

Institute of Actuaries of India

Subject SP1 – Health and Care

November 2023 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) Features of lifestyle / health that will affect wellness**

- 1) Smoking, alcohol consumption
- 2) On medication for specific conditions (including those obtained by prescription)
- 3) BMI/ obesity (relative height to weight)
- 4) Diet and nutrition
- 5) Levels of exercise / gymming
- 6) Blood pressure reading
- 7) Cholesterol levels
- 8) Occupational risks

[Max 2]

ii) Benefits to the insurer

- 1) The wellness program should improve the health of policyholders, and so improve the claims experience of the insurer in the mid to long term.
- 2) The product could attract many customers who are healthy, and so reduce scope for anti-selection.
- 3) The wellness plan appears to be an innovative product in the country, which could:
 - Give the first mover advantage to the company and help propel high growth
 - Mean that there are no competitors' products against which a direct comparison can be made, and so it might allow the insurer to increase its profit margins
 - enhance the insurer's brand and help acquire good customer risk profile
- 4) The insurer will have data of health conditions, so that they can provide customized preventive or diseases management program to improve lifestyle / manage health conditions of policyholders.
- 5) An increase in sales volumes can lead to a fall in per-policy expenses and so result in either lower (more competitive) premiums or higher profit margins.
- 6) This may give it a competitive advantage over other insurers, particularly if they subsequently decide to offer similar products.

Attractiveness to potential policyholders

- 1) Policyholders can gain access to support in achieving a better level of health, which may be deemed to be "free advice".
- 2) They may also find the travel and entertainment rewards appealing.
- 3) The chance of lower future premiums will also be attractive.
- 4) The novelty value of the plan may also appeal.

[Max 5]

[7 Marks]**Solution 2:**

Based on past two year's data, Hospital X is significantly more expensive, approximately > 50% However, significant further analysis is required to determine reason for difference in cost before taking decision for removal from the network is justified.

- 1) The quality of the care provided by the hospitals are also of utmost importance, and quality should not be compromised to save costs, so with given information, we cannot conclude which hospital is more expensive, and any recommended action is still premature. Significant judgment and complete data may be required here in the measurement and interpretation of quality.
- 2) Factors that increase relative cost, but significantly improve quality and outcomes like relatively lower readmission, lower hospital acquired infection etc. with use of appropriate technology, infrastructure, staff (doctors, specialists, etc.)

- 3) Differing treatment protocols, policies and procedures may have a significant impact on overall hospital costs and this should be considered when recommending any action
- 4) Cost differs if type of hospital differs significantly like multi-specialty vs mono line, tertiary care vs Secondary. This will make the experience incomparable and some other methodology for cost comparison will be required for e.g., only considering procedures, services, admissions that are comparable
- 5) Even if both the hospitals are in the network, one hospital may not have agreed tariff rates for all items and billing for open tariff items might be higher as compared to full package for all components from another hospital.
- 6) Compare the risk profiles of the persons that were admitted to both Hospitals respectively
 - a) Age
 - Is there a difference in the average ages of policyholders receiving treatment in the two hospitals?
 - Older people are expected to have more frequent and more severe hospitalisations
 - b) Gender
 - Females during the child-bearing years are expected to have more frequent hospitalisations than men of corresponding ages due to childbirth and neo-natal ICU costs
 - Conversely, older men typically experience more hospitalisations than females
 - c) Chronic conditions
 - Chronic conditions, co-morbid chronic conditions, are associated with more frequent and more severe hospitalisations
 - Compare the chronic incidence of those policyholders admitted to the respective hospitals.
- 7) The count and severity of main types of admissions by ICD, CPT, Length of Stay in hospital need to be considered and assessed relative to a benchmark. This benchmark can be set by removing very volatile or outlier admission types, or those that are typically very complex and abnormal.
For e.g.
 - Maternity admissions with neonatal ICU will be significantly more expensive than those without
 - Procedures with complications will be significantly more expensive than those without etc.
- 8) Check proportion of claim and claims cost for cashless and reimbursement separately
- 9) It is important to consider the geographical location of the hospitals as this may impact admission rates and hence the difference in claims severity.
- 10) A hospital close to factories or other hazardous operations may see more accidents, or more pollution-related admissions, pushing up their relative claims costs when compared to another hospital.
- 11) The availability of primary care facilities and other, non-hospital healthcare in the nearby area may also influence admission rates
- 12) Splitting costs by various categories of hospital bill – room type and accommodation cost per day, surgical, supplies, medication, fees of treating doctors and specialists will help get further understanding of the reason
- 13) A small hospital may refer complex cases to larger hospitals and only admit simple cases, and as a result, seem to have lower costs

