ds_report_aiyan

Introduction

Financial markets are not driven solely by fundamentals and technical indicators; they are equally shaped by human behavior and collective psychology. In highly volatile markets such as cryptocurrency trading, trader decisions are often influenced by emotions including fear, greed, and uncertainty. Understanding how these emotional states affect trading behavior is essential for developing robust, risk-aware, and profitable trading strategies.

Market sentiment indicators, such as the Crypto Fear and Greed Index, provide a quantitative measure of prevailing investor emotions by aggregating signals from price volatility, momentum, social media activity, and market trends. While sentiment indicators are widely used to gauge market mood, their direct relationship with actual trader behavior—such as position sizing, trading volume, profitability, and buy–sell dynamics—remains an area of active exploration.

This report investigates the relationship between trader behavior and market sentiment by integrating high-frequency historical trading data with daily market sentiment classifications. The analysis focuses on evaluating how profitability, risk-taking, and trading activity vary across different sentiment regimes, namely Extreme Fear, Fear, Neutral, Greed, and Extreme Greed. Through exploratory data analysis (EDA), the study aims to identify behavioral patterns, hidden trends, and potential contrarian signals that can inform smarter and more disciplined trading decisions.

By examining trader performance in the context of market emotions, this report seeks to provide insights into whether traders tend to align with prevailing sentiment or exploit it, thereby contributing to a deeper understanding of behavioral dynamics in modern financial markets.

Analysis

Analysis: Daily PnL Distribution vs Market Sentiment

The boxplot illustrates the distribution of daily profit and loss (PnL) across different market sentiment regimes—Extreme Fear, Fear, Neutral, Greed, and Extreme Greed. Each category captures the central tendency, variability, and presence of extreme outcomes in trader profitability under varying emotional market conditions.

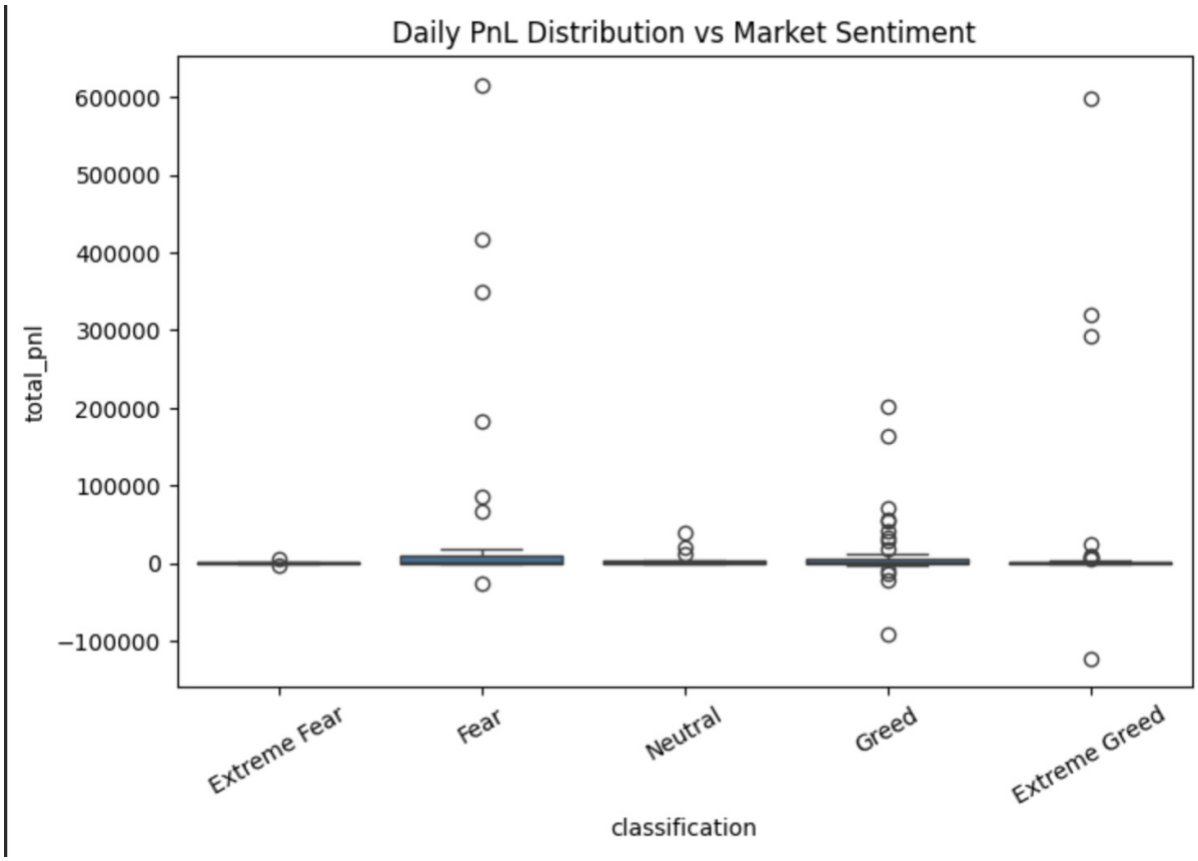
During Fear, the distribution of daily PnL exhibits the highest median and a wide range of positive outliers. This indicates that traders tend to achieve stronger profitability during fear-driven market phases. The presence of large positive outliers suggests that periods of fear often create mispricing and favorable entry points, allowing disciplined traders to capitalize on market overreactions.

