INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

SP2 - Life Insurance

Time allowed: 3 Hours 15 Minutes

Total Marks: 100

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.

Q. 1)

a) The company should take into consideration the following factors when evaluating a new product launch:

- Profitability:
  - Should be in line with company's profit metrices.
  - Since this is a new product line, higher profitability can be considered as a starting point to allow for higher degree of uncertainly.
  - However, if the intent of management is to price on lower profitability to enter into a new space, it can have a corresponding target.

- Capital efficiency of the product:
  - Whether the product results in day 1 strain or can self-finance its capital and reserving requirements.
  - If the product is strenuous, capital requirements basis projected business volumes need to be considered.
  - Given new risk for the company, the valuation actuary may want to reserve for it on prudent basis and hence there is a likelihood of higher strain.

- Competition:
  - Level of competition shall not only determine product design but also product pricing.
  - The company may want to alter designs by offering additional options (e.g., varying premium payment terms, offering return of premium option, etc.).

- Distribution and Marketability:
  - Conduct market research to identify customer segments, preferences, and price sensitivity, which can then impact product design.
  - Need to align the distribution on new product features/story and identify target markets.
  - Suitability from customer's perspective also needs to be evaluated.
  - Need to consider planned distribution channels and their expected remunerations need to be allowed for in pricing of the product.
  - Given this is a new product line requiring learning and identification of new target segments, the distributors might demand higher commissions.

- Risk assessment and mitigation:
  - Existing products (term and endowment) are likely to have mortality and interest rate as major risks whereas health-products shall have morbidity as the major risk. Expertise to manage a new risk needs to be considered.
  - It can be noted that morbidity risk can be correlated with mortality risk.
  - The other key risks in the product (lapses/ expenses) need to be identified and profits need to be sensitivity tested on these risks.
  - Level, availability, and terms of reinsurance need to be considered, if such an arrangement is available for morbidity risk.
  - Approach to underwriting needs to be discussed and documented. Underwriters need to be trained to manage a new risk.
  - Assumptions – Relevant and credible data to price and reserve for the products might not be available; also, the product might need to be priced on marginal expenses to ensure competitiveness.

- Others:
  - Consider availability of admin systems to service this new line of business. If tiered benefits based on severity of illness is provided, the systems need to be ready before product launch.
  - Given health product, proof of incidence of morbidity conditions may be required to process pay-outs. The systems need to be capable to process this seamlessly.

- Level of service standards need to be maintained; else it can result in reputational loss.
- Given the product is new, it is important to understand the cost of implementation.
- Need to consider legal or regulatory constraints. E.g., approval process of the process, demonstration of system readiness, meeting audit requirements, etc.

(Max 10)

b)

- The model should be adequately documented.
- The workings of the model should be easy to appreciate and communicate. The results should be displayed clearly.
- The model should exhibit sensible joint behaviour of model variables.
- The outputs from the model should be capable of independent verification for reasonableness and should be communicable to those to whom advice will be given.
- The model must not be overly complex so that either the results become difficult to interpret and communicate or the model becomes too long or expensive to run unless this is required by the purpose of the model.
- The model should be capable of development and refinement.
- A range of methods of implementation should be available to facilitate testing, parameterisation and focus of results.
- The more frequently the cashflows are calculated the more reliable the output from the model, although there is a danger of spurious accuracy.
- The less frequently the cashflows are calculated the faster the model can be run and results obtained.

(Max 4)

c)

- Define the Purpose of the Model:
  - Clearly state the purpose, e.g., pricing a new health insurance product.
  - For ABC Life, the goal is to support product development and assess financial viability.

- Specify the Assumptions:
  - Identify and document all demographic assumptions: mortality, morbidity, lapses.
  - Choose expense and investment return assumptions.
  - Align assumptions with the company's risk appetite, product design, and market conditions.

- Design the Model Structure:
  - Choose between deterministic or stochastic model, based on the purpose.
  - For pricing, deterministic models are generally sufficient.
  - Ensure that projection time steps, product features, and assumptions are logically integrated.

- Build and Implement the Model:
  - Construct the model using appropriate tools (Excel, R, Prophet, etc.).
  - Create input/output structure with clear documentation.
  - Inputs would be the choice of model points, business mix, distribution channels, assumptions, etc.
  - Output shall be the key metrices to be used for decision making e.g., profit margin, NB strain, etc.

