Data Science Report – Trader Behavior Insights

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Role Applied For: Junior Data Scientist – Trader Behavior Insights
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1. Introduction & Objective

The cryptocurrency market is heavily influenced by trader psychology, often summarized by the *Fear and Greed Index*. Understanding how trader performance aligns with prevailing sentiment can help improve trading strategies, risk management, and capital allocation.

The primary objective of this analysis is to:

- Explore the relationship between **market sentiment** (Fear/Greed) and **trader performance**.
- Identify patterns in profitability, win rates, trade volume, and risk exposure across different sentiment phases.
- Provide actionable insights to support smarter Web3 trading strategies.

2. Data Description

Two datasets were analyzed:

1. **Bitcoin Market Sentiment Dataset**
    - Columns: `date`, `value`, `classification` (Extreme Fear, Fear, Neutral, Greed, Extreme Greed)
    - Period: 2018–2024
    - Purpose: Measure market mood and classify sentiment into categories.
2. **Historical Trader Data from Hyperliquid**
    - Columns include: `account`, `coin`, `execution price`, `size tokens`, `size USD`, `side`, `timestamp`, `start position`, `direction`, `closed PnL`, `fee`, `trade ID`
    - Size: **211,224 trades**
    - Purpose: Capture execution-level trader performance data.

Data Preparation Steps:

- Converted timestamps to `datetime` format.
- Extracted trade dates for alignment with sentiment data.
- Merged datasets on the `date` field.
- Cleaned column names for analysis.

3. Methodology

The following analytical steps were performed:

1. **Merging Data:** Joined the trader dataset with the sentiment dataset using the trade date as a key.
2. **Grouping by Sentiment:** Calculated aggregated performance metrics per sentiment classification.
3. **Performance Metrics Computed:**
    - **Total PnL** – Overall profit/loss per sentiment category.
    - **Average PnL** – Mean PnL per trade during that sentiment.
    - **Win Rate** – Percentage of trades with positive PnL.
    - **Trading Volume** – Total token volume traded.
    - **Drawdown** – Maximum peak-to-trough loss during each sentiment phase.
4. **Visualization:** Generated multiple bar charts, line plots, and distribution plots to compare metrics across sentiment categories.

4. Exploratory Data Analysis (EDA) & Visual Insights

4.1 Average Closed PnL by Sentiment

- **Highest:** Extreme Greed (~67.89)
- **Lowest:** Extreme Fear (~34.53) and Neutral (~34.30)
- Traders tend to achieve higher profitability during high-confidence market phases.

4.2 Total Closed PnL by Sentiment

- **Top performer:** Fear (≈ 3.35M) followed closely by Extreme Greed (≈ 2.71M)

- **Lowest:** Extreme Fear (≈ 0.74M)

4.3 Win Rate

- Best win rates observed in Extreme Greed (~46.49%) and Fear (~42.07%).
- Extreme Fear had the lowest win rate (~37.06%).

4.4 Trading Volume

- Greed and Extreme Greed phases see significantly higher trade volumes (over 200M tokens).
- Extreme Fear periods show reduced trading activity.

4.5 Drawdowns

- Largest drawdowns occurred during Greed phases (-460K), indicating higher volatility and potential overconfidence.
- Extreme Fear phases had smaller drawdowns compared to Greed, suggesting reduced risk-taking.

4.6 Time-Series Trends

- Cumulative PnL lines show steady growth during Extreme Greed and Fear phases.
- PnL stagnation or decline is more frequent during Neutral and Extreme Fear periods.

5. Key Findings

From the analysis, several patterns emerge:

1. **High Profitability in Greed Phases:** Traders tend to achieve better average PnL in Extreme Greed and Fear phases, possibly due to higher volatility and directional conviction.
2. **Volume Peaks in Confident Markets:** Larger trade volumes align with Greed and Extreme Greed, indicating more market participation.
3. **Risk Exposure:** Greed phases produce higher profits but also larger drawdowns, suggesting overleveraging or overconfidence.
4. **Caution During Extreme Fear:** Lower profits and reduced trade volume suggest traders avoid risk when sentiment is pessimistic.
5. **Fear Can Be Profitable:** Despite negative sentiment, Fear phases generated the highest total PnL, possibly due to contrarian strategies.

