SUMMER OF SCIENCE

(MID-TERM_REPORT)

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TOPIC → Algorithmic trading

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TOPIC_1 - Introduction to stock market

= Before getting into the stock market let's first see why there is a need to invest instead of storing your money .

A. The Need to Invest

= Let's have a look on an example where one person invest and another not

For the sake of simplicity, let us ignore the tax effect in this discussion.

To drive the point across, let us make a few simple assumptions –

1. The employer is kind enough to give you a 10% salary hike every year.
2. The cost of living is likely to go up by 8% yearly.
3. You are 30 years old and plan to retire at 50, this translates to 20 working years.
4. You don't intend to work after you retire.
5. Your expenses are fixed, and you don't foresee any other expenses.
6. The balance cash of Rs.20,000/- per month is retained as hard cash.

Going by these assumptions, here is what the cash balance will look like in 20 years.

Let X be the person who invests and Y be the person who does not invest .

After 20 years Y is going to save Rs.1.7cr whereas we consider investing where our cash grows 12% per annum . X has a total of Rs.4.26cr which is 2.4x times when you keep your cash idle .

Now, going back to the initial question of why invest? There are a few compelling reasons –

1. **Fight Inflation** – By investing, one can deal better with the inevitable reality of life – the growing cost of living – generally referred to as Inflation.
2. **Create Wealth** – By investing, one can build a bigger corpus by the end of the target period. In the above example, the period was up to retirement, but it can be anything – children's education, marriage, house purchase, retirement holidays, etc
3. **Better life** – To meet life's financial aspirations.

B.**The Stock Markets and the Stock Markets index**

= The stock market is an electronic marketplace where Buyers and sellers electronically express their points of view in terms of trade.It also refers to the collection of exchanges and markets where stocks and other financial instruments are bought and sold.

For example→Assume there are two traders – A and B.
A's view on Infosys – The stock price will likely go down further because the company will find it challenging to find a new CEO. If A trades from his point of view, he should be a seller of the Infosys stock.

However, B views the same situation differently and has a different point of view. According to her, the stock price of Infosys has overreacted to the succession issue, and soon the company will find a great leader. The stock price will eventually move up.

If B trades from her point of view, she should be a buyer of the Infosys stock.

How to calculate the returns from the stock

= There are different kinds of returns that one needs to be aware of. The following will give us a sense of what they are and how to calculate these returns.

a. ***Absolute Return*** – This is the return that your trade or investment generates in absolute terms. It helps you answer this question – I bought Infosys at 3030 and sold it at 3550. How much percentage return did I generate?
   Ex→

The formula to calculate is – [Ending Period Value / Starting Period Value – 1]*100
i.e. [3550/3030 -1] *100

= 0.1716 * 100

= 17.16%

A 17.6% is not a bad return at all!

b. ***Compounded Annual Growth Rate (CAGR)*** – An absolute return can be misleading if you want to compare two investments. CAGR helps you answer this question – I bought Infosys at 3030, held the stock for two years, and sold it at 3550. At what rate did my investment grow over the last two years?

   CAGR factors in the time component, which we had ignored when we computed the absolute return.

$$CAGR = \left(\frac{\text{Ending Value}}{\text{Beginning Value}}\right)^{\left(\frac{1}{\text{\# of years}}\right)} - 1$$

The formula to calculate CAGR is…

Stock Market Index

→ A stock market index is a numerical representation of the performance of a specific group of stocks or the overall stock market. It serves as a benchmark or indicator of the overall direction and health of the market. Stock market indices are calculated using various methodologies, but they typically involve selecting a sample of representative stocks and assigning them weights based on factors such as market capitalization, price, or other criteria.

C.Clearing and Settlement Process

= The clearing and settlement process is an essential part of financial markets, especially in securities trading. It involves the finalizing and transferring of ownership of securities and the settlement of funds between buyers and sellers. The process ensures that transactions are completed efficiently, accurately, and securely. Here's a general overview of the clearing and settlement process:

- Trade Execution: The process begins with the execution of a trade. Buyers and sellers agree on the terms of the transaction, including the price, quantity, and settlement date.
- Trade Confirmation: Once the trade is executed, both the buyer and seller receive trade confirmations, which provide details of the transaction. These confirmations typically include the trade date, settlement date, security details, and transaction costs.
- Trade Registration: The trade details are then registered with a central clearinghouse or a securities depository. This step ensures that the trade is properly recorded and tracked throughout the settlement process.
- Clearing: Clearing involves the validation, matching, and netting of trades to determine the obligations of each participant. The clearinghouse acts as a central counterparty between buyers and sellers, assuming the counterparty risk. It compares the trade details, verifies the availability of securities and funds, and ensures compliance with regulatory requirements.

