MATHEMATICAL BASIS OF LIFE ASSURANCE

May, 2014

[Time: 3 Hours]

Answer ANY FIVE questions only. All questions carry 20 marks each.
(Candidates are allowed to refer handbook on Formulae and Tables).

Q.1

a) Calculate the annual premium payable annually by a 40 year old select life for a 20 year temporary assurance of Rs. 15,00,000 payable immediately on death. Initial expenses are 60% of annual premium plus 1100 as fixed cost. Renewal expenses are 600 p.a. from year two onwards.

Given:

\[ a'[40] : 20 = 13.93 \]

\[ \frac{M[40] - M_{60}}{D[40]} = 0.0341085 \]

intt. Rate = 4% p.a.

b) Calculate gross single premium for an annuity of Rs. 3600 p.a. payable monthly for a certain period of 10 years and if person survives the certain period then annuity is payable throughout the life to life aged 55. Initial expenses incurred 6 per thousand single premium, renewal expenses are 5% of annuity payment and basis 8% intt.

Given: \( a_{65} = 7.719 \), \( D_{65} = 5497.37 \), \( D_{55} = 13557.51 \)

Q.2

An impaired life aged 35 wishes to effect an endowment assurance without profit of SA 10,000 for term of 20 years. The life insurance company expects that impaired life is subjected to mortality equivalent to that normal life age 40.

a) Calculate extra premium

b) Alternative Debt to be calculated and charged, reducing by an uniform amount every year so that debt extinguishes at end of 10 years.

Basis LIC 70-73, Interest rate 6%, ignore expenses,

c) Also apply rough check on your results arrived at in part (b) above

\[ P_{35} = 0.2769, \quad a'[40,35] = 11.682 \]

\[ A_{40:10} = 0.03173 \]

\[ 10 M_{40} - R_{41} + R_{51} = 15383.29 \]

\[ D_{40} = 93645.23 \]
Q.3 You are the Appointed Actuary of a medium sized life insurance company which started its operations 12 years back and has written significant volume of business. One of the Directors of your company remarked that reinsurance is an unnecessary expense that only generates profits for reinsurance companies at the cost of the life insurance company.

a) Define re-insurance.  3
b) Prepare a reply for the Director of the company explaining why the company would seek reinsurance.  8
c) The company has reinsured a large proportion of its term assurance business since outset. Discuss why the term assurance business was so heavily reinsured at outset.  9

Q.4 You are the Valuation Actuary of an established company with over 1 million policies in force both investments linked and with profits. The Appointed Actuary has asked you to review the data checking processes before the next statutory valuation.

(a) Describe the risks to which a life insurance company is exposed with regard to policy data.  7
(b) Describe the actions the life insurance company could take to limit the risks arising from policy data.  9
(c) In respect of consistency checks, explain with reasoning what relationship would you expect in respect of the following when the figures for this year are compared with those of previous valuations?
   (i) Premium per thousand sum assured under different type of plans.  4
   (ii) Average sum assured under different plans

Q.5 a) List the components that are likely to be used to determine the asset share of a conventional with profits endowment assurance policy.  6
b) Describe the principles involved in the determination of surrender terms under life insurance policies  9
c) Discuss the effects of surrenders on future profits and policy reserves of a life insurance company.  5

Q.6 A company ABC writes all types of life insurance business. The company is a limited company and plans to write new business aggressively. One of the Board members of the company has sought your opinion on this strategy of the company.

a) Describe how the level of new business written by the company may be a source of risk to a life insurance company.  9
b) Describe the actions the company could take to limit the risks arising from the level of new business written by the company.  5
c) Discuss the significance of mortality risk and the possible actions the company could take to mitigate mortality risk.  6
Q.7  
a) Prove that in case of an Whole Life Assurance Policy  
\[ tV_x = 1 - \left( \frac{a_{x+t}}{a_x} \right) \]  
b) A person now aged 35 has Whole Life Assurance Policy for Rs. 50,000 issued  
to him 10 years ago. He now desires the policy to be altered to an Endowment  
Assurance Policy for the same sum assured maturing at age 60. Find the net  
annual premium he has now to pay. The basis is IALM (94-96) modified Ultimate  
mortality with 6% interest.  
c) If in ‘b’ above the policyholder desires reduction in sum assured, keeping  
the premium payable as per the original contract unaltered, calculate the  
reduced sum assured.

Q.8  
a) Explain the following formula relating to Policy value.  
\[ (tV + p)(1+i) = t_{t+1}V + q (S_{t+1}V) \]  
\( tV \) and \( t_{t+1}V \) are policy value at time \( t \) and \( t+1 \), \( p \) is annual Premium,  
\( S \) is sum assured and \( q \) is mortality rate, ignoring expenses.  
b) Name eight type of special reserves and adjustments, a Life Insurance Company  
may keep, explain in one sentence, why the particular reserve/ adjustment made.  
c) An appointed actuary of a Life Insurance Company decides to bring with profit  
business products following recommendation of the Management.  
The decision for distribution of surplus lies with Appointed Actuary in this  
back drop, explain;  
a) What are three major sources of surplus.  
b) What is one fundamental Principle for distribution of surplus and why  
you think it is important  
c) Explain Compound Reversionary Bonus System.

END