6. Recommendations for Trading Strategy

1. **Exploit Volatile Greed Phases:** Develop momentum or trend-following strategies during Extreme Greed/Fear periods to capture large price swings.

2. **Risk Management in Greed Markets:** Limit leverage and use stop-losses to counter high drawdown risk.

3. **Contrarian Approaches in Fear:** Consider selective long entries in Fear periods where total PnL historically peaks.

4. **Reduce Exposure in Neutral Markets:** Avoid overtrading during low-volatility, indecisive market phases.

5. **Integrate Sentiment in Algorithmic Models:** Use Fear & Greed index as a feature in machine learning models for trade signal generation.

7. Conclusion

This analysis highlights that trader performance is closely tied to market sentiment. By incorporating sentiment indicators into trading strategies, traders can better time entries and exits, adjust risk levels, and improve profitability.

In particular:

- **Greed phases** offer the best average returns but come with higher risk.

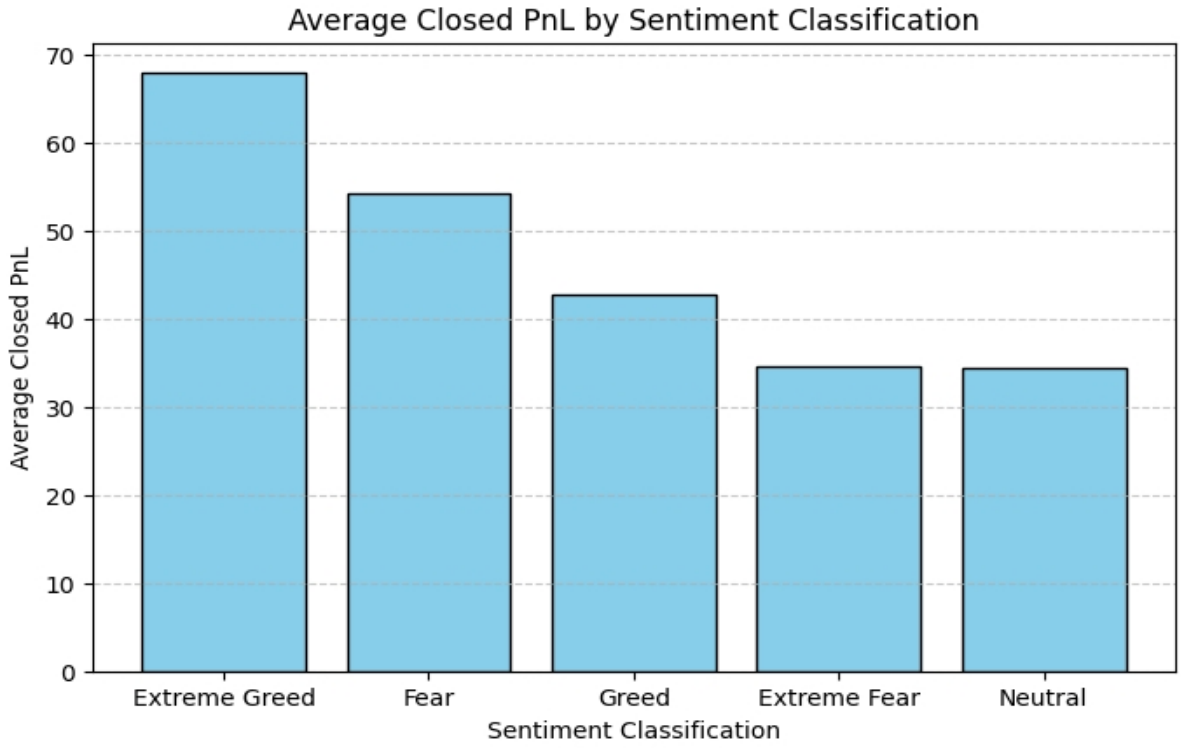
- **Fear phases** can yield high total profits if approached strategically.

