Institute of Actuaries of India

Subject SP5 –Investment and Finance

September 2021 Examination

INDICATIVE SOLUTION

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:

i) Cross-border tax schemes

With globalization of businesses, there has been a growing perception that governments lose substantial tax revenues through companies shifting profits to locations where they are subject to a more favorable tax treatment. [0.5]

This is evidenced by the rise in cross-border tax schemes, such as:

- moving earnings to a country with a lower tax rate (eg internal group leverage such as financing subsidiaries in high tax countries primarily with debt) [1]

- profit shifting through transfer mispricing, i.e. by setting prices for intra-group transactions which are inconsistent with market rates or by levying high charges for the use of intellectual property such as trademarks [1]

- taking advantage of differences between tax regimes, e.g. through the use of 'hybrid' instruments (which may lead to a tax deduction in one country without incurring taxation in another). [1]

[Max 2]

ii) Role of non-executive directors

The role of the non-executives is to provide an impartial view and represent the shareholders' interests. [0.5]

In practice, this is likely to involve:

- challenging and contributing to the development of strategy [0.25]
- monitoring the performance of management [0.25]
- role in setting the remuneration for executive directors' pay [0.25]
- role in the nomination and appointment of new board members [0.25]
- role in the audit committee. [0.25]

Audit committee aims to monitor the financial reporting of the company, together with its financial / risk controls, and meet with external auditors with no members of the executive present. [0.5]

Separate committees for each of the remuneration, nomination and audit functions may be set up consisting exclusively of non-executive directors. [0.5]

[Max 2]

iii) Herding

Investment managers show herding behaviour when they make buy or sell decisions based on what others are doing. [0.5]

Herding is potentially bad for financial markets as it may increase volatility and possibly even threaten the integrity of the whole system if markets are driven to extremes. [0.5]

There are a number of explanations for herding by investment managers including:

- the idea that they copy others that they perceive to be better informed about a particular situation [0.5]
- the incentives facing them (for example, the idea that if every manager performs equally badly you are unlikely to be sacked) [0.5]
- fear of missing out; or [0.5]
- an intrinsic desire to conform [0.5]

Herding is rather difficult to measure directly as it is hard to know an individual's true motives for an investment decision. [0.5]

Generally, there is some evidence of herding amongst investment managers and this is more pronounced

- in times of financial stress
- in less developed markets [0.5]

[Max 3]

iv) Effect of options

The framing effect refers to the fact that choices may be influenced by the way in which the choices (options) are presented or framed. [0.5]

The primary effect refers to the fact that people are more likely to choose the first option presented. [0.5]

The recency effect refers to the fact that in some instances, the final option that is discussed may be preferred [0.5]

The gap in time between the presentation of the options and the decision may also influence the choice. The sooner/later the decision is made; the more likely it is that the first/last option will be chosen. [1]

A greater range of options tends to discourage decision-making. On the other hand, a higher probability is attributed to options explicitly stated than when included in a broader category. [1]

Other research suggests that people are more likely to choose an intermediate option than one at either end. [0.5]

[Max 3]

v) Tax issues affecting investment decisions

Each investor, individual or institution, will attempt to maximize after-tax returns (subject to risk constraints) and will therefore attempt to find tax- efficient investments. [0.5]

Factors that need to be considered are:

- the total rate of tax on an investment [0.5]
- how the tax is split between different components of the investment return i.e. between income and capital gains [0.5]
- the timing of tax payments [0.5]
- whether the tax is deducted at source or has to be paid subsequently [0.5]

- the extent to which tax deducted at source can be reclaimed by the investor [0.5]
- to what extent losses or gains can be aggregated between different Investments or over different time periods for tax purposes [0.5]

We need to know the effective rate of tax once we have allowed for the time at which tax becomes payable and the extent to which tax paid on an asset can be offset against other tax liabilities. [0.5]

[Max 3]

[Max 13 Marks]

Solution 2:

i) Working of CDS

A Credit Default Swap (CDS) is a contract that provides a payment if a particular credit event (like insolvency, winding-up, rating downgrade, cross-default) occurs. [1]

