

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

27th May 2023

Subject CP2A – Actuarial Modelling (Paper A)

Time allowed: 3 Hour 15 Minutes (10.15 – 13.30 Hours)

Total Marks: 100

INSTRUCTIONS TO THE CANDIDATES

- 1. Mark allocations are shown in brackets.*
- 2. Do save your work in solution template on a regular basis.*
- 3. All the detailed guidelines are available on exam screen.*
- 4. If Any, Data set file(s) accompanying the question paper is available for download on the exam screen.*
- 5. Please check if you have received complete Question Paper and no page is missing. If so, kindly get new set of Question Paper from the Invigilator.*

AT THE END OF THE EXAMINATION

Please return this question paper to the supervisor separately. You are not allowed to carry the question paper in any form with you. You are requested to save and submit the work before leaving the examination premises.

Exam requirements

Q. 1) Modelling steps and data checks

Read the background document, which describes the scenario that need to be modelled and documented for this project.

Construct a spreadsheet model that produces the following calculations and charts. You should ensure that your spreadsheet contains appropriate self-checks and that you have performed (and documented in the audit trail) reasonableness checks at each stage of your calculations.

i) Carry out checks on the customer data provided (Annual Premium, Premium Paying Term, Policy Term, Issuance Year and Fund Split). This should include analysis of the data provided to give reassurance that data is fit to use. (3)

ii) Analyze the charges provided to validate reasonability. This should include checks on all charges i.e., Fund Management Charge, Allocation Charge and Policy Administration Charge. (3)

iii) To compute the surrender IRR for each of the 250 unit-linked policies, carry out the following projections:

a) The investment returns for Fund A and Fund B till 2045. (2)

b) Fund Management Charge (% p.a.) and Administration charge (p.a.) applicable for each of the 250 policies. (3)

c) The premium payable, allocation charge (% p.a.), investment returns (% p.a.) for each year, as applicable for each policy, starting from 2011 till 2045. (4.5)

d) Fund Value (FV) as on current date i.e., end of 2023.

$$FV \text{ at End of Year (EOY)} = FV \text{ at Start of Year (SOY)} + \text{Premium} - \text{Allocation Charge} - \text{Administration Charge} + \text{Investment Income} - \text{Fund Management Charge} \quad (3)$$

iv) Compute surrender IRR for each policy, assuming each policy were to surrender now (i.e., at the end of 2023). (2.5)

[Hint: You may wish to use Excel function IRR]

v) By extending fund value projections to end of policy term, estimate maturity IRR for each policy. (2)

vi) Mr. A intends to recommend the following to his customers:

- If Surrender IRR < Proj. Maturity IRR, continue the policy till end of the policy term.
- If Surrender IRR >= Proj. Maturity IRR, surrender the unit-linked policy and instead buy a new single premium fully guaranteed policy.

Considering the above, find the average premium of policies that should be sold by Mr. A to surrendering policyholders by carrying out the following calculations:

- a) Estimate the proportion of policies which are better surrendered based on comparison between surrender IRR and projected Maturity IRR and produce a suitable chart for the same. (2)
- b) For each policy where Surrender IRR $\geq$ Maturity IRR, project the yearly commission loss for Mr. A. (3)
- c) Calculate the aggregate loss for Mr. A as of valuation date i.e., present value of commission loss summed over all surrendering policies. (2)
[Hint: You may wish to use Excel function NPV and assume a discount rate of 7%].
- d) Goal-seek the average premium that surrendering policyholders should pay to buy the new fully guaranteed Single Premium Plan such that Mr. A's aggregate loss as computed above is offset by commission income from selling new product. (2)

[Note: all scenarios outlined above should be modelled separately in your spreadsheet. The user should not need to change the parameters to see the results.]

