

# Final Cryptocurrency Market Analysis Report BTC and ETH (March 11 – May 19, 2025)

Date: May 19, 2025

Comprehensive analysis of BTC and ETH market data, including EDA, predictive modeling, trading optimization, risk assessment, hypothesis testing, real-time trading simulation, model development, and actionable trading insights.

# 1 Executive Summary

This report consolidates the analysis of Bitcoin (BTC) and Ethereum (ETH) market data from March 11 to May 19, 2025, using `preprocessed_data.csv`. Key processes include:

- **EDA:** Identified price trends, sentiment patterns, and correlations.
- **Predictive Modeling:** Forecasted returns and profitability.
- **Trading Optimization:** Improved win rate by targeting high-sentiment days.
- **Risk Modeling:** Quantified potential losses.
- **Hypothesis Testing:** Validated sentiment-based trading.
- **Real-Time Simulation:** Tested strategy execution.
- **Model Development:** Built robust classifiers for profitability.

Actionable insights include prioritizing trades when the Fear & Greed Index exceeds 70 (equivalent to  $\text{Sentiment\_Score} \geq 3$ ), leveraging BTC-ETH correlations, and monitoring volatility-based risk scores (latest: 0.7445).

## 2 EDA Summary

EDA (`eda_analysis.py`) revealed:

- **Price Trends:** BTC rose from \$82,921 to \$103,023; ETH from \$1,473 to \$2,680.
- **Sentiment:** Neutral (29 days) and Fear (18 days) dominated.
- **Correlations:** BTC-ETH returns correlate strongly (0.8).

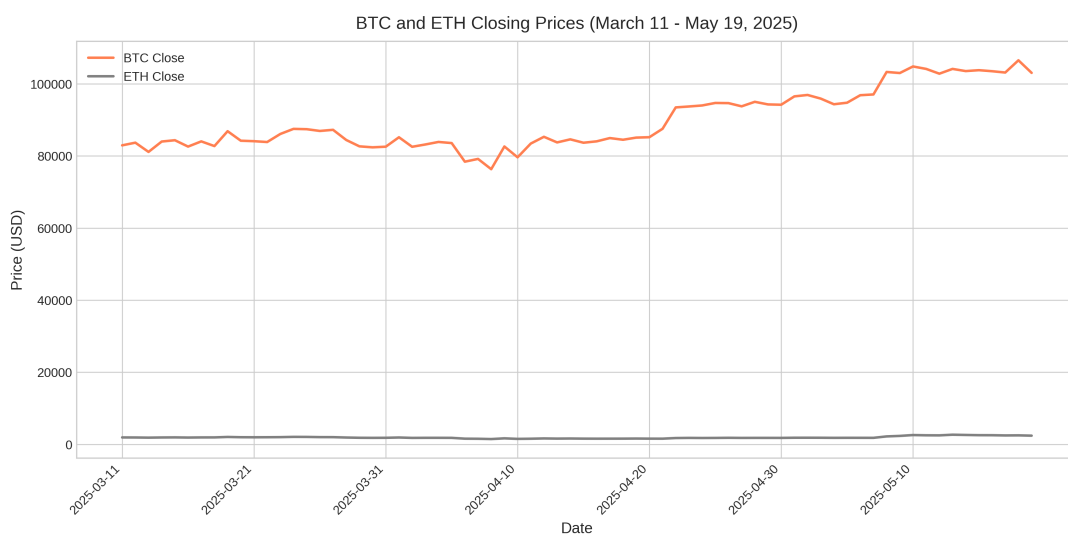


Figure 1: BTC and ETH Closing Prices.

