

Predictive Hedging Strategies Using LSTM for Automated Trading

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Introduction

- ▶ Financial markets face volatility and uncertainty.
- ▶ Traditional methods like ARIMA and GARCH are limited in capturing non-linear patterns.
- ▶ Long Short-Term Memory (LSTM) models outperform traditional methods for time-series forecasting.
- ▶ Objective:
 - ▶ Forecast *Close Price* accurately.
 - ▶ Generate trading signals (BUY, SELL, HOLD) for hedging strategies.

Data Preprocessing Steps

- ▶ Data Source: Daily stock data for SBI.
- ▶ Steps:
 - ▶ Handled missing values using forward and backward fill.
 - ▶ Removed duplicates.
 - ▶ Standardized numerical features (*Open*, *High*, *Low*, *Close*, *Volume*).
 - ▶ Added engineered features:
 - ▶ Rolling mean and standard deviation (window = 7 days).
 - ▶ Lagged feature (*lag1_close*).
 - ▶ Day-of-week indicator.

Feature Distributions

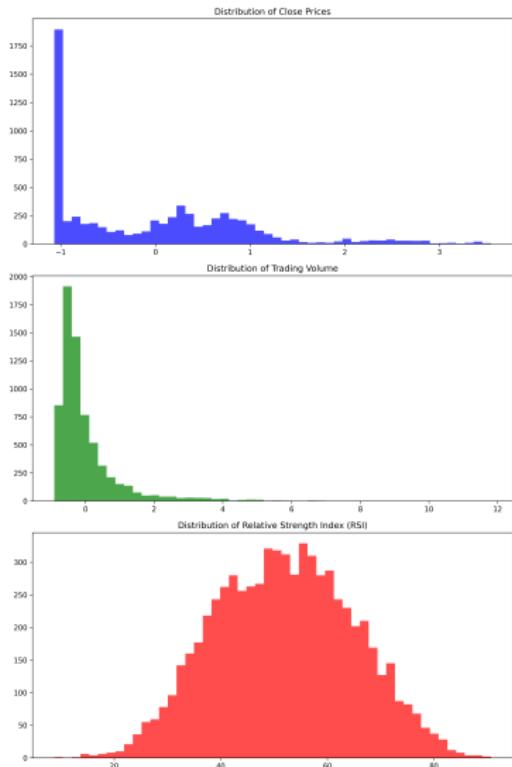


Figure: Distribution of Close Prices, Volume, and RSI.

Correlation Matrix

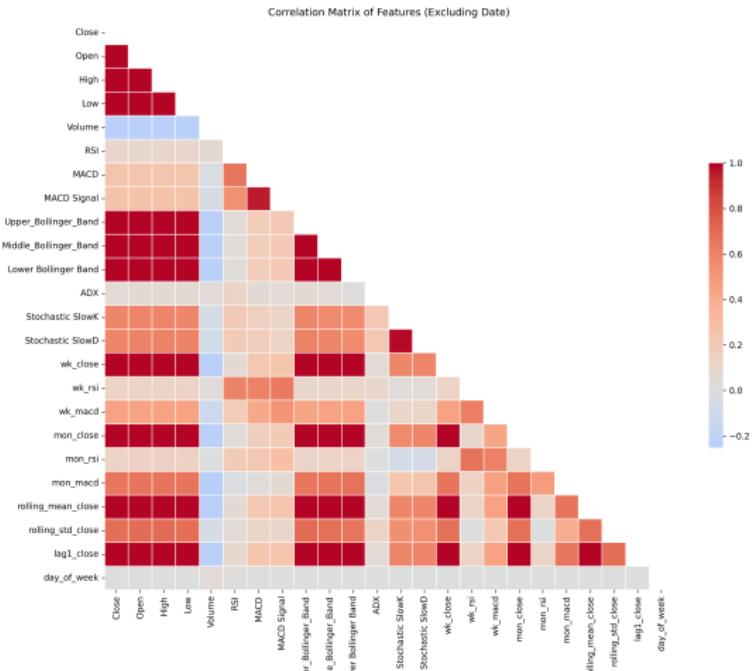


Figure: Correlation Matrix of Key Features.