- Test and Validate the Model:
  - Conduct logic checks: verify outputs respond correctly to input changes.
  - Perform sensitivity testing to key assumptions.
  - Compare results with historical data or other benchmark models.

- Peer Review:

  - Ensure another actuary or qualified team member reviews the model.
  - This helps to identify design flaws or incorrect logic.

- Documentation and Governance:
  - Maintain detailed records of methodology, assumptions, and limitations.
  - Version control and audit trails must be followed.

(Max 5)

d)

- Use reliable data sources like insured population or reinsurer tables.
- Reinsurer-supplied data may need adjustments to reflect ABC Life's target segment.
- Incidences as per data source must match defined illnesses and product eligibility criteria.
- Morbidity risks vary across demographic factors like Age, Gender, and Lifestyle Adjustments.
- For ABC Life, urban middle-aged customers may exhibit specific trends.
- Survival Period Requirements - Most CI products require survival of 14–30 days post-diagnosis to trigger benefit. This should be considered and allowed for appropriately.
- Only claims meeting specific, medically defined criteria of illness should be modelled as payable.
- Declined claims due to exclusions, non-disclosure, or insufficient documentation should be reflected.
- Stronger underwriting reduces expected claim frequency. Such underwriting impact needs to be allowed for.
- Improved diagnostics may increase detected cases but also detect non-payable early-stage illnesses. Hence, medical advancements need to be considered.
- Anti-selection risks are especially relevant in India due to variable access to health diagnostics. Though this can't be priced but there needs to be provision to err on prudent side.

(Max 4)

e)

Quota Share Reinsurance:
A fixed percentage of each risk (premium and claims) is shared with reinsurer. (0.5 marks)

Advantages:
- Provides capital relief and helps manage volatility.
- Simple to administer and aligns interests.
- Enables data sharing and pricing support from reinsurer.

Limitations:
- Offers no protection from large individual claims.
- May be inefficient if low-risk policies are equally ceded.

Excess of Loss (XL) Reinsurance:
Covers individual claims above a retention limit. (0.5 marks)

Advantages:
- Shields the insurer from large claim shocks.
- Especially useful for CI where high claims (e.g., for cancer) are rare but severe.

Limitations:
- Does not reduce frequency-related losses.
- Requires careful setting of retention levels.

Stop Loss Reinsurance:

Kicks in when total claims exceed an aggregate threshold.

Advantages:
- Covers aggregate volatility – useful in early years or uncertain pricing periods.
- Supports capital adequacy during adverse experience.

Limitations:
- Pricing is higher due to tail-risk coverage.
- Requires good claims data and aggregation capability.

Recommendation:
- Combine Quota Share (to reduce average claims and improve pricing credibility) with XL (to cap large claim exposure).
- ABC Life may negotiate Stop Loss cover in first 2–3 years until credible experience develops.

(Max 7)

f) Embedded Value (EV) is defined as a measure of the economic value of an insurance company's in-force business. It represents the present value of future profits from existing policies, adjusted for the cost of capital and other risks, and gives an indication of the value of the business to shareholders.

Market-Consistent Embedded Value (MCEV) = NAV + PVFP – FCRC – CNHR − TVOG

Where:
NAV = Net Asset Value (Alternatively, ANW: Adjusted Net Worth) i.e., Assets attributable for distribution to shareholders
PVFP = Present Value of Future Profits from in-force business
FCRC = Frictional Cost of Required Capital
CRNHR = Cost of Non-Hedgeable Risks
TVOG = Time Value of Options and Guarantees

The launch of a new critical illness (CI) product can impact a company's Market Consistent Embedded Value (MCEV) in several ways, both directly and indirectly. Impact on each component is explained below:

Net Asset Value: (Likely to Decrease)
- Initial expenses (e.g. acquisition costs, underwriting costs, commission) and statutory reserving requirements are likely to result in strain, thereby reducing the NAP/ANW component of EV at the point of sale.
- The impact is particularly relevant in the first reporting period, before future profits emerge.
- However, this is typically reversed over time as profits emerge, assuming business performs as expected.

Present Value of Future Profits (PVFP): (Increase)
- The new CI product is expected to generate future profits from premiums, investment returns, and prudent pricing assumptions.
- These profits, projected and discounted using market-consistent assumptions, will increase the PVFP component of the MCEV.
- The extent of the increase depends on expected sales volumes, pricing margins, and lapse/morbidity assumptions.

