**1.What is survivorship bias?**

It's when we only consider the winners or success stories, and forget about the failures that didn't make it, which distorts our understanding of reality.

- Imagine you're analysing the performance of S&P 500 companies over 10 years. If you only look at the companies currently in the index and ignore the ones that were removed (because they went bankrupt or underperformed), you'll think the average return is higher than it actually is. That's survivorship bias.

**2.What is Garman-Klass volatility?**

Volatility refers to how much the price of an asset fluctuates over time. Traditional volatility estimates often use just the closing prices, but that ignores valuable intraday price movement.

Introduced by Garman and Klass in 1980, this method estimates daily volatility by taking into account:

- Opening price
- Closing price
- High price
- Low price

Because it uses more information than just closing prices, it's statistically more efficient—meaning it gives a better estimate of "true" volatility.

**3. What do different values of Garman-Klass volatility indicate? (If the value is negative, positive, low, or high)**

**Positive Value (Expected)**

- This is normal and meaningful.
- The value represents the estimated variance or standard deviation of returns based on high, low, open, and close prices.
- The higher the value, the more volatile (risky or active) the asset is.
- The lower the value, the more stable (less risky) the asset is.

**Low Volatility (Close to 0)**

- Indicates very little price movement during the period.
- This may suggest:
    - Market is stable or stagnant
    - Not much trading activity
    - A calm before a breakout (depending on market context)

**High Volatility**

- Indicates significant price swings during the period.
- Can mean:
    - Increased trading activity or speculation
    - Reactions to news/events
    - Higher risk, but also potentially higher reward

Garman-Klass gives an intraday volatility estimate. It is more accurate than close-to-close measures, but it still assumes:

- No overnight jumps
- No intraday trends (which may not be true in practice)

**volatility (like the Garman-Klass estimate)** should **never be negative**

**4. What do you mean by overnight jumps?**

📉 Example:
Let's say:

- A stock closes at £100 on Monday.
- Overnight, news breaks (e.g. a major acquisition or earnings report).
- On Tuesday, it opens at £107.

That £7 jump didn't happen during regular trading—it happened overnight. This is an overnight jump or gap.

**Why It Matters for Volatility Measures:**
Some volatility estimators like Garman-Klass assume that all price movement happens during trading hours (i.e. between open and close). So they don't capture price changes that occur when markets are closed.

However, in reality:

- Major events (earnings reports, geopolitical news, policy changes) often happen after hours.
- These events can cause significant price changes overnight, making Garman-Klass underestimate true volatility.

**5. In Yahoo Finance data, what does the 'Adj Close' column represent?**
**Adjusted Close** is the stock's closing price on a given day, adjusted for corporate actions such as:

- Dividends
- Stock splits
- Rights offerings
- Spin-offs

This adjusted figure reflects the true value of a stock to investors and provides a consistent basis for comparing historical prices.

Let's say:

- A stock closed at £100 yesterday.
- Today, it pays a £5 dividend.

The raw closing price today might be £95 (because the value dropped by the dividend amount).
✅ But Adj Close would still show £100 for yesterday, so that the historical chart reflects this adjustment and maintains continuity.

**6. What is RSI?**

**RSI**, or **Relative Strength Index**, is a popular technical analysis indicator used to measure the momentum of a stock or asset. It helps traders determine whether an asset is **overbought** or **oversold** — which can suggest a potential reversal or continuation of a trend.

**How is RSI Calculated?**
RSI is calculated using the formula:

$$RSI = 100 - (100 / (1 + RS))$$

Where:

- RS = Average Gain over *n* periods / Average Loss over *n* periods
- Typically, *n* = 14 (14-day RSI is standard)

The result is a value between 0 and 100.

**RSI Value Interpretation**

- 70 and above → Asset is overbought (may decline)
- 30 and below → Asset is oversold (may rise)
- 50 → Neutral — no strong trend

**7. I need more clarity on RSI. What do overbought and oversold mean?**

**Overbought**
When an asset is said to be overbought, it means:

- It has gone up a lot and very quickly.
- Traders may think it's too expensive right now.
- It might be due for a pullback or a temporary drop in price.

