

Institute of Actuaries of India

Subject SA3 – General Insurance

March 2017 Examination

INDICATIVE SOLUTION

Solution 1:

i) The six primary exposure variables are:

a) Currency; Building; Furniture; Parked Vehicles; Safe Deposit Lockers; Computers ATM's etc

Expect the answer to elaborate on how each variable is to be measured -- Area X Cost per sq ft, etc; The methodology should describe the parameters – e.g. cost per sq ft would depend on construction type and age of building, location, etc.” Marks are distributed as 0.25 for naming the variable, and up to 3 X 0.25 for each additional cogent description/characteristics of the variable.

Currency – Denomination – number per denomination – uncertainty in numbers

Building – area – cost per unit depending on construction type, vintage, location

Furniture – Value – metal or wood – any reasonable explanation of why likely to be total loss

Parked Vehicles – broad count of 2 wheelers and private cars – average value – likely to be total loss
(4)

b) Safe Deposit Lockers --

Computers, ATM's, etc

For both of these variables, expect candidates to state that “replacement cost” basis should be used and how replacement cost is dependent on current vintage and the vintage inflation

(2)

c) Total Exposure

The answer to this part should elaborate how the random variables are aggregated and the statistical measures that have to be developed to characterize summation. Expect at least four major points at 0.5 each (to make up 2 marks). Candidates should clearly indicate how their proposed solutions are mutually exclusive and jointly exhaustive, summation process, measurement of variance, and the potential extent of error in the estimate. The candidate should convey that a non-technical audience easily understands a simple multiplicative model but it is essential to impress the importance of variance.

(2)

ii)

Answers to (a) and (b) can be organized together.

Expect the candidate to focus on banks’ “account operations” and “lending operations”. 1 mark for identifying the operation, 1 mark for defining the appropriate measuring variable(s) for the operation (business volumes), 1 mark for the appropriate coefficients, 1 mark for the statistical measures needed to.
(4+4 = 8)

The expectation for ii (c) is similar to the expectation for i (c) above.

(2)

iii) The three liability covers are: Workers compensation for employees (2 marks); PA cover for customers on the premises (2 marks), and content's liability for lockers (1 mark). Mark distribution will be similar to the property variables.

(5)

iv) Candidate should discuss the mean and variance of the basic burn estimate from the different exposure composition components; capital cost requirements; cost of reinsurance, and the basic cost of the risk transfer and how the price should not be below this cost.

(2)

[25 Marks]**Solution 2:**

i) Valuation of Assets:

- a) Dues from Govt exceeding 180 days to be placed zero value (not in 2000 regs)
- b) Reinsurance balances exceeding 365 days to be zero for Indian and Foreign reinsurers with Branches in India and 180 days for all other reinsurers (earlier 90 days)
- c) Coinsurance balances exceeding 90 days to be zero (earlier not mentioned)
- d) Provisions on computer equipment removed
- e) Leasehold improvements zero
- f) Service Tax Unutilized Credit outstanding for more than ninety days zero
- g) FV change subject to zero (as against actual in earlier regs)

The above reduce available assets and hence reduce ASM

Valuation of liabilities

PDR to be estimated and added to UPR to get URR (earlier only UPR considered) – *increase PH liabilities, reduces ASM*

(4)

ii) a)

- Premium Deficiency Reserve means the reserve held in excess of the unearned premium reserve, which allows for any expectation that the unearned premium reserve will be insufficient to cover the cost of claims and related expenses incurred during the period of unexpired risk (IRDAI definition);

(2)

b)

- Chief determinants of PDR are:
 - Ultimate claims costs
 - Management expenses
 - Premiums
 - Combination of above

Circumstances where they give rise:

Adverse claims experience:

A worse than expected claims experience would give rise to a need to provide additional amount as reserves plainly for the uncertainties in claim incidence and quantum that were unknown to the insurer at the time of pricing. Corrective measures would be a product review by way of increasing premiums for same terms / stricter policy terms

Expense overruns

Where management expenses budgeted at the time of pricing was less than actual. This could be a short term phenomenon and hence may not need an immediate price correction and could be controlled through monitoring expenses. However continued expense stress may warrant a price revision.

Premiums

This could be seen as the most onerous cause for premium deficiency – i.e. a deficiency arising because of premiums being insufficient to cover expected claims costs and expenses. This situation could primarily arise from competitive / market pressures that could drag the premiums southward. Since this arises purely out of commercial considerations, the corrective measures are known but may not be acted upon.

The other circumstance could also be a government mandate to write certain businesses in view of social welfare which could have little scope for premium flexibility.

Both these circumstances could be addressed through writing other independently profitable portfolios that could give rise to a surplus and addition to equity.

