INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

SP5 – Investment and Finance

May 2025

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.

Q.1)

i) A bond forward is a contract between two parties to buy or sell a specific bond at a fixed price on a future date.

- It's like agreeing today to buy (or sell) a bond later at a price you both lock in now.
- No money usually changes hands until the settlement date.
- The bond itself could be a government bond, corporate bond, etc.

(2)

ii)

Aspect	Bond Forward	FRA (Forward Rate Agreement)
What it is	Contract to buy/sell a specific bond at a future date for a fixed price.	Contract to lock in an interest rate on a notional amount for a future borrowing or lending period.
Underlying asset	A specific bond (e.g., 10-year G-Sec).	Interest rate (e.g., 6-month OIS).
Purpose	To hedge or speculate on bond prices (and indirectly, interest rates).	To hedge or speculate on future interest rates.
Settlement	Deliver or cash-settle the bond (or cash difference).	Cash settlement based on the difference between agreed rate and actual market rate. No bond or loan is exchanged.
Risk exposure	Bond price moves (duration, credit risk if applicable).	Interest rate moves only.
Market	OTC (over-the-counter) contract.	OTC contract.

(5)

iii) Liquidity Risks in an FRA Portfolio:

- **Market Liquidity Risk:**
  FRAs are over-the-counter (OTC) contracts, meaning they are not traded on an exchange. It can be hard to find a counterparty willing to enter or exit a position quickly, especially in stressed market conditions.
- **Exit Difficulties Before Maturity:**
  Since FRAs are customized and non-standardized, unwinding a position before maturity may be expensive or even impossible without significant price concessions.
- **Valuation Uncertainty:**
  The lack of a centralized market can cause discrepancies in pricing. Bid-ask spreads can widen during volatile periods, leading to potential losses if forced to sell or adjust the position.
- **Counterparty Liquidity Risk:**
  If the counterparty faces financial trouble, they might fail to meet settlement obligations, adding liquidity strain to the portfolio.
- **Margin Call Pressure (for Cleared FRAs):**
  If FRAs are centrally cleared (as is becoming more common post-2008), margin calls must be met daily. In times of high market volatility, this can create liquidity stress if the portfolio experiences rapid mark-to-market losses.

Mitigating liquidity risk in FRA portfolios requires a combination of

- contract standardization – Where possible, structuring FRAs using **market-standard terms** (such as common settlement dates, reference rates, and notional sizes) improves their tradability, making it easier to find counterparties for unwinding or offsetting positions.
- Moving FRA contracts to **central clearing houses** can improve liquidity. Cleared FRAs often have standardized terms and benefit from netting, reducing the need for bilateral negotiations when exiting or modifying positions.
- careful counterparty management - Spreading FRA contracts across multiple counterparties rather than concentrating exposure to one party reduces the risk of liquidity pressure if a single counterparty becomes financially unstable.

- strategic liquidity planning - Keeping sufficient cash or liquid assets available ensures that unexpected settlement needs (e.g., early termination or margin requirements in cleared trades) can be met without forced liquidation of assets.
- proactive market monitoring. - Active monitoring of FRA market spreads, counterparty creditworthiness, and broader liquidity conditions helps anticipate potential liquidity issues early, allowing proactive management.

(6)
[13 Marks]

Q.2)

i) A central bank may be interested in:

- monetary, interest rate and inflation policy
- banking regulation
- implementation of government borrowing
- performance and integrity of financial markets
- intervention in currency markets
- printing and minting of notes and coins, and taxation.

In many countries, central banks are now primarily concerned with monetary policy and control, including the following aspects:

- adjustment of banking sector liquidity
- control of money supply growth and short-term interest rates.

(3)

ii) Minimum liquid reserve ratios

Banks expand the money supply through lending. They are able to do this because they need only to keep a proportion of the deposits made with them in the form of liquid investments. Imposing minimum liquid reserve ratios therefore restricts the ability of banks to expand the money supply by restricting the money multiplier.

Interest rate ceilings for bank deposits

Setting an interest rate ceiling for bank deposits restricts the ability of the banks to compete for investors' money. This reduces the amount of money coming into the banking system and so limits the extent to which bank lending is able to expand the money supply.

Directives on types of lending

Here the central bank restricts the expansion of the money supply by directly restricting lending. For example, the central bank could restrict the extent to which consumer credit is available (eg by limiting the proportion of a purchase that can be made on credit) or impose restrictions on mortgage lending.

