CryptoTradeRisk-DSA210: Model Evaluation Results

April 25, 2025

1 Introduction

This document presents the model evaluation results for the CryptoTradeRisk-DSA210 project, conducted as part of Step 5 on April 25, 2025. The models were developed to predict trading outcomes and assess risk in cryptocurrency trading, using the dataset `processed_data.csv` and supporting files (`trades.csv`, `news.csv`, `social_media.csv`, `fear_greed.csv`, `portfolio.csv`). The evaluation focuses on three models: Logistic Regression (balanced), Random Forest for predicting `Total_PnL`, and a VAR model for forecasting `Portfolio_Value_USD`, `BTC_Price`, and `ETH_Price`. Additionally, a refined risk metric is presented.

2 Model Evaluation Results

2.1 Logistic Regression Model for Total_PnL (Balanced)

The Logistic Regression model predicts whether `Total_PnL` is positive (80) or negative (-40), using features: `News_Sentiment_Avg`, `Lagged_News_Sentiment`, `BTC_Price_Change`, `ETH_Price_Change`, and `BTC_Momentum`. Class weighting (`class_weight='balanced'`) was applied to address class imbalance.

- **Mean Cross-Validation Accuracy**: 0.500
- **Classification Report (on full data)**:

```
              precision    recall  f1-score   support

Negative PnL       0.30      0.60      0.40         5
Positive PnL       0.86      0.63      0.73        19

    accuracy                           0.62        24
   macro avg       0.58      0.62      0.56        24
weighted avg       0.74      0.62      0.66        24
```

- **Feature Coefficients**:
  - `News_Sentiment_Avg`: 0.054
  - `Lagged_News_Sentiment`: -0.409

  - BTC_Price_Change: -0.080
  - ETH_Price_Change: 0.288
  - BTC_Momentum: -0.013

2.2 Random Forest Model for Total_PnL

The Random Forest model uses the same features as Logistic Regression, with `n_estimators=50` and `class_weight='balanced'`.

- **Mean Cross-Validation Accuracy**: 0.830
- **Classification Report (on full data)**:

```
              precision    recall  f1-score   support

Negative PnL       1.00      1.00      1.00         5
Positive PnL       1.00      1.00      1.00        19

    accuracy                           1.00        24
   macro avg       1.00      1.00      1.00        24
weighted avg       1.00      1.00      1.00        24
```

- **Feature Importances**:
  - News_Sentiment_Avg: 0.171
  - Lagged_News_Sentiment: 0.212
  - BTC_Price_Change: 0.149
  - ETH_Price_Change: 0.283
  - BTC_Momentum: 0.184

2.3 VAR Model for Portfolio_Value_USD, BTC_Price, and ETH_Price

The VAR model forecasts `Portfolio_Value_USD`, `BTC_Price`, and `ETH_Price` using a lag order of 1. The last 5 days (04/14/2025–04/18/2025) are used for testing.

Date	Actual Portfolio Value (USD)	Forecasted Portfolio Value (USD)	Actual B
04/14/2025	2607.07	3901.95	
04/15/2025	3850.77	4213.86	
04/16/2025	2560.68	4467.78	
04/17/2025	3885.73	4764.11	
04/18/2025	2622.93	5068.55	

Table 1: Forecasting Results

- **Mean Absolute Error (Portfolio_Value_USD)**: 1377.81

2.4 Risk Metric

The risk metric uses a 7-day rolling window for volatility, with adjustments for BTC momentum.

- **Latest BTC Volatility (7-day)**: 0.0218
- **Latest ETH Volatility (7-day)**: 0.0257
- **Latest Risk Score (Normalized)**: 0.7445

3 Conclusions

The model evaluation highlights the following insights:

- The Logistic Regression model (balanced) achieves a cross-validation accuracy of 0.500, performing no better than random guessing. While recall for `Negative PnL` improved to 0.60, the model's overall performance is poor due to the small dataset.
- The Random Forest model significantly outperforms Logistic Regression, with a cross-validation accuracy of 0.830. However, the perfect performance on the full data (accuracy: 1.00) suggests overfitting, and the cross-validation accuracy may be optimistic given the small dataset.
- The VAR model forecasts `Portfolio_Value_USD` with an MAE of 1377.81, much higher than the previous ARIMA model (MAE: 134.28). The model overestimates portfolio value and fails to capture volatility, likely due to the small dataset and simple lag order.
- The risk metric (score: 0.7445) indicates moderate-to-high risk on the latest day (04/18/2025), driven by recent volatility and positive BTC momentum.

Future steps include deploying the Random Forest model for `Total_PnL` prediction, improving the VAR model with more data and tuning, and operationalizing the risk metric with actionable thresholds. Collecting more data is critical to enhance model performance.