Quantitative Finance

MD AADIL RIZWAN

December 2024

Introduction of basic knowledge of financial markets and quantitative analysis

---

Markets, Exchanges, OTC, Regions

- **Markets**: Platforms or environments where buyers and sellers trade financial instruments like stocks, bonds, and commodities. Markets can be physical or virtual.

- **Exchanges**: Regulated venues where securities, derivatives, or commodities are traded (e.g., NYSE, NASDAQ). Exchanges provide transparency and standardized contracts.

- **OTC (Over-the-Counter)**: A decentralized market where trading happens directly between parties, usually for less liquid or customized instruments like derivatives.

- **Regions**: Refers to geographical segmentation of markets (e.g., Asia-Pacific, Europe, Americas), which can influence trading hours, regulatory environments, and market behavior.

Money, Currencies

- **Money**: A medium of exchange, store of value, and unit of account (e.g., cash, bank deposits).

- **Currencies**: National or regional monetary units (e.g., USD, EUR, JPY) used for trade and valuation. They can be fiat (government-issued) or digital (cryptocurrencies).

Stocks, Equity Indices, IPOs

- **Stocks**: Ownership shares in a company, entitling the holder to a portion of the company's profits and assets.

- **Equity Indices**: Benchmarks that track the performance of a group of stocks (e.g., S&P 500, FTSE 100). They reflect market trends and investor sentiment.

- **IPOs (Initial Public Offerings)**: When a private company offers its shares to the public for the first time to raise capital and gain liquidity.

Primary/Secondary

- **Primary Market**: Where new securities are issued and sold directly to investors (e.g., IPOs, bond issuance).

- **Secondary Market**: Where existing securities are traded among investors (e.g., stock exchanges).

Loans, Bonds, Credit Products

- **Loans**: Agreements where a lender provides money to a borrower, who agrees to repay with interest over time (e.g., personal, business loans).

- **Bonds**: Fixed-income instruments where investors lend money to an issuer (government or corporation) in exchange for periodic interest payments and principal repayment.

- **Credit Products**: Financial instruments based on credit agreements, including credit default swaps, collateralized debt obligations, and lines of credit.

Commodity

- **Commodity**: Physical goods like oil, gold, or agricultural products that are traded in spot or futures markets. They serve as raw materials or investment assets.

Real Estate, Mortgages, ABS

- **Real Estate**: Property consisting of land and buildings. It is a key investment asset class.

- **Mortgages**: Loans secured by real estate property, typically for purchasing homes or commercial properties.

- **ABS (Asset-Backed Securities)**: Financial instruments backed by pools of underlying assets (e.g., mortgages, car loans, credit card receivables).

Derivatives, Structured Products

- **Derivatives**: Financial contracts deriving value from an underlying asset (e.g., options, futures, swaps). They are used for hedging or speculation.

- **Structured Products**: Customized financial instruments combining derivatives and traditional securities to meet specific investment needs (e.g., capital-protected notes).

Banks: Deposits, Commercial Lending

- **Deposits**: Funds placed by customers in bank accounts, which banks use to provide loans.

- **Commercial Lending**: Loans provided by banks to businesses for operational or growth needs.

Investment Banks

- **Fixed Income**: Services involving bonds, loans, and interest rate products, focusing on debt markets.

- **Equity**: Services related to equity issuance, trading, and investment.

- **IBD (Investment Banking Division)**: Offers advisory services for mergers, acquisitions, and capital raising.

- **Corporate Finance**: Focuses on financial management strategies for companies, including capital structure and funding.

Asset Management

- Professional management of investment portfolios for individuals and institutions, aiming to achieve specific financial goals.

Wealth Management

- Financial advisory services tailored to high-net-worth individuals (HNWIs), encompassing investment planning, tax strategy, and estate planning.

Zero-Sum Game

- A situation where one participant's gain equals another's loss, often used in trading contexts like derivatives markets.

Investors and Borrowers

- **Investors**: Individuals or entities providing capital to earn returns.

- **Borrowers**: Individuals or entities seeking capital, taking on obligations to repay with interest.

Market Participants

- **Dealers**: Trade securities for their own accounts, profiting from bid-ask spreads.

- **Market Makers**: Ensure liquidity by quoting both buy and sell prices in a security.

- **Brokers**: Facilitate trades between buyers and sellers for a commission.

Investor Types

- **Individuals/Retail Investors**: Non-professional investors trading for personal financial goals.

- **Mutual Funds**: Investment funds pooling money to invest in diversified portfolios.

- **Insurance Companies**: Use financial markets for managing risk and investing policyholder premiums.

- **Pension Funds**: Invest in long-term assets to pay retirees.

- **Asset Managers**: Manage portfolios for clients to achieve specific investment objectives.

- **SWFs (Sovereign Wealth Funds)**: State-owned funds investing national surplus reserves.

