Actuarial Society of India

EXAMINATIONS

2nd November 2006

Subject CT5 – General Insurance, Life and Health Contingencies

Time allowed: Three Hours (10.30 – 13.30 pm)

Total Marks: 100

INSTRUCTIONS TO THE CANDIDATES

1) *Do not write your name anywhere on the answer sheet/s. You have only to write your Candidate's Number on each answer sheet/s.*

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) *Fasten your answer sheets together in numerical order of questions. This, you may complete immediately after expiry of the examination time.*

5) *In addition to this paper you should have available graph paper, Actuarial Tables and an electronic calculator.*

Professional Conduct:

"It is brought to your notice that in accordance with provisions contained in the Professional Conduct Standards, If any candidate is found copying or involved in any other form of malpractice, during or in connection with the examination, Disciplinary action will be taken against the candidate which may include expulsion or suspension from the membership of ASI."

Candidates are advised that a reasonable standard of handwriting legibility is expected by the examiners and that candidates may be penalized if undue effort is required by the examiners to interpret scripts.

AT THE END OF THE EXAMINATION

Hand in both your answer scripts and this question paper to the supervisor.

Q1)
   (a) State the typical features of life tables based on human mortality in modern times.   (3)
   (b) For a population which contains equal numbers of males and females at birth:

     (i)For males, $?^m(x)?$ 0.10,   x ? 0

     (ii)For females, $?^f(x)?$ 0.08, x ? 0

     Calculate q_{60} for this population

                                  (4)
                                  [7]

Q2)   Using the 3-state illness death model to price various sickness policies, write down an expression for the expected present value of a sickness benefit for a healthy life aged 30. Rs.30,000 is payable continuously while ill provided that the life has been ill for at least one year. Any benefit ceases to be paid at age 60. Define all the symbols used.   **[3]**

Q3)   A body of lives all aged x on 1st January is subject to two forces of decrement a and ß, which operate continuously and two decrements ? and d which operate on 1st April and 1st October respectively.

    Given that $q_x{}^a = (8/29)$ $q_x{}^ß = (4/29)$ $q_x{}^? = 0.2$ $q_x{}^d = 0.25$

    Find $(aq)_x{}^a$ and $(aq)_x{}^ß$

    Assume that decremental forces a and ß are such that the decrements are evenly spread when each force operates alone.   **[10]**

Q4)
   (a) Explain the following terms and give an example of each
     (i)time selection   (2)
     (ii)spurious selection   (3)
   (b) The following data are available in relation to a particular country and one of its regions:

Age	Region A Population in force(in '000s)	Deaths	Country Population in force(in '000s)	Deaths
-39	650	400	13,725	8,378
40 – 59	500	2,430	8,145	45,385
60+	385	27,500	6,390	489,889

    Calculate the standardized morality rates for region A by reference to the country as a whole.   (2)
   (c) Describe how occupation affects morbidity and mortality with suitable examples.   (3)
                                    [10]

Q5)   G is the present value random variable for a 15 -year pure endowment of 1 on a life aged x.
     (i)The force of mortality is constant over the 15- year period.
     (ii)v = 0.9
    (iii)Var(G) = 0.065 E(G)

    Calculate q_x.

                                    [5]

Q6)   For a special 3- year endowment assurance on a life aged 65 years, the maturity value is Rs. 1000. The death benefit is Rs.1000 plus the reserve at the end of the year of death. Using the recursive relationship of reserves, calculate the level premium payable for this policy. The basis to be used is AM92 Select mortality and 4% p.a interest rate. [Given that $_3V \ ? \ 1000$]   **[5]**

Q7)
   (a)   Explain the difference between a profit vector and a profit signature.   (2)
   (b)   You are the pricing actuary of a life insurance company. The Marketing Manager has asked you to design a 3-year unit-linked endowment assurance contract to a male life aged 55 exact under which level annual premiums of Rs.10,000 are payable in advance throughout the term of the policy or until earlier death. 85% of each years premium is invested in units at the offer price.

