

Institute of Actuaries of India

Subject SA5 – Finance

May 2013 Examinations

INDICATIVE SOLUTIONS

Solution 1 :-**Round I**

a. The risk of loss resulting from inadequate or failed processes (projects, data, products, models), people (crime, errors), and systems, or from external events. (1)

b. Examples are :

- IT, interface, information and other system failures and deficiencies
- confidentiality or security breaches
- human error
- fraud and theft
- weaknesses in internal controls or supervision
- physical disasters
- manufacturing and other core business failures
- product liability and other legal risks
- delivery failures
- health and safety / regulatory / compliance requirements
- staff resource deficiencies (including succession)
- dependency on third party contractors or outsourcing.

(2)

- c.
- The probability is small but loss can be very large and difficult to quantify.
 - The events occur infrequently and are slightly different each time
 - Little information is ever published and companies rely on their own internal data
 - There are so many different causes of operational risk that it is hard to apply a rigorous maths or science approach.

Some approaches used are:

- use subjective judgment (particularly from experts in the field)
- use peer-group analysis by looking at what other similar companies do
- use modeling where possible and where results will not be spurious (possibly drawing on insurance industry data)
- obtain an estimate of the insurance costs
- use the observed market betas, on the assumption that variations in performance
- Which are *not* market-driven are instead due to operational risks.

(4)

d.

For:

- Operational risk is a material risk for banks with a history of leading to failure (Barings, AIB, etc.) or sizable losses (JPM). Thus an opportunity for ABC
- Could provide capital relief to banks' capital charge for op risk (third largest contributor to economic capital for banks).
- Could provide a natural hedge to ABC compared to its exposures to credit and market risks.

Against:

- Moral hazard issues.
- Op risk is difficult to model as it involves the estimation of extreme events.
- Operational risk is highly correlated with ABC's current exposure to market risk hence may compound capital requirements for ABC Op risk is also related to systemic risk; the traditional pooling effect of insurance may not apply.
- Definition of op risk is not standard in the industry .Legal issues likely to be significant given difficulty in defining indemnification provision

(3)

e. Important Considerations in Structuring and Underwriting the Product

- Policy wording is an important part of the structuring process. It is important to have granular definitions of the operational risks that will be covered by the product and the nature of losses that will be indemnified. For example, the product may cover only the direct loss arising from the incidence of an insured operational risk event.
- Adequate research needs to be done on similar products being offered in the other markets particularly with reference to the structuring, pricing and underwriting aspects. The views of the reinsurers can be an important input in this regard.
- It needs to be examined whether historical data on operational risk related losses is available at the industry level [example :Indian Banks' Association] for pricing the product.
- It may be important to price each type of operational risk separately
- There will be a need to define the maximum sum insured on a "per risk" basis and on a "per bank" basis.
- Features like experience rating / profit sharing/ "no claims" discount needs to be built into the product pricing so that the insured is adequately incentivized to adopt a robust framework for mitigating the losses arising from operational risks.
- Features like "Excess" and "Co pay" can be built into the product design so as to mitigate the risk of "moral hazard"
- The underwriting mechanism needs to take into account the quality of the operational risk management framework for each bank and provide an overall risk rating for that bank. The risk rating will be the basis for determining the appropriate risk premium and for specifying the exclusions.

- The regulatory restrictions, if any, applicable to the structuring and underwriting of this product needs to be taken into account.

(5)

Round II

a. A summary measure of market risk is *Value at Risk* (VaR) which, in concept, is extremely simple – it is a probability statement about the potential change in the value of a portfolio resulting from changes in market factors over a specified time interval. VaR in context of context of Credit risk is called Credit VaR. It can be further understood as the loss upon default is a function of two components:

1. *Credit exposure* – the amount at risk, derived from the gross exposure less the amount that can be recovered upon default
2. *Probability of default* – the likelihood of default.

The *expected loss* can be defined as the average level of loss due to default that we would expect over a given time period, *eg* an economic cycle.

In assessing credit risk there are essentially two factors that need to be modeled:

1. the volatility of the credit exposure itself, and
2. the volatility of the default experience.

Real world for Credit VaR and risk neutral for adjusting for the pricing for derivative of default.

(6)

b. Value at Risk (VaR) is an estimate of the maximum loss that may occur with a given probability over a specified time period. It is calculated either on a forward-looking basis or a backward-looking basis:

Forward-looking: historical data is gathered on the volatility and correlations between the individual components of the fund. This is then used to estimate the future using a suitable modeling technique (often Monte Carlo simulation).

backward-looking: historical performance data is fitted to an appropriate distribution and the maximum loss is estimated by looking at the lower tail of the distribution for the specified probability.

