Algorithmic Trading

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Midterm Report

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1 Introduction to Stock Markets

1.1 The Need to Invest

1.1.1 Why Invest

There are a few good reasons to invest:

- **Beat Inflation** – Investing helps you handle rising living costs, known as inflation.
- **Build Wealth** – Investing helps grow your money over time. This can be for retirement, kids' education, buying a house, or any other goal.
- **Improve Quality of Life** – Investing can help you achieve your financial goals.

1.1.2 Where to Invest

Different types of investments have their own risks and returns. Here are some popular ones:

- **Fixed Income Instruments**: These are safe investments where you get regular interest. Examples include bank fixed deposits. Your initial amount is returned after a set period.
- **Equity**: This means buying shares of companies listed on stock exchanges like BSE and NSE. There's no guarantee of your initial amount, but the potential returns can be higher than fixed income investments.
- **Real Estate**: This involves buying and selling property. You can earn from rent and the increased value of the property. However, it requires a lot of money and has complicated legal processes.
- **Commodities (Precious Metals)**: Investing in gold and silver is popular. Over the long term, these metals have given returns of about 5-8percent per year. You can invest in jewelry, ETFs, or Sovereign Gold Bonds (SGBs).

1.1.3 Things to Note Before Investing

- **Risk and Return**: Higher risk usually means higher return, and lower risk means lower return.
- **Fixed Income**: Good for protecting your initial amount and is less risky. But it may not beat inflation. For example, a 9 percent return when inflation is 10 percent means you actually lose 1percent per year. Corporate fixed income can be riskier.
- **Equities**: Good for beating inflation over a long time. Historically, they have returned about 14-15

- **Real Estate**: Requires a lot of money and isn't very liquid, meaning you can't buy or sell easily.
- **Gold and Silver**: Safer but haven't given high returns historically.

1.2 Regulators, the Guardians of Capital Markets

1.2.1 What is the Stock Market?

The stock market is where people buy and sell shares. Its main job is to make these transactions easy. You can do this electronically through your computer using a stockbroker. In India, the main stock exchanges are the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE).

1.2.2 The Regulator

Stock markets need rules to keep things fair. In India, the regulator is SEBI (Securities and Exchange Board of India). SEBI makes sure:

- The stock exchange runs fairly
- Stockbrokers are fair
- No one cheats
- Companies don't misuse the market
- Small investors are protected
- Big investors don't manipulate the market
- The market grows overall

SEBI sets rules for each market player, which are available on their website under 'Legal Framework'.

1.3 Market Intermediaries

These entities operate quietly behind the scenes, adhering to SEBI regulations to ensure a seamless experience for stock market transactions. Commonly known as financial intermediaries or market intermediaries, they form an ecosystem essential for the functioning of financial markets.

1.3.1 The Stock Broker

A stockbroker is a corporate entity registered with the stock exchange as a trading member and holds a stockbroking license issued by SEBI after due diligence. Stockbrokers act as your gateway to the stock markets, enabling investments in stocks, bonds, ETFs, and mutual funds. To trade, you must open an account with a stockbroker of your choice.

- Simplicity of the broker platform
- Efficiency of the broker's support system
- Access to ready reports – Profit & Loss reports, Tradebook, Tax P&L
- Broker's financial health (ensuring they are profitable and have a good P&L)
- Educational initiatives

Once you select your broker and open a trading and DEMAT account, you can start trading in the stock market. Here are a few common ways to interact with your broker:

- Call your broker, identify yourself with your client code, and place an order. The dealer will execute and confirm the order status while you're still on the call.
- Self-service through a 'Trading Terminal', where you log in, view live market quotes, and place orders. For example, Zerodha's trading platform is called 'Kite'.
- Advanced users can access the market programmatically via APIs, provided by some brokers for a fee.

Essential services provided by the broker include:

- Access to the markets and transaction facilitation
- Provision of trading margins
- Support for queries and market education
- Issuance of contract notes detailing daily transactions
- Facilitation of fund transfers between your trading and bank accounts
- Access to a back-office portal for various account reports, such as Zerodha's 'Console'

The broker charges a fee for these services, known as the 'brokerage charge' or simply brokerage. Brokerage rates vary, and you should find a broker that balances costs with the services provided.

1.3.2 Depository and Depository Participants

Digital share certificates are stored in a DEMAT account. A Depository, a financial intermediary, offers this service, converting paper share certificates to digital format in a process called "Dematerialization" or DEMAT. Currently, only two depositaries offer DEMAT services: National Securities Depository Limited (NSDL) and Central Depository Services (India) Limited (CDSL). To open a DEMAT account, contact a Depository Participant (DP), who acts as an intermediary between you and the Depository and is regulated by SEBI.

1.3.3 Banks

Banks facilitate fund transfers between your bank account and trading account. Brokers link these accounts after verifying your bank account. The account you choose to withdraw funds from is called the 'Primary account'. Dividend payments and money from buybacks are also sent to the primary bank account, which is connected to your trading account, the Depository, the Registrar, and the transfer agents (RTA).

1.3.4 NSE Clearing Limited and ICCL

NSE Clearing Limited and Indian Clearing Corporation (ICCL) are subsidiaries of the National Stock Exchange and Bombay Stock Exchange, respectively. Their role is to ensure the guaranteed settlement of your trades and transactions by:

- Identifying the buyer and seller and matching the debit and credit process
- Ensuring no defaults by either party

1.4 IPO Markets

When a company files for an IPO, it offers its shares to the general public for the first time, hence called the "Initial Public Offer".