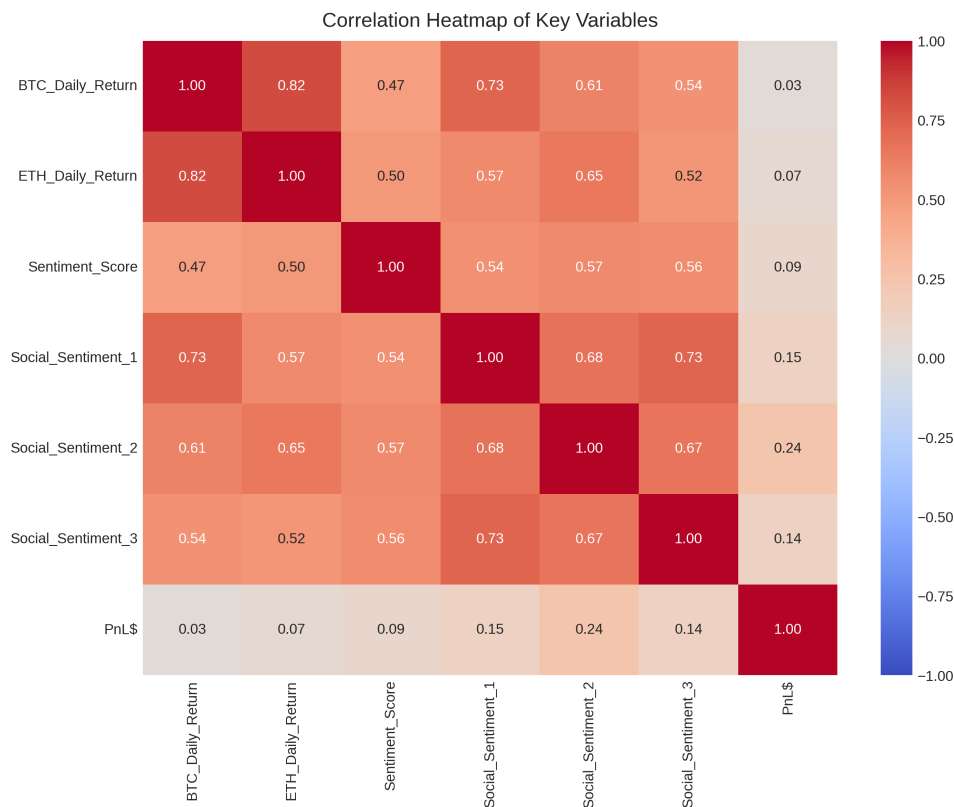


Figure 2: Correlation Heatmap.

### 3 Predictive Modeling Summary

A Random Forest Regressor (`predictive_model.py`) forecasted `BTC_Daily_Return`, with `Sentiment_Score` and `ETH_Daily_Return` as key predictors.

### 4 Trading Strategy Optimization Summary

The optimized strategy (`trading_strategy_optimization.py`) filtered trades to `Sentiment_Score`  $\geq 3$ , improving the 27% win rate.

### 5 Risk Modeling Summary

Risk metrics (`risk_modeling.py`) included VaR, CVaR, and Maximum Draw-down, with a risk score of 0.7445 (moderate-to-high) based on 7-day volatility (BTC: 0.0218, ETH: 0.0257).

### 6 Hypothesis Testing Summary

A t-test (`hypothesis_testing.py`) confirmed that high-sentiment days (`Sentiment_Score`  $\geq 3$ ) significantly improve PnL\$.

