

Institute of Actuaries of India

Subject SA6 – Investment

May 2013 Examinations

INDICATIVE SOLUTIONS

Solution 1 :-

- i. The company is exposed to various risks as given below:
- a) Reinvestment risk
 - b) Parallel shifts in yield curve
 - c) Non-parallel shifts in yield curve
 - d) Duration mismatch risk
 - e) Basis risk / Spread risk
 - f) Interest rate gap risk, liquidity gap risk

However the main risk is reinvestment risk on the future renewal premiums. Interest rates may drop in the future leading to the renewal premiums earning lower than the guaranteed rate of interest.

The risks arise because there is a duration gap or mismatch between assets and liabilities. Lack of assets with long term duration and which also give matching guarantees on future investments would lead to exposure to interest rate risks.

Thus the ALM would require estimating the parallel shifts or otherwise of the yield curve and its impact on the assets and liabilities.

In the Indian market the long term government securities are not available beyond 30 years maturity and such securities can only serve to hedge the interest rate guarantee on the first premium when reserves are very small.

Also the market risk is not only pertinent for maturity value guarantees; it becomes more risky if there are guarantees on surrender values as well (even though they can be partly mitigated by the surrender penalties).

(4)

- ii. The recurring deposits offered by banks also guarantee the interest rates on future deposits / investments to be made thus creating a good ALM match for the guarantees on future renewal premiums.

The duration of such deposits because of future reinvestment rate guarantee becomes higher and when there is a lack of long duration assets it serves to be a good match for the long term liabilities with reinvestment risks.

The other possible instruments for such long term liabilities are long term government securities (30 year maturity or longest term to maturity available). Corporate bonds for such long terms are not available. Currently the longest term government security available has 28 years maturity term. This can be a good investment considering liabilities are also long term however it helps lock the interest rates for the current premiums only and the reinvestment risk on future premiums still remains.

(3)

iii.

- a) The callable bonds come with an in-built call option to the issuer of the bonds wherein he can call the issue off if the interest rates decline significantly. It thus gives the issuer an option to purchase back the bond after some time period at a pre-determined price. (1)
- b) Effective Duration is used to measure the price volatility of debt instruments (government securities or other bonds). It gives the average change in the price of the bond due to change in interest rates/yields. The formulae is given as follows:

$$(P1 - P2)/(P0 \times 2 \times \Delta i)$$

where Δi is the change in the interest rate/yield

$P0$ is the base (original) price

$P1$ is the price when interest rates / yields drop by Δi

$P2$ is the price when interest rates / yields increase by Δi

Macaulay duration is the discounted mean term of the bond and gives the average term to maturity for the bond cashflows weighted by the present value of the cashflows given by the following:

$$\frac{\sum (\text{PV of each cash-flow} \times \text{term or time for the cash flows})}{\text{Current Bond Price}}$$

$$\text{Where current bond price} = \sum (\text{PV of all the cashflows})$$

Modified duration like effective duration measures the sensitivity of the bond price to changes in interest rates (yields) with the only difference that all cash-flows are considered while calculating the price and any option (call option etc) are ignored for such pricing. Modified duration = Macaulay duration / (1 + i) where i is the current bond yield. (3)

- c) The effective yield allows for the call option or any other option on the bonds which means while considering the up price or the down price if the cap on price is reached (due to the embedded option) then the formulae of the Effective duration uses the capped price or floor at which the option would be exercised. [Please see the solution of question number D (v) below] (2)
- d) If the interest rates fall at the time when the issuer has an option to call back the bonds then the price of the bond which should have otherwise shown an increase will not behave in the same manner since the issuer has

a right to buy-back the same at the pre-determined price communicated at the time of the issuance. Hence the price of the bond will show negative convexity after some time wherein the increase in price of the bond due to drop in interest rate will be much tapered and would become fixed (once it touches the pre-determined price) for very high / low interest rates. (1)

