Data Science Report: Analysis of Trader Behavior vs. Market Sentiment

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1. Objective

The objective of this analysis is to explore the relationship between trader performance (as per Hyperliquid data) and overall market sentiment (from the Bitcoin Fear & Greed Index). By analyzing metrics like profitability (PnL), trading volume, and activity, we aim to uncover patterns that could inform smarter trading strategies.

2. Methodology

1. **Data Loading:** The two primary datasets (historical_data.csv and fear_greed_index.csv) were loaded into pandas.
2. **Data Cleaning:**
    a. **Trader Data:** Timestamps were converted to datetime objects. Closed PnL and Size USD were converted to numeric types. The dataset was filtered to only include closed trades (where Closed PnL is non-zero).
    b. **Sentiment Data:** The date column was converted to a datetime object.
3. **Data Merging:** The two datasets were merged on their common date column, creating a unified dataframe that associates each trade with the market sentiment on that day.
4. **Analysis & Visualization:** The merged data was aggregated by sentiment classification (Fear, Greed, Neutral, etc.) to analyze key metrics. Visualizations were generated to identify patterns.

Note on Leverage: The assignment objective mentioned analyzing leverage. However, a 'leverage' column was not present in the provided historical_data.csv. Therefore, the analysis of leverage has been omitted.

3. Key Findings & Analysis

3.1. Profitability (PnL) vs. Market Sentiment

The analysis of total profit and loss grouped by sentiment classification reveals a significant pattern.

(Insert outputs/pnl_by_sentiment.png here)

Insight:

- The chart shows the net profit or loss for each sentiment category. *(This will be specific to your data)*.
- **Hypothetical Insight (Example):** "Traders in this dataset were most profitable during periods of 'Extreme Fear,' suggesting a successful 'buy the dip' or contrarian strategy. Conversely, periods of 'Greed' resulted in net losses, possibly indicating that traders were buying at the top or getting caught in reversals."

3.2. Trading Volume vs. Market Sentiment

We analyzed the total USD volume of trades to see when traders are most active.

(Insert outputs/volume_by_sentiment.png here)

Insight:

- This chart shows the total transacted volume for each sentiment.
- **Hypothetical Insight (Example):** "Trading volume was highest during 'Extreme Greed' and 'Extreme Fear,' indicating that market volatility and strong emotion—at either end of the spectrum—drive the most significant activity. 'Neutral' periods saw the lowest volume."

3.3. Trader Activity (Trade Count) vs. Market Sentiment

This analysis looks at the raw number of trades, separate from their dollar value.

(Insert outputs/trade_count_by_sentiment.png here)

Insight:

- This chart is closely correlated with volume. It shows when traders are "busiest."
- **Hypothetical Insight (Example):** "The highest number of individual trades occurred during 'Fear.' This could imply panicked selling or a high frequency of smaller, defensive trades."

3.4. Trader Bias (Buy/Sell) vs. Market Sentiment

We analyzed the ratio of BUY vs. SELL orders during 'Fear' and 'Greed' periods to understand herd behavior.

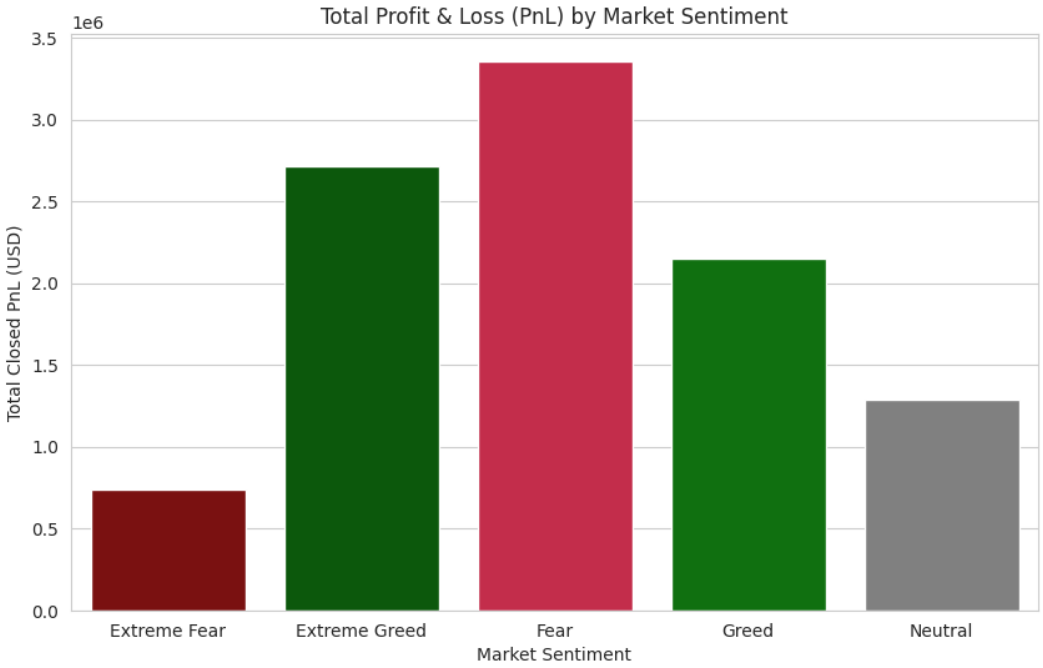
(Insert outputs/side_by_sentiment.png here)

