

Institute of Actuaries of India

Subject CA1-I – Actuarial Risk Management

November 2012 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.

Ans. 1) Advice to start-up company

advice may be on:

- Products which could provide
 - Protection against financial loss arising from the death or ill-health of key employees
 - protection of tangible assets
 - protection of intangible assets like trademarks and copyrights
- provision of work-related benefits that will attract and retain good quality staff
- assist in meeting legislative requirements relating to labor laws
- level and form of capital required
- managing the costs of running their business
- quantification of the amount of surplus capital in the business
- investment of surplus capital

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Ans. 2) Contents of key document

The written strategy should include the following:

- a clear identification of the objectives of the project i.e license to be obtained within a certain time frame
- statements on how these objectives will be met, clearly enunciate steps involved in the process-
 - setting up liaison office,
 - setting up internal or engaging external consultants to do market research on products, distribution, investment, IT,
 - internal people skills required and recruitment
- the acceptable quality standards for meeting the objectives- for eg., the company may have minimum internal quality standards relating to finance, operations etc. which would need to be documented and complied
- the project sponsor's role
- the role of any third parties, eg consultants to be employed, at what stage of the project and when
- the financial and economic objectives-
 - License approval typically involves preparation of long term business plans and approval of same by Board of company. Financial objective would be to get finalized a business plan acceptable to internal management which meet company's internal financial objectives.
 - The company may have internal objectives relating - maximum capital that can be invested and its phasing, the plans need to satisfy these objectives
- details of the expected cost of the project- setting up liaison team, employing consultants, time and cost of project members, travel and other office costs

- the financing policy- eg., how will the project be financed- typically the head office would have a budget allocated , then budget constraints and financial approval matrix for various levels of expenses
- the policy for dealing with legal issues eg., including any conflicts with third party service providers
- a structured breakdown of the work to be completed under the project- milestones and target date of completion
- the key milestones for reviewing the project- for eg., when market research will be completed, when will business and financial planning commence, when will key people need to be identified and recruited
- the risk management policy- for eg., ensuring back up for key members, documentation of technical work
- the communications policy of dealing with press, public etc.
- the information technology policy – to ensure protection of data and secrecy

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Ans.3) (i) importance of livestock insurance

- Animal death is the biggest risk for poor cattle owners. Given that the country has a significant rural population this could be a risk for a large proportion of the country's population.
- Since animals often represent a major asset for a low-income household, perhaps even it's their most valuable asset, their death can cause a significant decline in the household's net worth, not to mention a fall in income and productive output. Hence a need for insurance.
- Further, if the animal has been purchased through a loan the household may have a debt on an asset it no longer owns. Hence, forms of insurance similar to credit-life insurance may be suitable.

(ii) Points on report

- Providing livestock insurance is transaction-heavy and also would require robust claim handling systems.
- Monitoring and verification of claims – to combat fraudulent claims the insurance company would need to appoint their own veterinarians for tagging, valuation and risk calculation.
- Risk of collusion between veterinarians and farmers is high.
- Valuation of animals – value is closely correlated to their age, health and production capacity.
- Due to the range of breeds in different geographical areas with different feeding patterns, the insurance company may find it difficult to assess the correct value
- Identification of animals – poor identification techniques substantially increase the moral hazard problem
- High operational costs – operational processes associated with issuing policies and settling claims can be labour-intensive and hence expensive
- High risk of fraudulent claims – fraudulent practices are rampant in livestock insurance due to fragile identification methods.

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Ans.4 (i) Financing approaches

There are two approaches to financing benefits, *unfunded* or *funded*.

By *unfunded* we mean just find the money to pay for the benefit as the benefit falls due, the unfunded approach is called *pay-as-you-go*.

By *funded* we mean to some extent the monies to meet the benefit costs are set aside before the benefits fall due.

As a funded approach, the following funding choices available to the provider:

- lump sum in advance
- terminal funding
- regular contributions
- just-in-time funding
- smoothed pay-as-you-go.