- Netting: Netting is the process of consolidating multiple trades between the same counterparties into a single net position. This reduces the number of transactions that need to be settled, minimizing costs and operational risks.
- Settlement: Settlement is the final step in the clearing and settlement process. It involves the actual exchange of securities and funds between the buyer and seller. Depending on the market and the type of securities, settlement can occur either through a centralized system (such as a central securities depository) or a decentralized system (such as bilateral arrangements).
- Securities Delivery: In the settlement process, the seller delivers the securities to the buyer, typically through electronic book-entry transfers. The buyer's account is updated to reflect ownership of the securities, and the seller's account is debited accordingly.
- Fund Transfer: Simultaneously with the securities delivery, the buyer transfers the funds to the seller. This transfer can occur through various payment systems, such as wire transfers or electronic funds transfers.
- Confirmation and Reconciliation: After the settlement process, both parties receive confirmation of the completed transaction. They reconcile these confirmations with their own records to ensure accuracy and resolve any discrepancies.

By following this clearing and settlement process, financial markets ensure that trades are executed smoothly, securities are delivered securely, and funds are transferred accurately. It helps maintain the integrity and efficiency of the financial system. It's important to note that specific details and procedures may vary across different markets, jurisdictions, and types of securities.

D.Key Events and Their Impact on Markets

= Let's first see what we meant to say by Events

EVENTS

→ Trading or investing based on just company-specific information may not be sufficient. Outside events, both economic and/or non-economic, impact stocks and the market’s performance in general. It is also important to understand the events that influence the markets.

Now let's have a look at some common events and how the stock market reacts to these events.

- Central Bank Decisions: Central banks raising interest rates to combat inflation can increase borrowing costs, impacting consumer spending and business investment, and potentially leading to market declines.
- Economic Data Releases: Higher-than-expected inflation figures can raise concerns about potential interest rate hikes, leading to market volatility and potential declines, while lower-than-expected inflation may be viewed positively by markets.
- Wage Growth: Higher wages can lead to increased costs for businesses, potentially resulting in higher prices for goods and services and impacting sectors such as retail and leisure.
- Commodity Prices: Higher commodity prices can increase production costs, which may be passed on to consumers, affecting inflation levels and market sentiment.
- Government Fiscal Policies: Expansionary fiscal policies, such as increased government spending or tax cuts, can stimulate demand and potentially contribute to inflation, while contractionary fiscal policies may have a moderating effect on inflation.
- Inflation Expectations: Rising inflation expectations can lead investors to adjust their portfolios to protect against inflation, favoring assets like commodities, real estate, or inflation-protected securities.

TOPIC_2 - Reading the Candlestick Chart

A.Technical Analysis

= Technical Analysis is a popular method to develop a point of view on markets. Besides, TA also helps in identifying entry and exit points.It is the study of price movement . Some key features of

- Price Patterns: Technical analysis studies historical price patterns to identify recurring formations and trends that can offer insights into future price movements.
- Indicators: Technical analysts use indicators like moving averages and oscillators to generate signals on market strength, momentum, and potential overbought or oversold conditions.
- Market Trends: Technical analysis focuses on identifying and following market trends, aiming to align trading or investment decisions with the prevailing direction of the market.
- Support and Resistance: Support levels act as a floor where buying pressure may halt price declines, while resistance levels act as a ceiling where selling pressure may prevent further price increases.
- Volume Analysis: Volume helps confirm the strength of price moves, with increased volume often supporting the validity of the move.
- Time Frames: Technical analysis can be applied to different time frames, enabling traders and investors to analyze short-term, medium-term, and long-term price movements.
- Limitations: Critics argue that technical analysis relies solely on historical data and patterns, and other factors like fundamental analysis and market news should be considered for more comprehensive decision-making.

