

# **Institute of Actuaries of India**

## **INDICATIVE SOLUTION**

**November 2011 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

Q. 1)

1. Liquidity is an important feature while considering stock investments:
  - a. The liquid stocks investments are preferred because they provide sufficient opportunities to sell and realise value in case portfolio needs to be altered. This becomes important for mutual funds which may get unplanned redemption requests wherein the investors may suddenly like to sell their units and withdraw cash. (Insurance companies generally require lower liquidity since liabilities are not as short term).
  - b. If the stock is not liquid then it may be difficult to buy or sell large chunks or volumes of the same in the market without significantly altering the price. Thus positions in liquid stocks can be acquired at lower price as compared to stocks which are illiquid and similarly while selling the liquid stocks can be sold at a higher average price.
2. The important indicators for liquidity are:
  - a. Higher numbers of outstanding shares imply more liquidity but more importantly it is the number of floating shares i.e. those shares that are not closely held by promoters etc and are available for trading.
  - b. Liquidity Beta is considered to be a good indicator. It is the number of shares of any company which are traded after which the price changes by 1%. Thus if higher number of shares are required to be traded to move the price by 1% it is considered to be more liquid vis-a-vis those where 1% price change happens quickly even if lesser number of shares have exchanged hands.
  - c. The best measure to evaluate liquidity is the spread between the bid and ask price. A high spread indicates lower liquidity. If the stock is available for sale at much lower price than it is available for purchase it indicates a high spread and lower liquidity.
3. The stock with lower float will be preferred in this situation. The smaller float means the liquidity will be low and thus volatility will be high leading to higher stock price appreciation in the rising market (lesser volumes will be available for purchase hence price rise will be higher for every share traded).
4.
  - a. When the market prices are rising the number of advances are generally more than the decline i.e. high Advance / Decline ratio and similarly in a falling market the number of declines will be more than the number of advances. Generally weekly advances or decline or averages of last 10-15 days ratio is used by many to form view of the markets. The average ratio may vary from 0.33 to 3 in Indian markets. When the average ratio is upwards of 1.5 it may indicate that the bull market is on and is perhaps peaking.  
Using the advance decline statistics over a period we can construct an Advance-Decline line which is a simple measure calculated as the difference between the number of stocks that have advanced during the last week and the number of stocks that have decline over the same week. When there are more advancing stocks than declining stocks then the line is positive and moves upwards. Similarly if more shares have declined than the line will move downward. A better measure over time will be the difference of advancing stocks less declining stocks divided by the total number of shares traded over the week (shares where prices have changed). If this ratio shows an uptrend then it is more likely that the market may move upwards (bullish sentiment). This ratio is easy to use and compare data over different

time periods when numbers of shares traded are different (gradually with time more number of shares gets added in the market).

- b. The ratio of advancing stocks to declining stocks in itself may not be a good indicator however when the volumes flowing into advancing and declining stocks are also considered then it may be a better indicator of market sentiments. High volume of transactions in advancing stock generally reflects bullish sentiments and similarly if more volumes are seen in shares which are declining then the sentiments can be considered to be bearish. Thus the data can be used to calculate the average volume of shares traded per advancing stock and also average volume of shares traded per declining stock. The ratio of (volume of share advances / number of advancing shares) ÷ (total volume of declining shares / number of declining shares). If the ratio is close to 1 it shows a neutral view and if it is greater than 1 it indicates bullish sentiments prevailing. A very high ratio (say 3 or 4) may reflect a peak of the bull market. Similarly a ratio of less than 1 may indicate a bearish sentiment and a ratio of 0.33 or 0.25 etc may reflect a very bear market, perhaps the bottom wherein a recovery may be expected soon. Tracking the ratio can be utilized in many ways for example a change in the ratio from say 0.8 to 1.15 etc may again signal a change in sentiments (bearish to bullish) and indicates a buying opportunity.

	1st Situation		(Volume of A/D) / (Number of A/D)	2nd Situation		(Volume of A/D) / (Number of A/D)	3rd Situation		Volume of A/D) / (Number of A/D)
	Number of Stocks	Total Volumes (in lacs)		Number of Stocks	Total Volumes (in lacs)		Number of Stocks	Total Volumes (in lacs)	
Advances	495	512	1.03	721	706	0.98	1104	1119	1.01
Decline	906	1000	1.10	675	1355	2.01	355	167	0.47
Unchanged	77			82			19		
Total	1478		Neutral	1478		Bearish	1478		Bullish

5.