1.4.1 Why do companies go public?

Promoters have three main advantages when taking a company public:

- Raising funds to meet CAPEX requirements
- Avoiding debt, thus eliminating finance charges and improving profitability
- Spreading risk among many investors rather than one large investor

1.4.2 Merchant Bankers

The first step in going public is appointing a merchant banker, also known as Book Running Lead Managers (BRLM) or Lead Managers (LM). They assist the company with various IPO processes, including:

- Conducting due diligence, ensuring legal compliance, and issuing a due diligence certificate
- Preparing listing documents, including the Draft Red Herring Prospectus (DRHP)
- Helping determine the IPO price band
- Organizing roadshows to market the IPO
- Appointing other intermediaries and devising marketing strategies

1.4.3 IPO sequence of events

Every step in the IPO process must follow SEBI guidelines. The general sequence is:

1. Appoint a merchant banker (more than one for large issues)
2. Apply to SEBI with a registration statement detailing the company's operations, reasons for going public, and financial health
3. Await SEBI approval
4. If approved, prepare the DRHP and circulate it to the public, including details such as:
    - Estimated IPO size
    - Number of shares offered
    - Purpose and utilization plan for raised funds
    - Business description, revenue model, expenditure details
    - Complete financial statements
    - Management Discussion and Analysis
    - Risks involved
    - Management details and background
5. Market the IPO through TV and print advertisements
6. Fix the price band
7. Open the subscription window for the public, collecting price points and quantities in a process called Book Building
8. Decide the listing price based on maximum bids after the window closes
9. List the company on the stock exchange, with the stock listed at a premium, par, or discount of the cut-off price

1.4.4 IPO Jargons

- Under subscription - If fewer bids than the offered shares are received, indicating negative public sentiment.
- Oversubscription - If more bids than the offered shares are received, indicating high demand.
- Green Shoe Option - Allows the issuer to authorize additional shares (typically 15
- Fixed Price IPO - A set price for the IPO without a price band.
- Price Band and Cut off price - The range within which the stock is listed, with the cut-off price being the final listing price within that range.

1.5 The Stock Market

1.5.1 What is the stock market and what moves the stock market?

The stock market is a marketplace where participants can trade shares of publicly listed companies. Prices move based on news and events, which can be related to the company, industry, or economy as a whole. For example, when Narendra Modi became the Indian Prime Minister, the stock market reacted positively. Sometimes, prices change even without news due to supply and demand dynamics.

1.5.2 How to calculate returns?

Absolute Return – This is the return generated by an investment in absolute terms. It answers the question: If I bought Infosys at 3030 and sold it at 3550, what percentage return did I achieve?

The formula to calculate absolute return is:

$$AbsoluteReturn = \left(\frac{EndingPeriodValue}{StartingPeriodValue} - 1\right) \times 100$$

For example:

$$\left(\frac{3550}{3030} - 1\right) \times 100 = 0.1716 \times 100 = 17.16\%$$

A 17.16% return is quite good!

Compounded Annual Growth Rate (CAGR) – Absolute return can be misleading when comparing investments over different time periods. CAGR factors in the time component and helps you determine the annual growth rate of an investment. For example, if you bought Infosys at 3030, held it for two years, and sold it at 3550, CAGR answers the question: At what rate did my investment grow annually over the last two years?

The formula to calculate CAGR is:

$$CAGR = \left(\frac{EndingPeriodValue}{StartingPeriodValue}\right)^{\frac{1}{n}} - 1$$

Applying this:

$$\left(\frac{3550}{3030}\right)^{\frac{1}{2}} - 1 = 8.2\%$$

This means the investment grew at an annual rate of 8.2% over two years. Considering that bank fixed deposits offer around 5.5% with capital protection, an 8.2% return looks reasonable in comparison.

So, always use CAGR for multi-year returns and absolute return for a year or less.

1.5.3 Traders and Investors

Different types of traders include:

Day Trader – Buys and sells positions within the same day, avoiding overnight risk. For example, buying 100 shares of TCS at 2212 at 9:15 AM and selling at 2220 at 3:20 PM for a profit of Rs.800. Day traders typically trade multiple stocks per day.

Scalper – A type of day trader who makes small, quick profits by trading large quantities of shares. For example, buying 10,000 shares of TCS at 2212 at 9:15 and selling at 2212.1 at 9:16 for a Rs.1000 profit. Scalpers are highly risk-averse and trade multiple times a day.

Swing Trader – Holds trades for a longer period, ranging from a few days to weeks. For example, buying 100 shares of TCS at 2212 on June 12 and selling at 2214 on June 19.

Two popular types of investors are:

Growth Investors – Look for companies expected to grow significantly due to emerging industry trends. For instance, buying Hindustan Unilever, Infosys, and Gillette India in the 1990s due to industry changes that created significant wealth for shareholders.

Value Investors – Seek good companies that are undervalued due to short-term market sentiment. An example is buying stocks during the COVID-19 crash in March 2020, when good stocks were significantly undervalued, leading to a V-shaped recovery in the following months.

2 Fundamental Analysis

Fundamental Analysis (FA) involves evaluating a business from various perspectives to determine its investment potential. The goal is to identify companies that create wealth over the long term. Fundamental Analysis gives investors the conviction to make long-term investments by highlighting attributes of wealth-creating companies.

While Technical Analysis (TA) can help with short-term market timing, it is not effective for creating long-term wealth. Both TA and FA should be part of a comprehensive market strategy.

