



**University of  
Niagara Falls  
Canada**

# **STOCK PRICE FORECASTING FOR AN INTEGRATED OIL & GAS COMPANY (IMPERIAL OIL LIMITED):**

**ANALYSIS OF THE IMPACT OF OIL PRICES AND MACROECONOMIC FACTORS**

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# INTRODUCTION

**Imperial Oil Limited (IMO):** One of Canada's largest integrated oil & gas companies, operating across exploration, refining, and retail sectors.

The industry is highly sensitive to external factors, including:

- Crude oil price volatility driven by global supply–demand shifts and geopolitical tensions.
- Macroeconomic conditions such as CAD/USD fluctuations, inflation, and global trade dynamics.
- Accelerating adoption of electric vehicles (EVs), reshaping fuel demand and long-term energy consumption trends.

## Research Goal:

Develop and test predictive models to forecast IMO's daily stock price by analyzing the combined influence of oil markets, macroeconomic indicators, and energy transition signals.



# PROBLEM STATEMENT

The Canadian integrated oil & gas sector is exposed to multi-factor complexity that directly impacts firm valuation.

## Key influencing variables include:

- **Global oil benchmarks (WTI):** Highly volatile due to OPEC+ decisions, geopolitical events, and global demand cycles.
- **Domestic vehicle sales (EV & non-EV):** EV adoption reduces long-term demand for refined petroleum products.
- **CAD/USD exchange rate:** Currency fluctuations affect export competitiveness and revenue margins.

**Challenge:** IMO's stock valuation is no longer explained by crude oil prices alone—macroeconomic and transition variables now play a critical role.

**Objective:** Build a predictive model that quantifies the combined impact of oil prices, macroeconomic conditions, and EV adoption on IMO's stock performance.



# RESEARCH QUESTIONS & HYPOTHESES

## Research Questions

- Which variables exert the greatest influence on IMO's stock price volatility?
- Is there a measurable correlation between electric vehicle (EV) adoption and IMO's stock performance?
- Among the forecasting approaches tested, which model delivers the highest accuracy and reliability for stock price prediction?

## Hypotheses



$H_a$  (Oil Price Dependence): Global crude oil prices are the dominant driver of IMO stock movements.



$H_\beta$  (Energy Transition Dependence): EV adoption and energy transition trends are the most influential factors.

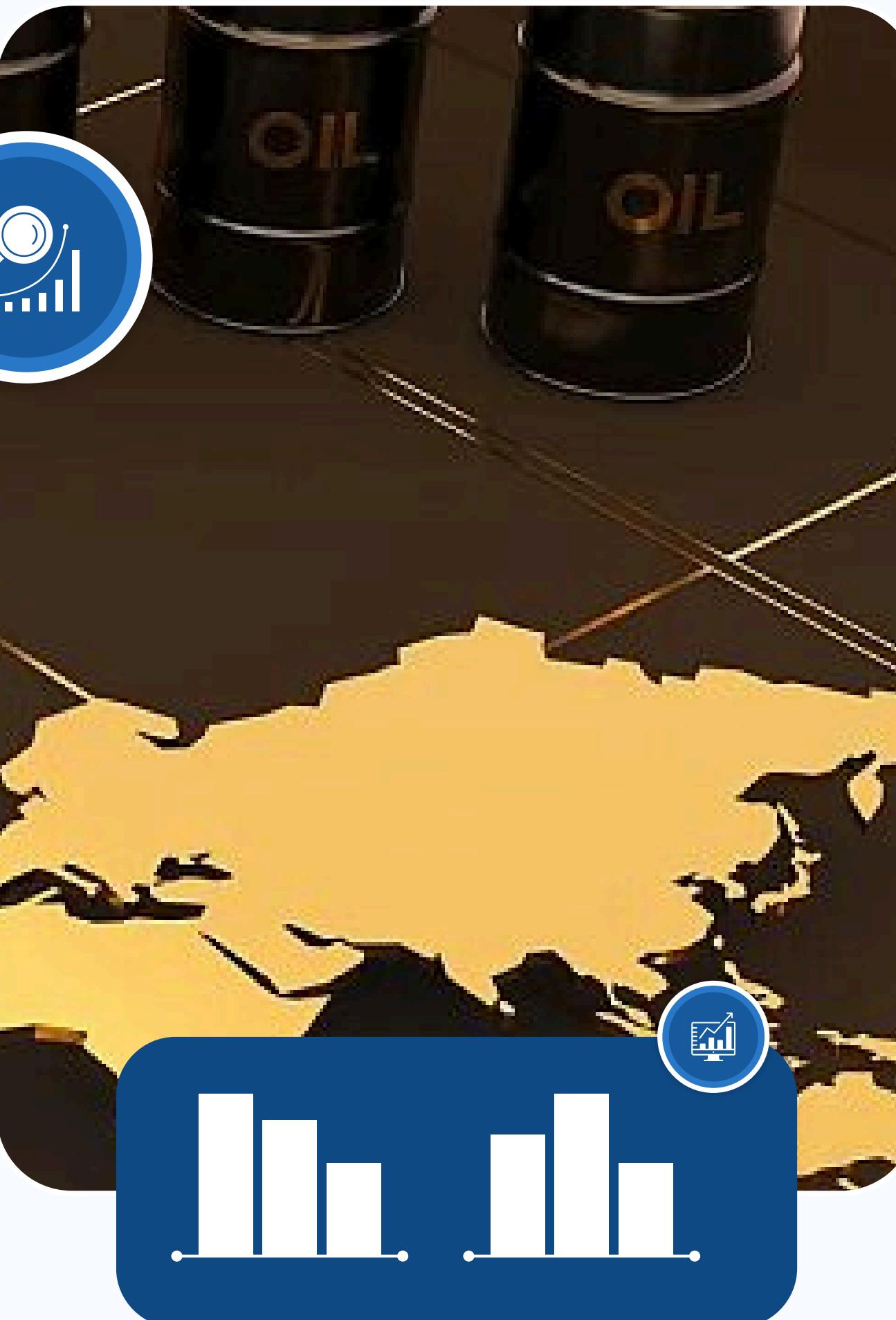


$H_c$  (Macroeconomic Dependence): Currency exchange rates and macroeconomic indicators have the strongest effect.



$H_0$  (Null): No single factor group (oil, EV adoption, macroeconomics) dominates significantly—impacts are balanced.





