

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

23rd October 2009

Subject CT5 – General Insurance, Life and Health Contingencies

Time allowed: Three Hours (10.00 – 13.00 Hrs)

Total Marks: 100

INSTRUCTIONS TO THE CANDIDATES

- 1) *Please read the instructions on the front page of answer booklet and instructions to examinees sent along with hall ticket carefully and follow without exception*
- 2) *Mark allocations are shown in brackets.*
- 3) *Attempt all questions, beginning your answer to each question on a separate sheet. However, answers to objective type questions could be written on the same sheet.*
- 4) *In addition to this paper you will be provided with graph paper, if required.*

AT THE END OF THE EXAMINATION

Please return your answer book and this question paper to the supervisor separately.

Q 1) A life insurer writes level premium whole life non-par business where the premiums are payable at the beginning of each year and the benefits are payable at the end of the year of death. Derive the formula in terms of assurance functions to calculate the variance of the profit for a policy issued to a life aged x . Ignore expenses.

[4]

Q 2) (i) Define the following terms:

- ? Death strain at risk
- ? Expected death strain
- ? Actual death strain
- ? Mortality profit

(4)

(ii) A life insurance company has a portfolio of non profit pure endowment and immediate annuity policies. You have been provided the following information in respect of the business during the year 2008.

Item	Immediate Annuity		Pure Endowment	
	1 Jan 2008	31 Dec 2008	1 Jan 2008	31 Dec 2008
Age	50	51	45	46
No of inforce policies	1000	995	1000	997
Sum Assured per life	-	-	100000	100000
Annuity Per annum per life	10000	10000	-	-
No of deaths during the year	5		3	

You are given the following:

- ? All benefits are payable at the end of the year
- ? The elapsed period for all pure endowment policies is 10 years as at 31.12.2007 and the policies have been issued at age 35 for policy term of 25 years.
- ? Company calculates the net premium reserves
- ? Bases: Mortality - AM92 Ultimate for pure endowment and PFA92C20 for immediate annuity policies. Interest rate 4% per annum.

(a) Calculate the reserve required as at 31st Dec 2008

(6)

(b) Calculate the Mortality Profit for the Company for the year 2008.

(8)

[18]

- Q 3)** What do you mean by the Net Premium Reserve? What would be impact of the following basis changes on the net premium reserve of a whole life insurance contract?
- A) the interest rate is increased
 - B) the expenses are increased
 - C) the mortality rates are increased.
- [3]**
- Q 4)** (i) You are assisting the appointed actuary in setting expense assumptions for pricing life insurance products. Classify the following costs as
- A) Overhead or Direct
 - B) Initial expenses, Renewal expenses or Termination expenses
- (a) Salary of the Chief Executive Officer
 - (b) Incentive to sales managers for procuring new business
 - (c) Claims investigation costs
- (6)**
- (ii) A policy has the profit vector (-500, -100, -50, 600, 400) for a 5 year insurance contract. The regulations require that a reserve needs to be set up to zeroise the negative cash flows. Calculate the reserve at the end of each year and the revised profit vector after allowing for the reserve. Assume that the valuation interest rate is 5% per annum and the mortality rate is 0.01 for all ages.
- (4)**
- [10]**
- Q 5)** An immediate annuity plan pays Re.1 per annum payable continuously to a life aged 35 exact. Calculate the variance of the present value of the annuity benefit under this plan. Assume the force of mortality of 0.01 for all ages and force of interest of 0.08 for all years.
- [6]**
- Q 6)** A 20-year level premium endowment policy is issued to a life aged 40 exact for the sum assured of Rs.5,00,000. Calculate the net premium reserve at the end of 10 years. Assume the mortality table of AM92 Ultimate and interest rate of 4% per annum.
- [2]**
- Q 7)** a) What are the advantages and disadvantages of using single figure indices to summarize and compare mortality levels? **(3)**
- b) What is the main advantage and disadvantage of crude mortality rates? **(2)**
- c) What is the main advantage and disadvantage of directly standardized mortality rate? **(2)**
- d) What are the advantages of indirectly standardized mortality rate? **(2)**
- [9]**

- Q 8)** A life insurance company issue a 3 year unit linked pension plan to a life aged 45 exact under which level premiums are payable yearly in advance. 90% of the premiums are allocated to units in all three policy years. A fund management charge 1% of the fund value is deducted at the end of the policy year.