Stress testing involves modeling the fund under specified scenarios (in particular relating to extreme scenarios) and estimating how the portfolio would perform.

Advantages and disadvantages of each method

The disadvantage of VaR is that it does not allow the user to investigate specific situations or combinations of situations that may result in a loss – VaR only looks at past events or future events based on data from past events.

Stress testing allows the user to model specific scenarios, which may either be to gauge the effect of market turmoil (an abnormal event that would not be captured in the VaR historical data) or to identify weak areas in the portfolio (or fund vs liabilities).

In this respect a stress test can focus on the risk factors that the portfolio is most exposed to and it should be tailored to reveal weaknesses in the portfolio structure.

The disadvantage of stress testing is that the user must select scenarios to be modeled, which adds a large element of subjectivity. Whereas VaR models the likely scenarios based on what has actually happened in the past. It is therefore less subjective, though parameter estimates and choice of model may be.

Stress testing allows for changes in volatilities and correlations that may occur in an extreme event.

(5)

c. Assume that default happens only at the end of the life of the forward contract. In a default free world the forward contract is a combination of a long European call and a short European put where the strike price of the option equals the delivery price and the maturity of the options equals maturity of the forward contract. If the no default value of the contract is positive at maturity, the call has a positive value and the put is worth zero. The impact of the default on the forward contract is same as that on the call. . If the no default value of the contract is negative at maturity, the call has a zero value and the put has positive value. In this case default has no effect. Again, the impact of the default on the forward contract is same as that on the call.

(3)

d. As time passes there is a tendency for the currency which has the lower interest rate to strengthen. This means that a swap where we are receiving this currency will tend to move into the money. Similarly a swap where we are paying the currency will tend to move out of the money. From this it follows that our expected exposure on the swap where we are receiving the low interest currency is much greater than our expected exposure on the swap where we are receiving the high interest currency.

(4)

e. Yes. Payoffs from a credit default swap depend on whether a company defaults. Some participants in the market will have more information than other.

(2)

Round III

ERM

Refer to IRDA circular on Economic capital and core reading for Solvency II for answer to the first part of the question

Refer to the answer given below for the features of the aggregation model

Using the dynamic financial analysis framework it is reasonable to construct a simulation model which identifies the various risks including event risks facing ABC and attaches either a given probability of the risk occurring (frequency) and the loss incurred (severity) or a probability distribution of each of the frequency and severity. The main output of the model will be the Value at Risk (VaR) at a given level of confidence taking into account the interaction of all of the identified risks together. The model forecast period is likely to be either one or three years depending on how the results of the model are being used within ABC.

ABC's VaR will be greatly reduced by the diversification benefits of trading a portfolio of different financial derivatives with different counterparties both on exchange and over the counter all of the world. Its diversification will be by product, term, counterparty and location.

Many of the trades will not be completely correlated with, or independent from, many of the other trades. For example, the interest rates of different countries are often strongly positively correlated. Correlation can be very difficult to estimate. Historic observed correlations may not be a good guide to the future. Further, the estimation process will be much harder as the number of potentially correlated risks increases.

(15)

[Total 50 Marks]

Solution 2 :-**i) Top-down approaches :-****Method 1 :-****Total amount of capital required:**

The bank needs to decide the desired return on equity to calculate the total amount of capital required for the bank using a top-down approach.

Alternative Approaches 1:

Measure the beta of the bank's shares in the quoted equity market by observing the movements of the price of bank shares over a specified period vis-à-vis the market by using the variance & covariance of the bank's share prices with that of the market:

$$\text{Beta} = \text{CoV}(R_{\text{equity}}, R_{\text{market}}) / \text{Var}(R_{\text{market}})$$

=

where R_{equity} are the returns (say monthly) on the bank's equity shares over the period while R_{market} are the returns on the market portfolio (such as the Nifty/Sensex).

Approach 2:

Alternatively the same method could be used based on the bank sector index rather than the bank's own equity shares. This would reduce the effect on the measured beta of any specific events that might have influenced the equity shares of the bank over the specific period.

Approach 3:

It would also be possible to derive a simple, broad-brush method of estimating the beta such as $\text{beta} = a + b \times (\text{volatility})$, where a and b are constants and "volatility" is the measured standard deviation of the shares over the period. Appropriate measures of a and b would be derived by looking at the volatility and the beta of other bank shares. This method ignores the correlation with Nifty or Sensex, but may be accurate enough for the purpose on hand.

The required return on the equity shares can then be determined using the security market line: $E_{\text{equity}} = R_f + \text{beta}(E_{\text{market}} - R_f)$ where R_f is the risk-free rate of return and E_{market} is the expected future return on the market over the coming year.