RSI above 70 usually signals an overbought condition.

**Example:**
If a stock has been rallying for days and RSI hits 75, it means many traders have been buying — but now the stock may be overpriced and selling pressure could follow.

**Oversold**
When an asset is oversold, it means:

- It has dropped a lot in price and too quickly.
- Traders may think it's undervalued or cheap.
- A bounce or upward reversal might be coming.

🔁 In RSI terms: RSI below 30 usually signals an oversold condition.

**Example:**
If a stock drops sharply and RSI hits 25, it may indicate panic selling or market overreaction — and buyers might start stepping in soon.

**8. What does RSI value between 30–50 and 50–70 indicate?**

🔍 **30–50 RSI Zone**

- This usually follows a price drop or downtrend.
- It can mean:

    - The asset is trying to recover.
    - Sellers are losing strength, but buyers haven't taken full control yet.
- Often seen in the early stages of a trend reversal (from bearish to neutral/bullish).

📌 If RSI moves upward through this zone, it may signal:
"Momentum is shifting toward the upside."

🔍 **50–70 RSI Zone**

- This indicates a strengthening uptrend.
- It can mean:
    - Buyers are gaining control.
    - The trend is becoming more bullish.
    - Price is rising, but not yet "overbought."

📌 If RSI remains in this zone, it often suggests:
"The asset is in a healthy uptrend."

**9. What are Bollinger Bands?**

**Bollinger Bands** are a technical analysis tool created by John Bollinger in the 1980s. They help traders identify:

- Volatility (how much the price is moving)
- Potential overbought or oversold conditions
- Price breakout or reversal zones

📐 **How Do They Work?**

Bollinger Bands consist of three lines plotted on a price chart:

1. **Middle Band** – A simple moving average (usually 20-day SMA)
2. **Upper Band** – Middle Band + 2 standard deviations
3. **Lower Band** – Middle Band − 2 standard deviations

These bands expand and contract based on market volatility.

📈 **What They Tell You:**

| When Price… | What It Might Mean |
|---|---|
| Touches or breaks Upper Band | Price might be overbought (possible reversal) |
| Touches or breaks Lower Band | Price might be oversold (possible bounce) |
| Stays between Bands with narrow width | Low volatility – possible upcoming breakout |
| Bands widen significantly | High volatility – price is moving sharply |

🧠 **Think of It Like This:**

- The bands act like boundaries.
- When price hits those boundaries, it's like saying:

"This is far from the average — maybe it's gone too far."

But don't take it as a guarantee — it's a signal, not a certainty.

📊 **Real-World Use:**
Traders use Bollinger Bands to:

- Spot breakouts
- Identify trend reversals
- Create mean-reversion strategies (buy low near the lower band, sell high near the upper band)

**10. What is ATR?**

ATR stands for Average True Range — it's a technical indicator that measures market volatility, or how much an asset moves on average over a given period.
It was developed by J. Welles Wilder Jr., the same person who created RSI.

🧠 **In Simple Terms:**
ATR tells you how "wild" or "quiet" the price movement is.
It doesn't show trend direction (up or down) — only how much the price is moving.

**High ATR** – High volatility — price is moving a lot
**Low ATR** – Low volatility — price is moving calmly

📌 **Note:** ATR values are in price units, not percentages.

🔍 **Example:**
If a stock has:
• ATR of $2.50, it means over the past 14 days, the stock moved $2.50 per day on average.

🧭 **How Traders Use ATR:**

1. **Set Stop-Losses:**

• Volatile stocks need wider stops. ATR helps set dynamic stop-loss levels.

2. **Filter Trades:**

• Avoid entering trades during low-volatility periods.

3. **Detect Market Shifts:**

• A sudden spike in ATR might signal a breakout or news event.