(4)

iii)

INR Crore

Class of business	NWP	Net UPR	Net Loss Ratio	Net Commission Ratio	Management expense Ratio
Fire	250	150	69%	5%	20%
Health	400	250	75%	10%	20%
Motor	600	350	99%	8%	20%

a) Assumptions & basis:

- past experience of losses is a reasonable guide of future
- claims experience is uniformly spread over the term of the policy i.e. both expired and unexpired book would have similar claim incidence rates (ignores seasonality/cyclicalities)
- Nil cancellation rates assumed during the residual period to expiry i.e. no premium refunds from the reserves
- Loss ratios given are on NEP and Expense ratio given on NWP
- In Indian context:
 - o commissions are accounted upfront hence no deferred reserves for acquisition cost
 - o No set-off across lines
 - o No discounting allowed
 - o Net UPR subject to regulatory minimums , if applicable

PDR amount:

Fire – Nil; Health – Nil; Motor – 19%*350 = INR 66.5 Crore

Insurer level PDR estimation also awarded

(4)

b) Useful in

- Assessing profitability of lines / products
- Useful in A/E analyses of policy and claims management expenses and business overheads vis-à-vis those considered in pricing
- Underwriting year wise line wise PDR estimation helps assess intra-line profitable segments by looking at the mix of business and premium variations over the various years of underwriting
- Assessing PDR on Gross and Net basis could help in assessing efficiency of reinsurance programme i.e. if there is no PDR on Gross basis but PDR arises on Net basis it could indicate excess ceding (particularly excess of loss arrangements)
- Tool to monitor the appropriateness of pricing assumptions through A/E analyses of pricing loss ratios and estimated ultimate loss ratios
- Strategise business mix by identifying necessary loss leaders and those lines leading to a surplus thus helping balance market penetration, regulation and profitability.

(2)

iv) Other considerations:

- Gross and Net basis: PDR on a gross and net basis would help the insurer identify whether a price was low or the premiums ceded to reinsurer were high (particularly excess of loss reinsurance arrangements).
- Prudence in claim reserves: higher prudence in claim reserving could have a dual impact on reserves i.e. they could impact claim reserving as well as PDR (through loss ratio) whereas lesser prudence could bring down both.
- Product vs. Line: There could be arguments in favour of PDR at product level as there are in favour of line of business level PDR. A practical issue here is that a product could be a combination of many lines and vice versa – thus a product could be profitable but some individuals components may be loss making; this must be appropriately and consistently addressed
- Claim incidence pattern: claim experience on expired book could be favourable but cyclicity / seasonality in claim incidence could mean the unexpired book could be more prone to higher claims.
- PDR estimation: An interval estimate of PDR could be more reflective of inherent uncertainties than a fixed amount estimate
- Multiple premium payments: In certain lines of business more frequent premium payments than annual are not uncommon. In such cases the UPR as on date may not fully reflect the actual amount of premium reserves (as the instalment premiums would not have been received). This might tend toward underestimation of PDR.

- Long term policies: Investment income could be an important consideration where contracts are for longer terms. However, in Indian context, discounting of policyholder provisions is not allowed.
- Expense rate: An important consideration is whether the actual expense rate be taken into account or the long term steady state expense ratio. For example, capital expenditure may be written off over a term that is much shorter than the realisable benefit from that expenditure. This could tend to overstate the expense ratio and hence could give rise to a PDR technically.

(6)

[22 Marks]

Solution 3:

i) - (a), (b), and (c) Expect at least 10 major points (0.5 each) for each exposure group. Marks will be awarded for cogent answers. The expected structure of the solution is explained in the question wording itself.

Motor Risk- the candidate should identify the OD component and the TP component in the case of motor exposures with an approximate number for the exposures (given the premium volume, OD/TP split, premium expectations), etc. The candidate should then identify the two kinds of stress situations -- cyclone/weather situation in major cities impacting OD, and explosion in death claim awards impacting TP exposures. The candidate should show how to estimate these impacts and how accuracy will be improved if the exposures are drilled down to appropriate levels.

Health exposures should minimally be split at least into Individual (exposures ageing risk/ regulatory pricing risk), Group (market pricing risk and incorrect exposure measure risk), PA (external events CATS, etc) and International travel (Adverse Selection from people travelling for treatment and Exchange Rate). Ideally, candidates should cite industry loss ratios and discuss how these values will be skewed under the different scenarios.

Fire Exposures should be split into major and minor risk classes; discussion on “incorrect Sum Insured risk”, Underestimation of PML and the resulting basis risk, concentration risk; current market pricing risk in the Indian market; etc. Use of Model estimates for Nat CAT events and the modelling of large losses should be integrated with the answer.

(15)

ii)

The statistical summation of random variables, the need for simulation, and how capital need should be derived at the enterprise level should be discussed in this section.

- Basic Equation defining the total funds requirement as a sum of at least 5 random variables consisting of 3 loss variables, 1 expense variable, and 1 investment variable. (1 mark -- full marks only if the “random nature of the sum” is described.
- Basic cash-flow equation: Starting cash + Inflows – outflows = ending cash. (1 mark - - should describe the randomness of the summation for full marks)

- Why simulation is needed to evaluate this equation – complex nature of obtaining a Convolution integral and how simulation helps - (1–mark)
- Tracking of ASM and RSM and how to compute the Capital requirement – (2 marks)

(5)

iii)

Given the starting values in the question, the candidate should derive typical capital needs for each major line and how the stress situations will impact the capital needs.