- e) For investors the risk is that the bond may be called back when interest rates fall and hence the upside in the price is limited. The investors are like writers of the option and run the reinvestment risk when such bond would be called off and the investment amount is returned to them by the issuer to be reinvested only at lower rates prevailing at that point of time. (1)
- f) Coupons are given at pre-determined time periods and they need to be reinvested when received to create a match with longer term liabilities where the payout is largely deferred till maturity. Thus the higher coupons add to reinvestment risk wherein if the interest rates are lower when coupons are received then we may have to lock the new reduced rates on the coupon money. In case of the company the guaranteed returns given to customers are on the maturity (long end fixed liabilities) whereas new premiums and coupons will need to be reinvested. On the other hand the duration reduces if the coupons are higher in size (zero coupon will have the longest duration) which means the interest rate risk reduces with increase in coupon size. (1)

iv.

- a) The price of the g-sec is calculated as the present value of the cash-flows to be received

Coupons of Rs 90 are received for 28 years along with final payment of face value of Rs 1000 after 28 years. Thus the present value of cash flows is equal to:		
90× Present Value Interest Factor for Annuity (PVIFA for immediate annuity) for 28 years at 8% + Present Value of 1000 (to be received after 28 years, at 8%)		
PVIFA factor = $((1+0.08)^{28}-1)/((1+0.08)^{28}*0.08)$		
Thus PVIFA factor =	11.05108	
Thus we get $90 \times 11.05108 + 1000/(1.08^{28})$		
994.5971	+	115.9137 = 1110.511

(2)

- b) The risks on yields making an upward or downward parallel shift arises if the durations of assets and liabilities are not matched. The price change in assets and liabilities is approximately equal to their duration times the

change in the yields. Thus if yields drop by 100bps where assets have a 10 year duration and liabilities have 20 years duration then the increase in the asset price will be 10% whereas the liabilities will increase by 20% thus creating a strain on the shareholders capital. (1)

c) The yields drop by 150 bps to 6.5% thus new price of the bond is equal to

Coupons of Rs 90 are received for 28 years along with principal investment of Rs 1000 after 28 years.		
Thus the present value of cash flows is equal to:		
90× Present Value Interest Factor for Annuity (PVIFA for immediate annuity) for 28 years at 6.5%		
+		
Present Value of 1000 (to be received after 28 years, at 6.5% pa interest)		
PVIFA factor = $((1+0.065)^{28}-1)/((1+0.065)^{28}*0.065)$		
Thus PVIFA factor =	12.74648	
Thus we get $90 \times 12.74648 + 1000/(1.065^{28})$		
1147.183	+	171.479 = 1318.662

Similarly when the yields increase by 150 bps to 9.5% then the new bond price would be $Rs\ 90 \times 9.6971 + 78.7779 = Rs\ 951.5146$. (3)

d) The effective duration takes into account the 150 bps change (from the base yields) in both upward and downward direction to calculate the duration as follows:

$$(1200-951.51) \div (1110.51 \times 2 \times 0.01) = 7.5 \text{ years approx}$$

Please note that callable bond price of 1200 is used instead of 1243 which is the price when the yield dropped by 100 bps (i.e. there was a downward parallel shift in the yield curve by 100 bps). (2)

e) Normally the yield curve would be upward sloping since long term rates would be higher than short term yields. However non-parallel shifts can result into yield curve becoming downward sloping. Sometimes the yields in short and long range may remain the same and the medium term rates may change thereby changing the curvature of the yield curve. Such non-parallel shifts may not be common but can happen and can impact the assets and liabilities differently depending on the term of the assets and liabilities cashflows. These risks are difficult to hedge. (1)

v. A downward sloping yield curve is considered to be an aberration from the normal since we would expect the yield curve to normally slope upwards implying that the longer term yields are higher than the shorter term. The interest

rates are higher for longer terms since the risks/uncertainties would increase as the term increases thereby seeking higher returns for longer term.