(ii) PROS and CONS**Pros**

- Benefit is funded well in advance and hence security of benefits is better compared to any other funding approach
- Benefit is purchased from an independent third party, and hence the benefits will be perceived as being highly secure by employees .
- The insurance company will possibly have better administrative and investment expertise than the company
- The CFO will not have to face liquidity issues at the time of paying out benefits as the policy will pay for the benefits
- Investment and investment related expense are passed to insurer

Cons

- The company has to lay out the money in advance when an employee joins the firm- liquidity issues might still arise,
- What would happen if employees were to leave before completing 5 years of service, will the policy need to be surrendered- what will be the surrender value that will be paid by the insurer
- Deciding the Sum Assured for each policy will be tricky- as estimates would have to be made about salary escalation. There is risk that the Sum Assured could turn out to be low or higher than the cash required for payment.
- The insurance company will charge for its own expenses and profits- hence this method might prove to be more expensive than an internally run scheme
- Risk of insolvency of insurance company

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Ans. 5(i) Regulatory regimes and forms

Listing in the order of increasing degree of regulation, the following types of regulatory regime are possible:

- Unregulated markets

Where the costs of regulation outweigh the benefits, often the best option may involve no specific regulations.

- Voluntary codes of conduct

The rules and regulations are set by those with the greatest knowledge of the industry.

- Self regulation

A self-regulatory system is organized and operated by the participants in a particular market without the regulator's intervention.

- Statutory regulation

The regulator and the government set out the rules and regulations and police them. There are usually stringent reporting and compliance requirements.

- Mixed regimes

In practice many regulatory regimes are a mixture of all of the systems described above, with codes of practice, self-regulation, and statutory regulation all operating in parallel.

Each of the above regimes can adopt any of the following forms:

Various forms of regulation

- Prescriptive – this form of regulation has detailed rules setting out what may or may not be done
- Freedom of Action – A company can do what they want, but the company will have to provide sufficient information for the regulator to check that it is being properly managed.
- Outcome based – this form of regulation can allow freedom of action but prescribes the outcomes that will be tolerated.

Ans 5 part (ii)

Merits of this proposal

- Since it is large country with a rapidly growing insurance sector the process of licensing and subsequent supervision of brokers could be costly and ineffective. A self-regulatory organization could manage it more effectively from a cost benefit perspective
- A self regulatory regime would also be able to respond to rapid changes in market needs compared to a statutory regime where every change would require legislative intervention.
- the system is implemented by the people with the greatest knowledge of the market(brokerage firms are specialists in the area of their work), and have the greatest incentive to achieve the optimal cost benefit ratio.

De-merits of this proposal

- A lack of public confidence since the regulated and the regulator are one and same.
- Existing brokerage firms may inhibit new entrants to a market, This could especially be the case if the market is dominated by a few large players.
- The existing participants could frame the rules in such a way as to act as a barrier to entry, *eg* by imposing very exacting capital requirements that a new entrant
- it is likely that a group of large brokers, may cartelize and impact price, terms and conditions which could lead to fewer choices for public

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Ans. 6) (i) Actuarial model to be used

Because of the underlying guarantee, a stochastic investment model should be used to assess the expected profitability of a contract with guarantees

Stochastic models are good for modeling guarantees as the output can be used to work out the likelihood of the guarantee biting as well as key statistics such as the expected cost and the variability of the cost of the guarantee.

An advantage of such a stochastic model is that it can automatically allow for correlations between returns on different asset classes .