In this case, CDS gives ABC bank the right to sell a bond issued by the infrastructure company to XYZ investment bank for the full face value of the bond in the event the infrastructure company defaults on the bond. [1]

The party that buys the protection pays a fee (premium) to the party that sells the protection – i.e. ABC bank makes a payment to XYZ investment bank. [0.5]

Upon credit event within the term of CDS, a payment is made from the seller to the buyer. If the infrastructure company defaults within the term of CDS, then a payment is made from XYZ investment bank to ABC bank. [0.5]

The payment may take the form of either:

- a pure cash payment, representing the fall in the market price of the defaulted bond [0.5]
- physical settlement: exchange of both cash and the security. *S*eller pays the buyer the full notional amount of the bond in return for the defaulted bond. [0.5]

If there is no credit event within the term of CDS, then the buyer (ABC bank) receives no monetary payment but would has benefited from protection from possibility of default during the tenure of the contract. [1]

[Max 4]

ii) Cost of CDS and Comments

The current price of the Government bond per 100 face value is given by:

$12a_{\overline{15|}} + 100v^{15}$ @8% $= 134.24$ [1]

So the issue price of the infrastructure company bond with 1% spread would be:

$12a_{\overline{15|}} + 100v^{15}$ @9% $= 124.18$ [1]

The cost of the CDS is estimated to be equal to the difference between prices of the Government bond and the infrastructure company bond, i.e.:

Value $= 134.24 - 124.18 = 10.06$ [0.5]

This value is only an estimate because this calculation:

- assumes no arbitrage opportunities whereas in reality there could be a narrow window for arbitrage opportunities due to different supply and demand dynamics in different markets [0.5]
- ignores transaction / arrangement costs [0.25]
- assumes that the difference between the Government bond price and the infrastructure company bond price is due entirely to credit risk [0.5]

… in particular, it ignores the lower marketability of infrastructure company bond and also the risk aversion of investors [0.25]

- assumes that XYZ investment bank selling the CDS is risk-free and will never default on the CDS [0.5]
- ignores XYZ investment bank's desire to make a profit on the CDS deal. [0.5]

[Max 4]

iii) Regulations controlling use of CDS

Regulations may require all standardized CDS trades to be cleared by a regulated central counterparty, which would stand ready to fulfill the obligations that any one party was unable to make, and require that all financial institutions with large CDS risk (sellers) be subject to capital requirements and strict oversight. [1]

Regulations may require all customized CDS transactions to be recorded in a regulated trade depository, which in turn, would report the information in aggregate to the public and in a more detailed fashion to regulators. [0.5]

Regulators may allow use of CDS for hedging but may restrict or prohibit use of CDS for speculation purposes. [0.5]

Hedging: An institution that has reached its internal credit limit (self-regulated) for exposure to a particular client, but wishes to extend its lending to the client (in order to maintain a good relationship) still further can do so using CDS. [1]

The "notional value" of a CDS contract is the amount of the loan referenced by the contract. Regulators may impose a limit on use of CDS as a proportion (say 50%) of referenced corporate bonds held by the institution. [0.5]

Speculation: Based on their view about bond issuer's financial strength, institutional investors may make money by selling or buying CDS to increase or reduce their credit exposure to the underlying bond issuers. [0.5]

In order to make money an institution may:

- Sell a CDS, if its view is that a default will not occur within the CDS term. [0.5]
- Buy a naked CDS, if its view is that a default will occur within the CDS term. [0.5]

In order to restrict speculative use of CDS; regulations might

- prohibit any institution to buy naked CDS [0.5]
- impose market wide position limit like notional value of CDS be within X% (say 40%) of total referenced bonds outstanding by the bond issuer. [0.5]

- require public disclosure, at a common forum, if any institution holding a position in CDS exceeds Y% (say 5%) of the market wide position limit [0.5]
- limit any institution holding a position in CDS to Z% (say 20%) of the market wide position limit [0.5]

[Max 6]

[Max 14 Marks]

Solution 3:

i) Return on forward by estimating forward price

Assumptions:

- latest dividend yield remains same for the remaining term of the forward [0.5]
- dividends are paid at the end of the year [0.5]
- interest rate is the forward rate implied by the current yield curve [0.5]