If there is a reversal in the yield curve whereby it has become downward sloping then it is abnormal and the trend in the market may be bearish. This can happen when there are more investors looking for shorter term assets. Normally longer term assets are sought by insurance companies or annuity providers and /or pension funds which have long term liabilities and are seeking longer term assets to match / hedge their liabilities. However if there is a short term liquidity crunch wherein companies, governments or other borrowers are looking to pay high interest to meet their liquidity requirements / payouts etc then the interest rates in shorter term will become higher than longer terms.

It also indicates that long term investors have lesser cash availability and hence their demand for long term assets has reduced. Such liquidity crunch or lack of investible amount with long term investors generally leads to a bearish market. The high short term rates may also occur due to central bank increasing bank rates or increasing CRR/SLR requirements thereby causing a short term liquidity squeeze. All of these indicates a bearish trend. (3)

- vi.** A high Put/Call ratio means the option buyers have higher number of puts than calls thus more option buyers seems to believe that markets may go down (thus buying more Put options). Historically the option buyers have been more incorrect in assessing the market as compared to option sellers/writers. It has been seen that the market trends in an opposite direction of the views of the option buyers.

The option writers have opposite view of option buyers (and that is the reason why they have sold the options). Most of the times Individuals are option buyers and large Financial Institutions only write options. It has been seen that the market knowledge and research by Institutional investors is much higher and hence the Institutions who are option writers are more equipped than option buyers to predict the market trend correctly.

Thus in a market with a high Put/Call ratio the Option writers believe that the markets may go up and hence they are happy to write more Puts than Calls. It has been seen that the writers predict the trends better hence a high Put/Call ratio means the market would have a bullish trend. (2)

- vii.** The investment risks increases with the following:
- Higher savings component in the product
 - Future renewal premiums, thereby increasing reinvestment risk

- Longer policy term
- In-built interest rate guarantees
- Flexibility or liquidity options such as early surrender values etc thereby making it difficult to ascertain the future cash flows and a higher possibility of mismatch between assets and liabilities

Based on the above we can give the following explanation of the product risks followed by an appropriate ranking in terms of investment risks.

- a)** Regular Premium Non-Par Whole life Assurance product with higher surrender options.

This is risky because it is very long term (whole life) and also has savings element in it. It has regular premiums thus having reinvestment risks. The non-par products have in general higher guarantees thereby increasing the risks. Also this product has more surrender options which exposes it to policyholders behaviour leading to risks of assets being liquidated to pay the surrender liabilities at an inopportune time.

- b)** Regular Premium Par Endowment Assurance for 20 years with higher surrender options.

This is again risky for various reasons like it has regular premium payment (reinvestment risks) for sufficiently long term and has savings element. There are also higher surrender options making it exposed to interest rate risks.

- c)** Regular Premium Term Insurance for 25 years

This one has lower risks since savings component is low but still some risk is there since in the initial years the premiums would be higher than the claims thus small reserves would be created.

- d)** One year Renewable Group Term Insurance product

This one may have the lowest risk since it has no savings component, it has very short term (1 year) and no future premium reinvestment risk etc.

- e)** Single Premium Endowment Assurance for 20 years

Single premiums have in general lower risks than the regular premium products (though savings element is higher and all are received together) since the premiums are received upfront as Single premium and a good Asset Liability management can be carried by investing the

premiums into long term assets available (thus the liabilities can be hedged better). However in case this product is a Non-Par single premium it would carry significant guarantees and must be classified as risky from investment point of view. If it is a Single Premium Participating product with low guarantees the risks will be significantly lower.

f) Regular premium Par Endowment Assurance for 20 years with lower surrender options

This one has similar risks as explained for number (ii) above however since surrender options are fewer, the risk is lower than the number (ii) which has much higher surrender options exposing to an additional risk wherein assets may have to be liquidated at an inopportune time.

g) Regular Premium Non-Par Endowment Assurance for 20 years with higher surrender options

This one again is similar to number (ii) option above but has higher risks than number (ii) since it is offered on non-par platform which has generally higher guaranteed values offered on maturity as compared to par products

h) Unit Linked Endowment Assurance for 20 years with no guarantees

This has virtually no investment risk except that the earnings from fund management charges may reduce if the investments do not perform well. All the risk are transferred to policyholders.

i) Single Premium Whole life Annuity (Non-Par platform)

This one has large risks since the term can be very long and savings component is high. However being single premium it can be matched with long term assets to reduce the risks.

j) Single Premium Annuity with Return of Premium on Death (Non-Par platform)

This has higher investment risks than number (ix) even though the longevity risks reduces as compared to number (ix).

