1. Understanding the basic structure of the data before analysis

**1.1 Libraries Used**

* **pandas**: For data handling
* **numpy**: For numerical operations
* **matplotlib & seaborn**: For visualizations
* **datetime**: For date/time handling

**1.2 Datasets Loaded**

1. **Fear & Greed Index**: Market sentiment data
2. **Historical Trading Data**: Price and trading information

**1.3 Initial Checks**

* Checked dataset dimensions (rows and columns)
* Viewed column names
* Displayed first few rows to understand data structure

2. Cleaning and Preprocessing

**2.1 Fear & Greed Index Cleaning**

* **Date Conversion**: Converted 'date' column to datetime format with day-first format
* **Value Conversion**: Converted 'value' column to numeric format

**2.2 Trading Data Cleaning**

* **Date Conversion**: Created new 'date' column from 'Timestamp IST' in datetime format
* **Numeric Conversions**: Converted key columns to numeric type:
  + **Execution Price**: The price at which trades were executed
  + **Size USD**: Trade size in USD
  + **Closed PnL**: Profit and Loss from closed positions

**2.3 Missing Value Detection**

Checked both datasets for missing values to identify data quality issues that need handling in subsequent steps.

3. Feature Engineering - Time-Based Features

**3.1 Extracting Time Features from Trading Data**

Created new columns to analyze patterns across different time periods:

* **hour**: Hour of the day when trade was executed (0-23)
* **day\_of\_week**: Day of week (0=Monday, 6=Sunday)
* **month**: Month of the year (1-12)
* **year**: Year of the trade

These features let us see if there are patterns - like better performance on certain days, months, or times of day.

**3.2 Preparing for Data Merge**

* Created **date\_only** column in both datasets (removes time, keeps only date)
* This allows us to match Fear & Greed Index values with trading activity on the same day

We can now join both datasets and see how market sentiment on a particular day relates to our trading performance.

**4. Merging Datasets**

**4.1 Combining Trading Data with Sentiment**

* Merged trading data with Fear & Greed Index based on matching dates
* Used left join to keep all trading records, even if sentiment data is missing for some dates
* Brought in sentiment score (numeric value) and classification (fear/greed label)

**4.2 Renaming Columns**

Renamed the merged columns for clarity:

* **value** → **sentiment\_score**: The numeric sentiment value
* **classification** → **sentiment\_class**: The category (e.g., Fear, Greed, Neutral)

**4.3 Checking Merge Quality**

* Printed final dataset size after merge
* Calculated sentiment coverage percentage to see how many trading days have matching sentiment data

This creates a single dataset where we can analyze how market sentiment affects trading performance. The coverage check tells us if we have enough sentiment data to draw meaningful conclusions.

**5. Trader Performance Analysis**

**5.1 Calculating Trader Metrics**

Grouped data by each trader account and calculated key performance indicators:

**Profit & Loss Metrics:**

* total\_pnl: Total profit/loss for each trader
* avg\_pnl: Average profit per trade
* pnl\_volatility: Standard deviation showing consistency of results
* trade\_count: Number of trades executed

**Trading Behavior:**

* total\_volume: Total USD traded
* avg\_trade\_size: Average size of each trade
* avg\_sentiment: Average market sentiment during their trading period
* buy\_ratio: Percentage of trades that were BUY orders (vs SELL)

**5.2 Trader Classification**

Categorized traders into three groups based on total PnL:

* **Losing**: Total PnL below $0
* **Break-even**: Total PnL between $0 and $1000
* **Profitable**: Total PnL above $1000

This analysis identifies which traders are performing well and helps understand their trading patterns. We can see if profitable traders have different behaviors (like trade size, buy ratio, or sentiment exposure) compared to losing traders.

**6. Sentiment Distribution Visualization**

**6.1 Market Sentiment Analysis**

Created two visualizations to understand market sentiment patterns:

**Chart 1: Sentiment Classification Distribution**

* Bar chart showing frequency of each sentiment category (Fear, Greed, Neutral, etc.)
* Helps identify which market conditions were most common during the analysis period
* Shows if the market was generally fearful, greedy, or balanced

**Chart 2: Sentiment Score Distribution**

* Histogram showing the distribution of numeric sentiment values
* Uses 30 bins to show the spread of scores
* Helps identify if sentiment values are normally distributed or skewed toward fear/greed

**6.2 Interpretation**

These charts reveal:

* Which sentiment dominated the market during our data period
* Whether sentiment was stable or volatile
* The range and concentration of sentiment scores

**Purpose**: Understanding overall market sentiment helps us later analyze if traders performed better in certain market conditions (like extreme fear or greed).

**7. Trading Activity vs Market Sentiment**

**7.1 Sentiment-Based Trading Analysis**

Grouped trading activity by sentiment class and calculated:

* Size USD: Total trading volume in each sentiment condition
* Closed PnL: Total profit/loss during each sentiment period
* Account: Number of unique traders active in each sentiment condition

**7.2 Visualizations**

Created three bar charts to compare trading behavior across different sentiment conditions:

**Chart 1: Trading Volume by Sentiment**

* Shows how much total USD was traded during Fear, Greed, and other sentiment periods
* Identifies if traders are more active during certain market moods

**Chart 2: Total PnL by Sentiment**

* Displays cumulative profit/loss for each sentiment category
* Reveals which market conditions were most profitable overall

**Chart 3: Active Traders by Sentiment**

* Shows how many traders participated during each sentiment period
* Indicates if certain sentiments attract or discourage trader participation

This analysis helps answer:

* Do traders make more money during fear or greed?
* Are trading volumes higher in extreme sentiment conditions?
* Does trader participation change with market sentiment?