(ii) Steps require in this model

Stochastic modeling could involve the following steps:

- decide the variables that need to be modeled stochastically- for eg., equity return, return on debt securities
- an investment return projection model needs to be built based on the proposed investment pattern
- the model used for projection must allow for portfolio rebalancing if same is proposed as part of investment strategy
- a suitable density function and underlying parameters based on historical data has to be chosen for each of the variables that needs to be modeled stochastically
- specify correlation between variables for eg., co-relation between equity and debt returns, interest rate and inflation
- back tests needs to be performed to ensure that the fitting is appropriate and attempt to fit a different distribution if the fitting is not good
- an appropriate policy cash flow model based on future expected decrements and investment scenario has to be built to determine specific results like cost of guarantee

- check whether any other variable needs to be modeled stochastically or co-related with investment performance for eg., policyholder lapse behavior might need to be modeled co-related to investment returns
ascribe values to the variables that are not being modeled stochastically- eg., mortality, expenses etc.
- finalize model points which are representative of likely future new business – age, sex, policy term etc
- policy cash flow model is then run for each model point, each time using a random sample from the investment return projection model output
- decision on number of simulations that needs to be run has to be decided, a compromise needs to be made between run time and accuracy as stochastic models take a lot of time to run
- The cash flow model will produce a summary of the results for the various model points that shows the distribution of the modeled results(cost of guarantee and variability of guarantee) after many simulations have been run

(iii) Main requirement in good model

A good model will:

- be valid, rigorous enough for its purpose and well documented
- reflect the risk profile of the business being modeled adequately- eg;, policyholder dynamic lapses, expenses per policy etc.
- allow for all the significant features of the business being modeled that could significantly affect the advice being given
- have appropriate input parameters and parameter values, taking into account any special features of the provider and the economic & the business environment (expected changes in economic environment which could impact asset performance-eg. tax changes, new trading laws etc.)
- easy to appreciate and communicate, the result should be displayed clearly
- focus of exercise is to determine cost of guarantee and variability under various scenarios, instead of giving results for all simulations, percentiles, mean, and its variability could be focused on
- should exhibit sensible joint behavior of model variables and the assumption should be consistent,e.g. the assumed rate of investment return should be consistent with the assumed rate of inflation, policyholder lapse behavior linked to investment performance
- capable of independent output verification for reasonableness and should be communicable to those to whom advice will be given – using back of envelop calculations or using a deterministic model to check reasonableness of results
- not be overly complex so that the results become difficult to interpret and communicate
- not be time consuming to run unless this is required by the purpose of the model- how many variables to be modeled stochastically for eg. policy maintenance expenses inflation can be modeled as fixed for except may be under extreme scenarios
- be capable of development and refinement - nothing complex can be successfully designed and built in a single attempt
- be capable of being implemented in a range of ways such as to facilitate testing, parameterization and focus of results

Ans. 7) (i) Types of expenses

Development expenses
New business administration expenses
Underwriting expense
Initial commission/ Renewal commission
Maintenance/renewal expenses
Investment management expenses
Claim expenses
Other overheads

(ii) Reasons for analysis of expenses for charging structure

It will enable company to fix appropriate charge that will cover the expected level of initial and on-going expenses associated with writing and subsequently servicing the contracts

Understand the level of cross subsidy between new business and renewals, between different lines of business and management of the same

It is always better to know the theoretically correct expense loadings even if company is not able to implement it commercially ie to understand the cost implications of not charging the correct loadings

Understand the actual costs of writing and servicing contracts and how these may vary, for examples by distribution channels say agents and bancassurance channels.

This would enable to understand the profitability of the product, cash flow management and financial planning.

(iii) Factors determining charges

- The charges should match the respective expenses as closely as possible – both the timing and size of charges.

For example:

- Charges related to the size of premium match commission related expenses (e.g. allocation rate, bid/ offer spread).
- A fixed up-front charge for new business administration expenses.- like policy issuance,
- An annual policy fee increasing with inflation (e.g. average earnings inflation) for maintenance expenses.
- A fund-related charge for investment expenses.