Time-Series Trends

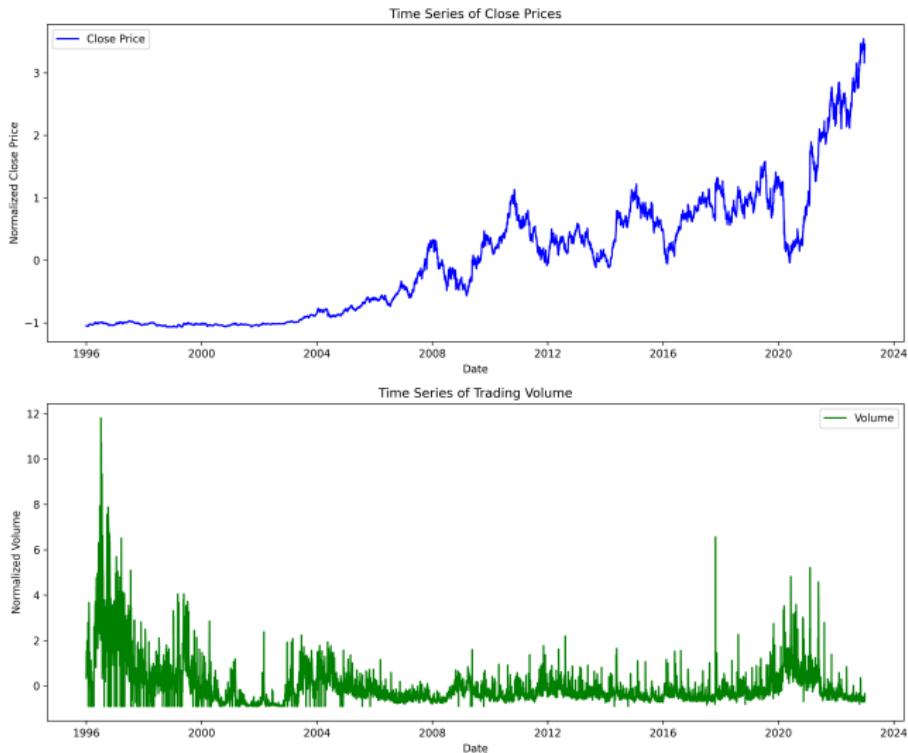


Figure: Time Series of Close Prices and Trading Volume.

Weekly and Monthly Variations

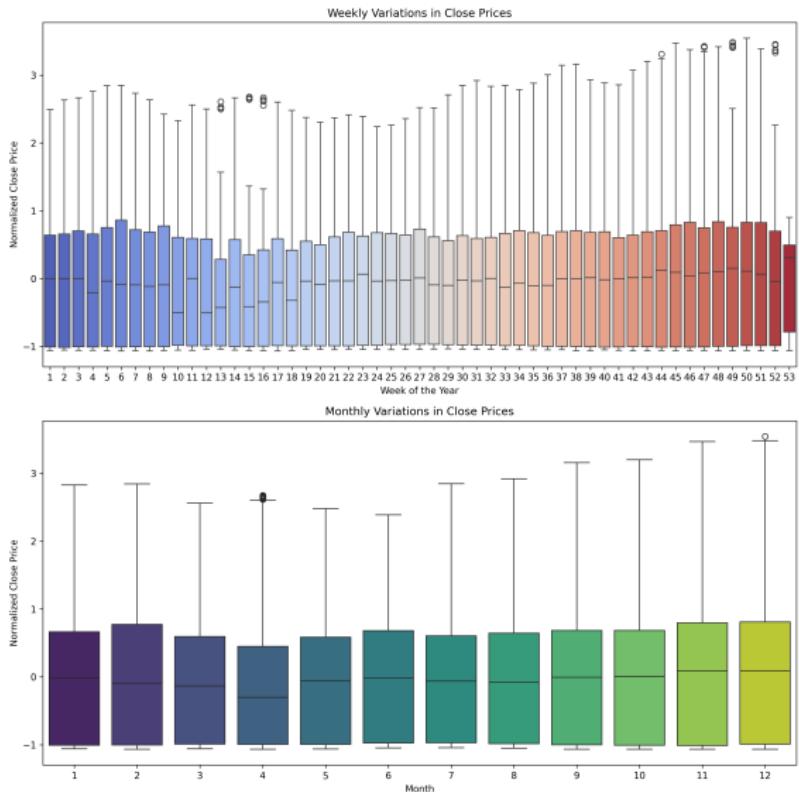


Figure: Weekly and Monthly Variations in Close Prices.