Put-Call ratio reflects the number of puts traded divided by the number of calls. If there are many put option buyers as compared to call option buyers then the trade in puts will be high and the Put-Call ratio will be high. The Put-Call ratio is high when the buyers of options are more bearish. However it has been observed that the markets have actually gone up in such cases of high Put-Call ratio since the writers of options perhaps were more knowledgeable and when they wrote a higher volume of puts than calls perhaps they were aware that the markets were bottoming out and may rise from there. The writers of options are generally institutions with more information and it has been seen in past that the markets have risen upwards after a period of high Put-Call ratio against the bearish sentiments of option buyers. Similarly markets have gone down in case of low Put-Call ratio again against the expectation of a large number of call buyers.

Thus as mentioned above the value of Put-Call ratio can indicate what kind of trend the market will have in the future. In the given chart the markets have continuously been having a Put-Call ratio above 2 and hence it may be a signal of an upward trend in the coming months. Historically the

markets have gone up when Put-Call ratios have been high (more Puts have been purchased than Calls) and they have gone down if the call options purchased are more than puts (implying a lower Put-Call ratio).

6.

- a. ETFs are a group of securities and like the shares they can be traded on a stock exchange. They are a hybrid of a share and a mutual fund wherein they have the characteristic of both. They have a basket of securities as underlying like a mutual fund and can be traded on Exchange on a real time basis like a share.
- b.
  - i. In Index Fund the NAVs are computed at the end of the day and entry and exit is possible at the single price which is the NAV computed at the end of the day. On the other hand the ETFs can be traded throughout the day in the stock exchange and are available for purchase or sale on a real time basis.
  - ii. In the open ended mutual funds including the Index fund the investors pay cash to the Mutual Fund(AMC )to buy units and the fund in turn uses the cash to buy stocks etc. However when an ETF is initially created it approaches a set of large investors or institutions who are called initial participant. These initial participants give basket of stocks to the fund (ETF) and receive units of the ETF in exchange. The initial participants then become distributors of the ETF units selling the same to other investors including retail investors.
  - iii. Brokerages and bid-ask spread needs to be paid on investments in ETFs since they are sold on the exchanges through brokers. Earlier mutual funds had entry and exit loads to account for such costs however now the entry load has been done away by SEBI and now investors can purchase units of different mutual funds (including Index funds) through their brokers paying brokerage fees. Thus this difference between Index fund and an ETF no longer exists. The only difference now is that the ETFs can be purchased only through exchanges and thus through brokers whereas mutual fund units can be purchased with the help of a AMFI certified agent or directly through the company without paying any brokerage.
  - iv. Despite brokerages etc the overall cost / expenses are lower in case of ETFs since they do not require to pay trail commissions to distributors as in case of Index funds and hence the tracking error is lower in case of ETFs.
  - v. Portfolio of the mutual funds including Index funds need to be disclosed only a monthly basis whereas the portfolio of the ETFs need to be disclosed on a daily basis.
- c. The main advantages of ETFs:
  - i. Lower cost. Generally they are passive portfolios and hence cost of managing the same is lower.
  - ii. More tax friendly specially the Index linked ones which are passive, i.e. have low churning of the portfolio leading to lower capital gains and thus lower tax associated therewith. Gold ETFs do not attract wealth tax unlike physical gold.
  - iii. As liquid as a single stock
  - iv. Gives exposure to more asset classes which are otherwise difficult or expensive. Example Gold ETFs, Bond ETFs