In number (ix) the regular annuity payouts are higher since the capital is also paid back as annuities. In return of premium only the interest component is paid regularly as annuities and the premium component is retained for longer period and given only on death. Thus a large

component is retained for longer period exposing it to more interest rate volatilities.

The ranking of the products from most risky to least risky keeping the investment risk into perspective is given below.

1. Regular Premium Non-Par Whole life Assurance product
2. Regular Premium Non-Par Endowment Assurance for 20 years with higher surrender options
3. Single Premium Annuity with Return of Premium on Death (Non-Par platform)
4. Single Premium Whole life Annuity (Non-Par platform)
5. Single Premium Endowment Assurance for 20 years (Assuming it is a Single Premium Non-Par Endowment Assurance with high guarantees). However if it is a Single premium Par Endowment Assurance (with low guarantees) then its ranking would drop down from number (v) currently to number (vii), i.e. after the Regular Premium Par products since the regular premium products would have higher reinvestment risk on future premiums as compared to a single premium product.
6. Regular Premium Par Endowment Assurance for 20 years with higher surrender options
7. Regular premium Par Endowment Assurance for 20 years with lower surrender options
8. Regular Premium Term Insurance for 25 years
9. Unit Linked Endowment Assurance for 20 years with no guarantees
10. One year Renewable Group Term Insurance product (14)
- 11.

viii.

- a) Insurance regulations require companies to hold solvency capital to run the business. The capital acts as a cushion and is maintained over and above the reserves. Many companies maintain capital which is higher than the solvency capital. This extra capital is called fund beyond solvency (FBS).

The solvency capital is a regulatory requirement whereas the Fund beyond solvency (FBS) is an extra capital which many shareholders maintain to provide extra cushion to the existing business, write new business, infrastructure and expansion strategies of the organisation, smoothening of bonus, creating extra returns by taking higher risks on this capital.

(1)

- b) The Fund beyond solvency if regulated reduces the incentive for shareholders to put in extra capital. Shareholders want higher returns from the capital they put. Since Solvency funds investments are strictly regulated the shareholders do not have incentives to bring extra capital in the solvency fund. However if the Fund beyond Solvency (FBS) is not as strictly regulated then shareholders may be able to generate extra returns (utilising the investment freedom) and would thereby have incentives to infuse higher capital as FBS.

Thus the cons of higher investment regulations on FBS are as follows:

- Prohibit extra capital to be brought into business
- Restricts expansion and growth strategies
- Will mean frequent visits to shareholders for capital requirements
- Will reduce shareholders returns on investment
- Robustness of the business may go down
- Reduces risk taking appetite of the fund manager

The pros of higher investment regulations on FBS are as follows:

- Will restrict FBS from becoming a speculative avenue for the investment manager
- Will make it simple from monitoring and process point of view since both the Solvency Fund and FBS would have the same pattern for investments. It may also lead to companies maintaining only Solvency Fund (no FBS).

We can see that the extra capital through FBS helps in many ways. It creates an extra cushion for the business risks. It helps in writing new business (absorbing the new business strain). It can help create more returns since more asset classes are available to invest. It can help reduce the volatility in capital requirements. It allows the business to take more risks and expand. In my view the Fund beyond Solvency should not be regulated since it discourages shareholders to put in extra capital as FBS.

(5)

- c) FBS was less regulated and given higher freedom in terms of exposure norms and assets classes. However the recent regulations make the investment regulations for FBS more aligned to the Fund for Solvency thereby reducing the investment freedom earlier available for the FBS.

The regulator has extended the applicability of Regulation 9 which is dealing with Exposure / Prudential Norms to 'Fund Beyond Solvency Margin (FBS).

