

# **INSTITUTE OF ACTUARIES OF INDIA**

## **EXAMINATIONS – May 2009**

**SUBJECT: SA2 - LIFE INSURANCE SPECIALIST  
APPLICATIONS**

### **INDICATIVE SOLUTIONS**

## Question 1

### a) Asset liability matching issues

- the main problem is that this is a *regular* premium contract
- we cannot know the rates at which future premiums can be invested
- the future investment income arising over the policy term also has to be reinvested on terms that are not known at the time of pricing the product
- a single premium product would avoid the problem of investing future premiums, but would still have the problem of reinvesting the future investment income
- the investments backing such a product would be nearly all be fixed interest securities and deposits of a suitable term, with no equities or very little equity exposure
- the shorter the premium term, the shorter the time for which the company is exposed to interest rate risk
- the five year premium term is therefore a less risky option than if the premium term had been set at 10 years
- initial expenses and commission have to be met out of the first year premium and so the proportion of the premium invested is least at the time when the level of interest rates is actually known
- for annual premiums, the company will actually be exposed for only four years
- for monthly premiums, the exposure will be four years and eleven months etc
- in setting the rates the actuary will have to take a view on how the yield curve will evolve over the premium paying term of the policy
- need to consider the stage of the economic cycle and whether rates are more likely to go up or to go down
- to be conservative, the actuary will have to allow for the possibility that interest rates will fall over the premium paying term
- if the actuary is not conservative enough, the accumulated premiums will not be enough to pay the sum insured and the guaranteed additions
- if it turns out that the actuary has been too conservative, then the company will make excess investment profits, but policyholders will feel they have been given a poor deal
- persistency experience will tend to aggravate the investment risks, if interest rates fall, rational policyholders will pay all their premiums, but if interest rates rise, policyholders will be attracted to new higher yielding opportunities

Ways in which the impact of asset liability management issues might be reduced:

- make the product a single premium one, or reduce the premium term below five years
- consider annual premiums only, avoid monthly and quarterly premiums
- consider unequal premiums, with the premiums in the earlier years being larger
- incorporate some kind of final addition on maturity, like a terminal bonus, with which to absorb the uncertainties in investment returns while still giving policyholders good value
- set the rates of guaranteed addition to reflect actual investment experience i.e.

- average earnings on reserves
- or, relate the guaranteed additions to each premium paid, and the yields available at the time that premium was paid
  - restrictions apply on derivatives, but it may be possible to arrange swaps to lock in future interest rates
  - Alternatively the adequacy of the pricing could be verified by using stochastic techniques
  - Policy and asset related cash flows would be modeled with the latter being driven by a predetermined investment policy
  - Allow for defaults if corporate bonds are envisaged
  - Ideally policyholder behaviour should also be taken into account especially the possibility that surrenders might increase should interest rates increase and asset values are depressed
  - The profit margins will vary by scenario
  - The pricing of the product should be adjusted until the average profit margin across the scenarios is acceptable
  - The variability in profit margins is also a factor to be taken into account consistent with the company's tolerance for risk
  - The profit margin and its variability will be determined by the investment policy assumed and this can be adjusted to produce an optimal outcome from the company's perspective.

Reserving issues are also relevant:

- Starting point for reserving is the gross premium method as prescribed in the Regulations
- Allowance for MADs in accordance with GN7 paying particular attention to investment scenarios
- Could supplement this approach with stochastic assessment
- Project policy and asset related cash flows starting with assets equal to proposed level of reserves
- Determine a criteria for 'failure' eg could be negative residual assets at end of projection period or market value of assets less than cash value at any point
- Determine an acceptable number of failures (percentile approach) or extent of loss (conditional tail expectation)
- Adjust initial assets as necessary so that extent of failures is acceptable
- Alternatively or additionally, modify investment policy if this produces a better reserving outcome.

