INSTITUTE OF ACTUARIES OF INDIA

SUBJECT CA1 –Paper I

May 2010 EXAMINATION

INDICATIVE SOLUTION

1) Solution:
Advantages of stochastic model over the deterministic model are:

a) A stochastic model takes into account the variability of the model assumptions and the covariances between them. Deterministic models do not allow for the random nature of the assumptions.

b) With a deterministic model, identifying potential problems depends upon the scenario being tested, whereas stochastic models generate results for a wide range of random scenarios.

c) The output of a stochastic model forms a distribution of values from which statistics such as the mean and the variance of the output can be calculated.

d) It is better in assessing the impact of financial guarantees and options.

Disadvantages are:

i. It can be time consuming to run

ii. It may be complicated, poorly understood.

iii. It is difficult to interpret and communicate. Deterministic models are easy to explain.

iv. It is difficult to determine a suitable probability distribution for modeled random variables

[4]

2) ***Parties to consider***

- *Shareholders*
  - It is a proprietary company and hence bonus declaration needs to be equitable and fair between shareholder and policyholder. Excessive payment to one would result in inequitable treatment of the other. But the market expectations in terms of dividends will need to be taken into account

  Excessive payout to shareholders will also impact future sales and competitiveness of products.

  - There may be rules(in the memorandum of association or state regulations) that state that the shareholders are entitled to a fixed proportion of the bonuses awarded to policyholders only. Any bonus declaration will impact shareholder profits as well

  The level of bonuses awarded should fit in with the long term strategic aims of the company and should be in line with the dividend philosophy of the company

- *With-profit policyholders* – The level of bonuses awarded should be in line with policyholders' expectations to avoid policyholder dissatisfaction and the risk of losing existing and new business.

- *Without-profit policyholders* – The level of discretionary benefits awarded to with-profit policies should not threaten the security of without-profit policies., especially if the with out profit business is being financed by the with profit fund

- *Competitors* – The level of bonuses awarded should not be too far out of line with discretionary benefits awarded by competitors.

- *Regulators* – The level of bonuses awarded should fulfill any regulatory requirements and any requirements specified in the policy literature.

- *Creditors of the company* – The level of benefits awarded should not threaten the security of any outstanding debt / balances to third parties.

- *Marketing* – The marketing department may be able to advise on an appropriate level of bonuses bearing in mind current and future potential policyholders' needs and competitors.

- *Administrators / IT* – The bonuses must be able to be administered on the *IT systems.*

[6]

3) a) Solution:
Attractions:

i. flexibilities both parties have within the process. i.e. the reinsurance can be tailored to suit the particular risk taken on without the constrains typical under a treaty.

ii. direct writer is under no obligation to use a particular reinsurer and can approach several reinsurers in search for the best terms for each risk individually

iii. best option for special large risks which is not covered under the normal treaty conditions

Drawbacks:

i. It is time consuming to place each risk

ii. Administratively costly

iii. No certainty that the desired cover will be available when needed

iv. Price of the reinsurance cover at the time it is sought may be unacceptably high

v. Also if the risk is unusual, there may not be much competition for the reinsurance, hence the price charged could be prohibitive.

vi. The primary insurer may be unable to accept a large risk until it is able to find the required reinsurance cover. This may deter potential customers.

b) 1. 120,000

2. none

3. 160,000

[8]

4) Domestic fixed-interest government bonds

- Most secure and marketable investment
- good for matching benefits with no or fixed increases (*eg* pensions in payment)

- high and fixed income stream compared to other asset classes
- guaranteed nominal return if held to redemption
- Opportunities for gains mainly but not totally secure.

- Portfolio yield heavily influenced by Government policy relating to interest rates, fiscal and monetary policy

- regulation may treat them relatively well (*eg* in assessing scheme solvency)

Overseas fixed-interest bonds

- large market and offer a wider risk reward pattern than a purely domestic portfolio
- significant currency risk as pension scheme liabilities likely to be exclusively domestic (unless a multi-national sponsor)

- offers diversification from a domestic fixed interest portfolio and so reduced portfolio risk

Domestic shares

- Shares generally have lower income stream than bonds and much of the return is expected to arise from an appreciation in capital values

- expected real return(relative to price/wage inflation) in the long term and so are more suitable than bonds for salary-linked liabilities

- empirical evidence shows they have produced better historical returns than government bonds over long time periods

- market values volatile This may be problematic for valuation and solvency demonstration if asset valuation uses market values and the liability valuation is not similarly volatile

- large and diverse market

Overseas shares

- offers diversification from domestic shares
- opportunity to invest in faster expanding economies and therefore higher returns

- opportunity to invest in some sectors not available in the home market

- currency risk- currency gives a potential high return as well as a risk since unlike bonds shares are primarily purchased for return rather than for minimizing risk

- Investment overseas usually means- higher expenses, need for expertise, lack of information, etc.

