

Institute of Actuaries of India

Subject CA1-I – Actuarial Risk Management

April 2016 Examinations

INDICATIVE SOLUTIONS

Introduction

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

Solution 1:

- i) Tactical allocation involves a departure from the benchmark position in order to maximise return and hence may conflict with the minimization of risk. The size of the assets relative to the liabilities will determine the risk involved in such an action.

Factors to be considered before making a tactical asset switch are:

- The level of free assets
- The expected extra returns to be made relative to the additional risk (if any)
- Constraints on the changes that can be made to the portfolio
- The expenses of making the switch
- The problems of switching a large portfolio of assets.

[3]

- ii) In most cases, the manager should devise the best strategy for the realistic ongoing liabilities and then check that this strategy is acceptable in terms of the statutory liabilities. If it is not, the investment strategy may need to be revised until it produces an acceptable level of matching for the statutory valuation.

If it is not possible to arrange assets to provide an acceptable level of matching for both bases simultaneously, then probably the manager may have not got enough assets. In this case, radical measures may be required (eg seek more capital from shareholders, close to new business, merge with another insurer).

[2]

[5 Marks]

Solution 2:

i)

Rating factors required to price private motor insurance policy:

- Age and gender of driver
- Make and model of vehicle, geographical location
- the number of miles driven and age of vehicle
- the density of the traffic where the car is driven
- the ability of the driver
- the speed at which the vehicle is usually driven and its general level of performance
- the ease with which the vehicle can be damaged and the cost of repairing it
- the theft risk
- weight of the vehicle
- fire risk.

[3]

ii)

Same Rating factors could be considered. In addition need to allow for:

- Product is being priced over a 3 year period hence insurance coverage of the car for own damage will actually decrease over a period due to depreciation, hence premium needs to allow for decreasing cover
- Effects of inflation in claims costs and claim expenses-Since own damage cover is for a 3 year period, estimates of medium term inflation levels to assess increase in average claims costs due to increased labor and materials costs.
- In case of third party/fully comprehensive cover additional level of prudence may be required for liability claims as cover is over a longer period to allow for changes in court awards etc.
- No claim discounts-The price to a 3 year policy and a 1 year policy must be actuarially neutral so that long term customers get the same benefit in terms of no-claim discounts over the 3 year policy term. Hence this needs to be allowed for in pricing.
- Effect of interest rate discounting since policy over a longer term
- Savings in operating expenses, which will include expenses like policy issuing expenses, renewal expenses, policy management expenses etc. in a 3 year policy compared to a 1 year policy

[4]

[7 Marks]

Solution 3:

i)

The principal economic factors influencing bond yields are as follows:

Inflation

- Inflation erodes the real value of income and capital payments on fixed coupon bonds.
- Expectations of a higher rate of inflation are likely to lead to higher bond yields and vice versa.

Short-term interest rates

- 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. Therefore long bond yields may fall by a small amount or even rise.

Fiscal deficit

- Fiscal deficit is often funded by the government issuing bonds which puts upward pressure on the yields. This will be particularly acute at the durations that the government is targeting with its bond issues.

The exchange rate

- Changes in expectations of future movements in the exchange rate will affect the demand for bonds from overseas investors.

- In addition it will alter the relative attractiveness of domestic and overseas bonds for local investors.

Institutional cashflow

- When an institution has an inflow of funds its demand for bonds will increase and hence bond yields can be affected accordingly. Changes to investment philosophy can also affect demand and hence bond yields.

Returns on alternative investments

- The relative attractiveness of alternative investments will influence the demand for bonds and hence the yields that they offer. If other investments are attractively priced then demand for bonds will fall and the yield will rise.

[6]

ii) The comment “Equity is the best investment when invested for long term”

- Need to understand what is meant by best. Does best implies returns on investment being highest, or most liquid and/or most marketable or highest security.
- Certainly equities is not the best investment for liquidity, marketability or security as they are other asset classes which are superior to equity in these parameters
- Need to define what is meant by long term as it varies from one investor to another. Is it 1 month, 1 year, 5 years or 20 years?
- If returns are the parameter, are we looking are fixed or variable returns; or real or nominal returns
- Equities provide real returns. Further, the returns are volatile. Risk of capital loss
- Equity investment in one company or type of industry? It should be based on diversification of equity investment. Equity through collective investment vehicles or through creating a diversified portfolio
- Type of equity investment, blue-chip versus unrated. This shall affect the level of security and level of liquidity/marketability
- Tax position needs to be considered; both on income and capital gains

