

Contingencies (BUS324S). Test 3 October 2005.

Instructions, etc: Answer all questions. Show your working in full in all questions other than multiple-choice. Marks shown are approximate. Please use separate books for questions 1-3 and 4-6.

Time allowed: 90 minutes.

Total marks: 50.

1. (a) Explain, in the context of both a whole-life assurance and a life annuity, the concepts of:
 - i. adverse selection, and
 - ii. selective lapsation (i.e. selective decrement with respect to lapsing or surrendering a policy). (6)
- (b) Hence or otherwise explain why life assurance companies offer surrender values on whole-life assurance policies but not on life annuities. (3)

2. You have been given the following data:

act
 $\theta_{x,r}$: the number of deaths aged x last birthday and with duration r curtate at death;
 $E_{x,r}^c$: the central exposed to risk of lives aged x last birthday and with duration r curtate during the period of investigation.

Explain how you would estimate the force of mortality for lives that were aged $x - r$ at entry and have been policyholders for $r + \frac{1}{2}$ years. [7]

3. A with-profit whole-life insurance policy was issued to a life aged 50 with level premiums payable annually in advance. The original sum assured was R20 000, and bonuses declared in the first 5 years total R1 500. The death benefit is payable at the end of the year of death.

Which of the following gives the (approximate) net premium policy value for the contract just before the 6th premium is due, assuming A1967-70 ultimate mortality and 4% p.a. interest?

- (A) R2 095
 (B) R2 252
 (C) R2 549
 (D) R2 768

[3]

4. Two lives, (x) and (y) , are assumed to be independent with respect to mortality, (x) being subject to a constant force of mortality of 0.02, and (y) subject to a constant force of 0.025.

(a) A single-premium (contingent) whole-life assurance is offered to these lives, with benefit of R200 000 paid immediately on the death of (x) , provided it occurs after that of (y) .

Using the basis stated below, find the single premium for this assurance. (4)

(b) As an alternative, the following assurance is offered. The amount of R200 000 is payable immediately on the earlier death of either life. Level premiums are payable annually in advance until the first death of either life.

Using the basis stated below, find the level annual premium. (4)

[8]

Basis:

interest	force of interest of 0.05
renewal expenses	2% of all premiums including any single premium
claim expenses	1.5% of claim amount

5. A life office issues a ('non-profit') 3-year endowment assurance with sum assured of R20 000, to a life aged 57. The sum assured is payable at the end of three years, or *immediately* on earlier death. The annual premium is R6200.

The office holds net premium reserves for the contract, using A1967-70 ultimate mortality and 4% interest, and assuming death claims are paid at the *end* of the year of death.

(a) Using the assumptions given below, find the net cash-flows expected to emerge at the end of each of the three years, per policy in force at the start of the year.

Mortality	A1967-70 <i>select</i>	
Expenses	Initial: R250 plus 1% of sum assured	
	Renewal (i.e. excluding year 1): 5% of the gross premium	
Interest earned	10% p.a.	(5)

(b) Hence find:

- i. the profit expected to emerge at the end of each year, per policy in force at the start of the year, and the profit signature;
 - ii. the net present value of profit at a risk discount rate of 12%. (7)
- [12]

6. 200 people aged exactly 50 are each sold a (non-profit) 15-year endowment assurance policy with sum assured R200 000. The premiums are paid annually in advance, and the sum assured is paid on maturity or at the end of the year of earlier death. The life assurance company's assumptions are:

Mortality	A1967-70 (ult), and the lives are independent with respect to mortality.
Interest	6% p.a.
Expenses	initial: R500 renewal: 3% of each premium including the first.

Let P denote the gross annual premium.

(a) State the gross future loss random variable for one policy at the outset. (3)

(b) Using your answer to part (a) or otherwise, evaluate, in terms of P :

- i. the mean and variance of the loss (in present value terms) for a single policy at outset;
- ii. the mean and ~~variance~~ of the loss (in present value terms) for the entire portfolio at outset.

Use $A_{50:\overline{15}|.1236} = 0.20426$. (8)

[11]

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