

# **Institute of Actuaries of India**

## **Subject CA1-I – Actuarial Risk Management**

### **May 2015 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:**

Asset	Required Return	Expected Return	Ranking
G- Bonds	Risk-free Real Yield + Expected Inflation + inflation risk premium	GRY	
G Index Linked bonds	Risk free Real Yield + Expected Inflation	Real yield + expected inflation	
Equity	Risk free Real Yield + Expected Inflation + equity risk premium	Dividend yield + expected dividend growth	
Property	Risk free Real Yield + Expected Inflation + property risk premium	Rental yield + expected rental growth	

Asset	Required Return	Expected Return	Ranking
G- Bonds	$2\% + 5\% + 1\% = 8\%$	9%	2
G Index Linked bonds	$2\% + 5\% = 7\%$	$2\% + 5\% = 7\%$	3
Equity	$2\% + 5\% + 4\% = 11\%$	$5.5\% + 5\% + 3\% =$ 13.5%	1
Property	$2\% + 5\% + 6\% = 13\%$	$4.5\% + 5\% + 1.5\% =$ 11%	4

**[4 Marks]****Solution 2:**

(i) The student is partially right.

The pay off for a person who buys a futures contract is similar to the payoff for a person who holds an asset. He has a potentially unlimited upside due to appreciation of asset to any level. However downside is limited to the agreed price of the asset as the actual price can utmost fall to zero on the exercise date. **[2]**

(ii)		
Party to transaction	Downside	Upside
Seller of put option	Limited to the extent of difference between strike price and actual price	Limited to option premium
Buyer of put option	Limited to option premium	Limited to the extent of difference between strike price and actual price
Seller of call option	Unlimited	Limited to option premium
Buyer of call option	Limited to option premium	Unlimited

[7]

[9 Marks]

**Solution 3:**

- i. individual risks should be independent
  - Here the risks taken by insurer may not be independent if group schemes/members are concentrated in a particular region, location increasing concentration risk
  - Further concentration risk may also be there due to having exposure to only one particular group or a particular industry type covered, for eg. say armed forces
- ii. the probability of the event occurring should be relatively small
  - The probability of death is relatively small
  - However, given the cover is whole of life when death is certain, the probability is not small
  - But the given the considerable uncertainty on the timing of death, this is still considered as an insurable event
- iii. large numbers of similar risks should be pooled to reduce variance
  - this depends on the number of lives covered by the insurer, more so, how many similar/different types risks are covered
  - Similar risks mean similar occupation, geographical location, industry etc.
- iv. there should be a limit on ultimate liability undertaken
  - though the cover is capped to 5 times the annual salary
  - however, the annual salary at time of death is not known at outset so some uncertainty exists on amount

- v. moral hazard should be eliminated as far as possible
- cover is capped at 5 times annual salary 5 times the annual salary, hence moral hazard resulting from having a disproportionate life cover is reduced
  - however, there is no initial underwriting nor any exclusions which increases moral hazard
  - moreover, cover continues even after employee leaves employment, which could increase moral hazard, especially if a scheme is voluntary
- vi. there should be sufficient existing data / information in order to quantify risk
- this depends on the maturity of the industry as a whole and the availability of local industry data
  - Mortality experience is known to vary with occupation and hence availability of information based on occupational classes is essential

[10 Marks]

**Solution 4:**

(i) Example of regulatory restrictions on investment strategy of an insurance fund:

- restrictions on the types of assets that an insurance company can invest in
- restrictions on the amount of any particular type of asset that can be taken into account for the purpose of demonstrating solvency
- a requirement to match assets and liabilities by currency
- restrictions on the maximum exposure to a single counterparty
- custodianship of assets
- a requirement to hold a certain proportion of total assets in a particular class – for example government stock
- a requirement to hold a mismatching reserve
- a limit on the extent to which mismatching is allowed at all.

[4]

(ii)

a) In general, this depends of the following

- Due to regulatory move, there will be shift to invest more in government bonds
- However, It may happen that companies are already holding more than the minimum prescribed limit in which case, the impact may be lower
- There will be forced sale of certain investments, like equities, property or corporate bonds etc. which could lead to loss/gain depending on market conditions.