**8.1 Correlation Matrix**

Created a heatmap showing relationships between:

* Sentiment score
* Closed PnL
* Trade size (USD)
* Execution price

**8.2 Sentiment vs PnL Relationship**

Tested if market sentiment affects trading profit/loss.

Results:

* Correlation: 0.0110
* P-value: 0.0372

What this means: There is very little connection between market sentiment and trading profits. Sentiment doesn't strongly predict whether trades will be profitable or not

**9. Profitability Analysis by Sentiment**

**9.1 Trade Classification**

Created a new column **is\_profitable** that marks each trade as:

* **True**: If Closed PnL > 0 (profitable trade)
* **False**: If Closed PnL ≤ 0 (losing trade)

**9.2 Performance Metrics by Sentiment**

Grouped trades by sentiment class and calculated:

* **Win rate**: Percentage of profitable trades in each sentiment condition
* **Average PnL**: Mean profit/loss per trade
* **Average trade size**: Mean USD amount traded

|  |  |  |  |
| --- | --- | --- | --- |
| Sentiment Class | Win Rate | Avg PnL ($) | Avg Trade Size ($) |
| Extreme Fear | 29.3% | 1.89 | 4,118.76 |
| Extreme Greed | 55.3% | 205.82 | 3,242.09 |
| Fear | 38.2% | 128.29 | 5,744.78 |
| Greed | 43.6% | 53.99 | 5,051.88 |
| Neutral | 49.5% | 27.09 | 4,332.20 |

* **Extreme Greed** showed the highest win rate (55.3%) and best average profit ($205.82)
* **Extreme Fear** had the lowest win rate (29.3%) and smallest profits ($1.89)
* Traders used larger position sizes during Fear periods but achieved lower profitability
* Trading during greedy market conditions appears more profitable than fearful conditions

**10. Time Series Analysis**

**10.1 Daily Summary**

Aggregated data by day showing:

* Daily sentiment score
* Total daily PnL
* Total trading volume
* Number of active traders

**Chart 1: Daily Sentiment Score**

* Tracks how Fear & Greed Index changed over the period
* Shows sentiment volatility and trends

**Chart 2: Daily Total PnL**

* Displays cumulative daily profits/losses
* Red dashed line at 0 separates profitable days from losing days
* Reveals profitability patterns over time

**Chart 3: Daily Trading Volume**

* Shows total USD traded each day
* Indicates trading activity levels and trader participation

These visualizations help identify:

* If sentiment changes align with PnL movements
* Whether high-volume days are more profitable
* Trading patterns and trends over time
* Correlation between market mood and trading intensity

**11. Top Performers by Sentiment**

**11.1 Function Created**

Built a function to identify top 10 most profitable traders in each sentiment condition based on total PnL.

**11.2 Analysis by Sentiment Class**

Analyzed top performers across all five sentiment categories:

* Extreme Fear
* Fear
* Neutral
* Greed
* Extreme Greed

This identifies:

* Which traders consistently profit in specific market conditions
* If certain traders specialize in fear or greed periods
* Performance patterns of successful traders across different sentiments

**12. Buy vs Sell Strategy Analysis**

**12.1 Strategy Performance by Sentiment**

Analyzed BUY and SELL trades separately across different sentiment conditions:

* **Average PnL**: Mean profit per trade type
* **Total PnL**: Cumulative profit for each strategy
* **Volume**: Total USD traded

**12.3 Visualization**

Created a bar chart comparing average PnL of BUY and SELL strategies across all sentiment conditions:

* Shows which direction (BUY/SELL) is more profitable in each sentiment
* Reveals if traders should prefer buying in greed or selling in fear

1. Extreme Fear: SELL trades profitable (+$7.08), BUY trades lost money (-$3.25)
2. Extreme Greed: SELL trades extremely profitable (+$288.35), best performance overall
3. Fear: BUY trades surprisingly very profitable (+$210.43)

*SELL strategy generally outperformed BUY across most sentiments*

**Recommended Trading Strategies by Market Sentiment:**

**1. Extreme Greed - SELL Strategy Best Performance**

Average profit: **$288.35 per trade**

Strategy: When market is extremely greedy, SELL/short positions are highly profitable

Reason: Overvalued market likely to correct downward

**2. Fear - BUY Strategy**

Average profit: **$210.43 per trade**

Strategy: When market shows fear, BUY/long positions work well

Reason: Market undervalued, good buying opportunity

**3. Extreme Fear - SELL Strategy**

Average profit: **$7.08 per trade**

Strategy: Continue selling even in extreme fear

**AVOID BUYING** in extreme fear (loses $3.25 on average)

**4. Greed & Neutral - SELL Preferred**

SELL trades consistently outperform BUY in these conditions

Safer to take short positions