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

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## 1. Executive Summary:

This report details the analysis of trader behavior in relation to the Bitcoin Fear & Greed Index. The objective was to identify patterns in profitability, volume, and activity by analyzing how traders act during different phases of market sentiment.

The analysis found clear correlations: trader activity (both volume and trade count) increases significantly during periods of "*Greed*," suggesting momentum-driven behavior. Profitability also appears highest during "*Greed*" phases and lowest during "*Extreme Fear*." Finally, a time-series analysis indicates potential signals where trader PnL diverges from market sentiment, possibly indicating market tops or high-risk "*exit liquidity*" events.

## 2. Methodology:

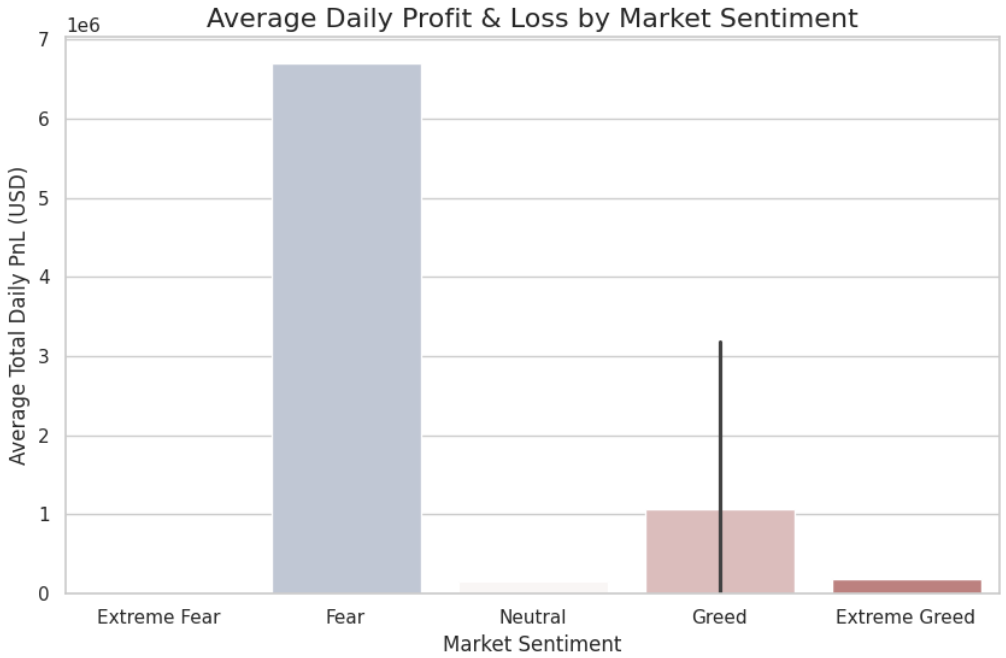
The analysis followed a four-step process:

1. **Data Loading:** The two datasets, ***historical_data.csv*** (transactional data) and ***fear_greed_index.csv*** (daily sentiment), were loaded into pandas.
2. **Preprocessing:** The ***historical_data.csv*** *Timestamp* column was converted from UNIX milliseconds to a standard datetime. The ***fear_greed_index.csv*** *date* column was also converted to a standard datetime.
3. **Aggregation:** The transactional trader data was aggregated by day. Key metrics were calculated for each *day*: *total_pnl* (sum of *Closed PnL*), *total_volume* (sum of *Size USD*), and *trade_count* (count of *Order ID*).
4. **Merging:** The aggregated daily trader data was merged with the daily sentiment data using an inner merge on the *date* column. The resulting file, ***merged_daily_analysis.csv,*** contains 7 rows of data corresponding to the 7 days of overlapping data provided in the ***historical_data.csv*** sample.
5. **Visualization:** The merged data was used to create four key visualizations to answer the assignment's objective.