(5)

iii) When the Reserve Bank of India (RBI) cuts its policy repo rate—the rate at which it lends short-term funds to commercial banks—it sets off a chain of effects through the economy.

1. Cheaper Bank Funding

- Lower cost of funds for banks **-** Banks borrow from the RBI at a cheaper rate, which reduces their own funding costs.
- Transmission to lending rates - Over time, banks generally pass some of those savings on to customers in the form of lower lending rates (e.g. on home, auto and business loans).

2. Stimulus to Credit Growth

- Boost to corporate and retail borrowing - Lower interest rates make credit more attractive, so businesses are likelier to invest in expansion, and consumers more likely to finance big-ticket purchases.
- Higher aggregate demand - Investment and consumption pick up, supporting GDP growth.

3. Impact on Inflation
- Upward pressure on prices
  As demand strengthens, there can be a pull on prices, especially if supply doesn't keep pace. The RBI will watch inflation benchmarks (CPI) closely to ensure they stay within its 2–6% tolerance band.

4. Exchange Rate and Capital Flows

- Weaker rupee (in the short run)
  Lower domestic rates can make rupiah-denominated assets less attractive to foreign investors, putting modest downward pressure on the rupee.
- Portfolio rebalancing
  Some foreign portfolio investors might seek higher yields elsewhere, though overall FX impact often depends on global rate differentials more than a single rate cut.

5. Impact on Savers
- Lower deposit rates
  Banks typically reduce the interest they pay on savings and term deposits, squeezing retail savers' returns.
- Shift toward riskier assets
  To chase yield, some investors may move money into equity markets, real estate or gold.

6. Financial Markets and Bond Yields
- Government bond yields tend to fall
  When policy rates come down, new government securities often offer lower coupons; existing bonds with higher coupons appreciate, pushing yields lower.
- Equity markets often rally
  Cheaper finance and expectations of stronger corporate profits can boost stock prices.

A repo-rate reduction is a classic monetary stimulus: it lowers borrowing costs, encourages spending and investment, and thereby supports growth—but it must be calibrated so that inflation and currency stability remain under control.

(9)

iv) **RBI reduces the policy repo rate** (the rate at which banks borrow money from the RBI), it generally means:

- Interest rates across the economy tend to go down.
- Bond yields fall (since bond prices rise when interest rates drop).
- It becomes cheaper for businesses and individuals to borrow.
- Fixed income returns (like from government bonds) reduce.

Now, for an insurance company's ALM (Asset-Liability Management) — which is all about matching assets (investments) with liabilities (future payouts to policyholders) — a repo rate cut has several impacts**:**

1. Investment Returns Drop (Asset Side Impact)

- Insurers, especially life insurers, invest heavily in government bonds, corporate bonds, etc.
- Lower repo rates push down bond yields, New investments will now earn lower returns.
- This reduces the overall portfolio yield over time.
- Future investment income falls, which can cause a mismatch if the liabilities (like guaranteed payouts) remain fixed or are high.

2. Liability Valuation Increases (Liability Side Impact)

- When discount rates fall (driven by falling interest rates), the present value of future liabilities goes up.

- Especially true for long-term insurance products like annuities, pensions, endowment policies.
- Liabilities "look" bigger on the balance sheet, funding gap widens if asset returns don't catch up.

3. Duration Mismatch Risk Increases

- Lower yields may encourage insurers to invest in longer-duration bonds to maintain returns.
- This introduces duration mismatch risk: if liabilities move differently from assets with rate changes, there's trouble.
- ALM teams have to carefully rebalance portfolios to match durations and hedge risks.

4. Product Pricing and Strategy Need Adjustment

- If guaranteed return products (like traditional life insurance plans) are priced assuming higher yields, the company may face a squeeze.
- Need to reprice products, reduce guarantees, or push customers toward unit-linked products (ULIPs) that shift investment risk to customers.
- Business models and product offerings may need rethinking.

5. Potential Regulatory Pressure

- Regulators watch ALM gaps closely, especially for solvency margin and stress testing.
- A sustained low-rate environment could trigger more regulatory scrutiny on the ALM position.

(9)
[26 Marks]

Q.3)

i) To combine historical risk and historical return (relative to a benchmark) a commonly used statistic is the information ratio – the ratio between the relative return and the historic active risk or tracking error.

