# Institute of Actuaries of India

## Subject SP2 – Life Insurance Principles

# March 2021 Examination

# 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.

**Solution 1:**

**i)** To compute standard premium without the option.

Let P: Standard annual premium
We need to solve the following equation for P

$P\ \ddot{a}_{[55]:\overline{5}|} = 500000\ A_{[55]:\overline{5}|}^{1}$

$P\ \ddot{a}_{[55]:\overline{5}|} = 500000\ (A_{[55]:\overline{5}|} - \frac{l60}{l[55]} * v^5)$ where $v = \frac{1}{(1+0.4)}$ [1]

Hence,

$P\ (4.59) = 500000\ (0.82348 - \frac{9287.2164}{9545.9929} * (1.04)^{-5})$ [0.5]

$P\ (4.59) = 500000\ (0.82348 - 0.799646)$

$P\ (4.59) = 500000\ (0.023834)$ [0.5]

$P\ (4.59) = 11917.007$ [0.5]

$\boxed{P = \text{Rs. } 2596.30}$ [0.5]

Hence the standard annual premium without any option is Rs 2596.30. **[3]**

**ii)** First of all, we need to find the standard annual premium from age 60 if the policyholder has decided to exercise the option for cover of Rs 500,000 and the term of 5 years.
Let P' be the standard annual premium from age 60 for the Rs 50000 cover and for the term of 5 years.

$P'\ \ddot{a}_{[60]:\overline{5}|} = 500000\ A_{[60]:\overline{5}|}^{1}$

$P'\ \ddot{a}_{[60]:\overline{5}|} = 500000\ (A_{[60]:\overline{5}|} - \frac{l6}{l[60]} * v^5)$ where $v = \frac{1}{(1+0.4)}$ [0.5]

Hence,

$P'\ (4.559) = 500000\ (0.82465 - \frac{8821.2612}{9263.142} * (1.04)^{-5})$ [0.5]

$P'\ (4.559) = 500000\ (0.82465 - 0.782719)$

$P'\ (4.559) = 500000\ (0.041931)$

$P'\ (4.559) = 20965.70$

$\boxed{P' = \text{Rs. } 4598.75}$ [1]

This is the standard annual premium of 5 years for those who will exercise the option at age 60 with the cover of Rs 5,00,000.

Now we need to find the cost at age 60 which is given as:

$500000\ A_{60}^{1}{}_{:\overline{5}|} - P'\ \ddot{a}_{60:\overline{5}|}$

$= 500000\ [A_{60:\overline{5}|} - \frac{l65}{l60} * v^5] - P'\ \ddot{a}_{60:\overline{5}|}$ [0.5]

$= 500000\ [0.82499 - \frac{8821.2612}{9287.2164} * (1.04)^{-5}] - 4598.75 * 4.55$ [0.5]

$= 500000\ [0.82499 - 0.78069] - 20924.31$

$= 500000\ [0.0443] - 20924.31$

$= 22150.18 - 20924.31 = \text{Rs } 1225.87$

$\boxed{\text{Hence cost at age 60 is Rs 1225.87}}$ [1]

Now we need to find the annual Option Premium (OP) using the following equation.

(OP) $\ddot{a}_{[55]:\overline{5}|}$ = (1225.87)* $(\frac{l60}{l[55]} * v^5)$ [0.5]

(OP) (4.59) = (1225.87)* $\frac{9287.2164}{9545.9929} * (1.04)^{-5}$

(OP) (4.59) = 1225.87 *0.799646 = 980.262 [1]

(OP) = Rs 213.56

Hence annual option premium for 5 years from age 55 is Rs 213.56 [1]

Hence, premium that would be charged for the policy with the option, assuming that the additional premium is paid for a maximum of five years is: 2596.30 + 213.56 = Rs. 2809.86

[0.5]

**[7]**

**[10 Marks]**

**Solution 2:**

**i) The main distribution channels are:**

a. Insurance intermediaries;
b. Tied agents;
c. Own sales force;
d. Direct marketing; [0.5 mark each, Max 2]

**Operating models of the distribution channel:**

1. **Insurance intermediaries:**
   a. Insurance intermediaries represent the customers
   b. they operate independently without tying up with any insurance companies.

   c. They are expected to consider the needs of their clients and advise the best contracts from among all the contracts available in the insurance market.

   d. The remuneration can be paid either by the insurance companies in the form of commission, whose products they sell or by fees from their clients.

