

x	$l_{[x]}$	$l_{[x]+1}$	$l_{[x]+2}$	$l_{[x]+3}$	x	$l_{[x]}$	$l_{[x]+1}$	$l_{[x]+2}$	$l_{[x]+3}$
25	9998.75	9997.65	9996.30	9994.66	74	8987.73	8932.10	8862.49	8775.52
26	9997.00	9995.83	9994.40	9992.66	75	8897.04	8836.71	8761.27	8667.10
27	9995.14	9993.90	9992.38	9990.52	76	8798.69	8733.34	8651.66	8549.78
28	9993.16	9991.84	9990.22	9988.24	77	8692.13	8621.41	8533.09	8423.00
29	9991.05	9989.65	9987.92	9985.80	78	8576.81	8500.36	8404.95	8286.16
30	9988.81	9987.30	9985.46	9983.18	79	8452.13	8369.60	8266.68	8138.66
31	9986.40	9984.80	9982.82	9980.38	80	8317.52	8228.53	8117.67	7979.93
32	9983.83	9982.11	9979.99	9977.37	81	8172.36	8076.57	7957.35	7809.41
33	9981.07	9979.23	9976.95	9974.13	82	8016.08	7913.13	7785.15	7626.56
34	9978.11	9976.13	9973.68	9970.64	83	7848.11	7737.67	7600.54	7430.89
35	9974.93	9972.79	9970.16	9966.88	84	7667.89	7549.66	7403.05	7221.99
36	9971.50	9969.20	9966.36	9962.82	85	7474.92	7348.64	7192.27	6999.51
37	9967.80	9965.33	9962.25	9958.44	86	7268.77	7134.21	6967.86	6763.22
38	9963.81	9961.14	9957.82	9953.69	87	7049.07	6906.07	6729.62	6513.04
39	9959.50	9956.61	9953.02	9948.55	88	6815.55	6664.05	6477.46	6249.02
40	9954.84	9951.71	9947.82	9942.98	89	6568.09	6408.10	6211.48	5971.42
41	9949.79	9946.41	9942.19	9936.94	90	6306.70	6138.35	5931.96	5680.73
42	9944.32	9940.66	9936.08	9930.38	91	6031.59	5855.15	5639.41	5377.67
43	9938.39	9934.41	9929.45	9923.26	92	5743.19	5559.08	5334.61	5063.27
44	9931.96	9927.64	9922.25	9915.52	93	5442.15	5250.97	5018.61	4738.86
45	9924.97	9920.28	9914.42	9907.10	94	5129.44	4931.97	4692.79	4406.12
46	9917.37	9912.28	9905.91	9897.94	95	4806.33	4603.54	4358.89	4067.08
47	9909.11	9903.58	9896.65	9887.98	96	4474.39	4267.51	4018.96	3724.10
48	9900.13	9894.11	9886.57	9877.13	97	4135.60	3926.04	3675.44	3379.91
49	9890.36	9883.80	9875.59	9865.30	98	3792.25	3581.66	3331.11	3037.57
50	9879.71	9872.57	9863.63	9852.42	99	3447.02	3237.23	2989.05	2700.39
51	9868.12	9860.34	9850.59	9838.38	100	3102.90	2895.94	2652.63	2371.88
52	9855.48	9847.01	9836.39	9823.08	101	2763.19	2561.21	2325.37	2055.64
53	9841.72	9832.48	9820.90	9806.39	102	2431.39	2236.61	2010.90	1755.27
54	9826.71	9816.64	9804.02	9788.18	103	2111.15	1925.80	1712.81	1474.18
55	9810.34	9799.37	9785.60	9768.33	104	1806.12	1632.34	1434.48	1215.44
56	9792.49	9780.52	9765.51	9746.67	105	1519.82	1359.55	1178.94	981.65
57	9773.03	9759.97	9743.60	9723.05	106	1255.46	1110.36	948.70	774.71
58	9751.79	9737.56	9719.69	9697.28	107	1015.81	887.14	745.58	595.71
59	9728.63	9713.10	9693.62	9669.17	108	802.96	691.49	570.56	444.87
60	9703.36	9686.43	9665.17	9638.51	109	618.23	524.17	423.71	321.41
61	9675.80	9657.33	9634.15	9605.07	110	462.04	385.00	304.13	223.65
62	9645.73	9625.59	9600.31	9568.61	111	333.80	272.80	210.00	149.10
63	9612.94	9590.98	9563.42	9528.85	112	231.99	185.53	138.71	94.62
64	9577.18	9553.24	9523.19	9485.52	113	154.19	120.34	87.07	56.74
65	9538.19	9512.09	9479.35	9438.30	114	97.30	73.90	51.50	31.84
66	9495.69	9467.25	9431.58	9386.86	115	57.78	42.55	28.41	16.52
67	9449.37	9418.39	9379.54	9330.85	116	31.92	22.69	14.43	7.81
68	9398.90	9365.17	9322.87	9269.88	117	16.15	11.04	6.63	3.30
69	9343.95	9307.23	9261.20	9203.55	118	7.34	4.79	2.69	1.21
70	9284.12	9244.18	9194.11	9131.43	119	2.90	1.79	0.93	0.37
71	9219.03	9175.59	9121.17	9053.07	120	0.95	0.55	0.26	0.09
72	9148.24	9101.03	9041.91	8967.97	121	0.23	0.13	0.05	0.01
73	9071.30	9020.03	8955.85	8875.63	122	0.03	0.02	0.01	0.00