From 1 April 2013 the new regulation has extended the applicability of exposure norms to FBS. However the regulator continues to exclude the applicability of pattern of investments to FBS.

(2)

[Total 52 Marks]

Solution 2 :-

(i)

An appropriate investment policy ensures that the liabilities are met as they fall due and also maximize the returns of the asset

To do so following are the questions one needs to look at:-

1. Nature of liabilities:- Are the liabilities fixed or real in monetary terms? Are there any guaranteed benefits? What is the level of bonus adjustment possible keeping in mind policyholder's expectations
2. Term of the liability:- What is the term of the liabilities? Is it short term or long term? This will depend upon the product and maturity. Are the products are mainly sold as single premium or regular premium?
3. Currency:- Are there are any overseas liabilities?
4. Certainty of liabilities:-Are the claims susceptible to external environment e.g surrender due to economic conditions, health claims due to pandemic etc
5. Level of expenses:- What is the level of expenses? Are there any regular policy related expenses which are related to inflation?
6. Level of Free assets:- What is the level of free assets? Is there is any restrictions on investment of free assets?

Looking at the portfolio

Unit link constitutes 30%. For unit linked business the assets in the unit fund are exactly matched with the unit liabilities. This has to follow a principle of close matching. Most of the risk are passed on to the policyholder. However if the product has some guarantees then one may require a investment guarantee reserve. This reserve will have to be matched by assets which are less volatile and fixed in nature. Government bonds will be most appropriate

Term + Critical Illness + Health business constitutes 30%. This is usually a short term business. Health Claims are highly uncertain. Also the payments may be related to

inflation if the products are indemnity type products. This has to be matched with short term assets like cash or short term

Par Products constitutes 40%. This is usually a long term business. Bonus once declared vests and are guaranteed. However declaration of bonus depends upon the investment performance of the assets subject to PRE. This gives flexibility in terms of the return. Par Products are best backed by a combination of bonds and equities. Property is also a good match for long term liabilities and provides real returns. However they have the disadvantage of being illiquid.

Looking at the current asset mix

Bonds:- 78%

Equities + Property:- 12%

Unsecured debenture:- 5%

Cash:- 5%

It appears looking at the portfolio exposure to equities maybe increased and more short term assets may be held to cover the health liabilities. (10)

(ii)

IRDA Investment Regulations

Type of Investment	%
Government Securities and other approved securities	Not less than 50% of the controlled fund shd be invested of which Government securities alone shd not be less than 25%
Infrastructure and Social Sector	At least 15% of the controlled fund should be invested in this sector
Other investments to be governed by exposure norms	Not exceeding 35% of the CF to be invested of which investment in "other than approved investment" category cannot exceed 15% of the fund

Comparing this with current portfolio of assets there appears to be no violation except no information about infrastructure bonds.

(5)

(iii) Points on Equity Investment:-

Equity Investment would generate higher expected returns. Also equities are long term and real and hence provide a match to long term liabilities. Given that company has 40% with par portfolio, equities should be able to provide a higher return

Comparing the asset mix in light of IRDA norms also shows that there is scope to increase the equity exposure

However, the volatility of equities should also be considered. For this we will need to consider the duration of liabilities as well as existing level of free assets.

Also increasing the exposure to equities will have to be planned and executed.

Points on Market being at 2 yr low:-

Just current level of markets being low cannot be a barometer of investing into equities

It needs to be researched along with the fundamentals of the economy

When it is said markets are 2 yr low, is he referring to a particular INDEX? Does that have any reference to the model portfolio the company follows?

Overall increasing equity exposure would mean more diversification. Hence CFO's suggestion seems reasonable to switch more into equities

Iv Some important points:-

Economic Recovery is not a easy prediction. Most times recovery is already underway for several months before it can be recognized

Markets tend to recover before the economy, so it should be seen if markets have discounted that or not.

GDP forecasts can fluctuate.