# DATA COLLECTION

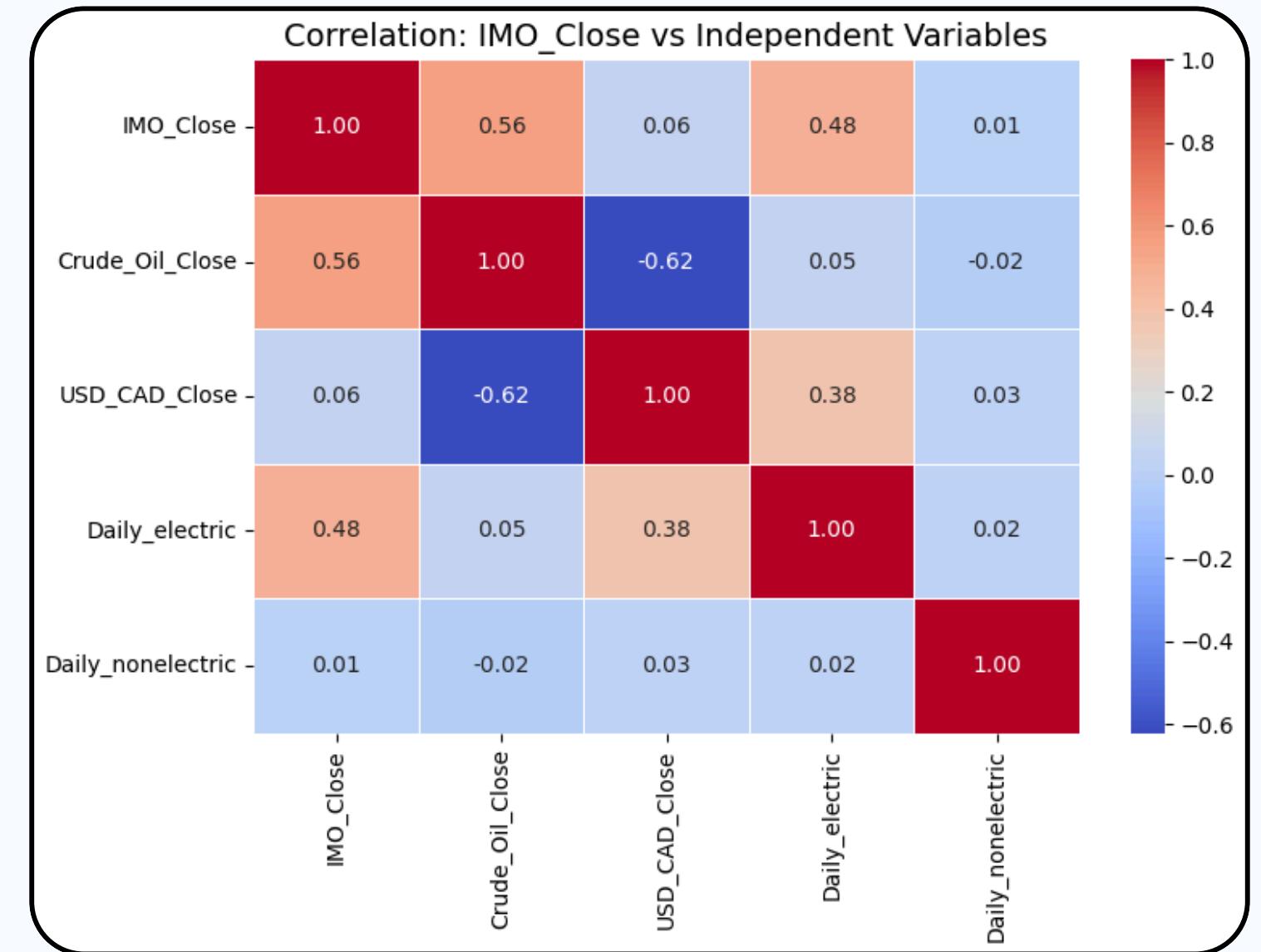
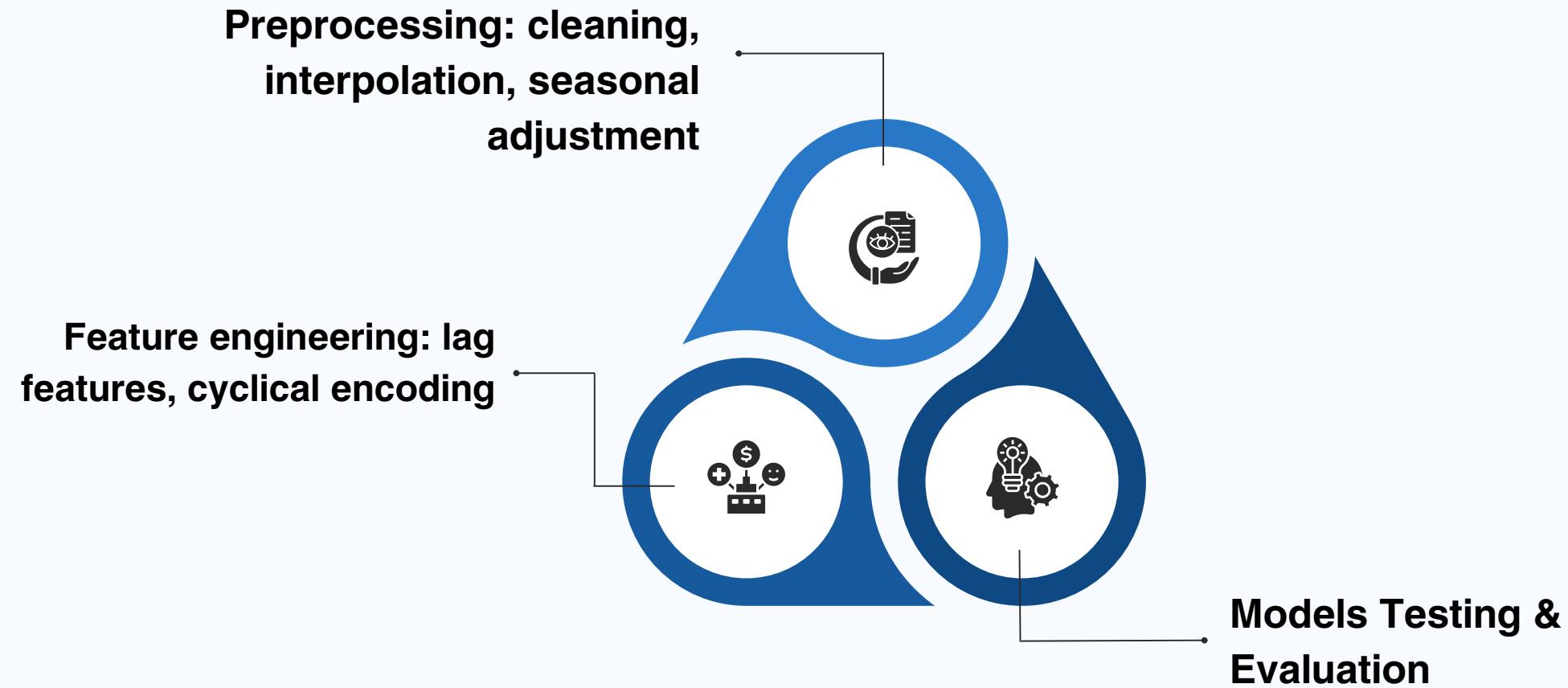
## Dependent Variable

- Imperial Oil (IMO) stock price - Daily records obtained from Yahoo Finance (open, close, adjusted close, volume).

