INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

6th November 2008

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.)   In the context of net premiums and reserves, state the conditions necessary for equality of prospective and retrospective reserves.   (2)

              b.)   Give two reasons why, in practice, these conditions may not hold.   (2)

                                                                                       [4]

Q. 2)   Explain why a life insurance company will need to set up reserves for a regular premium whole life policy.   **[3]**

Q. 3)   Explain the terms "**Adverse Selection**" and "**Spurious Selection**" and give one example of each.   **[4]**

Q. 4)   (i)   List down the steps involved in profit testing a conventional product.   (5)

              (ii)   A unit linked contract has the following features:

- The benefit payable on death is the sum of Sum Assured, Unit Account Value and the Guaranteed Addition. Sum Assured in the first year is Rs.100, 000 which increases by Rs.50, 000 at the end of each year.
- The benefit payable on maturity is the sum of Unit Account Value and the Guaranteed Addition.
- The benefit payable on Surrender is the sum of Unit Account Value and the Guaranteed Addition.
- The Guaranteed Addition is defined as 5% of all premiums paid till the date of this benefit is payable.
- The policy term and premium payable term is 3 years and all premiums are payable on annual basis i.e. at the beginning of every year.
- Following charges are payable under this contract:
  - Premium Allocation charge of 4% in all years
  - Bid offer spread is 5%
  - Fund management charge is 1% per annum

Following profit test assumptions are given to you.
- Expenses: Rs.1,000 at the start of the first policy year and Rs.200 at the start of subsequent policy years;
- Commission: 10% of first year premium
- Dependant Rate of Mortality: 0.001 per annum for all ages
- Dependant Rate of Surrender: 0.10 for first year and 0.05 for second policy year
- Unit Growth Rate: 12% per annum
- Interest rate on non unit cash flows: 8% per annum
- Risk discount rate is 15% per annum

You may further assume that;
- Death claims and surrenders occur at the end of the year
- The Fund management Charge for a year is deducted at the end of the year
- The investment return on the unit account is credited at the end of the year
- The interest income on non unit cash flows is earned at the end of the year
- Ignore non unit reserves

a) Calculate the unit account value on maturity if the annual premium is
   Rs.50,000.   (3)

b) Calculate the net present value of the profit signature of the contract.   (4)

c) Suggest three modifications in the contract to reduce the capital need in the
   Contract   (3)

d) It was noticed that the contact does not meet the profit targets of the
   Company. Suggest 4 modifications to increase the profitability of the
   contract.   (4)

[19]

Q. 5) An old extract of a multiple decrement table that allows for resignations and deaths
between the ages of 41 and 43 is as follows:

Age	No of lives aged x	No of resignations between x to x+1	Number of death between x to x+1
41	20,000	1000	400
42	18,600	100	200
43	18,300		

In a recent investigation it has been observed that the independent rates of mortality
have improved by 50% since the previous investigation. Following improvements in
the mortality experience, it is decided to construct a new table taking into the above
improvement. Construct the new multiple decrement table.

State clearly any assumptions made in constructing the new multiple decrement table.

[9]

Q. 6) i.   List down the mortality and morbidity risk classes over which the insured
              lives may be grouped for charging the risk premiums.   (4)

ii.   Explain the advantages and disadvantages of using only one premium rate
      table for all risk classes?   (5)

[9]

Q. 7) a. Define the terms Temporary select period and length of select period?
How would you determine the length of select period? (3)

b. In a special mortality table with a select period of one year, the following relationships are true for all ages:

$$_{0.5}q_{[x]} = (0.25) q_x$$

$$_{0.5}q_{[x]+0.5} = (0.60) q_x$$

Express $p_{[x]}$ in terms of p_x.

(3)

[6]

Q. 8) Calculate the probability of survival to age 60 exact using ELT15 (Females) for a life aged $49^{1/2}$ exact using two approximate methods. State any assumptions you make.

[5]

Q. 9) **(i)** Calculate the following probabilities:
(a) Joint life status of a couple aged 44 and 41 years does not fail in the next four years
(b) Joint life status of a couple aged 65 and 62 years fails within one year

Use AM92 (Ultimate) mortality table for all lives. (3)

(ii) A couple aged 25 and 20 years buys a contingent assurance policy that provides the benefit of INR 1.0 million payable on the death of the last survivor provided the following two conditions are satisfied:
(a) both the lives survive to the retirement age of 60 years and
(b) the survivor dies within 5 years of the death of the first life.

In order to calculate the present value of this benefit on the contract commencement date, derive an expression in terms of joint life assurance functions, temporary assurance functions and the contingent assurance functions payable on first death. (12)

[15]

Q. 10) By considering a term assurance policy as a series of one year deferred term assurance policies, show that

$$\overline{A}{}^{1}_{x:n} = \frac{i}{\delta} A{}^{1}_{x:n}$$

[6]

Q. 11) Write a recursive equation relationship between the reserve at the start of the year and the reserve at the end of the year assuming level annual premium P payable in advance for the following benefit structures:

a) A death benefit of S payable at the end of the year of death. A guaranteed benefit of X payable at the end of every month which doubles from the second month. This benefit is payable at the fixed durations to all policies in force at the start of the year.   (3)

b) A death benefit of S payable at the end of the year of death. A survival benefit of R payable in the middle of the year.   (2)

[5]

Q. 12) A life insurance company decides to introduce a new product in which the customer can choose the pattern of premium payment (for e.g. whether level or increasing) for a defined set of benefits. The sum assured will vary depending on the pattern of premium payment chosen

The life advisor is provided with a calculator which gives the sum assured that can be provided by choosing the amount of premium and the way the premium will vary. The details of the policy and the basis used for calculation are:

Type of Plan – with profit endowment
Policy Term – 30 years
Mortality – AM92 Select
Interest – 4% per annum
Initial expense – Rs 250 plus 50% of gross first annual premium
Renewal expenses – NIL
Claim expenses – Rs 300 on death; Rs 150 on maturity

Future simple reversionary bonuses will be declared at the rate of 2% per annum and vesting at the end of each policy year (i.e. death benefit does not include any bonus relating to the policy year of death)

The prospective policyholder is 35 year old male life.

The policyholder wants to know whether the amount of sum assured he will get for the two different premium payment patterns given below:

a. Level annual premiums of Rs 10,000 are payable in advance which increases by Rs 500 every year from the second policy year.
b. Level annual premiums of Rs 20,000 payable in advance for the first 25 years and then it reduces to Rs 2,000 from the 26th policy year.

[15]

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