Economists use a variety of indicators, including GDP, inflation, financial markets and unemployment to analyze the state of the economy and determine whether a recovery is in progress

Manufacturing Stocks

In a recovery Phase of a business cycle there is a period of early cycle phase. This is a phase where credit begins to grow, monetary policy is easy and environment is considered healthy for growth. Typically economically sensitive sectors such as manufacturing industry are boosted by a recovery. These stocks tend to perform well with growth of the economy. However the profits can be volatile. Identification of appropriate stock which return shareholder value is critical.

P/E Ratio:- P/E is Market Price / earnings per share (usually 12 months) and is an important measure of value and is widely used measure for stock selection. It shows the sum of money one is ready to pay for each rupee worth of earnings of the company. It offers an idea of stock has potential to grow. For ex if P/E of a stock is low as compared to its peers it can be considered a good bargain and is still unknown to the market

As the economy starts to recover, the P/E ratios of cyclical companies will rise in anticipation of

future earnings growth. P/E ratios of defensive companies may now be lower than those of

cyclical stocks. As growth continues, the earnings of cyclical companies will catch up with the share price and P/E ratios will fall back towards their long-term average level.

However it has its own drawbacks. Earnings per share are forecast of future growth based on past performance. So this in itself is a caveat. There is no guarantee that company will perform. In a economic recovery situation, it is a test on companies to deliver on future growth.

Also PE ratio is dependent on comparison with peers which can be driven as per sectors. Also major announcements or acquisitions tend to move PE.

Real-estate Stocks

Real estate stocks are usually laggards in a economic recovery. The catch up is usually a little late. Consumers start buying into real estate once their income levels rise and they are bullish about the economy. This leads to higher demand of property and rise in stock prices.

Hence it is crucial to identify the appropriate real estate stocks before the market becomes bullish about the economy. So in a recovery mode it is possible to identify some underpriced real estate stocks. (11)

(v) Problems in carrying out such a switch without using derivatives are:-

- Possibility of shifting market prices in 3 months time
- Sale of commercial property may take longer than 3 months
- Detailed Research on stocks requires time
- Dealing costs and research costs need to be considered
- Tax liabilities

(5)

(vi)

- To lock into the low level then index linked derivative can be bought till the time property market transaction is carried out
- Using Derivatives saves dealing costs.
- Derivative markets are much more liquid

(5)

[Total 40 Marks]

Solution 3 :-

(i) The option strategy which will work best for this situation is to form a straddle.

A straddle involves buying a call and a put option with same strike price and expiry date. In a straddle whenever there is a sufficiently large move in either direction, a significant profit will result. If the stock price is close to strike price at expiry of the option, the straddle will lead to a loss

Hence a straddle works only if there is a large move expected in a stock price but which direction is unknown. In this case the supreme court ruling would move the share price either ways.

Payoffs

Suppose stock price is S_T and strike price is K

Let Cost of buying a call and put = P

$S_T < K$

Pay off from Call $\rightarrow 0$

Payoff from Put $\rightarrow K - S_T$

Total = $K - S_T - P$

$S_T > K$

Pay off from Call $\rightarrow S_T - K$

Payoff from Put $\rightarrow 0$

Total = $S_T - K - P$

$S_T = K$

Pay off from Call = 0

Payoff from Put = 0

Total = $-P$

Hence the maximum loss in this strategy is two premiums. (4)

(ii) If only call options were to be used then the strategy would be to do a bull spread. This involves buying a call option with a certain strike price (say K_1) and selling a call option on the same stock with higher strike price (K_2)

$K_1 < K_2$

Both options have the same expiry. The bull spread limits investor's upside as well as downside. So like a straddle above this strategy will neutralize the effect of the announcement but will limit upside and downside

If $S \geq K$

Pay off long call $\rightarrow S - K_1$

Pay off from short call $-(S - K_2)$

Total $K_2 - K_1$

If $K_1 < S < K_2$

Pay off long call $\rightarrow S - K_1$

Pay off from short call = 0

Total $S - K_1$

If $S \leq K_1$

Pay off long call $\rightarrow 0$

Pay off from short call = 0

Total 0

(4)

[Total 8 Marks]
