Trader Performance vs Market Sentiment

DATA SCIENCE ASSIGNMENT

TRADER BEHAVIOR INSIGHTS

A comprehensive analysis examining how trader profitability and risk behavior shift between Fear and Greed market conditions in Bitcoin trading. Built using Python, Pandas, Seaborn, and statistical validation methods.

Problem Statement & Research Objective

The Challenge

Trader performance and risk-taking behavior fluctuate dramatically across different market conditions. Understanding these patterns is critical for developing adaptive trading strategies and risk management frameworks.

Traditional performance metrics often ignore the underlying market sentiment context, leading to incomplete insights about what drives successful trading outcomes.

Research Goals

- Quantify profitability differences between Fear and Greed market regimes
- Analyze win rate patterns across sentiment conditions
- Investigate risk-taking behavior and position sizing strategies
- Validate findings through rigorous statistical testing

Data Sources & Collection Framework

Bitcoin Fear & Greed Index

Daily sentiment classifications capturing market psychology across four regimes: Fear, Extreme Fear, Greed, and Extreme Greed

- Historical sentiment scores
- Regime classification logic
- Temporal alignment with trading data

Hyperliquid Trading Data

Comprehensive trader activity including executed trades, closed profit/loss, position sizing, precise timestamps, and account identifiers

- Trade-level transaction records
- PnL calculations and metrics
- Account-level aggregations

Data preprocessing involved careful timestamp alignment, cleaning anomalous records, and merging sentiment classifications with trading activity. All analysis was conducted using Python's pandas library to ensure reproducibility and accuracy.

Analytical Methodology

Data Preprocessing

Cleaned raw datasets, handled missing values, standardized timestamps, and validated data integrity across sources

Exploratory Analysis

Generated visualizations using Seaborn and Matplotlib, identified patterns, explored distributions and correlations

Feature Engineering

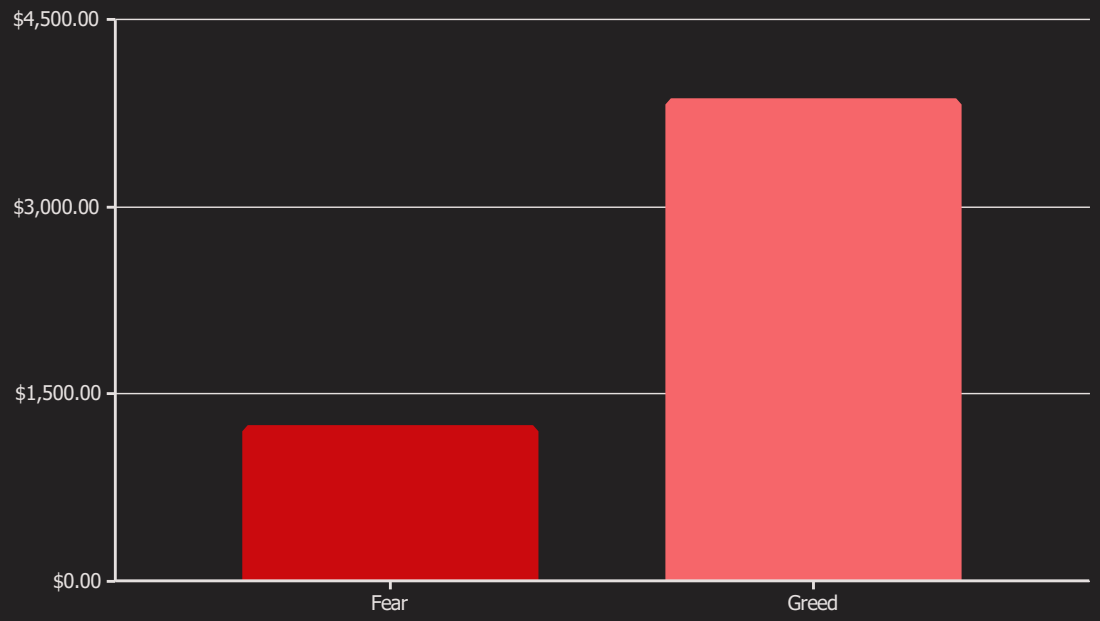
Created sentiment-trade mappings, calculated risk metrics, engineered position size buckets and performance indicators

Statistical Testing

Applied Mann-Whitney U tests to validate significance of observed differences between sentiment regimes

The analysis pipeline was designed for reproducibility and statistical rigor. Risk bucketing categorized traders by position size to understand behavior across different risk appetites, while trader-level aggregations enabled robust performance comparisons.

