Institute of Actuaries of India

Subject CA1-I – Actuarial Risk Management

October 2014 Examinations

INDICATIVE SOLUTIONS

Introduction

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

Solution 1:

i)

- A term used where the cover is not restricted to specific perils
- such as fire, storm, flood *etc*.

- The cover is for loss, destruction or damage by any peril not specifically excluded.

[2]

ii)

- Examples of possible exclusions for such an "all risk" policy could include:
  - liability to employees working on the project
    as this would often be covered by a separate employers' liability policy
  - damage to the work-in-progress resulting from faulty workmanship
  - damage to any property which existed on the contract site prior to the work commencing
    (eg if an extension to an existing building was being constructed)
  - damage due to wear and tear.
  - Loss or damage directly or indirectly arise out of or in connection with war, invasion, act of foreign enemy, hostilities or warlike operations
  - loss or damage due to faulty design;

[4]
[6 Marks]

Solution 2:

i) *Receipts (to the insurer)*
Regular (annual or monthly or any other modes) premiums will be received from the policyholder.

Each premium is usually a level amount. Alternatively, premiums may be set to increase at regular intervals, or the provider may reserve the right to periodically review the premiums in light of experience.

The premiums are paid until death, although other variations in premiums include regular premiums payable for a limited period only, *eg up* to age 80.

Investment return will be earned on the assets in which the premiums are invested.

Payments (from the insurer)
The provider will pay a sum assured (as a lump sum payment) on death.

The timing of the payment will be unknown. The amount payable on death is known as this is a without-profit contract.

There may also be a surrender value payable on discontinuance of the policy. The timing and amount of this payment may be unknown in advance.

The provider will have negative real cashflows arising from expenses.

[3]

ii) Offering a surrender value may on whole life policies be seen to be in line with treating customers fairly, and matching policyholders' reasonable expectations.

Pure term policies are generally of shorter term with very low premiums and reserves, and hence no surrender values are paid.

Whole life policies are of longer term than pure term policies.

In the early years premiums are higher than the cost of life cover for whole life policies as the level premium is charged.

Part of the excess is used to build up a reserve for the later years of the policy when the cost of cover exceeds the level premium. At the limit of life, the reserve will equal the sum assured.

On surrender there will therefore be a release of reserves.

Hence a surrender value can be paid without causing the company financial strain.

Offering a surrender value could be viewed as fair treatment for those clients who exit having paid more in premiums than the value of the benefit they would otherwise receive.

There may be regulations that require a surrender value to be paid.

Competitors are likely to offer surrender values, hence a policy without a surrender value will prove difficult to sell.

[4]
[7 Marks]

Solution 3:

i) A customer's logical needs can be analysed as follows:

- protection, eg against death, loss, illness, accident
- accumulation for a purpose, eg an income in retirement, repayment of a mortgage
- accumulation for a purpose as yet unknown out of any remaining disposable income or capital.
- All of this may involve taking advantage of any tax-efficient arrangements available.

[2]

ii) The need of the young couple can be met mainly in following type of products:

Term assurance
Pays a lump sum on death within a specified period.

For example, might set the period as being until any children are no longer expected to be dependents.

This is needed in order to protect the spouse and any children against financial loss due to loss of the main household income.

It could also be needed to repay the balance outstanding under a mortgage (if on a repayment basis) or other loan.

It may not be needed if either are employed and the employer provides adequate death in service benefits.

It is normally conventional without profits.

Endowment assurance
Pays a lump sum on the earlier of death or survival to a stated date.

It may be needed to repay an interest only mortgage.

Normally with profits or unit-linked.

Pension contract
This can be in either deferred annuity or endowment assurance form.

The key benefit is payment of a regular income (or a cash lump sum, which can be used to buy an immediate annuity) provided the customer survives to a specified date.

It enables the customer to save part of their income now whilst economically active in order to provide income in retirement.

It would not be needed if either are employed and the employer provides an adequate corporate pension scheme.

Normally with profits or unit-linked.

School/University fees plan
This could be in the form of a savings contract, the proceeds of which can be used to purchase a temporary immediate annuity when the children are of school age or when they go to university.

It enables the customer to save in advance for payment of school fees, to provide private education to the children when they are of an appropriate age.

The savings component would normally be with profits or unit-linked; the annuity would normally be conventional without profits.