- **Extreme Fear** and **Neutral** markets warrant caution.

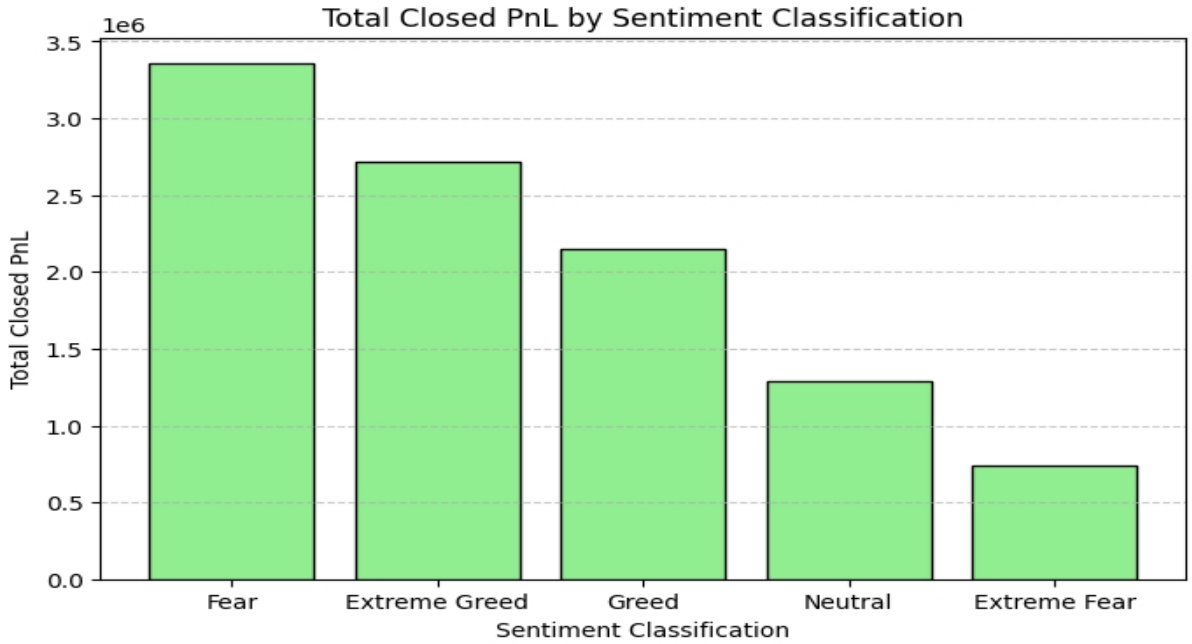
These findings can be directly applied to Web3 trading systems, enhancing decision-making and profitability in dynamic crypto markets.

Attachments (Outputs/Charts):