[5]

[11 Marks]

Solution 4:

i) Possible reasons to offer the scheme:

- A good incentive for retention of employees
- A feel-good, good to have scheme for employees which employees appreciates
- As mandated by government, legislations
- The company would have been taken over and the scheme would have been running with earlier sponsor
- Tax advantages for sponsor, employees, or both

[2]

ii) Assumptions needed to value the scheme

Current employees

- Future salary levels
- Future investment returns
- Future inflation
- Death rate - before retirement
- Ill- health decrement rates

- Rates of people eligible to receive benefits. i.e proportion who stay for more than 5 years
- Since it is not mention whether 5 years of continued service or multiple times employment with the company, needs to take into account the probability of those who leave and join back and covers 5 years of service
- Future expenses associated with the scheme
- Expected rate of new joiners and all the assumptions above needed for new joiners which can be same and/or different from existing employees

[4]

iii) Risks to employer

- a. Benefit is defined in terms of final salary and service-
 - i. uncertainty around future salary escalation levels and hence benefits,
 - ii. uncertainty around time of exit due to deaths, ill health retirements, how many will qualify for benefits etc
- b. Investment risk- If scheme is funded, risk of fund performing poorly and defaults, if unfunded- large outgo in any year means liquidity issues for employer
- c. Expense risk- expenses of managing the scheme , uncertainty around that
- d. Employee dis-satisfaction with scheme benefits especially as no benefit on early withdrawal

Risk to employees-

- e. No benefits for those leaving before superannuation/death/ill-health even those superannuating with less than 5 years of service, too penal
- f. Employer inability to pay out benefits at time of separation –due to employer doing poorly and not funding benefit in advance or even if funded, funds performing poorly
- g. Low level of benefits especially for low wage earners or due to salary escalation being low and not keeping pace with inflation
- h. Death in service /ill health benefits would be low for those with less service/lower salary
- i. Bankruptcy of employer

[6]

[12 Marks]

Solution 5:

i) General factors to consider by any personal investor before investing:

- Existing assets (wealth)
- Current income relative to spending
- Likely future income and spending and level of uncertainty on these
- Personal tax position
- Time horizon of investments

- Just started career so it is unlikely to have any existing wealth. May have some education loans
- In his early twenties, hence a long time horizon of earning period. Also, given a professional, it can be reasonably expected that the salary will increase at a rate exceeding inflation, in particular, in the initial years.
- In case unmarried and staying in rented place, then the spending will be mostly on; rent, day to day living, both of which will increase with inflation and educational loan repayments, which are probably fixed.
- Therefore, over time the current small amount of 'spare' income that he may have for investment will probably increase.
- Need to consider the reason for investment and when to do the investment. May be his first home?
- The cost of a wedding, home or bringing up children will all increase with inflation. It is likely that he needs to spend his investments in under ten years' time.
- Therefore a short/medium term investment that is expected to grow with inflation would be appropriate.
- Bearing in mind the small amount to invest and the short-term investment, it is unlikely that he may want to take much risk in his investment. Hence, probably need to avoid investments that give volatile returns.
- The small amounts that to invest will mean that any nominal charges or dealing costs may significantly reduce any return on the investment.
- May consider taking insurance or an investment with a guarantee to reduce the uncertainty of the financial position.
- With only a small amount of money to invest it is difficult to achieve a diversified investment portfolio and hence using a collective investment vehicle like a mutual fund may help with diversification. In addition using a collective investment vehicle will mean benefiting from expert investment experience.
- Need to bear in mind the tax position is likely to change as the income level changes and that some investments may have tax advantages

[5]

ii) The range of the property assets it should invest in:

The starting point for the choice of property assets will be the fund's governing documentation i.e. what is the fund being advertised as

Fund's governing documentation could be

- **very broad like ::** To gain exposure in property assets anywhere the fund manager deems appropriate, in this case the fund managers should be given a wide mandate for eg., leasehold/freehold, property under development, various sizes-big or small, being used for any purpose-residential/commercial, direct or indirect exposure
- **Very narrow like –** Only direct property, or only domestic, only lease holds, commercial etc. In which the fund manager's would be given a range of assets that can be invested in

The choice design of fund's objective itself may depend on whether the fund is targeted at individuals or institutions.

In any event, since the investment company is large, the property fund might also be targeted to be large. Hence it would be expected (other things being equal) to hold most of its assets in direct property rather than in property company shares.

In a large fund, it is possible to diversify within and between categories of properties – unless a narrower mandate were specified. The large size also enables the fund to invest in unique and/or large properties.