- v. Many diverse applications can be created around them
- d. The main advantages offered by Index Fund are as follows:
  - i. The Index fund is generally for people who believe in markets being efficient and do not trust the active management approach towards Investments, in trying to create a positive alpha (an extra return over the market returns). The approach is to simply track the market index and thus the Index funds mirror / replicates the Index and do not attempt to beat the market.
  - ii. Fund managers stock selection expertise is not required and thus costs are much lower.
  - iii. Churning of portfolio is less since the idea is to be passive in approach wherein the funds are invested in same proportion as the components of the Index and are not subjected to many churns. Hence the transaction costs are much lower.
  - iv. The portfolio of Index funds as like Index are fairly diversified and do not have returns getting influenced by the biases of the fund manager and thus may have lower risks.
- e. The annualised standard deviation of the difference in returns generated by a benchmark Index and the Index fund which is trying to replicate that Index is called tracking error. The tracking error happens for various reasons including the following:
  - i. The brokerage fees and other transaction costs which an Index fund occurs
  - ii. day to day management costs are another reason why the returns generated by the Index fund will lag behind the returns generated by the Index
  - iii. The dividends received by the Index funds will increase the returns generated by the Index fund since most Indices are not adjusted for the dividend payouts and are just capital returns index.
  - iv. The liquid cash amounts maintained by Index fund to meet any redemption requests will be another source of difference between returns generated by Index fund vis-a-vis the Index
  - v. AMCs which have Index fund are floated in many cases by companies who are themselves part of the Index and the fund may not be allowed to invest in the parent. Thus the mirroring of the Index may not be complete.
- f.
  - i. The active fund managers invest time and money in researching for good companies which would outperform the overall Index and they try to create a portfolio of such stocks which together are expected to do better than Index.
  - ii. Constant monitoring of the portfolio of stocks by experts, studying the financials, tracking the management quality and business processes gives the active fund manager more insights into the business of the companies who stocks they follow.
  - iii. There is still a large segment which believes that market efficiency is evolving and Indian markets may not be fully efficient hence people trust their money with active fund managers who are expected to have more information than others.
- g.
  - i. Gold ETFs provide a diversification in portfolio by allowing one to choose another asset class.
  - ii. The liquidity element is high unlike holding the physical asset.

- iii. Investments are exempt from wealth tax unlike holding physical gold which is subject to wealth tax.
  - iv. Capital gains tax rule is similar to the debt mutual funds.
- h. The price of the units traded during the day can be different from the NAV of the scheme however in the difference is very small. The reason why the price is not different from the scheme's NAV is that the arbitragers continuously track such differences for potential arbitrage opportunities. Thus if the price of the units is lower then the arbitragers may buy units and sell Index futures or underlying of the Index in similar proportions to make arbitrage profits.
- 7.
- a. CDS instruments are created to serve the following needs:
    - i. They can help transfer credit risk from a party not willing to take the risk to another who is willing to take the same.
    - ii. As a credit derivative it is used to help in reducing credit risk exposure to specific counterparties.
    - iii. For banks it is useful if one bank is overexposed to a particular company and wants to transfer the credit risk through such derivative without disturbing the basic financial contract ( i.e. the loan or investment in debentures etc of that company).
    - iv. For many investors who are looking for exposure to particular companies they may use the credit derivatives to gain such exposure.
    - v. In the risk capital regime it may be helpful to transfer credit risk if capital is a constraint since the risk capital requirements will reduce with such transfer.
    - vi. It expands the market for the underlying securities and may help in reducing the borrowing costs by broad basing the distribution of risk.
    - vii. The CDS spreads given an indication of the credit conditions in the market and also provide a benchmark for the price of new bonds to be issued by companies.
  - b. The main risks in CDS contracts which make it quite destructive are as follows:
    - i. No limit on risk exposures, high built-up of speculative positions leading to systemic risks
    - ii. The risk is transferred from the primary issuer who knew the risk better in many instances than the one who is acquiring the risk
    - iii. Complexity concerning actual risk exposures and lack of transparency in the positions
    - iv. Counterparty risk since they are OTC contracts
      - v. Not well regulated as compared to insurance contracts or exchange traded derivatives
    - vi. Interconnectedness of large market participants and concentration of risk in a few entities

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Q. 2) A)

1) An exchange traded fund (ETF) is a collective investment vehicle which is traded on a securities exchange at a price that is closely related to its net asset and is quoted in real time. It combines the valuation features of a unit trust with the tradeability of an investment trust. ETFs are generally managed as index tracker funds.

2)

i) Owning the gold removes any basis risk.

The disadvantage is that it is costly to look after gold which will reduce return to investors or the fund manager's profits.

ii) Owning Gold mining stocks should have a high correlation with owning Gold, and may offer higher leverage (e.g. if gold extraction company has issued debt). The custodial charges for equities are significantly less than for physical gold.

The selection of which companies to hold and in what quantities would require a skilled fund manager which will add to costs.

The gold mining stocks are subject to other risks eg mismanagement or political risk and so correlation with physical gold would not be perfect

iii) The investment bank offers a synthetic ETF via a derivative whereby the investment bank receives cash and delivers the gold index return. This approach is relatively simple for the ETF but there is a credit risk against the investment bank

iv) It should be very easy to trade the gold index, and there may be less taxes on trades than from holding actual gold. Custodial charges are significantly less than holding actual gold. However, there could be a tracking error

3) There is a credit risk to the investment bank, and so the bank could pledge collateral to mitigate the risk.