🛑 **What ATR Doesn't Tell You:**
• It doesn't say if price will go up or down.
• It doesn't identify overbought/oversold conditions.

**11. What is MACD?**

MACD stands for Moving Average Convergence Divergence. It's a trend-following momentum indicator that shows the relationship between two moving averages of a security's price.
It helps traders spot trend direction, momentum strength, and potential buy/sell signals.

🧠 **In Simple Terms:**
MACD tells you when momentum is shifting — whether a stock's trend is gaining strength or starting to reverse.

📐 **MACD Components:**
MACD is made up of three parts:

1. **MACD Line** = 12-day EMA − 26-day EMA
2. **Signal Line** = 9-day EMA of the MACD Line
3. **MACD Histogram** = MACD Line − Signal Line (shows the distance between the two lines)

📊 **How to Read MACD:**

| Signal | What It Means |
|---|---|
| MACD crosses above Signal | Bullish – Momentum may be shifting upward |
| MACD crosses below Signal | Bearish – Momentum may be weakening |
| Histogram is growing | Momentum is increasing in that direction |
| Histogram is shrinking | Momentum is slowing – potential reversal |
| MACD above 0 | Overall uptrend |
| MACD below 0 | Overall downtrend |

🔍 **Example:**
• If the MACD line crosses above the signal line → traders might consider buying.
• If the MACD line crosses below the signal line → could be a sell signal.

⚠️ **Things to Watch:**
• MACD works best in trending markets, not sideways ones.
• Like all indicators, it can give false signals — best when used with RSI, volume, or support/resistance levels.

**12. What is moving average and exponential moving average?**

📘 **Example: Simple Moving Average (SMA)**
If you want a 5-day SMA, you'd just add the last 5 closing prices and divide by 5.

$SMA_5 = (P_1 + P_2 + P_3 + P_4 + P_5) / 5$
Where P is the closing price for each day.

✅ It treats all past prices equally.

⚡ **What is an Exponential Moving Average (EMA)?**
An EMA is a more advanced version of the moving average. It gives more weight to recent prices, making it more responsive to new information or sudden changes.

That makes EMAs better for:
• Short-term trading
• Spotting momentum shifts faster

📈 **Example in Real Life:**
Let's say a stock's recent prices are going up:
• SMA will be slower to reflect that change.

• EMA will react faster and rise more quickly.

📋 **Final EMA Values (5-Day):**

| Day | Price | EMA (5-Day) |
|---|---|---|
| 1 | 22 | – |
| 2 | 24 | – |
| 3 | 25 | – |
| 4 | 23 | – |
| 5 | 26 | 24.00 |
| 6 | 28 | 25.33 |
| 7 | 27 | 25.89 |
| 8 | 30 | 27.27 |
| 9 | 29 | 27.85 |
| 10 | 31 | 28.90 |

✅ **Calculations:**

Day 5 (SMA): $EMA_5 = 24.00$
Day 6: $EMA_6 = (28 \times 0.333) + (24.00 \times 0.667) = 25.33$
Day 7: $EMA_7 = (27 \times 0.333) + (25.33 \times 0.667) = 25.89$
Day 8: $EMA_8 = (30 \times 0.333) + (25.89 \times 0.667) = 27.27$
Day 9: $EMA_9 = (29 \times 0.333) + (27.27 \times 0.667) = 27.85$
Day 10: $EMA_{10} = (31 \times 0.333) + (27.85 \times 0.667) = 28.90$

**13. What is volume in Yahoo Finance data?**
In Yahoo Finance (and most financial platforms), the **Volume** column represents the total number of shares or contracts traded for a particular asset (like a stock) during a specific trading day.

🔍 **More Specifically:**
• For stocks: Volume is the number of shares traded.
• For options or futures: It's the number of contracts traded.
This value resets daily.

📈 **Example:**

| Date | Close | Volume |
|---|---|---|
| 2024-04-08 | $150 | 5,000,000 |

**14. What is monthly return?**
Monthly return refers to the percentage change in an asset's price over one month.

🕰️ **What Are Lags?**
Lags are simply delayed values of a time series, used as input features.