The fund's investment managers may have particular expertise in certain areas and this could drive exposure.

The proportion of the fund that should be held in liquid assets:

As this is a new fund, there might be time lag between receipt of money and actual investment in property. Hence substantial amount could be parked in liquid money market instruments awaiting investment opportunities. As the fund matures, this proportion of funds being parked may reduce.

In the long run, the Company needs to maintain a minimum level of liquid assets to allow for redemption for units. This could be fixed at a proportion of 5-10% of the fund depending on average redemption requests received.

The higher the risk of large numbers of net repayments over a short period of time, the greater the need for liquid assets.

Such demand for repayments could rise if the outlook for the property sector was poor or

if there were internal problems with the management company leading to a loss of investor confidence.

Hence the investment strategy should specify how much liquid assets the fund will hold in the initial period after subscription, in the normal course of events, in case of adverse property market events (which could be specified in the investment strategy)

The company may have the resources and desire to provide any extra liquidity needed by buying and holding units itself (subject to regulation) in which case fund might not need high liquid assets, but there would be limit to how much company could hold.

If delays in payment on redemption can be easily justified by rules governing redemption, the risks involved in low levels of liquid assets may be less and hence company may like to hold low liquidity in the fund.

If the fund holds a significant proportion of assets in the form of property company shares then these shares being easier to sell may provide some liquidity and hence there may be limited need to hold other liquid assets. However, capital values of shares may be volatile and so care will be needed if relying on them to provide liquidity.

Assuming that the fund cannot borrow to meet the payments, cash will not be immediately available and hence a delay until sales of assets are completed is needed. Holding more liquid assets so as to try to ensure that repayments can always be met is likely to reduce investment returns and hence the attractiveness of the fund.

[8]

[13 Marks]

Solution 6:

i) For the calculation of NPV we would require the amount and timings of all cash flows. Hence we will need to know (or make a reasonable estimate of) the following:

- Suitable risk discount rate (this could be difficult to estimate given the uncertainties of the cashflows relating to the project; the cost and availability of capital could be considered ; the willingness of shareholders to provide capital and the returns they expect from the new venture) .This rate could be cost of raising incremental capital. This is the most important assumption
- Initial cost of installation of the solar plant and possibility of any delay in the same
- Expected income from sale of generated electricity; rate of increase of such income over a reasonable time horizon
- If there is any financial assistance or grant from any organization or government the same would be considered in the calculations
- Any favourable tax treatment by either State or Central Government
- Expected cost of salaries to staff, especially skilled staff and other regular expenses (such as office related expenses, admin expenses)
- Cost of electricity saved which will depend on climatic conditions as well as any losses on transmission and distribution
- Expected inflation rate for electricity
- Expected maintenance costs of the plant in future and the timings of such cost, insurance, etc
- Expected inflation for maintenance costs
- Expected lifetime of the solar panels and plants
- Any residual value (could assume zero residual value)...
- or termination cost

A positive NPV would be considered satisfactory.

[6]

ii)

- In addition to NPV the investor may also need to look at other measures like IRR (if it exists) and DPP.
- DPP would give a good idea for time to recovery of capital invested. This is a capital intensive project.
- Will need to consider whether this will achieve synergy or be compatible with other activities undertaken by the company or such similar companies in urban centres.
- May be suitable if the company is wanting to be seen as an eco-friendly company and currently spends extensively on research to explore alternative sources of energy in view of shortage of other natural resources.
- The decision may be a business strategy for diversification into various geographical areas and simultaneously to explore the natural resource such as solar power available in the desert area of Rajasthan.
- There may be upside potential as this decision could lead to increased sales if used in marketing.
- It will be necessary to decide if this is the best way of using what may be scarce funds.
- Are there any other suitable projects which may be considered? May wish to consider alternative renewable energy schemes such wind energy, biomass energy etc.

- What kind of competition is the company likely to face in the new place ? Are there any such power plants built locally? If so, do they differ in any way?
- Are there any tax benefits offered by local State Governments for such projects ?
- Will need to consider whether planning permission is likely to be given. Are there likely to be any objections?
- Can the company raise funds easily ? are there angel investors available ? what would be the cost of raising funds ?
- This could help with diversification of the business.
- It will be necessary to investigate the risks involved in the project and come to a view on the best course of risk mitigation, having regard to the costs involved, e.g. can estimate maintenance costs and mitigate against any unplanned increases by using a long term maintenance contract to fix the price.