## Independent Variables

- WTI Crude Oil Prices - Daily global benchmark prices (Yahoo Finance).
- CAD/USD Exchange Rate - Daily values reflecting currency fluctuations (Yahoo Finance).
- Canadian Car Sales Data (EV vs Non-EV):
  - **Original dataset:** Annual car sales from 2011-2024.
  - **Challenge:** IMO stock data is daily, creating a mismatch.
  - **Solution:** Applied interpolation techniques to generate a synthetic daily dataset (1995-2025) that:
    - Preserved annual totals when aggregated.
    - Captured seasonal patterns (higher in spring/summer, lower in winter).
    - Distinguished between EV and non-EV sales, reflecting energy transition trends

# METHODOLOGY



## Models Tested

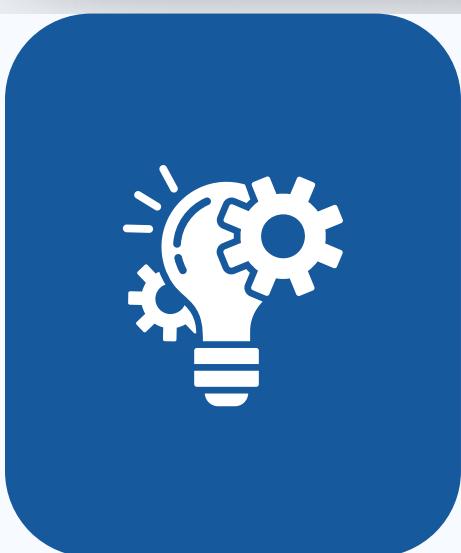
- Linear Regression – Baseline model to evaluate direct relationships.
- Random Forest Regressor (RFR) – Ensemble method to capture nonlinear interactions and improve prediction accuracy.

## Validation Approach

- **Train-Test Split:** 80% training, 20% testing ( $\approx 6,400$  rows vs  $1,600$  rows).
- **Evaluation Metrics:**
  - **RMSE (Root Mean Squared Error):** Measures prediction error.
  - **R<sup>2</sup> (Coefficient of Determination):** Explains variance captured by the model.

# LINEAR REGRESSION

After analyzing the correlations, two models were developed to predict the stock price. To build these models, the dataset was randomly split into two subsets: 80% for training and 20% for testing. The models were trained on the training set and then evaluated on the testing set to assess their performance.



- X = Crude\_Oil\_Close , USD\_CAD\_Close, and Daily\_electric, Daily\_nonelectric.**
- Y = IMO\_Close.**



# LINEAR REGRESSION (RESULTS)

**R-SQUARED**

0.6286

**RMSE**

8.0504

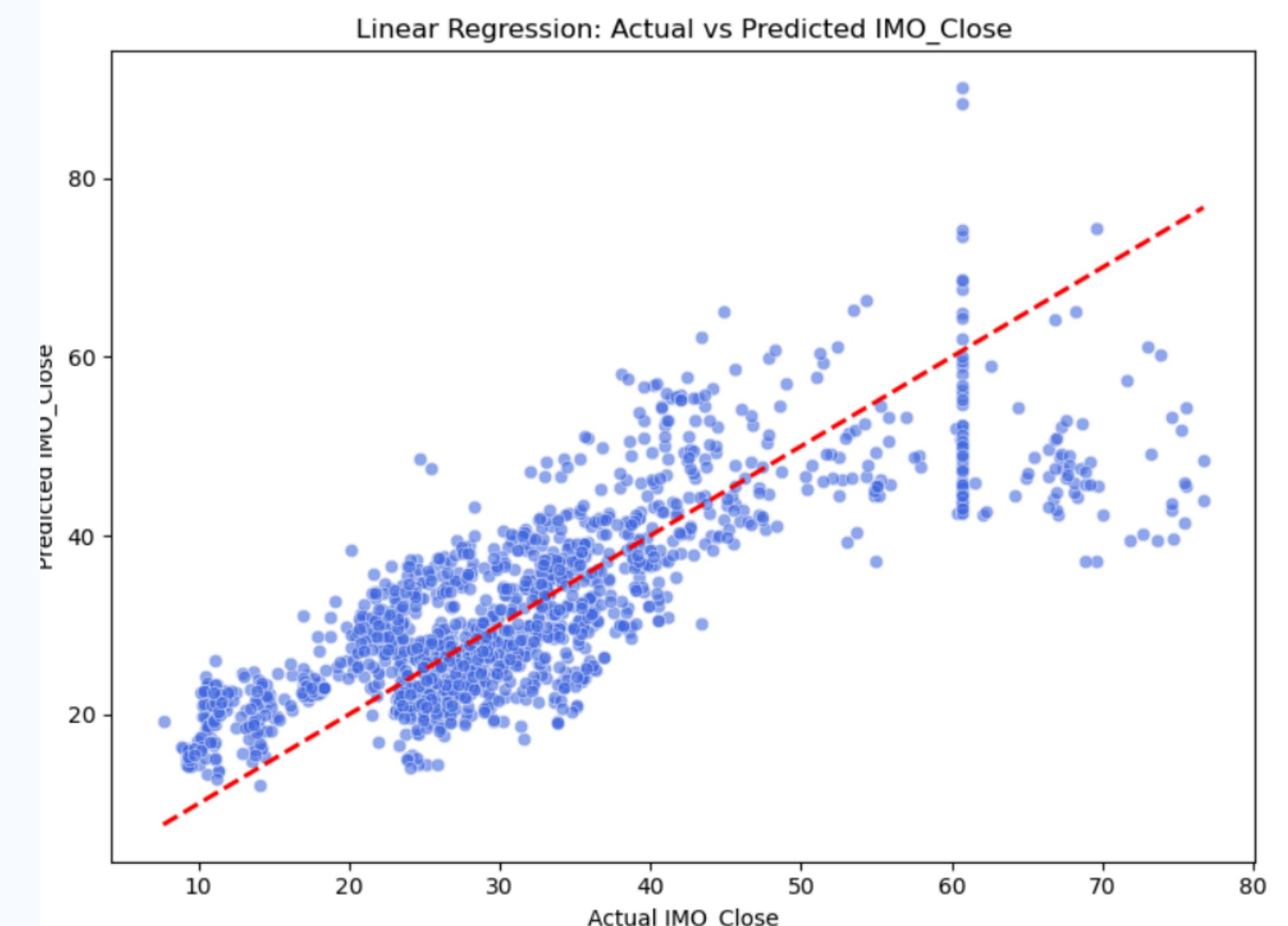
**COEFFICIENTS**

Crude\_Oil\_Close: 0.5153

USD\_CAD\_Close: 47.7481

Daily\_electric: 0.0093

Daily\_nonelectric: 1.7735



# LINEAR REGRESSION (FEATURE ENCODING)

Cyclical encoding was applied to the month and day of the week using sine and cosine transformations, and all features were standardized. A linear regression model was then trained and evaluated, with results compared to the previous version.

