

INSTITUTE OF ACTUARIES OF INDIA

SUBJECT CA1 –Paper I

November 2010 EXAMINATION

INDICATIVE SOLUTION

Q1. Solution:**(a) Value at risk**

Value at Risk (VaR) generalizes the likelihood of underperforming by providing a statistical measure of downside risk.

VaR assesses the potential losses on a portfolio over a given future time period with a given confidence level.

(b)

It could be used to measure the riskiness of the two funds using historical data as follows-

- Construct appropriate distributions reflecting the investment performance of the funds. This distribution would be based on monthly fund performance of the 2 funds for the last 3 years at least.
- Once the distribution is determined, run 1000 or so scenarios and for each fund, estimate the point below which there is a (say) x% chance of falling
- Ensure that runs are done using the same criteria for each fund (so as to ensure a fair comparison)
- the reported VaR for each fund would be the level of underperformance that equated to this x% tail, and the two results could be compared to establish relative downside risk.
- Return on benchmark is also required to understand the relative risk of the portfolio strategy of the 2 funds to beat the specified benchmark
- the use of historic returns may not help much eg if a fund has changed tactics. Some more analysis is required to understand relative riskiness of the 2 portfolio.

[4]**Q2. Solution:**

To calculate the risk premium, the general insurance company would need information-to-determine expected cost of claims.

Determination of expected cost of claims requires estimation of

- Likely frequency of claim and
- cost of replacement (as defined in the policy)

To estimate frequency and cost, the insurer requires the following information-

- The manufacturing cost plus associated other costs eg postage costs for sending the replacement and general admin which should be available from manufacturer
- Data from the manufacturer covering the past history of any of such products previously launched and the % of manufacturing defects reported
- Likewise similar data, if available from the competition or industry in general
- If similar products had been insured by the insurer in the past than data from the insurer about similar products for this or similar manufacturers,
- or if available from other insurers or the insurance industry, reinsurers.

- However, all data must reflect the event being insured ie claims data for the specific insurance cover.

All of this is historic data. For a new product in a relatively new industry, this may not help much.

So we may need some subjective data to determine expected claim rates eg where they are manufactured, quality of management, and quality control measures views on any new processes or just a loading for uncertainty.

In order to calculate the upfront premium to be charged initially, some projection of sales volumes and timings may be needed. For example, expected to sell x 000 per month so pay premium based on this – adjusted when actual volumes are known.

[6]

Q3. Solution:

Aim of any solvency regime is to ensure insurers have adequate assets to meet claims and expenses as and when they fall due.

The solvency regime expressed as a % of claims reserve gives additional buffer to reserves calculated (and hence a provision for adverse deviations from the reserving assumption).

Additional % of assets held gives protection against fluctuating value of asset and protection against credit defaults.

Hence in principle the approach is suitable for the preservation of solvency since it addresses the main potential areas of concern

The solvency regime is –

- Objective and simple, Easily verifiable,
- Easily understood and applicable
- could be appropriate for a range of general insurer as there may be companies with different characteristics

The draw back in this regime however is that any solvency requirement should not be looked in isolation but rather in conjunction with reserving requirements, asset valuation methods etc. In particular, if the company can choose its own reserving basis then their reserves may be inadequate hence adding a margin to them may not help much.

A flat % of market value does not reflect asset appropriateness. Hence a company with inappropriate assets will have the same solvency requirement as a company with appropriate assets. In particular, a company whose assets and liabilities are mismatched are at greater risk and so should hold more capital.

The regime also does not allow for-

- Non availability of market value of all assets, short term volatility of market value of assets
- Quality of Reinsurance cover available, quality of reinsurer and hence default risk
- Quality of internal control systems
- Liquidity issues
- Minimum absolute capital requirement to discourage “fly by night” operators etc.

The regulations also talk about: at any point of time". The practical implication of measuring solvency frequently and at times of extreme asset volatility is not addressed in the regulation.

[6]

Q4. Solution:

A flexible benefit package to heterogeneous group of employees will enable the employer to make the compensation package as inclusive as possible and help the employer to attract and retain good staff. This is because flexibility can help the employer better meet the needs of his employees.

**a) Employees
Additional holiday**

Since 60% of the employees are in the age group 25-30, and they could possibly well paid, they might prefer holidays rather than cash eg due to work-life balance,, travel, children etc and they may value choice and flexibility. This option might also be attractive from a tax perspective especially if they pay high tax.