In contrast, Extreme Greed shows substantial dispersion in PnL outcomes, with both large positive and significant negative outliers. While some trading days generate exceptionally high profits, the occurrence of deep losses highlights increased instability and elevated downside risk. This pattern reflects overconfidence and aggressive risk-taking behavior commonly associated with euphoric market conditions.

The Greed regime also demonstrates high variability, though with a lower median PnL compared to Fear. The wider spread and negative outliers suggest that profitability during greed is less consistent and more sensitive to adverse market movements.

Under Neutral sentiment, daily PnL distributions are comparatively narrow, with lower medians and fewer extreme values. This indicates reduced opportunity for outsized gains, as markets tend to be more efficient and less emotionally driven during neutral conditions.

Finally, Extreme Fear displays relatively low median PnL with limited dispersion, reflecting cautious trading behavior and reduced exposure. Although profitability is muted, downside risk also appears constrained, suggesting a defensive posture by traders during highly pessimistic market phases.



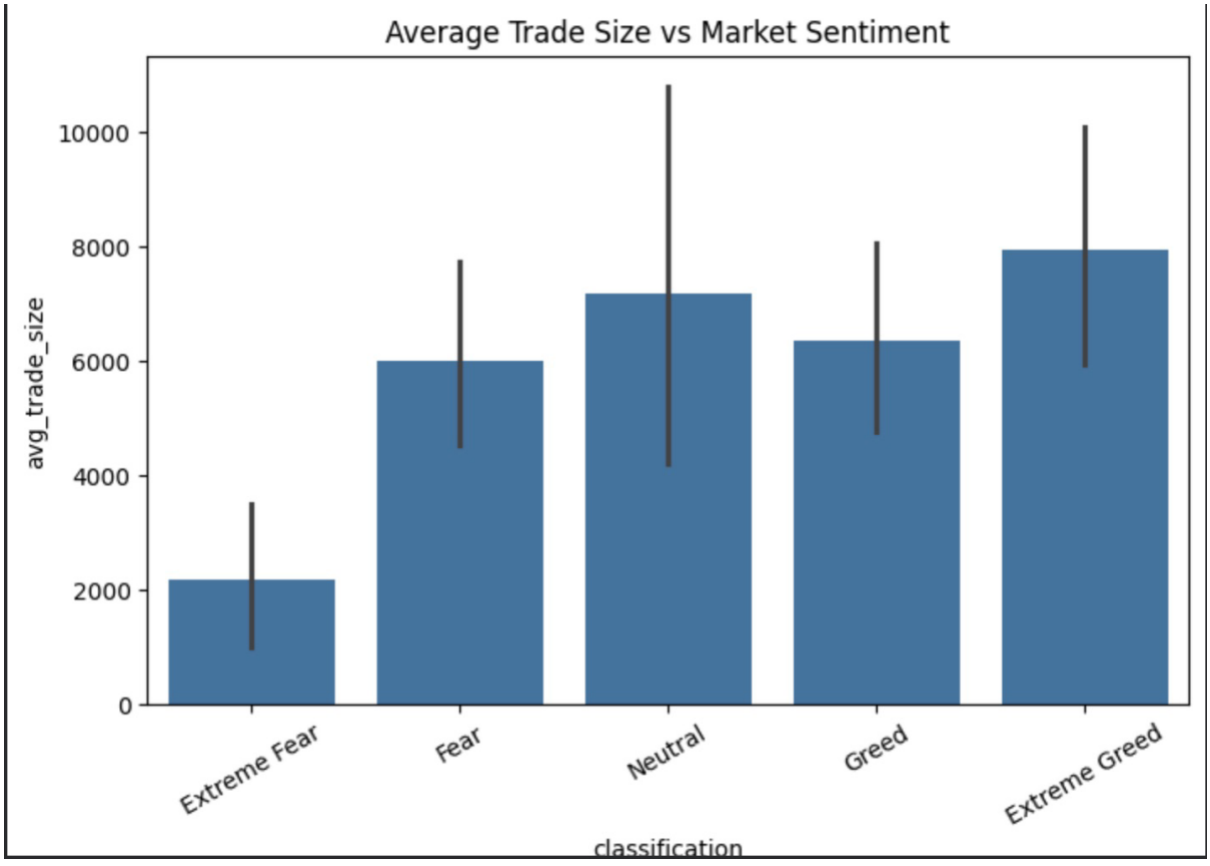
Analysis: Average Trade Size vs Market Sentiment