   [0.5 mark for each point, Max 2]

2. **Tied agents:**
   a. Tied agents, as the name suggests, are tied to one or a limited number of insurance companies depending on the country specific legislation and represent those insurance companies.

   b. They offer the products of only those companies with whom they are tied.

   c. If the tied agent is tied to more than one insurance company, it is generally expected that the product categories that are offered by such insurance companies are mutually exclusive.

   d. Generally, tied agents are financial institutions such as banks.

   e. Tied agents are remunerated by the companies to which they are tied. The remuneration could be in the form of commission payments or by salary plus bonuses.

   [0.5 mark for each point, Max 2]

3. **Own salesforce:**
   a. Generally, own sales force are employees of an insurance company.

   b. They sell only the products of that company.

   c. They are remunerated either in the form of salary or commission or a combination of the two.

[0.5 mark for each point, Max 1.5]

4. **Direct Marketing:**
   a. Direct marketing, generally, include are telephone selling, press advertising, mailshots, and the Internet.

   b. Telephone selling may involve cold-calling by the company representative or could be in response to an advertisement. In the later case, press advertising and telephone selling becomes part of the same process.

   c. Press advertising may invite requests for further information or include an application form.

   d. With respect to mailshots, application forms are generally included.

   e. Internet selling could involve online advertising, and web-based application processing.

[0.5 mark for each point, Max 2.5]

**[Max 8]**

**ii)**

**a) <u>Financial risks for the insurers:</u>**

**1. Capital & New Business Strain:**

- The immediate effect of the proposal could be a change in the capital requirements for writing the new business and the renewal business.
- The overall new business strain on the products could be reduced to the extent of reduction in the upfront commission.
- However, the overall renewal costs on account of renewal commission could be higher than earlier arrangement of renewal commission.
- The impact of increase in the renewal costs might depend on the quantum of the uniform commission proposed instead of upfront commission.

[0.5 mark for each point, Max 2]

**2. Profitability:**

- However, it is not clear from the proposal whether the lower rate of uniform commission would be of equivalent value to the initial upfront higher commission.
- Depending on this, it may immediately impact all future sales and the corresponding profitability, as there is no pricing change anticipated.
- In particular, the expected profitability of the product may reduce, if the present value of the uniform commission exceeds the upfront commission payable.

[0.5 mark for each point, Max 1.5]

**3. Emergence of profits:**

- The emergence of profits may also undergo a change.
- There could be an increase in the profits in the first year and decrease in profits for the remaining term of the contract.

[0.5 mark for each point , Max 1]

4. **Sales and distribution channels:**
   - The sales may depend on how the distribution channels perceive this proposal.
   - There is a risk that the distribution channels prefer upfront commission.
   - If other financial institutions within the country offer upfront commission for their distribution channels, there is a risk that the distribution channels may move out of the insurance sector.
   - This may lead to risk of reduced volumes across the insurance sector and may also lead to lack of sufficient number of distribution channels for solicitation.
   - Reduced volume will increase the per policy expenses as some of the expenses are overheads and this will reduce the profitability of the company.
   - Over a period, it may threaten the financial strength of an insurer, if sales are depressed due to this gap.

[0.5 mark for each point , Max 3]

5. **Surrender Values:**
   - If the reduction in the new business strain is reflected in the surrender values, the surrender values offered during the initial period may improve.
   - Improved surrender values may possibly result in the risk of more surrenders during the initial periods.

[0.5 mark for each point , Max 1]

6. **New Life Insurer:**
   - In the case of new life insurance companies, if tax reliefs or reduced taxes are applicable for the expenses incurred during the initial years, the insurance company may not be in a position to utilize fully such facility under the new proposal. [1]
   - To that extent, there is a risk of reduced profits. [0.5]

[Max: 1.5 marks]

7. **Tax Rates:**
   - If the tax rates increase subsequent to the issuance of the contract, there is a risk of reduction in the profits expected from the contract.