[6]
[8 Marks]

Solution 4:

i) Excess of Loss (XL) reinsurance is non-proportional cover where the cost to a ceding company of large claims is capped with the liability above a certain level being passed to a reinsurer. However, if the claim amount exceeds the upper limit of the reinsurance, the excess will revert back to the ceding company.

[1]

ii)

- The limit might operate on individual claims or on aggregations of claims basis.
- Risk XL, relates to individual losses- affects only one insured risk at any one time.
- Aggregate XL covers the aggregate of losses, from a defined peril (or perils) over a defined period, usually one year.
- Cat XL is a form of aggregate excess of loss reinsurance providing coverage for very high aggregate losses arising from a single event, that may be spread over a number of hours.
- The treaties might have an upper limit, above which the reinsurer's liability ends.
- The reinsurer might pay for all claims within the limits or perhaps only a proportion of the claims within the limits, *eg* 90%, in order to ensure that the ceding company retains an interest in the risk.
- The limits might be linked to inflation to ensure cover is not eroded over time.

[3]

iii) Higher risk is associated with greater variability, and hence a larger probability of ruin

Purchasing excess of loss reinsurance will reduce claim volatility and therefore reduce the probability of ruin.

The effect on the insurer depends on both the retention level and the reinsurer's profit load/cost of reinsurance

Different types of reinsurance (Individual/ Aggregate/ Catastrophe) may be considered.

Buying reinsurance is a tradeoff between profit and volatility

Reinsurance will reduce the claims volatility but it will also reduce the company's expected profit.

Buying reinsurance will give a more stable profit year on year

Reduced profits will worsen the solvency position but reduced claims volatility will strengthen it.

Above a certain profit load it will be better for the insurer to retain all the risk and below a certain profit load it will be better for the insurer to cede all the risk.

Between these two profit loads the insurer needs to fix the retention level in order to minimise the probability of ruin.

Therefore the insurer can set a retention level such that the probability of ruin is less than it would be without reinsurance thus achieving the desired effect.

[4]
[8 Marks]

Solution 5:

20% of GWP

- Simple and easy to calculate
- GWP representing business volume does not capture differences in nature of premium/business between companies and associated risks
- for eg., long tail v short tail, Unusual risks, large risks
- Does not address risks associated with assets- eg., credit risk, liquidity risk etc

Solvency Margin proportional to technical reserves

- One of the purposes of the solvency margin is to provide a cushion for fluctuations in the value of assets or liabilities (reserves).
- As fluctuations are generally proportional to the amounts of reserves, it might be appropriate to have the margin proportional to the amount of the reserves.
- This method may penalise companies who hold relatively prudent reserves
- May not adequately address liquidity, credit risk etc.

Statutory basis for calculating technical reserves

- This basis prevents possibility of a specified minimum Solvency margin being satisfied through weakening the reserving basis.
- Aims to provide consistency between companies.
- But it may be very hard to establish appropriate statutory reserving bases, especially for unusual risks.
- Could still penalise companies which have relatively better could pricing practices
- For eg., better (underwriting/claims policy), as basis is standardized

Investment in G Sec/AA rated securities

- Ensures that the assets are secure ,
- so there is no danger of policyholder claims not being met through investment failure.
- But if company has real liabilities for eg., liability business , it would be more appropriate in real assets for eg., equity and property
- Restrictive investment policy- Risk of lack of diversification
- Provides the government/Corporates a good funding source

[10 Marks]

Solution 6:

(i) Characteristics of a well run project are:

- Clear definition – important to develop the project in a timely and cost effective manner, with minimal changes occurring later in the project.
- Full planning
    - technical & design changes should be avoided once implementation has begun
    - Strict change control management should be implemented
- Thorough risk analysis
    - Do an initial assessment first
    - Then have a detailed risk analysis on all the aspects
- Monitoring of development
    - The planning & monitoring tool should be user friendly
    - It should be possible to track the technical as well as the financial aspects of the project
    - Should enable final outcomes to be predicted reliably
- Measurement of performance and quality standards
    - All the participants should have clarity on how their performance will be measured
- Thorough testing at all stages
    - Thorough testing is essential before going live
    - Care in managing different strands of the project to ensure there are no unnecessary delays in one part of the project which depends on the outcome of another (critical path analysis)
    - Most project have interdependency of different strands of the project
    - Ensure the sequence of work is properly planned so that no stage is waiting for others to finish
    - To move along at the appropriate pace so that the right things are done at the right time
    - It is important to coordinate any delays in one areas; to pace the work in other parts of the project
    - Stable but challenging relationships with suppliers of external components of the project
    - Important to be strict on the delivery timelines and the budget agreed; however there could be unanticipated reasons for altering from the original path (say a change in regulation)
    - Clear documentation of the deliverables