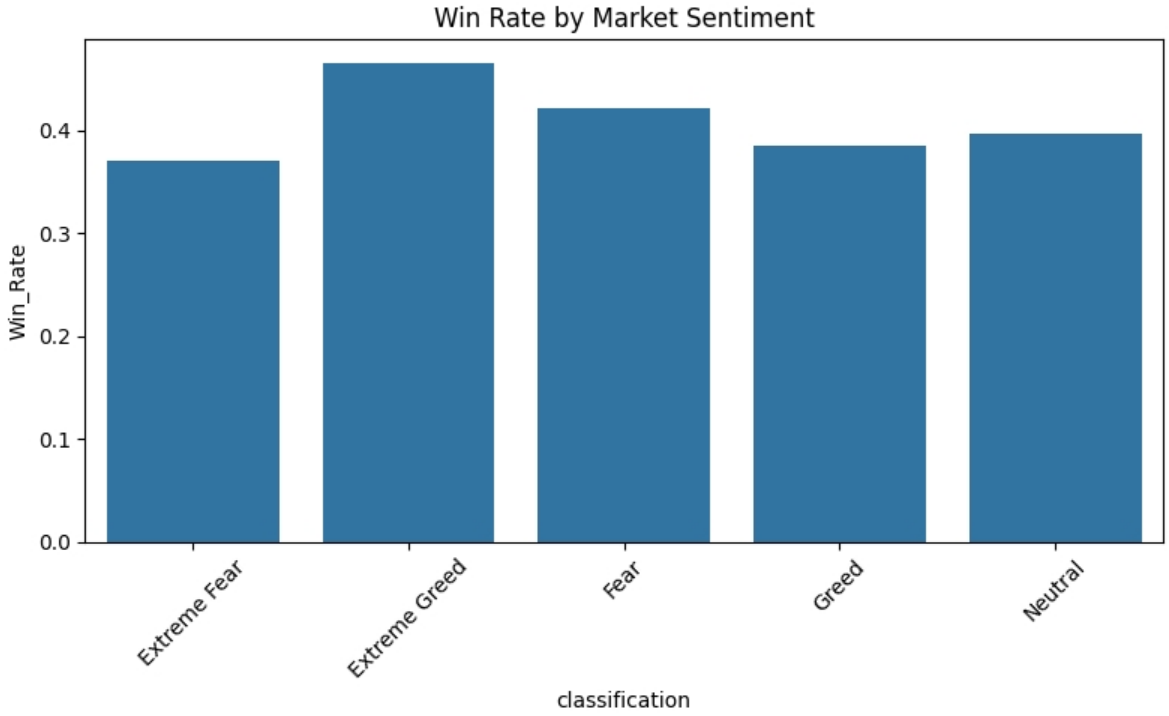
1. Average Closed PnL by Sentiment
   (`average_pnl_by_sentiment.png`)



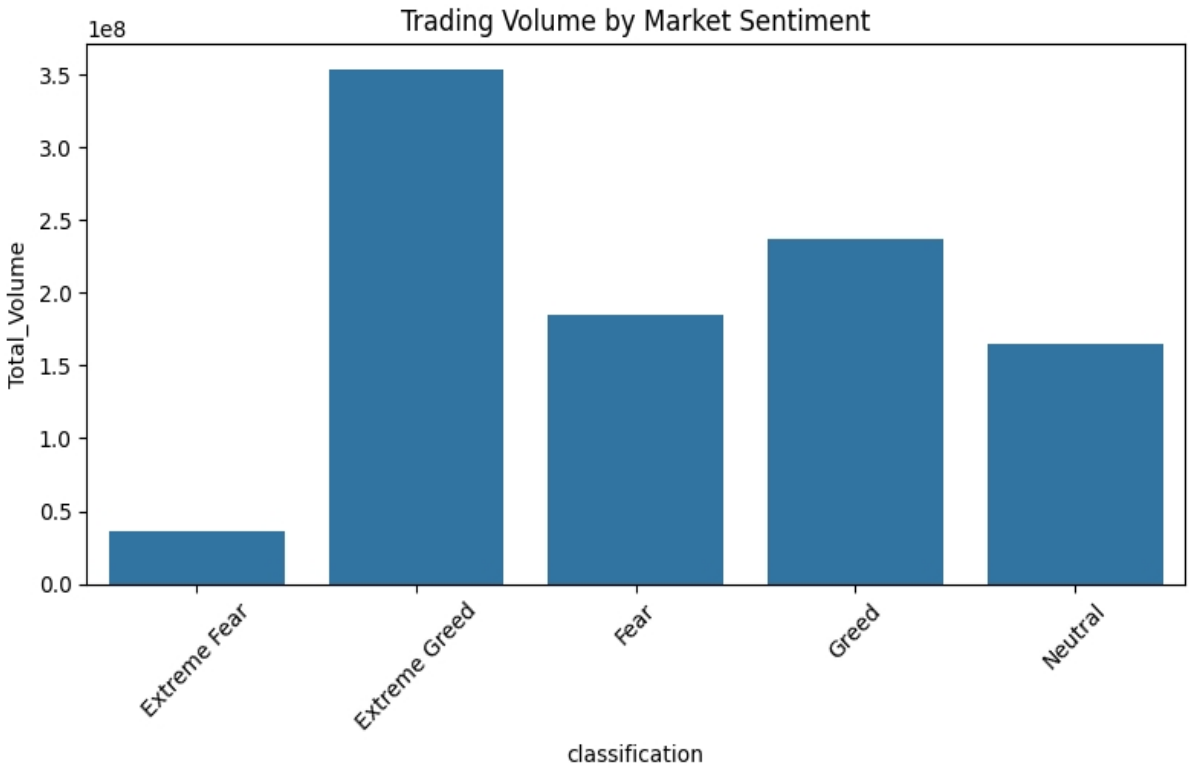
2. Total Closed PnL by Sentiment
   (`total_pnl_by_sentiment.png`)