Premium towards a Health Plan

- The health policy option is attractive essentially because it could be cheaper than doing it individually. Attractive terms may be available on a group basis than on an individual policy. For example there may be tax benefits, lower expenses or a lower basic premium rate. There could also be more liberal underwriting norms and a greater range of benefits with better terms and conditions.

**b) Problems for Employer
Additional Holiday**

- Administrative hassles like maintaining/determining leave eligibility, leave availed etc. based on cash bonus each employee is eligible for
- If due to work pressure the employee are not able to avail leave it might lead to unnecessary angst . The nature of the company may affect the holiday benefit ie it is small and an IT company may need its employees to be flexible so holidays are problematical. For example, if too many opt for holidays at the wrong time
- Also if lots opt for holidays, they may need to recruit more staff or temporary staff to cover the gaps ie extra expenses etc.

Premium towards a health Plan

- Administration issues are lower ie much done by the insurer but
- Premiums and bonuses will vary by individual so some bonuses will be too much or not enough and it will vary year by year. Some individuals will have to pay extra and they may be unhappy - could lead to dissatisfaction if the plan is unaffordable next year. For example, what happens to any "extra" bonus? All this implies extra admin headaches.
- . There is a risk that, providing comprehensive health care may lead to people taking more time off and/or being off for longer.

- If some employees don't want it eg they have their own or state provision, the employer wastes time and money setting it up. There is then a risk of losing the attractive features if it's a low take up.

[8]

Q5. Solution:**Option 1**

Advantages

- Simple to understand
- Easy to compare quotes so as to see value for money.
- Gives Mr.X what he wants- known flat income whilst Mr X is alive- will enable him to plan his expenses
- Longevity risk, interest rate risk, credit risk, liquidity risk taken by insurance company

Disadvantages

- No protection against inflation, the annuity might be eroded by inflation in the long run and prove inadequate
- If there is a Mrs X who outlives Mr. X, then there is no protection for her
- Risk of insurer default is with Mr X.
- No control over his investments and no upside if investment returns are good,
- not good value if MR X is in poor health unless Mr X gets better annuity rate due to his state of health,
- charges may be hard to see ie may not good value unless market is competitive
- Crucially, annuity depends on rate at retirement so if it is low then, it will be low forever. This could especially happen in an low interest rates/inflation risk scenario

Option 2

Advantages

- Control over investments and availability of different fund options
- Mr X can choose fund options which offer him protection against inflation
 - Index Linked Debt fund which can be expected to offer some protection against inflation for moderate risk
 - Equity fund which in the long run can be expected to offer better protection against inflation, and could also give potentially higher return due to the inherent risk
- Flexibility to withdraw more to meet sudden and temporary increase in expenses- however Mr X should also be vary of penalties associated with withdrawals. Besides due to excessive withdrawals, there is also a risk of fund running out fast
- On his death the remaining fund value if any, can be used by spouse to purchase a similar product
- Liquidity risk is with the insurance company as unit price will be quoted daily
- It is unit linked plan and hence the charging structure could be expected to be transparent and hence competitive as well compared to a conventional annuity

Disadvantages

- Mr X has to be reasonably savvy to understand the various fund options, understanding movement in daily unit prices, calculating amount of units to be withdrawn, deciding switches between various fund options etc.

A fairly active involvement is required which may not be possible during periods of sickness, incapacity, loss of mental faculties in later ages etc.

- Investment risk is with policyholder
- There is an administrative hassle of asking for cash every month. That is time and effort is needed – also if there is a withdrawal charge it implies lots of expense – the alternative is to withdraw says a year's cash in one go but this could lead to loss in investment return
- Unit prices will fluctuate in the short term and could lead to volatility in no of units en cashed.
- Longevity risk is with policyholder and he may outlive the unit policy proceeds.
- There may be legislative restrictions on how much can be taken out eg if viewed as a pensions arrangement.

[10]

Q6. Solution:

a) Monetary policy is the control of some measure of the money supply and/or the level and structure of interest rates.

(b) **Central bank control of the money supply**

- A central bank can intervene in the money markets to control the money supply using Open market operations.
- These involve the central bank buying (selling) Treasury bills back from (to) the banks and other investors in the money markets thereby increasing (reducing) the amount of money in the banking sector allowing (forcing) the banks to expand (contract) the money supply.

