Data Science Project: An Analysis of Trader Behavior and Market Sentiment

Executive Summary

This report presents the findings of a data science project aimed at analyzing the relationship between trader behavior and market sentiment. By combining a Bitcoin sentiment dataset with historical trader data, we explored how trader profitability, risk, and volume align with periods of market "Fear" and "Greed." Our analysis found that while trading activity is highest during periods of market volatility (particularly "Fear"), there is no strong statistical evidence to suggest that a specific market sentiment directly correlates with a trader's average profitability.

1. Methodology

The project was executed in a two-stage process using Python in Google Colab.

1.1 Data Ingestion and Preprocessing: The project utilized two datasets: fear_greed_index.csv (Bitcoin market sentiment) and historical_data.csv (Hyperliquid trader data). The datasets were loaded into pandas DataFrames. Date columns were cleaned and converted to a consistent datetime format, and the two datasets were merged on the common date field. Missing values were handled to ensure data integrity.

1.2 Exploratory Data Analysis (EDA): Initial analysis focused on understanding the data's characteristics. Visualizations were created to explore the distribution of market sentiment, trading volume, and PnL. The key plots generated for this stage are included in the outputs/ directory.

1.3 Advanced Analysis and Hypothesis Testing: To gain deeper insights, the analysis included identifying top and bottom-performing traders based on their total PnL. The correlation between key trading metrics and market sentiment was calculated and visualized using a heatmap. Finally, a t-test was performed to statistically determine if there was a significant difference in average PnL between "Fear" and "Greed" periods.

2. Key Findings and Analysis

2.1 Market Sentiment and Trading Activity: The distribution of trades across different market sentiments showed that the highest number of trades occurred during periods classified as "Fear." This was followed by "Greed" and "Neutral" periods. This indicates that trading activity is

highest when the market's collective emotion is strongest, whether due to fear of missing out or fear of losses.

Furthermore, a bar chart of total trading volume confirmed this finding, showing that volume was highest during "Fear" periods. This suggests that high market emotion correlates with high trading activity, as traders react to price swings.

2.2 Profitability Across Sentiments: A box plot of PnL by sentiment revealed that while the median PnL for all sentiment categories was close to zero, there were many outliers representing both significant profits and losses. The spread of PnL did not appear to be dramatically different between "Fear" and "Greed," suggesting that both periods present opportunities for large gains or losses.

2.3 Trader Behavior (Buy vs. Sell): An analysis of buy versus sell trades showed a relatively balanced ratio in all sentiment periods. This indicates that while traders are highly active during "Fear" and "Greed," there is not a clear bias toward buying or selling.

2.4 Correlation Analysis: The correlation matrix showed a weak positive correlation (r=0.12) between Closed PnL and Size USD (trading volume), which is a surprising find. This suggests that traders who execute larger trades might have a slight tendency to be more profitable. However, the correlation between sentiment (represented by sentiment_numeric) and Closed PnL was near zero (r=0.00), indicating no linear relationship between market sentiment and a trader's profitability.

2.5 Hypothesis Testing: The t-test comparing the mean Closed PnL of "Fear" periods versus "Greed" periods returned a p-value of greater than 0.05. This result leads us to fail to reject the null hypothesis. Statistically, there is no significant difference in a trader's average profitability when the market is in a state of "Fear" versus "Greed."

3. Conclusion

This project's analysis suggests that for the provided dataset, market sentiment (Fear vs. Greed) does not have a statistically significant impact on a trader's average profitability. While market sentiment does appear to influence overall trading activity and volume, the average trader's PnL remains close to zero regardless of the prevailing sentiment. This implies that "smarter" trading strategies may need to look beyond the simple Fear/Greed index and consider other factors, such as individual risk management, trading frequency, and market entry/exit points, to achieve consistent profitability.