**b) Discuss marketing manager's proposed variations.**

Loyalty addition:

- this method works by passing some of the investment risk back to the policyholder
- the guaranteed additions are prospective, but the loyalty addition can be set with hindsight
- if the loyalty addition is to be an allocation of surplus then the product may be participating instead of non participating
- this would trigger various regulatory provisions applicable to participating

- products particularly restrictions on shareholder profit margin
- the actuary can take a conservative view and set the guaranteed additions at a low level, knowing that if investment returns turn out to be better, then this can be reflected in a higher loyalty bonus
  - to set the rate of loyalty addition, the actuary would have to reconstruct the investment performance of each block of 10 year policies
  - each block would be either a full year's new business, or at least a block of business issued during a period during which yields were reasonably stable
  - if segregated assets have not been held for the block of business, then construct a notional asset portfolio to which historical premiums are added
  - compare the portfolio yields each year with those assumed in setting the rate of guaranteed addition
  - hopefully there won't be a shortfall, and the excess can be accumulated to the end of the ten year term
  - express the accumulated excess as an addition per Rs 1,000 sum insured

Guaranteed additions determined each year:

- this is a more like a linked product, where the returns are more directly related to the performance of the underlying assets
- the risk to the company is reduced because the guaranteed additions are determined retrospectively when the investment result is known
- the actuary doesn't need to set aside any margins for unknown future returns
- specify the method as precisely and simply as possible to help make it clear that the product is non participating
- there are at least two ways of setting the rate of guaranteed additions
  - the average rate earned on policy reserves from year to year
    - a segregated asset portfolio needs to be maintained, or else a notional portfolio of assets considered
    - the average annual rate of investment return is re expressed as a percentage of sum insured payable at maturity
    - for non participating business, need to remove the effect of deaths, lapses, surrenders from the portfolio
  - the prevailing rates at which each premium can be invested
    - e.g. the second annual premium would be (notionally) invested at the prevailing rate for nine year fixed interest investments
    - need to allow for expenses and that the whole premium is not available for investment (especially in the first year)
    - need to allow for reinvestment risk
    - need to convert the rate based on premium to an accumulated amount expressed as a percentage of sum insured

### c) Par and non par business

ActEd course reading:

With-profits

A life insurance contract is with-profits if the policyholder is entitled to receive part of the surplus of the company. The extent of the entitlement is usually at the discretion of the company, subject to being consistent with the company's Principles and Practices

of Financial Management.

Without-profits

A life insurance contract is without-profits if the life insurance company has no discretion over the amount of benefit payable, i.e. the policy document will specify at outset either the amount of the benefits under the contract or how they will be calculated.

IRDA (Actuarial Report and Abstract) Regulations 2000:

- (i) “non-par policies” or “policies without participation in profits” means policies which are not entitled for any share in surplus (profits) during the term of the policy;
- (j) ....
- (k) ....
- (l) “par policies” or “policies with participation in profits” means policies which are not non-par policies as defined under clause (i);

IRDA (Registration of Insurance Companies) Regulations 2000

- (i) “linked business” means life insurance contracts or health insurance contracts under which benefits are wholly or partly to be determined by reference to the value of underlying assets or any approved index;

Solution:

- Forms DD, DDD, DDDD and NLB1 have to be completed separately for products “with participation in profits” and for products “without participation in profits” ]
- for linked business, the investment returns are credited directly to the policyholder through the unit price, the investment returns do not form part of surplus

Original product with guaranteed additions determined at outset:

- if the benefits under this policy are guaranteed at outset then there is no element of surplus being shared and the product should be classified as non participating

Loyalty addition:

- the loyalty addition mentioned is quite vague and there is no indication about how it will be determined
- in practice it may be difficult to determine such a loyalty addition precisely for each policy and the company seems to have discretion about how it will be set between policies and from year to year
- this would indicate that there is unallocated surplus in which the policies will share and that the product participates in profits
- if the loyalty addition is a very small part of the total guaranteed additions then it might not be material and perhaps the product could still be classified as non-participating

Guaranteed additions determined each year:

- if the company decides to determine the guaranteed additions after each year with reference to the actual investment returns achieved, then this is like a linked policy and there is no element of surplus

- the method of setting the guaranteed additions should be clearly specified so it is obvious that investment earnings are fully allocated and that there is no residual surplus to be shared

**d) Benefit illustrations**

- the prescribed benefit illustrations are designed with traditional participating business or unit linked business in mind, showing the base guaranteed benefits, and illustrative non guaranteed benefits which would arise if the investment returns were 6% and 10% gross
- these are not intended to be indicative of what the returns might be, the two rates are provided to show that there is a range of possible outcomes and that the range is large
- in spite of the required warning that these are not upper and lower limits, there is a real possibility that they will in fact create a PRE
- to have any real prospect of achieving 10% gross you would have to have a significant equity holding
- but the asset allocation demanded by ALM issues will be practically 100% fixed interest
- using a 10% illustrative rate may therefore create PRE which cannot be met

Original product with guaranteed additions determined at outset:

