INSTITUTE OF ACTUARIES OF INDIA

Subject SA3– General Insurance

May 2024 Examination

INDICATIVE SOLUTION

Introduction

The indicative solution has been written by the Examiners with the aim of helping candidates. The solutions given are only indicative. It is realized that there could be other points as valid answers and examiner have given credit for any alternative approach or interpretation which they consider to be reasonable.

Solution 1:

i) EPD – Expected Policyholder Default is defined as the expected value by which the available assets of an insurance company would be insufficient to meet its estimated policyholder obligations over a pre-defined time horizon based on a chosen criteria. The expected value so determined is usually expressed as a percentage of expected value of policyholder obligation estimates, which is called the EPD ratio.

Alternatively:

Let there be *n* scenarios under which policyholder liabilities have been estimated and let X_i be the estimated policyholder liabilities in the i^{th} scenario. Let A be the total available assets to meet the estimated policyholder obligations. Then:

Amount of Policyholder Default = $\begin{vmatrix} 0 \text{ (if } X_i <= A) \\ X_i - A \text{ (if } X_i > A) \end{vmatrix}$

Expected Policyholder Default = $\sum_{i=1}^{n} P(X_i) * \text{Max}(0, (X_i - A))$

EPD ratio =

$$\frac{\sum_{i=1}^{n} P(X_i) * \text{Max}(0, (X_i - A))}{E[X]}$$

(2 marks)

Probability of ruin is the chances of an adverse event whereby the available assets would not be sufficient to meet the policyholder obligations over a given time horizon. It is expressed as a percentage and lies between zero and one.

Alternatively:

Let there be *n* scenarios under which policyholder liabilities have been estimated and let X_i be the estimated policyholder liabilities in the i^{th} scenario. Let A be the total available assets to meet the estimated policyholder obligations. Then:

Probability of ruin = $\sum_{i=1}^{n} P(X_i | X_i > A))$

(2 marks)

(4)

ii)

a) Given that capital to be allocated equally between the two LOB. Therefore, capital allocated is INR 1350 Crore in each LOB.

(1 mark)

Health:

Probability weighted expected policyholder obligation in all 3 scenarios:
(8%*500) + (85%*800) + (7%*1400) = INR 818 Cr

(1 mark)

Expected default in each of the 3 scenarios:

Scenario	Available Assets	Policyholder Liabilities	Amount of Default
1	1350	500	0

2	1350	800	0
3	1350	1400	50

Probability weighted expected policyholder default in all 3 scenarios:
(8%*0) + (85%*0) + (7%*50) = INR 3.5 Cr

(2 marks)

EPD as % of overall expected liabilities (EPD ratio) = 3.5 / 818 = 0.428%

(1 mark)

Motor:

Probability weighted expected policyholder obligation in all 3 scenarios:
(8%*600) + (85%*1000) + (7%*2000) = INR 1038 Cr

(1 mark)

Expected default in each of the 3 scenarios:

Scenario	Available Assets	Policyholder Liabilities	Amount of Default
1	1350	600	0
2	1350	1000	0
3	1350	2000	650

Probability weighted expected policyholder default in all 3 scenarios:
(8%*0) + (85%*0) + (7%*650) = INR 45.5 Cr

(2 marks)

EPD as % of overall expected liabilities (EPD ratio) = 45.5 / 1038 = 4.383%

(1 mark)
(Max 9)

b)

		3 marks		*2 marks*	*1 mark*	*2 marks*
		A	B	C	D	A * D
Motor	Health	Probability	Assets	Liabilities	Shortfall	Expected default
Scenario 1	Scenario 1	0.00640	2700	1100	0	-
Scenario 2	Scenario 1	0.06800	2700	1500	0	-
Scenario 3	Scenario 1	0.00560	2700	2500	0	-
Scenario 1	Scenario 2	0.06800	2700	1400	0	-
Scenario 2	Scenario 2	0.72250	2700	1800	0	-
Scenario 3	Scenario 2	0.05950	2700	2800	100	5.95000
Scenario 1	Scenario 3	0.00560	2700	2000	0	-
Scenario 2	Scenario 3	0.05950	2700	2400	0	-
Scenario 3	Scenario 3	0.00490	2700	3400	700	3.43000
		1.00000				9.38000

EPD as % of overall expected policyholder liabilities for Health & Motor = 9.38 / (818+1038) = 0.51%

(2 marks)

Probability of ruin = sum of probability of scenarios that give rise to a default
= 0.0595 + 0.0049 = 6.44%

(2 marks)
(Max 12)

c) To meet PoA criterion of 99.5%, the amount of capital should be such that probability of ruin is less than or equal to 0.5%. From above calculations we see that ruin probability is 6.44% (5.95%+0.49%).