So if you calculate monthly returns, you might use:
• Lag 1 = return from 1 month ago
• Lag 2 = return from 2 months ago
• Lag 3 = return from 3 months ago
• etc.

They help your model learn patterns from past behaviour.

15. What are Fama French Factors?

### 📘 What is CAPM?

The **Capital Asset Pricing Model (CAPM)** is a mathematical model that describes the **expected return** on an investment, based on its **systematic risk** (also known as market risk or beta).

It helps answer the question:

*"How much return should I expect for taking on a certain level of market risk?"*

### 📐 The CAPM Formula:

$$\text{Expected Return} = R_f + \beta \times (R_m - R_f)$$

Where:

- $R_f$ = **Risk-free rate** (e.g., Treasury bond rate)
- $R_m$ = **Expected market return** (e.g., return on the S&P 500)
- $\beta$ = **Beta** of the asset (measures how sensitive the asset is to market movements)
- $R_m - R_f$ = **Market risk premium** (extra return for taking market risk)

### 🧠 What is Beta (β)?

Beta (β) measures how sensitive an asset is to movements in the overall market. It's a core concept in finance used to understand risk and return.

| β Value | Interpretation |
|---|---|
| **β = 1** | Asset moves **exactly** with the market. |
| **β > 1** | Asset is **more volatile** than the market. |
| **β < 1** | Asset is **less volatile** than the market. |
| **β = 0** | Asset is **uncorrelated** with the market (e.g., cash). |
| **β < 0** | Asset moves **inversely** to the market. |

📌 **Example:**

Let's say you're evaluating a stock with:

- **Risk-free rate (Rf)** = 2%
- **Market return (Rm)** = 8%
- **Beta (β)** = 1.5

📈 Using the **CAPM (Capital Asset Pricing Model)**:

**Expected Return**

$= Rf + \beta \times (Rm - Rf)$

$= 2\% + 1.5 \times (8\% - 2\%)$

$= 2\% + 9\%$

$= \mathbf{11\%}$

🔍 Interpretation:

You should expect an **11% return** on this stock because of its high beta (i.e., higher market sensitivity or risk).

📘 **Fama–French Factors**

The **Fama–French Factors** are a set of risk factors introduced by Eugene Fama and Kenneth French to provide a **more accurate model for stock returns** than traditional CAPM.

While **CAPM** explains returns using just **market risk**, the Fama–French model adds **additional dimensions** to capture observed return patterns.

📊 **The Original 3-Factor Model Includes:**

| Factor | Meaning |
|---|---|
| **Market (MKT)** | The market return minus the risk-free rate (same as in CAPM). |
| **Size (SMB)** | "Small Minus Big": Return spread between small-cap and large-cap stocks. |
| **Value (HML)** | "High Minus Low": Return spread between value (high book-to-market) and growth (low book-to-market) stocks. |

These factors help investors understand **why** a stock may have higher or lower returns, based on broader market behaviors.

So the 3-factor model formula is:

$$R_i - R_f = \alpha + \beta_1(R_m - R_f) + \beta_2 \text{SMB} + \beta_3 \text{HML} + \epsilon$$

Where:

- $R_i$ = return of the asset
- $R_f$ = risk-free rate
- $R_m$ = market return
- SMB = size factor
- HML = value factor
- $\alpha$ = abnormal return not explained by the model

🧠 **Why Add These Factors?**

CAPM assumes **market beta alone** explains stock returns. But studies showed:

- Small-cap stocks tend to outperform large-cap (→ **SMB**)
- Value stocks outperform growth stocks over the long term (→ **HML**)

So Fama and French added **SMB and HML** to account for this.