- If there is a gain, then reduction in capital gains tax would imply a net reduction in tax and higher net yield than expected earlier, if the investments are subject to capital gains tax.
- The forced exposure to government securities may impact overall returns to the companies in the long run as other asset classes like equity, property etc. could offer a higher return but a higher risk as well
- Companies which have presence in long tail GI business like liability might face issues relating to matching of assets and liabilities as government securities offer limited protection against inflation.
- Higher exposure to Government securities may impact pricing and reserving in the long term due to expected lower return from G Sec compared to other “real assets”, on the other hand,
- It may reduce capital requirement as Government securities may attract 100% admissibility and 0% credit risk.

[6]

b)

- Due to regulatory move, there will be more demand for more government bonds. This will increase demand of government bonds increasing its price and reducing yields
- It may happen that that the regulatory move is coupled with intention of government increasing its borrowing leading to issuance of more government bonds which may have a slight dampening effect on prices and demand and hence overall limited impact on prices and yields
- There could be demands for asset having higher capital gains like equity, however the need to hold more government securities may dampen the overall demand for equities.

[3]

[13 Marks]

**Solution 5:**

(i) NPV : The present values of all cash flows of the project at the risk discount rate.

IRR : The discount rate at which the Net Present Value of all the cash flows of the project becomes zero.

Payback period : is the length of time before the capital expended on the project is recouped from the net revenues (consisting of the gross revenues less running costs), without discounting the cash-flows.

Discounted pay back period : is the length of time before the capital expended on the project is recouped from the net revenues (consisting of the gross revenues less running costs), by discounting the cash-flows at a given rate of interest.

[4]

**(ii) Advantage :**

NPV : Gives satisfactory results on the viability or otherwise of a project

IRR : Helps in project decisions if IRR exceeds a pre determined hurdle rate set by sponsor.

PBP :easy to calculate and considered satisfactory if it is less than a pre determined period set by sponsor

DPBP : Easy to calculate and considered satisfactory

**Disadvantage :**

NPV : The main problems with the NPV are that:

- It is highly dependent on the risk discount rate assumption being correct.
- It says nothing about the length of the project or the time until profits will start to be made (as compared with the payback or discounted payback period).
- It cannot be used on its own to compare projects since it is an absolute amount viability or otherwise of a project

IRR : The IRR equation can sometimes have multiple solutions, especially if there are net negative cashflows at some points during the operating life of the project or at termination. In addition, if a project does not require a large amount of initial capital, a very high IRR could be generated, but the project could still make an inadequate absolute profit.

These features have helped make the IRR less popular than the NPV as a measure of project worth.

PBP : The main problems with the payback period are that:

- It ignores the time value of money.
- It ignores cash-flows beyond the date that payback is achieved.
- It ignores the scale / size of the project.

DPBP : ● It ignores cash-flows beyond the date that payback is achieved.

- It ignores the scale / size of the project.

[4]

**(iii)**

No. of students appearing	Fee per student	Inflow	Outflow	Outflow	NPV	Prob-ability	ENPV
3000	50	150000	100000	100000	-39207.8	30%	-11762.3
4000	50	200000	100000	100000	10792.19	50%	5396.096
5000	50	250000	100000	100000	60792.19	20%	12158.44
							5792.192

Expected NPV of project = Rs. 5792.19

[4]

**(iv)**

As ENPV is positive under the last two scenarios, minimum rate of interest is not material if 4000 or 5000 students enrol for the exam.

In the first scenario, where only 3000 students enrol for the exam, the ENPV is negative. Hence the institute is likely to make a loss even if the money is invested at 10% p.a.