[0.5 mark for each point , Max 0.5]

8. **Reserving:**
   - All the assumptions pertaining to the renewal commission may need to be increased.
   - To that extent the overall liability estimation may increase.
   - It may also have consequential impact of increased solvency margin requirement.

[0.5 mark for each point , Max 1.5]

9. **Discount rate:**
   - There is a risk that the insurance company may not achieve the discount rate at which the renewal commissions are discounted.

[0.5 mark for each point , Max 0.5]

**[Max 12]**

**b) <u>Possible advantages:</u>**

1. **Persistency:**
   - The uniform commission may improve the persistency rates & hence, improve the overall portfolio contribution towards expenses and pooling of risks. [0.5]
   - This in turn may improve the overall profitability of the products, if withdrawal rates are low. [0.5]

2. **Distribution Channel**:

- The proposal may be perceived as career opportunity and attract many sales force to the insurance industry, considering the uniform income generation during the term of the contract. [1]
- This may improve the sales of the insurance companies. [0.5]

3. **Capital**
The products may become capital efficient with reduced new business strain. [0.5]

**[3]**

**[23 Marks]**

**Solution 3:**

**i)**

a. Investment assumption is sensitive to the size of the reserves built up, investment guarantees given, availability of matching assets, the duration of guarantee, the reinvestment requirements. [1]
b. In this product, the base annuity is guaranteed and the bonus rate is discretionary. However, there is an overall guarantee on the total annuity rate in any year leading to a guarantee risk. This may limit the choice of asset selection and hence, to be reflected in the investment assumption. [1]
c. The expected longevity of the annuitants and the availability of assets for such long duration may create a reinvestment risk. To that extent, allowance for future investment yields need to be made. [1]
d. Any hedging mechanisms, the company has, to meet the implied guarantees and its costs. [0.5]
e. Due to regular annuity payouts, the real cashflow could be predicted to be negative( as typically annuities are single premiums), leading to assets being sold and bought in the future. Future reinvestment yields might become an important factor in the estimation of investment assumption. [1]
f. However, if the assets are matched fully for the duration and represent the guarantee suitable, future investment rates may not have much impact on the investment return assumption. [1]
g. Future changes to the returns due to the impact of economic environment on the various asset classes and the availability of appropriate level of free assets need to be accounted for. [1]
h. The longevity risk along with the availability of assets for such duration may create a reinvestment risk. [0.5]
i. Investment assumption can also be set using stochastic approaches. [0.5]
j. Appropriate tax treatment with respect the different components of the investment return from different asset classes need to be allowed for, generally allowing for the current rates. [0.5]
k. Allowance for appropriate future bonus declarations need to be included, considering the overall guarantee on the annuity rates and the PREs. [0.5]
l. The guarantee risk and the need for additional level of free assets, in case of a guarantee risk in the future considering the level of guarantee already included in the base level annuity may also be allowed for. [0.5]

**[Max 6]**

**ii)**

a. **Many policyholders lapse the policy during the initial years.**
The impact of asset shares on remaining policyholders depends on whether the lapsed policies have made profit or loss. Most of the times, during initial years, due to high level of initial expenses asset share is low or negative. [0.5]

If asset share is negative for lapsed policies, then the asset shares for remaining in force policies will be smaller [0.5]

On the other hand, if the lapsed policies' asset share is positive at the time of lapse then asset shares for the remaining in force policies could be higher [0.5]

This situation could be possible as the plan is with profit endowment & premiums are loaded for expenses, benefits and expected future declaration of bonuses. [0.5]

b. **Many policyholders surrender the policy.**

If the surrender value is paid as asset share less administration cost of surrender then the asset shares for the remaining policyholders will not be affected. [0.5]

If the surrender value is lower than the asset share then the company would have made some profit from the surrender and this should be reflected in higher asset shares for the remaining policyholders. [0.5]

On the other hand, if the surrender value (eg guaranteed surrender value) is higher than the asset share then the company would have made some loss from the surrender and this should be reflected in lower asset shares for the remaining policyholders.

