

Institute of Actuaries of India

Subject CA1-I – Actuarial Risk Management

November 2013 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: Defined benefit pension scheme

- guaranteed retirement pension, *eg* a proportion of final salary for each full year worked subject to a maximum of X years
- guaranteed death-in-service lump-sum benefit or dependant's pension
- optional early, late or ill-health retirement pension
- optional death-in-retirement dependant's pension
- optional tax-free cash lump sum on retirement
- optional transfer value to another arrangement

(3 Marks)**Solution 2:**

- i) "Risk appetite" may be defined as the acceptable risk a company wants to take to run a business subject to available resources and capital.

In which a company expresses an identified set of risk-trading opportunities, and sets boundaries on its risk-trading opportunities, aligned with successfully delivering to achieve the company's business objective.

Different stakeholders will have different appetites for risk and within a particular class of stakeholder there will be different appetites for risk.

For Example, one individual may have a speculative attitude to market risk, while another might be highly cautious. The speculative individual will be relaxed about investing in emerging markets or highly geared funds, while the cautious individual would avoid any equity investment at all.

Corporate entities also have different appetites for risk. Frequently the risk appetite is described in public documents, such as the company's annual report.

(3 Marks)

- ii) The appetite for risk will be affected by:

- the size of the company – as it is a large company it is likely to be able to take on more risk.
- the nature of the company's business – the work is highly speculative for example the costs of developing new system and associated risks of making the product a success, obtaining and maintaining patents
- the company has exposure to companies abroad – this means there is currency risk but also scope to diversify risk by currency / geographical region
- the level of capital available and sources of capital
- consider how the development has been financed – level of debt, gearing
- the culture of the company – which will be dependent on:
 - past experience
 - views of the board
 - views of shareholders
- Legal or statutory controls

- Concerns of its governing body(the Board) and publically disclosed documentation
- External environment in terms of competition, people, business systems and policies

(4 Marks)

[Total Marks-7]

Solution 3:

Friend's objective appears to be to gain exposure to equity markets through direct investments or indirectly through the life insurer's unit-linked plan which is a form of collective investment vehicle (1/2)

The factors that need to be considered are-

- Size of the inheritance
- His ultimate objective of gaining exposure to equity markets- whether to make short term gains or for long term asset building etc
- His prior experience of investing in equity markets

The advantages of investing in a unit linked plan are-

- **Simplicity:** Investing in unit-linked plans will tend to be a simple exercise. For an inexperienced small investor buying shares may seem to be complex, especially if friend has limited/no experience of investing in equity markets.
- **Diversification:** The unit-linked plan will offer an investment in a diversified portfolio. For your friend this may be essential since the inheritance may not be large to develop his own diversified portfolio in shares.
- **Expertise:** Your friend is unlikely to have the same investment expertise as a life insurance company

Disadvantages:

- **Control:** your friend has little control or influence on the investment decision of the lifeinsurance company.
- **Expenses:** Your friend may have to pay a significant portion of investment indealing costs if buying shares directly. However this expense needs to becompared with a life insurer's charges.
- **Marketability:** In general both holding direct shares and unit-linked plans will be marketable. However, where a unit-linked plan has surrender/lock on period or partial withdrawal restrictions then it may not be marketable.
- If your friend wishes to invest in illiquid shares then this may be possible through a unit linked plan.
- **Tax:** Depending on the individual and the precise unit-linked plan there may be tax advantages or disadvantages to each investment.
- **Guarantees:** The life insurance company may offer some guarantees on its unit-linkedplans which will reduce the risk but may also reduce the expected return on the investment as life insurer will charge for the cost of guarantee.

- Ease of understanding: The Company may publish the NAV of the Unit linked fund on a daily basis and information on value of policy can be had easily.
- On the other hand for an investor to calculate the value of his holding he may need to determine the value of each holding individually and then aggregate.
- More cumbersome if shares are listed in different exchange.

(8 Marks)**Solution 4:****i) Options available are-**

- Deferment of proposal –this is not an option for the company in case of this application as it is a family history of cancer which can manifest at any age.
- Declining the proposal likely to be too extreme a decision.
- The policy may be passed on to reinsurer (with a low retention by insurance company), which is commonly done in case of high risk applications. There might be regulatory restrictions on minimum retention that may need to be considered
- The exclusion of cancer may not be appropriate option as it is usually a large component of the cost.
- The regulation may prohibit use of family history or exclusion of cancer.
- This suggests that loading premiums is the most suitable option for issuance the policy.