- 1 mark for identifying a basic and simple relationship to estimate marginal capital requirements.
- 1 mark each for developing the potential capital need for each of the 3 lines -- the numerical value should be consistent with the broad figures provided in the problem.
- 0.5 marks for a coherent argument that capital need for other items like expenses, investments variables, latent losses will be negligible.
- 0.5 marks for a coherent argument on how/why reinsurance can be used as a source of capital

(5)

[25 Marks]

Solution 4:

i)

- Volume and mix of business
- Profitability history and market outlook
- Loss distribution – incidence and claim size
- Tails of loss distribution - exposure to large claims and catastrophes
- Investment strategy and performance
- Solvency requirements and Capital structure
- Free reserves of the company
- Reinsurance choices available in the market
- Reinsurance cycle (hard or soft rates)
- Risk appetite of the insurer
- Corporate structure
- Stakeholder expectations
- Rating agency considerations
- Regulatory requirements

(4)

ii) a)

- Calculate μ and σ based on mean 72% and sd 18%
 $\mu = -0.3588$
 $\sigma = 0.2462$

$$X \sim \text{LogN}(\mu, \sigma) \text{ then } \log X \sim N(\mu, \sigma)$$

Value of Log X at 90th percentile

$$\begin{aligned} \text{Log } X &= \mu + \Phi^{-1}(90\%) * \sigma \\ \text{Log } X &= -0.3588 + 1.2815 * 0.2462 \\ &= -0.04327 \\ X &= \exp(-0.04327) \\ &= 95.765\% \end{aligned}$$

There is a 10% chance that the reinsurer suffers a loss ratio of 95.765% on the ceded premium.

$$\begin{aligned} \text{Reinsurer's deficit} &= 100\% - \text{Loss Ratio at 90}^{\text{th}} \text{ percentile} - \text{Ceding Commission payable} \\ &= 100\% - 95.765\% - 15\% \\ \text{Deficit} &= 10.765\% \end{aligned}$$

$$\begin{aligned} \text{Quantum of deficit} &= 10.765\% * 25\% * \text{INR 500 Crore} \\ &= \text{INR 13.456 Crore} \end{aligned}$$

Assumptions:

1. Ignores present value of cashflows i.e. investment income is zero
2. Assumes cashflow matching between insurer and reinsurer
3. Management expenses of reinsurer ignored

Comment: The programme passes the test as per the given criterion of 10-10 rule and hence can be termed efficient.

(9)

b)

-In this case expected RI deficit at 90th percentile is 5% which is less than the criterion of 10% and hence does not pass the 10-10 test.

Comment:

A 10% increase in commission upfront yet the programme does not pass the test. Important to also consider time value of money which might lead to second option being more efficient than the first

(2)

c)

Advantages:

- Easy to implement and communicate
- A good rule of thumb measure
- Takes into consideration loss distribution
- Is flexible – can be modified to add more inputs like profit commissions/sliding scale structures; management expenses; loss ratio caps
- In this above case appropriate because it is a quota share arrangement
- The rule can be customised reflecting the internal criteria of the insurer , e.g. 15-15 rule

Drawbacks:

- Appears to be an arbitrary criterion as the thresholds chosen are not linked with the claims profile of the underlying book
- Extreme events and catastrophic events that are much less frequent are ignored
- Ignores expected values at the tails i.e. in case of extreme events
- It is likely that the test could 'fail' arrangements that could have been efficient had the criterion been different. For e.g, the arrangement could have a 8% chance of 70% loss to reinsurer though not having met 10-10 rule
- In the above case, the measure does not take into consideration the timing of cashflows and lags / delays
- May not be appropriate for excess of loss contracts particularly at higher deductible levels

(4)**iii)**

Definitions:

a) ERD – Expected Reinsurer Deficit : It takes into consideration the expected present value of underwriting losses for the reinsurer by taking into account severity and probability of a loss. Thus a 10-10 rule tantamount to ERD of 1%

b) CTE – Conditional Tail Expectation: aka TVaR – takes into consideration expected loss given the loss exceeds the VaR threshold. Can be used in assessing Stop loss arrangements.

(4)**iv) Criteria to be pre-evaluated:**

- Triggers that would necessitate putting a programme through a test
- Measure(s) to be used and the criteria for each of the measures
- If more than one measure used then comparative limitations to be assessed and how they impact test results

Considerations:

- Complete details of the terms and conditions of the reinsurance plan
- How are the cash flows between the parties agreed upon
- Loss distributions of expected losses and incidence
- Expense scenarios and their impact
- Investment income / discount rate to be used for cash flows – consistent for both cedant's and reinsurer's cash flows for comparability
- Only insurance risk need to be included
 - Underwriting risk
 - Timing risk
- Appropriate risk metrics and thresholds to be identified for testing and communication

(5)**[28 Marks]**
