

INSTITUTE OF ACTUARIES OF INDIA
EXAMINATIONS

27th November 2020

Subject CM1B – Actuarial Mathematics (Paper B)

Time allowed: 2 Hour (14.30 – 16.30 Hours)

Total Marks: 100

- Q. 1)** A life insurance company issues a number of 15 year term assurance policies to lives aged 50. The sum assured under each contract/policy is INR 50,00,000 payable immediately on death. Premiums are payable annually in advance for the term of the policy, ceasing on death.

The company carries out the profit test for these policies/contracts using the following assumptions:

- Initial Expenses: 3,000
- Renewal Expenses: 500
- Initial Commission: Minimum(35%, 3%*Policy Term) of the annual premium
- Renewal Commission: 5% of the annual premium for year 2 and year 3; 3% of the annual premium subsequently.
- Mortality: As mentioned in the excel
- Investment Return: 7% per annum
- Risk Discount Rate: Investment Return + 5%
- Reserves: Annual Premium multiplied with the minimum of 80% of Number of Completed Policy Years and 120% of Policy Term minus Number of Completed Policy Years
- Fixed initial and renewal expenses incurred at the same time as the premium payment. Death decrement happen uniformly during year and its payments can be expected to be paid at mid-year for calculation purposes.

- i) Calculate the profit margin of the contract if the office annual premium of the contract is INR 52,000. (17)
- ii) Prepare and label the graph of per policy reserves over the term of the policy. (3)
- iii) Comment on the shape of the graph. (3)

A recent study has revealed that the mortality has improved by 2% for ages below 60 and has worsened by 1% for each ages 60 years.

- iv) Calculate the revised profit margin of the contract if the office premium and reserving requirement remains unchanged. (6)
- v) Comment on the results of part (iv). (2)
- vi) Perform a sensitivity of +/- 100 bps on investment returns on results of part (i) and compare the results with part (i). (12)
- [43]

- Q.2)** A life insurance company has issued a savings policy to a policyholder aged 30 years. The plan has premium payment term of 8 years while the policy term is 15 years. Premiums are payable annually.

The plan provides the benefits below:

- Upon death of policyholder during the policy term, a benefit of 10 times the annual premium is payable at the end of year of death.
- Upon survival of the policyholder to the end of the policy term, a benefit of 18 times the annual premium is payable.

The office premium is INR 50,000.

Reserving basis is:

Mortality table (as provided in Excel).

Interest rate = 5% p.a.

Expense assumption is 500 per annum, incurred at the start of the year, inflation is 0%

The policy has completed 4 years.

- i) Calculate the net premium (15)
 - ii) Calculate the net premium reserve and gross premium reserve at the beginning of the 5th policy year (i.e. post receipt of this premium). (12)
- [27]

Q. 3) Simon invests his money in a financial savings instrument. The instrument works like a savings account, where a return gets credited to the investor at the end of each year, as 90% of the total return based on an equity index in the first 5 years of investment and 95% thereafter. The approach remains the same whether the total returns implied by the equity index are positive or negative.

Simon has so far invested the following sums of money (assume each investment is made at the beginning of each year)

- INR 50,000 invested in each of the first 3 years
- No money was invested in the following 3 years
- INR 40,000 invested in each of the next 5 years.

The values of equity index has been provided in Excel.

- i) Calculate the accumulated value of Simon's investments at the end of 11 years. (6)
- ii) Calculate the annualized return earned by the Simon over this period of 11 years. (3)
- iii) For part (ii), calculate the force of interest. (3)
- iv) Calculate the spot return implied by the index at each step. (3)

Another version of the same financial product is available which also provides cover on death equal to 5 times the value of the fund at any time point. However, the company charges a fee equal to:

*Expected mortality rate for the year * (death benefit– fund value); where death benefit, fund value and age for mortality rate correspond to their values at the end of the year (i.e. after allowing for the crediting investment returns for the year)*

You have been provided with a mortality table.

- v) Calculate (i) and (ii) again and comment on your results; assuming Simon is aged 35 years today. (15)

[30]