**R-SQUARED**

0.6284

**RMSE**

8.0529

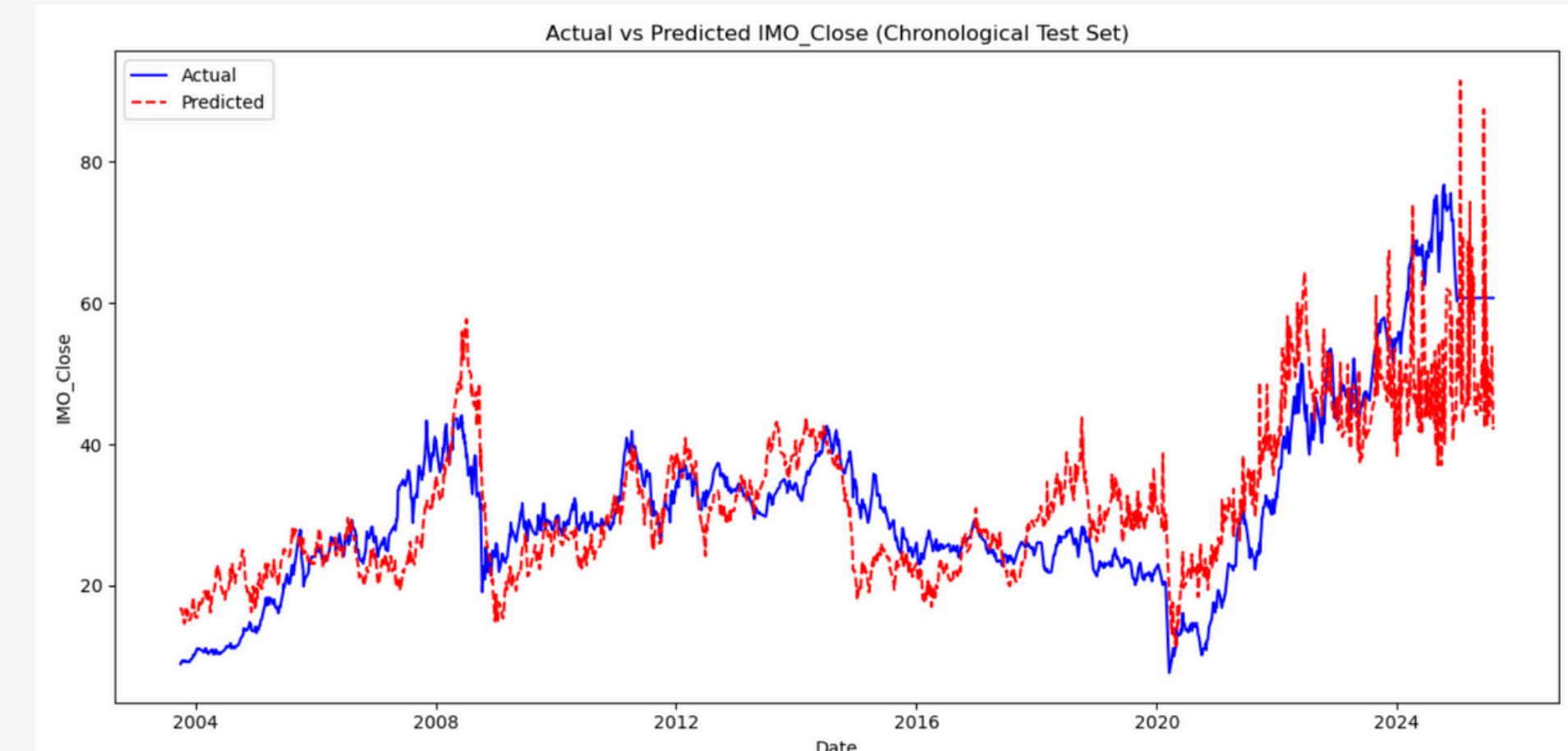
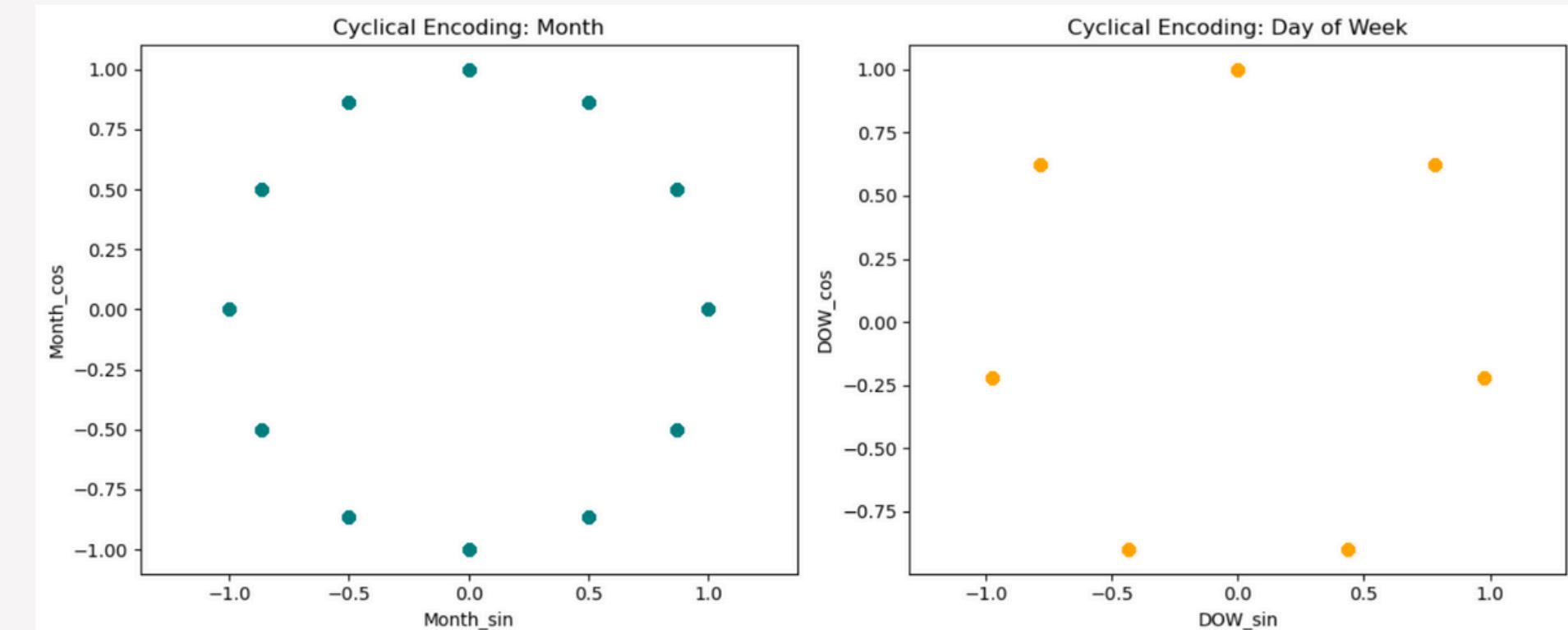
**COEFFICIENTS**