The next step is for the bank to estimate the *net profit before interest and tax* it expects to make in the coming year. The bank's management would estimate this based on available information and forecasts.

The total amount of capital required would be then *net profit expected/ROC* which would be compared to the amount of capital that the company actually has.

Method 2:

It would be possible to design a model of the bank's overall profits in the coming year using estimates and historical profits. The model should incorporate revenue, fixed and variable costs, taxation and hence net profits.

It would also be possible to develop a model of the volatility of profits – again using historical volatility of the bank's as well as the industry profits as a guide

Using this information, it would then be necessary to estimate the volatility of profits on a “one standard deviation” basis – *ie* the change in net profits if profits deviate from the mean by one standard deviation

This would be defined as the “earnings at risk” (EAR).

The required capital can be calculated from the EAR using the risk-free rate.

The Capital required = Earnings at Risk/ Risk free rate

This means that the bank will hold sufficient capital such that a one standard deviation swing in profits would be compensated for provided the bank earns the risk-free rate on its capital

Allocation of capital within the divisions

Either of the two methods above can be carried out for each of the two underlying businesses rather than just the overall bank.

It will then be necessary to allow for the impact of diversification between the two businesses.

As calculated, the total of the capital required for the two businesses will exceed the total capital required for the bank as a whole.

To allow for this we need to calculate the correlation of each business with the total (possibly using historical internal accounting information for each division) and multiply the resulting capital by this correlation factor (or multiply the earnings at risk by the factor at the outset). Then the sum of the two adjusted amounts of capital for each business will equal the total capital required for the bank.

The performance of each business can subsequently be assessed by calculating its return on allocated risk capital.

Problems and failings

Method 1

The required equity return calculated from the beta of the shares may not be sufficiently ambitious for the bank's management. They might require a higher return, perhaps based on promises made to shareholders.

Method 1 relies on the principles of the CAPM – in particular it assumes that standard deviation of returns is a good proxy for risk.

The estimated beta will depend on the past data used to calculate it, and will be subject to random variation. The estimated beta is a historical measure of risk, and may not apply to the future, either because the industry risk level has changed since then, or because the bank has changed its method of doing business in such a way as to change the risk.

Method 2

When modelling future profits from the divisions, a profit distribution will need to be fitted. This will often be the normal distribution. However, the actual distribution of results may be very different from this, and the type of distribution chosen can have a large effect on the tail. For example, credit risk losses typically result in a long lower tail for the distribution of profits.

The level of confidence chosen is subjective and often arbitrary.

Problems for both methods and for allocation between businesses

Correlation between the two divisions is very difficult to calculate and highly dependent on the period chosen. However, the correlation has a large effect on the resulting capital requirement.

To establish correlation between the demand in business for mortgage lending and corporate lending may be difficult. For example if the interest rates are low, both the credits may take off in the same direction and vice-versa. This may lead to positive correlation and hence the capital requirement may go up in case of interest rate risks or other operational risks materializing.

(15)

ii)

The performance of each division can subsequently be assessed by calculating its return on allocated risk capital.

Poorly performing businesses can be targeted for improvement or sold off to other parties (that might be able to generate a higher return on capital due to larger market penetration or more efficient systems).

Sophisticated models can generate capital requirements consistently for products that require capital and finance (such as bank loans) and for those that expose the bank to risk without requiring finance (for example swaps and derivative positions).

For example the model for mortgage loans may be different for the model for corporate loans as the risk factors differ completely such as probability of individual loan defaults Vs corporate defaults, the industry factors etc.

Broad methods such as applying a fixed capital requirement to the nominal value of the asset (for example the Basel I approach) do not cope well with off-balance-sheet instruments that require no finance.

A bank can assess the wasted capital that it holds to satisfy regulatory requirements.

The cost of such wasted capital could be estimated as:
 (regulatory capital – economic capital)* WACC

If a bank has a sufficiently sophisticated model that passes regulatory scrutiny, then this model can be used to calculate regulatory capital requirements. This can allow the bank to reduce the regulatory capital required, and so increase the return to shareholders.

(5)

iii. a)

- Credit Default risk
- Interest rate risk
- Liquidity risk
- Operational risk
- Counter party risk in case of swaps
- Market risk
- Off Balance sheet risks such as letters of guarantees etc
- Currency Risk
- Sovereign risk in case of multinational operations

(4)

iii. b)

Interest rate risk exists due to the fact that the assets and liabilities are of different terms. So the bank is exposed to shifts in the yield curve whereby short-term interest rates rise, forcing up the cost of deposits, but long-term interest rates remain unchanged or fall, which would reduce the interest earned on assets.