Information ratio = mean relative return/ standard deviation of relative return

(2)

ii) Information Ratio measures the quality of active management, not just the quantity of return. High return + Low risk = **High IR** = **Skill ful Manager**

Evaluate fund managers	Tells you how efficiently a manager converts risk into active returns (not just "who got lucky").
Compare funds	Between two funds, the one with the higher IR is usually better on a risk-adjusted basis — even if raw returns are similar.
Performance attribution	Helps separate whether performance is due to skill (high IR) or just taking more risk.
Portfolio construction	In multi-manager portfolios (e.g., pension funds), managers with higher IRs are given more capital allocation.
Manager incentives	Asset owners often tie bonus/incentive fees for fund managers to achieving certain IR thresholds.
Screening	Investment analysts use IR to screen large groups of funds for "skilled" managers before deeper analysis.

IR may not be the best choice for assessing the performance of the fund managers. Reason being:

Drawback	Why it Matters
Assumes normal distribution	IR uses mean and standard deviation — it assumes returns are "normally" distributed. But real returns often have fat tails, skewness, outliers (especially in stressed markets).
Doesn't differentiate upside vs downside risk	Standard deviation treats all volatility as bad — even if it's due to outperformance! IR punishes both positive and negative swings equally.
Sensitive to short sample periods	Over short periods (e.g., 1–2 years), IR can be highly unstable or misleading because small random variations can dominate.
Can be gamed	Managers might take tiny active positions to get a high IR with low tracking error — but without delivering meaningful returns.
Ignores absolute returns	A manager could have a great IR but still deliver low or even negative absolute returns if the benchmark itself is bad.
Backward-looking	IR is purely historical. A high IR in the past doesn't guarantee future skill, especially if market conditions change.
Sensitive to benchmark choice	If you pick the wrong benchmark (not representative of the manager's style), IR becomes meaningless or misleading.
Doesn't handle non-linear strategies	For managers using options, derivatives, or complex hedges (e.g., tail risk hedging funds), IR often fails because their return patterns are very non-normal.

(8)

iii)

Step 1: Calculate Excess Returns (Fund Return - Benchmark Return)

Year	Fund X Excess Return (%)	Fund Y Excess Return (%)
1	12% - 10% = **+2%**	9% - 10% = **-1%**
2	9% - 8% = **+1%**	7% - 8% = **-1%**
3	8% - 5% = **+3%**	5% - 5% = **0%**
4	6% - 7% = **-1%**	8% - 7% = **+1%**

Step 2: Calculate Average Active Return

Fund X:

Average Active Return$X = (2+1+3+(-1))/4 = 5/4 = 1.25\%$

Fund Y:

Average Active Return$Y = (-1+(-1)+0+1)/4 = -1/4 = -0.25\%$

Step 3: Calculate Tracking Error (Standard Deviation of Excess Returns)

Fund X:

Year	Deviation from Mean	Deviation²
1	2 - 1.25 = 0.75	0.5625
2	1 - 1.25 = -0.25	0.0625
3	3 - 1.25 = 1.75	3.0625
4	-1 - 1.25 = -2.25	5.0625

Sum of squares:

$0.5625+0.0625+3.0625+5.0625=8.750$

Variance (divide by n-1 = 3):

VarianceX=8.75/3≈2.9167

Tracking error:

Tracking ErrorX= sqrt{2.9167} = ~ 1.7078%

Fund Y:

Year	Deviation from Mean	Deviation²
1	-1 - (-0.25) = -0.75	0.5625
2	-1 - (-0.25) = -0.75	0.5625
3	0 - (-0.25) = 0.25	0.0625
4	1 - (-0.25) = 1.25	1.5625

Sum of squares:

0.5625+0.5625+0.0625+1.5625=2.750

Variance:

VarianceY=2.75/3= 0.9167

Tracking error:

Tracking ErrorY= sqrt{0.9167} = ~0.9574%

Step 4: Calculate Information Ratio

Fund X:

IRX=1.25%/1.7078%= 0.73

Fund Y:

IRY=−0.25%/0.9574% = −0.26

Final Results:

Fund Manager	Average Active Return	Tracking Error	Information Ratio
X	+1.25%	1.71%	0.73
Y	-0.25%	0.96%	-0.26

Conclusion:

Fund Manager X clearly **outperformed**:

- Positive active return (vs negative for Y)
- Acceptable tracking error
- **Positive Information Ratio** (0.73), while Manager Y had a **negative IR** (-0.26).