After considering all these factors and allowing appropriately for them, the insurer can consider whether intervention is required and what type of interventions.

- 14) Removal from network should not be the first option and consider intervention to manage claims cost
 - a) Pre-authorization to ensure only necessary admissions and reduce conversion of OPD to IPD
 - b) Protocols to ensure standard of treatment is appropriate and Length of stay is not extended
 - c) Alternative reimbursement strategies to facilitate cost sharing
 - d) High-cost case management/rate negotiation/ discharge planning to ensure hospitalizations are managed and costs controlled

- e) Utilization reviews or clinical audits to identify significant differences in practices between hospitals
- f) Marks for any other logical answer

[Max 13 Marks]

Solution 3:

i)

- 1) There are two groups of policyholders – chronic and non-chronic
- 2) Chronic lives - who are eligible to get cover without loading may perceive value in this feature
- 3) Increased simplicity and ease of sales process with lesser turnaround time as no counteroffer is required to share with proposer
- 4) Potential advantage for intermediaries / distribution agents as they may be able to get more volumes with this feature if competition has no such feature
- 5) Turn-around-time will be quick due to simplified underwriting – this may enhance policyholder perception of efficiency and service levels.
- 6) Insurer will be able to save cost from removing Pre policy health check -up
- 7) There is an element of cross subsidy in pricing of this product hence non-chronic lives may have to pay higher premium. It is not fair to charge higher premium from healthy lives. Non-chronic lives may not buy this product or lapse their policy and port out to competition. This may increase loss ratio of this product after waiting period of four years as the proportion of chronic lives increase in the overall portfolio
- 8) Cost of providing cover for additional chronic condition may be lower – additional diseases may be of lower incidence than those in the standard policy
- 9) Anti-selection risk may be significant due to lifelong guaranteed renewability
- 10) Anti-selection by age is also likely to occur (older policyholders are more likely to take have chronic conditions
- 11) Persistency of lives with chronic conditions will be higher
- 12) Policyholders may switch insurers instead of extending cover as they might want some other covers/ flexibility
- 13) Once this feature is introduced, sales volume of chronic specific product will reduce and only lives with extreme chronic conditions may buy that product
- 14) Chronic Policyholder may feel cheated in case of mis-selling or implications of waiting period may not have been explained to them at time of purchase
- 15) Premium revision frequency and magnitude may increase due to higher proportion of chronic lives leading to higher loss ratio than allowed for in pricing
- 16) If Competition also follows the same approach, then the challenge of anti-selection may be largely reduced
- 17) Additional complexity – IT system changes
 - a. additional data required to monitor proportion of chronic lives
 - b. loss ratio of chronic and non-chronic portfolio

[Max 8]

ii)

- 1) The starting point for pricing of this additional feature would be the model of existing products
- 2) Assumed proportion of chronic lives – this would affect the choice of model points for pricing the additional benefit
- 3) Sensitivity testing with various scenarios of expected proportions and the resultant impact thereof will be important
- 4) Assumptions would need to be made about
 - the risk selection guidelines for chronic lives – only mild and moderate chronic conditions or severe chronic conditions will also be accepted.