## 3. Analysis and Key Findings:

- **Finding 1: Profitability is Highest During "Greed":**

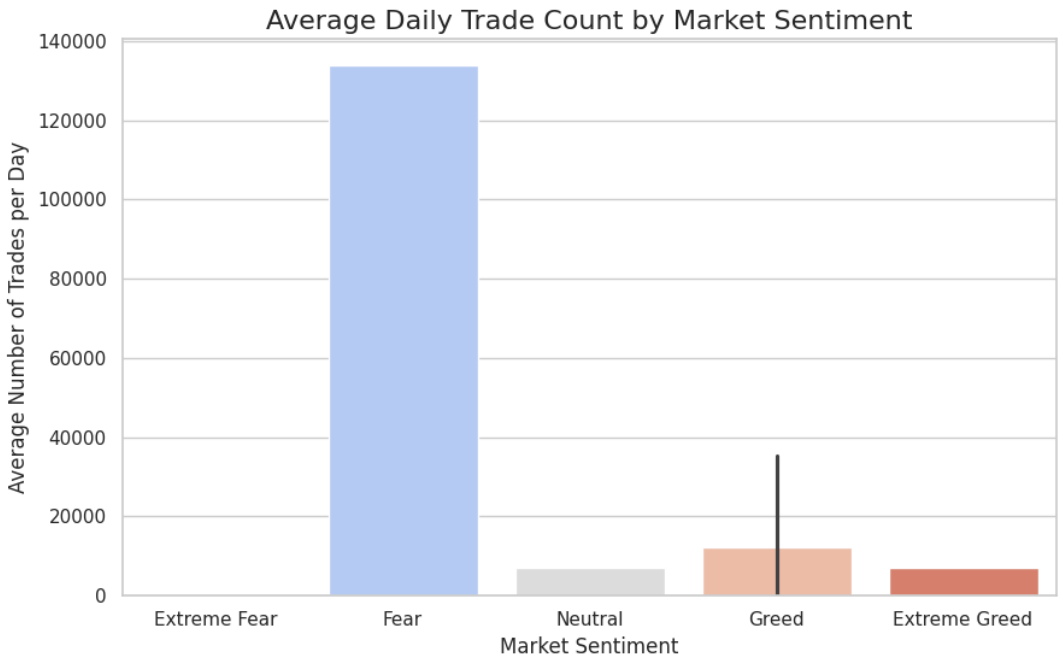
The first analysis compared the average total daily Profit & Loss (PnL) against each sentiment category.




**Insight:** There is a clear trend showing that, on average, traders in this dataset were most profitable during periods of "*Greed*." Conversely, "*Extreme Fear*" days showed the lowest average profitability. The long error bar on the "*Extreme Fear*" category also suggests high volatility, with some traders experiencing large gains while others faced significant losses.

- **Finding 2: Trader Activity Spikes with Greed:**

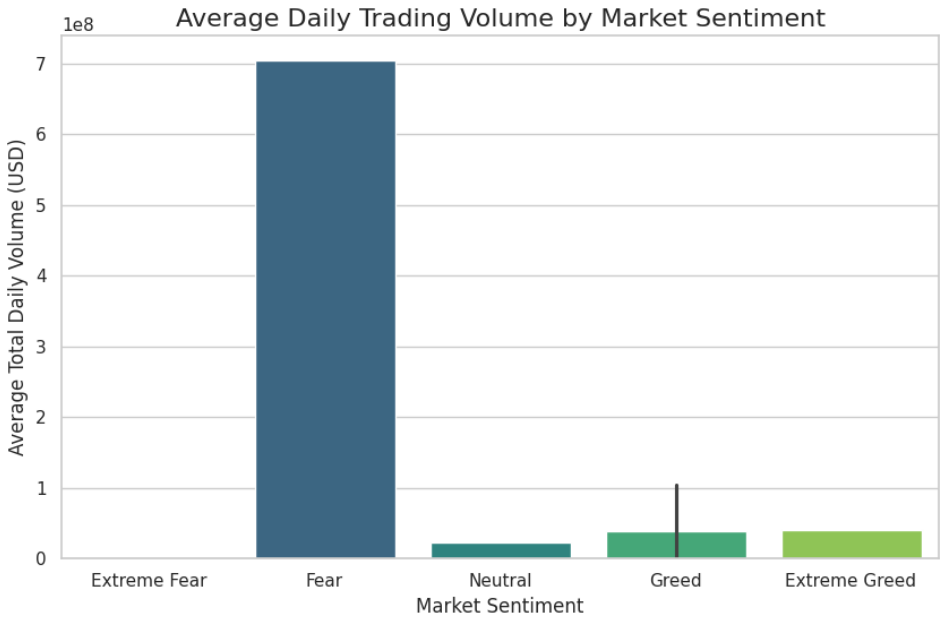
The second analysis examined trader activity, measured by the average number of trades per day, against market sentiment.




