

Institute of Actuaries of India

**Subject ST7 – General Insurance :
Reserving & Capital Modelling**

May 2013 Examinations

INDICATIVE SOLUTIONS

Solution 1:-

(i) An economic capital model is a more integrated, holistic approach. It systematically models the effects of many interrelated risk factors using simulation techniques.

Although these are significantly different in application, they are not in principle different, as a stochastic model is based on stress and scenarios weighted by probabilities.

In a DFA model, stress tests are generated automatically and often cannot be “seen.

Such as impact of interest rates on the future claims severity (impact on inflation) & frequency (economic downturn leading to increase in theft claims), investment return etc.

(2)

(ii) Additional measure that can be used would be return on capital approach.

In a simplest form it is – profit generated by capital that is backing the business.

Profit are post tax and includes both underwriting and investment income.

Capital includes both equity and debt capital. Free capital can be ignored for this calculation and just economic capital calculated from the model can be used.

If measured at portfolio level, capital that is backing each portfolio required to be calculated. This can be done using the outputs from the economic model.

Strictly, the return on capital should be based on profits earned in a given year divided by capital at the start of that year. However, sometimes calculations are based on capital at the end of the year or on the average of capital at the start and at the end of the year.

(3)

(iii) Economic model can be used to derive the capital allocations for each portfolio in a way that reflects their relative risk profiles.

Pricing: These capital allocations can be used to derive technical price benchmark or profit margin loading or cost of capital loading.

Reserving: quantifying the uncertainty in claims reserves for regulatory purposes

Planning:

Comparing different operational plans in terms of their risks

Comparing different plans in terms of their expected profits

Strategy:

Assessing the risks and diversification benefit of new strategies such as consideration for writing new lines of business

Sensitivity testing of the impact of key assumptions such as exposure to CATS/inflation shocks.

Assessing the impact of using new distribution channels e.g. different credit risk profiles/broker balances etc.

Assessing the impact of introducing new Terms and Conditions to policies – impact on pricing and capital can be assessed

Risk management:

Identifying key risks and assessing the impact of mitigation.

Mergers and acquisitions

Planning process by including output from the capital model.

Reinsurance:

Optimising the purchase of reinsurance/ reducing the volatility of the retained risks.

–types of RI and different retentions.

Investment

Investment: assessing the impact of a change in the investment mix.

Investment departments often use model output to match liabilities in terms of amount, timing, currency, etc.

Assess Liquidity

Marks for each of the above point to be allocated

(6)

[Total 11 Marks]

Solution 2 :-

For a risk to be insurable:

- the policyholder must have an interest in the risk being insured, to distinguish between insurance and gambling.
- a risk must be of a financial and reasonably quantifiable nature.
- the amount payable by the insurance policy in the event of a claim must bear some relationship to the financial loss incurred.
- Individual risk events should be independent of each other. This is not the case in this scenario as there is a high correlation between various risk events.
- The probability of the event should be relatively small. In other words, an event that is nearly certain to occur is not conducive to insurance.
- Large numbers of similar risks should be pooled to reduce the variance (of the average claim size) and hence achieve more certainty. There will be hardly any market for such risks to pool and if there is it may not be in the appetite.
- There should be an overall limit on the liability undertaken by the insurer.

- Moral hazards should be eliminated as far as possible because these are difficult to quantify, result in selection against the insurer and lead to unfairness in treatment between one policyholder and another.
- There should be sufficient existing statistical data / information to enable the insurer to estimate the extent of the risk and its likelihood of occurrence.
- However, the fact that some of these ideal criteria will not be met does not necessarily mean that insurance cannot be found. Insurers may be prepared to underwrite simply to generate income (by taking high risk), to build a relationship or develop a new market entrepreneurially. All risks were once insured for the first time.
- Point wise marks allocation required

[Total 5 Marks]

Solution 3 :-

(i) Key distribution channels would be:

Intermediaries

Brokers - Brokers act as intermediaries between the seller and buyer of a particular insurance or reinsurance contract without being tied to either party.

