

ACSC/STAT 3720, Life Contingencies I
 Winter 2015
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 Homework Sheet 3
 Due: Monday 9th February: 10:30 PM

Basic Questions

1. [Covers Material on Sheet 2] The lifetable in Table 1 applied 5 years ago. The following is an excerpt from the ultimate part of an updated lifetable:

x	l_x	d_x
39	10000.00	4.22
40	9995.78	4.68
41	9991.10	5.06
42	9986.04	5.52
43	9980.52	5.99

- Calculate the reduction factor used for each age between 39 and 43.
2. Calculate the expected benefit of a whole life insurance sold to an individual aged 93, if the death benefit is \$1,400,000 at the end of the year of death, the lifetable is Table 1, and the interest rate is $i = 0.05$.
3. Calculate the expected benefit, and the variance of the benefit of a 10-year endowment policy with benefit \$200,000 either at the end of 10 years or at the end of year of death of the policyholder. The lifetable for this policy is Table 1, and the interest rate is $i = 0.03$. The policy is sold to an individual aged 32.
4. A select individual aged 42 purchases a 5-year term insurance with a death benefit of \$100,000. Force of interest is $\delta = 0.028$ and the benefit is payable immediately upon the death of the individual. Using a uniform distribution of deaths assumption, calculate the expected benefit from this policy.
5. An individual aged 39 wants to purchase whole life insurance that pays a benefit at the end of the year of death. The interest rate is $i = 0.06$. The individual has a number of dangerous hobbies and uses the special lifetable:

x	l_x	d_x
39	10000.00	4.80
40	9995.20	4.86
41	9990.34	4.93
42	9985.41	5.01
43	9980.40	5.09
44	9975.31	5.18
45	9970.13	5.29

After age 45, the individual will be too old to participate in these hobbies and will use a standard lifetable, which will give the value $A_{45} = 0.1761$. Calculate the EPV of the benefit for this individual from a whole-life policy which has a death benefit of \$200,000.

Standard Questions

6. [Covers material on sheet 2] An insurance company has used Makeham's formula with a constant factor to discount for selected lives — that is $\mu_{[x]+s} = D^{3-s}\mu_{x+s}$ to construct a lifetable for female smokers. The lifetable is given below.

x	$l_{[x]}$	$l_{[x]+1}$	$l_{[x]+2}$	$l_{[x]+3}$
40	9946.06	9927.38	9899.70	9858.68
41	9897.42	9876.17	9844.66	9798.00
42	9842.05	9817.87	9782.05	9729.00
43	9779.05	9751.57	9710.85	9650.58
44	9707.41	9676.19	9629.95	9561.53
45	9626.00	9590.58	9538.11	9460.53

Find the parameters used in the model to produce the table. [It was constructed using the approximation $q_{[x]+s} = \mu_{[x+0.5]+s}$.]

7. A select individual aged 27 has whole life insurance with a death benefit of \$140,000 payable at the end of the year of death. The individual wants to convert this to a 5-year term insurance policy. If the current interest rate is $i = 0.04$, what benefit for the term insurance policy would have the same EPV as the whole life policy? [The company has already calculated that $A_{[29]+3} = 0.106825$ and $A_{[27]} = 0.0885419$.]
8. A woman aged 30 buys a house with a mortgage of \$200,000. She amortises this amount with monthly payments over a period of 25 years at $i^{(2)} = 6\%$. She takes out mortgage insurance, which pays off the outstanding balance (principle plus interest) of the mortgage at the end of the month in which she dies. [Assume that the mortgage company does not charge a penalty for early repayment in this case.] If the insurance company uses an interest rate $i = 5.6\%$ and the life table from Table 1, calculate the expected present value of the benefit on this policy. [Use the uniform distribution of deaths assumption. You are given the following values: At interest rate $i = 0.056$, $A_{30:\overline{25}|}^1 = 0.007131791$, while at interest rate $i = -0.00461872$, $A_{30:\overline{25}|}^1 = 0.01813134$.]

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