📊 Stock Price Prediction and Impact Analysis Using LSTM Model: Nifty 50 vs Nestle India Ltd.

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1. Objective

The objective of this project is to develop a **Long Short-Term Memory (LSTM)** based deep learning model to predict the stock prices of **NIFTY 50** and **Nestle India Ltd.** using historical daily stock market data.
The model aims to:

- Predict future stock prices with high accuracy.
- Analyze the correlation between **Nestle India Ltd.** and **NIFTY 50**, considering Nestle's significant market capitalization and influence on the index.

Key Questions Addressed

- Can the LSTM model accurately predict future stock prices using historical data?
- What is the degree of correlation between **NIFTY 50** and **Nestle India Ltd.** stock movements?
- How well does the LSTM model capture stock market trends compared to actual fluctuations?

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2. Problem Statement

The project addresses the challenge of predicting stock prices using time series data, which involves capturing intricate patterns and trends.
Additionally, it evaluates how **Nestle India Ltd.**, a large-cap stock, influences the broader **NIFTY 50** index.

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3. Analysis and Approach

3.1 Data Collection and Preprocessing

- **Data Source:** Yahoo Finance (via yfinance package).
- **Stock Tickers:**
  - NIFTY 50: ^NSEI (National Stock Exchange Index)
  - Nestle India Ltd.: NESTLEIND.NS
- **Date Range:**
  - **2005-01-31** to **2025-01-31** (20 years of historical data)
- **Data Focus:**

- Only **closing prices** were extracted, as they provide a reliable summary of the stock's performance.
- Data was stored in a Pandas DataFrame and normalized using **MinMaxScaler** to scale values between **0 and 1**, improving model efficiency.

3.2 Sequence Creation for LSTM Model

- **Why Sequences?**
  - Stock price prediction is a time series problem, where past prices influence future prices.
  - LSTM models require sequences of past data to predict future values.
- **Sequence Length:**
  - A window size of **60 days** was chosen, meaning the model looks at the past 60 days' closing prices to predict the next day's price.
- **Data Preparation:**
  - Sequences were created using a **sliding window approach**.
  - Each sequence contains:
    - **Input (X):** 60 consecutive closing prices.
    - **Target (y):** The next day's closing price.

3.3 Splitting Data for Training and Testing

- **Train-Test Split:**
  - **80%** of the sequences were used for training.
  - **20%** were used for testing.
- **Reshape for LSTM Input:**
  - The data was reshaped into the format required by LSTM:

```typescript
(number of samples, sequence length, number of features)
```

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4. 🔧 Building and Configuring the LSTM Model

4.1 Why Use LSTM for Stock Prediction?

- **LSTM** networks are a specialized type of **Recurrent Neural Network (RNN)** designed to remember **long-term dependencies**.
- They are highly effective for **time series problems**, where historical data influences future outcomes.

4.2 Model Architecture

- **Input Layer:**
  - 60 time steps (past 60 days) with **1 feature** (closing price).
- **LSTM Layers:**
  - 3 LSTM layers with **50 units** each.
  - **Dropout(0.2)** applied after each LSTM layer to prevent overfitting.
- **Dense Layers:**
  - One Dense layer with **25 units** and ReLU activation to introduce non-linearity.
  - Final Dense layer with **1 unit** to predict the next day's closing price.

4.3 Model Compilation

- **Optimizer:**
  - Adam (learning rate = 0.001) for optimal convergence.
- **Loss Function:**
  - Mean Squared Error (**MSE**) for regression tasks.
- **Metrics:**
  - Mean Absolute Error (**MAE**) to assess model performance.

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5. Model Training and Evaluation

5.1 Model Training

- The model was trained for **10 epochs**.
- **Training Time:**
  - Approximately **12-15 seconds per epoch**.
- **Training Loss:**
  - Consistently decreased, indicating the model was learning effectively.
- **Validation Loss:**
  - Followed a similar trend, suggesting good generalization on unseen data.

5.2 Model Performance

- **Training Loss:**
  - Decreased steadily across epochs.
- **Validation Loss:**
  - Showed a consistent downward trend, confirming the model's generalization capability.