[1]

c. **Two policyholders die in the first year of the policy.**

If the approach is to take the mortality rates experienced by the group and using these rates to calculate the asset share, then asset share will go down if our estimated mortality rates increase as a result of death. [0.5]

In reality two deaths in the large group of policies would have no influence on the mortality rates and so the asset share would not be affected. [0.5]

d. **Many policyholders die closer to their maturity dates.**

Asset share near maturity is almost closer to the maturity / death benefits (since this is endowment plan so both death and maturity values are very close to each other near maturity for the participating endowment plan) and hence the asset shares for the remaining policies will not be impacted. [1]

e. **Market value of assets decrease by 15%.**

The asset share would decrease by less than 15% as fall in market value of assets also reduces the tax liability on the unrealised capital gains. [1]

f. **Risk discount rate is increased due to high risk in the business.**

This will increase the cost of shareholders capital and hence the asset share will reduce.

[1]

[Max 8]

**[14 Marks]**

**Solution 4:**

**i) Data requirement & other information to carry out the business plan**

- Selection of policy level model points based on market research for planned procurement of new business every year as it is critical for model points to represent the business which is likely to be procured . If model points used to derive premiums & profitability significantly differ from actual business, it may have an impact on projected profitability & other aspects like capital etc..
- Collection of lapse related information for term insurance plan from the industry or reinsurance's data of the local market to set appropriate lapse assumptions.
- Setting the best estimate actuarial assumptions for projecting the financials for mortality, expenses, lapses, investment returns and new business for the projected time period.

- Setting the actuarial assumptions to value the projected liabilities based on either historical experience or industry experience if no sufficient company level experience is available. In this case the company is new, it has to rely upon industry experience.
- Projecting the solvency position based on value of assets and liabilities
- Current level of available capital & additional capital requirements in future to support the business and solvency position.
- Projection of Financials- Revenue Account, Profit & Loss Account, Balance Sheet & Cash Flow statement.
- Asset data-Current level of yields on existing assets & projection of yields in future depending on future level of projected investments from the premiums. However, since this is a term plan, the effect on profitability matrices will not be significant due to investment returns.
- Asset Liability Management policy including the liquidity position of the company in future to serve the death claims and the support the regular level of expenses.
- Current underwriting policy and potential change in policy in future in light of change in demographic and financial position of the future prospects. Strict underwriting will help to offer competitive premium rates and vice versa.
- Current reinsurance agreement and level of retention and impact of reinsurance arrangement in future from profitability perspective.
- Projection of claims, expenses and the terminations in the business plan.
- As mortality risk is very significant for the term insurance policy, and hence current Risk Management policy covering predominantly insurance and operation risks (eg risk of fraudulent claims).
- Current regulatory, legislative and taxation provisions and potential change in future.

[0.5 marks each, Max 7]

**Key matrices to be included in the outcome of the business plan**

- Overall capital requirement to support the business
- Breakeven period eg Discount Payback Period or Payback Period
- Projected profits & dividends to shareholders
- Sensitivities of profits under various parameters
- Profit margin based on risk discount rate
- IRR to policyholders

[0.25 marks each, Max 1]

**[8]**

**ii) Increasing capital requirements and the breakeven period**

There could be many reasons for increasing capital requirements:

- Company is new and it might be incurring significant amount of expenses in developing & maintaining the online platform.
- The projected new business premiums in the business plan might be lower leading to new business strain and hence increasing capital requirement. Further since, this company is new, there is a possibility that new business each year could be higher for initial few years thus new business strain may be outweighing the surplus from renewal business in the initial years.
- Also, higher level of projected business will lead to overall higher expenses and hence increase in capital requirement.

