ACSC/STAT 4720, Life Contingencies II
Fall 2015

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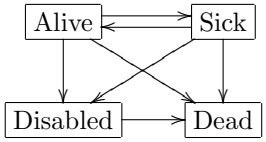
Homework Sheet 1

Due: Friday 2nd October: 12:30 PM

Basic Questions

1. An insurance company is developing a new policy. The policy considers 4 states: Healthy, Sick, Disabled, and Dead. The transition diagram is shown below:



Which of the following sequences of transitions are possible? (Indicate which parts of the transition sequence are not possible if the sequence is not possible.)

(i) Alive—Disabled—Sick—Dead

(ii) Alive—Disabled—Dead

(iii) Alive—Sick—Alive—Disabled

(iv) Alive—Sick—Dead—Disabled

2. Consider a permanent disability model with transition intensities

$$\mu_x^{01} = 0.001 + 0.000003x$$
$$\mu_x^{02} = 0.001 + 0.0000001x^2$$
$$\mu_x^{12} = 0.003 + 0.000005x$$

where State 0 is healthy, State 1 is permanently disabled and State 2 is dead. Calculate the probability that an individual aged 29 is alive but permanently disabled at age 56. [You may perform the integration numerically.]

3. Under a disability income model with transition intensities

$$\mu_x^{01} = 0.001$$
$$\mu_x^{10} = 0.002$$
$$\mu_x^{02} = 0.001$$
$$\mu_x^{12} = 0.003$$

calculate the probability that a healthy individual dies within the next 7 years. [State 0 is healthy, State 1 is sick and State 2 is dead.]

4. Under a disability income model with transition intensities

$$\mu_x^{01} = 0.001$$
$$\mu_x^{10} = 0.002$$
$$\mu_x^{02} = 0.001$$
$$\mu_x^{12} = 0.003$$

calculate the premium for a 5-year policy with premiums payable continuously while the life is in the healthy state, which pays benefits continuously at a rate of \$130,000 per year while the life is in the sick state, sold to a life in the healthy state. The interest rate is $\delta = 0.04$ [State 0 is healthy, State 1 is sick and State 2 is dead.]

[Hint: the probability that the life is healthy t years from the start of the policy is $0.1362e^{-0.0055616t} + 0.8638e^{-0.0014384t}$, and the probability that the life is sick t years from the start of the policy is $0.2426e^{-0.0014384t} - 0.2426e^{-0.0055616t}$.]

5. A whole life insurance policy can end either through death or withdrawl. The transition intensities are

$$\mu_x^{01} = 0.001 + 0.000002x$$
$$\mu_x^{02} = 0.002 + 0.000001x$$

Calculate the probability that an individual aged 43 withdraws from the policy at any time before they die. [State 0 is healthy, State 1 is withdrawn and State 2 is dead.]

Standard Questions

6. An insurance company is developing a new model for transition intensities in a disability income model. Under these transition intensities it calculates

$\overline{A}_{34}^{02} = 0.14$	$\overline{A}_{44}^{02} = 0.19$	$\overline{A}_{44}^{12} = 0.21$
$\overline{a}_{34}^{00} = 22.07$	$\overline{a}_{44}^{00} = 19.30$	$\overline{a}_{44}^{10} = 0.11$
$\overline{a}_{34}^{01} = 0.64$	$\overline{a}_{44}^{01} = 0.43$	$\overline{a}_{44}^{11} = 17.32$
${}_{10}p_{34}^{00} = 0.934$	${}_{10}p_{34}^{01} = 0.022$	$\delta = 0.03$

Calculate the premium for a 10-year policy for a life aged 34, with continuous premiums payable while in the healthy state, which pays a continuous benefit while in the sick state, at a rate of \$80,000 per year, and pays a death benefit of \$280,000 immediately upon death.