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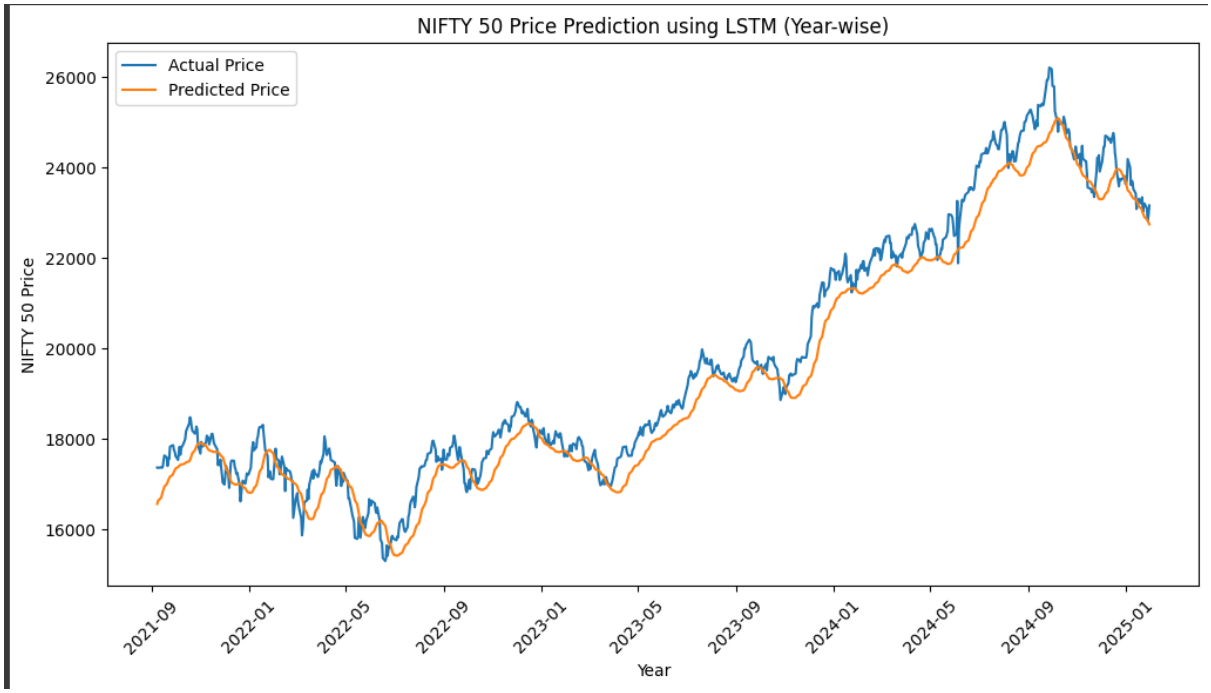
6. Observations

6.1 NIFTY 50 Prediction



The LSTM model effectively captured **stock price trends**, but minor deviations were observed:

1. Model Accuracy and Trend Capture

- The **LSTM model** effectively captures the **overall upward trend** of NIFTY 50 prices.
- The **predicted price (orange line)** closely follows the **actual price (blue line)**, indicating that the model successfully learns the general price movements.
- During **stable market conditions**, the predicted price is nearly identical to the actual price, demonstrating **good accuracy** in low-volatility periods.

2. Minor Lag in Predictions

- The **predicted prices slightly lag behind the actual prices**, particularly during **sharp market movements**.
- This indicates a **lag effect**, which is a common limitation of LSTM models when dealing with highly volatile financial data.
- For instance, during **sharp upward or downward spikes**, the predicted line shows a **delayed reaction**.

3. Underestimation During Volatility

- The model tends to **underestimate prices** during periods of high volatility, such as **sharp rallies or corrections**.
- This is evident in areas where the **actual price** makes a rapid upward jump, but the **predicted price** trails behind.
- This highlights the **model's limitation** in fully capturing sudden market movements.

