Stock Price Prediction Pipeline Evaluation

Stock: TSLA

Fetch ID: fetch_20250617_093553

Model ID: model_tsla_20250815_170544

Variants: with_outliers, without_outliers

Date: August 15, 2025

Author: Diego Lozano

Project Overview

This report examines a machine learning pipeline designed to predict stock price movements, adaptable to any stock symbol. The pipeline leverages historical data and key market features to assess predictive performance across various conditions. Visualizations illustrate the accuracy and limitations of the predictions, particularly during volatile periods.

Date: August 15, 2025

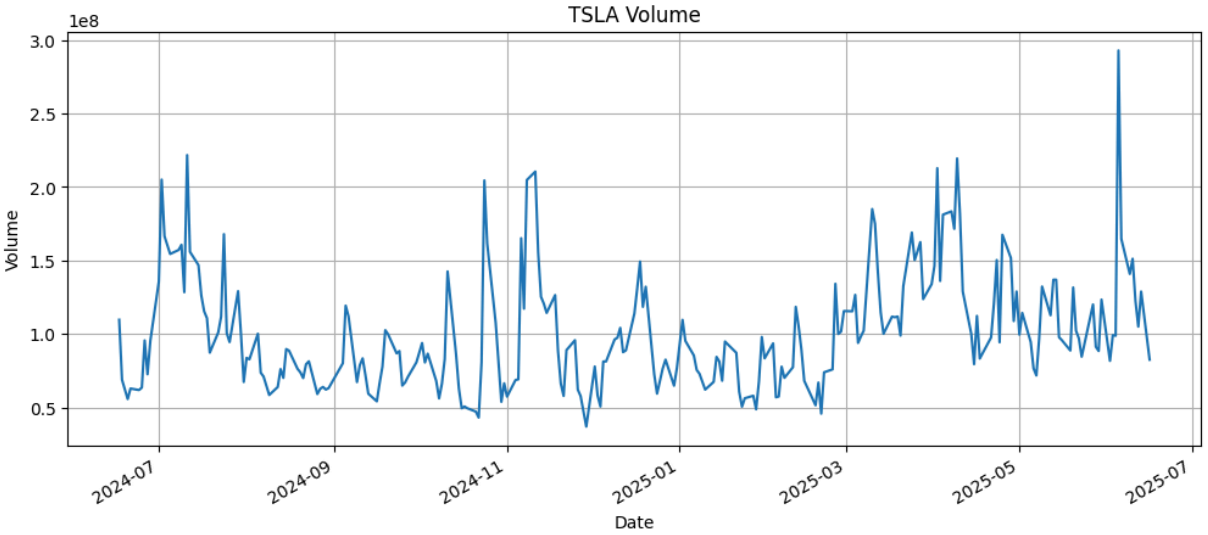
Stage: Inspect Raw Data

Objectives:

- Verify raw stock data integrity (row count, date range, data types).
- Identify gaps in trading days, missing values, and anomalies.
- Visualize closing price and trading volume to detect trends or outliers.

Visualization

Visualizations of closing price and trading volume help identify trends and anomalies visually, complementing the statistical analysis.



Quantitative Summary

Data

- **Row Count**: 250
- **Date Range**: 2024-06-17 to 2025-06-16
- **Missing Values**: 0
- **Anomalies**: 1

Anomalies

	date	column	value
1	2025-06-05	volume	292,818,655.00

Statistics

	open	high	low	close	volume
count	250	250	250	250	250
mean	290.45	297.72	282.84	290.46	100,814,958
std	72.62	74.00	70.21	71.99	39,521,561
min	177.92	183.95	177.00	181.57	37,167,621
25%	230.44	237.30	225.10	231.46	71,340,436
50%	263.05	274.11	257.10	265.41	93,858,026
75%	345.07	351.22	335.92	344.16	120,581,185
max	475.90	488.54	457.51	479.86	292,818,655