- If the lapse assumptions are higher in the business plan then per policy overhead expense will increase leading to higher capital requirement and also initial expenses might not have been recouped from the lapsed policies.
- As company is new and entering with this novel channel, Actuary would like to be conservative in setting the mortality and other assumptions for valuing the liabilities given that the company does not have any experience of this segment of the customers. This may increase the value of liabilities and hence it may require additional capital to support the business.
- Solvency requirement in the country is stringent for term policies leading to increase in capital requirements.
- Company deliberately wants to initially promote the term plan with competitive premium rates as a loss leader to capture the market. This will lead to capital requirements.
- Company wants to invest heavily in the new technology in the future. This might cause the increase in capital requirement.
- Currently company has very little human capital. In future, company wants to invest in human capital and expand its operations as per the business plan. This will lead to increase in capital requirement.
- Business plan might not have assumed reinsurance arrangement and hence no credit for reinsurance would have taken in the plan. This might increase the capital /solvency requirement.
- Business plan might have assumed reinsurance arrangements with the counterparty risk of non- payment of reinsured portion of claims. This may lead to increase in capital requirement.
- Business plan might have assumed higher level of projected death outgo as there could be lenient /no underwriting for the term plan.
- Risk discount rate assumed in the business plan might be higher leading to longer period to break-even.
- Company might have offered guaranteed insurability option with the term plan wherein policyholder can take out another term plan in future without any underwriting and with standard premium rates. This might have caused to increase in reserves due and hence capital requirement.
- The calculations in the business plan could have been wrong as there could be a model error or assumption error!

[0.5 marks each, Max 6]

**iii)**

- Reserving assumptions taken by an independent actuary could be significantly different than yours with lower level of prudence in the assumptions than yours.
- Business mix assumed for the projection could be different than yours.
- Independent actuary might have assumed that prospective policyholders might belong to a very healthy segment and hence their mortality could be lower than mortality of other insured population. This will lead to lower level of projected claims in the plan.
- Independent actuary might have taken reinsurance arrangement in the projection and also credit for reinsurance, leading to lower reserving and capital requirement.
- Projected premiums taken by an independent actuary might be higher than yours in the business plan.

- Expenses assumed for projections could be lower than what was assumed by you in the business plan, as other actuary might have believed that economies of scale will be achieved soon depending on the projected business volume.
- Risk discount rate taken by independent actuary could be lower than yours in the business plan.
- All the initial expenses are spread uniformly throughout the average term of the policy. This may lead to significant reduction in the initial level of capital.
- In subsequent years level of operating and renewal expenses have been assumed lower both in the projection and reserving of the business plan.
- Independent actuary might have assumed the low level of new business projection in & hence low NB strain compared to yours leading to early break even as per her business plan.
- There could be lapse profit emerging from the business profile considered by the independent actuary in the business plan leading to early break even.
- There could be modelling error or assumption errors inadvertently made by the independent actuary.

[0.5 marks each, Max 4]

**iv) Recommendations:**

- Check whether the model and assumptions are correct.
- Check whether the premium for the term plan is loaded appropriately for expenses, benefit and profit. Otherwise revise the premiums based on profitability criteria as set out by shareholders.
- Make reinsurance arrangement such that it can help the company to set appropriate level of retention and underwriting standards. Further, reinsurance arrangement should help to get the maximum credit in setting the solvency capital and also lowering the level of reserving requirements.
- Bring economies of scale in expenses by selling many policies that will help to reduce per policy expenses.
- If capital is a problem, company can explore financial reinsurance subject to regulatory considerations.
- Company can sell policies to a financially sophisticated & healthy customers with significant level of insurance cover.
- Company can develop another annuity plan and sell both these plans simultaneously to the same customer thereby can hedge the mortality risks in the business.
- Company can think of developing savings oriented simple plans such as traditional endowment or unit linked plan wherein the level of premiums are significantly higher compared to traditional term insurance plan. This may help company to recover expenses at fast pace and achieve breakeven at the earliest duration.
- Develop traditional savings or unit linked plans where there is lower level of solvency capital requirement than a traditional term insurance plan.
- Company can add flavour to the term insurance plan by including guaranteed insurability option or adding wrapper of critical illness benefit. This will boost the marketing of the product and thereby may help to increase the sale of the plan.
- As term insurance plan is a straightforward plan, the significant risk is mortality risk which can fairly be predicted in future and also robust underwriting and claims procedures along with reinsurance arrangement will help company to reduce this risk significantly. Hence, company

can think of reducing the risk discount rate and thereby increasing the profitability of the plan or reducing the breakeven period.