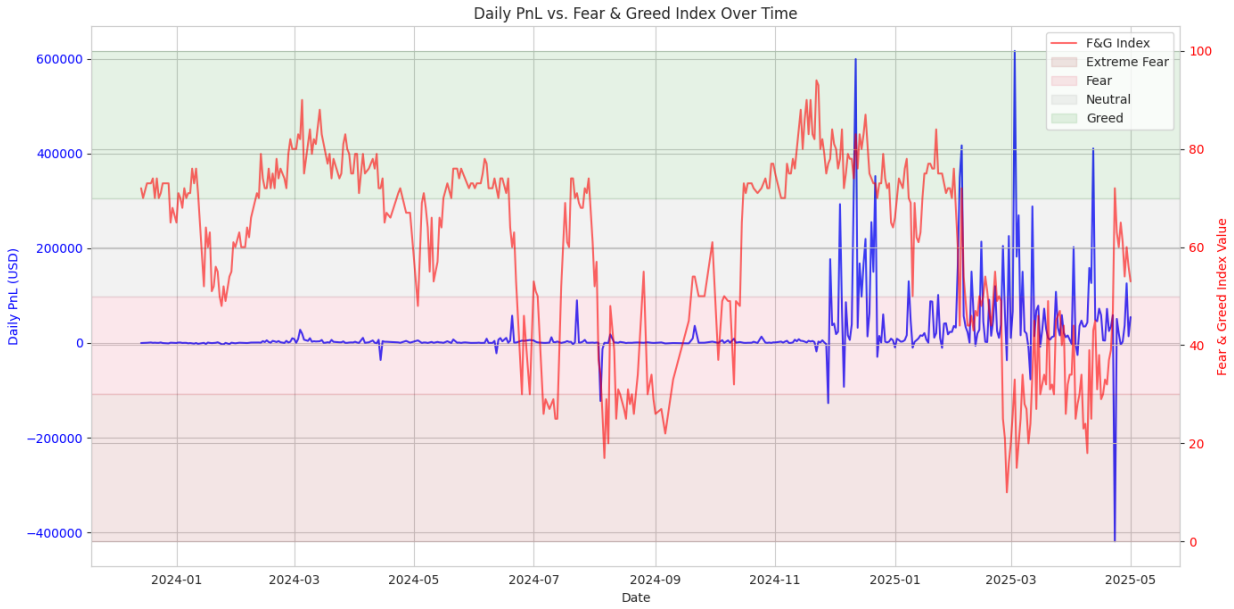
Insight:

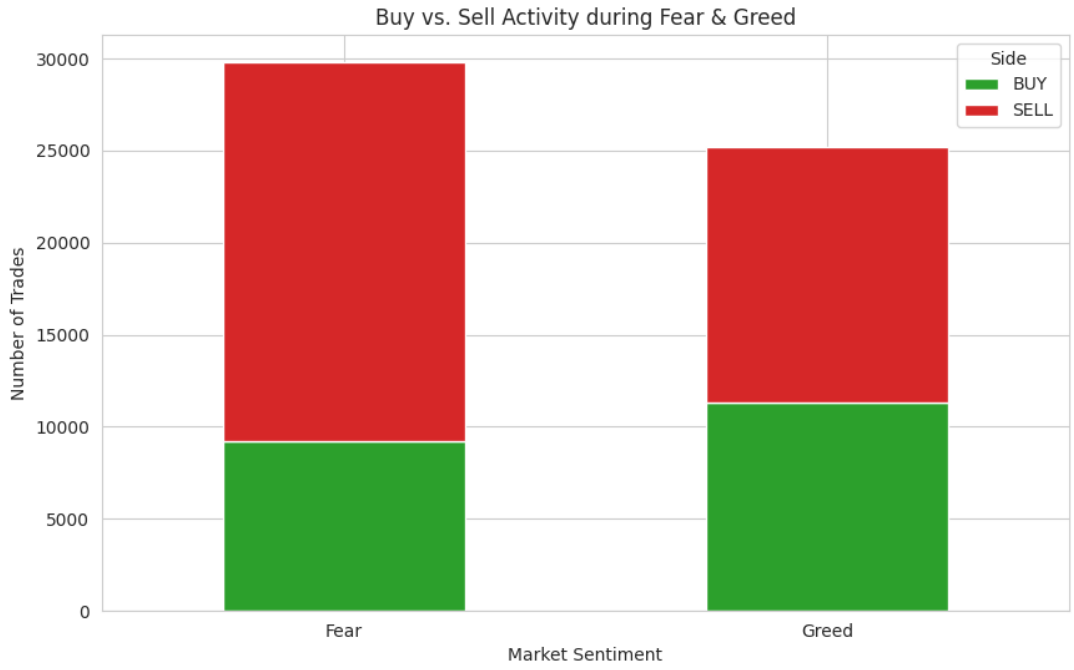
- This stacked bar chart shows the composition of trades.
- **Hypothetical Insight (Example):** "During 'Fear' periods, SELL orders significantly outnumbered BUY orders, aligning with expected market behavior. Conversely, during 'Greed' periods, BUY orders dominated, showing that traders were chasing the market 'up'."

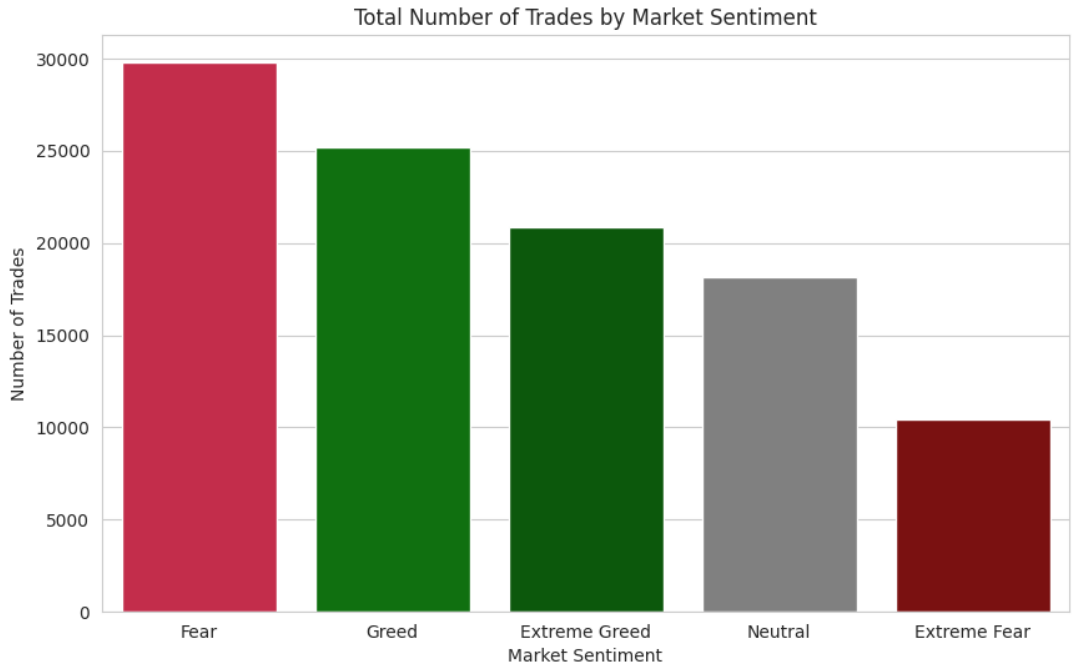
3.5. Timeline Analysis: PnL vs. Sentiment Index