Date: August 15, 2025

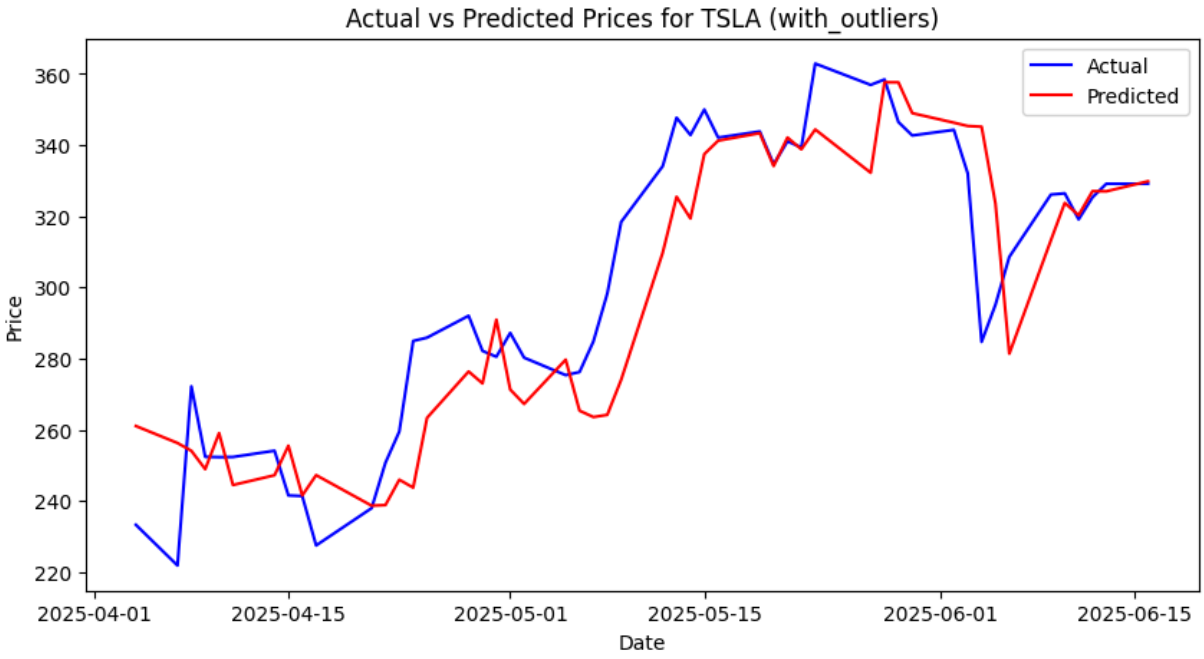
Stage: Model Performance Analysis

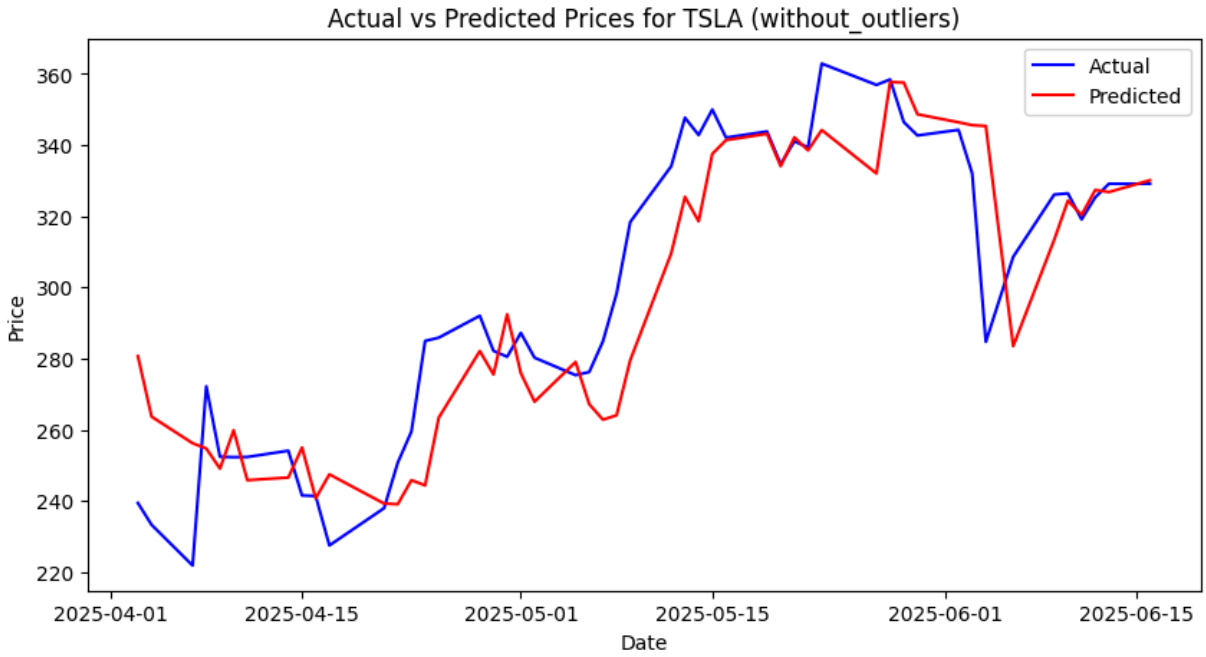
Objectives:

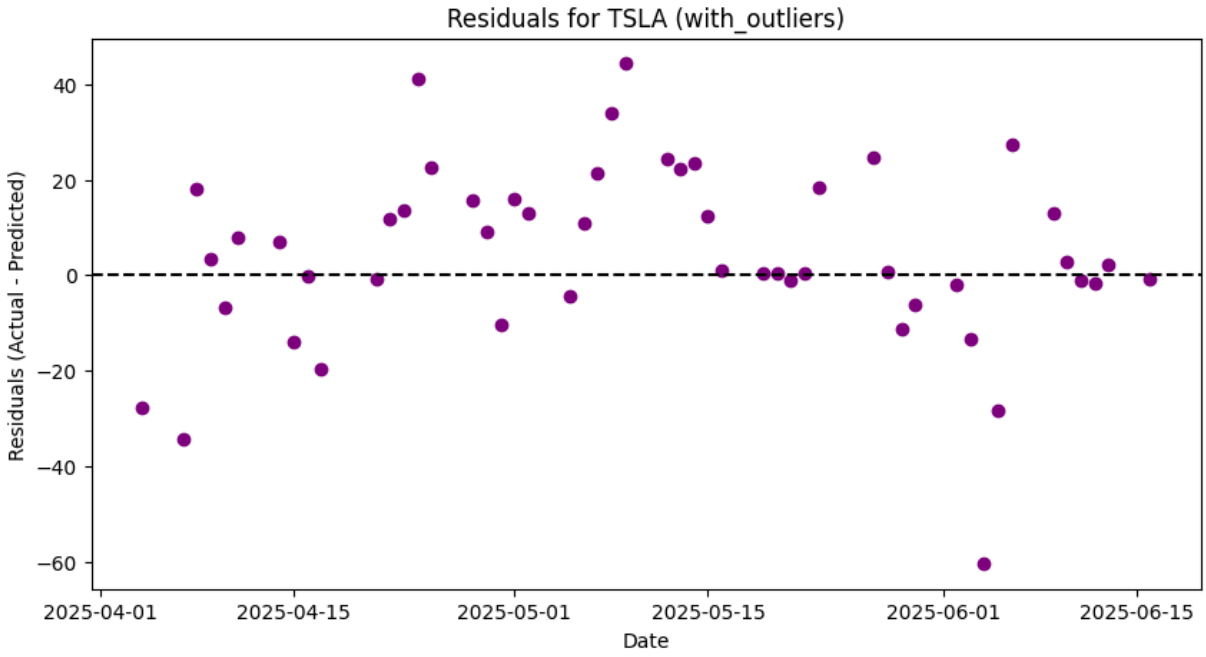
- Visualize predictions and residuals to assess model accuracy.
- Evaluate linear regression model performance (with/without outliers) using RMSE, MAE, and R^2.
- Analyze the impact of outliers on model performance.

