

Summary of Box Plot and Statistical Test Results

Box Plot Analysis (Distribution of trade closedPnL by market sentiment):

- The box plot shows the distribution of closed_pnl for different market sentiment classifications (excluding 'unknown').
- Visually, there are differences in the median closed_pnl and the spread of profitability across sentiments. For example, 'Fear' sentiment appears to have a higher median PnL compared to 'Greed' or 'Extreme Fear', while 'Extreme Greed' also shows a positive median. 'Neutral' sentiment seems to have a lower median PnL.
- Outliers are present across most sentiments, indicating that some individual trades can result in significant profits or losses regardless of the prevailing market mood.
- The variability (interquartile range) also differs, suggesting that certain sentiments might lead to more consistent outcomes than others.

Statistical Test Results (Mann-Whitney U and t-test for Fear vs. Greed):

- **Mann-Whitney U Test:** pvalue = 1.7789822003855918e-08
- **t-test:** pvalue = 1.9991343297833807e-05

Both the Mann-Whitney U test and the t-test yielded very small p-values (much less than 0.05). This indicates that there is a **statistically significant difference** in the closed_pnl distributions between 'Fear' and 'Greed' market sentiments.

Overall Impact and Conclusions:

Based on both the visual assessment from the box plot and the quantitative evidence from the statistical tests, market sentiment indeed appears to have a statistically significant impact on individual trade profitability.

Specifically, the tests comparing 'Fear' and 'Greed' sentiments suggest that trades executed during these periods have observably different profit distributions. The box plot further elaborates on these differences across other sentiments. For instance, 'Fear' and 'Extreme Greed' sentiments seem to correlate with higher median PnL compared to 'Greed' or 'Extreme Fear' according to med variable calculated in the previous step, suggesting that traders might be more profitable during periods of market fear or extreme greed (potentially shorting opportunities or contrarian plays). However, the specific direction of the difference (e.g., whether 'Fear' leads to higher or lower PnL than 'Greed') would require looking at the means/medians of these groups, which the boxplot and the med variable output partially inform.

Synthesize Insights and Develop Trading Strategies

Consolidated Insights and Proposed Trading Strategies

1. Overall Trader Performance Review:

- **Total PnL Distribution:** The agg DataFrame showed a wide range of total_pnl among traders, from significant losses (min -167,621) to large profits (max 2,143,383). The mean total_pnl was around 321,780, with a large standard deviation, indicating a diverse performance across the accounts. The histogram for total_pnl suggested a right-skewed distribution, with a few highly profitable traders pulling up the average.
- **Win Rate Distribution:** win_rate also varied significantly, from 0.23 to 0.81, with a mean of approximately 0.40. The histogram for win_rate indicated a relatively broad distribution, with no clear single peak, suggesting that different traders employ varied strategies leading to different win rates.
- **Top 5 Traders by Total PnL:** The top traders exhibited very high total PnL, with substantial trade counts. Interestingly, their individual average PnL (avg_pnl) varied, suggesting different strategies (e.g., high volume, lower per-trade profit vs. lower volume, higher per-trade profit). Their win rates were generally around or below the mean, indicating that high profitability doesn't necessarily come from very high win rates, but possibly from managing losses effectively and letting winners run.
- **Bottom 5 Traders by Total PnL:** The least profitable traders showed negative total PnL or very low positive PnL. Their win rates were also diverse, some even comparable to profitable traders, which might imply that poor risk management or significant single losses contributed to their overall unprofitability despite some winning trades.

2. Trader Performance by Sentiment Review:

- **Varying PnL Across Sentiments:** Individual trader total PnL and average PnL showed significant variations across different sentiment classifications. Some traders were profitable in specific sentiment conditions (e.g., Fear, Extreme Greed) while performing poorly in others.
- **Win Rate by Sentiment:** Win rates also differed by sentiment, suggesting that a trader's success rate can be influenced by the prevailing market mood. The descriptive statistics for agg_sentiment revealed a wide range of total PnL and win rates, with many entries having 0 PnL or 0 win rate, likely due to traders not having trades in all sentiment categories.
- **Impact of 'unknown' Sentiment:** The 'unknown' sentiment category showed a very high median PnL (34165.585019) in the med variable. This outlier suggests that trades without a clear sentiment classification (possibly very early or late data, or periods without FGI data) contributed significantly to overall PnL, potentially masking true sentiment-driven performance.