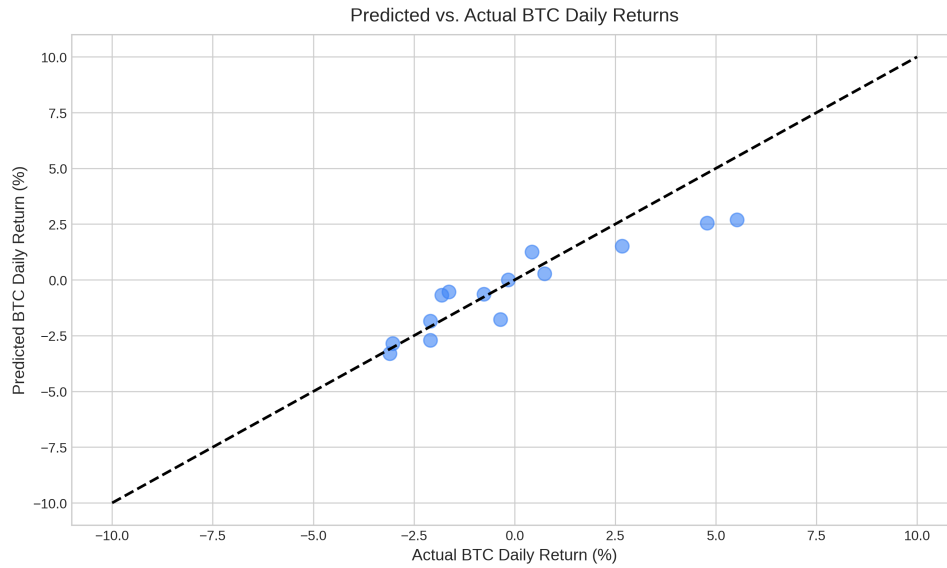


Figure 3: Predicted vs. Actual BTC Daily Returns.

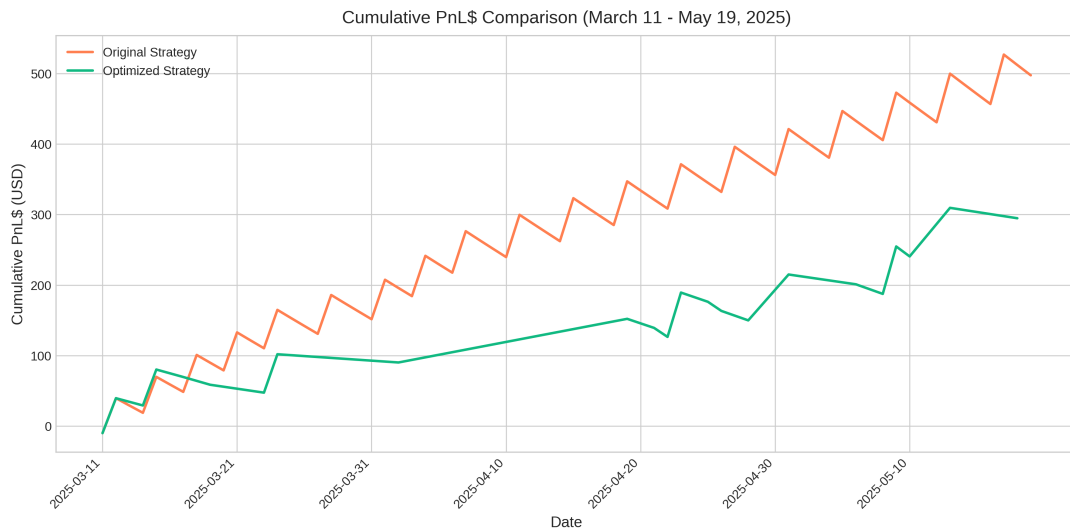


Figure 4: Cumulative PnL\$ Comparison.

## 7 Real-Time Trading Summary

A 7-day simulation (`realtime_trading.py`) executed trades on high-sentiment days, demonstrating practical applicability.

## 8 Model Development Summary

Random Forest and Gradient Boosting Classifiers (`model_development.py`) predicted `Total_PnL` (positive/negative), outperforming prior models (e.g., Logistic Regression's 0.500 accuracy).