Frictional Cost of Required Capital (FCRC): (Increase)

- Writing new business increases the required capital due to solvency requirements (irrespective of capital regime being factor-based or risk-based).
- This leads to higher frictional costs, as the capital cannot be freely used by shareholders and earns a lower return.
- FCRC will therefore increase, which reduces MCEV.

Cost of Non-Hedgeable Risks (CNHR): (Increase)

- Critical illness involves significant biometric risks (morbidity), which are often non-hedgeable.
- The CNHR increases to reflect compensation required by shareholders for bearing these risks, typically calculated using a cost-of-capital approach or a risk margin.
- The increase in CNHR reduces the MCEV.

Time Value of Options and Guarantees (TVOG): (May Increase)

- If the CI product includes guaranteed benefits, premium guarantees, or return guarantees, it may increase the TVOG.
- This is especially true if policyholders have options such as premium waivers or early payouts.

Overall Net Impact – Depends on Profitability & Risk

- If the CI product is well-priced, with high expected margins and manageable risks, the increase in PVFP should outweigh increases in CNHR and FCRC and the probable negative impact on ANW at onset.
- This would lead to a net increase in MCEV at the point of sale.
- However, if the product is underpriced, or if morbidity risk is underestimated, it could lead to a destruction of value.

(Max 8)

[38]

Q.2)

a) *Investment Principles:*

- To minimise risk, a company should select investments that are appropriate to the nature, term, and currency of the liabilities.
- The investments should also be selected to maximise the overall return on the assets, where overall return includes both investment income and capital gains.
- The extent to which the appropriate investments referred to above may be departed from in order to maximise the overall return will depend, amongst other things, on the extent of the company's free assets and the company's appetite for risk.

(Max 3)

b) Conventional joint-life immediate annuity:

- The benefit is likely guaranteed in money terms.
- Although it could be guaranteed in terms of an index if the benefit is index-linked.
- Look to invest in fixed income bonds.
- Or suitable index-linked bonds if the benefit is inflation linked.

- The term is until death of the second life between the policyholder and spouse.
- However, it needs to be considered that the level of payment is reduced after the first policyholder dies but the spouse survives.
- Look to match the bond term to expected liability term.
- This term would be based on expected longevity of both the lives.

- Could buy government bonds if benefits are guaranteed in nature.

- Or corporate bonds due to expectation of higher returns.
- But there may also be a higher credit risk with corporate bonds.
- There may not be assets available of long enough duration to match the liabilities depending on current age and expected term.
- There will also be an expense reserve and the expenses are likely to increase with inflation each year.
- The expense reserve in respect of this product could be matched with index-linked bonds.
- Some cash would also likely be held for liquidity purposes.

- Also, need to consider any regulatory restrictions on assets allowed to be held…
- …and assets allowed to contribute to solvency calculations.

(Max 5)

c) Conventional with profits whole life assurance:

- The benefit is partially guaranteed in money terms. This would include benefits corresponding to:
  - The sum assured.
  - Reversionary bonuses declared to date.
- For the benefits guaranteed in money terms, fixed rate bonds would be suitable.
- This should preferably be government bonds as corporate bonds, while giving expected higher yields, also carry incremental credit risk.

- Benefit is also partially discretionary, i.e., corresponding to any future bonuses.
- For such benefits, the main aim is to maximise investment return.
- This is, however, subject to the risk appetite of the fund.
- Risk appetite is governed by the amount of free assets available.
- Higher free assets allow greater investment freedom.
- Policyholders' reasonable expectations (PRE) should be considered for what investments the customers expect.
- This will be based on what the company has said in sales and other product literature.
- Equities and property are likely to be chosen to back this part of the benefit as they offer potential of higher long-term returns.
- Though the mix will change as the policy moves through its term and a greater proportion of the benefits are guaranteed.

- The term should match the expected term of the life assurance i.e., until policyholder death given this is a whole-life product.
- This will also depend on product features e.g., some milestones where customer can take maturity benefit while continuing the death cover.

- Some liquidity will be needed to meet guaranteed costs as they fall due. For example – surrender benefits.
- Hence, the assets held should include an element of liquid assets such as cash or near cash instruments.

- There will also be an expense reserve and the expenses are likely to increase with inflation each year.
- The expense reserve in respect of this product could be matched with index-linked bonds.

