Institute of Actuaries of India

INDICATIVE SOLUTION

May 2012 Examination

Subject SA6 – Investment

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 :

a)

i) Money Weighted rate of return

5000(1+i)+ 30*(1+i)^(10.5/12) -500*(1+i)^(7.5/12) + 78*(1+i)^(4.5/12)-28*(1+i)^(1.5/12)=5500

(1+i)^n ≈(1+ni)

i=19.41%

ii) Time weighted rate of return

Using linked internal rate of return

5000(1+i_1)+ 30*(1+i_1)^(0.5) =5200 => i_1 = 0.0339

5200(1+i_2)-500*(1+i_2)^(0.5) = 5100 => i_2 = 0.0808

5100(1+i_3) + 78*(1+i_3)^(0.5) = 5300 => i_3 = 0.0237

5300(1+i_4)-28*(1+i_4)^(0.5)= 5500 => i_4 = 0.0431

(1+i_1)(1+i_2) (1+i_3)(1+i_4)= 1.1899 => i = 19.33%

iii) Money weighted return is useful as an absolute measure of achieved return

It can be compared with the actuarial assumptions underlying the fund to see whether the achieved return is higher or lower than that expected.

It is not a good method for comparing two different fund managers as rate of return can be heavily influenced by the timing and size of cashflows which are not usually within the control of the investment manager

Time weighted rate of return addresses these issues

Time weighted rate of return is impractical as fund values are required for every occasion on which there is a cashflow

A practical compromise is to use the linked internal rate of return as an approximation for the time weighted rate of return – often using quarterly sub-intervals

iv)

Invest totally in Indian equity index		
value at 15 May	=5000*4200/4000	5,250.00
net cashflow		30.00
investment income	=5250*4.2%*.25	55.13
	sum	5,335.13
value at 15 Aug	=5335.13*4400/4200	5,589.18
net cashflow		- 500.00
investment income	=5589.18*3.8%*.25	53.10
	sum	5,142.28
value at 15 Nov	=5142.28*4500/4400	5,259.15
net cashflow		78.00
investment income	=5259.15*3.7%*.25	48.65
	sum	5,385.79
value at 15 Feb	=5385.79*4400/4500	5,266.11
net cashflow		- 28.00
investment income	=5266.11*4.0%*.25	52.66
	sum	5,290.77
value at 31 Mar	=5290.77*4600/4400	5,531.26
	actual fund	5,500.00
	notional Indian equity index fund exceed actual fund	31.26

i.e. the actual fund under-performed notional Indian equity index fund 31.26 crore

v)

Stock Selection attribution to the performance		
Notional fund if invested in US equity index so convert to US $		
value at 15 May	=(5000*2100/2000)/50	105.00
net cashflow	=30/52	0.58
investment income	=105*5.9%*.25	1.55
	sum	107.13
value at 15 Aug	=107.13*2180/2100	111.21
net cashflow	=-500/53	- 9.43
investment income	=111.21*6.1%*.25	1.70
	sum	103.47
value at 15 Nov	=103.47*2300/2180	109.16
net cashflow	=78/48	1.63
investment income	=109.16*6.5%*.25	1.77
	sum	112.56
value at 15 Feb	=112.56*2400/2300	117.46
net cashflow	=-28/46	- 0.61
investment income	=117.46*5.9%*.25	1.73
	sum	118.58
value at 31 Mar	=(118.58*2200/2400)*45	4,891.46