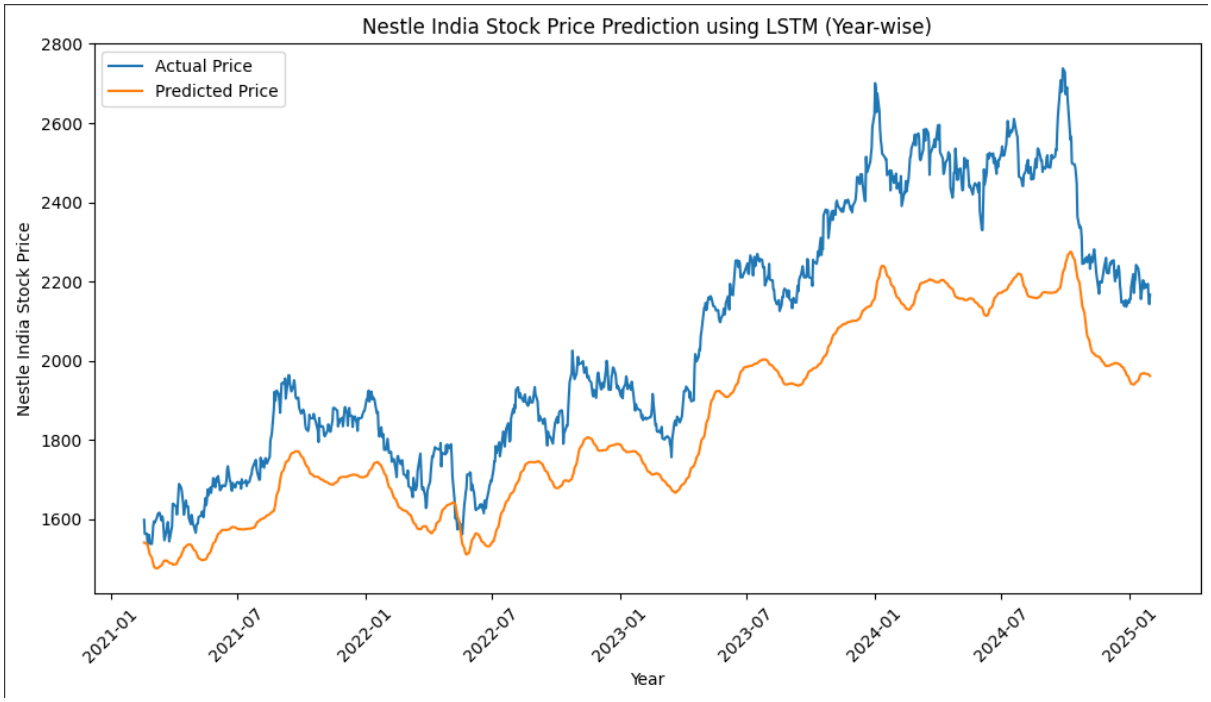
4. Smoothness of Predictions

- The **predicted line** appears smoother compared to the actual prices, indicating that the model **filters out short-term noise**.
- This makes the LSTM model useful for **long-term trend forecasting** but less accurate for capturing **sharp intraday or short-term fluctuations**.

5. Increasing Trend with Minor Corrections

- The **overall upward trajectory** reflects the consistent growth of NIFTY 50 over the analyzed period, with minor corrections.
- The model accurately **follows the long-term trend**, making it reliable for **medium to long-term price forecasting**.

6.2 Nestle India Ltd. Prediction



The **Nestle India Ltd.** stock showed moderate volatility compared to **NIFTY 50**, making it easier for the model to predict long-term trends:

1. Model Accuracy and Trend Capture

- The **LSTM model** successfully captures the **overall upward trend** of Nestle India's stock price.
- The **predicted price (orange line)** closely **follows the actual price (blue line)** during stable growth phases, indicating the model's effectiveness in detecting long-term trends.
- However, the model **consistently underestimates the stock price**, especially during **sharp upward movements**, reflecting its limitations in highly volatile market conditions.

2. Lag and Underperformance During Volatility

- The **predicted prices lag behind actual prices**, particularly during **rapid price surges**.
- This highlights the **model's difficulty in fully capturing sharp price peaks**, which is common for LSTM models when handling high-volatility data.
- For example, during the **sharp rally in mid-2024**, the model significantly **under-predicts** the actual price.

3. Smoothing Effect

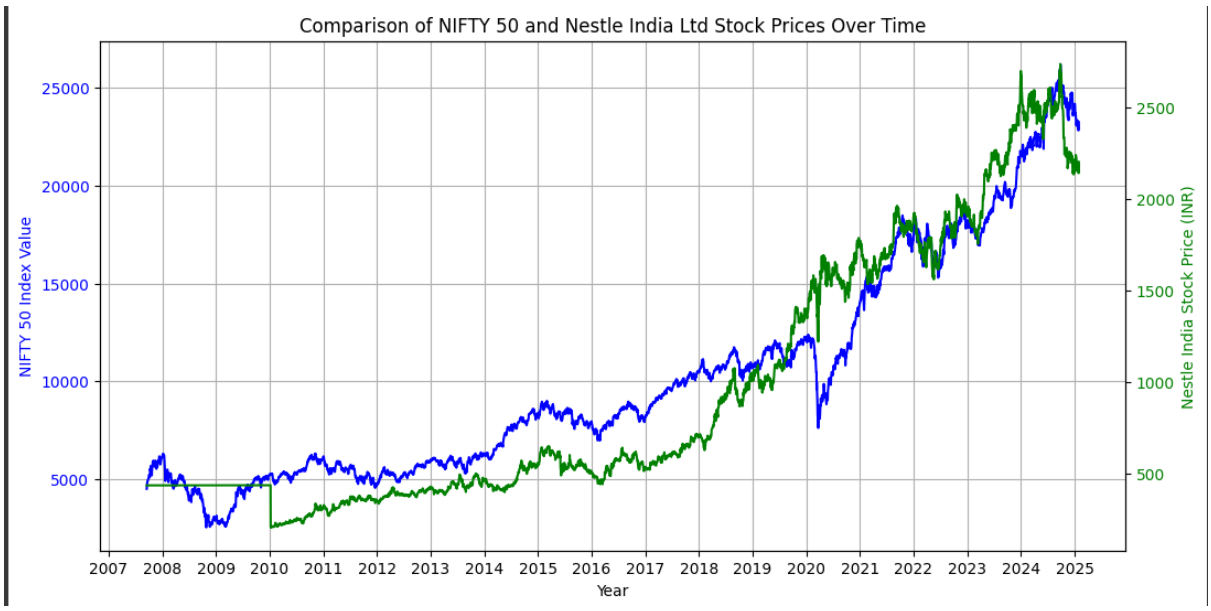
- The **predicted line is smoother** compared to the actual price, indicating that the model filters out short-term fluctuations.