Forward rates implied by the current yield curve are:

$f_{(0,1)} = 5.50\%$

$$100 = \frac{5.25 + \frac{105.25}{(1+f_{(1,1)})}}{(1+f_{(0,1)})} = \frac{5.25 + \frac{105.25}{(1+f_{(1,1)})}}{(1.055)} \Rightarrow f_{(1,1)} = 4.99\%$$ [1]

$$100 = \frac{5 + \frac{5 + \frac{105}{(1+f_{(2,1)})}}{(1+f_{(1,1)})}}{(1+f_{(0,1)})} = \frac{5 + \frac{5 + \frac{105}{(1+f_{(2,1)})}}{(1.0499)}}{(1.055)} \Rightarrow f_{(2,1)} = 4.46\%$$ [2]

The forward price is estimated by accumulating current index value over the term with forward rates of each year and deducting assumed future dividends at each year-end.

At start, $F = S\left(1 + f_{(0,1)}\right)\left(1 + f_{(1,1)}\right)\left(1 + f_{(2,1)}\right)(1 - div.yld)^3$

$F = 8{,}000\ (1.055)(1.0499)(1.0446)(0.975)^3 = 8{,}579.53$ [2]

After one year, $F = S\left(1 + f_{(0,1)}\right)\left(1 + f_{(1,1)}\right)(1 - div.yld)^2$

$F = 9{,}000\ (1.055)(1.0499)(0.985)^2 = 9{,}671.75$ [1]

Return on the forward contract is:

$\frac{9{,}671.75}{8{,}579.53} - 1 = 12.73\%$ [0.5]

[Max 7]

ii) Comment / compare with total returns on index

Return on the forward contract 12.73% compares to an increase in value of the index of:

$\frac{9{,}000}{8{,}000} - 1 = 12.50\%$ [0.5]

The forward price has increased more rapidly over the one-year period because:

- the effective/level risk-free rate over the term to maturity has increased between start $\left\{\left((1.055)(1.0499)(1.0446)\right)^{\frac{1}{3}} - 1\right\}$ and end $\left\{\left((1.055)(1.0499)\right)^{\frac{1}{2}} - 1\right\}$ of the year, making the forward a more valuable way of delaying the purchase of the underlying equities in order to earn more interest on the money saved by not purchasing the shares. [1.5]

- the dividend yield has fallen from 2.50% to 1.50%, meaning that the value of the future dividends to be received over the term to maturity of the forward has reduced (as a proportion of the value of the shares themselves). [1]

However, this comparison ignores dividends and interest.
The dividends would have been received had the index equities actually been held over the year. Dividend is approximately equal to: $9000\ (1.50\%) = 135$ [0.5]

Adding dividend to the capital return on the index would then give total return:
$12.50\% + \frac{135}{8{,}000} = 14.19\%$ [0.5]

Interest would be earned on the money saved by buying the forward and not the shares.
The interest could be estimated as: $8000\ (5.50\%) = 440$ [0.5]

Adding the interest to the return on the forward would then give a total return of about:
$12.73\% + \frac{440}{8{,}579.53} = 17.86\%$ [0.5]

This is higher than the total return from the index by 3.67% mainly due to fall in dividends for three years and to some extent due to rise in interest rates for two years, approximately $3.52\% = 3(2.50\% - 1.50\%) + 2\left(\left(\frac{5.50\%+4.99\%}{2}\right) - \left(\frac{5.50\%+4.99\%+4.46\%}{3}\right)\right)$. [1]

[Max 6]

iii) Key points on Terminal payoff chart

End-points given: Share price at 500 and 1000;

Turning points occur when Share price is at the strike prices; and

Break-even point (i.e. terminal payoff is zero) occurs between any two consecutive Share price points (an end-point and a turning point or two turning points) where terminal payoff values have opposite signs.