Consequently, additional capital of INR 100 Crore is needed so that the probability of adequacy of at least 99.5% can be reached. Overall capital therefore needed to meet PoA criterion is INR 2800 Crore.

(2 marks)

d) At the overall capital available of INR 2800 Crore, the company has 0.49% probability of experiencing a policyholder default of INR 600 Crore, which translates to an expected default of INR 2.94 Crore (600*0.0049).

(1 mark)

Let x be the capital allocated to Health. Therefore, capital allocable to Motor is (2800 – x). The equation to be solved to ensure that EPD in both LOBs equalise is:

(1400 – x) * 0.07 = (2000 – (2800 – x)) * 0.07
1400 – x = x – 800
2x = 600 which implies x = 300

(1 mark)

Health:
Capital allocated – INR 1100 Crore (1400 – 300)
Probability weighted expected policyholder default in all 3 scenarios:
(8%*0) + (85%*0) + (7%*300) = INR 21 Cr
EPD Ratio = 21 / 818 = 2.567%

(3 marks)

Motor:
Capital allocated – INR 1700 Crore (2800 – 1100)
Probability weighted expected policyholder default in all 3 scenarios:
(8%*0) + (85%*0) + (7%*300) = INR 21 Cr
EPD Ratio = 21 / 1038 = 2.023%

(3 marks)

Comment:

1. The method of allocation is intuitive as it allocates more capital to the LOB with greater volatility in expected liabilities, i.e., Motor in this case.
2. However, the capital allocated in above method only equalises EPD in both LOBs which may not be the most appropriate.
3. As per equalise relative method, relative measure is to be equalised among all LOBs i.e., in this case allocation to be based on equalised EPD ratios.

(1 mark for valid comment, Max 2)
(Max 8)

iii) The Actuary may consider the following additional steps and investigations to improvise the above model:

<u>Assets:</u>

- It is not clear how the value of assets was calculated. The actuary may want to take into account asset valuation method (book value, market value, fair value), investment cash flows, tax implications, expenses attributable to managing and liquidating assets, admissible vs inadmissible assets, current economic conditions, market conditions etc., .
- Volatility and uncertainty surrounding assets also may be considered under various scenarios.
- Since capital assessment also means there may arise a potential need for additional capital, cost of capital may be incorporated while discounting asset cashflows.

<u>Liabilities:</u>

- The probabilistic scenarios appear simplistic, and the actuary may want to consider scenarios with a range of expected values including possibility of stochastic analysis of liability outflows.

- The tail of the distribution has a significant impact on capital requirement. It needs to be investigated how the liabilities are distributed around the tail with say less than 1% probability.
- The liabilities of Health and Motor are assumed to be independent and uncorrelated. The actuary may want to assess any correlations that may exist between the LOBs which will have an impact on the joint probability distributions. Besides, Motor portfolio will need to be split up into Motor OD and Motor TP.,
- Since Motor TP liability valuation is more complicated, with judicial inflation playing a role in determining the cashflows apart from impact new Motor Vehicle Amendment Act, regulatory and legal environment should be considered while estimating the cash outflows.
- The actuary may be interested to run the capital adequacy tests with both discounted and undiscounted liabilities, and with and without prudential risk margins to assess sensitivity.
- Since the data given pertains to ultimate liabilities, it appears that the time horizon assumed is perpetuity (i.e., ultimate ruin probability). The actuary may further consider more short-term scenarios (one-year and three-year) to assess immediate liquidity and financial stability of the company.

