1. Executive Summary

Briefly highlight:

- Purpose: exploring how trader behavior aligns with market sentiment.
- Key finding: Trader position sizes (and implied leverage) increase during periods of extreme greed, while profitability dynamics vary across different sentiment states.

2. Data Overview

Summarize:

- **Datasets used:** Bitcoin Market Sentiment + Hyperliquid Trader Data
- **Time coverage & key fields:** Date, Classification, closedPnL, leverage, trade size, etc.
- **Preprocessing steps:** cleaning, merging by date/time, handling missing values, and normalizing formats.

3. Methodology

Outline the process:

1. Data cleaning & preparation
2. Aggregations per day and sentiment phase
3. Statistical tests (ANOVA / t-tests) for group differences
4. Visual exploratory analysis (P&L, leverage, trade volume trends)
5. Transition analysis (volume change before sentiment shifts)

4. Findings and Insights

Here's how to present your four main questions:

A. Do traders take more leverage during greed periods?

- **Finding:**
  Average trade size (USD) was highest during *Extreme Greed* phases.
  Larger trade sizes likely indicate higher leverage usage or risk exposure.
- **Visuals to include:**
  - Bar chart of average trade size by sentiment
  - Distribution of trade sizes across classifications

B. Are traders more profitable during fear or greed?

- **Finding:**
  - *Extreme Fear* showed higher average profitability ratios than *Extreme Greed*.
  - The *Unknown* category had the highest P&L and profit ratio overall.
- **Interpretation:**
  Profitability doesn't linearly follow sentiment — traders may find better opportunities during fearful markets (contrarian effect).
- **Visuals:**

- Boxplot of P&L by sentiment
- Bar chart of the average profitability ratio per sentiment

C. Does volume spike before sentiment shifts?

- **Finding:**
  - "Greed → Fear" transitions were preceded by **increases** in trade volume.
  - "Fear → Greed" transitions showed **decreases** in USD trade volume.
- **Interpretation:**
  Traders may become more active before negative sentiment changes — suggesting that spikes in volume can foreshadow fear entering the market.
- **Visuals:**
  - Line chart showing volume vs time, colored by sentiment phase
  - Transition matrix heatmap of volume changes

D. Can any behavior pattern predict a future market move?

- **Finding:**
  Correlations exist between sentiment and trading behavior (frequency, PnL, size), but they are not predictive.
  Further modeling (time-series ML or sentiment forecasting) is needed to predict future moves.
- **Next Steps:**
  - Use lag features (e.g., previous day's volume/leverage).
  - Try simple logistic regression or LSTM to test predictiveness.

5. Conclusions

Summarize key insights:

- Traders tend to scale up during greed phases but may achieve higher efficiency during fear phases.
- Extreme market conditions show non-linear profitability behavior.
- Volume spikes may act as early warning indicators for sentiment changes.
- Predictive modeling is a logical next step.

6. Recommendations

- Incorporate **sentiment signals** into trade risk models.
- Monitor **volume surges** before sentiment transitions.
- Encourage **behavioral diversification** — avoid over-leveraging during greed.

7. Visual Gallery (in /outputs)

Include labeled images:

- output_images.pdf