[8]

5) The product guarantees return of premiums, considering that charges would have been levied, then inherent guarantee on surrender is more than 0% return on premiums paid. he guarantee will bite when there is fall in market value of assets leading to a payout on surrender(at an unknown time) higher than the market value of underlying assets .

A very cautious approach would mean holding a provision that is at least as big as the guaranteed surrender value for all policies (*ie* a worst-case scenario).

However, this may be considered too cautious and result in provisions being held which are deemed too high.

We may want to factor the *likelihood* of the guarantee biting into the calculation and look at the provision required on a *global* rather than on an *individual* basis.

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.

However, stochastic models can be complicated and costly to build, time consuming to run and difficult to interpret and explain to other parties.

Withdrawal rates are difficult to model (to fit a distribution and parameters) as withdrawals are a consequence of human behavior and are influenced by economic conditions and public opinion.

Modeling withdrawal rates stochastically will give us information on the likelihood of withdrawals but it won't tell us the likelihood of the guarantee biting on withdrawal.

A better variable to model stochastically would be the investment return assumption and to link policyholder behavior to investment return assumptions (modeling dynamic policyholder behavior). The model could become complex and difficult to build and run

Choosing valid assumptions and correlations (for eg. Correlation between bond and equity markets, Fund performance and surrenders, lapses and economic conditions etc.) is important in any stochastic modeling exercise.

Alternative to a stochastic model would be to use a variety of deterministic scenarios to determine the likelihood of the guarantee biting. However, these simpler methods give us less information regarding the likelihood of the guarantee biting.

[8]

6) a) Answer

- To ensure confidence in the financial system as a whole, by guarding against the dangers of problems in one area spreading to other parts of the system, and the damage that would be done by a systematic financial collapse.

- To compensate for the asymmetry of information, expertise and negotiating strength that often exists in financial transactions, particularly in retail markets where the consumer will generally be a lot less well-informed than the financial services provider and/or intermediary. This is a particular problem for private investors.

The need is greater than for other markets because-

- company failures elsewhere in the economy are likely to have less serious consequences for the economy as a whole

- the financial consequences for the individual of inappropriate decisions are likely to be large, long-term and difficult to rectify

- lack of information will be less of a problem in other markets where the goods and services traded are themselves less complex.

b) Direct costs

Direct costs arise in:

- **administering the regulation-for the regulator eg.,** collection and examination of information provided by market participants and otherwise monitoring their activities.
- **compliance costs for the regulated firms-** for example, maintaining appropriate records, collating the requisite information and supplying it to the regulator and/or the investor.

Indirect costs

- an alteration in the behavior of consumers, who may be given a false sense of security and a reduced sense of responsibility for their own actions.
- an undermining of the sense of professional responsibility amongst intermediaries and advisors
- a reduction in consumer protection mechanisms developed by the market itself.
- reduced product innovation

c)

- Information asymmetry can be reduced or mitigated by requirements for a service provider to disclose full information about its products or itself in an understandable form

  For eg. In a ife insurance policy, by providing a customized illustration to potential policyholders of charges and benefits under different scenarios

- by consumer education by the regulator.

[8]

7)

a) The trustee must understand the nature of the liabilities eg. Whether they are real/nominal, short or long term and hence the appropriate investments to match those liabilities.

The aims of the fund in terms of investment returns balanced against the organization's attitude to risk.

The trustee should examine:

- the aims of the charity organization and how they may change in the future
- the trust deed or will and /any
- overriding regulation
  the Statement of Investment Policy or principles
- The degree of diversification within and between sectors that can be achieved considering the size of the fund
- the tax treatment of the charitable organization and the impact of this on asset choice.
- Investment expenses –including fund manger expenses
- Environmental, social and ethical issues may be important since the charity would not want a bad image or publicity

b) Specific details could include

setting of asset sectors and appropriate benchmarks
- performance benchmarks and timescales for measurement
- manager's approach to achieving the objectives- eg any 2 from general level of risk allowed, stand alone v pooled, specific manager, decision making process
- Active vs passive management.
- If active –degree of activism
  restrictions if any, on investments in sectors, stocks, credit issues etc
- Frequency of review of mandate
- – basis of fund managers' fees eg performance related component

[9]

8)

a) Expected and required return equations

Property
Expected return = rental yield (*ry*) + expected rental growth (*rg*)
Required return = risk-free real yield (*rf*) + expected inflation (*exp infl*)
+ property risk premium (*PRP*)

Conventional government bonds
Expected return = gross redemption yield (*GRY*)
Required return = risk-free real yield (*rf*) + expected inflation (*exp infl*)
+ inflation risk premium (*IRP*)

b) ***Comparison of rental yield and gross redemption yield***
Equating expected and required returns for each asset class gives:

