Institute of Actuaries of India

Subject CA1 – Paper II
Core Applications Concepts

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INDICATIVE SOLUTION

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.

Q.1 Customer needs

- Understand who is the target market and such investors might include those willing to trade off risk for potentially higher return
- The product does not offer any regular income but only pays a lump sum at the expiry of the contract if the specified event does not occur
- Consider whether this product will meet the need of these investors
- Investors could also look at liquidity and hence might find the product more appealing if a secondary market exists.

Options and Guarantees

- As the payout is linked to no catastrophes happening there is likely to be a need for a return much higher than the risk free return
- The provider has to therefore carefully consider the likely cost of this guarantee and whether any hedging is possible to manage this cost

Marketability

- Marketability of the product depends on the distribution channels, other competing products, credit rating of the provider
- It is important to define "catastrophe" very clearly
- The product is likely to be innovative
- Consider whether any credit rating can be obtained for this product

Other forms of raising money

- Consider whether there are other forms of raising capital in a cheaper way.
- Compare the cost of borrowing with other conventional methods

Other factors

- Consider any regulatory requirements
- Consider any possible issues with administration system, accounting norms

Total – [6]

Q. 2 a)

The project owner is the future operator of the project outcome and will be involved in some of the project management issues.

However, it is not necessary for the project owner to get involved in every detail of the project as these are left to the project manager and implementation specialists

Project owner should concentrate on the agreed milestone review points to ensure that they are properly scheduled and that the project is fully reviewed each time it reaches a milestone review point.

Project owner is often responsible for ensuring that the necessary funding is made available to the project.

b)

The key factors in making a successful project include

- a clear definition of the project, including objectives, roles and responsibilities
- careful planning
- risk analysis
- regular monitoring of progress against objectives
- excellent communication and support between all parties
- a strong leadership team

c)

The written strategy should usually include the following

- a clear identification of the objectives of the project
- statements on how these objectives will be met
- the acceptable quality standards for meeting the objectives
- the project sponsor's role
- the role of any third parties, eg consultants employed
- the financial and economic objectives
- details of the expected cost of the project
- the financing policy
- the policy for dealing with legal issues
- the need for insurance or reinsurance
- the technical policy
- a structured breakdown of the work to be completed under the project
- the key milestones for reviewing the project
- the risk management policy
- the communications policy
- the information technology policy

Total – [11]

Q.3 a)

- The choice of the risk discount rate to be used to determine the expected net present value of the project is of vital importance, as an incorrect choice could lead to the misleading appraisal of the project.
- The starting point is the cost of raising money for funding this project. This is the minimum that the company must earn if its shareholders are not to be better off or worse off.
- This should be the company's normal cost of raising capital, taking this as a weighted average where the weights are based on the optimum capital structure for the company as between equity and debt. (If the company's capital structure is not currently optimum, it could be made optimum through a separate decision).
- The cost of debt capital should be taken as the cost in real terms of new borrowing for the company, by taking an appropriate margin over the current expected total real return on inde*x*-linked bonds, having regard to the company's credit rating, and multiplying by (1-*t*), where *t* is the assumed rate of corporation tax.

- The cost of equity capital should be taken as the current expected total real return on index-linked bonds plus a suitable margin to allow for the additional return that equity investors seek to compensate them for the risks they run.
- This would generate a real discount rate, to be applied to cash flows expressed in present-day monetary values, or adjusted by the assumed future inflation rate and used with cash flows in nominal terms.
- The project might be considered a slightly higher risk as this is a big green field project. The project should be appraised on a slightly higher discount rate than would be considered for projects exhibiting normal degrees of risk for the company.
- A guide may be the discount rate used by other similar infrastructure projects, recently completed or ongoing. In practice these rates may be hard to obtain and therefore an arbitrary addition to the discount rate the company normally uses may be the only solution.
- Care should be taken to avoid spurious accuracy and to avoid the rate being too high and so distorting relative weights of short and long term values.

b)

NPV assuming no delays = 224.37
NPV assuming delay = -21.68
Expected NPV = 150.55
(I am not able to write the formulae here; please see attached spreadsheet for calculations)
The expected NPV is positive, suggesting that the project should be undertaken.
The critical aspect is the delay in land acquisition, which if takes longer or if the chances of delay are higher can impact the expected NPV adversely.

c)

- The capital cost of the project could be underestimated or overestimated. All areas of the project should be well planned and researched and costed at each stage. The risk of possible cost overruns could be mitigated by transferring the risks to a sub-contractor on a fixed price contract or try and insure the risk.
- Land acquisition could turn out to be more difficult than expected as this is a sensitive matter and could take political colours. This risk can be managed by building a proper image for the project, relationship management with various stakeholders and demonstrating value to the local community. Also, the risk regarding site clearance can be mitigated by surveying the site very carefully beforehand and being aware of all regulations.
- The time to be operational could be underestimated. Each part of the project should be planned in advance to ensure the project is completed on time. Action should be taken at the first sign of overrun.