🔄 **Extension to 5-Factor Model (2015)**

Later, they introduced **two more factors**:

| Factor | Meaning |
|---|---|
| **4. Profitability (RMW)** | **Robust Minus Weak**: Companies with high profits outperform those with weak profits. |
| **5. Investment (CMA)** | **Conservative Minus Aggressive**: Companies that invest conservatively outperform aggressive investors. |

📚 **Summary of All 5 Factors:**

| Factor | What It Measures |
|---|---|
| **MKT-RF** | Market risk premium |
| **SMB** | Small vs. big stocks |
| **HML** | Value vs. growth stocks |
| **RMW** | Profitability (robust vs weak) |
| **CMA** | Investment style (conservative vs aggressive) |

**16. What is Risk, Asset, What do you mean by Asset is More Volatile than Market? What is the Risk-Free Rate? What is the Market Risk Premium?**

📌 **1. What is Risk in a Market?**

In finance, **risk** refers to the **uncertainty of returns** — how much an investment's value might go up or down over time.

🔍 **Types of Risk:**

In the **CAPM (Capital Asset Pricing Model)**, we mainly focus on **systematic risk**, also known as **market risk** — the risk that affects the entire market (e.g., economic downturns, inflation, interest rate changes).

📌 **2. What is an Asset in a Market?**

An **asset** is anything that has value and can generate a return.

📊 **Examples of Assets:**

- Stocks (e.g., Apple shares)
- Bonds (e.g., government securities)
- Mutual funds
- Real estate
- Commodities

So when we say an **"asset in the market,"** we usually mean a **tradable investment**, often **stocks**.

📌 **3. What Does It Mean When an Asset is More Volatile Than the Market?**

It means the asset's **price fluctuates more dramatically** than the overall market. In CAPM, this is measured using **beta (β)**.

| β Value | Interpretation |
|---|---|
| 1 | Moves **in line** with the market |
| > 1 | Moves **more than** the market (higher volatility) |
| < 1 | Moves **less than** the market (lower volatility) |

A stock with **β = 1.5** is 50% more volatile than the market — if the market moves up or down 2%, this stock is expected to move 3%.

### 📌 4. What is the Risk-Free Rate?

The **risk-free rate** is the return you'd earn from an investment with **zero risk of losing money**.

✅ **Example:**

- Government-issued securities like **UK Gilts** or **US Treasury Bills** are commonly used as a proxy.
- If a UK 3-month gilt offers **2%**, that is considered the **risk-free rate**.

This rate acts as a **baseline** for evaluating **other riskier investments**.

### 📌 5. What is the Market Risk Premium?

The **market risk premium** is the **extra return** investors expect for investing in the **overall stock market** instead of risk-free assets.

🧠 Formula:

**Market Risk Premium** = Market Return − Risk-Free Rate

**Example:**

If the expected return of the market is **8%**, and the risk-free rate is **2%**, then:

📈 **Market Risk Premium = 8% − 2% = 6%**

This 6% is the **reward for taking on additional market risk**.

📐 **Formula:**

$$\text{Market Risk Premium} = R_m - R_f$$

Where:

- $R_m$ = expected return of the **overall market**
- $R_f$ = **risk-free rate**

🔍 **Example:**

If the market is expected to return **8%** and the risk-free rate is **2%**, then:

\text{Market Risk Premium} = 8\% - 2\% = \textbf{6\%}

This 6% is the **reward for taking on market risk** instead of keeping your money in a safe investment.

17.Need more clarity on SMB, HML,RMW and CMA and also why they have been added , how do they contribute in explaining stock returns?

🔷 **SMB: Small Minus Big**

📌 **What it means:**

The **return difference between small-cap stocks and large-cap stocks**.

- Small-cap stocks tend to outperform large-cap stocks **over the long run**.
- SMB captures this **size effect**.

🧠 **Why it matters:**

- Smaller companies are **riskier** (less established, less liquid), so they need to **offer higher returns** to attract investors.
- **CAPM can't explain** this outperformance, but SMB can.

🔶 **HML: High Minus Low**

📌 **What it means:**

The **return difference between high book-to-market (value) stocks and low book-to-market (growth) stocks**.