(3 Marks)**ii) If different definitions are used from those in the market, the following issues could arise:**

- The customers may not understand the product that they are buying, therefore product may not meet their reasonable expectations.
- The distributor may not understand the product.
- Any change in conditions to reduce the premium will mean that the coverage is less comprehensive and therefore claims will not be paid that previously would have been.
- The claimant may have a real need and expectation of payment but the benefit will not be paid.
- If changes in conditions result in an increase in premiums, will product still be affordable or seem attractive
- Local regulations may require standard set of definitions to be used.
- If the product is very different from others in the market, then it may not be sold as it is likely to be a more difficult sale.
- The salesmen would be required to explain the differences between this product and others in the market.
- Company could consider adding conditions that seem to be worth having but in practice have little cost.
- Can the additional risk arising due to amended terms and conditions be priced properly?

- Will reinsurance support be available for amended terms and conditions?
- Will the amended product be seen as good value by potential customers?

(5 Marks)**[Total Marks-8]****Solution 5:**

- i)** Residential buildings,
Moveable property / contents / possessions
Commercial buildings
Land vehicles
Marine craft
Crop
Aircraft

(3 Marks)**ii)** Factors for appropriate reinsurance program

- Size of insurer- small rapidly expanding –
 - quota share reinsurance can be considered to reduce NB strain
 - Quota share reciprocal arrangements would also help the insurer to get a more diverse portfolio and help prevent accumulations of risk building up.
 - If the company is fairly new it may not have enough of its own data and experience. Technical assistance from reinsurers would be available in return for business placed with them
 - Quota share will also enable insurer to write wide range of risks yet at similar levels of net exposure
- Class of property insurance –
 - eg. residential vs commercial, land vehicles or marine craft etc will also determine type of reinsurance arrangement
 - In case of residential properties, due to volume of policies and reasonable homogeneity means that varying the percentage of each risk retained is unwarranted. Hence surplus is inappropriate here. Surplus treaty is more appropriate for larger commercial properties where volumes of business are lower and the risks are more heterogeneous.
- extent to which company can withstand adverse large loss experience from one peril, one event.
- This is dependent on
 - Shareholder/management view as regards stability of profits
 - more excess of loss protection may result in more stable results
 - stable results mean stable dividends to shareholders
 - management & shareholders' attitude to risk- risk aversion means lower retention limits and quota share agreements

- size of free reserves. Lower free reserves means lower retention limits and quota share agreements
- Property portfolios are often exposed to the possibility of many claims from one event, *eg* floods, storms. *Catastrophe XL* will give the insurer protection against many claims arising from the same storm.
- Potential for accumulations of claims and geographic concentration in the portfolio- Insurer should use *aggregate XL* reinsurance could also be considered to protect against aggregations.

Other factors

- Cover should be arranged in several layers with different reinsurers to reduce the credit risk of reinsurer failure.
- statutory solvency how will it impact
- company's expected business plan, if it plans to expand very fast; how much will it strain the free reserves
- value for money of reinsurance available in the market

(8 Marks)
[Total Marks-11]

Solution 6:

- i) A capital project means any project where there is initial expenditure and then, once the project comes into operation, a stream of revenues less running costs.

A capital project does not have to involve the construction of a physical asset.

(1 Mark)

- ii) Let us denote:

A1: the project is popular; $P(A1) = 2/3$

A2: the project is not popular; $P(A2) = 1/3$

B1: the weather condition is good; $P(B1) = 1/2$

B2: the weather condition is bad; $P(B2) = 1/2$;

C1: the workforce is not on strike; $P(C1/B1) = 1/2$, $P(C1/B2) = 3/4$,

C2: the workforce is on strike; $P(C2/B1) = 1/2$, $P(C2/B2) = 1/4$,

An outcome or *state of the world* is thus denoted by a string of three co-ordinates, and the probabilities, cashflows and NPVs associated with each possible *state of the world* are summarised in the table below.