Risk Measure & Allocation:

- The risk measure used here is EPD. The actuary may want to iterate the calculations using other risk measures like VaR, CVaR and Tail VaR.
- If so justifiable the actuary may use different risk measures for different LOBs having studied the distributions and claim history.
- The actuary may want to revisit calculations to allocate capital under equalise relative method (i.e., equalising EPD ratio) rather that equalising absolute value of the EPD.
- The capital allocation may need to be compared with other methods like proportional allocation, marginal allocation (if there are diversification benefits) or capital allocation line to identify optimal allocation that potentially maximises RAROC.
- The actuary may want to see if the capital allocation meets the RAROC criteria if any, or conversely, to estimate RAROC under the given method of allocation.
- The risk capital estimated will need to be compared with the regulatory EC calculations.

(Max 9)

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Solution 2:

i) Four objectives of a reinsurance programme:

The Re-insurance Programme of every Indian Insurer shall be guided by the following objectives to:

- Maximize retention within the country, subject to proper and adequate diversification of risks;
- Develop adequate technical capability and financial capacity;
- Secure the best possible Re-insurance coverage required to protect the interest of the policyholders and (retro)cedants at a reasonable cost;
- Simplify the administration of business.

(4 marks)

Three main principles of an insurer's retention policy:
Every Indian Insurer shall:

- maintain the maximum possible retention in commensuration with its financial strength, quality of risks and volume of business;
- formulate a suitable insurance segment-wise retention policy; bearing in mind the above stated objectives, duly approved by its Board;
- ensure that the Re-insurance arrangement is not fronting.

(3 marks)

Three main considerations for the Board while formulating the insurer's retention policy:

- Business mix, overall risk appetite, type and extent of Re-insurance protection required;
- Level of risk concentration and retention levels;
- Mechanism of reinsurance.

(3 marks)
(10)

ii)

	Reinsurance	Captive	Self-Insurance
a) Set-up process	Set up through reinsurance contracts with reinsurer by paying reinsurance premium. May be for specific LOBs, all LOBs or at aggregate level. May need to consider the type of treaty / fac and proportional / XoL type of arrangements. Commission arrangements needs to be fixed at the outset with the reinsurer.	Captives set up as a legal entity and are effectively (re)insurance companies that do not write market business and only accept risks ceded by parent insurance company Can be a costly and time-consuming process to get licence, registration and meet legislative criteria	These are set up as reserves or provisions in the balance sheet In the absence of reinsurance, all Gross premium and claim reserves are effectively Self-insurance funds Additional reserves can be set up to protect against extreme events e.g., equalisation reserves
b) Compliance & Solvency issues	Company may need to meet minimum and maximum regulatory ceding requirements Periodic returns on the various reinsurance arrangements and treaties may need to be filed with regulator Reinsurance provides relief to an insurance company in estimating solvency requirements	Would need to meet minimum capital requirements as applicable to a reinsurance company Would be subject to submission of regulatory returns and reports as applicable Since it is effectively a retention strategy, reinsurance benefit may not be available to parent company for solvency purpose. However, the captive may need to meet solvency requirements as applicable to a reinsurer.	100% retention may not be allowed in most jurisdictions and minimum ceding may need to be demonstrated Capital requirements can be more stringent, and solvency can be more onerous for insurance companies that significantly self-insure. Self insurance results in less underwriting capacity and more volatility in the balance sheet thereby leading to requirement of more capital often.
c) Accounting treatment	Reinsurance premiums paid are accounted for through Gross and Net Premiums, claims through Gross & Net Incurred claims Premiums are recognised using accrual concept with calculation of Earned Premiums and UPR on Net Basis Gross and net commissions are separately accounted.	Premiums ceded to a captive are usually deductible as expense in P&L and claims paid by captive would be treated as income. The captive itself will need to carry out accounting as an insurance company. As a subsidiary company, the captive's accounts would be incorporated in parent company's group accounts	Gross premium and claim reserves would be accounted for as applicable for an insurance company. Any additional self-insurance reserves created may not be allowable as a charge in P&L and may sometimes be a direct Balance Sheet entry (e.g., transfer from shareholder funds to equalisation reserves)

