

MAY, 2011

FL-81

FELLOWSHIP EXAMINATION

MATHEMATICAL BASIS OF LIFE ASSURANCE

Time: 3 Hours]

[Total Marks : 100

Answer any FIVE questions only.
All questions carry 20 marks each.

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1. a) Given that: $A_x = 0.3801$ and $P_x = 0.0211$ Marks
5 each
Find:- a_x and the rate of interest.
- b) What is mortality surplus?
How does it arise ?
Give expression for mortality surplus.
- c) Prove :- for endowment assurance policy
$$P_{x:\overline{n}|} = P_{\dot{x}:\overline{n}|} + P_x : \overline{\overline{n}|}$$
- d) A person now aged 30 has a Whole Life Assurance Policy for Rs. 15,000 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 LIC (1970 - 73). Ultimate mortality with 6% interest.
- $\ddot{a}_{30} = 15.618$; $\ddot{a}_{20} = 16.371$;
 $A_{30:\overline{30}|} = 0.19852$; $\ddot{a}_{30:\overline{30}|} = 14.160$
2. On the basis of the LIC (1970-73) Ultimate Table at 6%, calculate the net annual premiums for a sum assured of Rs.1000 for the following assurances for a life aged 30. 5 each
- a) Whole Life Assurance.
b) Whole Life Assurance, premiums limited to 20 years.
c) Endowment Assurance for 25 years.
d) Endowment Assurance for 25 years. Premiums limited to 15 years.
- Given: $M_{30} = 19801.59$ $M_{55} = 12716.28$ $N_{30} = 2666994.53$
 $N_{45} = 927313.11$ $N_{50} = 623195.21$ $D_{55} = 35573.26$
 $N_{55} = 403807.17$

3. a) The following particulars are given :

x (age)	25	26	27	28	29	30
l_x	97,380	97,088	96,794	96,496	96,194	95,887
d_x	292	294	298	302	307	313

interest = 6%

- i) Workout commutation functions for ages 25 to 30.
 ii) Calculate level annual premium :
- a) $P_{25}^{\overline{1} | \overline{2} |}$ b) $P_{25}^{\overline{1} | \overline{4} |}$ c) $P_{27}^{\overline{1} | \overline{3} |}$
- b) The values of A_x on 3% interest basis are given below for a specified age range :

x	A_x
35	0.429
36	0.437
37	0.445
38	0.453
39	0.462

Calculate in a tabular form the values of a_x for all ages 35 to 39 to three decimal places.

4. a) Calculate office annual premium for an Endowment Assurance for Rs. 15,000 to a person aged 35 for 25 years. Provide for first year expenses at 50% of premiums and 15% Sum Assured and Renewal Expenses of 5% of premiums and 6% Sum Assured. 10 each
- b) Calculate office premium (annual) for a With Profit Endowment Assurance by providing a bonus loading of 20% Sum assured per annum.

Given : $\ddot{a}_{35:\overline{25}|} = 13.086$; $A_{35:\overline{25}|} = 0.25931$;

$$D_{35} = 12664.23 \quad R_{35} = 516333.68 \quad R_{60} = 132156.08$$

$$M_{60} = 10506.87 \quad D_{60} = 24604.43$$

5. On 1st January 1979, an Office issued a number of annual premium without profit policies to a group of lives each of whom was then aged 35. All the policies were for a term of 20 years and were of the following types:
 Endowment Assurances under which the sum assured was payable on survival to the end of the term or on previous death.
 Temporary Assurances under which the sum assured was payable only on death within the policy term.
 Calculate the profit or loss from mortality for the calendar year 1988 in respect of the policies issued to this group of lives given the following data:

Type of Policy	Sums Assured existing on 31 st December 1988	Sums Assured discontinued by death during 1988
Endowment Assurance	Rs. 27,00,000	Rs. 17,000
Temporary Assurance	Rs. 15,40,000	Rs. 4,000

Basis: LIC (1970-73) Ultimate Table and 6% interest

Assume that there is no source of decrement other than death and that all claims are paid at the end of the year of death.

Given: $q_{44} = .00420$ $\ddot{a}_{45:\overline{10}|} = 7.612$ $\ddot{a}_{35:\overline{20}|} = 11.864$
 $A^1_{45:\overline{10}|} = 0.05190$ $P^1_{35:\overline{20}|} = .00401$

6. i) A whole life insurance of Rs.1000 is purchased on a life aged 80. The death benefits are payable at the end of the year of death. Mortality follows a select table with a one-year select period and the following values are provided

$$q_{[80]} = 0.5 \cdot q_{80} \quad A_{80} = 0.67980 \quad A_{81} = 0.68952 \quad q_{80} = 0.1$$

Calculate the value of $1000 \cdot A_{[80]}$ for an interest rate of $i = 0.06$

- ii) An individual aged 25 takes a pension policy with a term of 30 years. The policy requires payment of annual premiums in advance for two thirds of the policy term. On death, 10 times the annual premium is paid. On survival to the end of the term, a pension of Rs. 12,000 per quarter is paid in advance until the death of the policy holder. After vesting of pension no death benefit is paid.

Assumptions: Interest: 4% p.a Ignore expenses;
Calculate the annual premium under the policy

$$\begin{aligned} \text{Given: } \ddot{a}_{25} &= 22.520 & \ddot{a}_{55}^{(4)} &= 16.989 & D_{45}/D_{25} &= 0.4494 \\ D_{55}/D_{25} &= 0.29606 & A_{25} &= 0.13886 & A_{55} &= 0.3895 \end{aligned}$$

7. i) A life insurance company has sold 1000 single premium endowment assurance policies to lives aged 30 for a policy term of 20 years and sum assured of Rs. 100,000 each. If the Company expects that 2 lives will die each year and it will earn an interest rate of 5% per annum, calculate the single premium. Assume that the Company incurs expense of 5% of the single premium only at the time of policy issue and death claims are paid at the end of the year. 8
- Given: $v^{20} = 0.37689$
- ii) a) A person now aged 30 has a Whole Life Assurance Policy for Rs. 15,000 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 LIC (1970-73) Ultimate mortality with 6% p. a. interest. 6
- b) In the data above, if the policyholder desires reduction in sum assured, keeping the premium payable as per the original contract unaltered, calculate the reduced sum assured. 6
- Given: $\ddot{a}_{20} = 16.371$ $\ddot{a}_{30} = 15.618$ $A_{30:\overline{30}|} = .19852$
 $\ddot{a}_{30:\overline{30}|} = 14.160$ $A_{20} = .07334$
8. i) Explain valuation of Non-standard Plans. 5
- ii) What is meant by renewal expense ratio of an insurer ? 5
Discuss the relationship of this ratio with the provision for expenses in a gross premium valuation.
- iii) A sub-standard life aged 40 effects an Endowment Assurance for Rs. 10,000 for a term of 25 years. The office has decided to accept the risk by charging extra premium calculated on basis of rating up of age by 5 years for first 6 years, by 3 years for next 8 years and by 2 years thereafter. Calculate extra annual premium. Basis LIC (1970-73) Ignore Exp. 10

Given: $P_{40:25} = 0.02148$; $\ddot{a}_{45:\overline{6}|} = 5.148$;
 $\ddot{a}_{49:\overline{8}|} = 6.405$; $\ddot{a}_{56:\overline{11}|} = 7.715$;
 $D_{51} = 46739.97$; $D_{45} = 68774.85$;
 $D_{57} = 30829.16$; $D_{49} = 53297.64$

—————**END**—————