Tools required for fundamental analysis include:

- **The company's annual report** – Contains all necessary information for FA. Available for free on the company's website.
- **Industry-related data** – Shows how the company performs relative to its industry. Basic data is usually available for free on industry association websites.
- **Access to news** – Keeps you updated on industry and company developments. Business newspapers or services like Google Alerts are useful.

Long-term commitment is essential for investments based on fundamental analysis. Investors must adopt this mindset when choosing to invest.

2.1 The Annual Report of a Company

The annual report is an official document of the company. Misrepresentation of facts in the annual report can be held against the company. It includes the auditor's certificates, certifying the accuracy of the financial data. For investors, the annual report should be the primary source of information about a company.

The annual report's last section contains financial statements, which are crucial. These include:

- **The Profit and Loss statement**
- **The Balance Sheet**
- **The Cash flow statement**

2.2 The Profit and Loss statement

The Profit and Loss statement, also known as the P&L statement, Income Statement, Statement of Operations, or Statement of Earnings, reports:

- The company's revenue for a specific period (yearly or quarterly)
- The expenses incurred to generate the revenue
- Tax and depreciation
- Earnings per share

2.2.1 The Top Line of the company (Revenue)

The first line item on the revenue side is the sale of products, representing the Rupee value of all products sold during FY14.

The next line item is the excise duty, the amount (Rs.400 Crs) paid to the government. Revenue must be adjusted for this.

The adjusted revenue after excise duty is the net sales, Rs.3403 Crs for FY14 and Rs.2943 Crs for FY13.

In addition to product sales, the company earns revenue from services, such as annual battery maintenance, totaling Rs.30.9 Crs for FY14.

The company also has "other operating revenues" of Rs.2.1 Crs, which may come from incidental sales of products or services.

Total operating revenue is the sum of product sales, service sales, and other operating revenues, totaling Rs.3436 Crs for FY14 and Rs.2959 Crs for FY13. Note number 17 provides further details on "Net Revenue from Operations."

Statement of Profit and Loss for the year ended March 31,2014

₹ million

Particulars	Note No.	Year ended March 31, 2014	Year ended March 31, 2013
REVENUE			
Sale of products		38,041.27	32,949.37
Less: Excise duty		4,005.15	3,512.45
Net sale of products		34,036.12	29,436.92
Sale of services		309.32	137.02
Other operating revenue		21.15	15.21
Net revenue from operations	17	34,366.59	29,589.15
Other income	18	455.14	465.51
Total Revenue		**34,821.73**	**30,054.66**
EXPENSES			
Cost of materials consumed	19	21,011.95	17,603.12
Purchases of stock-in-trade	20	2,113.69	2,632.54
Changes in inventories of finished goods, work-in-process and stock-in-trade	20	(292.10)	(320.89)
Employee benefits expense	21	1,583.16	1,262.30
Finance costs	22	7.18	2.69
Depreciation and amortisation expense [includes impairment loss of ₹Nil (PY ₹75.52 million)]	23	645.71	660.92
Other expenses	24	4,346.60	3,904.24
Total Expenses		**29,416.19**	**25,744.92**
Profit before exceptional items and tax		**5,405.54**	**4,309.74**
Less: Exceptional items (net)	33	38.84	91.57
Profit before tax		**5,366.70**	**4,218.17**
Less: Tax expense			
Current tax		1,580.00	1,377.97
Deferred tax (credit) / expense		106.23	(24.51)
Earlier year's (excess) / short provision		6.11	(2.34)
Profit for the year		**3,674.36**	**2,867.05**
Basic and diluted earnings per equity share of ₹1 each	37	21.51	16.78

Figure 1: Profit and Loss statement

2.2.2 The Expense details

The first expense item is 'Cost of materials consumed,' referring to raw material costs, which are the largest expense for the company. This expense is Rs.2101 Crs for FY14 and Rs.1760 Crs for FY13. Note number 19 provides details for this expense.

The next items are 'Purchases of Stock in Trade' and 'Change in Inventories of finished goods, work-in-process stock-in-trade.'

Purchases of stock in trade refer to finished goods bought by the company.

Changes in inventory refer to manufacturing costs from previous periods for goods sold in the current year.

The next item is "Employee Benefits Expense," including salaries, provident fund contributions, and other employee welfare expenses.

"Finance Cost" refers to interest and other costs paid when borrowing funds.

Depreciation and amortization costs relate to depreciating tangible or intangible assets over their useful lives.

The last expense item is "other expenses" at Rs.434.6 Crs, which includes manufacturing, selling, administrative, and other expenses.

2.2.3 The Profit before tax

Profit before tax (PBT) is the net operating income after deducting operating expenses but before taxes and interest. ARBL's PBT, after adjusting for an exceptional item of Rs.3.8 Crs, is calculated as follows:

$$Profit before Tax = Total Revenues - Total Operating Expenses - Exceptional Items$$

$$= Rs.3482 Crs - Rs.2941.6 Crs - Rs.3.8 Crs$$

$$= Rs.536.6 Crs$$

2.2.4 Net Profit after tax

Net profit after tax (PAT) is the operating profit after deducting tax liabilities. For ARBL, PAT is calculated as follows:

$$Net PAT = PBT - Applicable taxes$$

$$= Rs.536.6 Crs - Rs.165 Crs$$

$$= Rs.371.6 Crs$$

This represents a net profit margin of 10.7% and a 25% growth over the previous year.