- Revenues are overestimated. Market research should be carried out to determine demand for air traffic in that city and what is the competition (e.g. nearest airport). Sensitivity testing must be done for different air traffic volumes.
- It may prove difficult or costly than anticipated to raise finance for the project. It may be possible to mitigate this risk by underwriting the raising of the required finance. The financial position of the potential lenders and partners should be assessed and monitored very carefully and the financial backers diversified.

(Due credit to be given for any other major risk identified with appropriate mitigation)

Total – [24]

Q. 4 a) Immunization is the investment of the assets in such a way that the present value of the assets less the present value of the liabilities is immune to a general small change in the rate of interest.

b) The limitations of immunization theory are

- Immunization is generally aimed at meeting fixed monetary liabilities. Many investors need to match real liabilities. However, the theory can be applied to index-linked liabilities by using index linked bonds though time lag might exist.
- By immunizing, the possibility of mismatching profits as well as losses is removed apart from a small second-order effect.
- The theory relies on small changes in interest rates. The fund may not be protected against large changes.
- The theory assumes a flat yield curve and requires the same change in interest rates at all terms. In practice the yield curve does change shape from time to time.
- In practice the portfolio must be rearranged constantly to maintain the correct balance of
  - Equal discounted mean term
  - Greater spread of asset proceeds
- The theory ignores the dealing costs of a daily, or even monthly, rearrangement of assets.
- Assets of a suitably long discounted mean term may not exist
- The timing of asset proceeds and liability outgo may not be known

Total – [6]

Q. 5 a) The term risk budgeting refers to the process of establishing how much risk should be taken and where it is most efficient to take the risk (in order to maximize return)

The risk tolerance of the charity's sponsors can be determined using VaR techniques

There are two steps involved in allocating where to take the risk:

1. decide how to allocate the risk between strategic risk (ie the risk taken relative to the liabilities)
   and active risk (the extent to which individual managers are allowed to deviate from their benchmark portfolios)
2. Allocate the available active risk budget across the component portfolios

The distribution of risk will depend on the risk attitude of the sponsors – how much systematic risk are they willing to take in order to achieve higher returns.

It will also depend on whether the sponsors believe that active management adds value or not

Risk exposures will need to be monitored over time and rebalancing should be carried to keep the total risk within the tolerable limits.

b) Risk budgeting is an investment style where asset allocations are based on an asset's risk contribution to the portfolio as well as on the asset's expected return.

A risk budgeting strategy can free the manager to look for alternative investments that might increase the expected return on the portfolio. Because the constraint is that the total risk of the portfolio must stay at or below a targeted level, increased attention is paid to low correlation investments. Allocations to such investments can reduce the total risk of the portfolio through diversification.

Total – [7]

Q. 6 a)

- The need is to estimate future experience of those who will buy this product but the company, being newly starting, has no past data.
- There is no industry data for critical illness.
- The past data for mortality is ten years old and hence would require adjustments to be made for likely changes in mortality during the period. It is likely, as the country is growing economically, that standards of living could have improved resulting in reduction in mortality rates.
- For mortality and critical illness incidence, reinsurers could be a source of information. They could have gained experience through their association with other companies in the country or from similar markets elsewhere.
- There might be national population statistics on mortality and various illnesses.

- Anecdotal industry experience may be obtained by networking with industry experts.
- Published insurance and population experience of countries with similar demographic and economic profile could be available.
- While setting best estimate assumptions it is important to recognize adjustments that would be required to reflect the company's own underwriting standards, target market segment, product features, policy wordings, critical illness definitions and exclusions.
- Suitable margins will have to be built to reflect likely future experience and any rate guarantee in the product. At the same time, the margin should not be too big making the product uncompetitive.
- It is unlikely that any published data would be available on lapses. Assumption might have to be set based on anecdotal information and experience of the company in other similar markets.
- Pricing results must be sensitivity tested by changing the lapse assumption to reflect plausible adverse scenarios.

b)

- The main uncertainties arise from future events that cannot be estimated well at outset. These are future investment conditions, expense inflation, withdrawal rates, critical illness rates and mortality.
- Mortality and particularly mortality improvements could be tested through a stochastic model, as this is an important assumption. Similar approach could be adopted for critical illness incidence.
- If it is assumed that withdrawals are selective, it will be necessary to link the mortality / critical illness assumption to the withdrawal assumption.
- The product refunds premiums paid on maturity and hence has an investment risk. There is also a reinvestment risk as it is a regular premium product. A stochastic investment model could be used because of the importance of the assumption. This would generate future expense inflation rates automatically.

c)

- Customers looking at buying such a product and who do not like to be medically screened would prefer buying this product, assuming other terms and conditions are in line with the market.
- The sale process is simplified and hence sales people might take advantage of this offer. The underwriting process too would be faster.
- The above might result in improved sales which could get some strategic wins for the company, such as moving up in the market league tables and positioned in the market as an innovative company.
- The company will not incur the costs of obtaining the additional medical information. The savings will give the opportunity for premiums to be reduced, or alternatively profits increased.
- Reinsurers may charge a higher reinsurance premium because of weakening of underwriting, or become more involved in the underwriting

process for large cases. This might increase costs or introduce delays, offsetting the benefits above.