- the benefits are fully guaranteed and should be shown as such
- the 6% and 10% illustrations are not required

Loyalty addition:

- the loyalty addition will be set at the end of the policy term, when the actual investment experience is known
- depending on the investment policy and asset allocation followed, the actuary would be able to form a view on the likely range of investment returns that might be achieved
- if these are different (i.e. lower) than 6% and 10% then the regulations allow such lower rates to be used
- there is a danger that by moving from the neutral 6% and 10% to some other rates, the company will be signaling that the new rates are in fact an expectation of likely results
- the 6% and 10% columns would be identical right up to the last year which would show loyalty additions corresponding to 6% and 10% overall earnings
- or, the 6% and 10% columns could be dispensed with and the 6% and 10% values simply shown in a footnote

Guaranteed additions determined each year:

- under this proposal the rates would be set each year when the actual yield for that year is known
- the considerations are similar to those for the loyalty addition variant
- a return of 10% pa looks very unlikely in current conditions

**e) Reply to policyholder on surrender value**

(This letter is longer than a candidate could produce in the time available, but the main points should be brought out in prose.)

Dear Mr Policyholder,

Thank you for contacting us about the surrender value of your policy No 123456. The company takes customer complaints very seriously and I invite you to discuss any aspect of this complaint with me personally.

Life insurance contracts are long term in nature and the insurance company has fixed obligations which it cannot avoid. In contrast, policyholders have the option to break out of the contract at any time, either by not paying premiums or by surrendering the policy. The insurance company makes financial arrangements and investment decisions so that it can be sure of meeting its contractual obligations. When a policyholder breaks out of the contract, the insurance company is exposed to losses and the company designs termination conditions to protect itself.

The product you purchased has two characteristics which determine the surrender value we can pay:

- the policy provides very strong investment guarantees,
- there are no establishment costs of any kind, and the company recovers its expenses over the entire policy term.

When you pay each of your premiums the company invests them in high quality debt instruments like Government of India securities, according to a program we carefully devise so that the investment matures at the right time, and with sufficient proceeds to pay the benefits we have promised you. If we have to sell such investments prematurely to pay a policyholder a surrender value the proceeds depend on the market value of the investments at that time. In current conditions the market value of such instruments is less than their book value and we had to make a “market value adjustment” to your surrender value. In your case the market value adjustment was 15% of the notional value.

The other characteristic is the recovery of expenses over the term of the policy, especially the establishment expenses we have incurred. In common with almost all businesses, these include fixed overhead costs and variable costs of sale (commission). Commissions are limited by government regulation, and for your policy amounted to 10% of the first year premium, which is equivalent to 2% of every premium. As you had paid two premiums, the company has not been able to recover 6% out of the 10% commission paid. The company also needs to recover a further 6% of other fixed overhead costs which cannot be recovered.

There are further technical matters and a complicated formula is used in the calculation of the surrender value, but simply expressed your surrender value was represented by:

- the two premiums you had paid
- plus 9% investment earnings on the first premium and 6% investment earnings on the second premium
- less 15% market value adjustment
- less 12% unrecovered initial expenses

which totals  $(200\%+9\%+6\%-12\%) \times 85\% = 172\%$  of the annual premium. **[1 point for some simple reconciliation]**

Yours sincerely,  
Appointed Actuary

**f) Categories of risk**

- Credit risk  
A major issue if the reserves are invested in corporate bonds so as to increase the yields above those on risk free government securities.
- Market risk  
A major issue which makes it imperative to have a sound asset liability matching strategy.
- Liquidity risk  
A minor risk.
- Operational risk  
The asset liability matching program has to be implemented reliably, regularly and on time throughout the entire policy term.
- Insurance risk  
Mortality risk is relatively minor with an investment product like this one.
- Group risk  
Not a relevant risk at the product level.

**g) Sources of surplus**

- changes in valuation assumptions
  - Change in the valuation interest rate will have a big effect for the non par product. Other assumptions such as expenses or mortality will have similar effects for both the non par product and unit linked products.
- actual vs expected investment return
  - For this non par product, investment will be the major source of profit or loss, probably far greater than any other source
  - For unit linked business, where the investment risk is taken by the policyholder, investment returns are not a source of profit (except to the extent that fund management charges will be slightly larger if the fund growth is higher than expected)
- actual vs expected expenses
  - similar impact for both non par product and unit linked product
- actual vs expected mortality
  - similar impact for both non par product and unit linked product

- actual vs expected withdrawals
  - the non par product must have a market value adjustment
- actual vs expected charges under unit-linked and accumulating with profits contracts
  - The surplus is the expected charges less the actual charges
  - It may be possible to increase expense and mortality charges with unit linked contracts, but not for the non par product.
- actual vs expected tax
- new business.