The central bank can also use **non-market (direct)** controls such as:

- setting minimum liquid reserve ratios
 - Imposing minimum liquid reserve ratios that the banks are required to hold restricts their ability to expand the money supply by restricting the money multiplier.
- setting interest rate ceilings for bank deposits
 - Setting an interest rate ceiling for bank deposits restricts the ability of the banks to compete for investors' money thereby reducing the amount of money coming into the banking system and so reducing the expansion of the money supply through bank lending.
- issuing directives regarding the types of lending to be undertaken, Here the central bank restricts the expansion of the money supply by directly restricting lending, eg by imposing credit controls on banks or consumers eg in relation to mortgage loans, .
- using interest rate policy
 - cutting rates which would stimulate demand for borrowing so increasing the money supply , or,

- Physically controlling notes and coins in circulation (less relevant in a credit based economy).

c) Government bonds

- The yields on short term bonds are closely related to returns on money market instruments so a reduction in short term interest rates will almost certainly boost prices of short bonds.
- However, investors in long bonds may interpret a cut in interest rates as a sign of monetary easing, with potentially inflationary consequences over the longer term. So the yield on long bonds might decline by a smaller amount, or even rise.

Equities

- Low real interest rates should help to stimulate economic activity, increase the level of corporate profitability, and hence raise the general level of the equity market. Also, the rate of return required by investors should be lower, so the present value of the future dividends will be higher.
- Any inflationary fears would tend to increase the relative level of the equity market at the expense of the bond market.

[9]

Q7. Solution:

Purpose of insurance would be to protect the club from risk of loss of revenue arising from any event impacting its key players, conduct of matches, less than expected revenue generation or from events leading to higher costs or expenses

The club could also purchase insurance cover as a “benefit” for its players, staff etc.

Typically loss of revenue could arise if it loses its star players due to –

- Injury/critical illness/Death of a key player/s impacting team’s performance leading to loss of viewer’s interest, potential loss of prize money, revenue from merchandising etc. The club can purchase a “Key Man life insurance policy” – a term/critical illness policy. If any of its key players suffer from injury/critical illness/death the club receives the benefits as allowed in the policy and cover losses arising from these events
- Loss of revenue arising from business interruption due to
- Cancellation of matches due to rain, poor pitch condition
- Cancellation of matches, suspension of its players due to allegation of match fixing, rigging or betting
The risk can be covered by purchasing a cover for ‘Business interruption’
- Inability to sell advertisement spots/TV rights at expected costs, less than expected booking of spots etc. This can be covered by purchasing an insurance policy to cover the revenue shortfalls. This could also be extended to cover inadequate transfer fees on the sale of a player.

- Property insurance to cover losses arising due to damage caused to its property, damage to its premises etc. – *give ½ for the general point and ½ for an example*
- Travel cover to cover losses caused by eg delays caused by flight cancellations, delay in transit of players kit, loss of player's kit in transit etc.
- There will probably be a need to purchase liability cover
 - For own employees – accidents at work place, etc and
 - to the public(3rd part liability) eg parts of stadium fall down or poisoning in stadia food
- Pecuniary loss cover eg failure of 3rd parties such as TV companies or clothing suppliers ie they fail to pay (or supply) what they promise.
- cover against employee fraud or professional indemnity for any professionals eg accountants, lawyers etc the club employs
- A club will have coaches, trainers, doctors and administrative employees other than players. Each of the group of people would have different insurance needs. In order to retain key staff the club could consider purchasing following insurance cover as an important part of its overall compensation package.
 - Simple Term Insurance cover
 - Health insurance package for employees and their family
 - Pension plans
 - Accident cover , income protection cover etc.
- In respect of its players insurance cover similar to the above would be needed but also may need additional benefits to cover
 - loss of earnings for a career cut short due to injury/illness,
 - cost of specialist medical cover, ongoing treatment etc or other expenses eg legal fees in disputes, loss of income if suspended or fines.

[10]

Q8. Solution:

Factors would be:

- (i) The exercise of the option should be cost neutral.
- (ii) The approach will depend on whether the scheme wants relatively fixed conversion terms or whether they should vary as market conditions vary.
- (iii) Unlike the calculation of the annuity rate or commutation factor, spouse pension factor would be a ratio of two annuity factors. So absolute interest rates may matter less than possible changes in shape of the yield curve.
- (iv) If the option conversion basis should be stable then, some smoothed long term rate should be taken. In this case these conversion basis should be reviewed regularly.
- (v) Taking current rates might make the calculations accurate but no sponsor would want the conversion rates to be too volatile. It makes the decision making difficult for the members also.

