IC-104

Fellowship

EXAMINATION QUESTION PAPERS MAY 2009

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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) The amount of interest earned on A is Rs. 336, while the equivalent amount of discount is Rs. 300. Find A. 5

   b) Find the nominal rate of interest per annum convertible half-yearly, correct to two decimal places corresponding to : 8

      i) an effective rate of interest of 10.25% p.a.
      ii) a nominal rate of discount of 10% p.a. convertible half yearly.
      iii) a nominal rate of interest of 8% p.a. convertible quarterly.
      iv) a nominal rate of interest of 6.18% per half-year convertible once in two half-years.

   c) An insurance company has a liability to pay Rs. 25,00,000 three years from now, and another liability to pay Rs. 35,00,000 seven years from now. Instead of these liabilities, the insurance company would prefer to pay Rs. x at the end of 1 year, Rs. $1.5\,x$ at the end of 1.5 years and Rs. $2\,x$ at the end of 2 years to satisfy the liabilities. At a nominal rate of interest of 8% p.a. convertible half-yearly, calculate x. 7

      Given at 4% p.a. effective :- $v^2 = .92456$, $v^4 = .85480$ and $v^7 = .75992$

2. A loan of Rs. 80,000 is repayable by equated quarterly installments over 15 years at nominal rate of interest of 12% p.a. convertible quarterly. Calculate :-

   a) the quarterly installment. 2
   b) principal contained in the 20th installment. 2
   c) interest paid during the years 6-20 (both inclusive) 5
   d) principal repaid during the years 12-14 (both inclusive) 5
   e) principal contained in the last installment 3
   f) principal contained in the first installment. 3

   Given : at 3% : $a_{\overline{4}|} = 3.7171$ $a_{\overline{16}|} = 12.5611$ $a_{\overline{20}|} = 14.8775$
   $a_{\overline{40}|} = 23.1148$ $v^{40} = .30656$ and $v^{60} = .16973$

3. a) A Government Bond was issued for a term of 5 years with interest payments made at the end of every year at the rate of 6% p.a. The bond is redeemed at the end of 5 years at par. Find the price an investor is willing to pay for a bond with face value of Rs. 1,00,000 if he expects a return of 8% on his investment. 8

Given :

v^5 @ 6% = 0.74726, v^5@ 8% = 0.68058

b) Prove that :- 4

$$\ddot{a}_{x:\overline{n}|} - a_{x:\overline{n}|} = 1 - A^{1}_{x:\overline{n}|}$$

c) Show that the assumption of uniform deaths over each year of age implies :- 4

$$d_{x+t} = (1-t)d_x + t.\,d_{x+1} \quad \text{where } 0 \le t \le 1$$

d) If $l_x = 100 - x$, find the value of $A^{1}_{40:\overline{15}|}$ @ 6% interest 4

given that v^{15} at 6% = 0.417265

4. a) A student says : Premium rates under a whole life assurance policy are lower than those under endowment assurance policies. However, the rate of reversionary bonus under whole life assurance policy is significantly higher than these under endowment policies. Comment briefly giving actuarial reasoning. 6

b) A whole life assurance policy is effected on the life of a person aged 35 for sum assured of Rs. 20,000. Annual premiums are payable for 15 years or till death, whichever is earlier. Ignoring expenses, calculate :

i) the net annual premium. 4

ii) the perspective policy value at the end of 10 years. 5

iii) the retrospective policy value at the end of 20 years. 5

Given :

x	Dx	Nx	Mx
35	2507.40	52663.13	481.90
45	1677.97	31583.93	463.20
50	1366.61	23839.41	449.71
55	1105.41	17546.37	430.55

5. a) Prove that ${}_m|_n q_x = {}_m p_x - {}_{m+n} p_x$ 2

b) Calculate the net annual premium for a special money back policy of SA 50,000 for a person aged 40 years where 50% of the sum assured is paid at the end of 10th year on survival and the balance 50% on survival at the end of the term of 15 years. On death during the term of the policy sum assured is payable at the end of the year of death. 6

Given:-

$N_{40} = 138898.05$ $D_{55} = 3660.5858$
$N_{55} = 44326.169$ $M_{40} = 1598.1679$
$D_{40} = 9353.5601$ $M_{55} = 1258.3191$
$D_{50} = 5060.8614$

c) 3 unbiased coins are tossed simultaneously. Find the probability that 6

i) All 3 are heads.
ii) At least one tail.
iii) If on a particular trial of the above experiment, it is found that 2 tails are realized. What is the probability that the third is a head.

d) A 10 year special term assurance policy provides a benefit of Rs. 1,00,000 at the end of year of death together with a return of premiums paid without interest. Allowing for expenses of 10% of each premium. Find the annual premium for a life aged 50 years at 6% interest. 6

Given :-

$N_{50} = 66676.968$ $M_{60} = 1104.5519$
$N_{60} = 28268.269$ $R_{50} = 31331.215$
$M_{50} = 1393.4551$ $R_{60} = 18636.449$

6. Write short notes on :

a) Life year method of investigation 7
b) Bonus loading in premium rates. 7
c) Consequences of withdrawal of a Life Insurance Contract. 6

7. a) Explain by general reasoning the relationship :- 4

$A_{x:\overline{n}|} = 1 - d\ \ddot{a}_{x:\overline{n}|}$

b) **Given :-** $p_{62} = .989888$, $p_{63} = .988656$, $p_{64} = .987284$, 6

calculate - $A_{62:3\overline{]}}$ at interest of 4% p.a.

c) **Given :-** $l_{61} = 9213$, $d_{61} = 83$, $d_{62} = 92$ and $d_{63} = 103$, 6

calculate - $\ddot{a}_{61:4\overline{]}}$ at interest of 6% p.a.

d) What are natural premiums and what are their defects? 4

8. a) Calculate office annual premium under an endowment assurance policy for sum assured of Rs. 50,000 on the life of a person aged 40 years for term of 20 years. Premiums are payable for 20 years or till death, whichever is earlier. Provide for expenses : 12

First year : 3 per thousand Sum Assured and 60% of annual premium.

Renewal : 1 per thousand sum assured and 5% of annual premium.

Given :- $a_{40:19\overline{]}}$ at 4% = 12.927.

b) Calculate office single premium for an immediate annuity of Rs. 20,000 per annum payable quarterly in arrears for 20 years certain only. Basis : Interest 6% p.a. Provide for expenses at 3% of single premium and for payment of annuity at Rs. 50 per annuity installment. 8

Given :- **at 6%**

$v^{20} = .31180$ and $i^{(4)} = .058695$.

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