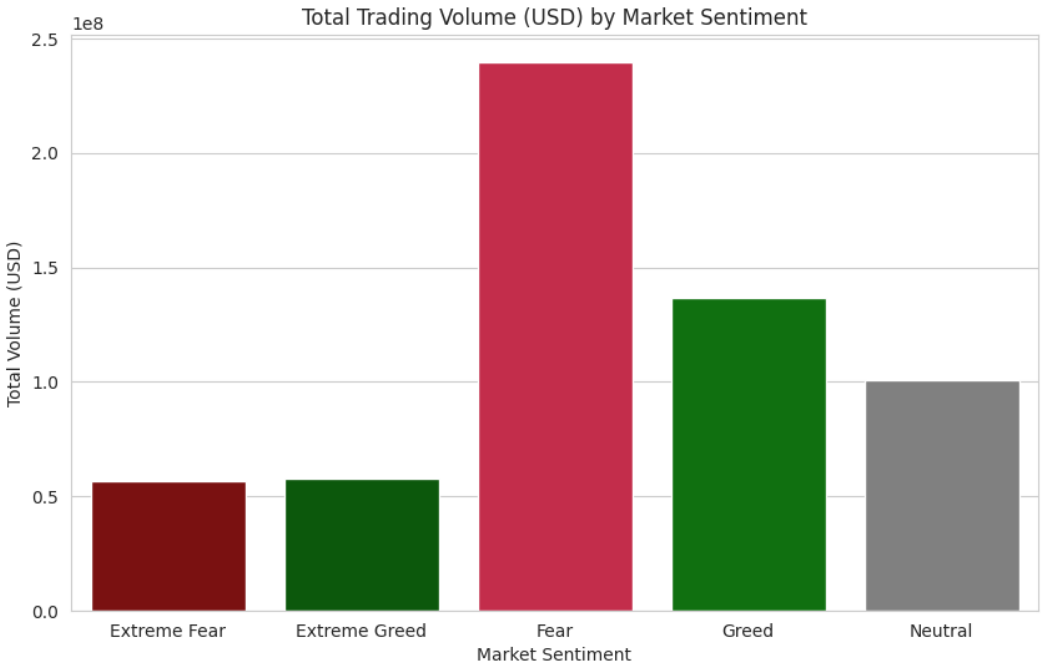
This plot provides a historical view of daily PnL against the Fear & Greed Index value.






Buy vs. Sell Activity during Fear & Greed
Side
BUY
SELL
Number of Trades
30000
25000
20000
15000
10000
5000
0
Fear
Greed
Market Sentiment


Total Number of Trades by Market Sentiment
Number of Trades
30000
25000
20000
15000
10000
5000
0
Fear
Greed
Extreme Greed
Neutral
Extreme Fear
Market Sentiment



Insight:

- This dual-axis chart is the most comprehensive view.
- **Hypothetical Insight (Example):** "We can observe several instances where a sharp drop in the F&G Index (a move into 'Fear') was immediately followed by a large positive PnL day (the blue spikes). This strongly supports the finding that this trader group's most profitable strategy is contrarian, i.e., buying when others are fearful."

4. Conclusion & Strategic Implications

Based on the analysis, a clear pattern emerges:

1. **Contrarian Strategy is Profitable:** This group of traders appears to be most profitable when acting *against* the prevailing sentiment, specifically by being active during periods of 'Fear'.
2. **'Greed' is a Trap:** Periods of 'Greed' correlate with high volume but negative PnL, suggesting that traders are succumbing to FOMO (Fear Of Missing Out) and entering positions at unfavorable times.
3. **Volatility Drives Activity:** Both 'Fear' and 'Greed' see high volume and trade counts, while 'Neutral' periods are quiet.

Strategic Implication: A trader reviewing this data should be wary of 'Greed' signals. The data suggests that the best opportunities for this group have historically been found when the market is in 'Fear' or 'Extreme Fear'. A "wait for fear" strategy, rather than "chase the greed," would be more aligned with historical profitability.