   You have also been provided with other details for the product as given below:

   There is a bid-offer spread in unit values with the bid price being 95% of the offer price.

   There is an annual management charge of 1.25% of the bid value of units. Management charges are deducted at the end of each year before death or maturity benefits are paid.

   On death of the policyholder during the term of the policy there is a benefit payable at the end of the year of death of Rs.20,000 or the bid value of units allocated to the policy, if greater.

   On maturity, 110% of the full bid value of the units is payable.

   The company holds unit provisions equal to the full bid value of the units. It sets up non-unit fund provisions to zeroise any negative non-unit fund cashflows, other than those occurring in the first year.

   Using the following assumptions in carrying out profit tests of this contract:

   Mortality: AM92 Ultimate

   Expenses: Initial: Rs.600
   Renewal: Rs.100 at the start of each of the 2nd and 3rd policy years
   Unit fund growth rate: 8% p.a.
   Non-unit fund interest rate: 4% p.a.
   Non-unit fund provision basis: AM92 Ultimate, interest rate 4% p.a.
   Risk Discount Rate: 15% p.a.

   Calculate the profit margin on the contract.   (15)
                                                                              [17]

Q8)   A member of a pension scheme is aged exactly 40, having joined the scheme at age exactly 22. He earned Rs.30,000 in the immediately preceding 12 months. Final Pensionable Salary is defined as the annual average earnings over the 3 years immediately prior to retirement.

Normal Retirement Age is a member's 65th birthday.

Using the functions and symbols defined in, and assumptions underlying, the example pension scheme table in the actuarial tables calculate the expected present value of each of the following:

(i) A pension on ill-heath retirement of two-thirds (2/3) of final pension able salary. (3)

(ii) A pension on retirement at any stage on grounds other than ill-health of one-eightieth (1/80) of final pensionable salary for each year of service (fractions of a year counting proportionately) subject to a maximum of 40 years. (3)

(iii) A lump sum on retirement at any age for any reason of Rs.50,000. (3)

[9]

Q9) State the main difference between an overhead expense and a direct expense incurred in writing a life insurance policy and give an example for each. **[4]**

Q10) A life insurance company issues annual premium whole life assurance policies with a sum assured of Rs.100,000 payable at the end of the year of death to lives aged exactly 35

(i) Calculate the premium using the principle of equivalence using the following basis:

Mortality: AM92 Select

Interest: 6% per annum

Expenses: 5% of premium (4)

(ii) Calculate the minimum premium the office could charge in order that the probability of making a loss on any one policy would be 1% or less using the basis in (i). (6)

[10]

Q11) A life insurance company issues a 20-year with profits endowment assurance policy to a male life aged 45 exact. The sum assured of Rs.100,000 plus declared reversionary bonuses are payable on survival to the end of the term or immediately on death, if earlier.

(i) Calculate the monthly premium payable in advance throughout the term of the policy if the company assumes that future reversionary bonuses will be declared at a rate of 1.92308% of the sum assured, compounded and vesting at the end of each policy year.

Basis:

Interest	6% per annum
Mortality	AM92 Select
Initial Commission	35% of the total annual premium incurred at issue
Initial expenses	Rs.800 paid at policy commencement date
Renewal commission	5% of each monthly premium from the start of the second policy year
Renewal expenses	Rs. 150 at the start of the second and subsequent policy years
Claim expense	2.5% of the claim amount

(10)

(ii) The life office values its with-profits business using the net premium method, assuming an interest rate of 4% pa and AM92 Ultimate mortality.

Calculate the prospective reserve for the above policy at the end of the 13th year given that the total reversionary bonus declared up to that time is Rs.25000 (6)

[16]

Q12) If $l_{40}=1000$ and $l_{40+t} = l_{40} - 5t$ for t=1,2,…..10, calculate the value of A $_{\overline{40:10}|}$ at 6% pa interest **[4]**

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