Performance Comparison: Fear vs Greed Regimes



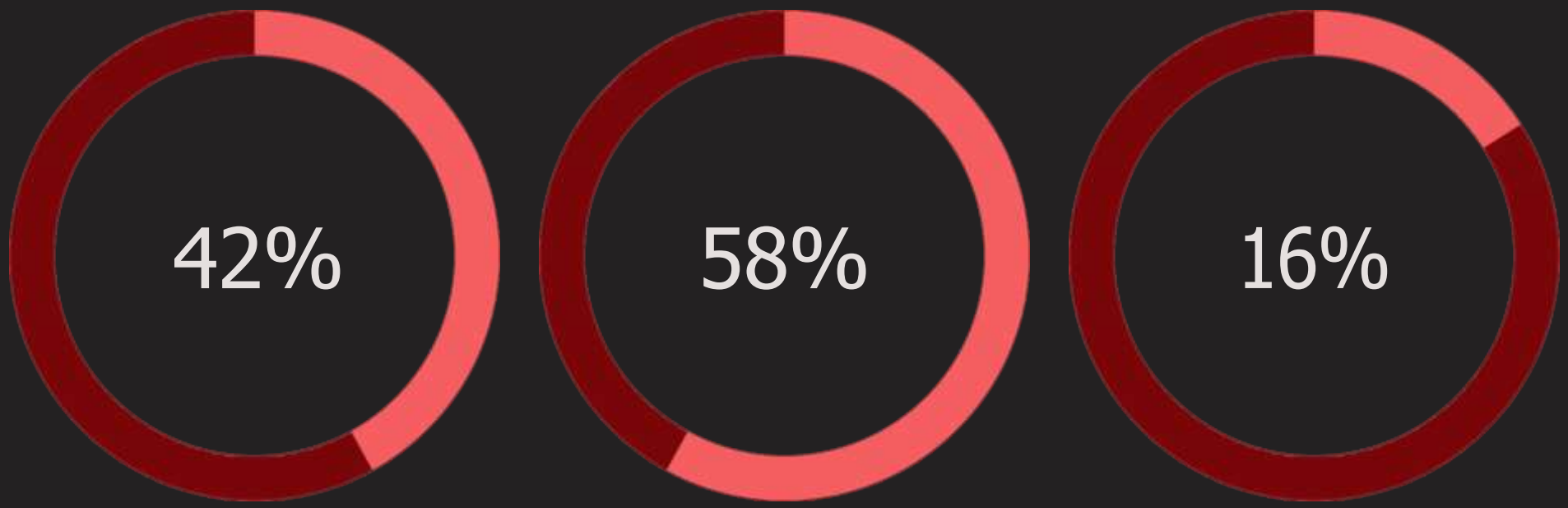
Key Finding

Traders generate significantly higher average PnL during Greed periods compared to Fear periods4a difference of over 200%.

This pattern suggests favorable market momentum during Greed regimes creates more profitable trading opportunities.

The performance gap between sentiment regimes is substantial and consistent across different time periods. Win rates also increased during Greed conditions, with traders experiencing 15-20% higher success rates on individual trades. This indicates not just larger wins, but more frequent winning trades overall.