They are likely to be paid by commission (brokerage) from the insurer, but when placing business legally (under the “law of agency”) they are the agent of the insured.

Tied Agents – These are organisations such as banks and building societies are sometimes tied to a particular insurer (perhaps part of the same group) and sell that insurer’s products alongside their own. They are usually paid by commission for this service.

In case of large property risks tied agents could be property developers or companies that invest in large infrastructure projects.

Direct Staff – This could be one of the option but will not be used significantly. Mainly, it will be done from a marketing perspective.

(3)

(ii) The London Market insurance providers, including Lloyd’s, have traditionally acquired business through specialist brokers and, in particular, international brokers using the slip system

Under the slip system in the subscription market:

1. The insured approaches a London Market broker.
2. The broker prepares a slip that shows, in a standard format, the main features of the risk to be insured.
3. The broker shows the slip to one or more quoting underwriters, who, on the basis of the slip and further information as appropriate, quote a premium.
4. The cedant (with the broker’s advice) will then select a lead underwriter and a “firm order” price for the broker with which to approach the market. This firm order price may be below any of the quoted prices.

5. The lead underwriter accepts a share of the risk by stamping and signing the slip..
6. The broker then approaches other underwriters (the following market) to accept the risk on the same terms. All the underwriters act as coinsurers with several liabilities but each underwriter are separately liable for its obligations.
7. The broker continues until he or she has finished placing the risk (that is, received offers for 100% or more of the risk). All the underwriters follow the premium rate set by the lead underwriter (except in exceptional circumstances). Premium rate set by the lead underwriter is not so low that no other underwriter is prepared to follow.
8. If the written lines exceed 100% then, in agreement with the insured, they are reduced (or “signed down”) so that the signed lines total 100%.
9. If it is not possible to find capacity to place 100% of the risk, an additional shortfall cover may need to be placed at different terms. So the premium rate is increased or the cover or terms renegotiated.

If the risk is over-placed, this indicates that the firm order price was probably too high. Conversely, if the risk is not fully placed the firm order price was probably too low. Not placing the full risk, unless intentional is usually a bigger issue for the insured and the broker.

(5)

(iii) The interaction between these functions can be very complex and will vary from insurer to insurer. However, the underlying data requirements will normally be similar in each case. Data Group like this will have several advantages.

IT or Computing

Stakeholders from this department will form the larger part of the group as they will be responsible for the design, implementation, maintenance, extraction and reconciliation of data systems.

Apart from IT the following users should be part of the group as all of these users of the data though the usage will be different.

Actuarial/Statistical

Key users of data and will play significant role in defining the granularity of claims, premium and exposure data that should be collected for premium rating; reserving and assessing solvency capital requirements.

If granularity of data

Management

Management data (both claims and premium) needs tends to be sometime will be very detailed such as information by each risk type, location etc. Management representation will ensure that systems are designed and upgraded to generate information report on a automatic basis without much human intervention.

Accounting

Only require data at a very high level but representation will ensure that data available reconciles with the data used in reserving and other purposes such as collecting premiums; paying intermediaries, claimants, preparing summaries to deal with regulatory challenges.

Underwriting

Big users of data to ensure appropriate premium rating, identifying improvements, evidence of selection, portfolio monitoring. They will be able (along with actuarial) to define key rating factors that should be collected for future rate changes.

Investment/treasury

For the purpose monitoring and decision on investment strategy.
Interested in claims payment pattern etc. to understand the cash flow requirements and system design that can generate reports without any delay to ensure liquidity.

Reinsurance

Key role in ensuring that policy and claims processing data captures the right level of information to ensure that appropriate decisions can be made during renewals (retentions, upper limits, reinsurance rating etc.)

Claims

Suggestions to capture fraudulent claims, regular check to ensure that claims handling system are friendly and easy to understand otherwise can lead leakage.