$ry + rg = rf + exp\ infl + PRP$ (1)

$GRY = rf + exp\ infl + IRP$ (2)

Subtracting equation (2) from equation (1), and rearranging gives:

$ry - GRY = PRP - IRP - rg$

Key assumption
Assets are *fairly priced* relative to each other enabling us to equate required and expected returns.

c) ***Why property yields may exceed conventional government bond yields***
Property yields may exceed conventional government bond yields if:
- the property risk premium is high – this is the case if:

- investors are particularly concerned about the poor marketability and indivisibility of property (compared to conventional government bonds)

- depreciation or the risk of voids (due to economic conditions) is expected to be high

- property is out of favor with institutional investors due to lack of matching with liabilities because of regulation ie the nature of proceeds from property are not viewed as suitable for institutional liabilities

- the inflation risk premium is low – due to low expectations of and/or low uncertainty concerning future inflation

- expectations of future rental growth are low – due to poor economic prospects and/or if current rental levels exceed rack rents

- the assumptions above do not hold – in particular, property yields may exceed conventional government bonds yields because property is cheap relative to bonds. Regulations or government monetary/funding policy may create an excess demand for bonds that forces yields down below property compared to what they should be on fundamentals.

[9]

9) Answer

a) Nature and suitability of the benefit to employee

- The first option gives pension as a basic benefit where as the 2nd one gives cash (on selling assets) to purchase pension [
- It may be easier for the member to understand Option 1 since all benefits will linked to salary.

- Under Option 1, retirement planning should be easier, as all the benefits will be defined
  Benefit in nature, and linked to final salary, there is reasonable certainty for member on post retirement standard of living

- Option 1 is likely to be perceived as "valuable" by employees nearing retirement than the employees in the age group 25-35. For younger members there is greater uncertainty over level of future salaries

- Option 1 will be beneficial for employees whose salary levels are growing fast and not for those whose salary levels are growing slowly

- Option 2 requires more planning as pension would depend on fund performance and annuity rate tec.

- If offered different fund options the member may find investment choices difficult to understand if such choices are offered.

- 80% of the employees are in age group 25-35 and might consider option 2 where the level of control over investments/choice of investments are higher1/2]

b) Risk to the employer

- Under Option 1, both upside and downside risk lies with the employer Under Option 1, the employer promises benefits at unknown costs. So the risk is that poor returns, lighter mortality or fewer exits (if exits subsidise stayers) will lead to an increase in costs. These costs are fixed as a % of salary short term but will vary at each valuation (so its an uncertainty risk) and deficits may have to be made good.

- Under option 1, there is also a regulatory risk in terms of legislation governing funding and deficit reductions.

- Under Option 2, both upside and downside risk lies with the member.For example, if investment returns are good and annuity terms favorable then the pension will be high and vice versa

- Under option 2, for employer, the contribution levels are fixed as a % of salary and the employer will be reasonably certain of out go every year

- But an employer risk is that poor experience leads to poor benefits, an unhappy and militant workforce especially if competitors provide better benefits. Also, there is a risk that if experience is good, the members get all the benefits so the employer ends up paying more than he needed to.

- Since the work force is fairly young, there is more uncertainty about future experience and it's harder to match their benefits with assets under option 1. Depending on the funding method, costs may rise as the workforce ages. On the other hand fewer pensioners implies more time to take action to reduce costs as future service benefits are easier to change.

c) Administration systems

- Option 1 requires regular calculations to determine the level of funding, adequacy and solvency position of the fund, satisfying regulatory and accounting requirements on funding, solvency etc.

- Option 2 requires no such calculations, but there will be administrative complications of member level of contribution history, and If members are offered investment choice under Option 2 then this increases administrative complexity and cost.

- A younger workforce may involve more administrative complexity under both options as turnover will be higher

d) Subsequent transfer out

- Option 2 is easy to deal with, since the member can just be allowed to take the face value of their money purchase account at that point.
- Option 1 is more complex. A calculation of the value of the member's benefits at that time would need to be determined

80% of the employees are in age group 25-35, and potability of the pension savings (which is transparent in case of option 2) might be an important consideration

[11]

10) Answer

When deciding on an appropriate system the company has to look at what the existing system can do and whether a new system is needed or can the current one be adopted eg are the requirements different from existing business

Users of data

The life company should consider the requirements of the end users of both the administration system itself and of the data extracted from the system.

The different users will have different requirements and it might be hard to design a system to cater for the needs of everyone. However, in general it is important that the system is user-friendly for all potential users.