**[2]****[14 Marks]****Solution 6:**

The risks faced are:

- i. Risk and uncertainty in the claims experience
  - Risk and uncertainty will arise both from the outcome of business already written and in the determination of premiums to charge in future periods
  
- ii. Variability associated with Claims
  - Health insurance claims are subject to wide variability in amount. As the insurer is small, there is uncertainty as to whether changes in claims costs year on year are due to changes in the underlying risk or merely random variation.
  - Variability will also exist in terms of frequency, incidence and cost of handling claims.
  - Delays from occurrence to notification and from reporting to settlement result in uncertainty regarding the ultimate cost of claims
  
- iii. Inflation
  - With medical costs increasing day by day the inflation expected can be significantly lower than actual
  - With medical advancements including technological advancements, it is getting earlier diagnosis of diseases
  - New type of risks – such as EBOLA which was say not allowed for
  
- iv. Changes in cover
  - If cover is added or deleted from the policies there probably won't be sufficient data to make a reliable estimate of the impact of the change.
  
- v. Characteristics of policyholders
  - If the company is aiming to attract different risks to those it has historically held the claims experience may differ from the past. It is difficult to determine how the claims will change.
  - There may be opportunities for anti-selection if the premium rates do not reflect the risk across the range of business written correctly.

- If the majority of contracts issued are those where the rates are inadequate, this anti-selection will result in losses.
- vi. Attitude to claims
- Moral Hazard – people start claiming for illnesses which does not require for urgent treatment/opt for expensive treatment which they would not have if they had to health insurance .
  - Fraudulent claims
- vii. Judicial decisions
- Precedents may be set for new types of claims and be applicable immediately or applicable retrospectively on all existing business. This may not have been priced for, for existing business
- viii. Legislation
- There may be fiscal changes in tax which can make health insurance unattractive to customers leading to poor persistency or fewer new sales than expected.
  - There may be a change in law, for example, a restriction on the factors that can be used in underwriting
- ix. Accumulation of risk:
- As this is a small company it could be geographically exposed by writing a lot of business in a limited geographical area. This could lead to an aggregation of
- claims from a single event for eg., influenza, flu etc
- x. Reinsurance
- This is subject to uncertainty as:
    - (a) the company may inadequately appreciate the scale of the risks and purchase inadequate reinsurance
    - (b) it may have doubts about the value for money and availability of reinsurance
    - (c) the ability to make a recovery will depend on the solvency position of the reinsurer.
- xi. Policy wording
- This must be precise so the only claims paid are those that the company intended to provide cover for. Similarly the wording on reinsurance contracts must be precise so that the company can recover what it expects to.
- xii. Business risks , insurer may be exposed to the following business risks:



- xiii. Competition:
- (a) The products may be inferior.
  - (b) The prices may be uncompetitive.
  - (c) The insurer may have fallen behind in the use of technology and so gained less business from internet etc.
  - (d) Prices may be too cheap, leading to unsatisfactory financial performance.
  - (e) The business is affected by changes in legislation which others have allowed for.
- xiv. Underwriting standards:
- Too different from market leading to loss of business or anti-selection against insurer
- xv. Underwriting cycle:
- As the insurer only writes health business there is no opportunity to cross subsidise with classes at different stages of the cycle, also there is limited diversification which could have benefited from capital perspective.

[14 Marks]

**Solution 7:**

(i)

- Timing and amount of withdrawal from fund unknown as both deaths, early retirement, resignation cannot be predicted with certainty.
- Inability to meet the return guarantee of 3% pa
- Risk relating to declaring returns for financial year in advance, as actual earned return may be lower than the declared return
- Not able to impose appropriate penalty for bulk withdrawal from fund till withdrawals exceed the limit prescribed, risk of loss from forced sale of assets and adverse market conditions
- The company can contribute any time leading to contributions when new money investment return is low and declared returns are high, hence the weighted average return earned could be lower than declared return in a year
- Liquidity risk as company can withdraw money anytime hence fund management company needs to have adequate liquid assets to minimize losses
- Inability to impose penalty even for withdrawals above the prescribed limit due to competitive pressure
- Poor fund performance leading to customer unhappiness, reduced future contributions or break up of agreement
- 1% FMC insufficient to cover costs of fund management company
- Declaration of return in advance involves making assumptions about amount and timing of contributions, withdrawals and new money returns, all or any of which could prove to be materially wrong.