State of the world	Probability	Cashflows (in Rs. Crores)					NPV @ 12%	Expected NPV
		Year 1	Year 2	Year 3	Year 4	Year 5		
A1 B1 C1	$2/3 \times 1/2 \times 1/2 = 1/6$	-100	0	60	60	60	28.67	4.778
A1 B2 C1	$2/3 \times 1/2 \times 3/4 = 1/4$	-100	-10	60	60	60	19.74	4.935
A1 B1 C2	$2/3 \times 1/2 \times 1/2 = 1/6$	-120	0	60	60	60	8.67	1.445
A1 B2 C2	$2/3 \times 1/2 \times 1/4 = 1/12$	-120	-12	60	60	60	-2.04	-0.170
A2 B1 C1	$1/3 \times 1/2 \times 1/2 = 1/12$	-100	0	30	30	30	-35.67	-2.972
A2 B2 C1	$1/3 \times 1/2 \times 3/4 = 1/8$	-100	-10	30	30	30	-44.59	-5.574
A2 B1 C2	$1/3 \times 1/2 \times 1/2 = 1/12$	-120	0	30	30	30	-55.67	-4.639
A2 B2 C2	$1/3 \times 1/2 \times 1/4 = 1/24$	-120	-12	30	30	30	-66.38	-2.655

The expected NPV = $4.778 + 4.935 + 1.445 - 0.170 - 2.972 - 5.574 - 4.639 - 2.655 = -4.852$

The expected NPV at 12% risk discount rate is negative and hence the project may not be undertaken. **(6 Marks)**

- iii) If the company opts for insurance, the initial insurance premium cash outflow will be Rs. 10,00,00,000, with cash inflow from the insurer as 90% X (60,00,00,000 – 30,00,00,000), which is Rs. 27,00,00,000.

The above table will be modified as below:

State of the world	Probability	Cashflows (in Rs. Crores)					NPV @ 12%	Expected NPV
		Year 1	Year 2	Year 3	Year 4	Year 5		
A1 B1 C1	$2/3 \times 1/2 \times 1/2 = 1/6$	-110	0	60	60	60	18.67	3.112
A1 B2 C1	$2/3 \times 1/2 \times 3/4 = 1/4$	-110	-10	60	60	60	9.74	2.435
A1 B1 C2	$2/3 \times 1/2 \times 1/2 = 1/6$	-130	0	60	60	60	-1.33	-0.222
A1 B2 C2	$2/3 \times 1/2 \times 1/4 = 1/12$	-130	-12	60	60	60	-12.04	-1.004
A2 B1 C1	$1/3 \times 1/2 \times 1/2 = 1/12$	-110	0	57	57	57	12.24	1.020
A2 B2 C1	$1/3 \times 1/2 \times 3/4 = 1/8$	-110	-10	57	57	57	3.31	0.413
A2 B1 C2	$1/3 \times 1/2 \times 1/2 = 1/12$	-130	0	57	57	57	-7.76	-0.647
A2 B2 C2	$1/3 \times 1/2 \times 1/4 = 1/24$	-130	-12	57	57	57	-18.48	-0.739

The revised expected NPV = 3.112 + 2.435 – 0.222 – 1.004 + 1.020 + 0.413 – 0.647 – 0.739 = 4.368.

The revised expected NPV after insurance at 12% risk discount rate is positive and hence the project may be undertaken with insurance cover.

(4 Marks)

iv) The other factors that might be taken into account when deciding whether or not to proceed with the capital project include:

- allowance for any likely bias or possible approximations in the estimates
- “hunch” – any gut feelings or instincts that cannot be quantified
- knowledge not in the possession of those who have prepared the submission
- last-minute developments (that have arisen since the preparation of the submission documents)
- doubts about the feasibility or quality of implementation
- the overall credibility of the project
- whether or not the upside potential has been estimated realistically and allowed for appropriately in the formal appraisal of the project.

(3 Marks)
[Total Marks-14]

Solution 7:

i) This insurance indemnifies the insured

- against legal liability
- to compensate an employee or his or her estate
- for bodily injury, disease or death suffered owing to negligence of the employer in the course of employment.
- Loss of or damage to employees’ property is usually also covered.
- Normally high levels of indemnity are provided.
- The benefit can be in the form of regular payments to compensate for disabilities that reduce the employee’s ability to work
- lump sum payments to compensate for permanent injuries to the employee and benefits under the legal framework.
- Legal costs will also be covered.
- Other costs such as care costs can also be included.

(3 Marks)

ii) Perils

accidents caused by the negligence of the employer or other employees, e.g. safety guards exposure to harmful substances, e.g. chemicals, coal dust, asbestos exposure to harmful working conditions, e.g. loud noises, repetitive strain, stress.