Even though **Fund Y** was more consistent (lower tracking error), the active return was negative, meaning Fund Y systematically underperformed the benchmark.

(9)
[19 Marks]

Q.4)

- Taxation significantly impacts investment decisions by affecting the expected after-tax returns on investments.
- Higher taxes on income, capital gains, or corporate profits can discourage investment by lowering net returns, while tax incentives such as credits, deductions, or lower rates can encourage it.
- Investors must consider the overall tax burden, the timing of tax payments, and the legal structure of their investments to optimize after-tax profitability.
- When evaluating investments, especially across different jurisdictions, tax implications like double taxation or access to tax treaties become critical factors.
- Methodologically, the impact of taxation on investment behaviour is often analysed using models like the user cost of capital, and empirically assessed through regression analyses of firm behaviour before and after tax reforms.
- In summary, understanding the structure and incidence of taxation is essential for making informed and strategic investment decisions.

[4 Marks]

Q.5)

i) Potential Benefits of International Diversification:

- **Risk Reduction**:
  - Foreign markets often have **lower correlation** with domestic equities.
  - Reduces overall portfolio volatility through diversification across **different economic cycles**, **political environments**, and **currency zones**.
- **Return Enhancement**:
  - Access to **new growth markets** (e.g., emerging markets, frontier economies).
  - Potential to **capture higher returns** where domestic markets are stagnant or underperforming.
- **Currency Diversification**:
  - Exposure to foreign currencies can act as a **natural hedge** if domestic currency depreciates.
- **Broader Opportunity Set**:
  - Ability to invest in sectors or industries underrepresented in the domestic market (e.g., tech giants, luxury goods, renewable energy leaders).

Critical Factors to Evaluate Before Implementation:

Factor	**Why It Matters**
Correlation analysis	Need to verify that international equities are truly less correlated — during global crises, correlations often spike ("correlation breakdown").
Currency risk	FX fluctuations can **amplify** or **erode** returns. Need decision: hedge currency exposure or leave unhedged?
Market selection	Should the focus be on **developed markets** (e.g., US, Europe) or **emerging markets** (e.g., India, Brazil)? Different risk/return dynamics.
Political and regulatory risks	Some foreign jurisdictions have high regulatory uncertainty, capital controls, or unstable political environments.
Cost of access	International investing often comes with **higher transaction costs**, **custody fees**, and sometimes **tax inefficiencies** (e.g., withholding tax on dividends).
Liquidity concerns	Some international markets (especially emerging/frontier markets) can have lower liquidity, leading to higher trading costs or exit risks.
Alignment with portfolio objectives	International investments should fit the portfolio's **strategic asset allocation** and not just be a tactical move.
Operational readiness	Evaluate whether existing systems, custody arrangements, and compliance processes can handle international securities.

The client suggested taking exposure through following types of derivatives:

- **Using futures market**
- **Using Options**
- **Undertaking an Equity swaps**

(8)

ii)

Futures:

- The manager would need to find a domestic equity market index future that closely matches the equities in their client's portfolio. The equity exposure could then be reduced by selling equity futures.

- They could obtain equity market exposure in international markets by buying futures in a variety of international equity markets. This would happen at the same time as selling the domestic equity market futures.

Options:

- The simplest way of getting international exposure through the options market would be to buy call options on overseas equity indices such that the market exposure (which would depend on the delta of the options) was sufficient.
- It would be possible to simultaneously sell call options in the domestic equity market to hedge domestic exposure.
- The exposure of the options would be measured as delta * nominal exposure.

Equity Swaps:

- This would be a contract under which the proceeds of a notional domestic equity index portfolio are exchanged for the proceeds of an index portfolio based on a basket of international equity indices over an agreed time period

(5)

[13 Marks]

Q.6)

i) Commodities can be defined as any products that can be used in commerce, ie any goods that are traded. For most people the term refers to internationally traded agricultural goods such as coffee, fuels such as oil and raw materials such as copper. (2)

ii) Institutional investment in commodities rarely means direct investment in the goods themselves, such as the purchase of a warehouse full of coffee. Institutional commodity investment is investment in derivatives based on the price of the underlying commodity.

Besides derivatives other ways of investing in commodities are:

- direct investment (eg buying precious metals)
- investment in commodity ETFs
- investment in companies whose share prices are interdependent on commodity prices (eg mining companies).