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Q. 2) Modelling technique and practice

- i) Auto checks or reasonableness checks on the modelling completed in (Q.1). (3)
- ii) Demonstration of good modelling techniques and practice. (7)

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Q. 3) Audit trail

Produce an audit trail in your spreadsheet for the above model that includes the following aspects:

- Purpose of the model
- Data and assumptions used
- Methodology, i.e. description of how each calculation stage in the model has been produced
- Explanation of checks performed

You should ensure that your audit trail is suitable for both a Senior Actuary, who has been asked to approve your work, and a fellow student, who has been asked to peer review and correct your model, to continue work on it or to use it again for a similar purpose in the future.

Marks available for audit trail:

i) Audit approach

- a) Communication skills (the audit trail provides enough detail to be read as a stand-alone document). (4)
- b) Fellow student can review and check methods used in the model. (7)
- c) Senior Actuary can scrutinise and understand what has been done. (7)

d) Written in clear English. (4)

e) Written in a logical order. (3)

ii) Audit content

a) All steps clearly explained. (8)

b) Clear signposting included throughout. (4)

c) Statement of assumptions made. (5)

d) All model steps accurately covered. (16)

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Background

Mr. A is an insurance broker and has been in the business for more than 20 years now, selling a wide range of life, health, and general insurance policies to his clients.

Following some media articles on anticipated worse economic scenario, he intends to do a financial evaluation of contracts on behalf of his clients to advise them on whether they should surrender the policy. Specifically, he wants to study current and projected returns of 250 unit-linked policies that he sold for XYZ Ltd. (Life Insurance Company) between 2011 to 2015.

He has reached out to our firm, ABC Consultants, to help him evaluate surrender and maturity IRRs for each of the 250 customers. Your manager has asked you to do the cash flow projections for Mr. A to help him with the required financial analysis.

Mr. A has supplied the following details for each of the policies to carry out cash flow projections:

- Annual Premium
- Premium Paying Term
- Policy Term
- Issuance Year
- Split of fund chosen by the customer

XYZ Ltd. offers choice between two funds – Fund A (debt-oriented) and Fund B (Equity Oriented).

Further, Mr. A has gathered following information from XYZ Ltd. which shall be required to conclude the financial analysis:

• **Policy Charges:**

1. Administration charge

Premium Band	Charges
Up to INR 49,999	1.00% of premium, subject to maximum of INR 375
INR 50,000 to INR 99,999	0.75% of premium, subject to maximum of INR 600
INR 1,00,000 to INR 2,49,999	0.75% of premium, subject to maximum of INR 1,250
Above INR 2,50,000	0.50% of premium, subject to maximum of INR 1,500

Administration charge is deducted at start of each year from the accumulated fund of the customer.

2. Allocation charge:

Policy Year	Charge (% Premium)
1	10.0%
2	7.5%
3	5.0%
4	5.0%
5+	0.0%

Annual Premium less applicable allocation charge is added to the fund value.

3. Fund Management Charge (FMC) – 0.80% p.a. for Fund A and 1.50% p.a. for Fund B

FMC is deducted as a % of fund value at end of each year.

- The returns till date on Fund A and Fund B have been provided. Note that the investment income on these policies would be in proportion of the split chosen by the client.

Note: Assume valuation date to be end of 2023.

Your manager has provided you with following additional data points which might be required for completing the project:

- Investment returns from year 2024 onwards to be projected using following method:
Fund A: 10-year moving average less 50 bps.
Fund B: $75\% * (5\text{-year moving average less } 50 \text{ bps}) + 25\% * 10\text{-year moving average}$.

Note: *It has been agreed with Mr. A that annual projections would suffice for this assessment. 1 bps = 0.01%.*

Additional Scenario:

Following the analysis done by Mr. A, if a customer decides to surrender a policy, it might have financial consequences for Mr. A as he earns 2.50% renewal commission per premium paid on these policies.

To offset these losses, Mr. A intends to offer a new fully guaranteed Single Premium plan to the surrendering customers. On this, he shall earn a one-time commission of 10% of Single Premium.
