ACSC/STAT 4720, Life Contingencies II
Fall 2017
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Homework Sheet 3
Due: Friday 13th October: 12:30 PM

Basic Questions

1. A life aged 42 wants to buy a 5-year term insurance policy. A life-table based on current-year mortality is:

x	l_x	d_x
42	10000.00	6.78
43	9993.22	7.35
44	9985.87	7.98
45	9977.89	8.66
46	9969.24	9.39
47	9959.84	10.19

The insurance company uses a single-factor scale function $q(x,t) = q(x,0)(1-\phi_x)^t$ to model changes in mortality. The insurance company uses the following values for ϕ_x:

x	ϕ_x
42	0.01
43	0.03
44	0.02
45	0.025
46	0.015
47	0.02

Calculate $A^{1}_{42:\overline{5}|}$ at interest rate $i = 0.05$, taking into account the change in mortality.

2. Using the lifetable from Question 1, the insurance company now uses the following mortality scale based on both age and year:

	t					
x	2017	2018	2019	2020	2021	2022
42	0.01	0.015	0.015	0.02	0.02	0.015
43	0.03	0.03	0.025	0.02	0.015	0.02
44	0.02	0.03	0.03	0.025	0.02	0.015
45	0.025	0.03	0.025	0.015	0.015	0.02
46	0.015	0.02	0.015	0.01	0.015	0.01
47	0.02	0.015	0.01	0.015	0.02	0.025

Use this mortality scale to calculate $A^{1}_{42:\overline{5}|}$ at interest rate $i = 0.05$.

3. A pensions company has the current mortality scale for 2017:

x	$\phi(x, 2017)$	$\frac{d\phi(x,t)}{dt}\Big\vert_{x,t=2017}$	$\frac{d\phi(x+t,t)}{dt}\Big\vert_{x,t=2017}$
42	0.028763796	0.00254272963	−0.0010005971
43	0.013387987	−0.00007704268	−0.0015410004
44	0.012284496	0.00122050593	−0.0002926677
45	0.020186718	−0.00230931319	−0.0006144058
46	0.023344489	−0.00079030424	−0.0023352259
47	0.007762005	0.00227442877	0.0053024871

Current mortality is given in the lifetable in Question 1. The company assumes that from 2030 onwards, we will have $\phi(x,t) = 0.015$ for all x and t. Calculate $A^{1}_{42:\overline{5}|}$ at interest rate $i = 0.05$, using the average of age-based and cohort-based effects.

Standard Questions

4. An insurance company uses a Lee-Carter model and fits the following parameters:

$c = -0.6$ $\qquad\qquad$ $\sigma_k = 1.2$ $\qquad\qquad$ $K_{2017} = -6.24$

And the following values of α_x and β_x:

x	α_x	β_x
41	−4.316805	0.2697564
42	−4.330498	0.1998375
43	−4.349431	0.2408687
44	−4.372390	0.2650377
45	−4.397883	0.1142745
46	−4.423151	0.1246374
47	−4.431606	0.2082677

The insurance company simulates the following values of Z_t:

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-1.2365624  0.1837002  1.2881093  1.0537143  -0.9344071  0.0940466
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Using these simulated values, calculate the probability that a life aged exactly 41 at the start of 2017 survives for 6 years.