[50]

## Question 2

### a) Realistic Capital

- Realistic capital - difference between market value of assets and liabilities
- MV of assets usually directly observed
- MV of liabilities estimated using market-consistent techniques.
- Liability cashflows are valued in line with the traded assets they most closely resemble.
- Where no exact traded price exists use combination of option pricing techniques and interpolation or extrapolation between or from the prices that do exist.
- Ensure no arbitrage is introduced i.e. switching between asset classes appears to create value.
- Short cuts and alternative approaches (e.g. certainty equivalent valuation, risk-neutral valuation and state-price deflators) used to make process easier.
- Any valuation which values cashflows in line with market prices is usually said to be market consistent.
- Insurance cashflows also subject to non-market risks e.g. variations in mortality rates
- Allowance for these risks is a complex area - consideration to be taken of the distribution of losses
- Economic theory indicates that starting point for diversifiable risk is a set of best estimate assumptions.
- With-profits business will need to allow for dynamic approaches to setting bonus rates
- Bear in mind TCF
- Model the interactions between the liabilities and the assets of the company
- Realistic capital can be used to define the shareholder capital that is actually locked in the company
- For a with-profits fund, determination of the ownership of capital within the fund between shareholders and policyholders will also be required.

### b) 'Economic Capital' and 'Regulatory Capital'

- *Economic Capital* - assessment of assets required in excess of liabilities so that

allowing for all risks claims can be met with a high degree of certainty

- How high is an outworking of the insurer's own risk appetite
- Irrespective of any internal Economic Capital assessment, *Regulatory Capital* the amount of capital required to meet its Regulatory solvency requirements
- Economic capital for non-diversifiable risks calculated by projecting Realistic Capital over a number of scenarios
- The more Economic Capital the fewer 'failures' i.e. negative projected Realistic Capital and there is a tolerance limit for the number of failures
- Two approaches - stochastic modelling and stress tests
- Stochastic modelling - project the realistic capital across a large number of "real world" scenarios.
- Especially investment scenarios but could be applied to mortality as well
- Stress test applied to realistic capital - where the distribution of a risk is less clearly understood,
- Need to consider impact of inter-dependencies to develop the overall economic capital requirement for the company.
- Under each approach need to consider time horizon
- No correct answer
- If risks to can be managed through capital markets, adopt a shorter time horizon - assume exposures can be hedged.
- Where risks are illiquid look at economic capital requirements over a longer time period.
- Current RSM requirements in India are based on simple factors applied to reserves and amount death benefit at risk
- Lack risk sensitivity and anomalous - greater capital requirements for more prudent reserves
- No allowance for default risk
- Also a failure can be considered to be a failure to be able to meet specific - significant practical difficulties – nested projections.

#### c) **Liquidity risk**

- Management of risk arising from short-term cash flows,
- Not the risk arising from longer-term matching of assets and liabilities (which is taken as part of insurance risk)

#### d) **Controlled Funds**

- Expression Controlled Funds defined in the Insurance Act 1938 to be all funds of an insurer that carries on no other classes of business
- IRDA Investment Regulations state that the IRDA has determined that assets related to Pension, Annuity, and all classes categories of Unit Linked Business shall not form part of Controlled Funds
- Investment Regulations specify constraints as to how Controlled Funds should be invested
- Different constraints apply to Pension and General Annuity Business

- The segregated funds for Unit Linked Business are to be invested in accordance with the pattern of investment selected by unit linked policyholders.
- Summary of the Controlled Fund investment limits:

Security Class	% of controlled funds
G Sec	At least 25%
G Sec and other Approved Securities (i.e. G Secs and other securities with various form of Central or State Government guarantee)	At least 50%
Infrastructure / social sector investments	At least 15%
Approved Investments and Other Investments where Approved Investments are defined in the Act and Regulations to include a range of debt instruments, shares and property	Not more than 35% of the fund with Other Investments not to exceed 15% of the fund