- Company can encourage its policyholders by providing fitness tips on regular basis and health coupons for purchase of healthy groceries, thereby reducing the mortality claims among these policyholders.
- Company can tie-up with banks & financial institutions with Unified Payment Interface (UPI) application and facilitate selling these plans to their customers through their ATM machines & UPI payments. Further, companies can set up a dedicated kiosk in each of the bank branches providing information about the products.
- Company can launch its brand and marketing campaign across the country so as to garner significant level of premiums.
- Company may initially go slow on its sales and can slowly build the capacity in a staggered manner taking into consideration the actual experience & focusing the business potentials where capital strain is lower.

[0.5 marks each, Max 5]

**[23 Marks]**

**Solution 5:**

**i) Aims of Underwriting**

- Protect a life insurance company from anti-selection
- To enable a life insurance company to identify lives with a substandard health risk for whom special terms need to be quoted
- For the sub-standard risks, the underwriting process will identify the most suitable approach and level for the special terms to be offered
- Adequate risk classification within underwriting process will help to ensure that all the risks are rated fairly.
- Underwriting will help to ensure that actual mortality experience does not depart too far from that assumed in the pricing of the contracts being sold. Underwriting is the process that aligns the risks written by a company with the pricing performed by the actuary.
- Financial underwriting will help to reduce the risk from over-insurance.

[1 mark each, Max 4]

**ii)**

a) **Impact on Existing business:**

i. Generally, in-force business would have guaranteed premiums considering certain assumptions about contract terms and conditions.

ii. The implications of the Government proposal to change the contract terms and conditions retrospectively may be potentially severe, as many claims which would have been excluded will required to be paid.

iii. Depending on the impact of the pandemic on the insured population, the potential losses could vary from possibly very large to moderate.

iv. As indicated, the term insurance industry has grown rapidly in the recent past and if the policies issued are with high value sum assured, the impact could be compounded by the fact that the industry had written significant volumes of business that is potentially affected.

v. If mortality rates are expected to be higher than assumed, the losses would impact the financial strength of the company.

vi. May also reduce the profits and lead to reduced dividends to shareholders.

vii. The extent to which the industry is adversely affected by the proposed legislation depends also on:
   a. The number of claims out of the insured population vis-à-vis the overall population mortality.
   b. how bad the pandemic turns out to be?
   c. how effective the exclusion clause would have been in identifying pandemic related deaths, in the absence of this legislation.

viii. The exclusion would very likely have been much less than 100% effective, if cause of the deaths is not recorded as the pandemic.

ix. Government proposal may encourage the policyholders to perceive their term insurance as a valuable option and to that extent the lapse rate may decrease. However, the target markets for the business will also be important to maintain premium payment during the pandemic situation.

x. The expected increase in claims might require an increase in the supervisory reserves.

xi. The future expected experience could be highly uncertain, the resulting future cost could also be very uncertain.

xii. This may require an assumption of huge margin over and above the best estimate to arrive at the associated reserves.

xiii. This might also require to enhance heavily the solvency capital held against mortality risks.

xiv. Overall, this could result in substantial constraints on capital and might negatively affect company's free asset ratio.

xv. The immediate consequences of this would include:
   a. reduced investment freedom, as around 20% of business represents term insurance,
   b. increased liquidity requirements,
   c. lower confidence from potential customers and intermediaries,
   d. reduced ability to write new business.
   e. in the extreme, the company's solvency position may be threatened.

xvi. The problem might get compounded, if major portion is not reinsured.

[0.5 mark each, Max 7]

b) **Impact on New business:**

i. In the case of new business, there is more that the company can do to protect itself.

ii. However, many of these actions have potential disadvantages.

iii. The companies could increase premiums to allow for the increase in likely pandemic related claims.
   a. it may be difficult to get any useful and reliable data.
   b. considerable uncertainty about future levels of pandemic related claims may lead to a very large increase in premium rates.

c. make the contracts much less attractive to most policyholders than they are now.
d. without a large increase in premiums, the business still may require substantially higher reserves.

iv. The company could try to underwrite more severely to exclude all people who are likely to be affected (assuming the legislation allows this).
a. the level of underwriting required could be stringent and would be unpopular
b. ask all applicants to have appropriate blood tests and to answer many personal lifestyle questions
c. expensive.