Fund value if invest entirely in US equities	4891.46
Fund value if invest entirely in Indian equities	5531.26
Benefit of sector selection =4891.46-5531.26	-639.80
Actual fund value	5500
Benefit of stock selection =5500-4891.46	608.54

vi) Method 1

Notional fund if invested in US equity index but no conversion to US $			
value at 15 May	=(5000*2100/2000)	5,250.00	
net cashflow	=30	30.00	
investment income	=5250*5.9%*.25	77.44	
	sum	5,357.44	
value at 15 Aug	=5357.44*2180/2100	5,561.53	
net cashflow	=-500	- 500.00	
investment income	=5561.53*6.1%*.25	84.81	
	sum	5,146.34	
value at 15 Nov	=5146.34*2300/2180	5,429.63	
net cashflow	=78	78.00	
investment income	=5429.63*6.5%*.25	88.23	
	sum	5,595.86	
value at 15 Feb	=5595.86*2400/2300	5,839.16	
net cashflow	=-28	- 28.00	
investment income	=5839.16*5.9%*.25	86.13	
	sum	5,897.29	
value at 31 Mar	=(5897.29*2200/2400)	5,405.85	

Thus if there was no fx movement the value of the US equity index fund would have been 5405.85 ie 5405.84-4891.46 =514.38 improvement or 639.80-514.38 = 125.42 is due to US equity selection

Hence

Country Selection	-125.42
Currency Selection	-514.38
Stock Selection	608.54
Total	-31.26

Method 2

Notional fund if invested in Indian equity index but experienced exchange rate movements					
value at 15 May	=(5000*4200/4000)/50	105.00			
net cashflow	=30/52	0.58			
investment income	=105*4.2%*.25	1.10			
	sum	106.68			
value at 15 Aug	=106.68*4400/4200	111.76			
net cashflow	=-500/53	- 9.43			
investment income	=111.76*3.8%*.25	1.06			
	sum	103.39			
value at 15 Nov	=103.39*4500/4400	105.74			
net cashflow	=78/48	1.63			
investment income	=105.74*3.7%*.25	0.98			
	sum	108.34			
value at 15 Feb	=108.34*4400/4500	105.93			
net cashflow	=-28/46	- 0.61			
investment income	=105.93*4.0%*.25	1.06			
	sum	106.38			
value at 31 Mar	=(106.38*4600/4400)*45	5,004.84			

Hence this notional fund overperformed a pure Indian equity fund 5531.26-5004.84 =526.42

Hence

Country Selection	-113.38
Currency Selection	-526.42
Stock Selection	608.54
Total	-31.26

vii) In almost any analysis of variance/attribution analysis where factors interact the order of carrying out the attribution analysis will impact the weighting given to particular factors.
As such it is common to analysis those factors which are believed most significant first or to maintain a fixed order year to year to provide consistency.

viii) The fund manager may have taken considerably more risk than competitors and so a comparison with competitors using a Sharpe type metric should be considered The return of

the manager may be very volatile and so the 10% pa return might be an average of some very good years and some very bad years.
The return in each year (and ideally in each quarter) should be compared over the five years to see the volatility of returns from period to period.
These annual/quarterly returns should be compared with an index and competitors.

ix) Projection of past results – a result attained in the past may not occur in the future due to the random element in investment returns and an investment technique which has proved successful in the past under particular circumstances may not work in the future under different circumstances.

Risk – in the longer term it is expected that a riskier strategy should produce a higher average return and so the measurement of relative performance should therefore take account of the degree of risk taken by a fund manager

Timescale – determining the frequency of performance measurement calculations requires a delicate balance between assessing performance frequently enough so that problems can be spotted and corrected and avoiding spurious conclusions based on too short a measurement period.

Differing fund objectives – different funds may have different objectives and constraints and so comparisons between such funds may not be valid. For example a defined pension fund trustee may prohibit the fund investing in the sponsoring company's shares or debt

Impact on fund manager behaviour – knowledge of how and how often the manager will be assessed is likely to influence the investment strategy of a manager ("what gets measured gets done"). This may not be in the fund's best interests e.g. too frequent monitoring can encourage a short-term approach to investing.

Cost – need to balance cost of performance measurement against benefits. For a number of assets (e.g. property) valuation is difficult, time-consuming and very subjective.