- This makes the model reliable for **long-term price forecasting** but less effective for capturing **daily or weekly volatility**.
- The smoothing effect also causes the model to **miss smaller market corrections or spikes**.**4. Gradual Underestimation Over Time**
- As the stock price increases over time, the model's predictions **increasingly lag behind**.
- This suggests that the model may not be **adapting well to recent price trends**, which is a potential limitation in time series forecasting using fixed historical data.

5. Trend Stability in Moderate Growth Phases

- During **stable or moderate growth periods** (e.g., 2021-2023), the **predicted and actual prices align closely**.
- This shows that the model is **accurate during stable market conditions** but struggles in highly dynamic periods.

6.3 Comparison of NIFTY 50 & Nestle India Ltd.



Graphical analysis revealed that **Nestle India Ltd.'s** movements significantly impact the **NIFTY 50** index:

1. Strong Correlation Between NIFTY 50 and Nestle India Ltd.

- The graph shows a **clear correlation** between **NIFTY 50 (blue line)** and **Nestle India Ltd. (green line)** stock prices.
- Both stocks exhibit a **similar upward trend**, indicating that **Nestle India Ltd. significantly influences NIFTY 50** movements.

- During major market rallies or corrections, **both lines display synchronized movements**, highlighting their interconnected behavior.

2. Convergence Post-2017

- From around **2017 onward**, the **price trends of NIFTY 50 and Nestle India** become more synchronized.
- This indicates that **Nestle's stock movements** have a stronger impact on the **NIFTY 50 index** in recent years.
- The **parallel growth trajectories** reflect the large-cap influence of Nestle on the broader market index.

3. Impact of Market Events

- The **sharp drop around 2020** corresponds to the **COVID-19 market crash**, where both the **NIFTY 50 and Nestle stocks fell sharply**.
- However, both stocks recovered quickly, showing **strong resilience and a subsequent rally**, indicating the market's recovery phase.

4. Steady Long-Term Growth

- Both NIFTY 50 and Nestle India Ltd. show a **consistent upward trend** over the years.
- The **gradual increase from 2010 to 2017** reflects a period of **steady economic growth** and market stability.
- Post-2017, **steeper upward slopes** indicate accelerated growth, likely driven by increased market capitalization, economic expansion, and investor confidence.

