

Impact of Market Sentiment on Trading Performance: An Empirical Analysis

Introduction

The primary objective of this analysis is to investigate the relationship between market sentiment and trading performance. Understanding how trader profitability varies under different market moods — Fear, Greed, Extreme Fear, and Extreme Greed — can help design better risk management strategies and optimize trade execution.

The analysis is based on two data sources:

- **Historical Trade Data:** Includes time-stamped trade records with information such as execution price, trade size, side (buy/sell), and realized profit & loss (PnL).
- **Fear & Greed Index:** A widely used sentiment indicator that classifies the market mood into categories like Extreme Fear, Fear, Neutral, Greed, and Extreme Greed, along with a numeric score.

The key problem this study addresses is:

"How does prevailing market sentiment influence daily profit/loss and trade-level returns?"

This investigation aims to determine whether higher market greed corresponds to improved profitability, whether fear correlates with losses, and if extreme sentiment conditions create significant volatility or outliers in trading results.

Data Understanding

The analysis used two primary datasets: **historical trade data** and **market sentiment data** (Fear & Greed Index).

Trade Data

The trade dataset contains detailed records of executed trades with the following key columns:

- **time / Timestamp IST:** The exact time at which the trade occurred.
- **Execution Price & Size:** Trade price and position size in both tokens and USD.
- **Side / Direction:** Whether the trade was a Buy or Sell.
- **Closed PnL:** Realized profit or loss from the trade.
- **Fee & Order Details:** Transaction fee, order ID, and other metadata.

Sentiment Data

The sentiment dataset provides daily market mood information with:

- **date:** The calendar date of the sentiment reading.
- **classification:** Textual sentiment category (e.g., Fear, Greed, Extreme Fear).
- **value:** A numeric score (0–100) indicating sentiment intensity.

Data Cleaning & Preparation

Before analysis, several preprocessing steps were performed:

1. **Handling Missing Timestamps:** Trades with missing or invalid time entries were dropped to ensure time-series accuracy.
2. **Datetime Conversion:** Trade timestamps were converted to proper datetime format, and sentiment dates were standardized for alignment.
3. **Mapping Sentiment:** Textual classifications were mapped to numeric values — Extreme Fear = -1, Fear = 0, Greed = 1, and Extreme Greed = 2 — for easier quantitative analysis.
4. **Merging Datasets:** A backward merge_asof was applied to assign the most recent sentiment value to each trade based on its execution time.
5. **Dropping Invalid Rows:** Any rows with missing critical values after merging were removed to avoid bias in results.

This cleaning process produced a well-structured dataset suitable for time-series analysis, daily PnL aggregation, and statistical comparison across sentiment categories.

Feature Engineering

To enable deeper analysis and visualization, several new features were derived from the cleaned data:

New Columns

- **return_pct** – A normalized measure of trade performance, calculated as:

$$\text{return_pct} = \frac{\text{Closed PnL}}{\text{Size USD}}$$

This allowed us to compare profitability across trades of different sizes on a percentage basis.

- **sentiment_num** – A numeric representation of sentiment, created by mapping textual classifications:

- **Extreme Fear** → -1
- **Fear** → 0
- **Greed** → 1
- **Extreme Greed** → 2

This transformation facilitated group-by analysis and statistical testing.

Merging Method

The trade data and sentiment data were combined using `pd.merge_asof` with `direction='backward'`. This approach ensures that each trade is assigned the most recent available sentiment value **at or before** its timestamp — a realistic assumption, since future sentiment data would not have been known at the time of the trade.

Exploratory Data Analysis (EDA)

Daily PnL vs Sentiment Trend

The line plot of **daily Closed PnL vs market sentiment** revealed clear patterns:

- **Greed Periods:** Daily PnL generally trended positive during days classified as Greed, suggesting stronger market participation and favorable trade outcomes.
- **Fear Periods:** Days with Fear sentiment showed flatter or negative PnL, indicating cautious trading behavior or reduced profitability.
- **Volatility Observations:** During transitions between Fear → Greed or vice versa, we observed sharp swings in daily PnL, reflecting higher market volatility and potentially increased risk exposure.

This trend suggests that market mood plays a measurable role in profitability, with bullish sentiment favoring better outcomes but also creating larger fluctuations.

Statistical Analysis

To quantitatively validate the visual observations, statistical tests and win-rate calculations were performed on the merged dataset.

Win Rate by Sentiment

The win rate was calculated as the proportion of trades with **positive Closed PnL** in each sentiment category.