The management charges are deducted from the fund before any death and surrender benefits are paid.

The death benefit as well as the surrender benefits is equal to the fund value and the benefits are paid only at the end of the year. The death benefits are payable before the surrender benefits.

The Company uses the following assumptions in its profit test for this policy:

Unit Growth Rate	10% per annum
Interest on non unit CF	5% per annum
Independent rates of Mortality	AM92 Ultimate
Independent rate of Withdrawal	5 % per annum
Acquisition Expense	Rs 500
Renewal Expenses	Rs 100 on subsequent premium anniversary
First Year Commission	7.5% of premium
Renewal Commission	2% of premium
Ignore Taxes	

The company sets premium rates so the Value of New Business is 12%. Value of New Business is defined as the present value of profits divided by the annual premium.

- a) Using a risk discount rate of 15%, calculate the premium for the policy assuming that the company does not zeroise future expected negative cash flows. (12)
- b) Without doing any calculations state with reasons the impact on profit margin had the company zeroised its future negative cash flows with the assumption that the interest earned on reserves is equal to the risk discount rate. (3)
- c) The regulators have recently issued a circular that the surrender/Maturity value cannot be less 110% of all premiums paid till date. Recalculate the value of new business incorporating the new circular. (8)
- d) Without changing the benefits and charges of the product suggest two approaches that can be followed to increase the value of new business. (2)

[25]

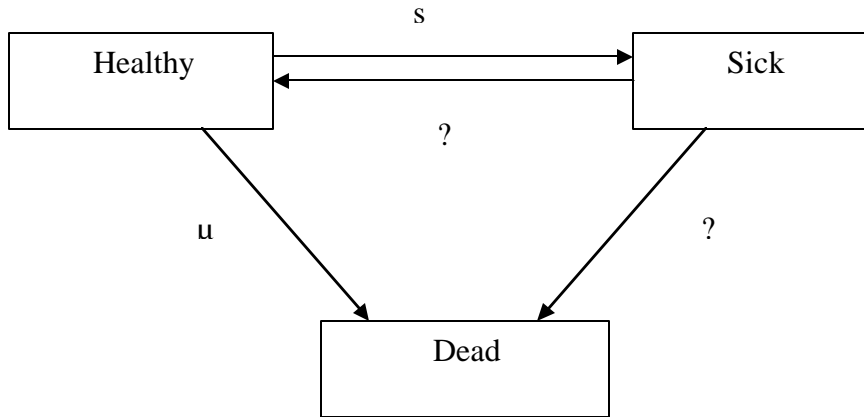
- Q 9)** Amit buys an annuity policy for himself and his wife Puja. Amit and Puja are aged 70 and 60 respectively. Under the policy, an annuity of Rs 500,000 per annum is guaranteed payable for a period of 10 years and thereafter during the lifetime of Amit. On his death, an annuity of Rs 300,000 per annum is payable to Puja, if she is alive then. The annuity commences on the annual payment date next following, or coincident with, the date of his death or from the 10th policy anniversary, if later and is payable for the lifetime of Puja. Annuities are paid annually in advance.

Calculate the Single premium required for this contract.

Basis:
 Mortality PMA92C20 for Amit and PFA92C20 for Puja
 Interest 4% per annum
 Ignore Expenses.

[10]

Q 10) A life insurance company prices its long term sickness policies using the following three-state continuous-time Markov model, in which the forces of transition s , λ , μ and ν are assumed to be constant:



The company issues a particular long term sickness policy with a benefit of X payable continuously while sick, provided that the life has been sick continuously for at least one year. Benefit payments under this policy cease at age 60 exact.

Write down an expression for the expected present value of the sickness benefit for a healthy life aged 35 exact. Define the symbols you use.

[5]

Q 11) The expected present value of the benefit in respect of future service which gives $1/80^{\text{th}}$ of pension entitlement is given by the formula:

$$\text{EPV of Future service liability of age retirement} = \frac{1}{80} S \frac{{}^z \overline{R}_x^{ra}}{{}^s D_x}$$

Derive the above from first principles. Define all symbols used.

[8]