2.2.5 Earnings per share

Earnings per share (EPS) is calculated by dividing the net profit by the total number of shares outstanding.

$$EarningsPerShare = \frac{NetProfit}{TotalNumberofSharesOutstanding}$$

For ARBL, with a net profit of Rs.371.6 Crs and 8.5 Crs shares:

$$EarningsPerShare = \frac{Rs.371.6Crs}{8.5Crs} = Rs.43.72$$

2.3 Balance Sheet

While the P&L statement gives us information about the company's profitability, the balance sheet gives us information about the assets, liabilities, and shareholders equity. It has financial information about the company right from the time it was incorporated. Thus, while the P&L talks about how the company performed in a particular financial year, the balance sheet, on the other hand, discusses how the company has evolved financially over the years.

2.3.1 Balance sheet equation

In any typical balance sheet, the company's total assets should be equal to the company's total liabilities. Hence,

$$Assets = Liabilities$$

The equation above is called the balance sheet equation or the accounting equation. In fact, this equation depicts the balance sheet's key property, i.e., the balance sheet should always be balanced. In other words, the Assets of the company should be equal to the Liabilities of the company. This is because everything that a company owns (Assets) has to be purchased either from the owner's capital or liabilities.

Owners Capital is the difference between the Assets and Liabilities. It is also called 'Shareholders Equity' or 'Net worth'. Representing this in the form of an equation:

$$Shareholdersequity = Assets - Liabilities$$

2.3.2 Components of a Balance Sheet

Assets

Accounts within this segment are listed from top to bottom in order of their liquidity. They are divided into current assets, which can be converted to cash in one year or less; and non-current or long-term assets, which cannot.

Here is the general order of accounts within current assets:

- **Cash and cash equivalents** are the most liquid assets and can include Treasury bills and short-term certificates of deposit, as well as hard currency.
- **Marketable securities** are equity and debt securities for which there is a liquid market.
- **Accounts receivable (AR)** refer to money that customers owe the company. This may include an allowance for doubtful accounts as some customers may not pay what they owe.
- **Inventory** refers to any goods available for sale, valued at the lower of the cost or market price.
- **Prepaid expenses** represent the value that has already been paid for, such as insurance, advertising contracts, or rent.

Long-term assets include the following:

- **Long-term investments** are securities that will not or cannot be liquidated in the next year.
- **Fixed assets** include land, machinery, equipment, buildings, and other durable, generally capital-intensive assets.
- **Intangible assets** include non-physical (but still valuable) assets such as intellectual property and goodwill. These assets are generally only listed on the balance sheet if they are acquired, rather than developed in-house.

Liabilities

A liability is any money that a company owes to outside parties, from bills it has to pay to suppliers to interest on bonds issued to creditors to rent, utilities, and salaries.

Current liabilities are due within one year and are listed in order of their due date.

Here are some accounts typically found within current liabilities:

- **Current portion of long-term debt** is the portion of a long-term debt due within the next 12 months.
- **Interest payable** is accumulated interest owed, often due as part of a past-due obligation.
- **Wages payable** is salaries, wages, and benefits to employees, often for the most recent pay period.
- **Customer prepayments** is money received by a customer before the service has been provided or product delivered.
- **Accounts payable** is debt obligations on invoices processed as part of the operation of a business that are often due within 30 days of receipt.

Long-term liabilities can include:

- **Long-term debt** includes any interest and principal on bonds issued.
- **Pension fund liability** refers to the money a company is required to pay into its employees' retirement accounts.
- **Deferred tax liability** is the amount of taxes that accrued but will not be paid for another year.

Some liabilities are considered off the balance sheet, meaning they do not appear on the balance sheet.

Shareholder Equity

Shareholder equity is the money attributable to the owners of a business or its shareholders. **Retained earnings** are the net earnings a company either reinvests in the business or uses to pay off debt. The remaining amount is distributed to shareholders in the form of dividends. **Additional paid-in capital** or capital surplus represents the amount shareholders have invested in excess of the common or preferred stock accounts, which are based on par value rather than market price.

2.3.3 Importance of a Balance Sheet

Determining Risk: The balance sheet provides a comprehensive view of a company's assets and liabilities. By analyzing these components, stakeholders can assess the financial health and stability of the company. This helps investors, creditors, and analysts evaluate the risk associated with investing in or lending to the company.

Attracting and Retaining Talent: Employees are often concerned about the financial stability of the company they work for. A strong balance sheet can reassure employees that their jobs are secure and that the company is in good financial health. This can help attract talented individuals to join the company and retain existing employees.

Securing Capital: When seeking external financing, whether from banks for loans or from private investors for equity funding, companies are typically required to provide a balance sheet. Lenders and investors use the balance sheet to assess the company's ability to repay debts and manage financial obligations. A strong balance sheet enhances the company's credibility and increases its chances of securing the necessary capital.

2.4 Cash Flow Statements

A cash flow statement monitors the inflow and outflow of cash, offering insights into a company's financial health and operational efficiency. The CFS evaluates how effectively a company manages its cash position, specifically in terms of generating cash to meet debt obligations and fund operating expenses.

The main components of the cash flow statement include:

- Cash flow from operating activities
- Cash flow from investing activities
- Cash flow from financing activities
- Disclosure of non-cash activities

Cash From Operating Activities This section reflects the cash generated from a company's primary business operations, such as the sale of products or services.

Cash From Investing Activities Investing activities include cash flows related to a company's investments. This encompasses the purchase or sale of assets, loans made to vendors or received from customers, and any payments associated with mergers and acquisitions (M&A).

Cash From Financing Activities Cash from financing activities covers the sources of cash from investors and banks, as well as cash paid to shareholders. This includes dividends, stock repurchases, and repayment of debt principal (loans) made by the company.