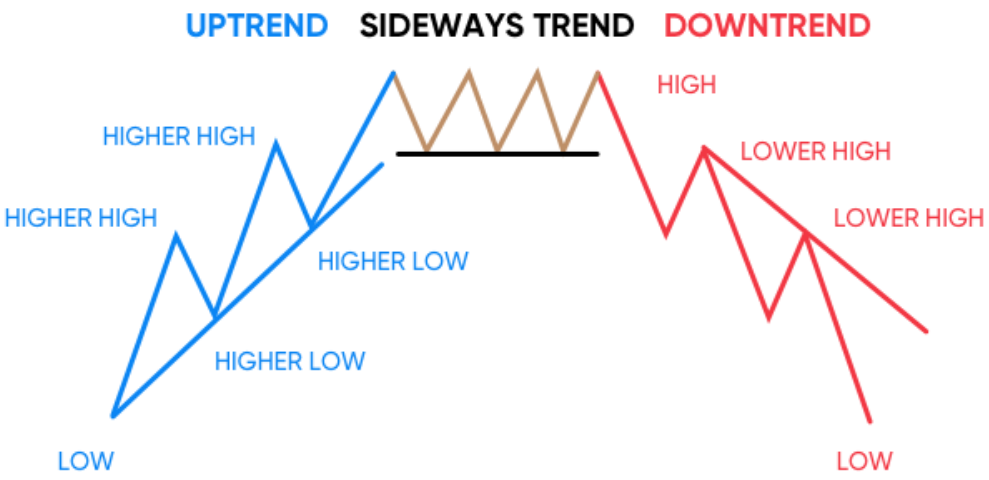
B.Price action and trends

= Price action and trends are important concepts in technical analysis that help traders analyze and predict future price movements in the stock market. Here's a brief explanation of each:

- Price Action: Price action refers to the movement of a stock's price over time, as reflected in its historical price chart. Traders who focus on price action study patterns, trends, and individual price bars to understand the underlying market

dynamics. They believe that price movement alone contains valuable information about market behavior and use it to make trading decisions.

- Trends: A trend in the stock market refers to the general direction in which prices are moving over a sustained period. There are three types of trends:
- Uptrend: An uptrend occurs when prices consistently make higher highs and higher lows. It signifies a bullish market sentiment, with buyers dominating and pushing prices higher.
- Downtrend: A downtrend occurs when prices consistently make lower highs and lower lows. It signifies a bearish market sentiment, with sellers dominating and pushing prices lower.
- Sideways (or Range-bound) Trend: A sideways trend occurs when prices move within a relatively narrow range, without making significant higher highs or lower lows. It indicates a lack of clear direction in the market.



C.Types of chart

= There are several types of charts commonly used in technical analysis of the stock market. Each type of chart presents price and volume data in a different visual format. Here are the main types of charts:

- Line Chart: A line chart connects the closing prices of a stock over a specific period using straight lines. It provides a simple visualization of the overall price trend but does not show intraday fluctuations or individual price bars.

- Bar Chart: A bar chart displays the high, low, open, and close prices for each period using vertical lines (bars). The top of the bar represents the highest price, the bottom represents the lowest price, and a horizontal line on the left represents the opening price (left side) and closing price (right side) of the period.
- Candlestick Chart: Candlestick charts are similar to bar charts but provide more visual information. Each candlestick represents a specific time period and displays the open, high, low, and close prices. The body of the candlestick is filled or hollow, indicating whether the close price is higher or lower than the open price. Candlestick patterns are widely used in technical analysis to identify potential trend reversals or continuations.

- Renko Chart: Renko charts focus solely on price movements and filter out time. They represent price changes using bricks or blocks, with each brick having a predetermined price range. A new brick is formed only when the price moves beyond the set range, allowing traders to identify trends more easily.
- Point and Figure Chart: Point and figure charts use X's and O's to represent price movements. X's represent upward price movements, while O's represent downward price movements. These charts filter out minor price fluctuations and

focus on significant price changes, making it easier to identify support and resistance levels.

- Heikin-Ashi Chart: Heikin-Ashi charts are derived from candlestick charts but use modified calculations to smooth out price fluctuations. They provide a clearer visual representation of trends, making it easier to identify trend reversals and potential entry or exit points.

Traders choose the type of chart that best suits their trading style and preferences. The choice often depends on the level of detail and visual information required to make informed trading decisions.