However, the quality of the collateral needs to be considered e.g. if the investment bank becomes bankrupt and the collateral was BBB rated MBS, then the investors in the gold ETF would be holding BBB rated MBS which is not what they might expect.

Appropriate disclosure of this risk would need to be mentioned in the ETF prospectus.

(4) Gold is expected to be a safe haven in times of crisis

Gold is expected to have a low correlation with equity, debt and other commodities

Gold is expected to have a positive correlation with inflation

(5) Affordability – the retail investor can buy small quantities which may not be economical to achieve directly

Purity of gold – Gold ETF's can guarantee the purity of gold if invest in bullion directly

Liquidity – Gold ETF should be very liquid as can be sold on an exchange

Risk of theft is greatly diminished as Gold ETF could be held in demat form

Transparency in pricing

Storage costs of holding demat ETF are significantly less than holding physical gold (and economies of scale would reside with ETF if it held physical gold)

Tax – no wealth tax on gold ETF, long term capital gains tax benefits may be less, securities

transaction tax may not be applicable

6) Future price = spot price + cost of carry

$$=10,000 + 0.5*100 + 10000 *0.08/4 = 10,250$$

B) The bank would buy GSecs of various durations and place them in a legally distinct ring-fenced fund

The bank would issue zero coupon bonds which were directly backed by the GSec coupon and principal payments

Specifically the total of coupon payments and repayments of principal at time t would be the value of the zero coupon bonds at time t, if the investment bank does not make a profit.

The investment bank would need to make a profit and so synthetic zero coupon yields would be lower

The bond covenant and legal ring-fencing would remove the investment bank credit risk from the structure and so risk of default would only occur if there was default by the government

C)

1) The bank would borrow in US \$ for a particular maturity and enter into a currency swap to hedge the currency fx risk

2) MIBOR is the Mumbai interbank overnight offer rate by which banks would lend to one another (unsecured lending)

3) If the market was arbitrage free, cost of funds should be the same whether they are raised domestically or off-shore.

However, India has capital controls and so there is not free flow of capital. Also as some market investors are not particularly sophisticated arbitrage opportunities can arise

4) Given US downgrade and interest rates to 2013 at least being kept very low, near 0%, there could be an expectation that INR would appreciate against the US \$, as RBI tightens interest rates to fight



inflation. Hence the borrowing would be very cheap in US\$ terms and repayment for say a 2 year term might be less in INR terms as the INR has appreciated against the US \$.

5) Singapore has an international rating of AAA whilst India has BBB. As such any Indian bank borrowing would have to pay a credit risk premium, which would be much lower in Singapore's case.

D)

1) Duration is the weighted average time to payments where the weights are the present value of each payment. If  $P = \sum_k C_k v^{t_k}$  where  $C_k$  is the cash flow at time  $t_k$  then  $D = (\sum_k t_k C_k v^{t_k}) / P$

Volatility is the sensitivity of the present value P of the cashflows to a change in interest rate i

$$V = \frac{-1}{P} \frac{dP}{dr}$$

Convexity is the sensitivity of the volatility of the cashflows to a change in interest rates  $C = \frac{1}{P} \frac{d^2P}{dr^2}$

2) For a change in yield we would like to know the change in price of the bond. Using volatility (modified duration) is a first order linear approximation as to how the price of the bond changes with yield.

However, for large yield movements a second order correction (of the Taylor Series approximation) is required.

For a positive convexity bond, a 1% decrease in interest rate will have a larger change in price than a 1% increase in interest rate.

3) A callable bond is a bond issued by a company which has an option that the company can redeem the bond prior to maturity.

Given the company issuing a callable bond has an option to redeem the bond early if interest rates fall and reissue new corporate debt with lower coupons at that time, lenders will demand higher payment for the prepayment risk i.e. coupon payments would need to be higher than for a same maturity corporate bond with no call option (all other things being equal).

4) A normal corporate bond has positive convexity with price increasing quickly as yields become lower.

For a 15 non-call 1 bond the longest maturity is 15 years and the shortest maturity 1 year.

If interest rates increase after issue, it is very unlikely that the security would be redeemed early, the call option moves out of the money, and so the behaviour would be more like a 15 year bond with no option.