The benefits of matching include:

- Immediate recovery of initial expenses reduces the initial financing requirement.
- Matching of renewal charges and expenses make it less likely that non-unit reserves are required, and hence also reduces capital requirements and releases profits more rapidly.
- Exact matching removes the sensitivity of the contracts profitability to variations in experience.
- In particular, it eliminates the company's exposure to the risk of early lapses.
- Overall, matching can maximise profitability and/or policyholder benefits.
- The charging structure also needs to be attractive to the potential market.
- Some types of charge, such as front end loads, are more obvious to the policyholder and hence can be less attractive (e.g. visible in low early surrender values).
- The needs of the proposed target market should be taken into account. For example, if not financially sophisticated then they may prefer a simple charging structure.
- The company will not want the structure and level of charges to differ too much from those of competitors.
- The company should consider the extent to which it will guarantee the level of charges;
 - Removing guarantees may reduce the overall reserves required to be held (including any additional solvency margin).
 - But including guarantees could be more attractive to potential policyholders.
 - If the charging structure is guaranteed, it may be necessary to increase the charges further to allow for this.
- It may not be possible to match the charges and expenses exactly for all contracts, for example large and small policies. The company must decide on the extent of cross-subsidy.
- Administration and systems implications should also be considered. Existing system structures may limit the types of charge that can be used.
- The company may wish to ensure that the charging structure is similar to that under any other unit-linked business that it already writes.
- There may be regulatory constraints on the level of charges permitted.

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Ans.8) (i) Need for annuity

- Annuities are specifically designed to cover the risk that an individual outlives their own resources by transferring such risk from the individual to an insurance undertaking or other annuity provider.
- From a customer's perspective immediate annuities meet a financial need for an income for a remainder of the life of the insured, for example, after his or her retirement
- Increasing longevity, decreasing state pensions and a rise in defined contribution pension plans (shifting responsibility for retirement income to individuals) mean an increased need for immediate annuity products.

(ii) Reasons for Annuity market not being well developed

Supply Side Constraints

I. Pricing

- Reasons for a lack of annuities products may be found on the supply side of the market – insurance companies may have been unwilling to offer these products (or to offer them at attractive prices) and few reinsurance companies are prepared to reinsure longevity risks. This could be partly due to the problems the insurance companies themselves have encountered in pricing annuities - largely due to the difficulties of forecasting mortality.
- Annuity providers therefore remain exposed to the risk that mortality rates of pensioners will fall at a faster rate than accounted for in their pricing and reserving calculations.
- Given that this is developing country the country may lack the demographic data that are necessary to construct accurate mortality projections.
- This is further aggravated by the improvements seen in the life expectancy in the past. This may have made it difficult to forecast future improvements, and no model may have yet been developed that gives accurate predictions of the rate of this longevity increase.
- Further annuities are relatively 'low margin' financial products, if incorrect mortality assumptions are used they can prove unprofitable for providers
- In theory an insurance company's life business may offer a hedge against mortality vs. annuities
- If the proportion of annuity business becomes too large such a natural hedge may not be possible
- In practice the difference in profiles of life and annuity policy holders and the small annuity markets make this possibility some way off.

II. Matching Assets

- A further supply side constraint is that insurers may have had trouble finding assets to match the liabilities represented by the annuity products they sell.
- A life insurer selling annuities faces a variety of risks including credit risk, liquidity risk, business risk, investment risk and longevity risk.
- Non availability of long term government bonds increases credit risk and reinvestment risk.

III. Solvency

- Capital adequacy and reserving are key measures for protecting against the insolvency of insurance companies, and therefore for protecting annuity holders.
If capital requirements are too high, and profitability too low, the supply of products may be impaired.

Demand Side Constraints

I. Complexity of products

In addition to supply side problems, there are various factors that may have limited demand for annuities –

- Other perceived attractive options- mutual fund monthly income plans, bank fixed deposits etc and hence unpopularity of the annuity products.
- The attractiveness of fixed annuities can be reduced by the risk of inflation eroding fixed annuity pay-outs, their illiquidity and often inappropriate advice provided by financial intermediaries .
- Lack of customer understanding - One of the factors limiting demand is that consumers do not seem to understand the pricing of annuities and often see them as 'bad value'- which prevents them for understanding the benefits these products can provide.
- For example, the expected return or the insurance value of a life annuity can be hard to grasp, and people may not understand the concept of a 'shared risk pool', allowing an insurance company to make the same promise for life to all holders of a life annuity.
- Poor quality of advice from financial intermediaries: Customers may need an intermediary to help navigate around these complex products, yet in developing markets these intermediaries themselves may not always understand the products sufficient to be able to provide accurate and tailored advice.
- A lack of understanding of the different types of annuity products and problems relating to deciding what types of risk they do or do not wish to take on.