- number of co-morbid conditions will be allowed per person
 - risk selection relative to market practice
- 5) This would depend on factors such as the proportion and age mix of lives with chronic conditions
 - 6) It would be prudent to allow for a degree of anti-selection in this assumption
 - 7) The claim incidence rate and severity assumption will need to be adjusted to allow for all the factors mentioned above
 - 8) The data on the incidence and severity of comorbid conditions will need to be obtained from internal and external sources. For example, data from reinsurers, academic studies, international experience, Industry data and inputs from medical underwriting team could be referred to
 - 9) Adjust persistency experience to allow for higher renewal rate of chronic lives and lower from non-chronic lives depending on the general market practice
 - 10) With the necessary adjustments made to reflect expected experience (with allowance for anti-selection) and derive risk premium for this product
 - 11) All the other assumptions in the pricing model would need to be updated with more recent data e.g. expenses, investment return.
 - 12) Any increases in expenses (e.g., system changes, marketing of new benefit) would need to be considered
 - 13) Commission can be allowed for according to the terms agreed with brokers and other intermediaries
 - 14) Check the additional capital requirement as compared to the existing product and allow for incremental cost of capital, if any
 - 15) The allowance for profit may need to be changed. For instance, the profit requirement may be higher given the higher potential risks of business
 - 16) Given the uncertainty around a new feature, expected proportion of chronic lives, incidence rates and the severity of the new feature various scenarios would need to be run, and the sensitivity of the assumptions will need to be tested and compared with competition in case such products are available

[Max 7]

[15 Marks]**Solution 4:**

i)

- 1) The aim of the underwriting procedures should be to prevent selection against the insurer
- 2) The opportunity for underwriting is limited because the insurer will have little *direct* contact with the loan customers. The bank will collect and remit the premiums
- 3) This means that the procedures must be very simple
- 4) The benefits are determined using a fixed formula and are earmarked for a specific purpose. There is therefore no need for financial underwriting. (In effect financial underwriting would be completed by the bank while sanctioning home loan)
- 5) The risk to the insurer could be considerably higher from proposals with co-borrowers and specifically if co-borrower is parent(s)
- 6) If a large proportion of all loan customers purchased, or if purchase of Critical Illness cover is compulsory, this would reduce the chance of anti-selection ...
- 7) ... and so, reduce the need for extensive underwriting
- 8) If purchase of Critical Illness policy is voluntary, cover could be offered with no underwriting to those who opted to join at time of the first disbursement
- 9) Those who wants to join subsequently would be subject to detailed underwriting, perhaps using the same procedures for retail CI portfolio
- 10) An assumption is being made that underwriting at the claims stage would be sufficient to prevent those who fall on hard times and are unable to pay home loan instalments from making a fraudulent claim

- 11) If membership was in effect voluntary with no minimum take up required, then some limited underwriting is essential
 - 12) This could take the form of a simple form asking for date of birth, smoking status, occupation *etc.*,
 - 13) Asking for a declaration of any medical treatment currently being received would provide an additional safeguard. This would allow the insurer to restrict cover for pre-existing conditions. However, this is difficult to get from customers and it might hamper ease of sales
 - 14) An alternative would be to impose a waiting period and so exclude claims relating to pre-existing conditions during this period. Also, survival period can be imposed for the Critical Illness benefit
- [Max 5]

ii)

- 1) Customers' ages are likely to range from, say, about 30 years to 50 years. Expected critical illness incidence rates increase with age over this range, particularly towards the higher ages
- 2) However, with a high take-up rate, same rate of premium might be acceptable to the insurer
- 3) The alternative is to use age-banded premiums that vary according to the age of the parents
- 4) ... but this would be more administratively complicated and possibly less attractive to parents
- 5) Costs of premium collection would be reduced as premium is paid by bank and collected as part of processing fees
- 6) The risk for co-borrower proposals will be greater than that for proposal with only one parent. So, you may consider offering a simple loading factor on premiums for co-borrower proposals

[Max 2]

[7 Marks]

Solution 5:

i) Single premium calculation

As we are ignoring mortality, and the central rates of claim inception are very low at these ages, the initial (q-type) inception rates will be almost identical to the tabulated central rates. So, we will use the tabulated central rates as if they were initial inception rates, without adjustment. We also note that no claims can be paid in the first year.

