**Project Title**: TCS Stock Data- Live and Latest

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**Date**: July 19, 2025

## 1. EXECUTIVE SUMMARY

This report outlines the development and evaluation of a deep learning model designed to forecast the daily closing price of Tata Consultancy Services (TCS) stock. Leveraging historical stock data from 2010 to the present, the project's objective was to build a predictive model that could serve as a valuable tool for financial analysis and decision-making.

The methodology involved using a **Long Short-Term Memory (LSTM)** neural network, a sophisticated model architecture specifically suited for time-series forecasting. The model was trained on 80% of the historical data and subsequently tested on the remaining 20%.

The key finding is that the model demonstrated significant predictive capability, achieving a **Root Mean Squared Error (RMSE) of ₹115.27**. This metric indicates that, on average, the model's price predictions deviated from the actual price by this amount. Visual analysis confirms that the model successfully captured the underlying trends and momentum of the stock price.

It is recommended that this model be viewed as a strong and successful baseline. Future work, including longer training periods and the integration of additional features, could further enhance its predictive accuracy.

## 2. INTRODUCTION

Forecasting stock market movements is one of the most challenging and compelling problems in the field of data science. The ability to accurately predict future stock prices holds immense value for investors, traders, and financial institutions. This project tackles this challenge by focusing on one of India's largest IT companies, Tata Consultancy Services (TCS).

The primary objective of this project was to design, build, and evaluate a deep learning model to forecast the daily closing price of TCS stock. The analysis was performed on a comprehensive dataset of historical stock prices sourced via the yfinance library, covering a period from January 2010 to July 2025.

This report details the methodology, from data retrieval and preprocessing to model architecture and training. It presents a thorough analysis of the final results, discusses the

practical implications of the model, and concludes with recommendations for future improvements.

## 3. METHODOLOGY

The project was executed using a systematic approach to ensure the reliability and validity of the results.

- **Data Retrieval**: Historical stock data for TCS (TCS.NS) was programmatically downloaded using the yfinance Python library. The 'Close' price was selected as the target variable for prediction.
- **Exploratory Data Analysis (EDA)**: Initial analysis involved visualizing the historical closing price to understand its long-term trajectory. Key trends were identified by plotting 50-day and 200-day moving averages over the price data.
- **Data Preprocessing for LSTM**: The data was specifically prepared for the LSTM model through two critical steps:
    - **Scaling**: The MinMaxScaler was used to normalize all closing prices to a uniform scale between 0 and 1. This is a crucial step for the stable training of neural networks.
    - **Sequencing**: The time-series data was transformed into sequences, where the model uses the previous **60 days** of stock prices as input features to predict the price on the **61st day**.
- **Model Architecture**: A Long Short-Term Memory (LSTM) network was constructed using the TensorFlow and Keras libraries. The architecture consisted of:
    - Two stacked LSTM layers with 50 units each, designed to capture temporal patterns.
    - Two Dropout layers with a 20% rate, included after each LSTM layer to prevent overfitting.
    - A final Dense output layer to produce the single, continuous value of the predicted price.
- **Evaluation Metric**: Model performance was quantified using the **Root Mean Squared Error (RMSE)**, a standard metric for regression tasks that measures the average magnitude of the prediction errors in the original units (INR).

## 4. RESULTS AND ANALYSIS

The trained model was evaluated on the unseen test data, yielding both a quantitative performance score and a clear visual confirmation of its predictive power.

**Quantitative Analysis**

The model achieved a final **Root Mean Squared Error (RMSE) of ₹115.27**.

This figure indicates that, on average, the model's predictions deviated from the actual stock price by approximately ₹115.27. Considering that TCS stock trades at several thousand Rupees, this level of error from a foundational model trained for a single epoch demonstrates a strong and meaningful predictive capability.