The key users will include:

- actuaries for reserving, value calculations, experience analysis, premium rating;
- customer services department for policy servicing, claim administration;
- accountants for financial and management accounting;
- management –regular information on business performance ;
- marketing department for data mining, understanding of customer segmentation, customer behavior, analytics etc;
- underwriters for experience analysis, effectiveness of underwriting norms etc;
- IT

Quality and quantity of data

- Good quality data is crucial, so it will be important to have a good system design from the outset.
- Sound data governance and management structure will help to ensure good data on an ongoing basis (for eg., doer-checker relationship and other QC measures when entering data, key controls for data alterations, controlled levels of access/permissions.
- Errors in data inputting are likely to be reduced by ensuring consistency between the layout of the system and the proposal and claim forms.
- Ideally, the data system should have the facility to record details beyond those required at the current time-for eg.,for business analytics, customer behavior analysis, customer segmentation etc .
- The system must be able to cope with complexities such as showing a decreasing sum assured over the policy term, in accordance with the outstanding loan schedule for each policy
- The system should have sufficient capacity to hold/process the expected volumes of business
- Business continuity and disaster recovery plans should be in place

Checks on the data

- The system should contain a variety of checks to ensure that the data is as complete and correct as possible.
- For example, it could contain checks that highlight when entering proposal details:

- data fields have been left blank

- data fields contain unusual/invalid values, incorrect or invalid date of birth, age outside min, max allowed etc

Other considerations

- The cost of the system will have to be considered and there is likely to be a trade-off between cost and quality/functionality of the system.

- Complexity will also have to be weighed up against the time and money spent training staff to use it.

The system should have the flexibility to accommodate:

- changes to the product, *eg* new rating factors introduced for underwriting purposes – smoking/non-smoking, male/female, rural/urban etc

- It should also be flexible in terms of output, *ie* users are able to extract the information in the appropriate format/level of data for their needs.

- The system should also be able to cope with details of reinsurance arrangements in respect of individual policies

[13]

11) Solution:

(a) Worst than expected claims experience could lead to:

(i) Inadequate Current & Future Premiums

- If claims are higher than expected in your pricing; premium will become inadequate

- There may be opportunities for anti-selection if premium rates do not reflect the risk of the business written correctly. This anti-selection will result in losses.

- Raising premiums can have marketability implications

(ii) Inadequate provisions

- Becoming insolvent

- If the proportion of this line of business is high in the company's portfolio, then it can have serious effects

- Regulatory intervention

- Restrictions in the investment freedom

- May need to raise capital at a high cost

- There could be fines or closure to new business

- Will have to rearrange investments

(ii) Other administration issues: staff not enough to handle increased claims processing. Leading to poor customer service and attracting bad publicity

(b) Uncertainty arises in relation to outstanding claims from past business, claims from existing business and future claims on new business being written.

i. Nature of business

- Motor claims are subject to wide variability in amount. This business covers lots of cars and events, some are more costly than others and in general things aren't predictable.
- Variability will also exist in terms of frequency, incidence and cost of handling claims
- Any reporting and/or settlement delays will result in uncertainty regarding the ultimate cost of claims
- There is also seasonal issues eg bad weather or local factors like bad roads in some areas.

ii. Changes in business mix – some covers give higher claim rates , new features as new risks cover will alter claims patterns.

iii. Characteristics of policyholders

- If the company is going to target a different risk group from the one in the existing portfolio then future claims experience will defer from the past. It is difficult to determine how the claims will change.
- Change in the social trends:
- Change in age and sex profile of the customers will lead to different expected claims.
- Fashion, wealth eg more expensive cars in the market
- Improved car safety standards or legal changes e.g. new speed limits being inforced

iv. Attitude of claims

- experience shows that policyholders are starting to claim for events they would not have done so previously.
- Introduction of Policy excesses
- Or the feeling that the hassle isn't worth a claim

v. Crime/ fraud rate

- As this increases, claims for accidental damage and theft may increase
- The timing of any increasing crime rate is uncertain, but it may be correlated to other economic indicators

vi. Judicial decisions – also referred as court award inflation

- Precedents will be set involving claim eligible for compensation

- If a new level is awarded to an existing type of claim, it is going to immediately increase the average amount at which all future claims are settled.
- These decisions could apply to existing outstanding claims as well as future claims.

vii. Legislation

- Changes in tax
- Changes in cover - Removal of upper limit on compensation
- Change in law – e.g. restriction on the factors that can be used in underwriting ; legislation to improve road safety eg speed cameras

viii. Catastrophe – can lead to many claims. Earth quake or a serious fault in a particular model

ix. Currency risks – claims in other currencies may be uncertain in domestic currency if exchange rate risk isn't hedged

x. Reinsurance

- Inadequate reinsurance
- They may have doubts about the value for money and availability of reinsurance
- Ability to make a recovery will depend on the solvency position of the reinsurer

xi. Policy wordings

- Claims paid are those the company intends to cover
- Reinsurance contract also should be precise so that the company can recover what it expects

xii. Inflation – uncertainty about future inflation especially for bodily injury claims

[16]

[Total Marks 100]

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