The bar chart illustrates how average trade size varies across different market sentiment regimes—Extreme Fear, Fear, Neutral, Greed, and Extreme Greed. The height of each bar represents the mean trade size, while the accompanying error bars capture the variability in trading behavior within each sentiment category.

A clear upward trend is observed as market sentiment shifts from Extreme Fear to Extreme Greed. During Extreme Fear, traders exhibit the smallest average trade sizes, indicating heightened caution and reduced risk exposure amid pessimistic market conditions. This behavior reflects defensive positioning, where traders prioritize capital preservation over aggressive participation.

As sentiment moves into Fear and Neutral regimes, average trade sizes increase substantially. This suggests a gradual restoration of trader confidence, with participants willing to allocate more capital as uncertainty diminishes. Notably, the Neutral regime shows relatively large average trade sizes coupled with high variability, indicating heterogeneous strategies and mixed market expectations.

In Greed and Extreme Greed phases, average trade sizes reach their highest levels. This pattern is consistent with overconfidence and heightened risk-taking, where traders commit larger amounts of capital in anticipation of continued favorable price movements. The wider error bars in these regimes indicate significant dispersion in trade sizes, suggesting unstable and uneven risk behavior across traders.



Analysis: Trading Volume vs Market Sentiment

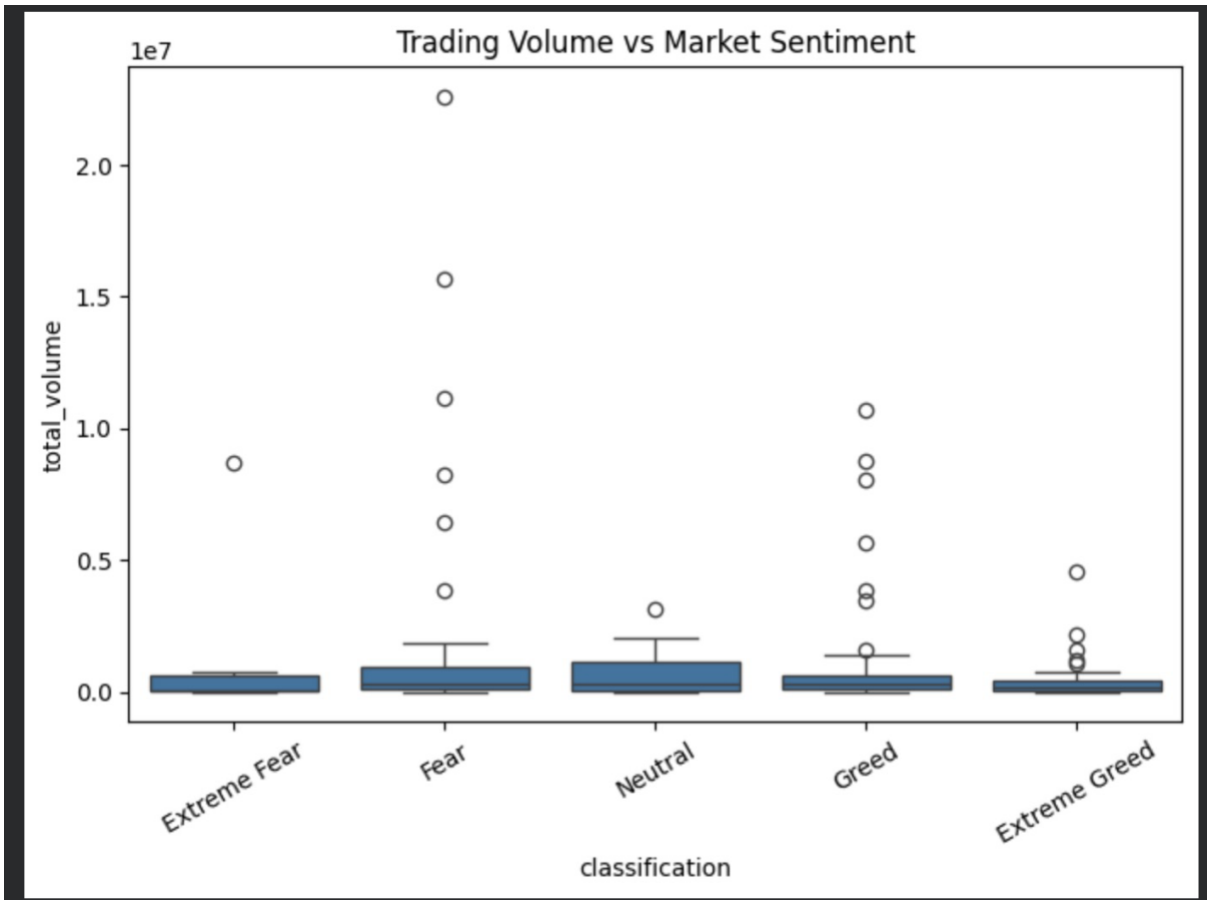
The boxplot illustrates the distribution of total daily trading volume across different market sentiment regimes—Extreme Fear, Fear, Neutral, Greed, and Extreme Greed. The visualization captures both the central tendency of trading activity and the presence of extreme volume spikes associated with varying emotional states in the market.