2.4.1 How Cash Flow Is Calculated

There are two methods to calculate cash flow: the direct method and the indirect method.

Direct Cash Flow Method The direct method sums up all cash payments and receipts, including cash paid to suppliers, cash received from customers, and cash paid out in salaries.

Indirect Cash Flow Method The indirect method calculates cash flow by adjusting net income. This involves adding or subtracting differences resulting from non-cash transactions.

2.5 Financial Ratios

The most effective way to analyze financial statements is through the use of financial ratios. These ratios utilize data from financial statements to determine their values and can be classified into various categories:

- Profitability Ratios
- Leverage Ratios
- Valuation Ratios
- Operating Ratios

2.5.1 Profitability Ratios

Profitability ratios allow analysts to gauge a company's ability to generate earnings relative to its expenses. We will examine the following profitability ratios:

- EBITDA Margin (Operating Profit Margin)
- EBITDA Growth (CAGR)
- PAT Margin
- PAT Growth (CAGR)
- Return on Equity (ROE)
- Return on Assets (ROA)
- Return on Capital Employed (ROCE)

EBITDA Margin The Earnings Before Interest, Tax, Depreciation, and Amortization (EBITDA) margin demonstrates the management's efficiency and the profitability of the company's operations.

$$EBITDA = OperatingRevenues - OperatingExpense$$

$$OperatingRevenues = TotalRevenue - OtherIncome$$

$$OperatingExpense = TotalExpense - FinanceCost - Depreciation\&Amortization$$

$$EBITDAMargin = \frac{EBITDA}{TotalRevenue - OtherIncome}$$

PAT Margin While the EBITDA margin is calculated at the operating level, the Profit After Tax (PAT) margin reflects the final profitability of the company, considering all expenses including taxes.

$$PATMargin = \frac{PAT}{TotalRevenues}$$

Return on Equity (RoE) Return on Equity (RoE) measures the return earned by shareholders on their invested capital, indicating the company's ability to generate profits from shareholders' investments.

$$RoE = \frac{NetProfit}{ShareholdersEquity} \times 100$$

The DuPont Model breaks down the RoE formula into three components, each representing a different aspect of the business. The components are:

$$NetProfitMargin = \frac{NetProfits}{NetSales} \times 100$$

This ratio expresses the company's ability to generate profits from its sales.

$$AssetTurnover = \frac{NetSales}{AverageTotalAssets}$$

The asset turnover ratio indicates how efficiently the company uses its assets to generate revenue. A higher ratio means greater efficiency.

$$FinancialLeverage = \frac{AverageTotalAssets}{ShareholdersEquity}$$

Financial leverage shows the extent to which a company is using borrowed money.

Return on Assets (RoA) Return on Assets (RoA) measures a company's ability to utilize its assets to generate earnings.

$$RoA = \frac{NetIncome + Interest \times (1 - TaxRate)}{TotalAverageAssets}$$

Return on Capital Employed (ROCE) Return on Capital Employed (ROCE) assesses a company's profitability by evaluating the capital employed, including both equity and debt.

$$ROCE = \frac{ProfitbeforeInterest\&Taxes}{OverallCapitalEmployed}$$

2.5.2 Leverage Ratios

Leverage ratios, also known as solvency or gearing ratios, evaluate a company's long-term ability to maintain its daily operations. These ratios include:

- Interest Coverage Ratio
- Debt to Equity Ratio
- Debt to Asset Ratio
- Financial Leverage Ratio

Interest Coverage Ratio: Also called the debt service ratio or debt service coverage ratio, the interest coverage ratio assesses how much a company earns relative to its interest obligations. This ratio indicates how easily a company can meet its interest payments.

The formula for calculating the interest coverage ratio is:

$$InterestCoverageRatio = \frac{EarningsbeforeInterestandTax(EBIT)}{InterestPayment}$$

Where EBIT is:

$$EBIT = EBITDA - Depreciation\&Amortization$$

Debt to Equity Ratio: This ratio measures the proportion of total debt capital to total equity capital. Both variables for this computation are found in the Balance Sheet. A ratio of 1 indicates an equal amount of debt and equity capital. A value greater than 1 suggests higher leverage, while a value less than 1 indicates a larger equity base relative to debt.

The formula for calculating the Debt to Equity ratio is:

$$DebttoEquityRatio = \frac{TotalDebt}{TotalEquity}$$

Debt to Asset Ratio: This ratio reveals the asset financing pattern of a company by indicating how much of the total assets are financed through debt capital.

The formula for calculating the Debt to Asset ratio is:

$$DebttoAssetRatio = \frac{TotalDebt}{TotalAssets}$$

Financial Leverage Ratio: Previously discussed in the context of Return on Equity, the financial leverage ratio indicates the extent to which assets are supported by equity.