II. Regulations

- Finally, regulations in the country may have been a barrier to demand for annuities. Notably, there may have been tax disadvantages relating to these products, such as adverse tax treatment vs. lump sum payouts or vs. tax breaks on other assets. Removing these tax disincentives can greatly encourage demand for annuities.

(iii) Steps to promote

A) Improved Data:

- *Improved mortality tables and forecasting:* The government could work either by itself or in partnership (with academics, consultants, insurance companies) to provide as accurate mortality data as possible.
- These databases take time to build, but policy makers should start compiling detailed national data bases as soon as possible.
- They could also support the development of more sophisticated, stochastic mortality modelling – including careful estimates for potential improvement factors - and encourage moving away from more limited, deterministic approaches.
- *Differentiated data in pricing products:* mortality tables for different segments of the population are also required (and could be constructed from insurance companies' data).
- Insurers may be permitted to put people into different risk categories, allowing for more flexible pricing, reducing adverse selection and increasing trust in the pricing of annuity products.

- Such segmented mortality data could be collected by governments, or alternatively a cooperative arrangement among insurers that spreads the cost amongst themselves could be used.
- *Accurate inputs:* The regulation may be used to ensure that pension and insurance companies are using the most up to date and accurate figures available. Attention may also be focused on the suitable training of actuaries.

B) Asset Liability Matching:

- *Long dated bonds:* an efficient market for life or long-term annuities requires a well developed government bond market with a complete maturity spectrum that is long enough to reduce the risk of unmatched distant liabilities to reasonable levels.
- The Government may ensure an adequate supply of long-dated paper, allowing annuity providers to match their liabilities and avoid reinvestment risk. However, this should be considered within the context of the objective of government debt management agencies to issue debt within cost and risk considerations.
- Other long-term securities, including corporate bonds and mortgage-backed securities could also be encouraged.
- *Index linked paper:* the issuance of index-linked paper would allow real annuity products to be provided and adequately hedged. Private sector issuance of index-linked paper may also be considered (though private corporations may not be willing to do so as – unlike governments – they have no control over inflation or a natural hedge against it).
- *Longevity bonds:* The government may encourage the development of a market in longevity hedging products, such as longevity bonds. Such issuance should be permitted by private sector players, and governments may even consider issuing such bonds themselves, in order to help the private market develop by providing pricing benchmarks and liquidity.
- *Alternative products:* The government may wish to ensure that restrictions do not unduly hamper the development of derivative products which could be used to hedge annuity related risks, or alternative products such as mortgages.

C) Risk Pooling:

- *Extreme risk pool:* Where insurers retain exposure to annuity products with certain types of risk which cannot be transferred, and which are large enough to interfere with supply (such as longevity risk), mechanism for pooling such risk could be considered.
- For example longevity risk after a certain age could be transferred to a pool either run jointly by insurance companies on a private basis, or wholly or partially with the government on a public basis. Such a pool could theoretically be arranged internationally.
- *Reinsurance:* Alternatively reinsurers could be encouraged to cover longevity and other annuity related risks over a certain level, potentially on a collective basis.

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Ans. 9) (i) Sources of risk company exposed**Market risk**

Market risks are the risks relating to changes in investment market values or other features correlated with investment markets, such as interest and inflation rates.

For this company, examples of market risk would be:

- inflation increasing its salary costs for drivers and administration staffs
- high interest rates increasing its borrowing costs
- falls in the company's own share price if it is listed as this would restrict its ability to raise capital in the future.

Credit risk

In general credit risk is the risk of failure of third parties to repay debts.

This company will face the risk that the companies and schools used vehicles and default on their payments.

Relatively lower credit risk on public sector companies/.

However, there is still the risk of failure to pay in a timely way.

Business risk

Business risks are specific to the business undertaken.