- Risks associated with its investments- market risk, credit risk, marketability risk, liquidity risk

[6]

(ii)

- Designing a suitable investment strategy which would match the liabilities- The nature, term and currency of the liabilities which in current case can be expected to be linked to return on comparable fixed interest securities plus a margin, however, subject to guarantee of return in advance for 1 year and 3% minimum guarantee
- The uncertainty of the liabilities and need for liquidity as the timing of withdrawal is unknown-Maintaining minimum liquidity in the fund at all times to meet the penalty free withdrawals, but this would mean lower returns
- 3% return guarantee- purchasing interest rate forwards or swaps to ensure a minimum rate of 3% can be earned always, but these assets may not be available/available for suitable term and would impact returns as well
- Fixing the amount of contribution and timing of contribution be made at the beginning of the financial year or allowing contributions to be made during a window period only
- Keeping margins while declaring of interest rate in advance but could be difficult due to competitive reasons
- Reducing credit risk by investing in high quality assets or suitable diversification across industries, term etc.
- Reducing downside on return from equities by having a suitable hedging strategy
- Manage costs within the FMC, or bargain for fixed fee + variable FMC to meet fixed costs and variable costs

[6]

(iii)

- The penalty should reflect the fact that market value of assets could be lower than fund value and there could be a loss to company on surrender
- The penalty should be set keeping in mind the ratio of MV of assets to BV
- Any expenses associated with withdrawals, investment sale etc. should also be allowed for
- Loss of FMC and hence profits due to significant withdrawals should be allowed for
- What is competition offering matters as well

[2]

[14 Marks]

**Solution 8:**

(i)

The advantages of indirect property investments compared to direct property investments are:	
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- They are an easy way of obtaining diversification. Indirect investments such as property companies can offer a greater spread of risk for a given level of investment and, furthermore, as property shareholdings are divisible, it is possible to extend the spread of risk by investing in a number of different property companies.
- Expenses associated with direct investments are avoided, particularly in case of properties where proportion of expenses incurred in every transaction is very high. Expenses reduce returns on the fund and hence indirect property investment can prove beneficial.
- Fund can gain access to larger/more unusual investments, which cannot be obtained through direct investment or could be very expensive to do directly.
- Economies of scale in the case of larger collective schemes: Larger property companies may invest in large properties, properties too large even for the large pension fund. Larger investment / development companies can also enter into extremely large development schemes. There may be considerable cost savings resulting from economies of scale in the case of large property companies.
- Holdings are divisible – part of a holding in any particular fund can be sold. Hence it offers increased liquidity, especially in case of run down like bulk withdrawals
- There may be tax advantages of indirect property investment which will enhance returns to customers of the pension fund.
- Marketability of property shares/ units may be better than that of the underlying property.
- A breadth of management expertise is provided by a property company, and management of a property share portfolio can be carried out by the institution's equity department itself. Hence costs reduced.
- Quoted prices, which make valuation easier
- No issues of obsolescence, void time etc

The disadvantages of indirect property investments are:

- This is a large pension fund. Indirect investments are usually more advantageous for small investors who cannot make huge investments in direct property than for such large companies/funds. Hence this pension fund may not derive many of the benefits of indirect property investments such as increased liquidity, marketability etc unless it was in need of increasing its liquidity or marketability.
- Loss of control – the fund would have no control over the management of the property portfolio or decisions taken on individual investments.
- Management charges are incurred.
- There may be tax disadvantages such as withholding tax, which cannot be reclaimed
- Lack of diversification away from equities, if company already has sufficient exposure to equity investments.
- Volatility: direct property values tend to be less volatile than property shares in the short term, partly because the true picture is obscured by the effect of long periods between valuations. Hence there could be volatility in returns from property shares in the short term, which could be disadvantageous to the fund.
- Exposure: a property company may invest in buildings under construction, or even land for development. The risks associated with this type of investment are much greater than with an established real property investment.
- Diversification of the overall portfolio: wider diversification can be achieved through direct investment than through property shares. This is because property

shares are affected by movements of the equity market as a whole as well as by factors relating only to property. [this point is there in advantage as well, normally

- Loss on forced sale: institutional investors are unlikely to be forced sellers of direct property. But if a property company has a cashflow problem or is facing bankruptcy, only forced sale values will be realised. Hence if the property company is in distress and hence resorts to forced sale of assets, then the pension fund may not realize the full benefits of market value of the property.