[7]

[13 Marks]

Solution 7:**i) Difference between forwards and futures :**

- ***Standardised vs non-standardised***

Futures contracts are *standardized*, where all of the details surrounding the asset to be traded, except the price at it would be traded, are pre-determined.

Forward contracts are non-standardised, whose details are tailor made and will be negotiated between the two trading parties.

- ***Exchange-traded vs over-the-counter (OTC)***

Futures contracts are traded on a recognised exchange.

Forward contracts are not exchange-traded but are traded *over-the counter* (OTC) and involves telephone-based trading between two financial institutions

- ***Credit risk and margin***

In the futures market, the clearing house guarantees settlement to both the parties of the contract in return for margin payments and therefore, the credit risk to each individual party is minimal.

In the forwards market, there is no such guarantee and no margin payments. The degree of credit risk will depend upon the creditworthiness of the counterparty.

[3]

ii) Uses of derivatives for investment funds :

Derivatives may be used to :

- assist in efficient portfolio management e.g. to give exposure to all assets classes, and also to reduce risk.
- hedge against fall in prices of assets and/or currency values and so could be used as part of the overall investment strategy to protect the portfolio against fall in value.
- ensure that income received is exposed to the market immediately, especially if they have temporarily large cash holdings.
- increase risk and hence returns through speculative investments.
- hedge against movements in the inflation index.
- The investment fund could be one that is invested entirely in derivatives.

[3]

iii)

a) Strategy 1

The company could:

- buy shares in companies constituting the index to provide the link to the growth in the index AND
- buy a put option on those shares giving it the option to sell the shares at a guaranteed level if need be

Strategy 2 :

Alternatively, the company could:

- buy a zero-coupon bond for a five year term to provide the guarantee of the minimum payment of a return of the amount invested AND
- buy a call option on index to provide exposure to the growth in the equity market.

[4]

b) Market, credit, business and liquidity risks are the financial risks relating to the product that the company and the investor face.

Market riskInvestor

- Market risk will be the most significant risk for investors as the movements in the index will directly impact the redemption value of the product and hence the return that the investor can make. If stock market underperforms he gets just return of capital.

Investment company

- Unable to get the open ended put options/call options it wants or for the tenure it wants
- Unable to invest in index stocks individually or deliberately chooses to maintain a mis-match by investing in select stocks of the index. Risk of mis-match between assets and liabilities.
- There may also be market risks relating to the index. For example if the index ceases to be produced, or if the stock exchange changes composition of the index. Which case investment company needs to realign its portfolio at a loss.

Credit riskInvestor

- The investment company may default on any payment due to failure of its investment strategy or any other issue.
- Credit risk should be relatively small for the investor because the company is large & the company is diversified across portfolios and products.

Investment company

- Failure of counterparty in a derivative transaction
- Failure of counterparty in a transaction involving bonds/cash/cash equivalents
- Risk may be higher if there are broader fears for the financial sector.

Business riskInvestor

- Better performance of alternative investment classes and other popular stock market indices,

Investment Company

- Business risk relating to the product not being commercially viable, i.e. few buyers for investment, at which point product may cease to be offered.

- If product ceases, then the investment strategy needs to be change and managed for a closed portfolio and could restrict investment freedom

Liquidity risk

Investor

- Liquidity of the product depends on the initial terms and conditions. Especially whether the product is listed and daily NAV being tracked or not.
- The actual liquidity will depend on the secondary market available for these products.
- The secondary market will be greatly improved if the company is willing to buy back before the full term of 5 years, although this may be on penal terms.
- If the company is in financial difficulty the liquidity risk may rise significantly.

Investment Company

- Depends on liquidity of investments that it holds and the investment strategy it follows.
- Liquidity of index stocks could be good while if ZC bonds are held it depends on issuer and size.

[9]

[19 Marks]

Solution 8:

i)

Action to maintain solvency ratio

Short term

Assets perspective/income perspective

- Increase capital by raising debt.
- This has a cost in terms of interest payable and would reduce profits.
- Some forms of subordinated debt need not be taken as liability for repayment and hence could improve solvency position.
- **Ask for capital from shareholders**
The shareholders may not have immediate capital to pump in.
Further, there is cost attached to the capital asked for in the form higher future dividend pay out though it is still non-guaranteed.
Will improve equity in the balance sheet and available capital for solvency
If it a listed company, it is not easy raising capita immediately as well through rights/IPO , as this takes time
- **Sell assets whose market value are volatile (like equity) and buy assets which are stable in market values; at least for a short term like cash**
Reduce exposure to long term bonds if liabilities are more short dated.
This will lead to a dent in the P&L account as unrealized losses(as interest rates are raising, equity markets are falling) are realized in P and L.
Solvency perspective no impact as assets is already measured at MV. Solvency position will become less volatile in future