Autocorrelation of Close Prices

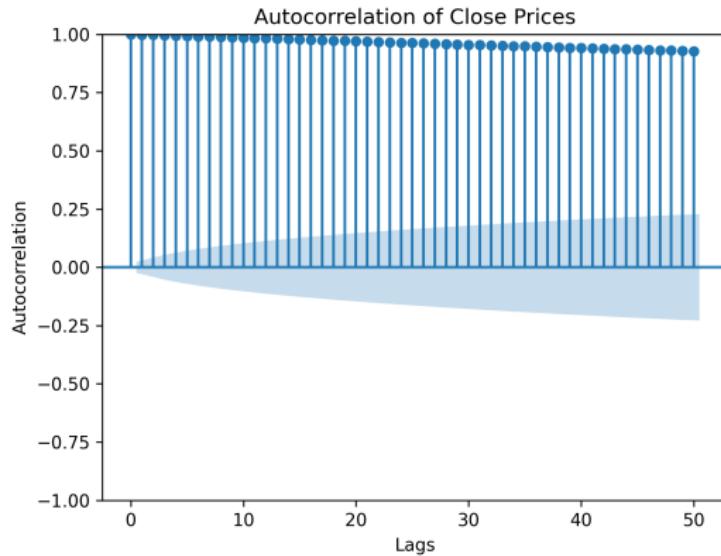


Figure: Autocorrelation of Close Prices.

Trend, Seasonality, and Residual Decomposition of Close Prices

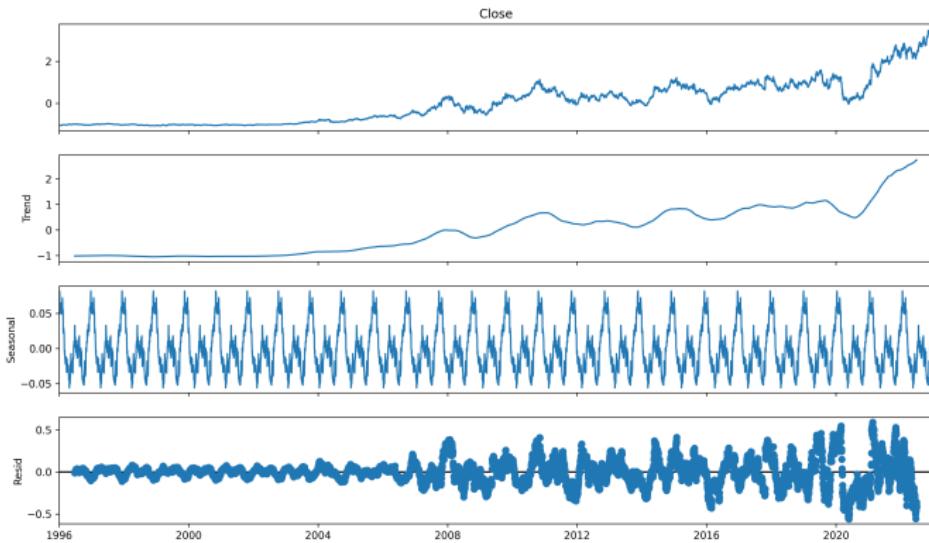


Figure: Trend, Seasonality, and Residual Decomposition.