d) Tax consequences	Since Net Earned Premiums and Net incurred claims are the reckoning factors for calculating the insurance result, reinsurance premiums do have a tax shield on an accrual basis particularly for proportional programmes. Also, commission paid to the reinsurer (if any due to losses) can be treated as an expense which may add to tax relief. XOL premiums are usually charged in full to arrive at Net Premiums.	Premiums ceded to a captive are deductible as expense usually in P&L. This means captive premiums ceded have a direct tax shield. However, the captive reinsurance company may need to recognise risks accepted through earning patterns and remaining coverage.	Funds transferred to self-insurance reserves over and above technically estimated premium and claims reserves may not be allowed as a deductible in P&L to make sure that companies do not employ it as a tax avoidance strategy. Direct Balance Sheet reserves would not come under the tax ambit. Hence there is no specific tax advantage because of provisions created for self insurance.
e) Investment freedom	The reinsurance premiums ceded may not directly provide investment freedom but indirectly frees up capital thus allowing investment flexibility on the free reserves. In some cases, where there is arrangement to hold the fund to be ceded, there may be possibility of earning investment income subject to the agreement with reinsurer,	Premiums ceded to a captive can be invested by the captive in allowable assets subject to investment regulations as may be applicable to an insurance company.	The reserves created by the company towards self-insurance would be subject to standard investment regulations.
f) Premium flexibility	Reinsurer and reinsurance market decide the premiums and therefore insurer has minimum control particularly for non-proportional & facultative cases. Also, for reinsurance driven products, the underwriting is in line with the policy of reinsurer. However, for proportional ceding, a portion of premiums set by insurer is ceded to reinsurer, so claims experience can determine reinsurance terms like ceding & profit commissions. Reinsurance terms and premiums can be dynamic and may change every year based on changing market conditions	The purpose of the captive is to assist the parent company to accept risks in a cost-efficient way. Therefore, the parent company can have a significant say in premiums to be ceded to its captive (subject to any regulatory minimums applicable to the captive) Since captives are formed for the parent company, there is likely to be reasonable certainty on the premiums to be ceded to the captive at least in the short to medium term	The company has the technical freedom to assess its premiums and claims experience and accordingly transfer funds to its inhouse self-insurance reserves. Based on experience, the company can adjust premiums and coverages however, such revisions may be subject to regulatory approvals.
g) Profit considerations	Reinsurer terms and premiums take into account profit considerations of the reinsurer which may be	Premiums charged by a captive by design are not intended to make profits and therefore the parent company may benefit from low premiums and better	Self-insurance may lead to extreme volatility in profits with year-on-year experience greatly impacting P&L results.

	onerous on the insurer P&L in the short term. However, since reinsurance offers significant protection against claim volatilities, in the long run reinsurance may help smoothen insurer profits	profitability in the short term. However, given the captive's capital and solvency considerations, the cost of capital in running a captive may reverse any profits and surpluses of the parent company in the long run. The captive itself may consider portfolio management through further reinsurance and ART arrangements	Profit volatility may also mean the insurer may adopt a different funding strategy every year leading to more uncertainty in financial results and the resultant tax implications.
h) Exit feasibility	Most reinsurance contracts are annually renewable and therefore, either the insurer or the reinsurer may choose to not continue or renegotiate the terms. Reinsurance markets are highly competitive, and the insurer can choose to change reinsurer if better terms are being offered.	Exiting a captive can be a complex process with considerations like wind-up formalities, liquidation of assets and transfer of liabilities either to a reinsurer or to the parent company's own balance sheet.	An insurance company can choose to exit its self-insurance strategy either through full or partial transfer to a reinsurer or to a captive insurer or through any of the ART mechanisms. The company may also choose to exit specific LOB(s)s or specific risks, however continuing to self-insure

(1 mark for giving at least one valid implication for each strategy , Max 3 marks per area)
(Max 24)
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Solution 3:

i)

- Product design and coverages
- Technical rating and setting minimum sustainable rates
- Provide opinion on the market rates and advise the underwriters on the possible scenarios that can render the rates inadequate
- Spot audits and verification of processes to ensure underwriters adhere to underwriting guidelines
- Screening the client with respect to their past experience, their risk management practices, their exposures (by sector/geography) and their current and future insurance needs
- Assessing if the capital available is adequate for supporting such large risks backed with scenario analyses and sensitivity tests
- Whether the risk being screened has any correlation with risks already assumed / accepted by the company (correlation between existing clients and potential clients)
- Warning indicators to avoid risks of accumulations and exposures breaching PML limits
- Justify technical rates with external stakeholders (regulators, reinsurers)
- Suggest the insurer on the commission which can be sustained and expenses are within limits.