Crude\_Oil\_Close: 11.4379

USD\_CAD\_Close: 6.6527

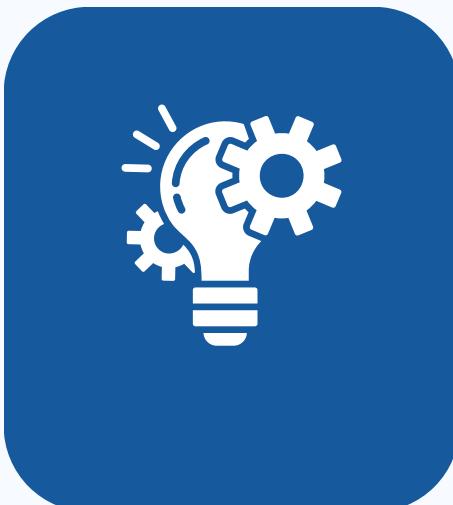
Daily\_electric: 3.3263

Daily\_nonelectric: 0.0573

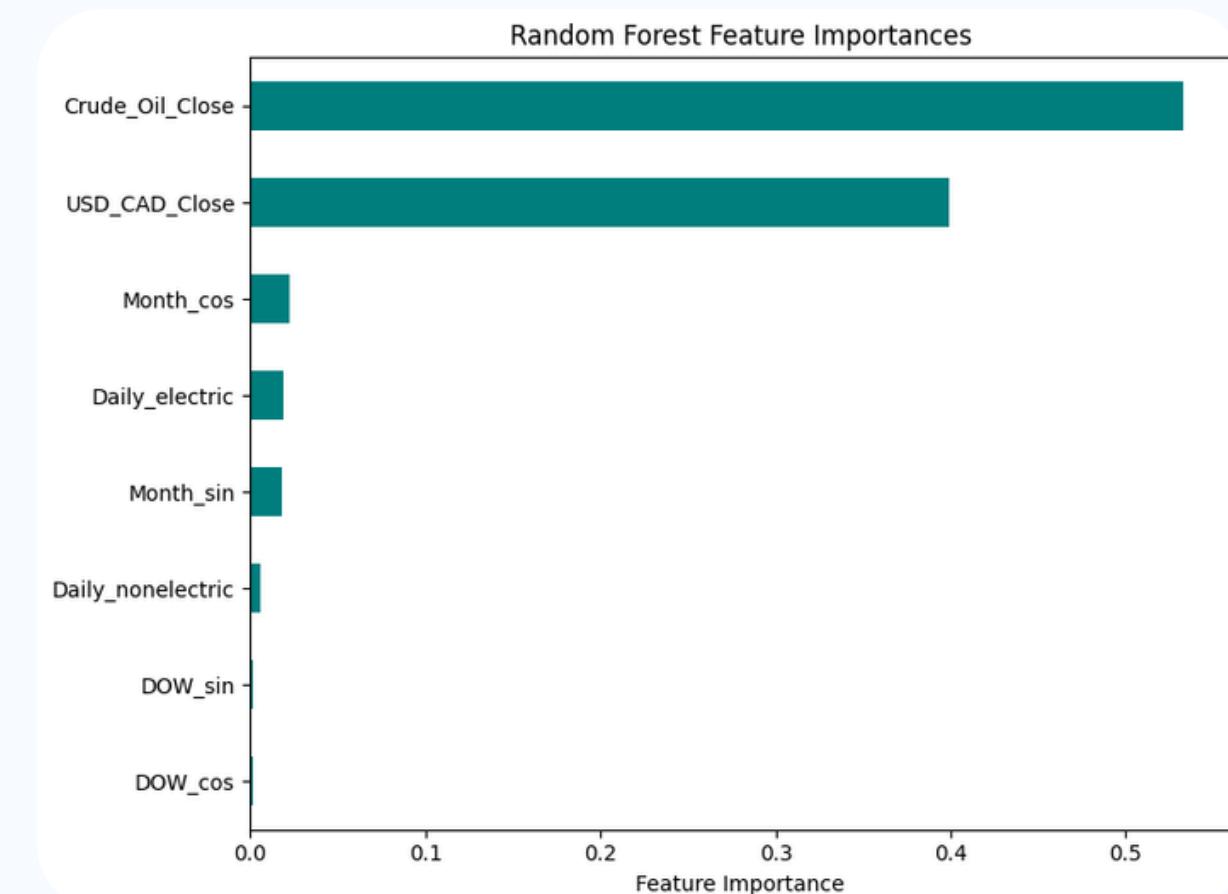
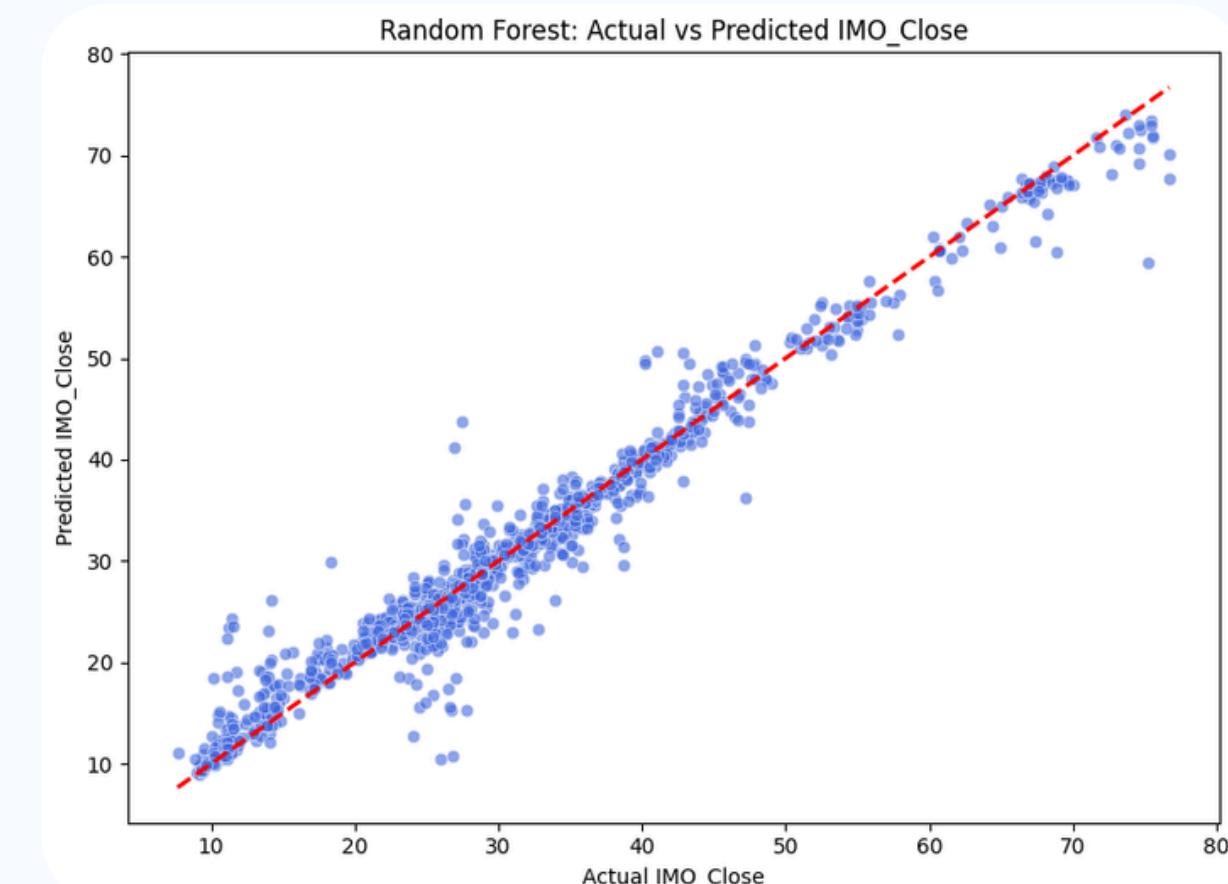


