ファンダメンタルズ、テクニカル、線形回帰分析を使用した株価予測
Stock Forecasting Using Fundamental, Technical & Linear Regression Analysis

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Abstract

　この研究は，ファンダメンタルズ，テクニカル，および定量的回帰分析を統合して，選択された金融機関 Nabil Bank Limited の財務健全性と市場パフォーマンスを評価することにより，株価予測の精度を高めることを目的としています。総資産，負債，自己資本利益率（ROE），一株当たり利益（EPS）などの主要な財務指標は，資産が一貫して負債を上回っており，定期的な配当金に支えられ安定した ROE を備えているナビル銀行の強固な財務状況を示しています。しかし，EPS の低下と加重平均資本コスト（WACC）の上昇により，株主の希薄化と資本コストの増加に関する懸念が生じています。移動平均（MA），相対力指数（RSI），MACD，ボリンジャーバンドを使用したテクニカル分析は，売り手が優勢な弱気市場傾向を示しています。線形回帰 (LR) モデルは株価を高精度で予測しますが，市場の弱気心理と一致しており，注意を促します。ナビル銀行は強力な財務安定性と長期的な投資魅力を示していますが，EPS の低下，WACC の高騰，弱気傾向は投資家にとって様子見のアプローチを示唆しています。

　This study aims to enhance stock price prediction accuracy by integrating fundamental, technical and quantitative regression analyses to evaluate a selected institution: Nabil Bank Limited's financial health and market performance. Prime financial indicators, including total assets, liabilities, Return On Equity (ROE), and Earnings Per Share (EPS), show Nabil Bank's strong financial position with assets consistently exceeding liabilities and stable ROE, supported by regular dividend payments. However, declining EPS and rising Weighted Average Cost of Capital (WACC) raise concerns about shareholder dilution and increasing capital costs. Technical analysis using Moving Averages (MA), Relative Strength Index (RSI), MACD, and Bollinger Bands indicates a bearish market trend, dominated by sellers. A Linear Regression (LR) model forecasts stock prices with high accuracy but aligns with bearish market sentiment, advising caution. While Nabil Bank demonstrates strong financial stability and long-term investment appeal, declining EPS, soaring WACC, and bearish trends suggest a wait-and-see approach for investors.

　Keywords: Stock Forecasting, Fundamental & Technical Analysis, Machine Learning, Linear Regression

1. Overview

Development of a country's capital market and securities industry is crucial for economic growth, as it facilitates the mobilization of funds from surplus to deficit parties and expands investment options. Stock forecasting plays a pivotal role in this process, enabling investors, traders, and businesses to make informed decisions about their financial strategies. Inherent complexity and volatility of financial markets necessitate the use of various analytical tools and models to predict future stock prices accurately. This research integrates fundamental analysis, technical analysis, and linear regression models to enhance the accuracy of stock forecasting.

Fundamental analysis involves examining a company's financial health [1], while technical analysis focuses on historical price and volume data to identify patterns [2]. Linear regression

models leverage historical data to establish relationships among factors influencing the stock prices [3]. By combining these methodologies altogether, this research offers a comprehensive approach to stock predictions, addressing the limitations of each method and backs in enhancing forecast accuracy. Ultimate aim is to provide investors and analysts with a holistic view of stock market dynamics, facilitating more informed investment choices in an increasingly complex financial landscape.

Basically, in an era where financial markets are becoming increasingly complex and volatile, investors and financial analysts are in dire need of advanced predictive tools that can provide them with a competitive edge. On a practical level, this research holds the potential to develop actionable trading strategies, thereby aiding financial practitioners in making informed investment decisions. The ability to accurately predict stock prices can lead to better investment returns, risk management, and overall financial planning. In essence, the motivation for this research is driven by a combination of academic curiosity and the practical necessity of improving stock forecasting techniques to benefit both researchers and financial market participants. This dual focus ensures that the findings will be relevant, impactful, and beneficial in both theoretical and practical contexts.

2. Analysis Methodology

Stock forecasting is a critical pursuit in the realm of finance, with far-reaching implications for investors, traders, and financial analysts. The power to anticipate market movements and price trends is not only central to investment decisions but also pivotal for risk management, portfolio optimization, and overall financial planning. This research project leverages a multifaceted probing methodology, integrating fundamental analysis, technical analysis, and quantitative modeling, to establish a comprehensive framework for predicting stock prices [4].

Proposed initiative forms the strategic framework guiding our quest to predict stock prices effectively. In the volatile realm of financial markets, where fortunes rise and fall with every trading session, the ability to forecast stock prices with precision is a paramount endeavor. This methodology elucidates the systematic approach and techniques that will be employed to meticulously analyze and forecast the stock price performance of Nabil Bank Limited, a key player in the financial banking sector. Proposed scheme emphasizes data collection from reliable sources, thorough data processing, and combining various analytical findings to develop a robust stock forecasting model.

