

IC - 104

Fellowship

EXAMINATION QUESTION PAPERS NOV 2008



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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. | <p>a) A person plans to deposit into a fund a sum of Rs. 40,000 on every 1st January from 1-1-2009 to 1-1-2014 (both inclusive). The fund allows simple interest at 4% p.a. Calculate the amount in the fund to the credit of the person on 31-12-2018.</p> | 4 |
| | <p>b) Find the effective rate of interest per annum, correct to two decimal places, corresponding to :</p> <p>i) a nominal rate of interest of 4% per half-year convertible two times in a half-year.</p> <p>ii) a nominal rate of interest of 10.5% per annum convertible once in two years.</p> <p>iii) a nominal rate of discount of 10% per annum convertible half-yearly.</p> <p>iv) an effective rate of discount of 2% per quarter.</p> | 8 |
| | <p>c) A person is entitled to receive three sums, namely, Rs. 20,000, Rs. 25,000 and Rs. 14,500 at the end of 8 years, 14 years and 17 years from now respectively. Calculate the total present value of these sums, assuming effective rate of interest of 8% p.a. for the first 5 years, nominal rate of interest of 6% p.a. convertible half-yearly for the next 6 years and effective rate of interest of 3% p.a. thereafter.</p> | 8 |
| | <p>Given:- v^5 at 8% = 0.68058 v^1 at 3% = 0.91514
 v^6 at 3% = 0.83748</p> | |
| 2. | <p>a) A loan was repaid over 3 years on payment of yearly instalment of Rs. 3,741. The interest charged is 6% p.a.</p> <p>i) Find the amount of loan.</p> <p>ii) Immediately after payment of the 2nd instalment, find the outstanding loan.</p> <p>iii) Find the total amount of interest paid.</p> | 9 |
| | <p>Given : v^3 at 6% = 0.839619</p> | |

- b) Three cards are drawn simultaneously at random from a pack of cards. 6
 What is the probability that:
 i) At least one is an ace
 ii) At least two are black
 iii) None is an eight.
- c) In how many ways can a 5 digit number containing non repetitive 5
 digits be formed such that the number comprises of alternating odd
 and even digits.
3. a) **Given:-** $q_{40} = 0.008022$, $q_{41} = 0.009009$, 8
 $q_{42} = 0.010112$ and $i = 0.04$

Evaluate:-

- i) $\ddot{a}_{40:\overline{3}|}$, correct to 3 decimal places
- ii) $A_{40:\overline{3}|}$, correct to 5 decimal places
- b) A life office issues a special policy on the life of a person aged 35 12
 for a sum assured of Rs. 80,000 payable on survival to age 60 or on
 death, if earlier. Further, on survival to age 60, the policy provides
 for a whole life assurance of Rs. 40,000 payable on death at any time
 after age 60. Annual premiums are payable for 25 years or till earlier
 death.
 Calculate the office annual premium taking into account expense
 loading as under. First year Rs. 600 plus 70% of the premium, Renewal
 Rs. 60 plus 7% of the premium.
- Given:-**
- | X | Dx | Nx | Mx |
|----|---------|----------|--------|
| 35 | 2507.40 | 52663.13 | 481.90 |
| 60 | 882.85 | 12477.80 | 402.93 |
4. a) Calculate the net single premium for a life aged 40 on a Special 5
 endowment assurance policy of sum assured Rs. 50,000, where on
 death during the term of 15 years the sum assured is payable and on
 maturity twice the single premium is paid.

- b) Calculate the net annual premium for a life aged 50, for a special whole life policy of sum assured 1lakh, where sum assured is payable on:
- death during the premium payment term of 10 years or
 - Survival to the end of the premium paying term and twice the sum assured payable on death after the premium paying term.
- c) Calculate the net single premium for a life aged 45 on a special cash back plan of sum assured Rs. 40,000 where:-
- On survival, 50% of the sum assured is payable each at the end of 10 yrs. and at the end of the term of 15 years.
 - Return of premium on death during the term of the policy.