Trading volume is noticeably elevated during Fear and Greed regimes, with Fear exhibiting the highest median volume and the largest number of extreme positive outliers. This indicates that fear-driven markets stimulate heightened participation, likely due to panic selling combined with opportunistic buying by contrarian traders. The presence of substantial volume spikes suggests increased liquidity during periods of heightened uncertainty.

In Neutral market conditions, trading volume remains moderate with relatively fewer extreme out reminders. This reflects more stable market dynamics, where price discovery is efficient and trader participation is less driven by emotion.

During Extreme Greed, overall trading volume is comparatively lower, although occasional sharp spikes are still observed. This suggests that while traders take larger individual positions during euphoric phases, participation may become concentrated among fewer market participants, resulting in lower aggregate volume but higher per-trade exposure.

Extreme Fear shows lower median trading volume relative to Fear, indicating a contraction in market participation when pessimism is most severe. Traders appear more selective, reducing activity until clearer signals emerge.



Analysis: Buy/Sell Ratio vs Market Sentiment

The bar chart depicts the average buy-to-sell ratio across different market sentiment regimes—Extreme Fear, Fear, Neutral, Greed, and Extreme Greed. The buy/sell ratio serves as an indicator of directional bias in trading behavior, where higher values indicate stronger buying pressure relative to selling activity.