- **Improve collectibles from intermediaries, co-insurers and reinsurers if pending for too long,**
 - this will improve liquidity and reduce bad debt provisioning,
 - measures will improve P&L and strengthen solvency

Liability /expense perspective

- **In respect of the recent catastrophe/claims in general**
 - ensure reporting and settlement delays are monitored
 - Proactively encourage customers to report claims from the catastrophe at the earliest
 - Settle any long pending litigations on o/s claims if possible
 - All measures may/may not hit P and L immediately but reduce uncertainty and volatility in provisioning and hence reduce need for prudence
- Defer expenses, e.g, reduce new hires, this will impact P and L positively immediately.
- Defer dividend payments if due . Will improve balance sheet position immediately and increase available capital.
- Sell inadmissible assets , could impact P and L if sold at a loss, but will improve solvency

Reinsurance

- Financial reinsurance could be an option but could take time to negotiate.
- Proportional reinsurance –retention proportion could be decreased on new sales- which will reduce reserving requirements for new business
- Release any catastrophe reserve by strengthening catastrophe reinsurance agreements, if possible.
- Increasing reinsurance or taking out new reinsurance (including financial reinsurance and or catastrophe reinsurance) would reduce liabilities, and reduce solvency capital requirement, thus strengthening the capital position. P and L could also be impacted positively due to initial commission received on proportional treaties.

However, reinsurance comes with a cost and these will reduce the absolute profits on the company in a long run.

Also, some types of reinsurance may not be allowed by the regulator.

- Stop or reduce writing capital intensive new business/stop writing business through expensive channels

Immediate strengthening of the P&L due to reduced expenses/capital strain but shall impact P&L in a short /medium term as new business value is lost.

Impact of reduction in sales on overhead expenses needs to be considered and could impact P and L adversely in the medium to long term.

- **Revisit the reserving methodology and assumptions to remove any unnecessary prudence**

This would require careful examination such that it does not lead to weakening of basis.

Further, the actuary must satisfy herself that it is indeed an over-prudence and do not affect the policyholder interests and there are sufficient provisions to meet liabilities post any change in methodology or basis.

This also requires justification to the regulator

Immediate strengthening of the P&L due to reduction liabilities but at the cost of reduced profits in the later years

[10]

ii) In the medium to long term –

- Look at raising additional capital through rights issue/Public offering
- Look at long term alternative forms of capital, if equity capital cannot be raised, like-
 - Preferential shares
 - Long term sub-ordinated debt
 - Alternative risk transfer
- Diversify business across products and geography
 - Diversify into a new class like engineering, marine –required time to build business
 - Reduce concentration of risk by spreading across geographies, types of property (for eg., residential) to reduce impact as from the recent NATCAT event
- Restructure existing CAT treaty
 - Review what all perils are to be included and time horizon (eg., 1/100 , 1/250 event etc are to be covered).
 - CAT cover limits may also need to be increased,
- Do an ALM study and the need for holding volatile and long term assets.
- Restructure asset portfolio based on liability profile, risk appetite of the company and the ability to withstand shocks due to economic events in the medium term/long term as well.
- Review adequacy of pricing levels and effectiveness of underwriting policy

[5]

iii) factors while reviewing existing reinsurance arrangements

- Since the company's solvency position is weak it would like to optimize benefits from reinsurance at an affordable cost
- It may need to review retained proportion on proportional treaties to reduce reserves and capital requirement
- May need to review exposure to large commercial properties and reduce retention under surplus treaties
- Review of XoL treaties in terms of per event, per risk and aggregate losses. Adequacy of layers of treaty will also need to be reviewed.
- Due to tight capital position the company may consider introducing increasing maximum limit in its existing layers or purchasing additional layers
- Recent NATCAT will throw up level of concentration of risks across product portfolio.

- Catastrophe treaty and its terms and conditions will need to be reviewed- perils covered , reinstatement clause, geographical concentration of various property and motor risks, period of coverage, new and emerging NATCAT risks
- Reinsurers credit rating
- Reinsurance terms – support on underwriting and premium rates, technical support on pricing and designing, assistance in sales strategy or distribution
- Try and benefit from any arbitrage on capital due to regulatory requirements

[5]

[20 Marks]