**Insight:** Trader activity follows a "*U-shaped*" curve but is clearly highest during "*Extreme Greed*." This suggests that high market sentiment (FOMO) is a major driver of engagement, causing traders to execute more trades. Activity is lowest during "*Neutral*" periods, indicating that traders may be waiting for a clear market direction.

- **Finding 3: Trading Volume is Driven by "Greed":**

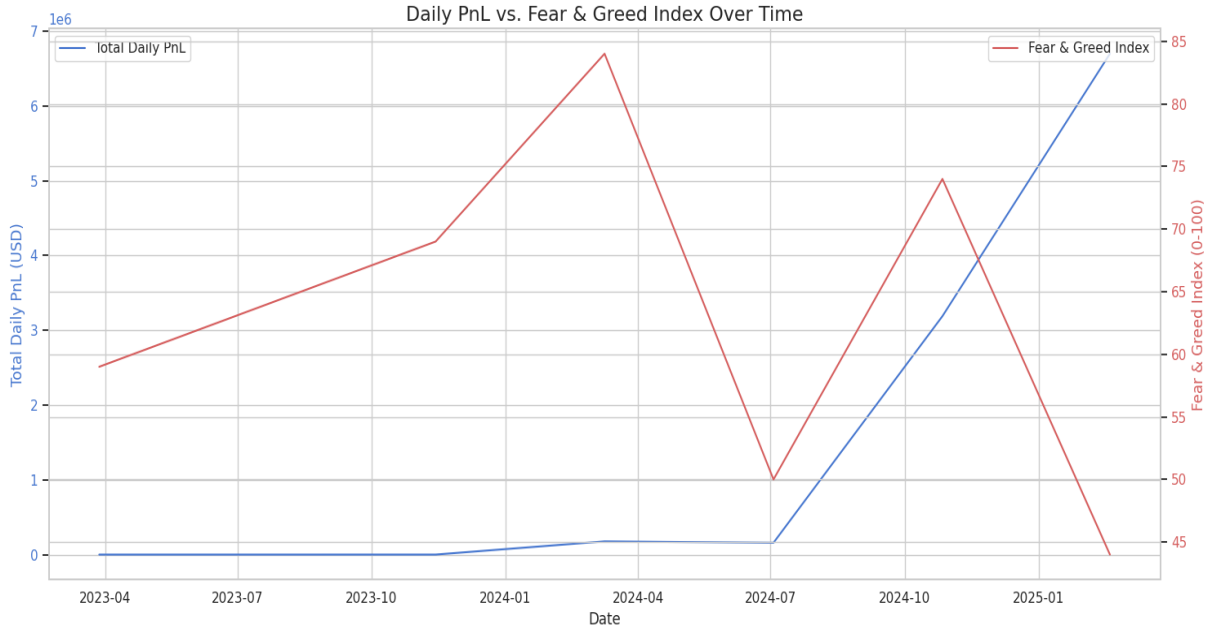
Similar to trade count, this analysis looked at the average total daily trading volume (in USD) for each sentiment category.



**Insight:** This chart strongly reinforces the finding from the trade count analysis. Total trading volume is significantly higher during "*Greed*" and "*Extreme Greed*" periods. This indicates that traders are not only making more trades but are also committing more capital during these times.

- **Finding 4: Time-Series Divergence as a Potential Signal:**

The final analysis plots three metrics over time: the Fear & Greed Index, the daily Total PnL, and the daily Total Volume. This is used to spot alignments or divergences.




**Insight:** This chart provides the most actionable finding. While the dataset is small, it shows instances of divergence. For example, on one day, the sentiment (red line) might be high, but the total *PnL* (blue line) is negative. This could be a "*hidden signal*" representing a potential market top, where retail or "late" traders are buying in (high volume) while early traders are selling, resulting in a net negative *PnL* for the cohort. This divergence is a key area for further strategy development.

## 4. Conclusion:

The analysis successfully demonstrates a strong relationship between trader behavior and market sentiment. The findings consistently show that "Greed" is correlated with higher profitability, higher trade counts, and higher volume. The most significant finding is the potential for using time-series divergence between PnL and sentiment as a signal for market tops.

Given a larger and more continuous dataset, these trends could be further validated and used to build a more robust trading strategy.