Pair Plot of Key Metrics

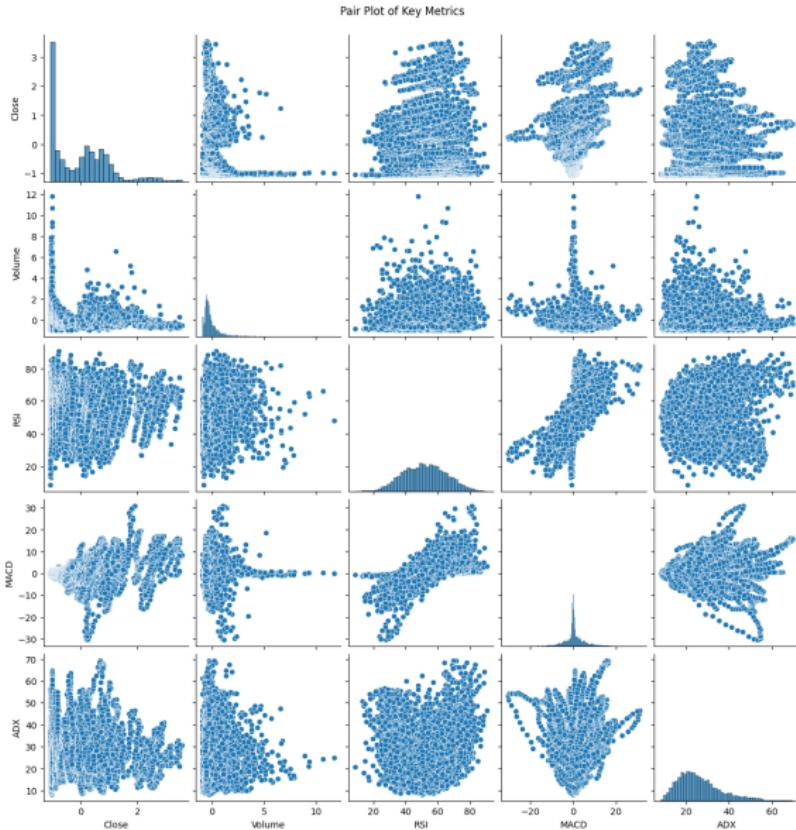


Figure: Pair Plot of Key Metrics.

Boxplot for Outliers in Close Prices

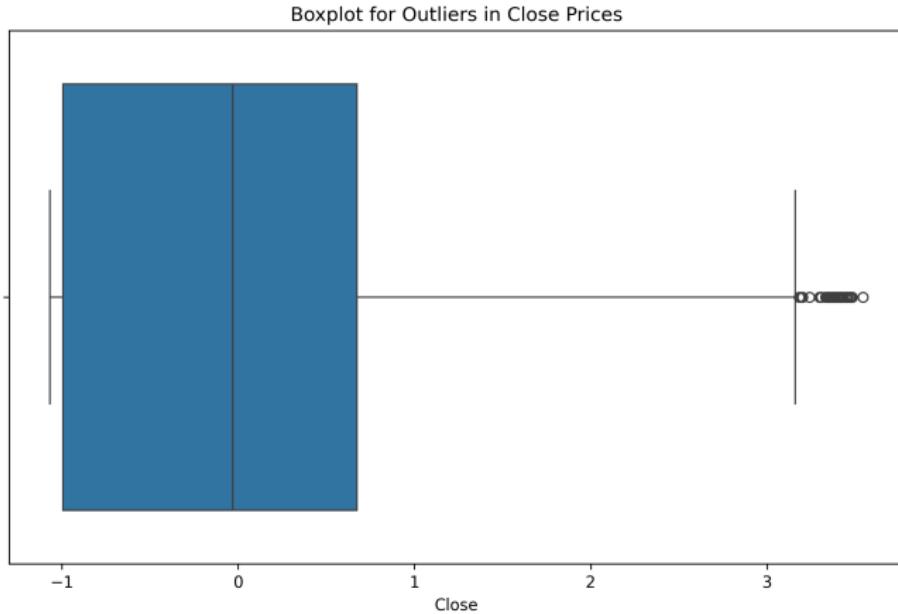


Figure: Boxplot for Close Prices.

Moving Averages for Close Price



Figure: Moving Averages for Close Price.

RSI Chart

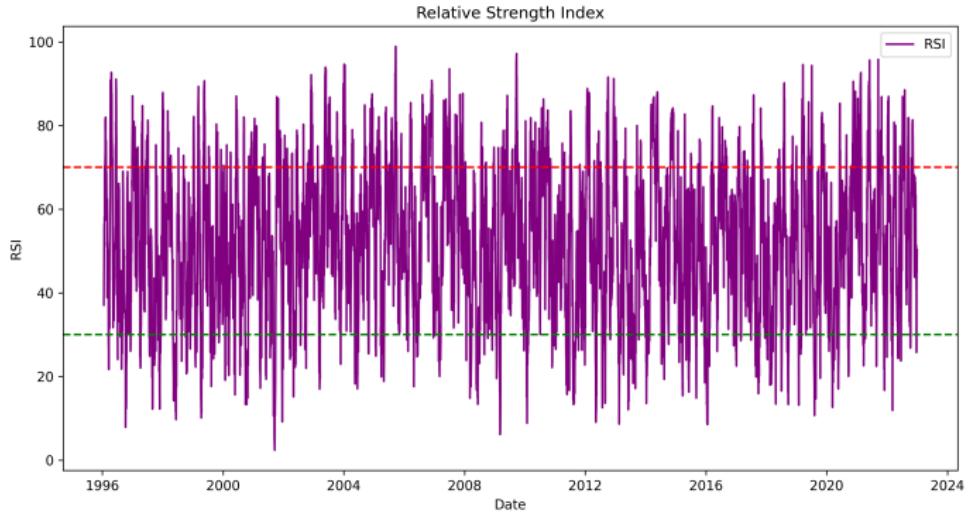


Figure: RSI Chart.