(4)

iii) Merit of the proposal:

Advantage of investing in commodities for an institutional investors

- commodities offer significant real returns that are produced by doing real economic work within the economy
- the returns accrue to the long-only investor without the need for active management, and
- commodities offer a package of diversification benefits unlike any other asset.

- in those environments that have produced the worst results from financial assets – rising inflation, excessive global demand, supply disruptions – commodities have produced higher returns than any other asset class used by institutional investors.
- Commodity returns have been based on real underlying economics, suggesting that a similar pattern of returns is likely to recur in the future.
- Unlike other asset classes, commodities are concerned with short-term supply and demand and short-term risk.
- Inflation Hedge: Commodities, particularly precious metals like gold and silver, tend to perform well during inflationary periods. By investing in commodities, investors can preserve the real value of their capital against the eroding effects of inflation

Disadvantage of investing in commodities:

- there is no strong historical evidence for a real return from commodities
- the markets are volatile, being driven by a number of factors unrelated to the underlying economic factors that affect institutional liabilities.
- the high level of specialist expertise required to trade commodities profitably can be prohibitive.
- Liquidity Constraints and Capital Lock-In, Certain commodities or commodity-linked instruments may suffer from low liquidity, especially in niche markets. Difficulty in quickly exiting positions can lead to potential losses or capital being tied up longer than expected.
- Regulatory and Political Risks, Changes in government policies, export-import restrictions, tariffs, or environmental regulations can affect commodity prices abruptly, posing risks to invested capital.
- Investing in commodities may involve higher costs, such as storage (for physical commodities), insurance, and brokerage fees. These costs can erode returns and thus negatively impact the portfolio return
- Commodity markets are inherently volatile due to factors such as geopolitical events, weather patterns, natural disasters, and macroeconomic trends. This volatility can lead to sharp fluctuations in investment value, increasing the risk of capital erosion if the market moves unfavourably.
- **Disadvantage of using derivatives can also be given relevant points**

Impact on Capital:

- Higher Volatility Leading to Larger Capital Buffers: To withstand price swings and avoid forced liquidation, investors need larger capital buffers than would be necessary in more stable asset classes like bonds or blue-chip stocks.
- Liquidity considerations - In illiquid markets, investors may need to hold additional capital to cover the risk of unfavourable exit prices or longer holding periods.
- Commodity exposures may attract higher regulatory capital charges due to their risk and volatility profiles.
- Proper hedging through derivatives can optimize capital efficiency, reducing the amount of capital at risk while maintaining exposure.
- Many commodities are priced in U.S. dollars. Non-dollar investors face additional foreign exchange risk, which may require capital reserves to manage currency fluctuations.
- Most commodity investments, especially through futures contracts, require a margin deposit. investors must be prepared for margin calls if market prices move adversely. This increases the potential need for additional capital on short notice to maintain positions.
- If capital calculations only depends upon absolute return on the portfolio and not risk adjusted methods, then it may be possible that increase in portfolio returns can help reduce the capital requirements, but that is unlikely to happen in a regulated environment.

(14)

iv)

- **Loss of Ownership and Control:**
  VC funding usually requires giving up a significant equity stake. Investors often

demand board seats and influence over major decisions, limiting founders' control over their own company.

- **Pressure for Rapid Growth:**
  Venture capitalists expect high returns within a relatively short time frame. This can force startups to prioritize aggressive scaling over sustainable growth, sometimes leading to operational risks.
- **Dilution of Equity:**
  With each round of VC funding, founders and early employees see their ownership diluted, potentially reducing their long-term financial gains.
- **High Expectations and Performance Pressure:**
  VC firms expect startups to hit ambitious milestones. Failure to do so can lead to down rounds (raising money at a lower valuation), loss of investor confidence, or even forced sales.
- **Loss of Strategic Flexibility:**
  Startups may have to align their strategy to fit VC exit goals (like aiming for an IPO or acquisition), even if that's not the founder's preferred path.
- **Time-Consuming Fundraising Process:**
  Raising VC money requires a lot of time pitching to investors, negotiating terms, and completing due diligence, which can distract founders from building the actual business.
- **Potential Cultural Misalignment:**
  VC firms may push for a growth-at-all-costs culture that may not align with the founders' vision for the company's values and working environment.

(5)

[25 Marks]

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