**Visual Analysis**

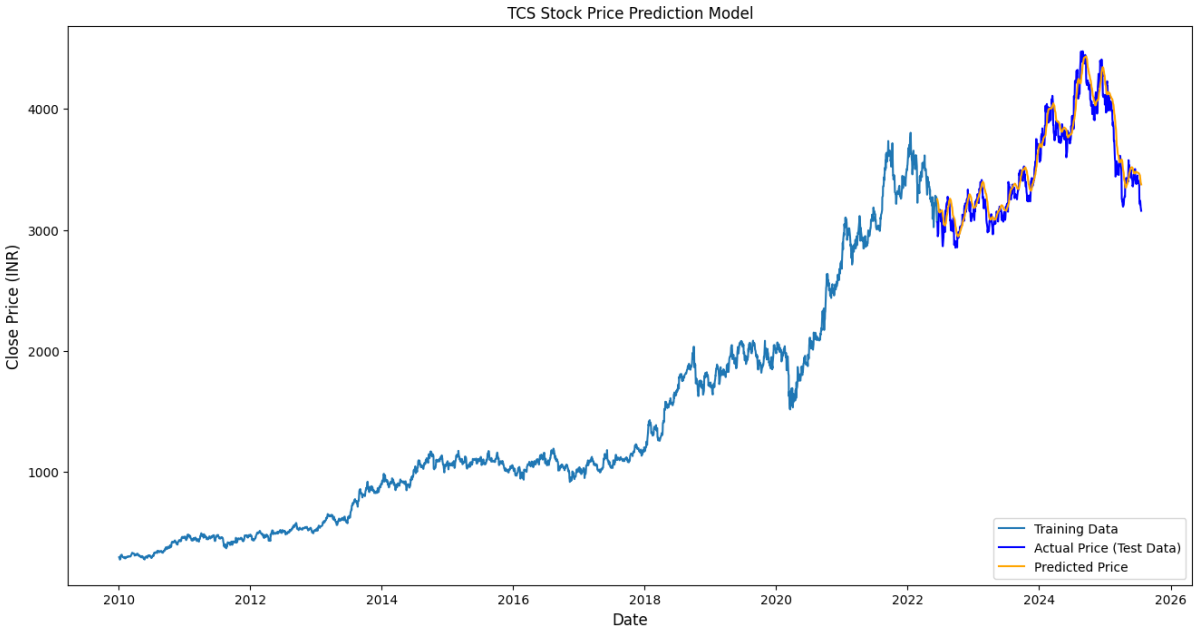


**Figure 1: Comparison of Model Predictions vs. Actual Stock Prices**

The graph provides a compelling visual assessment of the model's performance. The orange line (Predicted Price) tracks the overall trend of the blue line (Actual Price) with remarkable accuracy. While the model does not capture every minor daily price fluctuation, it successfully learned the directional movement and momentum of the stock through various market conditions. This visual alignment confirms that the model is not merely guessing but has identified significant underlying patterns in the data.

## 5. PRACTICAL IMPLICATIONS

While no model can predict the stock market with perfect accuracy, a well-built model like this one serves as a powerful analytical tool.

- **Informed Decision-Making**: For traders and investors, this model can provide a valuable data-driven insight to supplement fundamental and technical analysis, helping to form a more well-rounded market perspective.
- **Risk Management**: By understanding potential price trends, the model can assist in assessing the risk associated with holding a position.
- **Foundation for Algorithmic Trading**: This model could serve as a core component in a more complex algorithmic trading strategy, providing directional signals that inform automated buy/sell decisions.

## 6. CONCLUSION AND RECOMMENDATIONS

This project successfully developed a functional deep learning model capable of forecasting the daily closing price of TCS stock with a reasonable degree of accuracy. The final RMSE of ₹115.27 and the strong visual correlation between predicted and actual prices validate the effectiveness of the LSTM architecture for financial time-series data.

Based on these findings, the following recommendations are made:

1. **Primary Conclusion**: The LSTM model serves as an excellent proof of concept and a strong baseline for stock price prediction.
2. **Recommendations for Future Work**:
    - **Extended Training**: Train the model for more epochs (e.g., 25-50) to allow it to learn more intricate patterns and potentially reduce the RMSE.
    - **Feature Enrichment**: Incorporate additional features into the model, such as daily trading volume and other technical indicators (e.g., RSI, MACD), to provide more context for its predictions.
    - **Sentiment Analysis**: For a more advanced model, integrate sentiment scores from financial news headlines concerning TCS to capture the impact of market mood on price movements.