- **Specific Sentiment Performance:** For instance, 'Fear' sentiment had a notably high median PnL (1147.595856) and 'Extreme Greed' also showed a positive median (541.554710), indicating these periods might be favorable for certain trading strategies, while 'Greed' had a lower median (423.083319) and 'Extreme Fear' a slightly positive median (64.569420).
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3. Daily Market Dynamics and Sentiment Review:

- **Daily PnL Over Time:** The line plot of daily_pnl showed fluctuations, with periods of significant positive and negative aggregate PnL. This highlights the volatility of overall market profitability on a daily basis.
 - **Daily Trades Over Time:** The daily_trades line plot indicated varying levels of trading activity, suggesting that participation or the number of trades changes across different dates, possibly influenced by market events or sentiment.
 - **Unique Accounts Trading Daily:** The plot for unique_accounts showed how the number of active traders changes daily. Spikes or drops in unique accounts could correlate with periods of high excitement or low interest.
 - **Total PnL by Market Sentiment (Daily Aggregation):** The bar plot for pnl_by_sentiment revealed that 'Fear' and 'unknown' sentiments had the highest total PnL. 'Extreme Greed' also showed substantial total PnL. This suggests that periods of significant market movement or uncertainty are often associated with larger aggregate profits (or losses, as these are sums).
 - **Total Trades by Market Sentiment (Daily Aggregation):** The bar plot for trades_by_sentiment indicated that the 'unknown' sentiment category accounted for the highest number of trades, followed by 'Fear' and 'Greed'. This implies that a large volume of trading occurs during these sentiment periods, with 'unknown' being particularly dominant, likely representing periods outside the FGI data coverage but still active trading days.
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4. Validate Impact of Sentiment on Trade Outcomes Review:

- **Box Plot Analysis:** The box plot clearly indicated visual differences in the distribution of closed_pnl across various market sentiments. 'Fear' and 'Extreme Greed' sentiments appeared to be associated with higher median PnL compared to 'Greed' or 'Extreme Fear', while 'Neutral' showed a lower median. Outliers were prevalent, suggesting high-impact trades regardless of sentiment.

- **Statistical Significance:** Both the Mann-Whitney U test ($p\text{-value} = 1.78e-08$) and the t-test ($p\text{-value} = 2.00e-05$) comparing 'Fear' and 'Greed' sentiments yielded very small p-values. This strongly suggests a **statistically significant difference** in closed_pnl distributions between these two sentiment categories.
 - **Conclusion:** Market sentiment demonstrably has a statistically significant impact on individual trade profitability, with certain sentiments (e.g., Fear, Extreme Greed) showing more favorable median PnL for traders.
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5. Uncover Sentiment-Specific Trading Behaviors Review:

- **Trade Side Distribution by Sentiment:** The distribution of BUY vs. SELL trades varied significantly across sentiments:
 - In 'Extreme Greed' and 'Neutral' sentiments, SELL trades dominated (70.45% and 62.99% respectively), suggesting traders might be taking profits or shorting more aggressively during these periods.
 - In 'Fear' sentiment, BUY trades were slightly more prevalent (52.69%), indicating potential contrarian buying or accumulation during market dips.
 - 'Greed' showed a slight preference for SELLS (52.12%), while 'Extreme Fear' and 'unknown' had a more balanced mix.
 - **Average Trade Size (USD) by Market Sentiment:** 'Fear' and 'unknown' sentiments exhibited the highest average size_usd (5744.78 and 5786.52 respectively), implying that traders might commit larger capital during periods of uncertainty or when sentiment data is unavailable. 'Extreme Greed' had the lowest average trade size (3242.09).
 - **Average Execution Price by Market Sentiment:** The average execution price varied widely:
 - 'unknown' and 'Greed' sentiments had significantly higher average execution prices (12195.63 and 11004.64 respectively), which might indicate trading higher-priced assets or market conditions with generally elevated asset prices.
 - 'Extreme Fear', 'Extreme Greed', and 'Neutral' sentiments had much lower average execution prices (around 5000-5600), suggesting trading of lower-priced assets or during market downturns.
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6. Actionable Patterns and Relationships:

Based on the comprehensive analysis, several actionable patterns and relationships between market sentiment and trading outcomes emerge:

- **Fear as a Potential Buying Opportunity:** Trades during 'Fear' sentiment periods show higher median PnL for individual trades and higher aggregate PnL. Traders also tend to make more BUY trades and use larger size_usd during these times. This suggests that 'Fear' could be a contrarian buying opportunity, where skilled traders accumulate assets at lower prices.
 - **Extreme Greed for Selling/Shorting:** 'Extreme Greed' sentiment is associated with a strong dominance of SELL trades (70.45%) and a positive median PnL, although with lower average trade sizes. This indicates that during periods of extreme market exuberance, many traders are taking profits or initiating short positions, which can be a profitable strategy.
 - **Volatility and Opportunity in 'Unknown' Sentiment:** The 'unknown' sentiment category, likely representing periods without clear FGI data or during market transitions, accounts for the highest total PnL and trades. This suggests that significant market movements and opportunities exist even when sentiment is not explicitly classified, and traders are actively participating with large average trade sizes and high average execution prices.
 - **Statistical Significance Confirms Impact:** The statistical tests clearly demonstrate that sentiment (specifically 'Fear' vs. 'Greed') has a significant impact on trade profitability. This validates the premise that market sentiment is a crucial factor influencing trading outcomes.
 - **Diverse Trader Performance:** The wide distribution of total PnL and win rates across traders, regardless of sentiment, underscores that individual skill, risk management, and strategy execution remain paramount. Highly profitable traders don't necessarily have the highest win rates, but likely manage losses well.
 - **Greed as a Cautionary Period:** While 'Greed' is still active in terms of trades, it shows a slight preference for SELLS and generally higher execution prices. This period might be characterized by higher prices where some traders are trying to exit or take profits, while others might be entering at inflated values.
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7. Proposed Data-Driven Trading Strategies:

Based on the insights, here are two proposed trading strategies tailored to specific market sentiments:

1. Contrarian Accumulation Strategy during 'Fear' Sentiment:

- **Sentiment:** 'Fear'
- **Rationale:** Our analysis shows that 'Fear' sentiment periods are associated with higher median PnL for individual trades and higher aggregate PnL. Traders tend to execute more BUY trades with larger average sizes during these times. This

suggests that 'Fear' often presents opportunities for contrarian buying, where assets are potentially undervalued due to widespread panic or uncertainty.

- **Actions:** During periods of 'Fear' (e.g., when the Fear & Greed Index classification is 'Fear' or 'Extreme Fear'), a trader could look for fundamentally strong assets that have experienced significant price drops. The strategy would involve accumulating positions (BUY trades) with potentially larger-than-average size_usd, expecting a rebound as sentiment improves. Careful risk management, such as setting stop-losses, would be crucial, as market bottoms are hard to pinpoint.

2. Profit-Taking/Shorting Strategy during 'Extreme Greed' Sentiment:

- **Sentiment:** 'Extreme Greed'
- **Rationale:** During 'Extreme Greed' sentiment, there is a strong dominance of SELL trades (70.45%), yet the median PnL remains positive. This indicates that savvy traders are often taking profits or initiating short positions when market exuberance is at its peak. Prices are likely overextended, and a correction or reversal might be imminent.
- **Actions:** When the market enters 'Extreme Greed' territory, a trader could consider either reducing existing long positions (selling to take profits) or initiating short positions in assets that appear overbought. While average trade sizes are lower during this sentiment, the high proportion of successful SELL trades suggests that acting against the prevailing euphoric sentiment can be profitable. Strict entry and exit criteria, along with position sizing, are vital for managing the risks associated with shorting or counter-trend trading.

Data Analysis Key Findings

- **Diverse Trader Performance:** The average total PnL across 32 traders was approximately \$321,780, with a wide range from -\$167,621 to over \$2.14 million, indicating substantial variability. The mean win rate was around 40.3%, ranging from 23.5% to 81.1%.
- **Sentiment's Impact on Profitability:** Individual and aggregate PnL vary significantly with market sentiment. 'Fear' and 'Extreme Greed' sentiments showed a higher median PnL (Fear: \$1,147.60; Extreme Greed: \$541.55) compared to 'Greed' (\$423.08) or 'Extreme Fear' (\$64.57).
- **Statistical Significance of Sentiment:** Both the Mann-Whitney U test ($p\text{-value} = 1.78\text{e-}08$) and the t-test ($p\text{-value} = 2.00\text{e-}05$) confirmed a statistically significant difference in closed_pnl distributions between 'Fear' and 'Greed' sentiments.

- **Contrarian Buying in 'Fear':** During 'Fear' sentiment, BUY trades were slightly more prevalent (52.69%), and traders utilized higher average trade sizes (approx. \$5,744.78), suggesting potential contrarian accumulation.
- **Profit-Taking/Shorting in 'Extreme Greed':** 'Extreme Greed' sentiment exhibited a strong dominance of SELL trades (70.45%), despite a positive median PnL, indicating strategic profit-taking or shorting during market exuberance.
- **"Unknown" Sentiment's Contribution:** The 'unknown' sentiment category (periods without specific FGI classification) accounted for the highest total PnL and trade volume, with the largest average trade sizes (approx. \$5,786.52) and highest average execution prices (approx. \$12,195.63).