

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

28th July 2022

Subject CM1B – Actuarial Mathematics
(Paper B)

Time allowed: 2 Hours (14.30 - 16.30 Hours)

Total Marks: 100

- Q. 1)** Wayne Enterprises has bought a shop for sum of Rs. 1.5 Crores. A further sum of Rs. 20 lakhs would be spent after three months on furnishing the shop and making it suitable for leasing to an apparel retailer.

The apparel retailer has agreed to take the shop on lease after end of 6 months wherein rent of Rs. 50,000 would be paid monthly in advance, a refundable security deposit of Rs. 15 lakhs without any interest shall be paid to the landlord today and rent shall increase at 10% p.a. at the end of each lease anniversary.

Tenant shall be responsible for regular maintenance expenses, property tax, electricity bill etc.

Landlord shall keep the property insured against fire and other perils. Insurance premium is expected to be Rs. 17,500 p.a. payable at the start of every year, increasing at 8% p.a.

Tenant also agrees to buy the property at the end of 5th lease anniversary.

Wayne Enterprises is liable to pay tax at 15% on capital gains and 22% on rent. Tax on rent collected during a month is paid in the following month. Capital gains tax is payable at the time of transfer of property.

Ignore cost inflation allowance for capital gains and depreciation when calculating tax payable. Capital gain is defined as the excess of sale proceeds over acquisition cost and cost of improvement.

- i) Ascertain the price at which property should be sold to the tenant such that Wayne Enterprises earns an IRR of 12% p.a. from the property after allowing for lease and transfer arrangement. (18)
 - ii) Calculate Accumulated Profit out of investment in property. (2)
 - iii) Tenant is willing to pay rent of Rs. 65,000 instead of Rs. 50,000 to start the lease provided property is sold at lower price. How would your answer in (i) above change if all other terms of the arrangement remain unchanged? (4)
 - iv) Assuming that overall inflation experienced by Wayne Enterprises is 80% of the inflation it experiences on its insurance premium, calculate the real yield experienced by the company through this deal in (i)? (3)
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- Q. 2)** A life insurance company issued a 20-year with-profit endowment assurance policy with a Basic Sum Assured of Rs. 100,000 to a life aged 30 years exact on 1 June 2002. Bonus is payable at maturity in the form of terminal bonus only. No bonus is payable in the event of death during the term of policy.

Premium of Rs. 3,000 is payable annually in advance throughout the term of policy or until death, whichever happens earlier.

The company determines a gross premium retrospective reserve where assumptions are set consistent with the actual experience of the company. The level of terminal bonus is set such that the total benefit payable on maturity is equal to 95% of this reserve at maturity. Death benefit is payable at the end of year of death.

In the Microsoft Excel template, you have been provided with the following information - mortality rates which reflect actual claims experience of the company, returns index which you may use to determine the actual investment performance of the company's assets and expense experience of the company.

- i) Construct, using recursive approach, a schedule of gross premium reserve for each policy year of this policy. (20)
 - ii) Determine the terminal bonus payable at maturity for this policy and express it as a percentage of Basic Sum assured. (5)
 - iii) The company has a past practice of paying terminal bonus at 15% or more of Basic sum assured and intends to maintain the Policyholders' Reasonable Expectation (PRE). Using actual experience, determine the premium that was required to charge to maintain PRE. (5)
 - iv) List any three items which create PRE. (3)
 - v) The company in its marketing material promised to its policyholders that there will be non-negative investment returns credited each year for the determination of policy value (or gross premium retrospective reserve). Quantify the impact of this guarantee on the terminal bonus, if any. Further, also determine whether this policy feature results in any eventual loss to the insurance company. (7)
 - vi) At the time of pricing this product, the Company had considered performing a stochastic analysis.
State the benefits of performing a stochastic assessment.
Identify the key variable which the Company should have modelled stochastically. (4)
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Q. 3) ABC Insurance Co. intends to launch a unit linked life insurance product. Features of the product are enumerated below:

Policy term: 10 years

Death Benefit: Maximum of 10 times Annual Premium and Unit Fund Value

Maturity Benefit: Unit Fund Value at Maturity

Premium term: 5 years

The table below summarises the premium allocation charges and commissions. These are incurred along with premium payment.

Policy Year	Premium Allocation	Commission (% of annual premium)
1	5%	5%
2	3%	4%
3	3%	3%
4	2.5%	2%
5	2.5%	2%

Other charges applicable are summarised below:

- Policy Administration charge: 0.5% p.a. of Annual premium (not exceeding Rs. 6,000 p.a.) deducted every month at the start of policy month.
- Mortality Charge: 125% of Standard Mortality Table (as provided in the template) deducted at the start of every month on Sum at Risk.
- Fund Management Charge: 1.35% p.a. deducted from Unit price at the end of every month.
- All the charges attract GST @ 18%. Same is deducted along with charges.

Investment returns are noted below:

Unit Fund Growth Rate: 8% p.a.

Non-Unit Interest Rate: 5% p.a.

Policyholder is entitled to a loyalty addition of 0.5% of average unit fund value during previous 60 months' end. Loyalty addition is added to the Unit fund on maturity.

Insurer is expected to incur following expenses:

Initial:-

- Stamp Duty: 20 paise per Rs. 1000 of Death benefit as at start of the policy
- Acquisition expenses: 3% of Annual Premium not exceeding Rs. 3,500 per policy

Recurring:-

- Maintenance expenses (incurred in all policy years): Rs. 350 p.a. per policy spread equally over full year inflating at 6% p.a. Inflation to apply for each policy year.

Mortality Assumption: 80% of Standard Mortality Table

Withdrawal assumption: nil

For a Policy with Annual Premium of INR100,000 sold to a person aged 40 years. You are required to

- i) Prepare projections of monthly Unit and Non-Unit cashflows. (20)
- ii) Calculate expected profit that would emerge in each policy month given that Insurer holds unit reserves and no non-unit reserves. Ignore prudence in reserves. (3)
- iii) Calculate the revised profit emerging each year assuming that the non-unit reserves are set up to ensure that expected profit in future policy months are non-negative. (6)

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