v. Introducing yearly reviewable premiums to reduce the risk from future uncertainty, if allowed.
a. reduce the increase in premiums needed.
b. Occupation based rating may be introduced depending on the possible exposures.

vi. Despite increase in premium, it may decrease the capital efficiency of the product and decrease free asset ratios.

vii. Even to increase protection through reinsurance,
a. Appropriate support may not be available given the pandemic.
b. If available, cost of reinsurance could be high.
c. Reinsurers might have withdrawn from the market to reduce their exposure to the pandemic

viii. The companies could consider withdrawal from the market, in extreme situations.

[0.5 mark each, Max 5]

**[12]**

**[16 Marks]**

**Solution 6:**

i. Model of the business in force may be used to build a model investment portfolio.

ii. Allocate a proportion of free assets to support the assets for the reserves. The proportion that it may allocate may have regard to the requirements of holding prudent reserves and the current downward trends in the market movements.

iii. Such requirements might require a higher proportion of free assets to be allocated.

iv. The model also requires an indicative investment strategy, if it is being done for the first time or it may use the current investment strategy as the start point.

v. If the existing investment strategy has significant level of exposure to the assets which are currently facing downward movements, it may indicate an immediate need to revisit the investment strategy to ensure sufficiency of assets over liabilities at an appropriate level. [1]

vi. However, the level of free assets that may be required to meet the appropriate level would be determined based on the investigations.

vii. In the model, both the liabilities and assets are to be projected forward.

viii. The assumptions to be used for estimating the liabilities, generally, represents expected future experience. However, due to prudent regulatory requirements, this estimate may also consider margins for adverse deviations to include the effect of variance and appropriate levels of regulatory requirements. [1]

ix. With regard to estimating the expected future experience, inflation rate models may be used to project future expenses with respect to liabilities.

x. Assets may be projected based on the information available on the downward market movements and also on the possible expected future experience to arrive at the future investment income and changes to the capital values from such assets.

xi. Assets should be valued either on market basis or book basis depending on the type of investment instruments and any regulatory guidelines on valuation of assets.

xii. It must allow for:

a. investment return from the existing assets,
b. reinvestment of proceeds from the existing assets, and
c. investment of future premiums on existing and new business. [1.5]

xiii. Choice of assets must consider the regulatory requirements and their relationship with the investment assumptions used to value the liabilities.

xiv. Value of assets may also be projected using stochastic investment models.

xv. The values projected for inflation, interest rates and market values need to be consistent considering the downward market trends in the immediate future and to reflect the overall expected future experience in the long term. [1]

xvi. And also this needs to be consistent with the valuation interest rates used in the liability model.

xvii. The liabilities projected on prudent basis and assets considering the downward trends in market movements need to be valued at the end of each year of projection to test the solvency at such periods.

xviii. The value of the assets in excess of the value of the liabilities should sufficiently cover the level of solvency capital required by the company. The sufficiency will depend on the regulatory requirements, market practice, nature and riskiness of the business.

xix. Due to specific regulatory requirements, it is likely that the free assets that might be required at the end of each year would be generally higher than using the best estimate basis for valuation of assets and liabilities.

xx. A statistical distribution can be derived using stochastic investment model and simulation techniques.

xxi. By using the statistical distribution, the probability of potential future insolvency can be estimated for a given investment strategy to project of future solvency for a given investment strategy.

xxii. Simulations could be randomly generated and involve hundreds or thousands of scenarios depending on the computing capabilities.

xxiii. Dynamic assumption taking into account simulated investment conditions need to be incorporated into the model.

xxiv. A measure of success needs to be defined to compare the various investment strategy results. Generally overall profitability would be considered.

xxv. Based on the results, the optimum investment strategy would be selected or for a given level of free assets, an acceptable risk of insolvency is decided and determine the most risky investment strategy (expecting it to be the most rewarding).

xxvi. Also, the simulations can also be used to arrive at the level of free assets required to support a particular investment strategy and keep low probability of insolvency.

[0.5 marks for each points (other than those mentioned above) – **Max 14**]

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