Hedge Funds, PE

- **Hedge Funds**: Investment funds employing various strategies (e.g., long-short equity, global macro) to achieve high returns.

- **Private Equity (PE)**: Investment firms providing capital to private companies or conducting buyouts of public companies.

Governments and Policy Makers

- Influence markets through regulations, fiscal policies, and monetary policies to ensure stability and growth.

Corporate Hedgers and Liability Management

- **Corporate Hedgers**: Use derivatives to mitigate risks related to currency, interest rates, or commodities.

- **Liability Management**: Strategies for managing debt and other financial obligations efficiently.

Trader Types

1. **Hedger**:

    - A trader or entity aiming to minimize financial risk caused by market volatility (e.g., currency, interest rate, or commodity price changes).

- o Example: An oil producer locks in future oil prices using futures contracts to protect against falling prices.

2. **Market Maker**:

   - o Provides liquidity by quoting both bid (buy) and offer (sell) prices for a security. They profit from the spread between these prices.

   - o **Bid**: The price a market maker is willing to pay to buy a security.

   - o **Offer**: The price at which the market maker is willing to sell the security.

   - o Example: A market maker in stock trading facilitates buying and selling without significant price gaps.

3. **Proprietary Trader**:

   - o Trades using the firm's capital (not clients') to make profits. Focused on identifying lucrative opportunities based on market trends, mispricings, or arbitrage.

   - o Example: A trader taking a long position in undervalued stocks while shorting overvalued stocks.

Fund Portfolio Manager

- **Beta and Alpha**:

  - o **Beta**: Measures the correlation of an asset's return with the broader market. A beta of 1 means the asset moves with the market; greater than 1 indicates more volatility, and less than 1 indicates stability.

  - o **Alpha**: Represents the excess return earned relative to the market or benchmark.

  - o Portfolio managers aim to optimize beta and generate positive alpha through superior stock selection and strategy.

- **Linear Regression of Two Time Series**:

  - o A statistical method to model the relationship between two variables (e.g., asset returns).

- Equation: $R(a) = \alpha + \beta \cdot R(b)$, where:
    - $R(a)$: Return of asset A.
    - $R(b)$: Return of benchmark B.
    - B : Sensitivity of A's return to B.
    - α : Unexplained return (manager skill or inefficiency).
- Example: Comparing a stock's performance against an index.

Hedging Trade Examples

1. **Bond Issuer Hedge**:
    - Entities issuing bonds hedge interest rate risks.
    - Example: An Australian corporation issues 10-year Samurai bonds (JPY-denominated bonds). To protect against exchange rate fluctuations:
        - **Receive JPY and pay AUD** through swaps or cross-currency basis swaps.
        - Fixed-rate difference of 4.5% (JPY coupon) and 1% (AUD rate) implies a net cost of 3.5%.

2. **FX and Revenue Hedges**:
    - **Currency Hedge**: Protects against future receivable/payable currency fluctuations.
        - Example: An exporter hedges future USD receivables by locking exchange rates.
    - **Corporate/Producer Hedge**: Protects revenues from price changes in raw materials or finished goods.

3. **Deal Contingent Hedges**:
    - Pre-negotiated hedges activated upon deal completion.
    - Example: Hedging an acquisition-related currency risk contingent on regulatory approval.

Market Making Examples

1. **Bid/Offer and Liquidity**:

   o Market makers quote buy and sell prices to ensure liquidity and transparency.

   o Example: A dealer consistently quotes prices for a stock, allowing smoother trading.

2. **Inventory of Risks**:

   o **Manage Dealer Book**: Market makers manage positions (inventory) of securities to profit from spreads while controlling risk.

   o **Balancing Greeks**:

      ▪ **Delta**: Sensitivity to price changes.

      ▪ **Gamma**: Rate of change of delta.

      ▪ **Theta**: Sensitivity to time decay in options.

      ▪ **Vega**: Sensitivity to volatility changes.

      ▪ **Tail Risks**: Extreme events with low probability but high impact.

3. **Value at Risk (VaR)**:

   o Measures potential portfolio loss within a given confidence interval (e.g., 95%) over a specified time frame.

   o Example: A VaR of $1M at 95% means a 5% chance of losing more than $1M.

4. **Capital, Balance Sheet, Risk-Weighted Assets**:

   o **Capital**: Funds available to absorb losses.

   o **Balance Sheet**: Summary of assets and liabilities.

   o **Risk-Weighted Assets (RWA)**: Adjusted asset values reflecting their risk levels, used in regulatory capital requirements.

Proprietary Trading Examples

1. **Directional Trading**:

   - Betting on market direction (long for rise, short for fall).

   - Example: Going long on tech stocks based on favorable earnings.

2. **Arbitrage**:

   - Exploiting price differences between markets or instruments.

   - Example: Buying gold in the US market and simultaneously selling in the European market where it's priced higher.

3. **Value and Relative Value**:

   - **Value Trading**: Buying undervalued securities expected to appreciate.