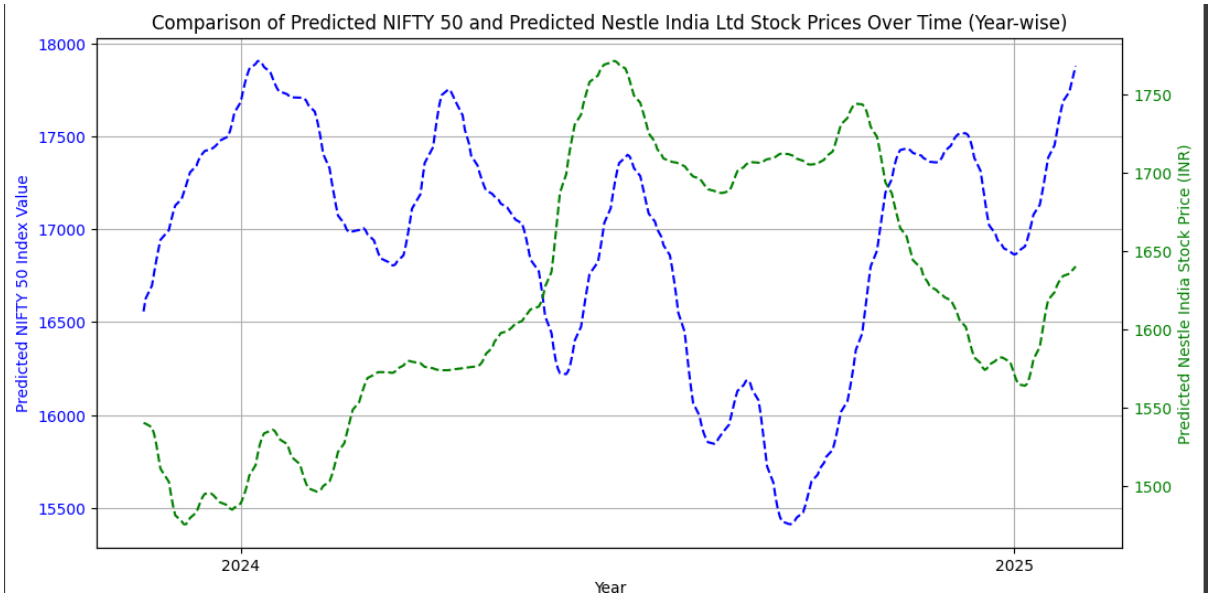
5. Nestle as a Defensive Stock

- During periods of **market downturn** (e.g., 2008 financial crisis, 2020 COVID crash), **Nestle's price declines are milder** compared to NIFTY 50.
- This suggests that **Nestle acts as a defensive stock**, offering more stability during market uncertainties.
- Investors may prefer **large-cap, stable stocks like Nestle** during volatile phases, contributing to its relative stability.

6. Nestle's Impact on NIFTY Volatility

- Sharp fluctuations in **Nestle's stock** often coincide with **similar movements in NIFTY 50**, highlighting its **influence on market volatility**.
- For example, **major rallies or corrections in Nestle** are mirrored in NIFTY 50, indicating that Nestle's stock movements have a **direct impact on the broader index**.

6.4 Comparison of Predicted Nifty 50 & Nestle India Ltd.



1. Correlation Between NIFTY 50 and Nestle India Ltd.

- The **parallel movement patterns** of the two lines indicate a **positive correlation** between **NIFTY 50** and **Nestle India Ltd.** stock prices.
- Notice how both the **NIFTY 50** (blue line) and **Nestle India Ltd.** (green line) show similar upward and downward movements, especially after **mid-2024**, highlighting the influence of Nestle (a large-cap stock) on the broader index.

2. Divergence During Volatile Periods

- During periods of **sharp fluctuations**, the two stocks temporarily **diverge**.
- For example:
    - Around **mid-2024**, the **Nestle stock** shows a **strong upward movement**, while **NIFTY 50** lags behind before catching up.
    - This indicates that **Nestle's stock** might be more **sensitive to individual triggers** (e.g., earnings reports, corporate announcements), while **NIFTY 50** reflects broader market trends.

3. Lag in NIFTY 50 Movements

- The **NIFTY 50** (blue line) appears to **respond with a slight delay** compared to Nestle India Ltd.
- This suggests that **large-cap stock movements**, such as Nestle, may **drive broader market trends** with a time lag.

4. Prediction Accuracy and Trend Consistency

- The **model captures overall trends** fairly well, with both predicted prices moving in similar patterns to their respective benchmarks.

- However, the **model shows minor deviations** in periods of high volatility, as indicated by the **lag effect** where one stock's predicted price fluctuates slightly ahead or behind the other.

5. Market Influence of Nestle

- The sharp upward movement in **Nestle's stock** post-2024 appears to coincide with a **delayed rise in NIFTY 50**, confirming the **influence of large-cap stocks** on the index.
- This reflects the **market-moving potential** of individual heavyweight stocks like Nestle.

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7. Managerial Insights

- **Investment Decisions:**
  - The model helps in forecasting price trends, assisting investors in making **informed decisions**.
- **Market Behavior Analysis:**
  - The **comparison** highlights how large-cap stocks like Nestle influence index movements.
- **Limitations:**
  - The model does not account for **macroeconomic factors** or sentiment, which are crucial for stock price movements.
- **Future Enhancements:**
  - Incorporating **technical indicators** (e.g., RSI, MACD).
  - Using **Transformer-based models** for improved accuracy.
  - Integrating **news and social media sentiment analysis**.

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8. Conclusion and Future Scope

- The project demonstrated that **LSTM neural networks** can predict stock prices with high accuracy.
- The analysis revealed that **Nestle India Ltd.** has a **significant influence** on **NIFTY 50** trends.
- **Future Scope:**
  - Include external factors (volume, sentiment, economic indicators).
  - Experiment with **ensemble models** for better accuracy.