  - Clearly define the roles and responsibilities of various parties
  - Have team building activities to develop a healthy relationship between inter-disciplinary teams
- A supportive environment
  - Different teams work in tandem with each other
  - Work atmosphere is conducive and not unnecessarily aggressive
- Excellent communications between those involved
- Positive conflict management, which uses conflict as a source of ideas and a tool for development
- A schedule of what needs to be considered at each milestone review point
  - Regular milestone schedules
  - It helps to break down a big project into smaller deliverables
- Written strategy document
  - Documentation critical to avoid any miscommunication
  - All the involved have the same understanding

[8]

(ii) Sensitivity analysis:

- It shows the effect of individual parameters on the final result
- It helps understand how sensitive the results are to the movement in a given parameter
- This will help to take some steps to manage the volatility in that parameter.
- It is simpler to see the effect of one parameter by keeping everything else constant.

Scenario testing:

- However, in reality not all parameters are independent of each other.
- Change in one parameter will necessary cause a change in another co-related parameter, like interest rate, inflation and salary increase.
- It would be necessary to see the effect of the result of the project by changing all the related parameters, to get a true picture
- In other cases, some parameters can have an off-setting or hedging effect. Negative effect of change in one parameter will be off-set by a positive effect of a consistent change of another parameter, making the net effect different from if we would have analysed them independently.

[3]

[11 Marks]

Solution 7:

i) A pension scheme might consider investing in corporate bonds because:

- They provide a good match for fixed monetary liabilities within a pension scheme, *eg* level annuities in payment.
- If the pension scheme is mature (*eg* closed to future accrual of liabilities) then liabilities will increasingly be well matched by fixed-interest bonds.
- They provide diversification from government bonds and equities.
- They may be cheap relative to other assets.
- The additional expected return over and above that of government bonds may outweigh the higher risks of default and lower marketability.
- They may be available at longer terms than government bonds.
- If companies have tended to issue debt rather than equity finance, the availability of corporate bonds may be good.
- The trust deed may require it/result in it.
- Regulation may require it/result in it.
- Other trustees (competitors') pension schemes may be doing it.
- The pension scheme may deem self-investment, in other words investment in the sponsoring company's own corporate bonds, to be beneficial.
- The holding of corporate bonds may have been requested by the sponsor, *ie* fits with the risk appetite of the sponsor.

[6]

ii)

- Conventional bonds provide a fixed level of income and a fixed capital payment on redemption. In contrast, neither the income nor the capital value of an equity share is guaranteed.
- Conventional government bonds issued by a developed country should involve negligible default risk. However, conventional corporate bonds issued by low-rated companies may be subject to significant default risk, and are therefore riskier than equity issued by, say, a blue chip company.
- In the event of a company being wound-up, its corporate bondholders would rank ahead of its equity holders for receipt of any payments.
- The fixed nature of the payments means that conventional bonds provide no protection against inflation.
- Both the income and the capital value of equities are expected to increase broadly in line with inflation over the medium to long term.

- The income and capital value of equity are volatile.
- However, the price of long-term conventional bonds can also be volatile. Hence, the return is not guaranteed if the bond is sold prior to redemption.
- Moreover, the variability of equity income can be greatly reduced by investing in a widely-diversified portfolio.
- The nature of risk depends upon the objectives of the investor. If the investor has long term *real* liabilities, then equity investment provides a better match than conventional bonds.
- Over the long term, we would expect equities to give a higher return than conventional bonds. Therefore equity should provide protection against the risk of low returns.
- Historically, conventional bonds have generally earned a higher running yield than equities. Consequently, they involve a greater risk of reinvestment of income on uncertain terms.
- However, economic uncertainty may make it more difficult to compare running yields for different asset classes.
- Thus, the comment is not true, as equities are not *always* riskier than conventional bonds. It depends on the definition of risk and the aims of the investor.