Bollinger Bands Chart

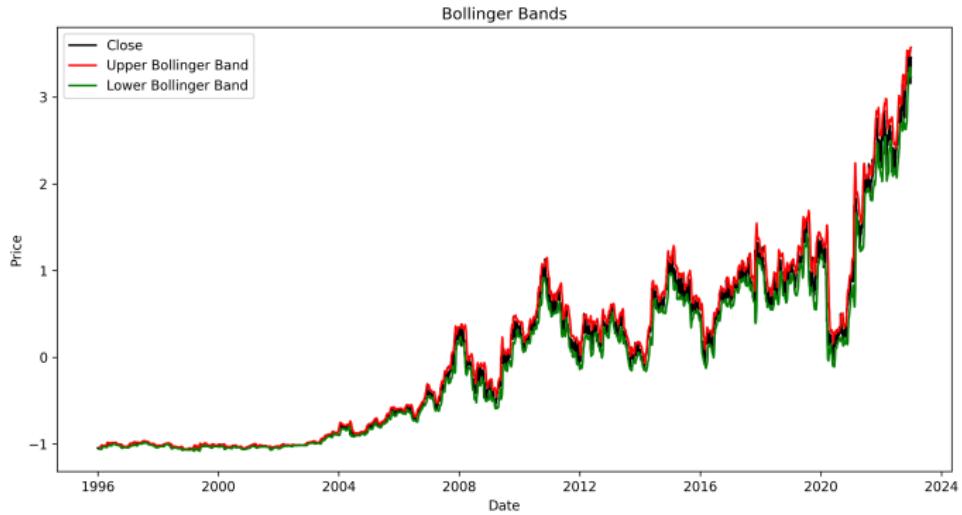


Figure: Bollinger Bands Chart.

MACD Chart

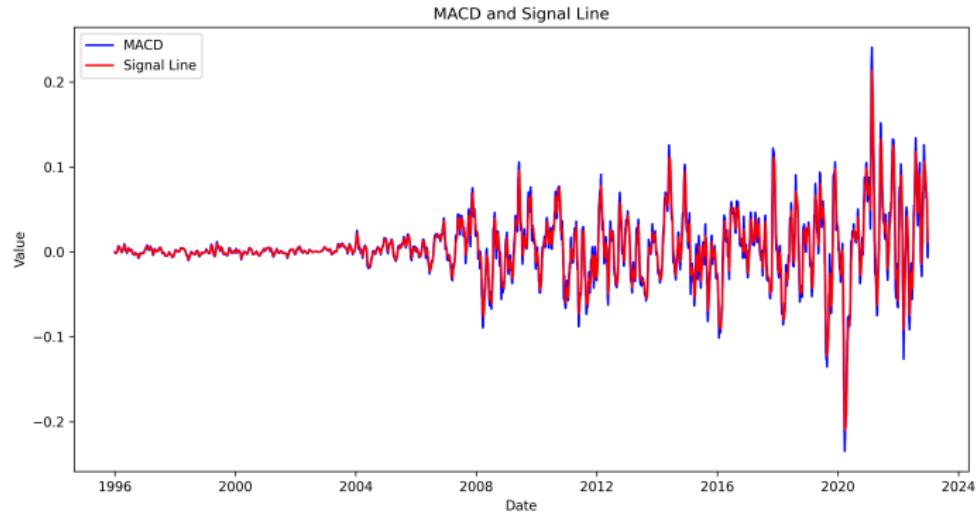


Figure: MACD and signal line.