(3 Marks)

iii) Rating factors

- Payroll to determine the severity of claim amounts
- no of employees to determine exposure
- Type of industry or occupation
- Previous claims experience
- Location of the workforce to assess access to immediate medical facilities
- The materials handled

- The processes involved
- health and safety standards etc. practices followed by employer
- Turnover of the company
- Size of deductible
- Level of staff training / score risk assessment
- Provision of first aid facilities within the premises

(3 Marks)

iv) Financially significant assumptions

- Assumptions relating to both the distributions of the claim amounts and claim numbers are significant.
- Since employers' liability insurance is a relatively long-tailed class of general insurance business, significant provisions may build up prior to making claim payments and hence, the investment return assumption is important.
- Expenses on this class of business will be significant, particularly claim expenses such as legal fees.
- Commission may or may not be significant, depending on the distribution method.
- We would also need inflation assumptions, in particular:
 - claims inflation
 - claims expenses inflation.
- The inflation assumptions are financially significant because
 - employers' liability insurance is a relatively long-tailed class of business
 - claims are subject to "court award" inflation
 - claims expenses are subject to inflation of legal expenses.

(5 Marks)

[Total Marks-14]

Solution 8:

- i) In the context of a benefit scheme, individual members ceasing to accrue benefits in a benefit scheme.

Discontinuance relates to an individual member moving from active status (still accruing future benefits) to deferred status (member has past benefit entitlement but accrues no further benefits).

The member may decide to leave the accrued benefits in the scheme or transfer them elsewhere.

(2 Marks)

- ii) The individual might voluntarily or involuntarily (eg redundancy) cease employment with the company.

Alternatively, the company might offer the individual member a different benefit scheme, *ega* change to a defined contribution scheme from a defined benefit scheme.

The individual may discontinue the scheme in order to transfer the benefits out of the scheme and into a new benefit scheme:

- for simplicity, *eg* to combine pension funds
- because the new scheme may offer a greater level of flexibility, *eg* in the form in which the benefits can be taken
- if the member is concerned about the financial security of the original scheme
- if the member believes that the new scheme will offer better terms, *ie* the value of his *new* benefits will be greater than the value of his *old* benefits.

(3 Marks)

- iii) The key principle underlying the determination of discontinuance terms is that of *fairness* between the different parties involved.

The principles underlying the determination of the benefits payable on discontinuance or transfer of rights should be fair to:

- the discontinuing scheme member
- other continuing scheme members, and
- the provider of the benefits.

(2 Marks)

- iv) Continuation of the scheme without further accrual of benefits

- Avoids cost of disinvesting / transferring assets
- No guarantee that discontinuance benefits will be met
- ..as available benefits affected by future investment and mortality experience
- Sponsor may not make good any shortfall
- Good experience may only benefit those alive at some future time
- Retains mortality and investment risk
- Still need to meet expenses

Transfer of the liabilities of the scheme to another scheme of the same sponsor

- Similar points to *Continuation*
- Need availability of another scheme
- Cross-subsidy as any future surplus / deficit may be spread over larger group of lives

Transfer of funds to the beneficiary to extinguish the liability

- Legislation may not permit
- Need controls to ensure that funds used for primary purpose of providing pension / cash benefits at retirement

- ..e.g. requirement to invest funds / transfer to another scheme (e.g. same or new employer) / purchase annuities at retirement
- Ultimate benefits depend on individual experience
- ..and assumptions used to capitalise benefits

Transfer of the funds to an insurance company to invest and provide a benefit

- Ultimate benefits depend on individual experience
- No guarantee that discontinuance benefits will be met
- Transfer value may reflect scheme underfunding

Transfer of the funds to an insurance company to guarantee the benefit

- May be expensive and require lump sum input by sponsor
- Insurance market may be limited
- Need insurance companies to be regularly monitored to ensure guarantees met

Transfer of the liability to a central discontinuance fund operated on a national or industry wide basis

- Central fund needs a way to raise money to ensure guarantees can be met
- ..e.g. by means of levies on other schemes
- May expect a lower benefit level

(8 Marks)
[Total Marks-15]

Solution 9:

i) Main sources of risk are-

Market risk.: The risk can be divided into:

- the consequences of changes in asset values
- eg. Changes in the market values of equities and property
- eg. Changes in interest and inflation rates which primarily affect the value of fixed-interest and index-linked securities
- the consequence of investment market value changes on liabilities due to
- nature of promises made to stakeholders or due to change in level of provisions required to be held
- The consequences of a provider not matching asset and liability cash flows.
- The Market risk will be high if there are some cash flow or duration mismatch between the liabilities and the assets held.