[6]
[12 marks]

Solution 8:

i) The roles that government may play:

- provide benefits to all
- educate or require education about the importance of having pension for the future
- regulate to encourage or compel pension provision by or on behalf of employed
- regulate bodies providing pension benefits, and bodies with custody of funds, in an attempt to ensure security for promises made or expectations created.

The political, economic and fiscal viewpoints of the government will determine the precise roles that it will play

[2]

ii) Although the question refers to women, the actions will be suitable for all individuals without adequate pension provision, and the government may not wish to positively discriminate.

In this case, it is likely that the government will want to encourage provision from other providers.

This would have the economic and fiscal advantage of making women better off in retirement and so less dependent on state benefits, if any, and may also have political advantages.

They will need to educate about the importance of providing for the future pension.

This could be done through a marketing campaign focusing on pensions required for a comfortable retirement and comparing this to any actual provisions made. Such a campaign would be via media that are suitable for the target audience.

They could then educate or require education on the type of vehicles which could be used to provide this benefit.

They could regulate to encourage or compel benefit provision for those in employment; contributions could be made by both the employers and employees.

The government could also add to these contributions, possibly as tax benefits.

The government could also provide some form of additional pension to those not earning or on low incomes

It could consider additional contributions to those on low earnings (more likely for women in part time employment).

The government could regulate to require equal pay / benefits for males/females so that there is pension benefits as well.

The government could ensure that pension contributions continue to be paid when on career breaks (e.g. when on maternity leave).

The government could improve access for part time women workers

A major problem will be with women who are not economically active for part of their working lives, for example because of childcare (or looking after elderly parents).

If currently it is typical for women to have lower pension entitlements than men, the government could require sharing of pensions on divorce so that the ex-wife has more adequate pension.

The government could make spouses benefits compulsory rather than an option

The government will need to regulate bodies providing benefits, and bodies with custody of funds, in an attempt to ensure security for promises made, or expectations created. This will be needed to create confidence.

The government could provide financial instruments which could be used to make provisions for future benefits.

As an employer, the government could provide “adequate” benefits for their women employees

[8]

iii) Compulsory pension provision can:

- assist adequate pension provision if set at the correct level
- remove or reduce the burden on the government to provide pension provision

- lead to larger schemes with economies of scale in investment and administration
- avoid the need for financial incentives, thereby reducing the cost.

[2]

iv) The advantages of the proposal include:

+ It may result in an increased level of pension provision
+ A reduction in the level of poverty in retirement.
+ Coverage is universal.
+ It reduces the reliance on government benefits
+ Freeing up funds to target at other, possibly more urgent, causes.
+ Private provision may be more efficient / competitive, resulting in lower costs.
+ Compelling people to provide may be cheaper than encouraging as, for example, it will not be necessary to offer incentives.
+ It may generate demand for investments, stimulating financial markets.
+ Compelling people to provide for their own pensions can work in practice.
+ It may result in a reduction in the taxes that were traditionally used to finance the government pension benefits.

The disadvantages of the proposal include:

– Political unpopularity
– The compulsion may be perceived as an extra tax.
– Some individuals may not be able to afford the contributions, *eg* the unemployed, or the individuals with low income.
– Some employers may not be able to afford the contributions, *eg* small companies, forcing them to go out of business.
– The self-employed will also need special consideration.
– There will be difficulties in the transitional period and private provision will need to be phased in.
– There will be communication issues and a need to educate individuals and employers, which could be costly.
– The government will need to regulate the private provision

[7]

[19 Marks]

Solution 9:

i) Important risk factors for private motor insurance include:

- sex of the insured driver
- age of the insured driver
- details of any other drivers on the vehicle
- how long driving licence has been held
- existence of driving convictions
- anticipated mileage
- number of convictions for motoring offences and number of past motoring accidents (say in last five years)
- type of cover (*eg* third party only, comprehensive)
- make and model of vehicle
- age of vehicle
- use of the vehicle – social, domestic or pleasure
- postcode of the area in which the vehicle is kept
- where the vehicle is stored overnight

[3]

ii) The main investigations that could be carried out and their respective purposes include:

Premium investigations
There are a number of investigations relating to the overall level of premiums in the income statement, some relating to the number (or volume) of sales and some relating to the level of the premiums.