However, if interest rates decrease significantly below the coupon rate, the bond is very likely to be redeemed early, i.e. the call option would be in the money and so the bond behaves more like a 1 year bond with no call option.

Hence starting from high interest rates, as we decrease interest rates the price of the bond would move from the 15 year non-callable bond price/yield curve to a one year non-callable bond price/yield curve. The 15 year non-callable bond would be more sensitive to interest rates than a one year non-callable bond.

The value of the call option to the issuer would depress the price of the bond compared to the 15 year non-callable bond. This negative impact on the price of the bond manifests itself as a negative convexity over an intermediate range of interest rates as we move effectively from the very sensitive price/yield curve of the 15 year non-callable bond to the much less sensitive price/yield curve of a 1 year non-callable bond.

5) Mortgage Backed Securities (MBS) have a prepayment feature. If the individuals who have taken out the mortgage repay them quicker than expected then there is effectively a call option in the MBS security to remove the risk from the originator/servicer of the MBS

E)

	linked US	base INR		base INR	linked US
spot at start		1	50.05=>		1 0.01998002
conversion rate		1	49.5=>		1 0.02020202
=> expect US to weaken against INR					
1) initial amount INR		50,000,000	US equivalent	999,001	
INR interest rate		8.10%			
2) Scenario 1					
prevailing rate		1	51.3=>		1 0.019493177
=> INR weaken against US and so payment in INR					
=50,000,000 *(1+ 0.081*180/360)	INR		52,025,000.00	US equivalent	1,014,132.55
Return on your investment INR			2,025,000.00		
3) Scenario 2					
prevailing rate		1	47.2=>		1 0.021186441
=> US weaken against INR and so payment in US					
=50,000,000 *(1+ 0.081*180/360)/49.5		US\$	1,051,010.10		
Return on your investment INR		=(1,051,010.1*47.2)-50,000,000	(392,323.23)		

4) Consider if the bank wishes to transfer for example US\$ dividends to India and convert into INR after six months. The bank has an option to buy INR 1 at US\$ 0.02020 from the customer but in scenario 1 the bank can buy INR 1 at US\$ 0.1949 and so they do not buy the customer's INR. In scenario 2 the market rate is INR 1 at US\$0.0211, and so the bank buys the INR from the customer. If INR appreciates, then the bank wishes to ensure that it has bought a certain minimum amount of INR with its US\$ ie a call option against INR appreciating against the US \$ (or alternatively a put option against US \$ depreciating) Hence the customer has written an fx call option with a US\$:INR strike price of 49.5:1.

The bank would price the call option using say Black Scholes and add other profit margins as well as a retail customer has less bargaining power than an institutional investor.

5)i)	Bank wishes to buy INR using US \$. Foreign currency is analogous to a stock paying a known dividend yield of foreign risk-free interest rate. In this case INR is analogous to equity if it appreciates in value then call option is exercised and so US\$ is the base/local currency for calculation			
	Assume			
	value of 1 INR in US \$= S <sub>0</sub>	0.01998002		
	risk free INR r <sub>f</sub>	8.10%		
	risk free US r	1%		
	T	0.5		
	strike price X	0.02020202		
	sigma	0.2		
		call option to buy one unit of INR in US\$		
	d <sub>1</sub> =	$\{\ln(S_0/X)+(r-r_f+(\sigma^2)/2)*T\}/(\sigma*\sqrt{T})$	-0.25844637	
	d <sub>2</sub> =	$d_1-\sigma*\sqrt{T}$	-0.399867726	
	N(d <sub>1</sub> )=		0.398031217	
	N(d <sub>2</sub> )=		0.344626972	
	c= (in US\$)	$\{S_0*\exp(-r_f*T)\}*N(d_1)-\{X*\exp(-r*T)\}*N(d_2)$	0.000709586	
	cost for 5 crore in US\$	$=c*(50,000,000/50.05)$	709	
		cost in INR	35,479	
	Broadly an out of the money option and expect INR to appreciate due to 8.1%pa interest rates compared to 1%pa in USA			

5(ii) Pay lower interest rate in INR  
Have bid/offer spread in fx

6) Credit risk of the bank which as dealing with a retail investors will not be collateralised though there may be bank deposit insurance

What the level of US interest rates are during the six months e.g. risk/return reward might be better if converted using fx rate at beginning and earning US interest rates  
Likely to be early redemption penalties

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