D.Candlestick Pattern

= Candlestick patterns are formations created by the arrangement of multiple candlesticks on a chart. Traders use these patterns to analyze price behavior and make predictions about future market movements. Here are some commonly recognized candlestick patterns:

- Doji: A Doji occurs when the opening and closing prices are virtually the same, resulting in a small or nonexistent body and long upper and lower wicks. It suggests indecision in the market and potential reversals.
- Hammer and Hanging Man: These patterns have a small body near the top or bottom of the candlestick, respectively, with a long lower or upper wick. Hammers occur after a downtrend and suggest a potential bullish reversal while hanging man patterns appear after an uptrend and indicate a potential bearish reversal.
- Engulfing Patterns: An engulfing pattern forms when one candlestick completely engulfs the body of the preceding candlestick. Bullish engulfing patterns occur during a downtrend and imply a potential bullish reversal, while bearish engulfing patterns form during an uptrend and suggest a potential bearish reversal.
- Morning Star and Evening Star: The morning star pattern consists of three candlesticks—a bearish candlestick, followed by a small-bodied candlestick (can be bullish or bearish), and finally a larger bullish candlestick. It indicates a potential reversal from a downtrend to an uptrend. The evening star pattern is the opposite, signaling a potential reversal from an uptrend to a downtrend.
- Shooting Star and Inverted Hammer: A shooting star has a small body near the bottom of the candlestick, with a long upper wick. It occurs after an uptrend and implies a potential bearish reversal. An inverted hammer has a small body near the top of the candlestick, with a long lower wick, and appears after a downtrend, suggesting a potential bullish reversal.
- Tweezer Tops and Bottoms: Tweezer tops form when two consecutive candlesticks have the same high price, indicating potential resistance. Tweezer bottoms occur when two consecutive candlesticks have the same low price,

suggesting potential support. These patterns often signify a reversal in the respective direction.

It's important to note that while candlestick patterns can provide valuable insights, they should not be relied upon solely for trading decisions. Traders often use these patterns in conjunction with other technical analysis tools and confirmations to increase the probability of accurate predictions.

TOPIC_3 - Basics of Algorithmic Trading

A.What Is Algorithmic Trading?

= Algorithmic trading (also called automated trading, black-box trading, or algo-trading) uses a computer program that follows a defined set of instructions (an algorithm) to place a trade. The trade, in theory, can generate profits at a speed and frequency that is impossible for a human trader.
The defined sets of instructions are based on timing, price, quantity, or any mathematical model. Apart from profit opportunities for the trader, algo-trading renders markets more liquid and trading more systematic by ruling out the impact of human emotions on trading activities.

B.How Algorithmic Trading Works

= Buy 50 shares of a stock when its 50-day moving average goes above the 200-day moving average. (A moving average is an average of past data points that smooths out day-to-day price fluctuations and thereby identifies trends.)

- Sell shares of the stock when its 50-day moving average goes below the 200-day moving average.

Using these two simple instructions, a computer program will automatically monitor the stock price (and the moving average indicators) and place the buy and sell orders when the defined conditions are met. The trader no longer needs to monitor live prices and graphs or put in the orders manually. The algorithmic trading system does this automatically by correctly identifying the trading opportunity.

C.Pros & Cons of Algorithmic Trading

= Pros

Instant order confirmation
Potential for best price and lowest cost trades
No human error in trade execution
Not biased by human emotion

Cons

Lack of human judgment in real-time
Can lead to increased volatility or market instability at times
High capital outlays to build and maintain software & hardware
May be subject to additional regulatory scrutiny

D.Algo-Trading Time Scales

= Much of the algo-trading today is high-frequency trading (HFT), which attempts to capitalize on placing a large number of orders at rapid speeds across multiple markets and multiple decision parameters based on preprogrammed instructions. Algo-trading is used in many forms of trading and investment activities including:

- Mid- to long-term investors or buy-side firms—pension funds, mutual funds, insurance companies—use algo-trading to purchase stocks in large quantities when they do not want to influence stock prices with discrete, large-volume investments.
- Short-term traders and sell-side participants—market makers (such as brokerage houses), speculators, and arbitrageurs—benefit from automated trade execution; in addition, algo-trading aids in creating sufficient liquidity for sellers in the market.
- Systematic traders—trend followers, hedge funds, or pairs traders (a market-neutral trading strategy that matches a long position with a short position in a pair of highly correlated instruments such as two stocks, exchange-traded funds (ETFs), or currencies)—find it much more efficient to program their trading rules and let the program trade automatically.

Algorithmic trading provides a more systematic approach to active trading than methods based on trader intuition or instinct.

E.What Programming Language Do Algorithmic Traders Use?

= Because it is highly efficient in processing high volumes of data, C++ is a popular programming choice among algorithmic traders. However, C or C++ are both more complex and difficult languages, so finance professionals looking to enter into programming may be better suited transitioning to a more manageable language such as Python.

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