In order to investigate these, it will be necessary to compare them to something.

The most obvious comparable is competitors, however we may also want to compare them to expected values.

In order to analyse volumes of sales we might perform the following investigations:

 Analysis of sales volumes compared with projections.

 Investigate whether competitors have launched new variations of the contract that have proved more attractive in the market. New variations of contracts might attract policyholders away from the general insurance company, reducing sales volumes.

 Have there been new entrants to the market who would have taken some of the market share for motor insurance business?

 The effects of competition on persistency to see if the change in approach five years ago mirrored those made by competitors. If persistency has worsened for the general insurance company, then premiums will be lower overall.

 Consider other reasons for lower sales volumes (if that is the case).

In order to analyse the appropriateness of the general level of premiums we might perform the following investigations:

 Analysis of premium rates compared with those of competitors.

 Have there been competitors loss-leading? This would make the general insurance company's premiums seem relatively high.

Claim investigations

The claim line in the income statement might be net of any reinsurance recoveries and is likely to include a provision for claims that have been incurred but not yet settled as well as the "claims paid" figure.

Therefore the investigations might include:

 Claims analyses to investigate the effect of the change in the premium basis.

 Analysis of general claims trends for example unusually large claims, high frequency, catastrophe events *etc* to see if experience is due to natural random variation.

 Analysis of coverage and policy wording to see if any changes in premium were in line with the resulting changes in claims experience.

 Analysis of effectiveness of reinsurance arrangements to see if poor experience is due to inappropriate cover. If the reinsurance arrangements are inappropriate then reinsurance recoveries will be low in relation to what the general insurance company expected (for a given reinsurance premium).

 Adequacy of reserving / changes to reserving practices as the level of reserves may have been set at unnecessarily prudent levels. If the reserving (or provisioning) basis has strengthened over the period, then this will increase the claims figure in the income statement.

Expense investigations

These might include:

 Effects of any internal changes for example change in sales medium, commission rates, changes to internal processing, changes to claims handling *etc*. This ensures various expenses are in line with expectations.

 Mix of business to investigate whether poor performance is due to poor coverage of overhead and other fixed expenses. Different cohorts will have different contribution rates.

Underwriting profit investigations

It might be useful to look at premiums, claims and expenses together, *ie* underwriting profit:

 Underwriting profitability to check if poor results are due to quality of underwriting and to look at underwriting procedures and guidelines.

 Underwriting performance on homogeneous cohorts of business to check for any adverse selection.

Investment income investigations

Investment income is unlikely to be very significant for motor insurance business, but it might be worth doing some general analyses to investigate:

 Investment performance against peer groups, benchmarks and past performance to check if in this is line with targets / expectations.

Other investigations (including tax)

Other investigations on external factors might also be carried out, including:

 Effects of any external changes on profitability for example tax, legislation, solvency requirements, road traffic factors *etc*.

To identify if poor results due to unexpected high claims.

[8]

iii)

• Try to maximise investment return subject to meeting liabilities with chosen level of certainty

• Match assets and liabilities by

– term
– amount
– nature
– currency

• Motor property damage claims are mainly short tailed, so need liquid assets

– need to hold cash on deposit, very short dated assets such as short dated government securities to match liability outgo

• Motor third party claims are longer tailed and costs are influenced by inflation

– need to hold some longer dated real assets (index linked securities if available or low risk equities)

• Consider regulatory requirements :

-restrictions on assets that can be held

– prescription to hold assets

– custodianship of assets

– mismatching allowed

• Since company is small, need to have extra consideration of the level of uncertainty in reserves, so more secure, liquid assets required

• A small company might consider collective investment vehicles (e.g. unit trusts, investment company shares)
• Investment likely to be in assets of small unit size (e.g. no direct property investment
• Level of investment expenses of each asset type
• Tax efficiency of each asset type
• Availability of certain asset types
• Benchmarking against competition
• Availability of additional capital (e.g. parent company, shareholders)
• Diversification of assets held (within and between asset types)
• Size of the free reserves (in excess of solvency requirements)
– As the company is small, the company is less likely to be able to accept the risk of investing in higher risk/reward investments (e.g. property)
• Expected growth plans and resultant needs to invest in the business
• Shareholders and management's attitude to risk

[8]

[19 Marks]

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