# RANDOM FOREST REGRESSOR

- We utilize a Random Forest Regressor, an ensemble method that excels at capturing the complex, non-linear relationships inherent in financial data.
- Unlike traditional linear models, the Random Forest algorithm demonstrates superior performance in high-dimensional datasets and intricate patterns, making it ideally suited for the volatile nature of stock market predictions.
- Our methodology not only delivers precise price predictions but also provides valuable insights into the key factors influencing stock movements, empowering more informed and strategic decision-making.



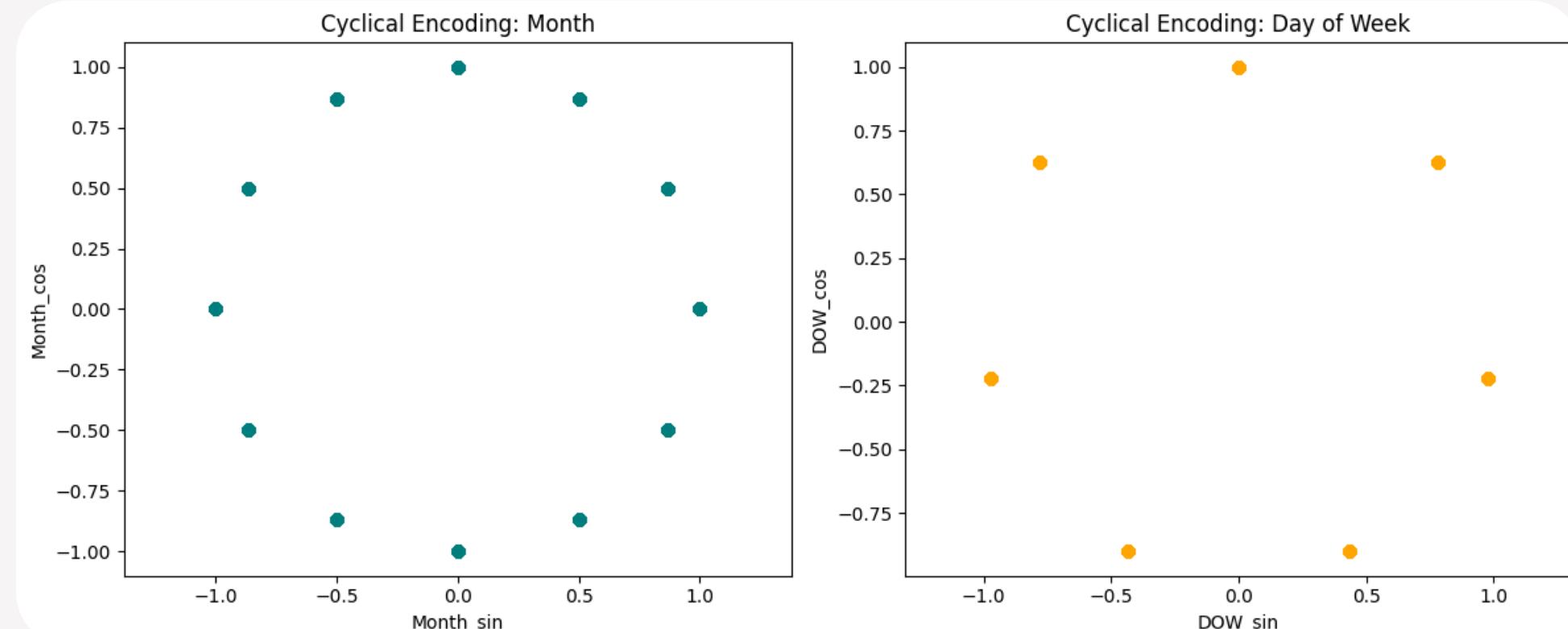
- Captures complex relationships
- Builds hundreds of decision trees
- Improves performance on unseen data through sophisticated pattern recognition