- Prudential / exposure norms apply to individual holdings

#### e) Liquidity Assessment

- Liquidity would be aggravated by immediate demands from policyholders exercising options such as surrender or switching investment options.
- Need to consider abnormal cash demands relative to cash on hand or generated by sale of investments
- Need to develop policyholder scenarios
- Consider activities of corporate agents advising 'their' clients
- Consider time frames – 30 day, 6 months, one year
- Consider extent of policyholder demands in these timeframes
- Consider ability to realize investments - consult with Chief Investment Officer
- Unit linked less problematic unless illiquid assets held; whatever is realised can flow through to unit prices
- But beware of unit pricing operational risks when transaction volumes are abnormal
- Certain mandated investments in Controlled Funds could be problematic
- Express results in terms of coverage of cash demands from realisable assets over time frames and under scenarios
- Extreme would be mass surrender of existing policyholders

#### f) GN3 - ability of an insurer to withstand change.

- Changes in:
  - external economic environment
  - experience of the insurer
- Combined effect of a change in two or more related assumptions may be more important than a change in any one of them in isolation.
- Address actions for dealing with the particular circumstances
- Make suitable recommendations.

- Detail the methods and assumptions that have been used
- Distinguish between
  - Important assumptions and those which are less important assumptions
  - Those within the insurer's control and those which depend on the external situation.
- Vigilance:
  - Concentration of assets in particular risk areas
  - Assets containing unusual provisions
  - Sources of new business with unusual characteristics;
  - Impending major claims or litigation
  - Risks arising out of product literature or policy documentation;
  - Loss of a distribution channel;
  - The impact of options and guarantees in the insurance liabilities

**g) Five Scenarios**

No correct answer – but scenarios should be reasonable in the circumstances and cover the broad range of factors likely to be relevant including an awareness of relationships.

<b>Primary scenario driver</b>	<b>Consequences to be modelled</b>
Continued fall in equity values	<ul style="list-style-type: none"> <li>• Reduced ULIP sales in particular</li> <li>• Increased lapses and assertions of market misconduct</li> <li>• Reduction in bonus rates</li> <li>• Loss of FMC charges on in force book</li> <li>• Increased unit costs</li> </ul>
Loss of corporate agencies	<ul style="list-style-type: none"> <li>• Reduction in sales from channels concerned</li> <li>• Increased unit costs in respect of remaining business</li> <li>• Increased lapse rates as servicing attention diverted</li> </ul>
Shortage of capital	<ul style="list-style-type: none"> <li>• Consider most effective management responses in circumstances</li> <li>• Strong focus on discretionary costs</li> <li>• Review of product design especially capital efficiency</li> <li>• Curtail new business</li> </ul>
Customer strain	<ul style="list-style-type: none"> <li>• Reduced overall sales generally</li> <li>• Reduction in average policy size</li> <li>• Increase in surrenders</li> <li>• Switching to more conservative investment options</li> </ul>
Government stimulus	<ul style="list-style-type: none"> <li>• Immediate improvement in equity values and stability of bond markets</li> <li>• Potential increase in tax rates to fund deficits</li> <li>• Potential higher interest rates – downwards pressure on bond values</li> <li>• Potential higher inflation – impact on costs</li> </ul>

**h) GNs 1 and 2**

- Advise the company of any proposed action or situation outside the control of the company that materially threatens solvency.
- Responsibility to look after the reasonable expectations of policyholders
- Make sure that the company appreciates the implications of significant change on its policyholders' reasonable expectations.
- Consider all aspects likely to affect the financial condition of the company including:
  - Premium rates and charges
  - Nature of contracts particularly options and guarantees
  - Investments and continuing investment policy
  - Rate of return on investments in terms of capital and income over the future lifetime of the liabilities.
  - Expected volumes and costs of sales
  - Future level of expenses
  - Extent of company's free assets
  - Future level of persistency rates,
- Especially where new business is being written on inadequate terms consider the company's ability to continue to write new business in the context of how much capital is required
- Indicate if need be the limits on the volume of sales that may prudently be accepted and/or how much capital is required
- Gain reinsurance from the Board of Directors that the required level of capital will be available and not earmarked for other purposes.
- Ensure that the ratio of the available solvency margin to the required solvency margin is reasonable taking into consideration the risk profile of the assets and liabilities.
- Where potential insolvency could arise from
  - factors within the control of the company, advise the company it of the limits within which it must act and why.
  - factors outside the company's control, take whatever action he/she considers necessary including that of communicating to IRDA after due deliberation with the Board of Directors.
- Recall that it is a professional duty to make timely disclosures both to the company and to the Authority about the financial viability of the insurer.

**[50]****[Total 100 marks]**

\*\*\*\*\*