1b)

i) An investor might purchase a put option to hedge their equity portfolio against a fall in the equity markets
The investment bank would use

$$p = Ke^{-rT}\Phi(-d_2) - S_0\Phi(-d_1)$$

Φ is the cumulative standard normal distribution function

$$d_1 = \frac{\ln\left(\frac{S_0}{K}\right) + (r+\sigma^2/2)T}{\sigma\sqrt{T}} \qquad d_2 = d_1 - \sigma\sqrt{T}$$

T is maturity date of option, S_0 is value of share at time 0, K is strike price, r is risk-free, σ is forward (implied) volatility

ii) The investment bank is taking on risks of equities falling and of the forward (implied) volatility changing. Changing volatility will increase value of options (assuming mark to market) and so result in a loss to the bank from the transaction

iii) Implied volatility is a forward looking measure and is the volatility of equity that the market expects in the future. In practice, it is derived (backsolved) from the price of equity options

iv) Realised (historical) volatility is the volatility that has actually occurred over a period e.g. annualised standard deviation of daily price movements.

v) Drawing an analogy from other instruments:

volatility risk premium = expected volatility risk + premium for uncertainty

ie investors require a premium for the possibility that actual future volatility will deviate from expected future volatility.

vi) The investment bank has excess exposure to implied volatility via writing the put option and so it might enter into a contract whereby it pays based on implied volatility and receives based on realised volatility (i.e. sets a reference point at today's implied volatility and if realised volatility at end of period is higher it receives a payoff and if less it pays a payoff - a volatility swap or more likely use a variance swap).

(50 Marks)

Solution 2(A) :

(1)

The depository receipts are created to allow Indian companies to raise money by issuing new shares in foreign currency. Since the Indian shares are denominated in Indian Rupees they cannot be directly listed on US or European or other countries stock exchanges. Hence a foreign Investment bank is used to act as depository of shares issued by the Indian companies. The new shares issued by the Indian company are deposited with the Investment bank or a custodian in India, appointed by the Investment bank. The Investment bank then issues depository receipts in lieu of shares. The depository receipts are denominated in foreign currency (USD for ADRs and either USD or EURO for GDRs).

(2)

The DRs help company raise capital from a different group of investors. The issuance of DRs enhances the domestic goodwill of the company since it requires to qualify the stringent requirements in terms of higher transparency / disclosures required for the listing of ADRS and GDRs on foreign bourses. It helps reduce the cost of capital since it enables to get a new group of investors who want to invest in other countries securities and have better diversification. The foreign investors get an opportunity to invest in their own currency and do not have the hassles of cross

border investments and/or understanding the regulations in the country of the issuing company. It helps the issuing company in case of mergers and acquisitions around the globe. The DRs are swapped for other

(3)

The number of depository receipts issued by the Investment bank may or may not be same as the number of new shares issued by the Indian company. If both numbers are same then one share is equivalent to one DR. However the company and the Investment bank may decide to issue one DR for two shares or five shares or 0.5 shares etc.

(4) Yes the rights and obligations are same for the DR holders. They receive the same percentage of dividend; they are also entitled to bonus and rights issues. However all dividends etc are given in foreign currency instead of Indian Rupees.

(5)

The ADRs are American Depository Receipts and are issued when the Indian company wants to raise money from the US market. The GDRs are Global depository receipts and are issued when the Indian company wants to raise money in European markets. The ADRs are denominated in US Dollars and GDRs are issued either in EURO or in US Dollars. The US Securities Exchange Commission has more stringent requirements and the process of issuing ADRs may be more complex, will have higher disclosure requirements and thus may involve more costs.

(6)

Yes the Indian companies can raise money from other markets (American, European etc) by issuing ADRs or GDRs without getting their shares listed on Indian Stock Exchanges.

Divestment by shareholders of their holdings of Indian companies, in the overseas markets would be allowed through the mechanism of Sponsored ADR/GDR issue in respect of:-
(a) Divestment by shareholders of their holdings of Indian companies listed in India;
(b) Divestment by shareholders of their holdings of Indian companies not listed in India but which are listed overseas.

