CONCORDIA UNIVERSITY

Mathematics & Statistics

Course	Number		Section(s)
Mathematics	**ACTU 257/4**		**A**
Examination	Date	Time	Pages
Final	**April 2012**	**3 hours**	**3**

Instructor
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Special Instructions: Calculators approved by SOA permitted.
Problems: 1-3: 5 marks each; 4-7: 4 marks each; 8-14: 2 marks each.

1. L is the loss random variable of a fully continuous 4-payment years, 30 year endowment insurance contract of \$1,000 issued to (25).

   The force of interest δ is 10% and $\mu = \dfrac{1}{105 - x}$ for $0 < x < 105$.

   Define L.

   Find the premium $\overline{P}$ from the equivalence principle. What is its symbol?

   Sketch the graph of L identifying the starting and ending value of each segment.

2. Consider a special semi-continuous 8-year deferred life insurance contract issued to (28). The death benefit is given by: $b_t = \begin{cases} 0 & 0 < t < 8 \\ t & 8 \le t \le 20 \\ 50 & t > 20 \end{cases}$.

   Level benefit premiums are paid every 6 months for 2 years.

   Define the random present value Z of benefits and Y of payments.

   Find the level benefit premium for this contract if $\delta = 0.06$ and $\mu(x) = 0.04$.

3. A fully discrete 3-payment years 4-year deferred life insurance contract of \$10,000 is issued to (93). You are given: $d = 10\%$ and

x	93	94	95	96	97	98	99
p_x	0.8	0.7	0.6	0.5	0.3	0.2	0

Define the loss random variable L. Find the annual premium for this insurance. Sketch the graph of L and identify the starting and ending values of each segment.

4. Find the expected value of the fully continuous version of the same contract issued to (93) under the UDD assumption. What is its symbol?

5. For a whole life insurance of 10 on (x) with benefits payable at the moment of death: $\delta_t = \begin{cases} 0.06 & t < 7 \\ 0.08 & t \geq 7 \end{cases}$ $\mu(x+t) = \begin{cases} 0.03 & t < 5 \\ 0.05 & t \geq 5 \end{cases}$

Calculate the actuarial present value of this insurance.

6. An insurance portfolio contains 300 identical and independent contracts issued to policy-holders aged 35 who each contribute an amount K to a fund at issue of the contract. The common contract is a fully discrete 20-year temporary life annuity due paying 100 per year. You are given: $\ddot{a}_{35} = 16.9$, $\ddot{a}_{55} = 14.8$, ${}^2\ddot{a}_{35:\overline{20}|} = 8.5$, ${}_{20}p_{35} = 0.82$ and $d = 0.05$. Calculate K such that there is a 95% probability that the fund is sufficient to pay those annuities to each member.

Use the normal approximation with $\Pr[N(0,1) \leq 1.645] = 0.95$.

7. Using probabilities of problem #3, determine ${}_{0.3|0.5}q_{93.8}$ under the UDD assumption.

8. Using probabilities of problem #3, determine the temporary 3-year complete life expectancy of (95), i.e. $\mathring{e}_{95:\overline{3}|}$ under the UDD assumption.

9. Consider the fully discrete contract issued to (93) from problem #3.

Determine Pr[$L \geq 3,000$] if the insurance company charges \$500 annually for this contract.

10. For a 1-year select mortality table you are given the following values:

x	$l_{[x]}$	$d_{[x]}$	$e_{[x]}$
75	1,000	100	10
76	800	120	.....

Calculate $e_{[76]}$.

11 L is the loss at issue random variable for a fully discrete whole life insurance of 1 on (49). You are given: $A_{49} = 0.29224$, ${}^2A_{49} = 0.11723$, $i = 5\%$, $Var(L) = 0.1$. Calculate E[L].

12. Z is the present value random variable for a special fully continuous whole life insurance on (x). You are given: $\mu_{x+t} = 0.03$ for $t \geq 0$, $\delta = 0.07$, and the death benefits $b_t = e^{0.02t}$ for $t \geq 0$. Calculate Var(Z).

13. You are given:

n	$\overline{A}_{x+n}$	${}_5E_{x+n}$	$\overline{a}_{x+n:\overline{5}\rceil}$
0	0.303	0.756	4.488
5	0.361	0.742	4.466
10	0.425	0.721	4.422
15	0.496	0.688	4.348
20	0.568	0.639	4.253

Calculate: ${}_{10}\overline{P}({}_{15|}\overline{A}_x)$

14. A special fully discrete 3-payment years, 5-year endowment insurance contract is issued to (x). The death and survival benefits are \$10,000 plus the sum of the premiums paid without interest. Find the premium of this special insurance using the equivalence principle if $d = 0.06$ and $q_x = 0.08$ for all x.

GOOD LUCK!!!