- **High book-to-market (H)** = "value" stocks (e.g., cheap relative to fundamentals)
- **Low book-to-market (L)** = "growth" stocks (e.g., expensive, fast-growing)

🧠 **Why it matters:**

- Historically, **value stocks outperform growth stocks**, but CAPM doesn't explain this.
- HML captures the **value premium** — extra returns for investing in value companies.

🟢 **RMW: Robust Minus Weak**

📌 **What it means:**

The **return spread between companies with high profitability and those with low profitability**.

- "Robust" = High operating profits relative to assets
- "Weak" = Low profits

🧠 **Why it matters:**

•Profitable firms **tend to outperform** less profitable ones, even after adjusting for risk.

- RMW reflects **profitability as a risk factor**: firms with weak profitability are riskier, so investors demand a higher return.

🔵 **CMA: Conservative Minus Aggressive**

📌 **What it means:**

The **return spread between firms that invest conservatively vs. those that invest aggressively** in assets or expansion.

- "Conservative" = Firms with slow asset growth
- "Aggressive" = Firms growing their assets quickly

🧠 **Why it matters:**

- Firms that invest aggressively **tend to underperform** — possibly because they take on riskier, less efficient projects.

- CMA captures the **investment behaviour** of firms and its impact on returns.

🧪 **So, What Do These Factors Do?**

They help **break down stock returns** by explaining:

| Factor | What it Captures | Why it Adds Value |
|---|---|---|
| SMB | Size risk (small vs. big) | Small stocks = more risk & return |
| HML | Value vs. growth | Value stocks outperform in long term |
| RMW | Profitability | More profitable firms are more stable |
| CMA | Investment patterns | Conservative investing is rewarded |

**18. What is Book-to-Market Ratio?**

The Book-to-Market Ratio compares a company's **book value** (accounting value) to its **market value** (stock price × shares).

🧱 **Formula:**

**Book-to-Market Ratio** = Book Value of Equity / Market Capitalisation

- **Book Value**: Net assets on the balance sheet (Assets − Liabilities)
- **Market Value**: What investors are willing to pay (i.e., share price × number of shares)

🟢 **High Book-to-Market (Value Stocks)**

If a stock has a high B/M ratio:

- Its book value is high relative to its market value
- Investors may not be pricing it highly — possibly seen as undervalued or risky
- These are often called **value stocks**

🔴 **Low Book-to-Market (Growth Stocks)**

If a stock has a low B/M ratio:

- Market value is much higher than its book value
- Investors expect high future growth
- These are often called **growth stocks**

🔍 *Think tech companies like Apple, Amazon, or Tesla.*

🧠 **Why This Matters in Investing:**

Fama and French found that:

- High B/M (value) stocks tend to outperform low B/M (growth) stocks over the long run
- The **HML factor** (High Minus Low) was added to their model to capture this effect

📌 **Who Are Investors?**

Investors are people or institutions who buy shares expecting future returns.

👨‍💼 **Types of Investors:**

- Retail investors (individuals)
- Institutional investors (banks, hedge funds, pension funds)
- Angel investors or venture capitalists (in startups)

They determine market value by trading shares on stock exchanges.

**19. Why Do Small-Cap Stocks Tend to Outperform Large-Cap Stocks Over the Long Run?**

🔍 **First: Definitions**

- **Small-cap stocks**: Market cap under $2 billion
- **Large-cap stocks**: Market cap over $10 billion

*(e.g., Apple, Amazon)*

📐 *Market Capitalisation* = Share Price × Number of Shares

🚀 **Why Small-Caps Tend to Outperform:**

1. **Higher Risk = Higher Expected Return**
    - Small-cap firms are more volatile, illiquid, and sensitive to shocks
    - Investors demand higher returns (risk premium)
    - This is captured in the **SMB factor** (Small Minus Big)
2. **More Room for Growth**
3. **Less Analyst Coverage**
    - Less scrutiny → more pricing inefficiencies
4. **More Innovative or Niche Markets**
5. **Behavioural Bias & Underreaction**
    - Investors often overlook small caps
    - Prices adjust quickly once noticed, leading to momentum-driven returns

**20. What Does It Mean That Investors Demand Higher Returns?**

🧠 It doesn't mean investors "ask" for returns like shopping — it's about **expectations**.