# RANDOM FOREST IMPLEMENTATION DETAILS

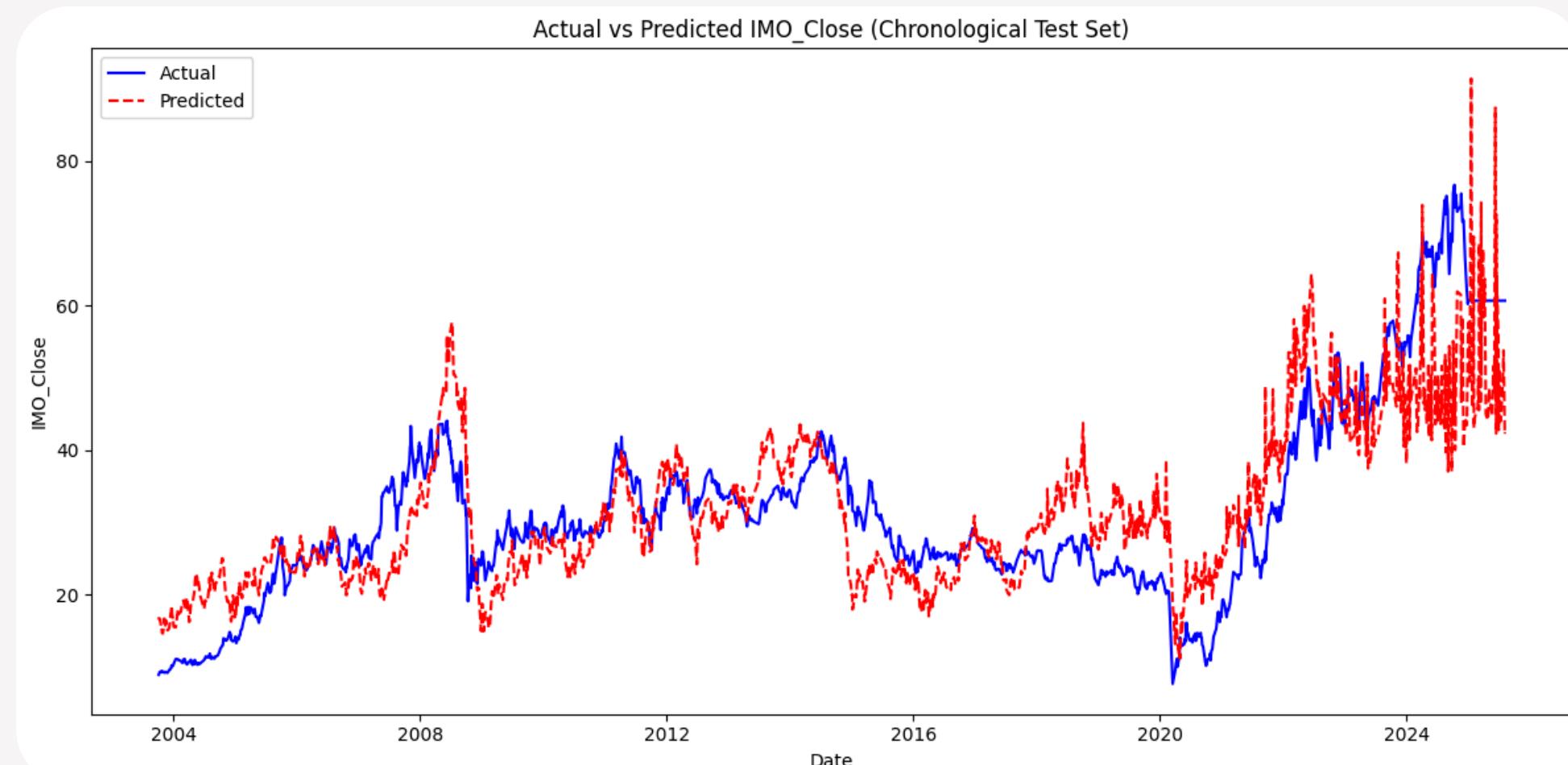
## Data Preparation

Applied feature scaling and engineered cyclical variables (month\_sin, month\_cos) to capture seasonal patterns in stock movements.



## Hyperparameter Tuning

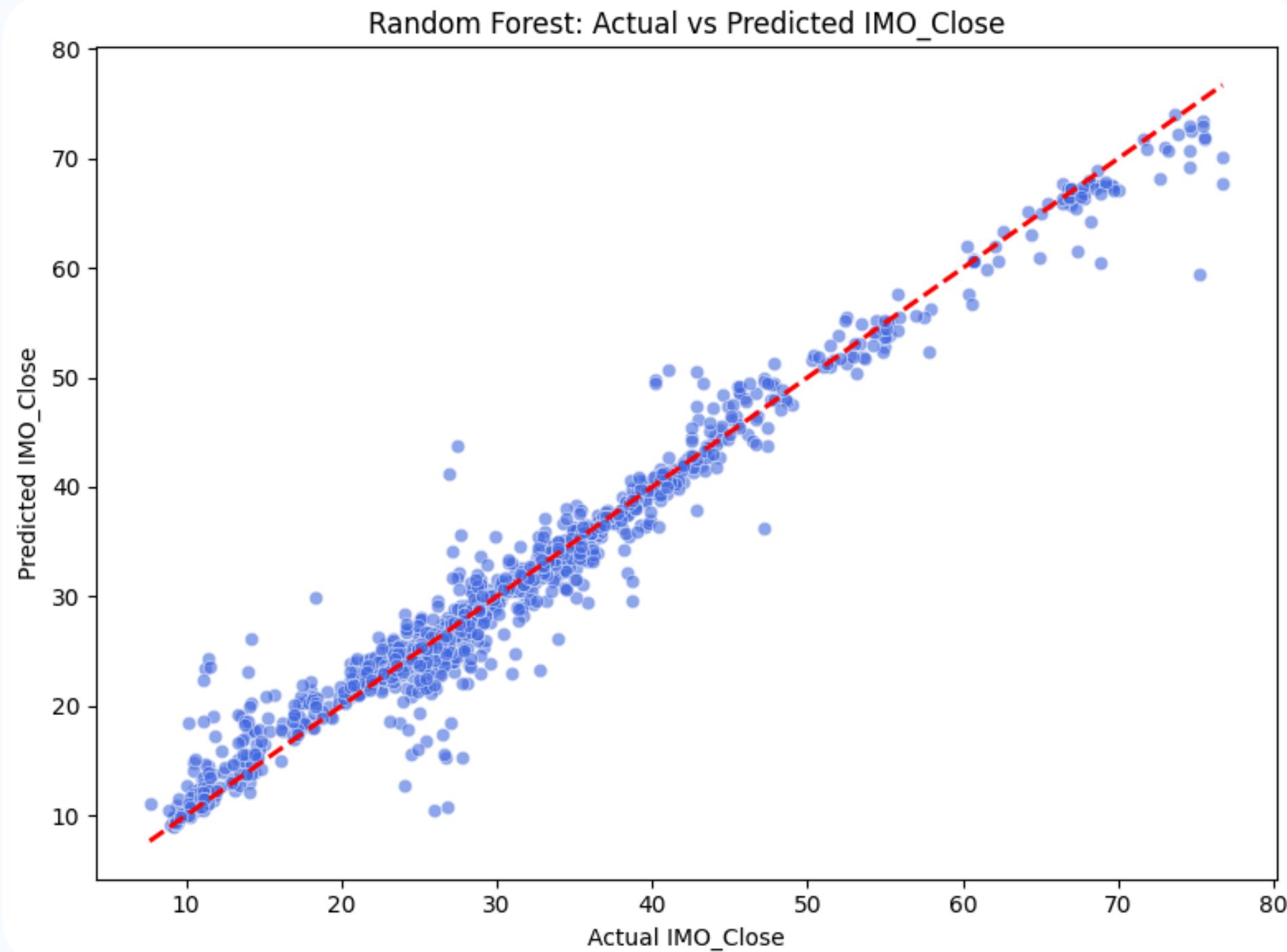
Optimized number of estimators and tree depth to balance accuracy with computational efficiency and prevent overfitting.



## Model Training

Trained on 6,401 samples using 80/20 train-test split, ensuring robust validation on 1,601 unseen data points.