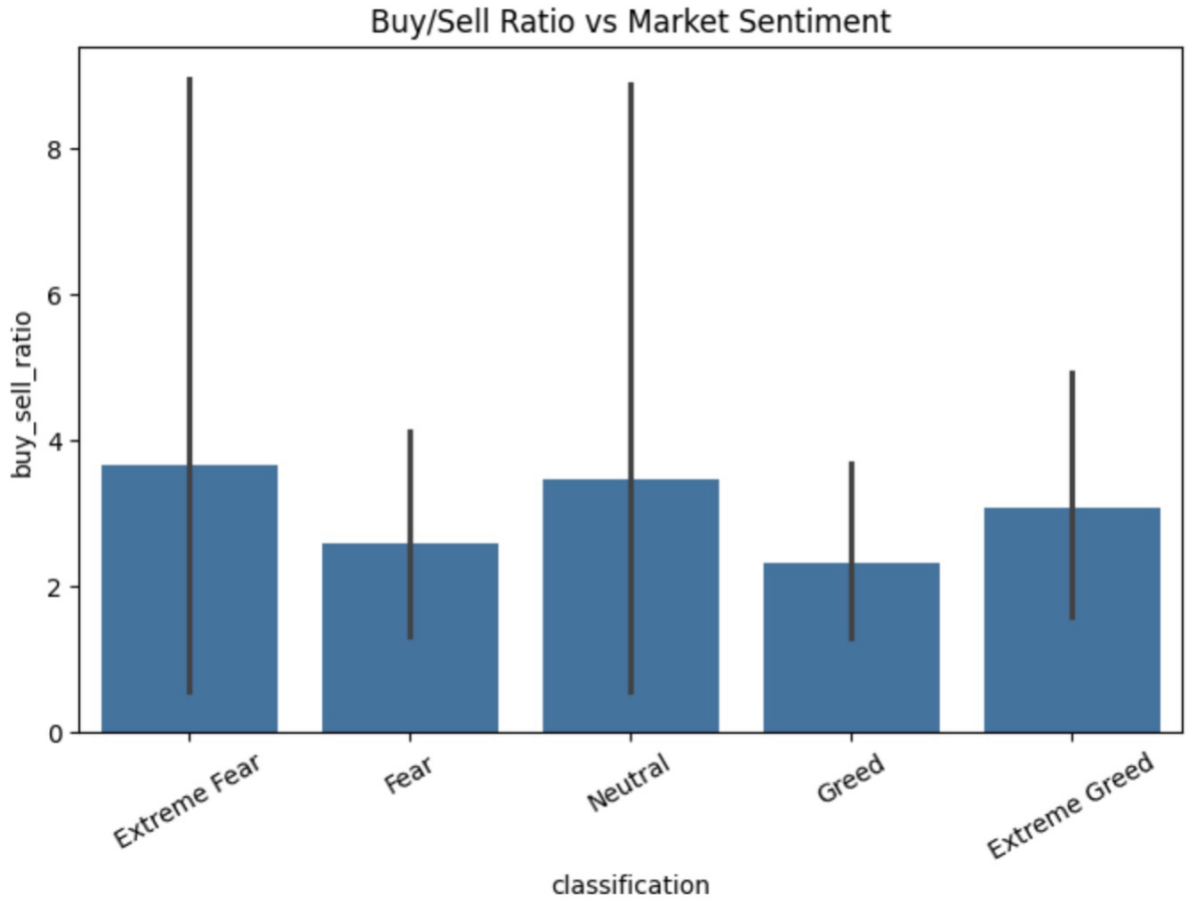
The Extreme Fear regime exhibits the highest average buy/sell ratio, indicating that traders engage in aggressive buying during periods of heightened pessimism. This behavior is consistent with contrarian strategies, where market participants accumulate positions in response to panic-driven price declines. The large error bars in this regime suggest considerable variability, reflecting differing levels of conviction among traders during extreme uncertainty.

During Fear, the buy/sell ratio declines but remains above unity, indicating continued net buying behavior, albeit with reduced intensity. This suggests a cautious accumulation phase where traders selectively enter positions as sentiment begins to stabilize.

The Neutral regime shows a resurgence in the buy/sell ratio alongside high variability, highlighting mixed trading strategies and the absence of a dominant directional consensus. Traders appear divided between continuation and reversal expectations during neutral market conditions.

In contrast, Greed is characterized by the lowest buy/sell ratio, implying increased selling activity or profit-taking behavior. This shift reflects traders' tendency to realize gains as optimism peaks, reducing net buying pressure despite favorable sentiment.