- (vi) There would be a possible impact on the investment strategy or asset liability matching; based on what proportion of members would select the option. This may mean a risk margin for this uncertainty.
- (vii) There is clearly a possible issue of anti-selection. Mortality rate used should that which would be appropriate for those choosing this option
- (viii) It would be fair to assume that those in poor health and their spouses in good health would opt for this benefit. So add loadings (or make deductions) as appropriate to the mortality rates
- (ix) If it is compulsory to take spouse's pension then we may not need any special adjustment to the mortality assumption.
- (x) We will have to limit the maximum proportion of pension that can be converted
- (xi) The factors would vary by the ages of the member and spouse. We can use average age difference under most cases, with adjustments in case the age difference happens to be significantly different
- (xii) If discretionary increase in pension should be factored in the calculation of the conversion factor
- (xiii) Need to check what the scheme rules say. Are there any specific minimum terms already mentioned in there
- (xiv) Any legislation/ regulation has to be kept in mind eg in terms of a maximum that can be surrendered
- (xv) Can the member change their mind or have their pension reinstated eg on early death of the spouse or divorce. This will add to uncertainty and hence margins needed.
- (xvi) We can't do very different from what competitors are doing. What is the industry practice, will set the member's expectations
- (xvii) Additional administration costs would be allowed for while calculating the conversion terms
- (xviii) It should be simple to understand and administer, so might need to take a few pragmatic approximations

[12]

Q9. Solution:

We need to look at how comparable ABC is with our company and hence whether similar bonuses can be expected

- Confirm whether the conclusion is based on payouts to maturing policies or based on illustration made to customers at point of sale.
- Understanding similarities and differences in respect of products being compared- for eg., are there difference in respect of options, guarantees, minimum premium sizes allowed. – is like being compared with like
- Are products similar by class eg term, whole life, endowment etc
- The split of bonus between reversionary/terminal, - are the splits similar
- Product strategy of Company ABC-high risk/high return, volatile bonuses
- Relative maturity of the company's with profit portfolio, relative size compared to total liability etc.
- Share of profits between shareholders and policyholders (90/10,80/20)-is it similar

We need to compare optimal investment strategies ie are similar strategies and hence expected returns appropriate

- Asset mix and return on various asset classes if available
- Level of credit risk in the portfolios
- Level of equity exposure
- Level of free assets
- Trend in Solvency ratio of the 2 companies
- Investment strategy-active/passive, overseas exposure, investment costs,
- Type of financing that Company ABC has and its WACC

We need to consider other reasons for differences in surplus that could have lead to differences in bonus declarations

- Large one offs- eg expenses, new systems, new business strain, high or low lapses, change in business volumes, catastrophic events – concentration of risk etc
- Size of inherited estate
- Bonus record of Company ABC-is it smooth or fluctuating from year to year.
- Comparison of Surrender values paid by Company ABC

We need to look at the existing investment strategy and portfolio to consider if and how changes are appropriate

- what can we do or not do ie explicit constraints or regulations
- What is the level of ALM risk in the portfolio
- What is the current risk level
- what is the risk mandate and what scope do we have to change risk even if we wanted to – eg are we already at the limit allowed
- What is the strategy –active/passive-held to maturity and compared to competition.
- What is the performance benchmark and the performance vis-à-vis the benchmark over the last few years.
- Is there capability in the investment team to manage higher credit risk portfolio, equity investments

We need to look at how to increase credit risk and what the implications of this and a higher proportion of equities

- Increasing credit risk could imply investing in less secure bonds, issuers, tenants etc, longer-term investments and more overseas assets.
- The consequences would be a mismatch, more volatility, possibly higher expected returns, legal constraints, liquidity and marketability issues and issues to do with a large switch eg admin, tax, right time to buy/sell.