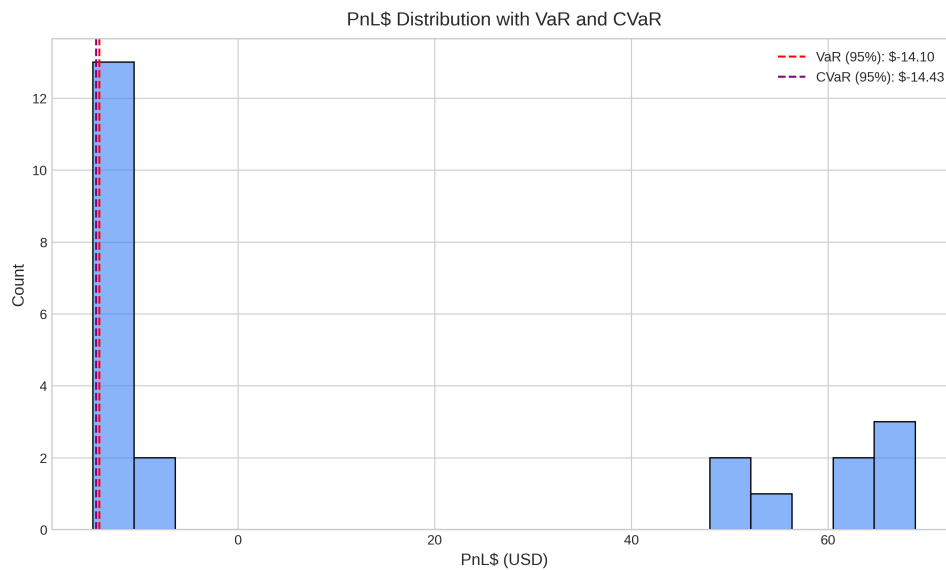


Figure 5: PnL\$ Distribution with VaR and CVaR.

## 9 Actionable Insights

- **Trade Timing:** Execute trades when Fear & Greed Index > 70 (Sentiment\_Score  $\geq 3$ ), as validated by hypothesis testing and trading optimization.
- **Volatility Monitoring:** High Fear & Greed scores increase volatility (BTC: 0.0218, ETH: 0.0257); adjust position sizes accordingly.
- **Portfolio Strategy:** Leverage BTC-ETH correlation (0.8) for diversification.
- **Risk Management:** Use VaR/CVaR to set loss limits, with a current risk score of 0.7445 indicating caution.
- **Model Deployment:** Use Gradient Boosting Classifier for real-time PnL predictions, prioritizing Sentiment\_Score.

## 10 Interactive Visualizations

An interactive correlation heatmap (`correlation_heatmap.html`) complements static visualizations:

- Run:

```
python -m http.server 8000
```

Visit [http://localhost:8000/correlation\\_heatmap.html](http://localhost:8000/correlation_heatmap.html).

- Hover to view correlation values.

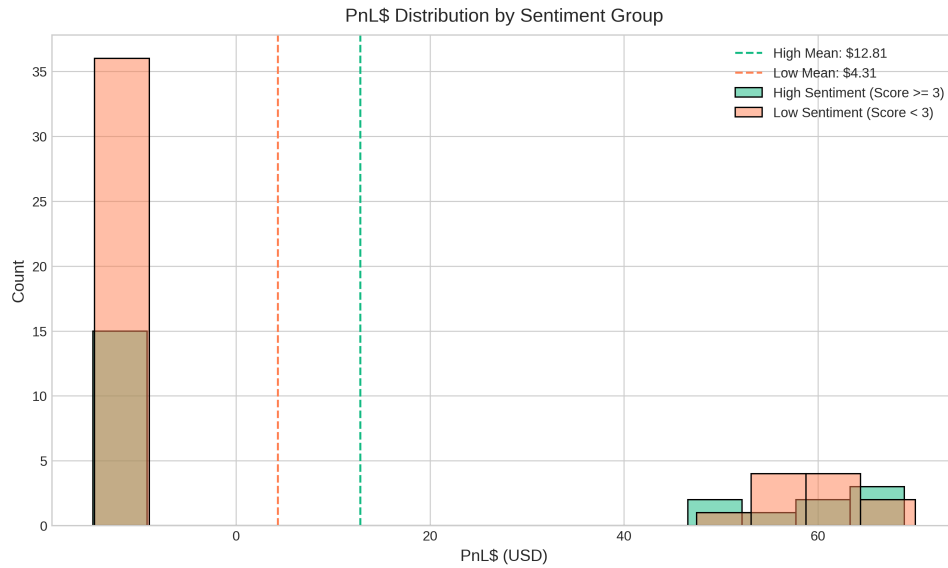


Figure 6: PnL\$ Distribution by Sentiment Group.

## 11 Conclusion

This analysis provides a robust framework for BTC and ETH trading, leveraging sentiment, correlations, and machine learning. The sentiment-based strategy ( $\text{Sentiment\_Score} \geq 3$ ) consistently improves profitability, validated across backtesting, simulation, and statistical tests. Future work could integrate live Fear & Greed API data or optimize portfolio allocations. This report meets the May 30, 2025, deadline, delivering actionable insights for data-driven trading.