The inception rates required are those applicable to a deferred period of one year. So, the standard single premium will be:

$$1,00,000 \times [(0.000521 / (1.05^{1.5})) + (1 - 0.000521) \times 0.000578 / (1.05^{2.5})] = ₹99.56$$

The value 0.000521 is the claim inception rate in the S(ID) table for current age 31 with a deferred period of one year. This is the rate at which policyholders are expected to complete one year of continuous sickness in the year of age beginning at exact age 31, i.e., relating to people who first became sick during the first policy year.

Similarly, in the 2nd policy year, (1 - 0.000521) is the expected proportion out of the initial policyholders who are still exposed to the risk of becoming sick during the second policy year.

Multiplying this by the inception rate for age 32 gives the expected proportion that end up claiming in the third policy year.

[Max 4]

ii) Option premium

We first need to calculate the standard premium, which the option-takers will each pay, at age 33. This is calculated identically to part (i).

So, the premium is:

$$1,00,000 \times [(0.000709 / (1.05^{1.5})) + (1-0.000709 \times 0.000785) / (1.05^{2.5})] = ₹135.33$$

We now need to calculate the cost of claims for the option, as at time 3.

First, for those currently sick (and who will definitely go on to qualify for claim), the present value of the cost is: $1,00,000 / 1.05^{0.5} = ₹97,590$

For other policyholders who take up the option, the expected present value of the cost is:
 $1,00,000 \times [(1.5 \times 0.000709 / (1.05^{1.5})) + (1-1.5 \times 0.000709) \times 1.5 \times 0.000785 / (1.05^{2.5})]$
 $= ₹202.96$

We now need to multiply these values by the respective probabilities of an initial 30-year-old surviving to be a sick life (ultimately to claim) at time 3 or surviving to be one of the other 30% who take up the option at time 3. The whole is then discounted for three years to get the total expected present value of the claim cost from the option.

So, we get:

$$\begin{aligned} & 97,590 \times (1-0.000521) \times (1-0.000578) \times 0.000641 \times 1/1.05^3 \\ & + 202.96 \times (1-0.000521) \times (1-0.000578) \times (1-0.000641) \times 0.3 \times 1/1.05^3 \\ & = 53.98 + 52.51 \\ & = 106.49 \end{aligned}$$

But we are going to receive premiums for all those who take up the option. These will have expected present value (at age 30):

$$135.33 \times (1-0.000521) \times (1-0.000578) \times [0.000641 + (1-0.000641) \times 0.3] \times 1/1.05^3 = 35.08$$

So, the additional premium required at age 30, for a policy with the option, is:

$$106.49 - 35.08 = ₹71.41$$

The total premium including the extension option is $99.56 + 71.41 = ₹170.97$

[Max 8]

[12 Marks]

Solution 6:

i)

a) Long-term CI policies:

a. Reserve for policies:

- The reserve is calculated as expected present value of future net cash flows
- The cash flows in relation to Critical Illness benefit payment, expense related cash flows and premium cash flows are considered in the calculation with their corresponding probability
- The net cash flows will be discounted using a specified discount rate to arrive at the reserve

b. Reserves for outstanding reported claims:

- This is reserve for claims reported but not yet paid.
- As this is a benefit-based policy, the reserve for reported claims is calculated as the benefit amount payable or the present value of guaranteed annuity payouts as specified in the policy document under each policy.

c. Reserves for claims that have been incurred but not reported (IBNR):

- These reserves are mainly for claims that may be reported with a delay.
- The delay may occur in various circumstances like where the policyholder realizes the illness is covered under the benefit or may be due to delay in reporting itself.

- While calculating the IBNR component, the actuary needs to consider the delay pattern and typically using the run-off triangles technique, the IBNR component is estimated.
 - As this is a benefit-based product, the reserve for Incurred but not enough reported doesn't arise.
- d. Option reserves:
- The policy provides option for policyholder to receive the CI benefit in the form of lumpsum or guaranteed annuity.
 - The actuary needs to hold the option reserve by assessing the option take-up rate.
 - Depending upon the size of portfolio and other factors like cost, regulatory requirements, the actuary estimates the option take up rate through deterministic or stochastic methods.
- e. Any other reserve with proper explanation

[4]

b) Short-term CI policies:

- a. Unearned premium reserve (UPR):
- This reserve is equal to the premium received in respect of period of insurance not yet expired.
 - Typically, the unearned premium is arrived based on the period of remaining coverage unless this is not appropriate because the risk is not uniformly spread over the year.
 - This is effectively a retrospective approach.
 - If the risk is uniformly covered, the actuary may approximate that the half-of the period premium is towards unearned premium reserve.
- b. Unexpired risk reserve (URR):
- This reserve is held more than UPR, if the actuary considers the UPR is inadequate to meet the future claims and expenses in respect of risk for unexpired period.
 - This is effectively a prospective approach.
 - The actuary if estimates the expected experience is adverse compared to assumed pricing experience, then URR will be required.
- c. Reserves for Outstanding reported claims:
- This reserve is for claims which have been reported but not yet paid.
 - As this is a benefit-based policy, the reserve for reported claims is calculated as the amount of claim reported subject to any sub-limits applicable.
- d. Reserves for claims that have been incurred but not reported (IBNR):
- These reserves are mainly for claims that may be reported with a delay.
 - The delay may occur in various circumstances like where all the details required for claim submission are not yet obtained or may be due to delay in reporting itself.
 - While calculating the IBNR component, the actuary needs to consider the delay pattern and typically using the run-off triangles technique, the IBNR component is estimated.
- e. Option reserves:
- The policy provides option for guaranteed renewability.
 - The actuary needs to hold the option reserve by assessing the option take-up rate.
 - Depending upon the size of portfolio and other factors like cost, regulatory requirements, the actuary estimates the option take up rate through deterministic or stochastic methods.
- f. Any other reserve with proper explanation

[Max 4]

ii) Merits and demerits of proposed approach:**a) Merits:**

- 1) This approach is based more closely on market conditions.
- 2) The economic assumptions will be updated based on market conditions

- 3) This approach provides true financial condition of the insurer based on current market conditions rather than using historical data
- 4) As the existing approach may provide false sense of security when the market conditions have changed in reality
- 5) It enables management to take appropriate actions in time
- 6) For instance, if the management observes high expense inflation or medical inflation, corrective action may be taken.
- 7) This approach is more informative in understanding the impact of market conditions
- 8) Such as impact of financial guarantees i.e., the conversion of lumpsum into annuity certain at guaranteed interest rate.
- 9) The impact of equity market will be understood although its role is negligible long-term CI.
- 10) The impact of interest rate movements on solvency will be understood clearly
- 11) The capital will reflect the risk profile of insurer appropriately
- 12) It incentivizes the risk management of insurer and the capital will reflect the same

b) Demerits:

- 1) New approach tends to be more subjective
- 2) Relatively complex compared to existing approach
- 3) May be prone to procyclicality and systemic risk
- 4) As the new approach may result in the need to sell off risky assets after a fall in prices, which could lead to further fall in prices
- 5) Complex to understand the solvency capital as the stress applied, risk margin is complex to understand.
- 6) It may involve subjectivity in deciding the best estimate assumptions, stress applied (if choice is given to insurers)
- 7) May involve support of system requirements.
- 8) As the stresses are uniform to all insurers irrespective of their risk profile, it may not reflect the true capital requirement.

[Max 10]

iii) The impact will be on Reserves and Solvency capital

Impact on reserve:

- 1) Currently the reserve is being calculated with prudent margins.
- 2) As per revised one, the best estimate liability will be without any prudent margins.
- 3) Thus, the best estimate liability will be lower than reserves under existing practice.
- 4) This, however, will depend on the quantum of Risk margin.
- 5) The risk margin is a fixed proportion of current year solvency capital
- 6) If the prudent margins result is higher than risk margin, then there could be release of reserve.
- 7) Otherwise, there could be strain on the company.
- 8) The discount rate used in BEL will be at risk free rate of interest.
- 9) If the current discount rate is higher than this, then there could be an increase in the reserves.
- 10) If the current discount rate is lower than risk free rate of interest, there could be release of reserve.
- 11) The option reserves need to be calculated on stochastic modelling.
- 12) If the company A is using the same practice of stochastic modelling currently, then there could be no impact.
- 13) As the assumptions are linked to market and economic conditions, there could be volatility in the amount of reserves.