For this company, business risks could include:

- product failings, e.g. lack of reliability, time mismanagement, quality of vehicles etc.
- poor customer service
- lack of innovation resulting in competitors taking the company's market share
- inadequate publicity / advertising
- poor understanding of the needs and concerns of customers.
- Poor pricing due to lack of assessment of future increase in petrol or diesel prices.
- A spate of accidents harming their reputation
- Sudden changes in road laws require increasing investments on vehicle upgradation (pollution laws, installation of speed deterrent's etc]

Liquidity risk

This would be the risk that the company, although solvent, does not have the resources to enable it to meet its financial obligations as they fall due or can do so only at excessive cost.

For example, although profitable, the company may face cash flow problems paying bills and salaries.

Operational risk

Operational risk refers to the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events.

For example:

- reliance on third parties to carry out various functions for which the organization is responsible.
- the condition of the vehicles under lease for the purpose may not fulfill customer satisfaction.
- death or move to another employer of a key persons say, manager or experienced driver.
- time mismanagement by the drivers to pickup and drop the employees or students.

External risk

Examples of external events that could be a source of risk include:

- fire / flood interrupting business
- changes in government regulation for the use of vehicles in schools
- Strikes by political parties
- The condition of the roads and traffics impacting run time performance and hence revenues

(ii) Likely actions as a part of risk management process

- Risk identification, ie recognising the risks that can threaten the income and assets of the company
- Risk measurement, ie the estimation of the probability of a risk event occurring and its likely severity
- Risk financing, ie determining the likely cost of a risk and ensuring that adequate financial resources are available to cover it
- Assessing the company's risk appetite
- The amount of capital it has available to cover risks
- Assessing existing control measures
- Implementing further risk control measures that aim to mitigate the risks or the consequences of risk events, eg by limiting their financial consequences
- Risk monitoring, ie regularly reviewing and re-assessing of all the risks previously identified
- Along with an overall business review to identify new or previously omitted risks
- Establishing a risk portfolio or risk register, to assist in the assessment and management of risks
- Implementing a risk reporting process that provides information at a level to enable the company's managers to make informed decisions
- Establishing clear management responsibility for each risk (in order that monitoring and control takes place effectively)
- Performing the risk assessment at a whole company level

(iii) Few approaches to managing risk

- Diversify the risk away.
- Implement control measures that reduce the likelihood of the risk event occurring.
- Implement control measures to ensure that the price paid for the risk is fair.
- Implement control measures to mitigate the consequences of a risk event that does occur.

(iv) Operational lease vs Cash purchase**Similarities:**

Under the lease, the lessee may or may not be responsible for the insurance, repairs, maintenance etc. Under cash, the company will definitely be responsible.

Both lease and cash will provide the company with full rights to use the vehicles in its business operations.

Both approaches have associated funding costs. The lease payments will include an implied interest rate and asset depreciation. The use of cash implies it is no longer able to be used elsewhere in the business or it has been borrowed from other sources at a cost.

If the lease is given by the manufacturer, under both approaches the vehicle manufacturer has sold the vehicles for cash.

Differences:

Typically a short term agreement and is cancellable at the option of the lessee. Hence the lessee does not contract to purchase the vehicles at the outset

A lease is a direct financing arrangement. Cash must come from the business or be obtained indirectly from other sources.

Lease is a contractual agreement conferring rights and obligations regarding the use of the vehicle.

Cash is a flexible alternative allowing the lessee to easily trade or encumber the asset in the future.

Cash is ownership and the lease is treated as a rental agreement. Hence there is different accounting treatment.

Cash means that the lessee will be directly concerned with the value of the vehicles. Under the lease the lessee will only be concerned with the vehicle value at the time(s) at which it may exercise its purchase option(s).

The purchase option mechanism is a valuable option for the transport company as he is not at risk to unexpected fall in the value of the vehicle. The lessor charges for accepting this risk.

Under the lease the lessor holds legal title. For cash, the transport company will hold legal title.

The tax treatment of the two alternatives will be different.

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