Given :

$M_{40} = 1598.1679$	$D_{40} = 9353.5601$	$N_{50} = 66676.968$
$M_{45} = 1503.7177$	$D_{45} = 6904.9981$	$N_{40} = 28268.269$
$M_{50} = 1393.4551$	$D_{50} = 3660.5858$	
$M_{55} = 1258.3191$	$D_{60} = 2597.8808$	
$M_{60} = 1104.5519$		

- d) Prove that :

$$\frac{{}^{(n+1)}C_r \cdot n P_{r-1}}{({}^{(n+1)}P_r \cdot n C_{r-1})} = 1/r$$

5. a) What are the lives usually excluded from the experience in the investigation of mortality of assured lives from life office data. Briefly give reasons for their exclusions.
- b) Applying the census method to life office data, calculate the mortality rates at ages 51 and 52 from the following data:

Age last birth day	No. of inforce policies as on 1.4.2007	No. of inforce policies as on 1.4.2008	No. of deaths at age last birth day during 1.4.2007 to 1.4.2008
51	31938	32065	319
52	29971	30242	332

c) - From the table given below calculate:

$${}^1q_{[52]}, \quad {}^{11}q_{[50]+1}, \quad {}^{12}q_{[51]} \quad \text{and} \quad {}^2P_{[50]+1}$$

Correct to 5 decimal places.

Age at Entry [x]	$l[x]$	$l[x]+1$	$l[x]+2$	Attained age x+2
50	583229	582113	580915	52
51	582034	580896	579671	53
52	580814	579650	578393	54

6. a) Explain by general reasoning the relation: $A_x = 1 - d \ddot{a}_x$ 4

b) i) **Given:** $a_{50} = 16.444$, $a_{60} = 13.134$, $v^{10} = 0.675564$, 8

$$l_{50} = 9712 \quad \text{and} \quad l_{60} = 9287$$

Calculate: $\ddot{a}_{50:\overline{10}|}$ correct to 3 decimal places.

ii) **Given:** $A_{40} = 0.23056$, $A_{60} = 0.45640$,

$$V^{20} = 0.456387 \quad l_{60} = 9287 \quad l_{40} = 9856$$

Calculate: $A \left[\begin{array}{c} 1 \\ 40:20 \end{array} \right]$ correct to 5 decimal places.

c) Calculate office single premium for an immediate annuity policy providing an annuity of Rs. 12,000 per annum, payable yearly in arrear for 5 years certain and thereafter during the life time of a person now aged 65. Provide for initial expense of Rs. 5 per thousand of single premium and 3% of the annuity payments. 8

Given: $V^5 = 0.82193$, $l_{65} = 8821$,

$$l_{70} = 8054 \quad \text{and} \quad a_{70} = 9.375$$

7. Fill up the blanks in the following portion of a life table.

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Age _(x)	l_x	d_x	q_x
40	982	0.00245
41	1021
42	0.00272
43	1161
44	1269
45	395298	1384

(Decimals in l_x , d_x may be rounded off and q_x to be given to 5 decimal places)

- b) 1000 members all aged 50 create a fund to which each contribute Rs. 1,000 at the beginning of each year as long as they are alive. On death of any member Rs. 20,000 is paid from the fund. The Fund was wound up after 10 years and the balance was equally distributed to all survivors. Find the expected amount each survivor would get if the fund earns 6% on its assets, assuming no expenses.

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Given :

$$D_{60} = 2597.8808 \quad N_{60} = 28268.269 \quad M_{60} = 1104.5519$$

$$N_{50} = 66676.968 \quad M_{50} = 1393.4551$$

8. Write short notes on :
- Actuarial valuation of policy liabilities
 - Reserve for revival of lapsed policies
 - Ultimate and aggregate tables of mortality rates,

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