IC-104

Fellowship

EXAMINATION QUESTION PAPERS NOV. 2006

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.

Marks

1. a) Mr. B. has taken a loan of Rs. 15,000/- at a rate of interest   4
        8% p.a. payable half-yearly. He repaid Rs. 2000/- after 2
        years, Rs. 6,000/- after a further 2 years and cleared all
        dues at the end of 8 years from the commencement of the
        transaction. What is the final payment made by him?

    Given :

    $(1.04)^{16} = 1.87298$, $(1.04)^{10} = 1.48024$, $(1.04)^6 = 1.26532$,

    $(1.08)^{16} = 3.42594$, $(1.08)^{10} = 2.15892$

    b) Find the present value of an annuity certain of Rs. 4000   8
        p.a. payable for 25 years under which the payments are
        made at the end of each year for the first 5 years, at the
        end of each half year for the next 10 years and at the end
        of each quarter thereafter. Assume a rate of interest of
        8% p.a. for the first 15 years and 6% p.a. thereafter.

    Given :

    at 8% $V^5 = 0.68058$, $V^{15} = 0.31524$, $\dfrac{i}{i^{(2)}} = 1.0196$,

    $a_{\overline{5}|} = 3.9927$, $a_{\overline{15}|} = 8.5595$

    at 6% $a_{\overline{10}|} = 7.3601$, $\dfrac{i}{i^{(4)}} = 1.0222$

    c) A loan is repayable by 20 equated yearly instalments of
        Rs. 3,000 each, comprising both interest and capital. The
        rate of interest on loan is 10% per annum effective.
        Calculate :

    i)   The amount of loan   2

    ii) Interest contained in 13th instalment   2

    iii) Loan outstanding at the end of 10th year   2

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iv) Principal loan contained in 15th yearly instalment. 2

   Given :

$$v^{20} = 0.14864, \qquad v^{18} = 0.17986,$$

$$v^{10} = 0.38554, \qquad v^6 = 0.56447$$

2. a) Establish algebrically the relationship : 4

$$_{n-1}P_{x+1} - {_nP_x} = q_x \times {_{n-1}P_{x+1}}$$

   b) Given the probability that a life aged 45 will survive 10 10
   years is 0.5 and the probability that a life aged 55 will
   survive 10 years is 0.2. Find the probability that of three
   persons aged 45 atleast one will die between ages 55 and
   65 and at least one after age 65 ?

   c) The following data are available in respect of a Mortality 6
   Table :

Age	L_x	m_x
65	48242	0.04421
66	46074	0.04783
67	43836	0.05185
68	41532	0.05619

   On the assumption of uniform distribution of deaths over
   the year of age, calculate the values of l_x, d_x and q_x
   for ages from 65 to 68 ?

3. a) What is the process of Graduation ? 4

   b) Calculate the value of Endowment Assurance Benefit of 4
   Rs. 10,000 for 5 years to a person aged 25 .

   Given :-

For Age X =	25	26	27	28	29	30
d_x =	292	294	298	302	307	313

$$l_{25} = 97380, \qquad l_{30} = 95887$$

c) Using the values of l_x, d_x and v^x @ 6% calculate the 6 values of D_x, C_x and M_x for the ages from 30 to 35

For Age x =	30	31	32	33	34	35	36
lx =	89685	88994	88294	87585	86866	86137	-
dx =	691	700	709	719	729	742	-
v^x =	0.1741	0.1642	0.1549	0.1462	0.1379	0.1301	0.1227

d) Using the values of the commutation functions calculated 6 in the above example, Find out

   i)   The value of whole life Assurance of Rs. 5,000 for a person aged 33 .

   ii) The value of Endowment Assurance Benefit of Rs. 25,000 for 3 years to a person aged 30 years.

   iii) The value of a Double Endowment Assurance Benefit of Rs. 10,000 for a person aged 31 receivable on attaining age 35.