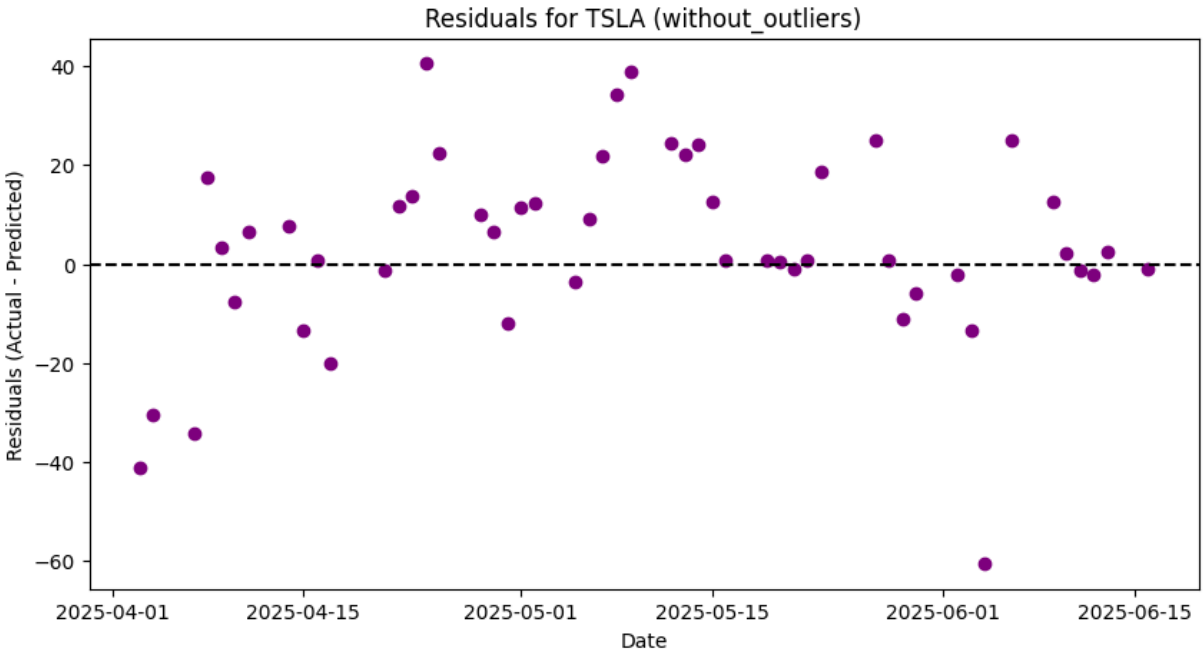
Visualization

Prediction vs. actual plots compare predicted and actual values, showing alignment with occasional deviations during volatile periods. Residual plots illustrate prediction error distribution, highlighting potential over- or underprediction, especially during market shifts. These visualizations are available for review.




Actual vs Predicted Prices for TSLA (without_outliers)
Actual
Predicted
Price
Date
360
340
320
300
280
260
240
220
2025-04-01
2025-04-15
2025-05-01
2025-05-15
2025-06-01
2025-06-15


Residuals for TSLA (with_outliers)
Residuals (Actual - Predicted)
Date
40
20
0
−20
−40
−60
2025-04-01
2025-04-15
2025-05-01
2025-05-15
2025-06-01
2025-06-15



Model performance and outliers impact

- **Model with Outliers**:
  - RMSE: 19.30
  - MAE: 14.16
  - R^2: 0.77
- **Model without Outliers**:
  - RMSE: 19.39
  - MAE: 14.07
  - R^2: 0.78
- **Outlier Impact**:
  - Date 2025-06-05: Error with outliers: 28.45, Error without outliers: 28.37

Model Performance and Experimentation Summary

model_id	model_type	outlier_handling	R2	RMSE	MAE	Status
20250813_102656	LinearRegression	with_outliers	0.76614	19.53968	14.46751	Good
20250813_102656	LinearRegression	without_outliers	0.78455	19.16335	14.29913	Good
20250815_170544	RandomForest	with_outliers	0.77194	19.29591	14.16102	Good
20250815_170544	RandomForest	without_outliers	0.77953	19.38564	14.06701	Good

The pipeline transitioned from Linear Regression (R^2 ~0.78) to Random Forest to capture non-linear patterns and improve robustness to outliers in TSLA data. Experiments tested additional features (e.g., 20-day moving average, returns) and a larger dataset, but no significant improvement was observed over the baseline Random Forest model (R^2 ~0.77–0.78, RMSE ~19–20, MAE ~14–15). The final model uses Random Forest (n_estimators=300, max_depth=20, min_samples_split=5, min_samples_leaf=2, random_state=42) with features prev_close, volume, and ma5, due to its robustness and suitability for iterative updates.