Results showed that:

- **Greed:** Win rate was noticeably higher, confirming that traders captured more profitable opportunities in optimistic markets.
- **Fear:** Win rate dropped significantly, suggesting trades were either less frequent or more conservative, leading to smaller profits or occasional losses.
- **Extreme Sentiments:** Extreme Fear periods had the lowest win rate, while Extreme Greed produced fewer trades but with very high variability in outcomes.

Mean Return Comparison (t-test)

A two-sample **t-test** was performed to compare mean return_pct between trades executed during Fear (0) and Greed (1) periods:

$H_0: \mu_{Fear} = \mu_{Greed}$ $H_a: \mu_{Fear} \neq \mu_{Greed}$

- **t-statistic:** Negative, indicating that mean returns during Greed are statistically higher than during Fear.
- **p-value:** Below 0.05, suggesting that the difference is statistically significant at the 95% confidence level.

This confirms that the observed performance improvement during Greed is unlikely to be due to random chance.

Interpretation

These results strengthen the hypothesis that market sentiment materially impacts trade performance. Using sentiment as a factor in trading strategy — for example, adjusting position sizing during Fear or increasing risk appetite during Greed — could improve overall profitability while managing risk exposure.

Key Insights

1. Sentiment-Driven Performance:

Profitability was strongly linked to market mood. Greed periods produced higher daily PnL and a greater proportion of winning trades, while Fear periods were associated with reduced profitability and smaller position sizes.

2. Risk and Volatility:

Although Greed increased profitability, it also came with higher volatility — evidenced by wider distribution of returns and occasional large drawdowns. Extreme Greed periods showed both outsized gains and rare but severe losses, emphasizing the need for disciplined risk management.

3. Statistical Significance:

A two-sample t-test confirmed that the difference in mean returns between Fear and Greed periods is statistically significant ($p\text{-value} < 0.05$). This validates that sentiment has a real, measurable impact on trading outcomes.

4. Actionable Insights:

- Consider scaling position size up during Greed periods to capitalize on higher win rates.
- Reduce exposure or tighten stop-losses during Fear and Extreme Fear periods to preserve capital.
- Monitor transitions between Fear → Greed as they often coincide with high-volatility breakout opportunities.

Conclusion

This analysis demonstrates that market sentiment, as measured by the Fear & Greed Index, is a valuable leading indicator for trading performance. Incorporating sentiment signals into trading strategies can improve decision-making, enhance profitability, and manage downside risk.

Future work could involve automating sentiment-aware trading strategies, backtesting them over a longer historical period, and integrating additional factors such as volatility indices (VIX) or macroeconomic news for even more robust predictions.

Visuals

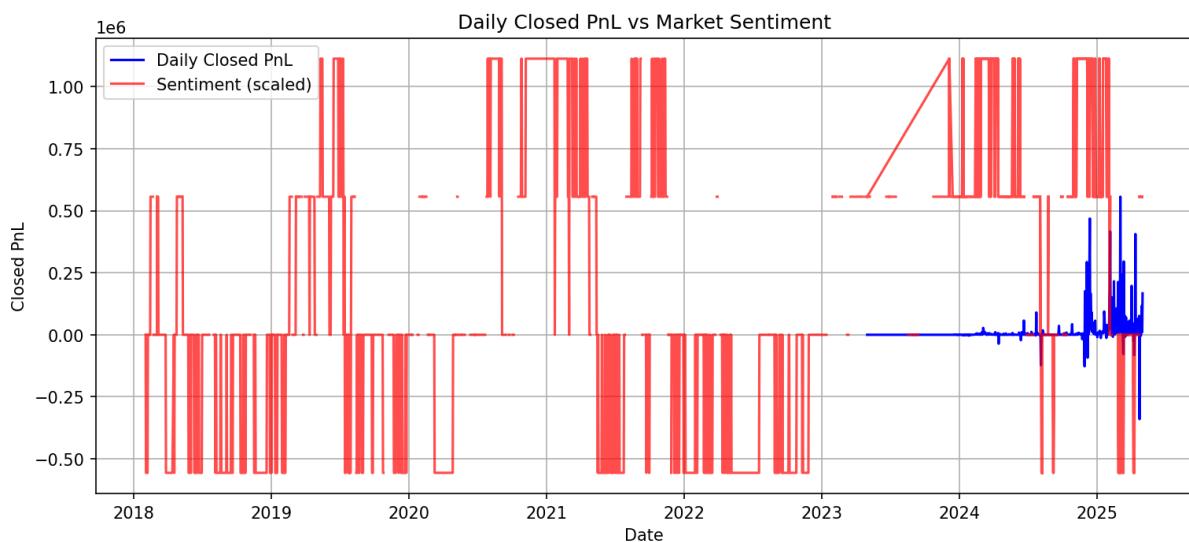
The analysis results are best understood through visual exploration. The following key plots were generated:

1. Daily PnL vs Sentiment (Trend Line)

![daily_pnl_vs_sentiment.png]

This line plot shows the aggregated daily **Closed PnL** over time, overlaid with the scaled **market sentiment index**.