- The underwriters will have to base decisions on more limited information and so more experienced underwriting staff may be needed, increasing staff costs and reducing the expense savings.
- The company could increase the number and depth of questions on the application form. This may be a deterrent to prospective policyholders, and offset the benefit of the faster underwriting process.
- With less information, it may be necessary to decline more lives. This may lead to complaints, or agents not selling the product.
- The product definitions and exclusions might be tightened resulting in more rejected claims on critical illness.
- The risk of underwriting incorrectly will be increased. This may cause mortality / CI experience to worsen.
- There is a risk of anti-selection if the company attracts lives where the additional information from a medical report would cause other companies to impose special terms.
- There is a risk of moral hazard if customers believe they can give incorrect information and not be found out by a medical exam.
- Once introduced, it might be difficult for the company to withdraw this feature and go back to medical underwriting.

Total – [20]

Q. 7 a) The role of capital in banking industry is to

- demonstrate regulatory solvency
- demonstrate financial strength to market and rating agencies
- enable the business to withstand deterioration of credit experience and unexpected losses
- provide funds in the event of other adverse events
- finance growth and investment in the business
- finance acquisitions

b) i)

1 - Lump sum in advance - under this method a lump sum payment is made when the employee joins service. The lump sum is designed to be sufficient to provide all future benefit outgo.

2 - Terminal funding – under this method funding is done when the benefit starts to be paid. If the employee opts for lump sum, it is paid out without any pre funding. If the employee opts for annuity funding is done as a capital sum at age 55.

3 - Pay As You Go – under this method no funding is done and every payment is made as and when they arise.

4 - Regular contributions – under this method regular funding is done from the day the employee joins service. It would make assumptions of which of the two benefits the employee is likely to opt or which of the two benefits is likely to be more expensive for the company.

b) ii)

- Under PAYG method no surplus or deficit will arise
- Surplus or deficit can arise under the other three methods.
- Under "lump sum in advance" and "terminal funding"
  - The employer can take any surplus
  - The employer will have to fund any deficit
- Under "regular contribution"
  - The employer can either take any surplus or adjust future contributions
  - The employer will have to fund any deficit
- Funding for deficit can be done as a one time amount or via periodical payments
- Regulatory or tax implications could also influence the approach taken to deal with surplus or deficit.

b) iii)

- Capital requirements can be considered in terms of economic or regulatory capital.
- Regulatory capital depends on legislative rules and accounting norms.
- The benefits being proposed to the senior management staff will have an effect on the economic capital as it increases its requirement. The extent of impact will depend on the method adopted to value the benefits and the pace of funding.
- Complete details of the proposed scheme have to be understood. Perhaps nothing is payable if the employee resigns before completing five years of service. Would any benefit accrue on death before completing five years or after opting for the deferred annuity benefit? Likewise on ill health retirement.
- It is important for the bank to recognize all risks in the proposed scheme and also the fact that the employees have the option to elect the type of benefit.
- The bank could consider insuring the deferred annuity once the employee elects this benefit. Obtaining quotes from insurance companies would also provide an idea of the likely cost of this benefit.

Total – [16]

Q. 8 a)

Losses can arise from events that affect several insured risks within a period, perhaps a year, leading to aggregation of claims.

Each individual claim might not be of exceptional size, but collectively the aggregate cost might be damaging to the insurer's gross account.

Aggregate excess of loss covers the aggregate of losses sustained from a defined peril (or perils) over a defined period, usually one year.

The aggregation of claims might be by event (e.g. winter influenza epidemic), by peril (e.g. subsidence) or by class of business (e.g. all motor policies)

This arrangement would usually cover losses above an excess point and subject to an upper limit.

b) i-

The key risks are claims of bigger size per life and accumulation of claims.
The reinsurance arrangement can protect exposure per life and also at portfolio level.
Thus a suitable arrangement could be proportionate reinsurance (surplus arrangement) and non proportionate reinsurance of aggregate excess of loss.
If the product has new risks to which the general insurance company has little experience, the proportionate reinsurance could be of quota share form.

ii-

The key risks are large individual claims, catastrophes, accumulations and general risk of variable claims experience.
As this a large company, it could go for a surplus reinsurance with higher retention limits.
An aggregate excess of loss reinsurance will provide protection from large claims in a year and a catastrophe excess of loss reinsurance will protect it from catastrophes.

c)

	Reinsured in quota share	Reinsured in risk XoL	Total retained
Claim 1	1.8	0	1.2
Claim 2	4.8	0.2	3.0
Claim 3	7.2	1.8	3.0
Total	13.8	2.0	7.2

Aggregate XoL claimed from reinsurer = 7.2 less 5 = 2.2 mn

Total – [10]

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