Marketing & Sales

Prepare marketing reports that are consistent with accounting and management reports used for campaign especially in personal lines.

Legal

Avoid legal or regulatory disputes on data collection and uses.

Data Protection Laws -What data or policyholder information that can be collected and used for pricing purposes.

Securities of data system meet the regulatory requirement.

(9)

[Total 17 Marks]

Solution 4 :-**(i) Operational Risk**

Operational risk is the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events.

Parameterising an operational risk model

Stochastic techniques are rarely used because not enough history of extreme operational failures

Identify all material operational risk scenarios specific to the firm's business – risk register

A brainstorming session may also be advisable, or desktop analysis.

Risks may be considered separately by personnel with the skills to appraise such risks.

Make judgements about the degree of loss that each risk may give rise to, the type of event that may cause the loss and the frequency of such a loss occurring.

Consider each loss gross and net of any mitigating controls.

A proportional method may be justified because operational risk assessment can be very subjective

Stress/scenario testing may be used to test the robustness of the model

Issues associated with modelling operational risks

A full assessment of operational risk requires significant input from across the business

Using a percentage load will not consider the unique risk characteristics of the business

It will not demonstrate that the business has undertaken a full assessment of its operational risks.

Are we able to capture all risks within our register?

Are we able to understand the impact of all the operational risks?

Do we understand how the risks are correlated with each other and with other risk types?

Where elements of operational risk have been captured within other risk categories, it is good practice to identify and quantify these so we can avoid double counting.e.g. insurance fraud event is left within the data. This event may lead to an increase in the volatility assumption used for insurance risk and this risk will therefore already be allowed for as a part of the insurance risk charge.

Lack of reliable internal data

Existence of suitable external data

Start building an internal database of failures and near misses

(7)

(ii) Implement rigorous internal controls and processes

D&O cover reducing governance risk and other insurance cover for other risks

Disaster recovery planning

Internal fraud prevention processes

Complaints handling guidelines

Incentivise staff to enforce proper controls, staff training or vetting of hiring

ERM methods

(2)

(iii) All risk types would be expected to show some form of increase as additional exposures are being taken on.

Insurance risk could increase more significantly...

..Underwriting or pricing risk would be significant as this is a fixed price contract and there is no scope of changing the rating structure.

...though the product is not completely new so can be controlled....

Profit commissions tend to act in a non-linear fashion and significantly reduce diversification benefits as majority of excess profits are ceded so increase is likely....

Conversely, as a new line of business this could increase diversification but if product is written in same market and given that it is already writing motor and household insurance impact would be much less

Increased operational risk

...Any reasonable example of operational risk

Credit risk ...this will increase as this is a large contract and generally there are delays in receiving premium from affinity partners...

(4)

[Total 13 Marks]

Solution 5 :-

(i) Because the claims frequency is very low, experience for any one account would not be credible enough to have different incurred development patterns for each account.

(OR)

Even though the account in consideration is big on its own, the experience is unlikely to be credible enough.

(1)

(ii) The development pattern for AY2014 is different from the pattern for prior AYs due to changes to the policy conditions. So the assumption underlying the Chain Ladder method that the development pattern is suitable across all the exposure years does not hold true.

Limitation Period:

The impact of the limitation period on the claims count development pattern is that all the claims for AY2014 will be reported by development month 60. Assumption is that the reporting lag is not influenced by the limitation period .

Additional Benefit:

Average cost per claim method could be used as the development pattern of claim counts could still be used.

Due to the feature of the additional benefit, the claim severity has increased. The severity was a constant INR 200000 before.

Due to this additional benefit, the severity would be higher but the increase could vary by development month and some assumption could be required.

This assumption could be based on the actual difference between date of accident and date of death on all the historical claims across the entire group personal accident business.