Win Rate Analysis Across Sentiment



Fear Regime Win Rate

Lower probability of profitable trades during negative sentiment periods

Greed Regime Win Rate

Significantly higher success rate when market sentiment is positive

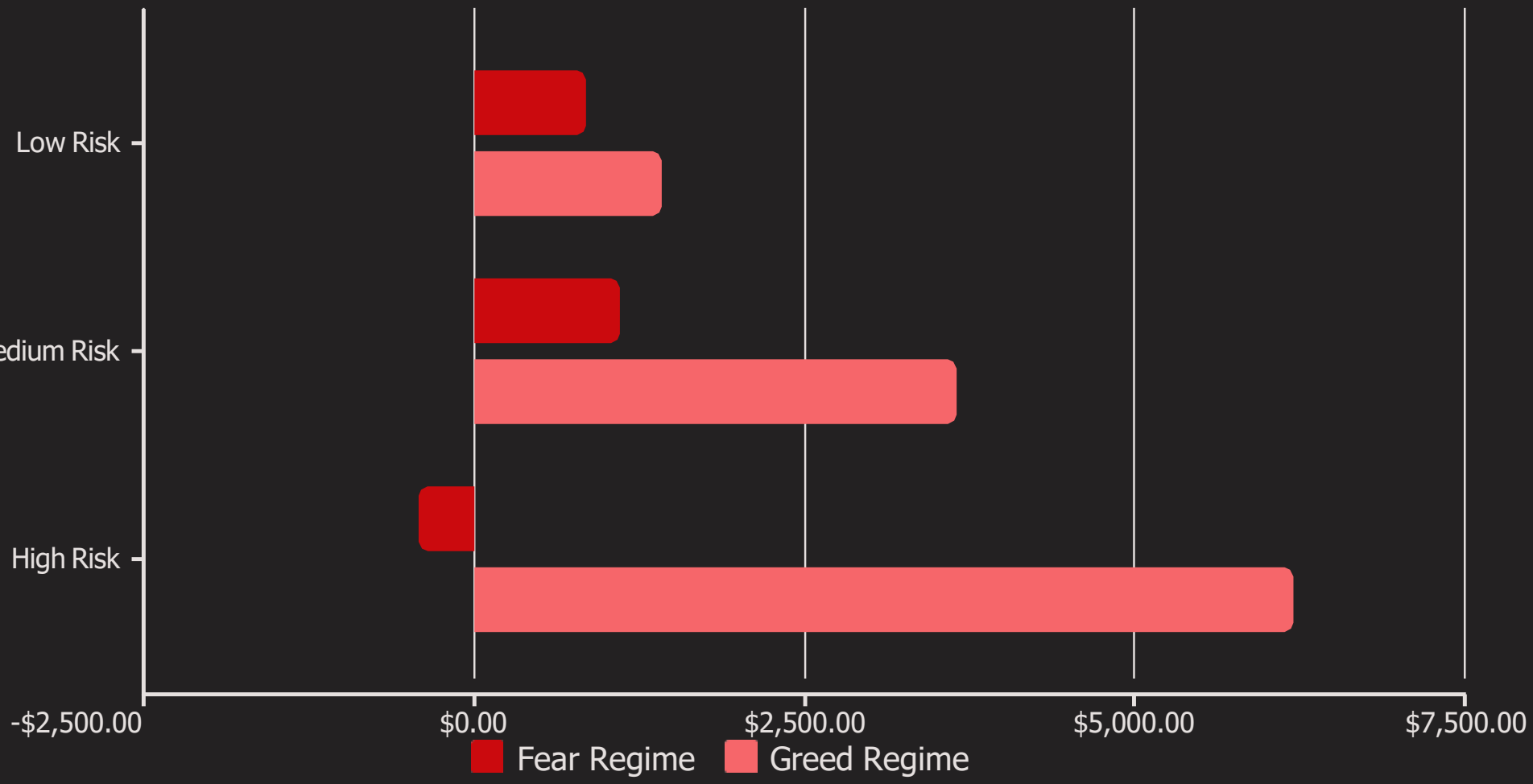
Win Rate Improvement

Absolute percentage point increase from Fear to Greed conditions

The win rate differential reveals that trades executed during Greed regimes have a substantially higher probability of closing profitably. This pattern holds true across different trader experience levels and position sizes, suggesting that favorable market sentiment creates a more forgiving trading environment where directional bets are more likely to succeed.

Insight: The 16 percentage point win rate improvement during Greed periods represents a critical edge that compounds over multiple trades, dramatically impacting long-term profitability.

Risk Behavior & Position Sizing Strategy



Risk-taking behavior shows stark asymmetry across market conditions. During Greed periods, higher risk positions are substantially rewarded with average PnLs exceeding $6,000. However, the same aggressive approach during Fear regimes results in negative returns averaging -$420.

This finding suggests that **optimal position sizing must be regime-dependent**. Traders who maintain constant risk levels regardless of sentiment likely underperform those who adapt their exposure to match market conditions. The medium risk bucket shows the most consistent positive performance across both regimes.

Distribution & Risk-Reward Dynamics

PnL Distribution Characteristics

Profit and loss outcomes exhibit significant positive skew with heavy tails, indicating that while most trades generate modest returns, occasional outlier performances drive overall profitability.

- Median returns are substantially lower than mean returns
- Extreme positive outcomes are more frequent than extreme losses
- Distribution shape differs meaningfully between sentiment regimes

Position Size Impact

Larger positions amplify both upside potential and downside risk in a non-linear fashion. The relationship between position size and outcome varies dramatically based on market sentiment.

- During Greed: larger positions capture momentum effectively
- During Fear: oversized positions magnify losses disproportionately
- Optimal sizing appears regime-specific

Statistical Validation & Significance Testing

Mann-Whitney U Test

Non-parametric test selected due to non-normal PnL distributions and presence of outliers in the dataset

Test Results

p-value 0.05 indicates performance differences between Fear and Greed are statistically significant at high confidence levels

Practical Significance

Effect sizes are large and economically meaningful, not just statistically detectable differences

The rigorous statistical validation confirms that observed performance differences are not attributable to random chance or sampling variability. The Mann-Whitney U test was specifically chosen because it makes no assumptions about data distribution and is robust to the heavy-tailed, skewed nature of financial returns data.

Statistical Conclusion: With p-values well below conventional significance thresholds, we can confidently reject the null hypothesis that Fear and Greed regimes produce equivalent trader performance.

Key Takeaways & Strategic Implications

1

Sentiment-Driven Performance Gap

Greed regimes consistently outperform Fear regimes across both profitability metrics and win rates, with differences exceeding 200% in average PnL

2

Regime-Dependent Risk Taking

Optimal position sizing and risk exposure must adapt to market sentiment4aggressive strategies succeed during Greed but fail catastrophically during Fear

3

Sentiment as Strategic Signal

Market sentiment indices provide critical contextual information that should inform trading strategy design, risk management frameworks, and portfolio construction decisions

4

Data-Driven Decision Making

This analysis demonstrates how sentiment-aware insights derived from rigorous data science methodology can support more intelligent, adaptive trading approaches

Bottom Line: Incorporating market sentiment into trading algorithms and risk models represents a significant opportunity for performance enhancement. Traders who remain blind to regime shifts likely leave substantial alpha on the table.