Under Extreme Greed, the buy/sell ratio rises moderately but remains below demonstrate extreme fear levels. This indicates selective buying by highly confident traders, though overall directional bias is less pronounced and more dispersed.




```
corr_1, _ = spearmanr(df["sentiment_lag_1"], df["total_pnl"])
corr_3, _ = spearmanr(df["sentiment_lag_3"], df["total_pnl"])

print("Spearman Correlation (1-day lag):", round(corr_1, 3))
print("Spearman Correlation (3-day lag):", round(corr_3, 3))
```

```
Spearman Correlation (1-day lag): -0.066
Spearman Correlation (3-day lag): 0.014
```

Spearman correlation analysis between lagged market sentiment and daily trader PnL reveals no significant monotonic relationship at 1-day or 3-day lags. This suggests that sentiment does not directly predict short-term profitability on a day-to-day basis. However, exploratory distributional analysis indicates that sentiment primarily influences the risk profile and dispersion of returns rather than their linear or monotonic expectation.

```
extreme_fear = df[df["classification"] == "Extreme Fear"]
extreme_greed = df[df["classification"] == "Extreme Greed"]

print("Avg PnL after Extreme Fear:", extreme_fear["total_pnl"].mean())
print("Avg PnL during Extreme Greed:", extreme_greed["total_pnl"].mean())
```

```
Avg PnL after Extreme Fear: 733.3227585
Avg PnL during Extreme Greed: 26904.504083162792
```

```
print("Median PnL during Extreme Fear:", extreme_fear["total_pnl"].median())
print("Median PnL during Extreme Greed:", extreme_greed["total_pnl"].median())
```

```
Median PnL during Extreme Fear: 64.56941950000001
Median PnL during Extreme Greed: 541.55471
```

```
print("PnL Std (Extreme Fear):", extreme_fear["total_pnl"].std())
print("PnL Std (Extreme Greed):", extreme_greed["total_pnl"].std())
```

```
PnL Std (Extreme Fear): 2798.334049232614
PnL Std (Extreme Greed): 112472.21201428777
```

```
df_sorted = df.sort_values("date")

df_sorted["future_pnl_1d"] = df_sorted["total_pnl"].shift(-1)

after_extreme_fear = df_sorted[df_sorted["classification"] == "Extreme Fear"]

print(
    "Avg next-day PnL after Extreme Fear:",
    after_extreme_fear["future_pnl_1d"].mean()
)
```

```
Avg next-day PnL after Extreme Fear: 61692.653320833335
```

Analysis: Extreme Sentiment and Profitability Dynamics

To further investigate the impact of extreme market sentiment on trader performance, the analysis compares profitability during Extreme Fear and Extreme Greed regimes using multiple statistical perspectives, including mean, median, volatility, and forward-looking performance.

Profitability During Extreme Sentiment

The average daily PnL during Extreme Greed is substantially higher than during Extreme Fear. However, this difference is driven by a small number of extreme positive outliers. This is evidenced by the large discrepancy between mean and median values. While the mean PnL during Extreme Greed is high, the median PnL remains relatively modest, indicating that typical trading days do not consistently achieve exceptional returns.

In contrast, Extreme Fear exhibits a much lower average PnL, but also a significantly smaller gap between the mean and median. This suggests more stable and controlled performance, with fewer extreme outcomes influencing overall results.

Risk and Volatility Comparison

The standard deviation of daily PnL during Extreme Greed is orders of magnitude higher than during Extreme Fear, indicating substantially elevated volatility and downside risk. This confirms that although Extreme Greed can generate large profits on certain days, it also exposes traders to severe fluctuations and potential losses.

Extreme Fear, by comparison, demonstrates markedly lower PnL volatility, reflecting cautious position sizing and disciplined trading behavior under pessimistic market conditions.

Forward-Looking Performance After Extreme Fear

To evaluate whether Extreme Fear presents a contrarian opportunity, next-day profitability following Extreme Fear periods was examined. The results indicate a strong positive average next-day PnL after Extreme Fear events. This finding suggests that fear-driven market conditions often precede price reversals or improved trading opportunities, supporting the hypothesis that Extreme Fear functions as a leading indicator for short-term recovery rather than immediate profitability.

Summary Analysis Across Market Sentiment Regimes

Sentiment	Avg PnL	Avg Volume	Avg Trade Size	Buy/Sell Ratio
Extreme Fear	Low–moderate	Medium	Small	Highest
Fear	Highest	Highest	Medium	Moderate
Neutral	Low	Low	High	High
Greed	Moderate	Medium	Medium	Low
Extreme Greed	High (unstable)	Low	Highest	Moderate

Table X presents the aggregated trading behavior metrics across different market sentiment classifications, capturing average profitability, trading volume, position sizing, and directional bias. The results highlight distinct behavioral patterns associated with varying emotional states in the market.