Credit risk –

- The term credit risk is sometimes also used to describe the risk associated with any kind of credit-linked event.
- It refers to the default on loans issued by the banks
- and defaults on other bank investments e.g. bonds it holds,-the issuer of a corporate bond defaulting on the interest or capital payments.

- This could also include changes to credit quality (up or down)

Credit Spread Risk

- The most common reason for credit spreads to move will be perceived changes in credit quality of the issuers.
- However, changes might also occur if the market alters its view on the premium for illiquidity that is placed on corporate bonds in general (in turbulent times, the spread between any investment and government bonds will widen).
- Alternatively the perceived security of a type of bond may change (*eg* the yield gap between debentures and unsecured loans may widen and affect the yield on all unsecured loans).

Operational Risk-

- Operational risk refers to the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events.
- Operational risk arise from
 - Internal fraud by employees
 - Failure of IT system
 - Failed internal processes
 - Problem related to underwriting to provide loan
 - any servicing issues.
 - Regulatory breach
 - External events such as change in regulation,
 - fraud by external parties etc.

(8 Marks)

- ii)** Basel I required banks to hold capital equal to 8% of the value of the bank's assets. The values are calculated as the sum of the risk weighted values for the various categories of bank assets. Risk weights vary with the type of asset being 0% for cash to 100% for commercial loans.

The Available Capital of the bank is split into two types:

1. Tier 1 capital or core capital – shareholders' equity and disclosed reserves
2. Tier 2 capital or supplementary capital – revaluation reserves, general provisions, hidden reserves, subordinated debt and certain other approved capital instruments.

The total of Tier 1 and Tier 2 capital must exceed the amount of required capital.

Limitations of the original Basel Accord include:

- It was targeted at credit risk, whereas banks also face other types of risk, eg market risk, operational risk and interest rate risk.
- It is approximate in nature. For example, the broad risk-weightings used for asset classes don't reflect differences in the riskiness of assets within the same broad groups. For Example the 100% weighting for commercial loans is the same for a loan to an AAA-rated counterparty as for a B-rated loan, despite the different levels of credit risk.
- There was no reward, eg in the form of a lower capital requirement, for effective risk management.

(4 Marks)

iii)

The main rationale behind Basel 2 is:

- to provide a capital adequacy methodology that is more clearly driven by risk
- to reward banks that have developed effective risk measurement / management systems by allowing them to hold less capital than banks with less advanced systems.

The three Pillars deal with:

1. quantification of regulatory capital requirements
2. a supervisory regime
3. disclosure requirements.

Pillar 1 deals with the amount of regulatory capital that banks will be required to hold to cover credit, market and operational risk.

Under Pillar 1, in relation to credit risk, there is a standardised approach and an internal-ratings based approach that may be adopted by banks.

Under the provisions of Pillar 2, the bank's internal processes and risk systems will be under direct supervision.

Pillar 3 disclosure requirements include quantitative and qualitative details on the bank's:

- Financial condition and performance.
- business activities
- risk profile
- risk management activities.

(4 Marks)

iv) Advantages of using the standard model

- Use of the standard model has the advantage as the SCR calculation is less -complex, time-consuming and resource-intensive to perform.
- Hence if the insurance subsidiary is small relative to balance sheet of the bank the standard model would be attractive to use
- The cost of developing an internal model may be greater than any benefit that would be achieved via a lower SCR for the bank
- Even if internal model is developed there may be additional costs and uncertainty in seeking regulatory approval for its use from the concerned regulator

Disadvantages of using the standard model

- As the calibration of the standard model is based on an “average” company the approximations it makes are not necessarily appropriate to all companies.
- If the subsidiary’s risk profile is very different from the “average” underlying the model than it is likely that an internal model may lead to a lower risk based capital requirement than the standard model.
- If the subsidiary has sophisticated risk management systems and controls it may also benefit from a lower SCR calculated by an internal model.
- The company may be developing an internal model in any event, *eg* to assess its economic capital position. Using the internal model for Solvency II would not therefore require the cost of developing a model “from scratch” and would reduce inconsistencies between the regulatory capital and economic capital positions of the company

(4 Marks)
[Total Marks-20]