   - **Relative Value**: Trading securities based on price discrepancies relative to each other.

4. **Systematic, Momentum, and Statistical Arbitrage**:

   - **Systematic Trading**: Automated strategies using predefined rules.

   - **Momentum Trading**: Riding trends by buying rising assets and selling declining ones.

   - **Statistical Arbitrage**: Using mathematical models to exploit pricing inefficiencies.

5. **Fundamental Analysis and Global Macro**:

   - **Fundamental Analysis**: Studying financial and economic factors to assess asset value.

   - **Global Macro**: Strategies based on economic trends, central bank policies, and geopolitical events.

6. **Special Situations and Distressed Trading**:

   - **Special Situations**: Trades based on corporate events like mergers or spin-offs.

   - **Distressed Trading**: Buying deeply undervalued or struggling company assets with potential for turnaround.

Financial Mathematics:

1. Pricing Models

1. **Relative Value**:

   o A method to determine the worth of a financial asset compared to similar assets.

   o Example: Comparing two bonds with the same credit rating and maturity to see which offers a better yield.

2. **Arbitrage-Free Pricing**:

   o A model ensuring that no arbitrage opportunities exist. If two securities provide the same payoff, they must have the same price.

   o Example: If gold costs $1,800 in New York but $1,850 in London, arbitrageurs would buy in New York and sell in London until prices equalize.

---

2. Risk Management

1. **Human Risk Aversion**:

   o The tendency to prefer safer choices to avoid losses, even at the expense of potential higher gains.

   o Example: Avoiding stocks despite their higher potential returns compared to bonds.

2. **Greed/Fear**:

   o Emotional factors influencing trading and investing:

      ▪ **Greed**: Overconfidence, leading to risky bets or ignoring warning signs.

      ▪ **Fear**: Avoidance of risk, potentially missing opportunities during market recoveries.

---

3. Trading Strategies

1. **"Holy Grail" Strategy**:

- o A hypothetical, foolproof strategy guaranteeing profits without risk.

- o In reality, such a strategy doesn't exist, as all investments involve some level of risk.

2. **Perpetual Motion Machine**:

- o A metaphor for an unattainable system that generates endless returns without input or loss.

- o Example: Expecting infinite growth in stock prices without market corrections.

3. **Robo-Trader**:

- o Automated trading systems using algorithms to execute trades based on pre-set criteria.

- o Example: High-frequency trading algorithms designed to exploit market inefficiencies.

Risk Aversion Example

Scenario 1:

- **Choice A**: 80% chance to lose $500, 20% chance to win $500.

- **Choice B**: 100% chance to lose $280.

Analysis:

- Risk-averse individuals often choose **B** (certain, smaller loss) over **A** (larger potential loss, even with a winning chance).

Scenario 2:

- **Choice A**: 80% chance to win $500, 20% chance to lose $500.

- **Choice B**: 100% chance to win $280.

Analysis:

- Risk-averse individuals usually choose **B** (guaranteed gain), while risk-tolerant individuals may go for **A** (higher potential payoff).

Control Factor and Marginal Utility

1. **Control Factor**:

   - Refers to the degree of control an individual feels over outcomes, influencing decision-making.

   - Example: A trader might hedge risks if they feel uncertain about market movements.

2. **Marginal Utility**:

   - The additional satisfaction or utility gained from consuming/earning one more unit.

   - Example: Winning $500 might feel less impactful for a millionaire compared to someone earning $30,000 annually.

Do People Always Learn From Experiences?

- **Long Market Cycle and Short Memory**:

   - Investors often forget lessons from past market cycles.

   - Example: Buying overpriced tech stocks during a bull market, ignoring past crashes (e.g., the Dot-com bubble).

- **Historical Extrapolation**:

   - Assuming future outcomes will mirror past trends, often leading to misjudgments.

   - Example: Believing a stock's historical rise guarantees continued growth.

Deterministic vs. Statistical

1. **Deterministic**:

   - Events with certain, predictable outcomes.

   - Example: A fixed-rate bond maturing with guaranteed interest payments.

2. **Statistical**:

- o Outcomes are probabilistic and uncertain, relying on probabilities.

- o Example: Stock market returns based on historical volatility and probabilities.

Efficient Market Theory vs. Behavioral Finance

1. **Efficient Market Theory (EMT)**:

   - o Claims that markets are efficient, reflecting all available information in prices, making it impossible to consistently beat the market.

   - o Example: Stock prices adjust immediately after earnings reports.

2. **Behavioral Finance**:

   - o Challenges EMT by incorporating human psychology (biases, emotions) into financial decisions.

   - o Example: Herd behavior during stock market bubbles.

Over-Simplification

- Oversimplifying complex financial systems can lead to misunderstandings or errors.

- Example: Assuming that higher risk always equates to higher returns, ignoring scenarios like market crashes.

--Thank You--