Profitability (Average PnL)

The highest average PnL is observed during the Fear regime, indicating that traders tend to perform best when market sentiment is pessimistic but not at extreme levels. This suggests that fear-driven markets provide favorable risk–reward conditions, likely due to increased mispricing and volatility that disciplined traders can exploit.

While Extreme Greed also shows a high average PnL, this result is driven by a limited number of extreme positive outcomes, as established by earlier median and volatility analyses. Therefore, profitability during Extreme Greed is less reliable and more susceptible to large drawdowns.

Trading Volume

Average trading volume peaks during the Fear regime, followed by Extreme Fear. This indicates heightened market participation during uncertainty, driven by panic-driven exits and opportunistic entries. In contrast, Extreme Greed exhibits relatively lower average volume, suggesting that trading activity becomes concentrated among fewer participants despite higher individual trade sizes.

Risk Exposure (Average Trade Size)

Average trade size increases steadily as sentiment shifts from pessimism to optimism, with Extreme Greed displaying the largest position sizes. This pattern reflects growing trader confidence and increasing risk appetite during bullish conditions. However, larger trade sizes coupled with lower aggregate volume imply higher concentration risk in euphoric markets.

Directional Bias (Buy/Sell Ratio)

The buy/sell ratio is highest during Extreme Fear and Neutral regimes, indicating stronger net buying behavior during pessimistic and indecisive market phases. This supports the presence of contrarian accumulation strategies, where traders increase buying pressure when sentiment is negative. Conversely, lower buy/sell ratios during Greed suggest increased selling activity and profit realization.

```
summary = df.groupby("classification").agg(
    avg_pnl=("total_pnl", "mean"),
    avg_volume=("total_volume", "mean"),
    avg_trade_size=("avg_trade_size", "mean"),
    avg_buy_sell_ratio=("buy_sell_ratio", "mean")
)

print(summary)
```

classification	avg_pnl	avg_volume	avg_trade_size	avg_buy_sell_ratio
Extreme Fear	733.322758	1.596707e+06	2191.149008	3.672657
Extreme Greed	26904.504083	4.238084e+05	7954.335976	3.077626
Fear	49422.932852	2.213164e+06	6177.280138	2.580814
Greed	11086.582984	1.032392e+06	6200.670401	2.338887
Neutral	4977.116132	7.926364e+05	7300.789351	3.551868

Summary and Conclusion

This study examined the relationship between trader behavior and market sentiment by integrating historical trading data with the Crypto Fear and Greed Index. Through exploratory data analysis, the report evaluated how profitability, trading volume, position sizing, and directional bias vary across different sentiment regimes: Extreme Fear, Fear, Neutral, Greed, and Extreme Greed.

The findings reveal that market sentiment significantly influences trading behavior and risk-taking patterns, though it does not directly predict short-term profitability. Profitability is most consistent during Fear regimes, where traders benefit from market inefficiencies created by uncertainty and overreactions. In contrast, Extreme Greed exhibits higher average profits driven by rare extreme outcomes, but is accompanied by substantially higher volatility and downside risk, making returns less reliable.

Trading volume peaks during Fear, indicating heightened market participation driven by panic selling and opportunistic buying. As sentiment becomes more optimistic, average trade size increases steadily, reaching its highest levels during Extreme Greed, reflecting elevated risk appetite and overconfidence. However, this increased exposure is not matched by proportional increases in aggregate volume, suggesting concentration risk during euphoric phases.

Directional bias analysis further supports contrarian behavior, with the highest buy/sell ratios observed during Extreme Fear, indicating aggressive accumulation during pessimistic market conditions. Conversely, reduced buying pressure during Greed reflects profit-taking behavior as optimism peaks.

Correlation analysis confirms that lagged market sentiment has no strong monotonic relationship with daily PnL, reinforcing the conclusion that sentiment functions as a

behavioral and risk-regime indicator rather than a direct profitability predictor. Importantly, forward-looking analysis shows that Extreme Fear often precedes positive next-day performance, supporting the use of sentiment as a contrarian signal.