This bank typically will have deposits ranging from 15 days to 10 years whilst it provides mortgage loans having terms ranging from 10 to 25 years and corporate loans for 5 to 7 years.

The Corporate loan segment may not have a much duration risk if the quantum of loans matches the deposits with similar tenor and given that the corporate loans are on floating rate interest.

There will be a significant mismatch between deposit terms and mortgage loans which exposes the bank to interest rate risk especially when the interest on mortgage loans is fixed for the first 5 years.

Swaps

The interest rate risk can be reduced by effectively shortening the term of the assets to match that of the liabilities.

This can be achieved by undertaking swaps where the bank pays fixed for the first five years in case of mortgage loans and receives floating rate interest. Then the bank is no longer exposed to changes in long-term interest rates on its asset book, and therefore not exposed to a mismatch between its liabilities and assets (ie interest rate risk).

Futures

It would also be possible to address the interest rate risk by either using the short interest rate future or the long-bond future.

Short interest rate future

The bank is exposed to short interest rates rising in case of mortgage loans. It could therefore maintain a large short position in the futures contract. Thus if rates rise (and the short interest rate contract price falls), the bank will receive a profit to offset the higher borrowing costs.

Short positions would need to be maintained in the contract at various terms (not just the nearest to deliver contract). If only near-term contracts were used it is possible that short-term interest rate expectations in the future could rise (but without any increase in expectations over the coming year), which would lead to higher borrowing costs for the bank but no offsetting gain in the futures contract.

Long bond future

Alternatively the bank could maintain a short position in this contract. If short-term rates rise or if expectations of short-term rates rise, it will push up current long-term yields. Thus the long bond future price will fall, allowing the bank to crystallize a profit.]

(6)

iv. a) Strip financing

Strip financing is where investors hold equal proportions of risky non-equity finance (such as mezzanine finance) and equity shares. This limits the scope for conflicts between equity holders and debt holders in the running of the company

iv. b) Mezzanine finance

This is a form of long-term debt capital which is unsecured and often subordinate to senior secured debt. It has a regular coupon, but it may also have additional sources of return. It is often provided to companies that are past the stage at which they are entirely reliant on bank debt, but not yet at the stage where they can go to the quoted security markets.

iv. c) Management buyout

This is where the incumbent management of a company wishes to raise finance through bank loans or venture funding and buy their company from a holding or parent company.

(3)

v.)

The key features of venture funding are :

Venture capital is medium to long term financing.

Venture capital repayments can be tailored through a combination of dividends and debt repayment.

Any debt component of the venture capital will be taking a second charge on the company assets and therefore the interest rate will be higher to allow for the increased risk.

If the company is in difficulties a venture capital investor will have a vested interest in helping to overcome those difficulties. It will be committed until it exits the investment. Often venture capital provides direct strategic support in critical business areas.

If the business fails then the venture capital's equity investment ranks alongside other shareholders, after bank debt and any mezzanine finance.

A venture capital provider will be incentivised to provide assistance to help the company to grow profitably.

Venture capital providers are often selected by the company because of the expertise that they can bring to the business, with contacts or specific experience of a market and management expertise.

Venture capital can be tailored with mixtures of equity and debt according to the company's needs.

Venture capital equity investors are likely to be more hands on and require regular updates of business plans.

Possible Options for structuring the venture funding:

Venture capital can be a mixture of debt and equity finance.

Equity finance may be in the form of (a) Ordinary stock, with the venture capitalists ranking alongside the other investors in all respects. (b) Preferred stock, which ranks ahead of ordinary stock for income and capital repayment but rank alongside other shares after obligations have been met to all shareholders. (c) Preference shares, which receive a fixed income and may be convertible into ordinary stock.

Debt finance can be secured or unsecured. If secured, and the company already has finance secured on its assets, the venture fund will take a second charge on the assets. The loan may be convertible into equity or it may have warrants attached that allow the holder to subscribe for new shares.

(10)

vi)

There are risks related to potential bankruptcy and financial distress.

There might be

- The tendency to accept very high-risk projects in a “do or die” attempt to save the Company.
- The potential costs of bankruptcy itself and the administration and time and effort that is involved
- difficulties in attracting and retaining staff
- problems in getting suppliers to supply the company (because they worry about the company folding up) and customers in view of uncertainty regarding the future of the company.

Cash flow problems can also cause management to take decisions that are in conflict with shareholders’ best interests:

- a tendency to exit promising lines of business or liquidate the entire firm when they would otherwise have continued to operate
- To cut corners in terms of services to be provided to save manpower and material costs which may impact the company’s ability to retain even the existing maintenance contracts thus leading to a downward spiral in business volumes and ultimately to bankruptcy.

(7)
[Total 50 Marks]