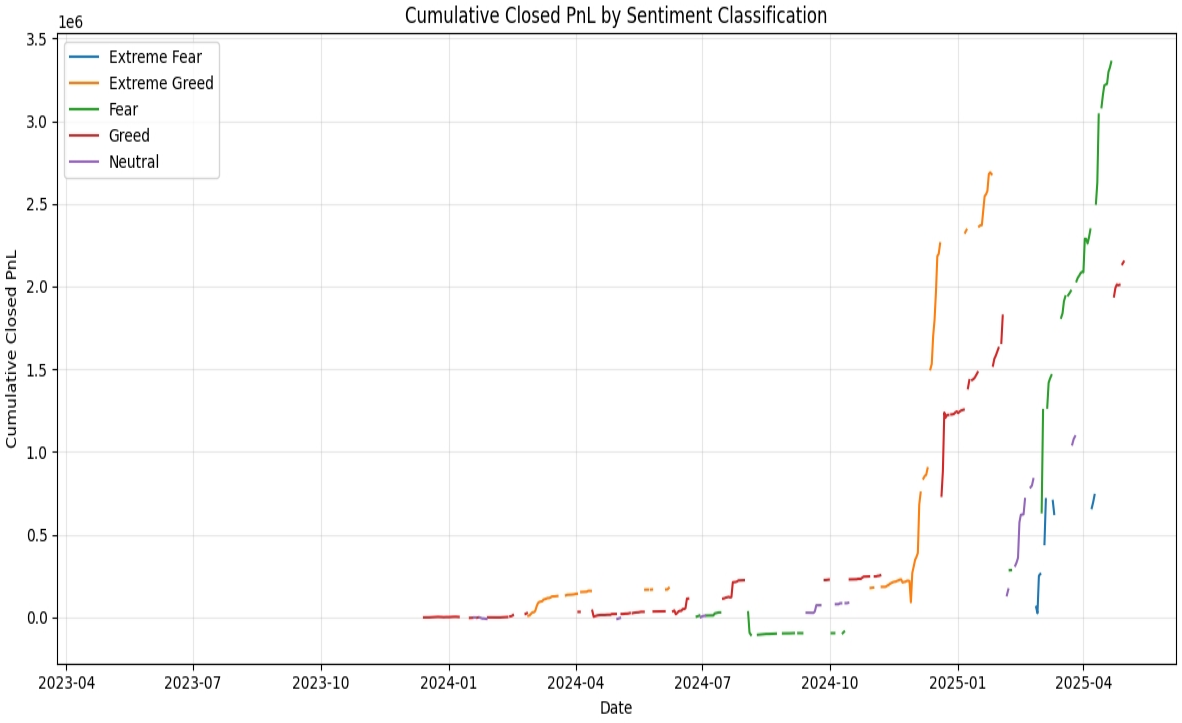
3. Win Rate by Sentiment
(`win_rate_by_sentiment.png`)



4. Trading Volume by Sentiment
(`volume_by_sentiment.png`)



5. Cumulative Closed PnL by Sentiment
(`cumulative_pnl_by_sentiment.png`)



6. PnL Distribution by Sentiment
(`pnl_distribution_by_sentiment.png`)