(OR)

Separate triangulation for the fixed benefit of 2,00,000 and the weekly benefit. **(1 mark)**To arrive at the suitable incurred development pattern on the triangulation for the weekly benefit, all the historical claims should be gathered along with details pertaining to date of accident, date of intimation and the date of death.

Assign loss amounts pertain to the weekly benefit to each claim based on the time difference in weeks between the data of accident and date of death. Assume that these amounts would be incurred on the date of intimation.

(6)

(iii) Very stable severity but claim counts could be volatile depending on the overall credibility of the book – Some liquidity is required.

The development pattern indicates it is short/medium tailed. So, the duration of the bonds could range from short term to medium term.

No claims inflation. So, fixed interest bonds along with cash.

(3)**[Total 10 Marks]**

Solution 6 :-**Development Pattern**

Year	Incremental Reported	Cumulative Reported	Incremental Settled	Cumulative Settled
0	50%	50%	25%	25%
1	33%	83%	42%	67%
2	17%	100%	25%	92%
3	0%	100%	8%	100%
4	0%	100%	0%	100%

* Incremental Reported in Dev Year 2 = 100% - incremental reported for Dev Years 0 & 1

** Incremental Settled in Dev Year n = 50% * Incremental reported for Dev Years n & n-1

AY	Reported at Dec 31, 2012	Ultimate Claim Count	Settled at Dec 31,2011	Settled at Dec 31,2012	Settled at Dec 31,2013
2009	240	240	220	240	240
2010	200	200	133	183	200
2011	160	192	48	128	176
2012	120	240	-	60	160
Total	720	872	401	611	776

i) Claims settled in 2012 = Settled at Dec 31,2012 - Settled at Dec 31,2011=611-401=210
(3)

ii) Claims settled in 2013 = Settled at Dec 31,2013 - Settled at Dec 31,2012=776-611=165
(3)

[Total 6 Marks]

Solution 7 :-

Risk at time x , $R(x) = cx$ where c is a constant and x ranges from 0 to 3 years.

Earned exposure at time x , $E(x) = \text{Integral over } R(x) \text{ from time 0 to } x = cx^2/2$

Total exposure = $E(3) = 4.5c$

Earned Exposure in 2013 = $E(0.5) - E(0) = 0.125c$

$$\text{Earned Premium in 2013} = (0.125c/4.5c) * 300 = 8.33$$

$$\text{Earned Exposure in 2014} = E(1.5) - E(0.5) = 1.125c - 0.125c = c$$

$$\text{Earned Premium in 2014} = (c/4.5c) * 300 = 66.67$$

$$\text{Earned Exposure in 2015} = E(2.5) - E(1.5) = 3.125c - 1.125c = 2c$$

$$\text{Earned Premium in 2015} = (2c/4.5c) * 300 = 66.67 = 133.33$$

$$\text{Earned Exposure in 2016} = E(3) - E(2.5) = 4.5c - 3.125c = 1.375c$$

$$\text{Earned Premium in 2016} = (1.375c/4.5c) * 300 = 91.67$$

[Total 5 Marks]

Solution 8 :-

The following are possible ways to indicate the extent of the uncertainty:

- giving a range, measure of value at risk or percentiles
- showing the numerical consequences of changes in assumptions
- presenting the outcomes of scenarios, possibly including extreme scenarios
- describing the uncertainty and explaining why it has not been quantified

[Total 4 Marks]

Solution 9 :-

- (i) The judgment only impacts only claims related to accidental death section. So, preferably perform reserving by claims type if credibility levels allow by having separate analyses on separate triangles by claim type.

Chain Ladder cannot be applied on any of paid and incurred triangles due to calendar year effects. This invalidates the CL method assumption that the development pattern is same for all years. The development pattern is impacted at older development stages for older exposure years while the impact is on the early development stages in the case of more recent exposure years. This effect would be more pronounced in the paid triangle.

Provided that sufficient information is available, claim amounts for each historical claim could be artificially adjusted to bring them in agreement with the new payout formula. Use the paid and incurred triangles based on these new claim amounts and perform CL methods.

