

ACSC/STAT 4720, Life Contingencies II

Fall 2018

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Homework Sheet 4

Due: Friday 19th October: 12:30 PM

Basic Questions

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

$$c = -0.1 \quad \sigma_k = 0.9 \quad K_{2018} = -3.90 \quad \alpha_{43} = -2.67 \quad \beta_{43} = 0.31$$

It estimates that its reserves are adequate in a given year provided $q(43, t) < 0.0016$. Calculate the probability that its reserves are still adequate in 5 years' time. Use UDD to calculate the relation between q_x and m_x .

2. An insurance company uses a Cairns-Blake-Dowd model with the following parameters:

$$\begin{array}{cccc} K_{2018}^{(1)} = -2.48 & K_{2018}^{(2)} = 0.33 & c^{(1)} = -0.32 & c^{(2)} = -0.01 \\ \sigma_{k_1} = 0.8 & \sigma_{k_2} = 0.14 & \rho = 0.3 & \bar{x} = 48 \end{array}$$

- (a) Use this scale to calculate the median value of $q(28, 2024)$.
- (b) For a life aged 31, how many years will it be until the life's mortality exceeds 0.001 with probability at least 0.4? [Remember that the life's age increases by 1 each year.]

Standard Questions

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

$$c = -0.3 \quad \sigma_k = 1.2 \quad K_{2018} = -4.02$$

And the following values of α_x and β_x :

x	α_x	β_x
42	-4.466353	0.2410742
43	-4.399855	0.1913984
44	-4.357340	0.1789869
45	-4.296188	0.1671459
46	-4.259301	0.1891794
47	-4.210775	0.1092111

Using the approximation $m(x, t) \approx q(x, t)$, calculate the probability that a life aged 43 survives for three years under this model.

4. An insurance company uses a Cairns-Blake-Dowd model with the following parameters:

$$\begin{array}{cccc}
 K_{2018}^{(1)} = -5.04 & K_{2018}^{(2)} = 0.16 & c^{(1)} = -0.2 & c^{(2)} = 0.01 \\
 \sigma_{k_1} = 0.6 & \sigma_{k_2} = 0.04 & \rho = 0.2 & \bar{x} = 45
 \end{array}$$

A husband aged 36 and a wife aged 48 purchase a last survivor insurance contract. The contract has a special clause allowing the wife to surrender the contract for a fixed price upon the death of the husband. The company calculates that the value of this clause is $50000(0.00324 - q(63, 2033))_+$ if the husband dies in 2033. They therefore want to estimate the quantity $50000q(51, 2033)(0.00324 - q(63, 2033))_+$. Calculate the expected value of this quantity.