The formula for calculating the Financial Leverage Ratio is:

$$FinancialLeverageRatio = \frac{AverageTotalAssets}{AverageTotalEquity}$$

2.6 Operating Ratios

Operating Ratios, also known as 'Activity ratios' or 'Management ratios', assess the efficiency of a company's operational activities. They also provide insights into the management's effectiveness to some extent. Some of the common Operating Ratios include:

- Fixed Assets Turnover Ratio
- Working Capital Turnover Ratio

- Total Assets Turnover Ratio
- Inventory Turnover Ratio
- Inventory Number of Days
- Receivable Turnover Ratio
- Days Sales Outstanding (DSO)

Fixed Assets Turnover: This ratio measures the revenue generated relative to the investment in fixed assets. It indicates how efficiently the company utilizes its plant and equipment.

$$FixedAssetsTurnover = \frac{OperatingRevenues}{TotalAverageAsset}$$

Working Capital Turnover: Working capital is the capital required to run day-to-day operations. It includes assets such as inventories, receivables, and cash. The difference between current assets and current liabilities determines the working capital of the company.

$$WorkingCapital = CurrentAssets - CurrentLiabilities$$

The formula to calculate Working Capital Turnover is:

$$WorkingCapitalTurnover = \frac{Revenue}{AverageWorkingCapital}$$

Total Assets Turnover: This straightforward ratio indicates the company's ability to generate revenues with its given amount of assets, including both fixed and current assets.

$$TotalAssetTurnover = \frac{OperatingRevenue}{AverageTotalAssets}$$

Inventory Turnover Ratio: Inventory represents the finished goods that a company holds with the expectation of selling them. The Inventory Turnover Ratio measures how quickly the inventory is sold and replenished.

$$InventoryTurnover = \frac{CostofGoodsSold}{AverageInventory}$$

Inventory Number of Days: This ratio provides an estimate of how long it takes for a company to convert its inventory into cash.

$$InventoryNumberofDays = \frac{365}{InventoryTurnover}$$

Accounts Receivable Turnover Ratio: This ratio shows how many times a company collects cash from its debtors and customers within a given period.

$$AccountsReceivableTurnoverRatio = \frac{Revenue}{AverageReceivables}$$

Days Sales Outstanding (DSO): Also known as Average Collection Period or Day Sales in Receivables, this ratio illustrates the average period for cash collection, i.e., the time lag between billing and collection.

$$DaysSalesOutstanding = \frac{365}{ReceivableTurnoverRatio}$$

2.7 Valuation Ratios

Valuation ratios provide insight into the attractiveness of a stock's price from an investment perspective. The purpose of these ratios is to compare the stock price relative to the benefits of owning it. The three important valuation ratios are:

- Price to Sales (P/S) Ratio
- Price to Book Value (P/BV) Ratio
- Price to Earnings (P/E) Ratio

Price to Sales (P/S) Ratio: This ratio compares the company's stock price with its sales per share. The formula to calculate the P/S ratio is:

$$PricetoSalesRatio = \frac{CurrentSharePrice}{SalesperShare}$$

Price to Book Value (P/BV) Ratio: The "Book Value" (BV) of a company is the amount remaining after the company pays off its obligations. The BV can be calculated as follows:

$$BV = \frac{ShareCapital + Reserves(excludingrevaluationreserves)}{TotalNumberofShares}$$

The P/BV ratio indicates how many times the stock is trading over and above the firm's book value. A higher ratio suggests a more expensive stock.

$$PricetoBookValueRatio = \frac{CurrentSharePrice}{BookValueperShare}$$

Price to Earnings (P/E) Ratio: Earnings per Share (EPS) measures the profitability of a company on a per-share basis. The P/E ratio is calculated by dividing the current market price by the EPS. This ratio indicates the market participants' willingness to pay for the stock relative to the profit the company generates.

$$EPS = \frac{PAT}{TotalNumberofShares}$$

The P/E ratio is:

$$PricetoEarningsRatio = \frac{CurrentStockPrice}{EarningsperShare(EPS)}$$

3 Technical Analysis

Technical Analysis is a method to find trading opportunities based on market actions. These actions are shown in stock charts, where patterns appear over time, each telling a story. A technical analyst's job is to spot these patterns and create a trading plan. Technical Analysis relies on a few key ideas:

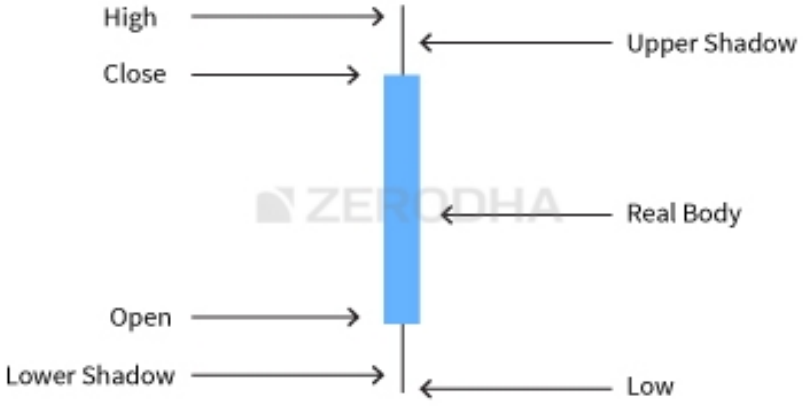
- Markets reflect all information.
- How something happens is more important than why.
- Prices move in trends.
- History often repeats itself.

A good way to summarize daily trading is by noting the open, high, low, and close prices, called OHLC.

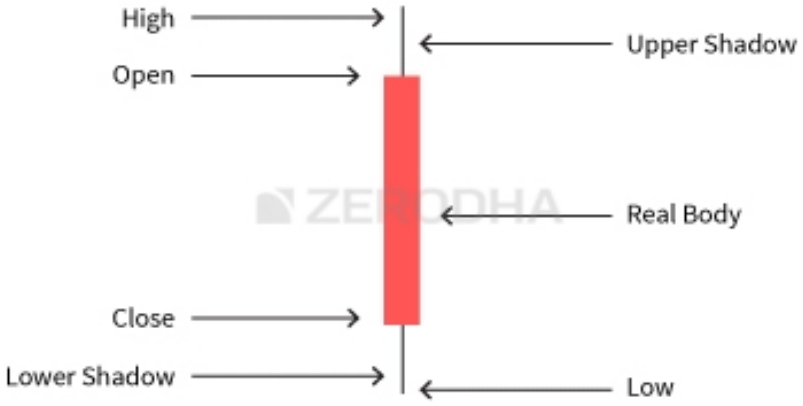
3.1 Candlestick Chart

The candlestick chart, similar to a bar chart, has three parts:

- **The Central Real Body:** The rectangle that connects the opening and closing prices.
- **Upper Shadow:** The line from the high point to the close.
- **Lower Shadow:** The line from the low point to the open.