Derived Trading Strategies

- ▶ **Strategy 1: Bollinger Bands for Trend Reversal Identification**
- ▶ **Strategy 2: RSI for Overbought and Oversold Signals**
- ▶ **Strategy 3: MACD Crossover for Momentum Trading**
- ▶ **Strategy 4: Moving Average Crossovers for Trend Identification**
- ▶ **Strategy 5: Volume Analysis for Breakout Confirmation**
- ▶ **Strategy 6: Combining Indicators for Robust Signals**

Significance of Strategies

- ▶ **Bollinger Bands:** Identifies overbought/oversold conditions and trend reversals.
- ▶ **RSI:** Helps detect trend exhaustion points for overbought/oversold signals.
- ▶ **MACD:** Momentum-based indicator for identifying bullish/bearish signals.
- ▶ **Moving Averages:** Golden Cross/Death Cross identifies short-term and long-term trends.
- ▶ **Volume Analysis:** Confirms breakouts and avoids false signals in low-volume markets.
- ▶ **Combining Indicators:** Enhances signal robustness for better decision-making.

Selected Features

- ▶ Methods Used:
 - ▶ Correlation Analysis
 - ▶ Recursive Feature Elimination (RFE)
 - ▶ Mutual Information
- ▶ Final Selected Features:
 - ▶ *lag1_close, Lower Bollinger Band, rolling_mean_close, High, Open, Upper Bollinger Band, wk_close, Low.*

LSTM Architecture

- ▶ Sequence Length: 50 days.
- ▶ Hyperparameter Tuning:
 - ▶ LSTM Units: 32-128
 - ▶ Dropout Rate: 0.2-0.5
 - ▶ Learning Rate: 0.001, 0.0001
- ▶ Best Performance:
 - ▶ RMSE: 0.1097
 - ▶ MAE: 0.0804
 - ▶ MAPE: 11.66%

Actual vs. Predicted Close Prices

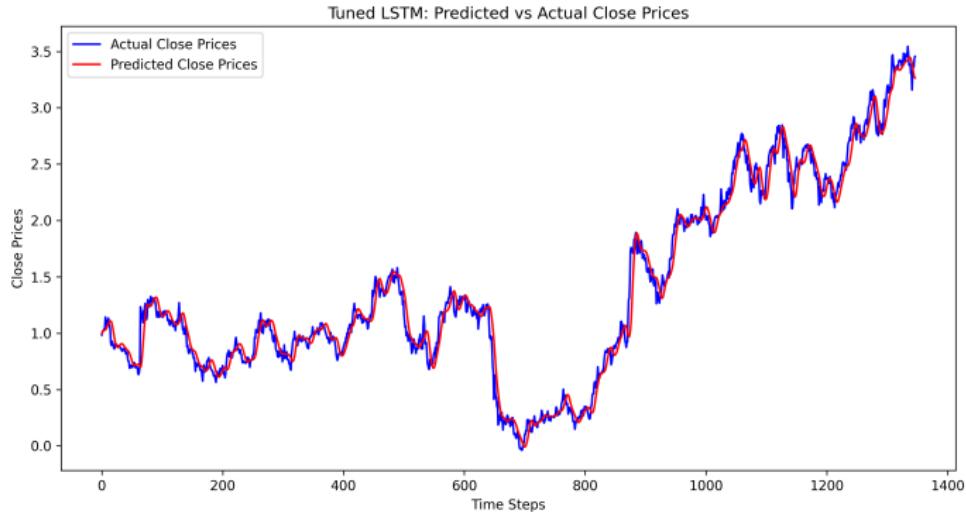


Figure: Actual vs. Predicted Close Prices.

Trading Signals

- ▶ Signal Generation Logic:

$$\text{Change} = \frac{\hat{P}_t - P_{t-1}}{P_{t-1}}$$

- ▶ Signals:
 - ▶ **BUY:** If Change $\geq 1\%$
 - ▶ **SELL:** If Change $\leq -1\%$
 - ▶ **HOLD:** Otherwise

Actual Prices	Predicted Prices	Signal
1.0116	1.0088	BUY
1.0229	1.0162	HOLD
1.0207	1.0213	HOLD
1.0393	1.0247	HOLD
1.0448	1.0271	SELL

Table: A Sample of Trading Signals Generated from LSTM Predictions

Conclusion

- ▶ The LSTM model accurately predicts price trends.
- ▶ Trading signals provide actionable BUY, SELL, and HOLD decisions.
- ▶ Results:
 - ▶ RMSE: 0.1097, MAE: 0.0804, MAPE: 11.66%.

Future Work

- ▶ Incorporate external factors such as macroeconomic indicators and news sentiment analysis.
- ▶ Develop ensemble models for improved accuracy.
- ▶ Deploy the framework in a real-time environment for live trading.
- ▶ Integrate blockchain-based smart contracts for automated execution.

Thank You!

Questions and Discussions are Welcome.