Let S be the settlement price of the Share at end of the month; K is strike price;

Consider the terminal payoffs of the Strategy:

Short two calls = – 2 max (0, S – 900)

Long call = + max (0, S – 850)

Long put = + max (0, 850 – S)

Short two puts = – 2 max (0, 800 – S)

If S < 800 then,

Terminal payoff = 850 – S – 2(800) + 2S = S – 750

If S > = 800 and S < 850 then,

Terminal payoff = 850 – S

If S > = 850 and S < 900 then,

Terminal payoff = S – 850

If S > = 900 then,

Terminal payoff = S – 850 – 2S + 2(900) = 950 – S

[1]

Terminal payoff value = 800 times the sum of payoffs of individual contracts. [0.5]

The seven key points on chart of the Strategy (Share price; terminal value payoff):
(500; – 200,000); (750; 0); (800; 40,000); (850; 0); (900; 40,000); (950; 0); and
(1000; – 40,000)

(0.5 for each key point) [3.5]

[Max 5]

iv) Views of the investor

The investor might choose the above option strategy because:

Investor thinks that the share price may move significantly in a month from current price (850) and is not sure of in which direction it will move. [0.5]

This situation can arise when the market is waiting for news (e.g. an announcement of the company's latest results or a court ruling) that will have a definite effect on the share price, but no one knows which way it will go. [1]

On the other hand, even if the share price is sticky and stays close to current price (in case of news item being postponed beyond current month) the investor would make decent gains, an amount at least equal to aggregate premiums collected. [1]

Aggregate premiums = 32,000 $\left(= 800\ (40) =\ 800\big(2(35) - 55 - 65 + 2(45)\big)\right)$

[0.5]

Investor might have an idea on the magnitude of the move, roughly 6% $\left(= \frac{50}{850}\right)$ where gains are maximum. [1]

Investor might be confident that in case of unexpectedly extreme move, maximum move may be within 16% $\left(= \frac{140}{850}\right)$ beyond which investor incurs losses (including aggregate premiums). [1]

[Max 5]

[Max 23 Marks]

Solution 4:

The first step would be to define what is market risk in this context. [0.5]

The variance of the return on the portfolio relative to NIFTY 50 over a specified period of time could be a suitable measure of market risk. [1]

For example – Tracking error relative to NIFTY 50. [0.5]

Set out a mathematical model to calculate the above defined measure of risk [0.5]

The risk factors used underneath the model should be easily understandable. [0.5]

The mutual fund company should measure the risk on a daily / weekly basis [0.5]
The fund manager for this fund has to be continuously aware of the risk exposures. The risk exposure arising between the index fund and the NIFTY 50 should be understood. [1]

There should be an automated system to capture the changes in asset values relative to benchmark fund. [1]

They also need the tools to understand the effect of their actions on the risk of the portfolio. The rationale behind investment decisions should be documented. [1]

The reports should also be made regularly to senior management. [0.5]

The limits for departure from the investment benchmarks shall be established clearly. [0.5]
Limits for departure can be set as Load ratio or load difference. Any departure should be documented. [1]

For an effective risk control system, personnel responsible for monitoring risk should be independent of the fund managers. [1]

The Company may consider the derivatives to manage market risk. [0.5]

[Max 10 marks]

Solution 5:

i)

a)	0.82%	[1]
b)	0.32%	[1]
c)	0.73%	[1]
d)	0.20%	[1]
e)	0.09%	[1]
f)	0.12%	[1]
g)	0.72% and 0.01%	[1]
h)	0.04% and 0.04%	[1]
i)	0.23% and -0.03%	[1]

j) 0.06% and 0.06% [1]

ii) Both the fund managers have outperformed the benchmark fund [0.5]

Fund Manager I has given higher return than Fund Manager II [0.5]

FM I has been better in picking individual stocks than FM II. [0.5]

However, FM II has performed better in sector selection. [0.5]

The stock selection profit is mainly due to equites for both the fund managers. [0.5]

FM II has given negative return in stock selection of Bond funds. [0.5]

As the benchmark fund was invested 50:50 in equities and bonds hence contribution of equities and bonds in sector selection has been same for both the fund managers. [1]

[4]

iii) The year-wise returns for FM I, FM II and the benchmark fund are:

Year	Fund Manager I	Fund Manager II	Benchmark Fund
1	7.7%	6.9%	7.3%
2	6.2%	7.7%	7.0%
3	8.4%	4.9%	6.7%
4	4.2%	5.4%	5.0%
5	14.5%	13.5%	10.7%