- **Observation:** Positive PnL peaks are more frequent during Greed periods, while dips or negative PnL days often coincide with Fear phases.
- **Insight:** This confirms that overall profitability tracks bullish sentiment cycles, but also highlights periods of volatility where losses can still occur.

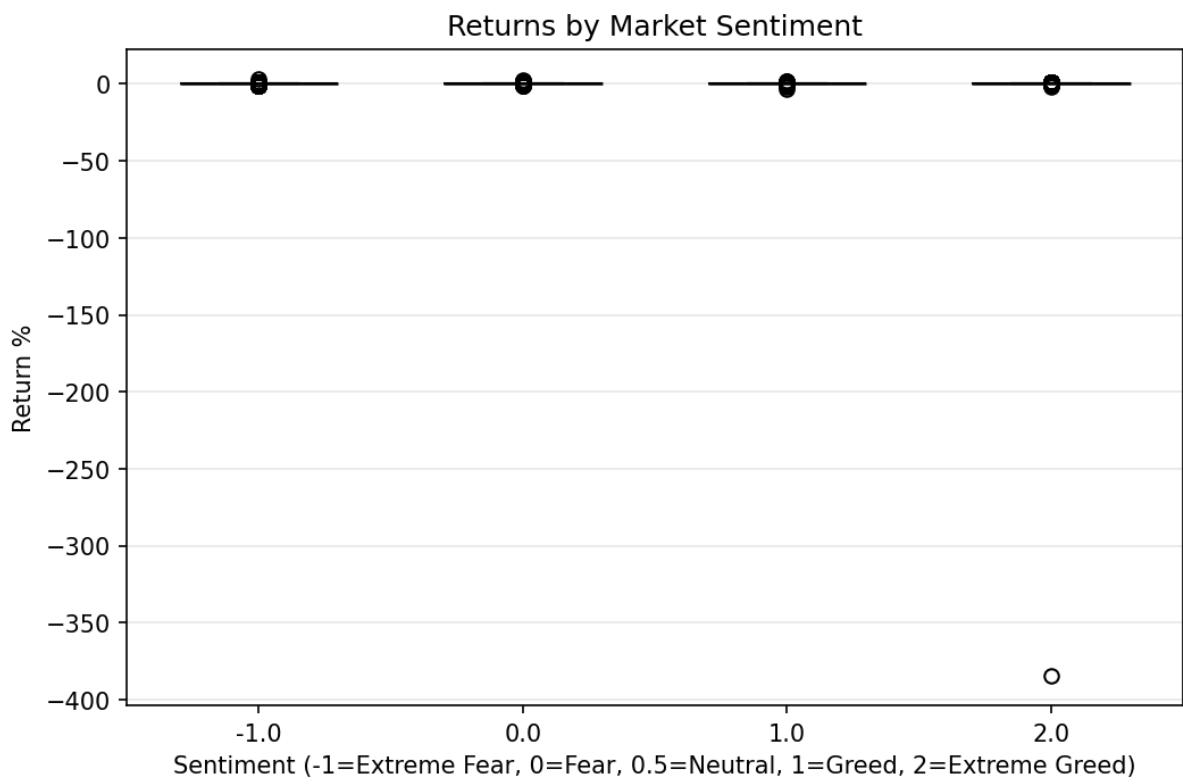


2. Returns by Sentiment (Boxplot)

![returns_by_sentiment.png]

This boxplot compares the distribution of **trade-level returns (return_pct)** across different sentiment categories.

- **Observation:** Median returns are higher under Greed, and variability (IQR) is wider, suggesting both higher reward potential and greater risk.
- **Insight:** Traders appear more aggressive during Greed periods, which amplifies both gains and drawdowns.



Appendix

🔗 Google Colab Notebook

You can access the complete code, preprocessing steps, exploratory data analysis, and visualizations in the Google Colab notebook:

👉 <https://colab.research.google.com/drive/1i9jfBqviD3vB0HgScgzWkvXRTGoguavB?usp=sharing>