2.1 Data Collection and Processing

To embark on a journey to predict stock performance insights, a pragmatic convenient sampling approach is under-taken to carefully collect and process representative data; it's extracted directly from the institution's own web resources and reputable data collection platforms. Principal financial metrics, earnings reports, and other critical up-to-date data for Fundamental Analysis are fetched from Nabil Bank Limited's official website thereby ensuring the authenticity of data metrics. To enhance the depth of dataset, some additional financial and market data are utilized from pertinent data collection sites. This step is crucial for obtaining a well-rounded and diverse set of quantitative indicators.

2.2 Fundamental Analysis of Stock Forecasts

Fundamental analysis forms the foundation for evaluating a company's intrinsic value in the stock market, going beyond surface-level metrics to explore deeper financial and operational insights. By meticulously examining financial statements such as balance sheets, income statements, and cash flow statements, analysts uncover a company's true performance and potential Fundamental Analysis: — unveiling a company's true value. This process, akin to peeling back the layers of an apple, reveals not

just numbers but also the "taste" and growth potential, including softer factors like management effectiveness, industry trends, and prevailing economic conditions. Key financial ratios like P/E and profit margins enrich this analysis, providing clarity on a company's financial health and prospects.

Primary value of fundamental analysis lies in its ability to guide investors through market complexities by focusing on a company's intrinsic value rather than its fluctuating stock price. It identifies hidden opportunities and aids in navigating market instability with a long-term perspective. While it emphasizes enduring value, combining fundamental analysis with tools like technical analysis and market sentiment evaluation ensures a comprehensive approach, enabling more informed and strategic investment decisions in the ever-changing stock market.

2.3 Technical Analysis of Stock Forecasts

Technical analysis involves the study of historical data, such as price movements, trading volume, and other market statistics, to predict the future performance of a stock. Unlike fundamental analysis, which examines the intrinsic (built-in) value of a company, technical analysis is rooted in the belief that past patterns and trends in stock prices can provide insights into future price behavior. By identifying these trends and patterns, traders and investors aim to capitalize on market movements and make more informed trading decisions.

This method relies heavily on charts and statistical tools to evaluate market dynamics. The core principle behind technical analysis is that all relevant information is already reflected in the stock's current price, and market trends tend to replicate over time. Thus, analyzing historical data allows traders to anticipate potential future patterns and movements. Key tools in Technical Analysis are Moving Averages, Relative Strength Index, Moving Average Convergence/Divergence, and Bollinger Bands. Technical analysis provides traders with tools to

make data-driven decisions based on historical patterns, offering insights into potential price movements and market trends. While it doesn't consider a company's fundamental value, it remains an essential method for short-term trading and market timing, complementing other investment strategies.

2.4 Regression Analysis of Stock Forecasts

Linear regression is a statistical modeling technique used to establish relationships between independent variables (e.g., economic indicators, company performance metrics, or technical indicators) and a dependent variable (stock price). By analyzing historical data, it models these relationships using a linear (straight-line) equation, enabling analysts to estimate the impact of various factors on stock prices. Linear regression provides a quantitative framework that integrates both fundamental and technical aspects to forecast stock prices effectively. It emphasizes the importance of selecting relevant predictors judiciously and rigorously evaluating model performance. This method allows for the creation of predictive models that help investors anticipate stock price movements based on changes in key variables, offering valuable insights for decision-making.

One of the primary drivers of this research is the desire to bridge the gap between theoretical financial models and their practical applications. While fundamental analysis provides insights into a company's intrinsic value and technical analysis focuses on historical price patterns, combining these with linear regression can yield more robust predictive models. Integrating fundamental analysis, technical analysis, and linear regression offers a comprehensive toolkit for stock forecasting. By merging insights into a company's financial health, historical price trends, and statistical modeling, investors and analysts can achieve more accurate predictions of future stock prices [5]. The combination of these approaches, coupled with advancements in technology, continues to improve the precision

and reliability of stock price forecasts, empowering investors to make well-informed decisions in the ever-changing financial markets.

3. Results and Discussion

3.1 Key Findings on Fundamental Analysis

Figure 1 compares total assets (red dotted line) and total liabilities (yellow dashed line) over nine time periods. Both metrics show a general upward trend, with total assets consistently exceeding total liabilities. A significant peak occurs at time period 4, where total assets reach 417,019 and liabilities peak at 363,983, followed by a decline before continuing the upward trend. Nabil Bank Limited's ROE, EPS, ROA, and Net Profit Margin (Table 1) show a consistent decline, indicating reduced profitability and efficiency

over time as showcased in multiple plots of Figure 2.