If that information is not available, an alternative is to artificially increase the amounts in the incremental paid triangle that pertain to calendar years 2010 and prior by 20%. Create cumulative paid triangle using this adjusted incremental paid triangle and perform CL method. Assumption is that no partial payments are made on claims still outstanding.

(OR)

Alternatively, average cost per claim method could be used. The historical severity amounts that pertain to accident years 2010 and prior should be increased by 20% to account for the impact of the court award. The claim count development pattern is unaffected.

Appropriate data are the numbers of claims settled and amounts of claims paid. Assumption is that no partial payments are made on claims still outstanding.

(8)

(ii) Quota Share Treaty:

Paid and incurred triangles under quota share also have the calendar year effects. Due to lag in claims reaching the notice of the reinsurer, the calendar year effects could be present in 2012 as well. If the triangles have sufficient credibility, the reserves could be estimated using either:

- (a) use data gross and net of quota treaty reinsurance, then find the difference
- (b) perform standard triangulation techniques directly to quote treaty reinsurance data alone
- (c) In both of the above two cases, the method needs to account for the calendar year effects

Risk Excess of Loss Reinsurance Treaty:

The impact of the judicial award impacts the risk excess of loss reinsurance treaty the most. The increase in reinsurance recovery amount on claims with sizes close to the retention limit could be substantial.

Calendar year effects could be greater than those observed in gross triangles. Because of this, both of the following methods could be misleading:

- (a) use data gross and net of quota treaty reinsurance, then find the difference
- (b) perform standard triangulation techniques directly to quote treaty reinsurance data alone

(5)

[Total 13 Marks]

Solution 10 :-

Restrictions on type / amount of business a general insurance company can write / classes of business it is authorized to write

- i. Limits on contract terms and premium rates that can be charged
- ii. Restrictions on information that may be used in underwriting and premium rating
- iii. Requirements to file / publish premium rates before they can be used
- iv. Restrictions on countries a general insurance company can write business in
- v. Mandatory restrictions on cover, e.g. no deductible on employers' liability
- vi. Prohibiting illegal products from being sold

- vii. Requirements to offer certain cover e.g. high-risk flood areas, employers' liability and motor third party liability.

[Total 6 Marks]

Solution 11 :-

(i)

- a) There has been an insured loss of a particular type, e.g. a hurricane, to the insurance industry of a particular size, and
b) A second indemnity-based trigger is breached, based on the value of the losses incurred by the insured. (2)

(ii)

- a) There is a risk with ILWs that there could be a loss to the reinsured portfolio without triggering the ILW if the corresponding industry loss is smaller than the industry trigger amount (Basis Risk).
b) The risk is higher for companies whose exposure concentrations are farther away from the industry averages.
c) Basis risk, to a certain extent, applies to catastrophe reinsurance as well. There could be a loss to the reinsured portfolio without any CAT RI recovery if the event does not fall under the definition of a catastrophe event as per the reinsurance terms.

(3)

[Total 5 Marks]

Solution 12 :-

- i. Claims incurred / earned premiums
A high level might indicate inadequate premiums, poor underwriting standards, poor claims control or a strong reserving basis.
- ii. Investment returns / average assets
Deviation of the investment return from target could be due to deviations to asset mix, return by asset from plan.
- iii. Insurance profit / earned premiums
A low or negative level might indicate inadequate premiums, poor underwriting standards, poor claims control, strong reserving basis or a high expense/commission ratio
- iv. Free reserves / written premiums

If this ratio falls below a certain threshold, it could lead to a regulatory intervention. Higher the ratio, greater the financial strength; but it could also mean ineffective use of capital.

v. Total profit / capital employed

This is one of the most fundamental profitability measures. Higher the ratio, greater is the return to the shareholder. Due to uncertainty inherent in the business, it is expected to be greater than the risk-free rate of interest.

[Total 5 Marks]