🎯 **Think of It Like This:**

You're offered two choices:

| Investment | Risk Level | Expected Return |
|---|---|---|
| Gov Bond | Very Low | 3% |
| Startup | High | ??? |

Would you accept 3% for a risky startup? Likely not. You'd expect **10%+** to justify the risk — that extra % is the **risk premium**.

📈 **How Expectations Affect Price:**

- If a stock is seen as risky, buyers won't purchase unless price drops enough to offer higher returns.
- **Lower Price → Higher Potential Return → Attracts Risk-Takers**

This is how markets "offer" higher returns on riskier assets — not by demand, but by price adjustment.

**21. Rolling Betas and RollingOLS from statsmodels**

🔁 **What Are Rolling Factor Betas?**

Rolling betas track how a stock's risk exposure evolves over time, using moving windows (e.g., 12, 36 months).

📌 *Reason:* A stock's risk profile isn't static. Rolling beta tracks shifts in market sensitivity.

🔧 **How to Calculate:**

1. Choose a window (e.g., 36 months)
2. For each window:
    - Run regression: stock returns vs. factor returns
    - Record the beta values
3. Shift window forward and repeat

📦 **RollingOLS in statsmodels**

RollingOLS runs linear regressions on rolling windows.

✅ **How It Works:**

Example: 36-month window using Jan 2010–Dec 2023 data

| Rolling Window | Beta Estimated For |
|---|---|
| Jan 2010 – Dec 2012 | Dec 2012 |

| Rolling Window | Beta Estimated For |
|---|---|
| Feb 2010 – Jan 2013 | Jan 2013 |
| Mar 2010 – Feb 2013 | Feb 2013 |
| … | … |
| Jan 2021 – Dec 2023 | Dec 2023 |

📉 **What You Get:**

- Time series of betas
- Shows evolving risk exposure over time

🧠 **Why It's Useful:**

- Captures **market shifts**
- e.g., Beta during 2008 ≠ Beta during post-COVID rally

**22. What is PyPortfolioOpt?**

🧠 **1. What Is It?**

PyPortfolioOpt is a Python library that builds optimal portfolios using **Modern Portfolio Theory**.

**It helps with:**

- Estimating expected returns
- Calculating volatility and covariance
- Optimizing weights for:
  - Sharpe ratio
  - Minimum volatility
  - Maximum return

📌 **2. What Is the Efficient Frontier?**

It's a curve representing all optimal portfolios:

- **Highest return** for a given risk
- **Lowest risk** for a given return

Anything below the frontier = suboptimal.

🧠 **3. What Is the Sharpe Ratio?**

**Sharpe Ratio** = (Portfolio Return − Risk-Free Rate) / Portfolio Volatility

It tells you how much return you're getting **per unit of risk**.

- Higher Sharpe = Better risk-adjusted performance

### 📉 4. What Is the Covariance Matrix?

It shows how stock returns move together.

- **Diagonal** = each stock's variance
- **Off-diagonal** = correlations between different assets

This matrix powers the risk model behind portfolio optimization.

### 23. What is Dollar Volume?

### 💵 What It Means:

**Dollar Volume** = Total money traded for a stock in a day

**Example:**

- Adjusted Close = $50
- Volume = 2,000,000 shares

✅ Dollar Volume = $100 million

### 📌 Why It Matters:

**Dollar Volume = Liquidity Gauge**

- **High Dollar Volume** → Easy to buy/sell without affecting price
- **Low Dollar Volume** → Harder to trade efficiently, higher slippage

This is why it's often used to **filter the most liquid stocks** (e.g., top 150) in backtesting.