4. a) From the Table given below evaluate 10

$2^P [22] + 1$, $1|3q [20]$, $|5q[20]$ and $1|q[22]$

Age at entry (x)	$l_{[x]}$	$l_{[x]} + 1$	$lx + 2$	Attained age x + 2
20	495353	494504	493613	22
21	494440	493590	492696	23
22	493526	492672	491775	24
23	492607	491751	490848	25
24	491694	490837	489933	26
25	490781	489923	489018	27

b) Prove the following expressions :- 6

   i) $A^1_{x:\overline{n}|} = \dfrac{M_x - M_{x+n}}{D_x}$

   ii) $A_{x:\overline{n}|} = \dfrac{M_x - M_{x+n} + D_{x+n}}{D_x}$

c) What is the differance between an annual premium and an instalment premium ?   4

5. a) Prove the following expressions :-   8

   i) $_{t}|\ddot{a}_x = \dfrac{N_x + t}{D_x}$ ii) $a_{x:\overline{n}|} = \dfrac{N_x + 1 - N_x + n + 1}{D_x}$

   iii) $\ddot{a}_{x:\overline{n}|} = \dfrac{N_x - N_x + n}{D_x}$ iv) $\ddot{a}_{x:\overline{n}|} = 1 + a_{x:\overline{n-1}|}$

b) Using the values of commutation functions given find the values of :   8

   i) $_{10}|a_{20}$ ii) $a_{20:\overline{10}|}$ iii) $\ddot{a}^{(12)}_{20:\overline{10}|}$ iv) $\ddot{a}_{\overline{20}|}$

   Given :- at 6% :-

$$N_{31} = 2496231.14 \quad D_{20} = 309771.22$$

$$N_{21} = 4761494.14 \quad D_{30} = 170763.39$$

c) What are the defects in the system of charging natural premium ?   4

6. a) On the basis of the commutation values given at 6% calculate the net annual premiums for a Sum Assured of Rs. 50,000 for the following assurances on age 30 years old .   10

   i) Endowment Assurance for 25 years

   ii) Endowment Assurance for 25 years, premium limited to 20 years

   iii) Whole life Assurance, premium limited to 20 years.

   iv) Deffered Temporary Assurance to commence at age 35 and then to continue for 10 years.

   v) Whole life Assurance :

   Given :-

$M_{30} = 19801$		$M_{45} = 16285$	
$M_{55} = 12716$		$M_{35} = 18748$	
$M_{50} = 14655$		$D_{55} = 35573$	
$N_{30} = 266694$		$N_{45} = 927313$	
$N_{50} = 6231958$		$N_{55} = 403807$	

b) Calculate the net annual premium under a Special 5
   temporary Assurance for Rs. 50,000 on a person aged 35
   years for term 20 years. On the life assured Survival to the end
   of 20 years total amount of premiums paid will be payable.

   Given :-

$$M_{35} = 18747.99 \quad D_{35} = 126664.23$$

$$\ddot{a}_{35:\,\overline{20}|} = 11.864 \quad M_{55} = 12716.28$$

$$D_{55} = 35573.26$$

c) Calculate the net single premium at 6% p.a. for an 5
   immediate annuity of Rs. 12,000 p.a. payable for 12 years
   certain and thereafter for life to a person aged 60 at entry.

   Given :-

   at 6% $a_{\overline{12}|} = 8.3838 \quad N_{73} = 48646 \quad D_{60} = 24604$

7. a) Given that $A_x = 0.3801$ and $a_x = 17.014$ determine the 4
   rate of interest ?

   b) Calculate the office annual premium for a whole life 6
   Assurance for Rs. 50,000 to a person aged 35. Provide
   for first year expenses at 60% of premiums and 20 ‰
   sum assured and renewal expenses of 5% of premium
   and 6 ‰ Sum assured .

   Given :-

   at 6% interest $A_{35} = 0.14801 \quad @_{35} = 15.052$

   c) Give expression for the retrospective policy value and 10
   prospective policy value at the end of 25 years under a
   whole Life Policy for a sum assured of Rs. 50,000 affected
   on the life of a person at age 20 years. Annual premiums
   under the policy were limited to 20 years. Show that both
   the expressions are equal. Ignore expenses.

8. a) What is meant by valuation of an insurer? Explain how it 8
   is necessary.

   b) Explain how the difference in prospective and 6
   retrospective policy value arises ?

   c) What is meant by fair distribution of surplus. Discuss how 6
   far this could be achieved ?

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