High
Close
Upper Shadow
Real Body
Open
Lower Shadow
Low


High = 70
Close = 67
Open = 62
Low = 58



A bearish candle also has three parts:

- **The Central Real Body:** The rectangle that connects the opening and closing prices, but the opening is at the top and the closing is at the bottom.
- **Upper Shadow:** The line from the high point to the open.
- **Lower Shadow:** The line from the low point to the close.

The three important rules about candlesticks are:

1. Buy strength and sell weakness.

2. Be flexible with patterns (check and measure).

3. Look at the prior trend.

Avoid trading on unusual candle lengths:

- A short candle shows low activity.
- A long candle shows high activity, but it's hard to set a stop loss.

3.1.1 The Marubozu

A Marubozu is a candlestick with no upper or lower shadow, looking bald. It can appear regardless of the previous trend, but it still has the same meaning. There are two types: bullish and bearish.

Bullish Marubozu A bullish Marubozu forms when the open price equals the low price and the high price equals the close price. This shows strong buying interest, meaning people were willing to buy the stock at any price throughout the day, closing near its high. The previous trend doesn't matter; the action on the Marubozu day shows a shift to bullish sentiment. Traders should look for buying opportunities around the closing price of the bullish Marubozu.

Bearish Marubozu A bearish Marubozu happens when the open price equals the high price and the close price equals the low price. This shows strong selling pressure, with people selling at every price during the day, closing near the low. Regardless of the previous trend, the action on the Marubozu day shows a shift to bearish sentiment. Traders should look for shorting opportunities, expecting the bearish sentiment to continue in the next sessions.

3.1.2 The Spinning Top

- The candles have a small real body.
- The upper and lower shadows are almost equal.

Small real body: This shows that the opening and closing prices are close to each other. The candle's color (blue or red) doesn't matter; it's the closeness of the opening and closing prices that is important.

Upper shadow: The upper shadow connects the real body to the day's high. It shows that bulls tried to push the market higher but didn't succeed. If they had, the candle would have a long blue body instead of a short one, showing a failed bullish effort.

Lower shadow: The lower shadow connects the real body to the day's low. It shows that bears tried to push the market lower but didn't succeed. If they had, the candle would have a long red body instead of a short one, showing a failed bearish effort.

Indecision: Spinning tops show a market with indecision and uncertainty. But, when looked at in the context of the trend, they provide valuable insights for market positioning.

Spinning tops in a downtrend: In a downtrend, spinning tops suggest that bears might be taking a break before another round of selling, while bulls are trying to stop the price decline but haven't succeeded. This can lead to either:

- Another round of selling.
- A market reversal with rising prices.

Spinning Tops in an Uptrend When spinning tops appear in an uptrend:

- Bulls are no longer fully in control; otherwise, spinning tops wouldn't form.
- Bears have entered the market, but their success is limited. The presence of spinning tops shows that bulls are giving way to bears.

Possible outcomes:

- Bulls might be taking a break before starting another upward move.
- Bulls might be tired, allowing bears to take control, possibly leading to a correction.

The chances of either event happening are equal, 50%.

Doji: A Doji has an opening price equal to its closing price, with a tiny real body. The upper and lower wicks can be of any length. Dojis have similar meanings to spinning tops. Often, dojis and spinning tops appear together, indicating market indecision.

3.1.3 Paper Umbrella

- If a paper umbrella appears at the bottom of a downward rally, it is called a 'Hammer'.
- If a paper umbrella appears at the top of an uptrend rally, it is called a 'Hanging Man'.
- To qualify as a paper umbrella, the lower shadow's length should be at least twice the length of the real body, known as the 'shadow to real body ratio'.

The Hammer Formation:

- The bullish hammer is an important candlestick pattern occurring at the bottom of a downtrend.
- Conditions for a hammer:

  - The prior trend must be a downtrend.
  - Shadow to real body ratio.

- Traders usually look for buying opportunities when a hammer appears.
- The low of the hammer is the stop-loss price for the trade.

The Hanging Man:

- If a paper umbrella appears at the top of a trend, it is called a Hanging Man.
- The bearish hanging man is a single candlestick and a top reversal pattern.
- Traders usually look for selling opportunities when a hanging man appears.
- The high of the hanging man is the stop-loss price for the trade.

3.1.4 The Shooting Star

- Unlike a paper umbrella, the shooting star does not have a long lower shadow. Instead, it has a long upper shadow, where the shadow's length is at least twice the length of the real body.
- The high of the shooting star is the stop-loss price for the trade.