# RANDOM FOREST: BREAKTHROUGH PERFORMANCE



Variance

Explained 0.9707 vs 63% from linear regression

97%

Error

Reduction

RMSE dropped from 8.05 to 2.26

72%

The Random Forest model achieved a **34% improvement** in explanatory power, demonstrating superior capability in capturing market complexities.

# HYPOTHESES TESTING



## Oil Price Variables

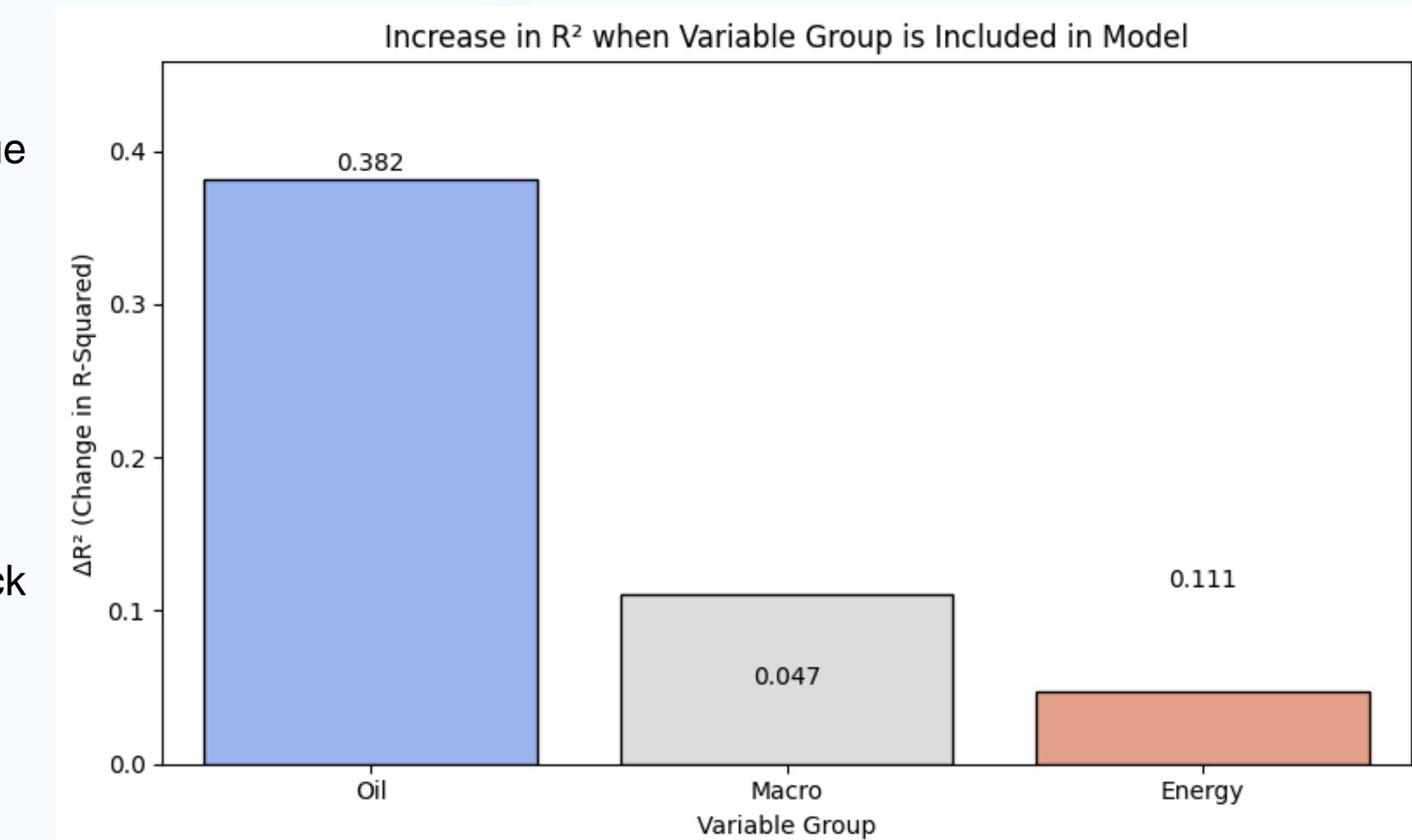
- Added +38.2% variance explained in stock price prediction.
- Supported by highly significant F-statistic (8364.64) and p-value ( $< 0.001$ ).
- Confirms oil remains the primary driver of IMO's valuation.

## Macroeconomic Indicators

- Contributed +11.1% variance explained.
- Strong statistical significance ( $F = 2423.14, p < 0.001$ ).
- Shows that exchange rates and related factors shape stock performance, though less than oil.

## Energy Transition Metrics (EV Sales)

- Emerging role with +4.7% variance explained.
- Statistically significant ( $F = 517.96, p < 0.001$ ).
- Indicates EV adoption is beginning to influence investor sentiment.



## Key Takeaway

- Crude oil prices remain the dominant predictor, but macroeconomic shifts and EV adoption are gaining importance in shaping long-term market behavior.

# BUSINESS IMPACT

## For Investors & Analysts

- WTI crude oil and CAD/USD exchange rates remain the most reliable indicators for predicting IMO's short-term stock performance.
- These variables can be integrated into trading strategies, portfolio risk models, and automated forecasting tools.

## For Imperial Oil (IMO) Management

- Current dependence on crude oil prices highlights the need for diversification strategies.
- Incorporating sustainability indicators (EV adoption, alternative fuels, emissions metrics) into long-term planning will strengthen resilience.

## Market Outlook

- EV adoption growth signals an inevitable disruption to downstream fuel demand, challenging traditional revenue models.
- Early adaptation to energy transition.



# RECOMMENDATIONS

## Monitor WTI futures & CAD/USD

- Since these variables showed the highest impact on IMO's stock, they should be primary signals in trading and risk models.

## Track EV adoption trends

- Although smaller today, EV sales are gaining statistical significance and will increasingly shape long-term demand forecasts.

## Expand models with scenario simulations

- Testing shocks in oil prices, currency, or regulations will improve resilience and prepare stakeholders for market volatility.

## Integrate sustainability metrics

- Including EV and clean energy indicators in disclosures will align IMO with investor expectations in the energy transition era.

### Strategic Recommendation

Imperial Oil should invest in real-time analytics platforms that integrate oil prices, currency movements, and EV adoption trends to drive proactive decision-making and strengthen resilience in the energy transition era.

# CONCLUSION

- **Crude oil prices remain the dominant driver** of Imperial Oil's stock performance, explaining the largest share of variance.
- **Macroeconomic factors and EV adoption add predictive power**, showing their growing relevance in forecasting models.
- **Random Forest outperformed Linear Regression**, achieving ~97% accuracy versus ~63%, proving the value of advanced machine learning.
- **Data-driven forecasting strengthens both investment and corporate strategy**, enabling informed decisions in a volatile, transitioning energy market.

# THANK YOU

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