[0.5 mark for each columns]

Year	FM I less Benchmark	FM II less Benchmark
1	0.4%	-0.4%
2	-0.8%	0.7%
3	1.7%	-1.7%
4	-0.8%	0.4%
5	3.9%	2.8%
Average relative return	0.9%	0.3%
Tracking Error	1.8%	1.5%
Information Ratio	**0.49**	**0.24**

[1 for relative returns, 1 for average, 1 for tracking error & 1 for information ratio]

[Max 5]

iv) Both the fund managers have positive information ratio.

FM I has higher information ratio, almost double, than FM II.

This signifies that FM I has been more efficient in converting additional risk into returns.

However, tracking error of FM I is higher than that of FM II and accordingly the performance of FM I is more volatile than FM II.

[0.5 mark each; Max 2 marks]

[Max 21 marks]

Solution 6:

The key risks for the liabilities under this new product are:

- Interest rate risk
- Inflation risk
- Longevity risk [1.5]

The base annuity rate is guaranteed till the annuitant is alive. As this is available for customers aged between 50 years and 55 years, so it implies that the tenure of liability would be higher. [1]

This implies a higher duration of liabilities and thus greater interest rate risk. [0.5]

Interest rate risk can be managed by investing in instruments which match the duration and value of the base annuity cashflows outgo, such as interest rate swaps or bonds. [1]

However, due to longer duration of liabilities it would be challenging to find suitable longer duration bonds to match the duration. [1]

Rolling over the bonds can be employed but this would expose to reinvestment risk. Use of swaps can be helpful in this scenario. [1]

The future annuities are dependent on the inflation level so the present value of these expected cashflows would be sensitive to inflation expectations. [1]

To match the inflation linked liability, investments in inflation linked bonds or inflation swap would be useful. [1]

As the annuity payments would be made till the time annuitant is alive so this exposes the liability to longevity risk. The longevity risk could be managed by entering into longevity swaps or longevity insurance policies that exchange fixed expected payments to annuitants in return for actual payments to annuitants. [1]

[Max 8 marks]

Solution 7:

The key risks for the liabilities under this new product are:

i) Asset pricing model: Asset pricing relates to the systematic determination of the value of risky securities such as equities, bonds and derivatives. Modern asset pricing models all derive from the notion that price equals the expected discounted payoffs from an asset. [1]

Approaches used include consumption-based models, which are derived from the fact that an asset's price should equal the expected discounted value of the asset's payoff, using the investor's marginal utility to discount the payoff. [1]

[2]

ii) Absolute pricing model: Absolute pricing prices assets by reference to exposure to fundamental sources of macroeconomic risk – i.e. unpredictable macroeconomic variables such as inflation, economic growth and interest rates. It is the unpredictability of these variables that leads to the unpredictability of returns on risky assets. [1]

The consumption-based and general equilibrium models (such as CAPM) are examples of this approach, which can be used to predict how prices might change if policy or economic structures change. The prices so obtained are therefore capable of an economic interpretation. [1]

[2]

iii) Relative pricing model: Relative pricing considers the value of an asset given the price of some other assets. [1]

Here we use as little information about fundamental risk factors as possible, and we do not ask where the prices of the other assets came from. For example – Black Scholes option pricing and Arbitrage pricing theory. [1]

[2]

iv) Risk budgeting process: Risk budgeting is an investment style where asset allocations are based on an asset's risk contribution to the portfolio as well as on the asset's expected return. [1]

Define the "feasible set" – the set of asset classes that could be included in the portfolio. Here the risk budgeter will wish to obtain careful estimates of the volatilities and covariances of each asset class. [1]

Choose the initial asset allocation using some risk / return optimization process, and with a VaR assessment to determine the risk tolerance. [1]

Monitor risk exposures (increases and decreases in the values of the positions) and changes in volatilities and correlations. [1]

Rebalance the portfolio in response to changes in the short-term conditional volatility and correlations of the assets. Allocations are altered to keep the overall portfolio risk at the level defined as tolerable for the investor. [1]

[5]

[Max 11 marks]

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