We need to consider how any change would affect customer expectations

- How does increased risk in the asset portfolio affect the positioning of the product, What have we and ABC done in the past and whether continuity is wanted/expected

- What will be impact of this positioning on existing customers and potential new customers? Will it violate existing customer's PRE. Our policyholders may want safety first rather than more risk eg even if ABC are better recently, what about a longer term view
- What is the impact of the high risk-high return strategy on the company's reputation

How will any change affect our solvency both internal and regulatory

- What will be the additional solvency capital requirement for holding a riskier asset portfolio
- Does the company have adequate capital to take on the higher risks.
- Will shareholders be adequately compensated for taking on higher risk
- What is level of estate and whether the estate is supporting other lines of business in terms of solvency capital . If yes, would a risky asset portfolio impact the company's ability to write new business

Analysis of sources of surplus

- Is there any possibility of increasing sources of surplus from other areas-
 - mortality (stricter underwriting, claims management),
 - lapses and other discontinuance terms (larger disincentive to lapse or less generous surrender payouts in line with competition) ,
 - better expense management (cost efficiencies) etc.
 - review of reinsurance agreements
 - is the level of cross subsidy between large and small policies justified or can it be reviewed

[15]

Q10. Solution:

- (a) Why such preferred rates:
- (i) Strong competition means unless you charge based on risk, you will lose market share i.e. some lives are better risk so can profitably be charged less.
 - (ii) It is fair to the customers; better lives should get cheaper rates
 - (iii) Otherwise there was cross subsidy from healthier lives to the not-so healthy lives
 - (iv) Worse lives could be charged higher rates (appropriate for their health condition); may be this would discourage them to insure with you
 - (v) Ultimately, it is about getting overall business volume and profitability; there is no point offering products that no one buys.
- (b) The aim is to identify factors that affect mortality i.e. in this case make it lower than standard:
- (i) Sex: female mortality is found to be lower than male rates. so given that the existing rates appear to be unisex rates, then separate female rates could make it cheaper for female customers
 - (ii) BMI (or height/ weight) measurements: certain range of BMI can be a indicator of healthy live
 - (iii) Smoker/ Non-smoker rates: non smokers or ex-smokers will have lighter mortality

- (iv) Alcohol consumption: a lot is bad
 - (v) Conviction for drug use (or any illegal substance) – certain drugs will increase mortality
 - (vi) Personal medical history: if the person has not suffered from any lifestyle related diseases (like blood pressure, cholesterol, etc), or any other dreaded diseases.
 - (vii) Family medical history: if no member of the person's family has suffered from any of the dreaded diseases before the age of 60, will suggest that person is unlikely to suffer from any hereditary diseases.
 - (viii) Occupation: certain occupations have inherent risks in it or there could be other occupations which can be proxy of keeping oneself fit and healthy or is an indicator of ones social status (hence the level of risk)
 - (ix) Marital status: Married men are supposed to be lower risks
 - (x) Income levels: higher income levels means the person can take good care of himself, subject to other factors being satisfactory
 - (xi) Hobbies: people pursuing hazardous hobbies should not be taken for this segment
 - (xii) Membership in gym and health clubs could be an indicator of lower risks but it depends if one is regularly using these.
 - (xiii) Full medical underwriting: if a life agrees to get fully medical tests and is found to be healthy, then again preferred rates can be offered. Here again the cost of full underwriting could be justified only for high SA.
 - (xiv) Place of residence: Some locations are healthier eg rural v urban; inner city v suburbs
- (c) Other factors that should be kept in mind while designing the product:
- (i) Regulations: will the regulations allow such differentiation. Use of tests and questions to determine mortality eg genetic profiling, disclosure of medical history, etc.
 - (ii) Cultural : in some countries, certain differentiations are not acceptable socially
 - (iii) Support of the reinsurer: it helps if you can get competitive reinsurance rates and supporting to offer preferred rates on same rating factors
 - (iv) Competitors: as there is severe competition, it is important to be aware of the rating factors and rates offered by the competitors. Are we trying to compete (on price) with what others do or have a niche product i.e. the nature of the competition.
 - (v) Sources of data: Do they have enough internal data. What other sources of data could be used for pricing , may reinsurer may be able to help
 - (vi) Market segment: the aim is to target new customers i.e. to boost market share as well as looking at offers to existing customers. New customers could be accessed through specialised sales channels. What would be the expected commission levels? What would be the level of new business strain acceptable?

- (vii) Estimated business volume: all this might be worth if we think there would be sizable business volume. The additional expenses can be justified only with some minimum volume.
- (viii) Underwriting process: ensure the different underwriting processes and requirements are in place. For example how do we check that any information is true. That is are lives really preferred. Especially valid for large sums assured.
- (ix) Customer communication: It is very important for a customer to understand if he has got preferred rates or standard rates.
- (x) Changing demographic trends might change future market
- (xi) System change and trainging of the operation/ underwriting staff: technological support will be critical, also appropriate training for the admin staff.

[20]

[Total Marks 100]