(1 mark per valid point. Max 6)

ii)

Liability insurance:

- Public Liability: to cover any physical injury or property damage caused to the third party within the insured premises or any public inconvenience caused in the course of installation and operation
- Employer Liability: to cover injuries and illnesses of employees caused in the course of their employment (e.g., electrocution or exposure to heat / radiation etc.)
- Professional Liability: to cover the business against third party claims and costs, or losses to business arising from negligence, acts of errors and omissions by employees and workers.

Property insurance:

- Physical damage to the property and premises
- Loss of accessories and electronic paraphernalia due to insured event
- Insured events may be STFI & EQ perils, theft, disruptions and civil commotion

Business interruption insurance:

- Loss of revenues owing to insured events e.g., natural events or power supply interruptions / outages, grid failures
- Penalties and compliance costs arising from temporary shutting down owing to insured perils

Equipment breakdown insurance:

- Electrical, mechanical and electronic failures caused by internal or external events
- Coverage may include repair, replacement, reinstatement or reinstallation

Commercial vehicle insurance:

- Transportation of charging equipment to various locations for installation or replacement
- Mobile charging vehicles plying on the road may need commercial vehicle insurance
- Coverage may include theft, collision, public/third party liability, accident coverage and STFI coverage.

Cyber Risk Insurance:

- Since the charging stations have their own apps and uses IoT for charging, cyber risk covering unauthorized digital transactions, theft of funds, theft of identity, cyber extortion can be covered.
- Maximum sum insured could be agreed at the outset of the policy to cap the losses for insurer.

Group Health insurance:

- Indemnity / benefit-based insurance to cover the health related perils for the employees / the dependents.
- Hospital cash and critical illness can be added as add-on.

(Max 5 marks for Liability and Property insurance. Max 2 marks for each other valid product category)

(Max 8)

iii) Policy terms:

- Annually renewable as against long term policies
- Policy deductibles at various levels with maximum limit per event (coverage wise and aggregate deductibles)
- Adjustable premiums based on business and claims experience
- Not agree to profit sharing with client for extremely favourable experience in the short term till experience stabilises.
- Policy wordings have to be tight to avoid any moral hazard in the part of insured.

(Max 2)

Risk controls and underwriting guidelines

- Determine maximum allowable exposures by territory / location
- Stringent guidelines for underwriting in risk acceptance
- Clearly identify triggers that necessitate Board approval for accepting risks
- If possible, try to cover the entire eco system of risks (EV manufacturers / charger manufacturers etc.,)etc.,) so that there is no concentration in one LoB .

(Max 2)

Reinsurance:

- Probably cede more in initial years with combination of proportional, non-proportional and facultative arrangements
- Seek reinsurer expertise in technical rating and risk assessment
- May have further portfolio level reinsurance like a stop loss arrangements to limit losses

(Max 1.5)

Client's risk management practices:

- Approved Licenses and certifications for quality standards and controls
- Appropriately trained and professionally qualified staff deployed at the premises
- Risk mitigation mechanisms in place to minimise losses (e.g., fire extinguishers, consumer guidelines while charging the vehicle, elevated installations, etc.)
- Workers are equipped with appropriate gears to prevent mishaps

(Max 1.5)

Co-insurance:

- Company may consider coinsurance or syndicated insurance agreement to start with instead of being a sole insurer
- May choose to be a follower or leader depending on whether it seeks greater control on technical rating or whether it intends to minimise gross exposure by taking a smaller percentage of the risk

(Max 1.5)

Inward reinsurance:

- The company may want to tread safely and test the waters by accepting inward reinsurance before writing this book on a direct insurance basis
- Inward reinsurance allows the company to take on risks in the segment and monitor experience, particularly when the gross exposures can be too onerous or lie beyond the scope of the PML estimates in the underwriting guidelines

(Max 1 mark)

(Max 8)

[22]

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