(7)

The prices should behave in the same manner in both the markets and should be driven by the fundamentals of the company. There are many practical reasons however why prices can be different in both the markets. The investor's in both countries may have different perception about the growth of the economy/country and the company. It may also arise because the investors expectations in both markets may be different. Thus the DR investor in another country may be buying to diversify the country risk and may be willing to pay premium for the same.

Yes the price difference gives rise to arbitrage opportunity and many investors do use the same to narrow down the price differences. The regulations regarding investment by Individuals, FIs (Financial Institutions), Mutual Funds or FIIs (Foreign Institutional Investors) and others restrict the arbitrage and thus the markets may not be fully efficient.

(8)

Yes, the DRs can be converted into shares and vice versa. Earlier only one way conversion (fungibility) was allowed wherein the DRs could be converted into shares which lead to many FIIs who could also trade in Indian market shares utilize the price differential in two markets to make arbitrage profits. They converted the DRs which were quoting at a discount, into shares and sold them in Indian markets making profits. The one way conversions lead to liquidity problems in DRs since there were lesser number of DRs available for trade after such conversion. However now two way conversions are allowed even though there is a restriction wherein only the DRs which have been converted into shares can be recreated / reissued by converting shares into DRs. Thus to the extent the DRs were extinguished to create shares they can be reissued by converting shares into DRs.

While issuing ADR/ GDR against the block of existing shares offered by the shareholders the facility would be available pari-passu to all categories of shareholders, of the company whose shares are being sold in the ADR/GDR markets overseas. This would ensure that no class of shareholders gets a special dispensation. The sponsoring company, whose shareholders propose to divest existing shares in the overseas market through issue of ADRs/GDRs will give an option to all its shareholders indicating the number of shares to be divested and the mechanism how the price will be determined under the ADR/GDR norms. If the shares offered for divestment are more than the pre-specified number to be divested, shares would be accepted for divestment in proportion to existing holdings.

(9) The IDR allows foreign companies to raise capital from Indian markets. Standard Chartered Bank is the only entity which has issued an IDR and raised more than 2000 crores from Indian Capital market. The foreign companies are not allowed to raise money from India by issuing shares in foreign currency however they can issue IDR to raise money in Indian currency.

Solution 2(B) :

(1) The option premium for a call option with strike price equal to current NIFTY levels is available at 23.8% of the NIFTY value /strike price (1250/5250=23%). Thus if an investor is putting Rs 100 as investment then Rs 23.8 is set aside to buy a call option with strike of 100. The balance of Rs 76.2 is invested in debt instrument with a yield of 9.5% to give Rs 100 after 3 years.

In case markets go up then by exercising the option we can get 100% of the upside. Thus if markets go to 6000 the NIFTY returns will be (6000/5250-1)= 14.28%. The exercise of call option will give us a return of 14.28% and the debt investment will give us our capital back.

In case equity markets give negative returns the call option is allowed to lapse with no value and the debt investment will give the capital back, thus protecting the capital from negative returns.

(2)

If the option premium is Rs 1050 which is 20% of the NIFTY value / strike price of 5250. The balance 80% can be invested in debt instrument with a yield of 9.5% to give Rs 105 at the end of 3 years.

Thus a 5% absolute return after 3 years can be guaranteed on the downside with full equity participation on the upside.

(3)

The returns in different scenarios are given in the table below:

Nifty Level after 3 years	Nifty Returns after 3 years	Return attributable to debt investment	Total Return after 3 years	Maturity Value along with option returns
4,500	-14.3%	5.0%	5%	105.0
5,000	-4.8%	5.0%	5%	105.0
6,000	14.3%	5.0%	19%	119.3
6,500	23.8%	5.0%	29%	128.8

Thus we can see that when NIFTY is below its current level of 5250 the returns are still positive whereas in case of upside the NIFTY returns are fully protected and added to the debt return of 5%.