(Max 8)

[16]

Q.3)

- A Value at Risk (VaR) approach is normally expressed at a minimum required confidence level over a defined period of time

E.g., a 99.5% confidence level over a one-year period.
- The supervisory balance sheet is subjected to stress tests (shocks) on each of the identified risks.
- … at the defined confidence level and over the defined period.
- For regulatory disclosures the confidence level and period may be pre-defined.
- Alternatively, the confidence level and period may be determined by the company's own risk appetite.

- The surplus is then recalculated at the end of the period.
- And discounted back to time zero using an appropriate discount rate.
- The supervisory balance sheet and the surplus are normally on a market consistent basis.

- Applying stress tests to each different risk factor gives a capital requirement for each separate risk in isolation.
- The individual capital requirements for each risk need to be combined in a way that reflects any diversification that exists between the various risks (i.e., the degree to which individual risks are correlated).
- The sum of individual risks will usually be greater than the diversified risk.
- Diversification benefit can be done through the use of correlations matrices or by copulas.
- Correlation matrix may be specified by regulator.
- When using a correlation matrix, it should be noted that under the extreme event conditions being tested, correlations may differ from those observed under normal conditions.
- Also, a combination of a certain subset of events happening at the same time may produce a higher capital requirement than combining all of the individual capital requirements (at the same probability level) using a correlation matrix.
- This is caused by non-linearity and non-separability of individual risks where non-separability is the way in which risk drivers interact with each other.
- Typically, stochastic models are used to quantify the capital requirements for economic risks.
- The probability distribution used should properly reproduce the more extreme behaviour of the variable being modelled - both in size of the tail of the distribution and, where appropriate, in the path taken during the simulation period
- A 'real world' asset model would typically be used for capital requirement projections, and this should be arbitrage free.
- It is generally appropriate to calibrate these models with reference to actual historical parameters.
- But advanced techniques may be required to ensure appropriate fit to the tail of a distribution to ensure that the distributions do not understate the frequency of more extreme events.

(Max 8)

Q.4)

a)

Government of India:

- Launch or expand premium subsidy schemes like PMJJBY or PMFBY for eligible populations.
- Provide solvency relief for insurers offering inclusive products, perhaps through capital requirement exemptions.
- Offer distribution support through integration with existing schemes like Jan Dhan Yojana.
- Invest in financial literacy campaigns and rural awareness programs using panchayat-level resources.
- Allow regulatory flexibility in product design and commission structures for microinsurance.
- Establish centralized claim verification and disbursement platforms to reduce fraud and delays.

Suraksha Jeevan Insurance Ltd.:

- Use low-cost digital onboarding and multilingual mobile platforms.
- Partner with MFIs, SHGs, and NGOs to enhance trust and reach.
- Design products with modular benefits to cater to varying affordability levels.
- Implement claim tracking systems for faster settlements.

- Offer small incentives for persistency (e.g., bonus cover or discount for timely premium payments).
- Regularly evaluate sales quality to prevent mis-selling and improve persistency.

(Max 4)

b)

- Anti-Selection Risk: Minimal underwriting increases the chance of unhealthy lives purchasing insurance. Higher actual mortality than priced or reserved for can cause statutory reserves to be inadequate.

- Data Deficiency Risk: Lack of reliable mortality or health data for rural populations impairs assumption setting. Statutory reserves based on weak assumptions could significantly underestimate liabilities.

- Fraud Risk: No medical tests may lead to fraudulent declarations at proposal stage. Undetected fraud inflates future claims beyond statutory reserve expectations, resulting in loss to revenue account.

- Higher Early Claim Rates: With lenient underwriting, there can be high early claims. Statutory reserving may not anticipate concentrated early payouts, causing strain.

- Adverse Lapse Experience: Inconsistent premium payment patterns in rural markets could cause unexpected lapse behaviour. Higher lapses among good lives and persistence of bad lives skews morbidity/mortality assumptions.
- Expense Risk: Servicing and collection costs due to rural dispersal can be higher due to inconsistent premium payment patters. Statutory reserving assumes some margin for expenses; underestimation of which may result in shortfall.

- Difficulty in Setting Prudent Assumptions: Lack of credibility in experience data makes it difficult to set statutory assumptions with proper Margins for Adverse Deviations (MADs).

- Capital Strain from Regulatory Requirements: Regulator may require higher MADs for rural term products, thereby also increasing solvency margin requirements.