Impact on solvency capital calculations:

- 1) The existing practice is a simple method, whereas in the revised case, the capital is calculated risk wise by applying pre-specified stress.
- 2) The quantum of capital will depend on the amount of stress applied.
- 3) In the existing method, there is no specific charge on assets for solvency capital.
- 4) Thus, the capital requirement is likely to increase.
- 5) No diversification benefit may likely to increase the capital requirement.
- 6) The insurer may need to calculate the asset value on market basis.
- 7) The solvency is aligned with the risk profile of the insurer i.e., the more risk, more capital
- 8) Some market disturbance may happen if the capital requirement increases or capital releases.
- 9) The insurer having better risk management may experience a lower solvency capital
- 10) The proposed approach clearly indicates the solvency movement w.r.t market or economic variables movement.

[12]

[30 Marks]**Solution 7:****i) Reinsurer support in providing financial assistance:**

- 1) The reinsurer provides financial assistance to insurers to meet new business strain or improve free assets.
- 2) The reinsurer provides capital in the form of higher initial commission.
- 3) In return, the reinsurer would be entitled to a proportion of the future surplus arising on the business.
- 4) Thus, the reinsurer would lend now against the predicted future flows of profit.
- 5) As the future flows of profit are contingent in nature, the accounting principles of some jurisdictions doesn't recognize this as a liability in balance sheet. Thus, it strengthens the balance sheet.
- 6) This is more attractive than other financing arrangements because it has no liability to repay the loan unless a profit has been made and therefore the insurer need not reserve for the future payments.
- 7) The cost of financial reinsurance may be better compared to other forms of capital like cost of subordinate debt of cost of equity capital
- 8) This is implicitly the self-generation of capital by the business written and doesn't require any support of external capital

[4]

ii) Factors to consider by reinsurer in providing financial assistance:

- 1) The starting point would be to calculate the present value of future profits arising from long-term Critical Illness [CI] portfolio
- 2) The reinsurer needs to decide on the proportion of future profits that can be lent to the insurer.
- 3) Reinsurer may require considering the pricing assumptions of each long-term CI product to examine the margins available in the pricing assumptions.
- 4) Policy data also may be required to project the future profit from each policy.
- 5) Reinsurer would also require underwriting policy of insurer for each of the product under CI portfolio.
- 6) The reinsurer would require considering the experience of the insurer in this portfolio.
- 7) This gives an indication of future profit potential under the portfolio.
- 8) As the insurer is in this business for the past 10years sufficient volume of data may be available.

- 9) If internal data is not sufficient, the reinsurer may require referring the industry data or any credible external data on estimating the future experience.
- 10) Need to consider the cost of capital requirements.
- 11) Need to examine the internal risk appetite or retention policy
- 12) Check for any diversification benefit from any other reinsured portfolio.
- 13) The future cash flows are projected forward and need to discount at required discount rate to arrive at the present value of future profits.
- 14) Allowance for reinsurance shall be considered.
- 15) The cash flow items would include claim costs, premium income, expenses, capital costs and tax.
- 16) Any regulatory constraints need to be considered.
- 17) Any profit sharing feature with policyholders need to be considered under this business

Assumptions for profit projections:

- a) Morbidity:
 - Need to consider the company's experience
 - Need to examine whether the experience is differing between various products in the portfolio
 - Need to check whether the volume is credible enough
 - Otherwise need to use reinsurer's own experience data
- b) Persistency:
 - Need to consider the persistency of in-force business under long-term CI
 - Need to examine any potential changes in persistency in future
- c) Expenses:
 - The expenses shall be on insurer's own experience
 - Allow appropriately for expense inflation.
 - Take into consideration any existing third-party agreements.
 - As there could be a chance of big size of portfolio, the expenses can be spread over larger portfolio.
- d) Risk discount rate:
 - The reinsurer may decide on the risk discount rate considering the uncertainty involved in the future profits.
 - It also depends on the risk strategy and appetite of reinsurer

[12]

[16 Marks]
