Data Science Report: Trader Behavior Insights

Candidate: Deekshant Rahangdale

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1. Executive Summary

This report analyzes the relationship between trader behavior and market sentiment using two key datasets: the Bitcoin Market Sentiment Dataset and Historical Trader Data from Hyperliquid. The objective of this assignment was to identify trends and signals that could influence smarter trading strategies. The analysis reveals that traders in the provided dataset are profitable on average across all market sentiments. The highest average profitability per trade is observed during periods of "Extreme Greed," while the highest total profitability is achieved during periods of "Fear" due to a significantly higher trade volume.

2. Methodology

The analysis was performed using Python and its data science libraries. The process involved the following key steps:

1. **Data Loading**: The `fear_greed_index.csv` and `historical_data.csv` files were loaded into pandas DataFrames.
2. **Data Preprocessing**: The `Date` column from the sentiment data and the `Timestamp IST` column from the trader data were converted to a uniform datetime format for accurate merging.
3. **Data Merging**: The two datasets were merged based on the date, allowing each trade to be associated with a specific market sentiment classification.
4. **Analysis**: The merged data was grouped by the `classification` column, and performance metrics such as `Total PnL`, `Average PnL`, and `Trade Count` were calculated.
5. **Visualization**: Bar charts were created to visualize the relationship between PnL and market sentiment, providing a clear and intuitive representation of the findings.

3. Key Findings

The analysis yielded several important insights into how trader performance aligns with market sentiment:

- **Overall Positive PnL**: Traders in this dataset, on average, achieved a positive `Closed PnL` across all market sentiment classifications. This suggests that the collective trading activity in the dataset is profitable.
- **Highest Average PnL in "Extreme Greed"**: The highest average PnL per trade was recorded during periods of "Extreme Greed" at **$67.89**. This indicates that traders are most effective at capitalizing on strong bullish market conditions.

- **Highest Total PnL in "Fear"**: Despite a lower average PnL ($54.29) compared to "Extreme Greed," the **"Fear"** sentiment period generated the highest total profitability at **$3.36 million**. This is attributed to the high volume of trades (61,837) that occurred during this market phase, suggesting a high level of activity and collective profitability.
- **Lowest Performance in "Neutral" Market**: The lowest average PnL ($34.31) was observed during a "Neutral" market sentiment. This could imply that a lack of a clear market trend or direction is less favorable for traders in this dataset.

4. Visualizations

The following charts, located in the `outputs/` directory, provide a visual summary of the findings:

- **Average Trader PnL by Market Sentiment**: This bar chart shows the average profitability per trade for each sentiment.
- **Total Trader PnL by Market Sentiment**: This bar chart highlights the cumulative profitability for each sentiment, emphasizing the significant total PnL during "Fear."

5. Strategic Recommendations

Based on the findings, here are some actionable recommendations for smarter trading strategies:

- **Exploit "Fear" Periods**: The data suggests that periods of market "Fear" present a significant opportunity. Trading strategies designed to capitalize on volatility or potential rebounds during these times could be highly effective given the high volume of profitable trades.
- **Develop "Greed"-Specific Strategies**: Since "Extreme Greed" and "Greed" periods yield the highest average profitability, a strategy could be developed to maximize returns during these strong bullish trends. This might involve trend-following or momentum-based approaches.
- **Further Analysis on Risk**: Future analysis should investigate the relationship between sentiment and risk, as measured by metrics like leverage, trade size, and the standard deviation of PnL. This would provide a more complete picture of performance and help