[10]

(ii)

The choice of other asset classes would very much depend on the investment objectives of the pension fund that might have created some reasonable expectations among the pensioners/deferred pensioners in terms of increase in pension etc.... Deviating from these objective would impact reputation as well could lead to regulatory issues.

Also alternative investments would depend on the nature of liabilities of the pension fund, which largely might have long term liabilities.

Since property is a “real” asset i.e., offering real rate of return, it would be prudent to invest the money in real assets such as :

Equities – real returns yet liquid  
 Index linked bonds – real returns  
 Indirect property investments – real returns  
 Index related funds such as exchange traded funds.  
 Derivatives

However depending on the asset mix and on the nature of liabilities, investments in, fixed interest bonds (– offering nominal returns) and /or money market instruments may also be considered.

[3]

(iii)

The fund manager could be suggesting overseas investments for the following reasons :

- Currency Matching : Perhaps a significant portion of the liabilities of the pension fund are in overseas currency. Hence procuring such assets would lead to currency matching and avoid exchange risks/adverse currency movements in respect of those liabilities.
- Higher Returns : Returns on overseas investment can be higher than domestic returns either due to local market conditions overseas or due to the principle of “higher reward for higher risk involved” or if inefficiencies in the global market allow fund managers to find individual countries whose markets are undervalued.
- Diversification :
  - A major benefit of overseas investment is diversification. The pension fund may not currently have any overseas investments and the fund manager may

<p>be foreseeing a need for the same clubbed with prospects of higher returns in other growing markets.</p> <ul style="list-style-type: none"> <li>➤ Investing in a number of different countries or economies with a low degree of correlation helps to reduce risk.</li> <li>➤ Diversification is also achieved by investing in industries that are not available for investment in the home market and gives a larger number of companies from which to construct a diversified portfolio.</li> </ul> <p style="text-align: right;"><b>[3]</b></p>	
<p><b>(iv)</b></p> <p>Potential drawbacks of overseas investments for this pension fund :</p> <ul style="list-style-type: none"> <li>• Currency exchange risk : Overseas investments are generally denominated in that country's local currency, in which case there is an additional currency risk.</li> <li>• Currency mismatch : If the fund does not have any liability in foreign currency, then the overseas investments would cause a currency mismatch. Investing overseas means that investors with domestic liabilities are accepting a mismatch, at least in the short term. Furthermore, currency movements lead to extra volatility of the total returns unless these are hedged using derivatives.</li> <li>• Taxation : Taxation varies from country to country. It may not be possible to recover withholding taxes imposed on overseas investments.</li> <li>• Expenses and expertise : A further problem of overseas investment is the cost of the increased expertise required. This arises because: <ul style="list-style-type: none"> <li>(a) There are extra variables to analyse (eg overseas economies and currencies).</li> <li>(b) More work is required to overcome the problems with information.</li> <li>(c) May be required to appoint an overseas custodian to deal with settlement, voting rights issues, receipt of dividends and holding stock certificates etc.</li> <li>(d) Costs will be further increased by the need to recruit additional staff and set up new administrative procedures to deal with a number of issues such as accounting for foreign currencies and repatriation of funds.</li> </ul> </li> </ul> <p>Further problems that may be encountered with overseas investment include:</p> <ul style="list-style-type: none"> <li>• May be required to follow different accounting practices; May need to adopt multi currency accounting systems and may need to adhere to regulatory restrictions of both countries. All these may lead to complex administration and increased costs which may far outweigh the advantages cited earlier.</li> <li>• less information may be available than in the home market</li> <li>• language problems – although many of the larger overseas companies publish accounts in English</li> <li>• time delays – timing differences have presented difficulties in the past, but advances in communications have made this much less of a problem</li> <li>• poorer market regulation in some countries may increase risk (although some large companies are listed in more than one major financial centre)</li> <li>• risk of adverse political developments</li> <li>• Liquidity – many less developed markets are not very liquid and hence it may be difficult to sell those investments as and when the pension fund desires to do so.</li> </ul> <p style="text-align: right;"><b>[6]</b> <b>[22 Marks]</b></p>	

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