3.2 Multiple Candlestick Patterns

3.2.1 The Engulfing Pattern

The engulfing pattern forms over 2 trading sessions. It consists of a small candle on day 1 and a longer candle on day 2 that engulfs the candle from day 1. There are two types:

- **Bullish Engulfing Pattern:**
  - Occurs at the bottom of a downtrend.
  - Day 1 (P1) is a red candle, and Day 2 (P2) is a blue candle that fully engulfs P1.
  - Risk-taker starts a long trade at the close of P2 after confirming the bullish engulfing pattern.
  - Risk-averse trader starts the trade the day after P2, near the close of the day.
  - Stop-loss is set at the lowest low between P1 and P2.
- **Bearish Engulfing Pattern:**
  - Appears at the top of an uptrend.
  - P2's red candle fully engulfs P1's blue candle.

- Risk-taker starts a short trade at the close of P2 after confirming the bearish engulfing pattern.
- Risk-averse trader starts the trade the day after P2, after confirming a red candle formation.
- Stop-loss is set at the highest high of P1 and P2.

3.2.2 The Piercing Pattern

The piercing pattern is similar to the bullish engulfing pattern, but P2's blue candle only partially engulfs P1's red candle, covering 50

- Risk-taker starts the trade on P2 around the close.
- Risk-averse trader starts the trade the day after P2, making sure a blue candle forms.
- Stop-loss is set at the low of the pattern.

3.2.3 The Harami Pattern

The Harami pattern has two candles. The first candle is usually long, while the second has a small body and is generally of the opposite color. This pattern suggests a potential trend reversal. There are two types: the bullish Harami and the bearish Harami.

The Bullish Harami A bullish Harami appears at the lower end of a downtrend. P1 is a long red candle, and P2 is a small blue candle.

- A risk-taker starts a long trade near the close of P2.
- A risk-averse trader starts a long trade near the close of the day after P2, ensuring it is a blue candle day.
- The stop-loss is set at the lowest low price between P1 and P2.

The Bearish Harami A bearish Harami appears at the top end of an uptrend. P1 is a long blue candle, and P2 is a small red candle.

- A risk-taker starts a short trade near the close of P2.
- A risk-averse trader starts a short trade near the close of the day after P2, ensuring it is a red candle day.
- The stop-loss is set at the highest high price between P1 and P2.

3.2.4 The Morning Star

The Morning Star is a bullish candlestick pattern that forms over a three-day period. It is a downtrend reversal pattern made up of three consecutive candlesticks. The Morning Star appears at the bottom of a downtrend. The idea is to go long on P3, with the lowest low of the pattern being the stop-loss for the trade.

3.2.5 The Evening Star

The Evening Star is the bearish version of the Morning Star. This pattern appears at the top of an uptrend and, like the Morning Star, it is a three-candle pattern that forms over three trading sessions. The idea is to go short on P3, with the highest high of the pattern being the stop-loss. Since the star pattern forms over three days, both risk-averse and risk-taking traders are advised to start the trade on P3.

4 Introduction to Algorithmic Trading

4.1 What is Algorithmic Trading

Algorithmic trading, or algo-trading, uses computer programs to make trades automatically based on set rules (algorithms). These programs can trade much faster and more frequently than humans. They follow instructions based on timing, price, quantity, or complex math models. C++ is often used for this because it can handle large amounts of data quickly.

4.2 Pros & Cons of Algorithmic Trading

Pros

- Orders are confirmed instantly.
- Trades can be made at the best prices and lowest costs.
- Reduces human errors in trading.
- Removes emotional decisions from trading.

Cons

- No real-time human judgment.
- Can increase market volatility.
- High costs for software and hardware.
- Faces strict regulatory checks.

4.3 Algorithmic Trading Strategies

Trend-Following Strategies
These strategies track trends in moving averages, price levels, and other indicators. They are easy to program because they don't need price predictions.

Arbitrage Opportunities
Traders make money from price differences of the same stock in different markets, aiming for risk-free profits.

Index Fund Rebalancing
Index funds adjust their holdings to match their benchmark indices. Traders take advantage of these predictable trades to make profits just before the rebalancing events.

Mathematical Model-Based Strategies
These use proven math models, like delta-neutral trading, which involves trading options and the underlying securities together.

4.4 High-Frequency Trading (HFT)

4.4.1 What Is High-Frequency Trading (HFT)?

High-frequency trading (HFT) is a type of algorithmic trading that uses powerful computers to make many trades in fractions of a second. It uses complex algorithms to analyze multiple markets at once and execute orders based on real-time conditions.

Key features of HFT:

- Very high-speed trading.
- Large volume of transactions.
- Short-term investments.

4.4.2 Pros and Cons

Pros

- Can handle many transactions at once.
- Fast and efficient trading.
- Increases market liquidity by boosting trading volumes.
- Reduces small bid-ask spreads, which helps market participants.

Cons

- Reduces human involvement in trading.
- Can cause big market movements due to high-speed trades.
- HFT strategies may not work well in less liquid markets.

4.5 Conclusion on Algorithmic Trading

Algorithmic trading has greatly improved financial markets by using advanced algorithms and powerful computers to make trades quickly and efficiently. By automating trading based on set rules, it enhances market liquidity, cuts trading costs, and reduces human errors. It allows for high-speed execution of large volumes of trades, which is especially useful for short-term strategies and capturing quick market opportunities.

However, algorithmic trading also brings challenges. Its fast execution can increase market volatility, and relying on math models can lead to unexpected market behaviors, especially in stressful times. Setting up and maintaining these systems requires a lot of money and careful risk management to handle potential risks effectively.

In summary, while algorithmic trading has transformed financial markets by providing access to advanced strategies and improving market efficiency, it requires careful oversight and regulation to maintain market stability and integrity. As technology evolves, algorithmic trading will likely continue to lead in innovation, shaping the future of trading by blending new tech with traditional financial principles to meet the changing demands of global markets.