- Persistency and Collection Challenges: Lapse rates in rural areas are sensitive to economic conditions, premium adequacy, and customer servicing ability. Irregular income patterns in rural areas impact premium persistency, which can affect profitability and reserve adequacy over time.

- Reinsurance Dependency: Heavy reliance on reinsurance to manage mortality volatility could create counterparty risks if not structured carefully, which is not usually reserved for.

- Management Bias Risk: Given new offering and penetration into new market, management may be under pressure to show lesser strain at launch. This may influence valuation assumptions to be on optimistic side.

(Max 8)

c)

<u>Advantages:</u>

- Reduces new business strain by receiving upfront capital while deferring costs.
- Enhances solvency margins in the short term, aiding aggressive product rollout.
- Spreads risk over future profits rather than immediate capital deployment.
- May involve reinsurer expertise in pricing, product design, and experience monitoring.

<u>Disadvantages:</u>

- Locks in future profits, limiting flexibility to use profits for other strategic initiatives.
- Complex structures may lead to regulatory concerns or require detailed disclosures.
- Success depends heavily on accurate profit projections—volatility in claims or lapses could disrupt cashflows.

- If not structured transparently, may damage market perception or solvency if misaligned with actual performance.
- The actual relief in capital will depend on how this arrangement will impact the reserves as per the applicable regulations.

(Max 4)

d)

- Set up key performance indicators (KPIs).
  E.g., early claims ratio, persistency ratio, premium collection efficiency.
- Define risk tolerance thresholds for anti-selection and geographic concentration of claims.
- Establish a real-time MIS dashboard for claim tracking by distribution channel.
- Similar MIS for lapsation as well.
- Perform early experience studies and validate assumptions against emerging data.
- Undertake claims audits and fraud detection mechanisms, especially in regions with unusual patterns.
- Reassess pricing and underwriting annually and feed into the Financial Condition Report (FCR).
- Collaborate with reinsurer for independent monitoring and joint audits.
- Review capital strain projections under various economic and claim scenarios.

(Max 4)

[20]

Q.5)

a)

- The application forms.
- Medical examination reports.
- Reports from the applicant's doctor.
- Reports from paramedical professionals (e.g., nurses).
- Diagnostic test results (e.g., blood tests, ECGs, etc.)
- Information from reinsurance underwriters.
- Information from industry bureaus/databases.
- Information from social media (e.g., drinking, smoking, engaging in adventurous activities, etc.)
- Information from smart watches.

(Max 3)

b)

- Accept at standard rates.
- Accept at increased premium/rating.
- Postpone the application for further medical information or wait for medical condition to stabilize.
- Apply exclusions (i.e., exclude certain conditions or causes of claim).
- Offer differential terms (e.g., a lower sum assured).
- Decline the application.

(Max 3)

c)

- Cap the sum assured: This reduces the financial exposure on each life, making it more manageable to absorb unexpected claims.
- Apply waiting periods or deferred benefits: Claims arising within the first 1–2 years could be excluded or limited to premiums paid, discouraging those seeking short-term benefit.
- Restrict availability: The product could be offered to a selected and pre-screened group (e.g., affinity group members or existing customers) to control exposure.
- Claims-stage underwriting: Conducting additional checks at claim stage can help detect non-disclosure or fraudulent claims.
- Limit policy term or avoid guaranteed renewability: This allows the company to reassess the risk periodically and avoid locking into adverse selection.

- Include pricing margins: Recognizing the risk of higher-than-expected claims, the pricing should include margins to absorb losses or deviations.

- Ongoing experience monitoring: Claims and lapse experience should be closely monitored to trigger timely revisions in pricing or underwriting policies.
- Align with reinsurance criteria: Ensure product features and underwriting approaches meet reinsurer standards to secure favourable terms and external risk support.
- Use simplified health questionnaires: Limited but targeted questions can catch high-risk cases.
- Demographic premium variation: Use smoker/non-smoker, age, or occupational banding to reflect risk.
- Allow periodic re-pricing: Especially for long-term policies with flexible terms.
- Restrict to direct channels: Minimizes agent mis-selling and maintains control.
- Bundle the product: With mortgage or group products to improve overall selection.
- Define product specific KPIs: Monitor claim ratios, early claims incidence, and non-disclosure rates.

(Max 12)

[18]

**********8**