(4)

The 110% participation in Equity upside is possible provided we purchase more call options (110% of the total investment). The table below summarises the situation wherein only 100% participation was done but a return of 5% was given (higher than only capital guarantee) whereas in the second case 110% participation is done and since more amount is invested in option premium the debt investment drops from earlier 80% to 78% giving somewhere around 102% of the capital as guaranteed amount. If we increase the option premium so that Equity participation becomes 119%-120% then the debt investment drops to 76% giving only capital guarantee.

	105% guarantee	110% participation	120% participation
Option Premium Rs. (C)	1,050	1,155	1,260
Nifty Call Option Strike Price (B)	5,250	5,250	5,250
Option Premium as % of strike (D=C/B)	20.00%	22.00%	24.00%
Equity (Derivative) Allocation (A)	20%	22%	24%
Debt Allocation	80%	78%	76%
Debt Yield	9.5%	9.5%	9.5%
Capital Guarantee after 3 years	1.050346	1.02408725	0.99782861

Solution 2(C) :

Intrinsic value refers to the value which an option buyer will get if he immediately exercises his/her option. Thus it is the difference between the current market value of the underlying stock or other asset and the strike price of the option on the underlying asset. At the money option or out of money option do not have intrinsic value. A very deep in the money option will have far more intrinsic value than that another in the money option.

Time value of an option is the value which an option buyer is willing to pay over and above the intrinsic value. The difference between the option premium and the intrinsic value is the time value of the option. The option buyer understands that the price of the option can change before the expiry date and if it does as he has anticipated he will be making gains and is thus willing to pay higher amount than the intrinsic value to buy the option.

The time value of an option depends on the time remaining for the expiry of the option. If there is more time remaining for the expiry the possibility of a favourable change in the option premium is higher. The time value becomes nil at the time of expiry. Option premium for at the money option or out of the money option is equal to time value.

Solution (D)

(1)

The duration of a zero coupon bond will be same as the maturity period. In this case the 15 year zero coupon bond will have a duration of 15 years. However in this case the option to return the proceeds at the end of 10 years which is quite likely if the interest rates drop in future means the company can choose to make the duration 10 years instead of 15 years. Hence in this case the duration will be 10 years.

(2)

Duration of a perpetual bond is = (1+ 1/YTM). The duration calculation would involve a payout which is a GP series where numbers of payouts are infinite.

In this case the duration = 1=1/0.08=13.5 years.

(3)

The important factors affecting the duration are:

- Maturity – Higher the maturity higher is the duration and the interest rate risk.
- Yield to Maturity (YTM)- Higher the YTM lower is the duration and the risk.
- Frequency of the coupon payouts – Higher the frequency lower is the duration

Solution 2(E) :

(1)

If the position is closed before the expiry date of the futures contract then the basis risk still remains. The basis risk refers to the difference between the spot price and the futures price on the date of closing the contract. Once you enter the futures contract on 16th May the sale price for the portfolio is locked and the price risk is hedged. However the spot price is expected to converge with futures price on the expiry date of the contract (in this case 26th July). On other dates before the expiry though the price of both spot and futures will generally move in a similar manner they will not be exactly the same and the difference is called the basis. Since the contract needs to be terminated on 10th July (prior to the expiry date) there will be some basis risk. However we need to understand that the price risk is far more than the basis risk and thus it is important to hedge.

(2)

If the price of the futures price is less than the cash / spot price of the underlying asset it is referred to as normal backwardation. It implies that futures price is expected to increase in the coming day etc so that it moves closer to converging with the spot price.

Similarly if the futures price is higher than the spot price it is referred to as contango. The futures price is expected to reduce and converge to spot price in the future.

(3)

If there are many hedgers who are short on futures to hedge market movement in their underlying asset which they are holding then the market will witness normal backwardation wherein futures price will be lower (due to more selling by hedgers) than the spot price.

(50 Marks)

[Total Marks-100]

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