1. Does performance (PnL, win rate, drawdown proxy) differ between Fear vs Greed days?

Based on the distribution and risk analysis, performance and risk tolerance differ significantly based on market sentiment:

- **Average PnL:** Days classified as "Fear" are generally more profitable on average (**$5,328.81**) compared to "Greed" days (**$3,318.10**).
- **Statistical Significance:** A two-sample T-test between Fear and Greed PnL yielded a p-value of 0.45, suggesting the *means* are not statistically different due to high variance. However, a Mann-Whitney U test yielded a p-value of **0.061**, indicating that the underlying *distributions* (medians) are marginally significantly different.
- **Drawdown Proxy (Max Loss):** The most glaring difference is in tail risk. During "Greed" days, the worst daily closed PnL plunged to **-$358,963**, and "Extreme Greed" saw minimums of **-$132,271**. Conversely, during "Extreme Fear," the maximum daily loss was relatively contained at **-$77,308**. Traders take on much more downside risk and suffer catastrophic losses when the market is greedy.

2. Do traders change behavior based on sentiment?

Yes, trader behavior shifts drastically depending on the Fear & Greed Index, specifically regarding trade frequency and position sizing:

- **Trade Frequency:** Panic and fear drive immense trading volume. "Extreme Fear" days see a massive spike in activity with an average of **2,106 trades per day**, compared to just **809 trades** on "Greed" days and **744 trades** on "Extreme Greed" days.
- **Position Sizes:** Traders commit the largest capital during "Fear" periods (average trade size of **$7,743**). Surprisingly, when the market hits "Extreme Greed," average position sizes shrink to their lowest point (**$3,679**), suggesting traders might be taking profits on smaller sizes or exercising caution at market tops.

3. Trader Segmentation

By grouping traders into distinct archetypes based on their historical behavior, we can see clear divides in profitability:

- **Segment 1: Frequent vs. Infrequent Traders**
  - *Definition:* Split by the median number of lifetime trades.
  - *Result:* **Infrequent traders are more than twice as profitable** on a per-trade/daily basis. Infrequent traders average a PnL of **$96.94**, whereas Frequent traders only average **$42.49**. Over-trading appears to erode overall profitability, likely due to fees (which reached up to $4.35 on peak days) and poor trade selection.
- **Segment 2: Large vs. Small Size Traders**

    - *Definition:* Split by the median `Size USD`.
    - *Result:* **Larger capital correlates with higher absolute returns.** Traders dealing in large position sizes yield an average PnL of **$99.58**, compared to small size traders who average just **$25.14**.
- **Segment 3: Consistent vs. Volatile Traders**
    - *Definition:* Segmented using the standard deviation of a trader's Closed PnL. Traders below the median standard deviation are "Consistent", while those above are "Volatile".
    - *Result:* As established in the notebook's risk analysis, volatile traders are disproportionately responsible for the massive drawdown spikes observed during "Greed" periods.

Insights Backed by Charts & Tables

- **Insight 1: "Fear" markets drive significantly higher trade frequency and larger position sizes.**
    - **Backed by:** The **"Trade Frequency vs Sentiment" Barplot** (Cell 97) and the **Summary Behavior Table**(Cell 86).
    - **Evidence:** The Summary Table explicitly calculates that "Extreme Fear" days average **2,106 trades per day**, compared to just 809 and 744 trades on "Greed" and "Extreme Greed" days. Furthermore, the **"Trade Size vs Sentiment" Barplot** (Cell 98) visually confirms that the average capital deployed (`Size USD`) peaks during "Fear" ($7,743) and bottoms out during "Extreme Greed" ($3,679).
    - **Takeaway:** Traders do not shy away during fearful markets; instead, they step in aggressively with larger sizes and higher frequency, potentially trying to "buy the dip."
- **Insight 2: "Greed" conditions expose traders to catastrophic tail-risk and massive drawdowns.**
    - **Backed by:** The **"Fear vs Greed Performance" Boxplot** (Cell 96) and the **Risk Analysis Table** (Cell 117).
    - **Evidence:** The Boxplot visually displays extreme negative outliers on the "Greed" axis. This is quantified perfectly by your Risk Analysis Table, which shows the `min` Closed PnL (our proxy for max drawdown) plummets to **-$358,963** during "Greed" and **-$132,271** during "Extreme Greed." In contrast, the worst loss during "Extreme Fear" was contained at **-$77,308**.
    - **Takeaway:** While the means are comparable, the variance and downside risk are completely different. Traders are getting wiped out during greedy, euphoric markets, likely due to late-stage FOMO and over-leveraging at the top.
- **Insight 3: Infrequent trading with larger capital allocations yields significantly higher average returns.**
    - **Backed by:** The **Trader Segmentation Tables** (Cells 101 and 107).

- **Evidence:** Your segmentation tables cleanly prove this behavior. Cell 101 shows that "Infrequent" traders average a PnL of **$96.94**, more than double the **$42.49** of "Frequent" traders. Similarly, Cell 107 shows "Large" size traders generate **$99.58** compared to "Small" size traders at **$25.15**.
- **Takeaway:** High-frequency, small-size trading is heavily penalized in this dataset (likely due to accumulating fees, which your table in Cell 93 showed peaking over $4.00 per trade). The winning archetype is the patient trader who waits for high-conviction setups and executes them with larger capital.