WACC has risen from 15.86% to 19.21%, reflecting amplified capital costs. P/E Ratio peaked at 43.8 but later dropped to 23.92, signaling reduced market expectations. Despite these challenges, the Debt-to-Equity and Debt-to-Asset Ratios remain low and stable, indicating financial stability. Overall, the bank faces declining profitability but maintains a conservative and stable financial structure.

Nabil Bank's dividend trend (Table 2 and associated Figure 3) illustrates consistent high payouts in 2017/18 and 2018/19, with a total dividend of 34% each year, split as 22% cash and 12% bonus shares. In 2019/20 and 2020/21, bonus shares increased significantly to 33.5% and 33.6%, while cash dividends declined sharply to
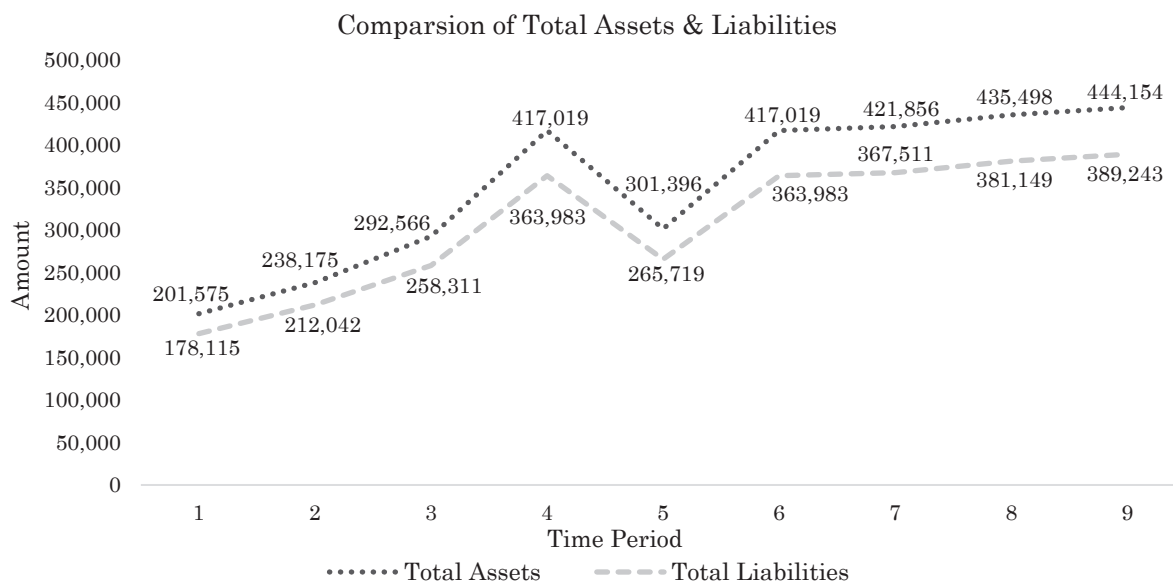
Comparsion of Total Assets & Liabilities

Figure 1: Compression of Total Assets & Liabilities

Table 1: Fundamental Indicators of Nabil Bank Limited

Fiscal Period	Total Assets	Total Liabilities	ROE %	ROA %	WACC %	Net Margin %	EPS	PE Ratio	Debt-to-Equity	Debt-to-Asset
1: 19-July	201,575	178,115	19.27	2.29	15.86	45.08	21.45	15.76	0.03	0
2: 20-July	238,175	212,042	14.07	1.58	13.73	37.67	23.02	17.49	0.13	0.01
3: 21-July	292,566	258,311	15.55	1.76	10.31	39.09	21.3	43.8	0.12	0.01
4: 22-July	417,019	363,983	11.6	1.42	12.95	41.56	18.62	39.92	0.33	0.04
5: 22-April	301,396	265,719	13.33	1.53	12.46	39.88	5.31	39.38	0.37	0.04
6: 22-July	417,019	363,983	14.48	1.78	12.95	46.93	5.91	39.92	0.33	0.04
7: 22-Oct.	421,856	367,511	12.08	1.54	15.96	35.6	5.97	30.95	0.12	0.01
8: 23-Jan.	435,498	381,149	13.87	1.75	16.76	36.72	6.93	28.63	0.12	0.01
9: 23-April	444,154	389,243	12.5	1.55	19.21	32.53	6.28	23.92	0.12	0.01

1.76% and 4.4%, respectively. By 2022/23, only an 11% bonus share was provided, marking the lowest total dividend (11%) in the analyzed period.

Focal discoveries include the bank's strong financial position, with total assets consistently exceeding liabilities and high net profit margins indicating productivity. However, concerns such as declining Earnings Per Share (EPS) and swelling Weighted Average Cost of Capital
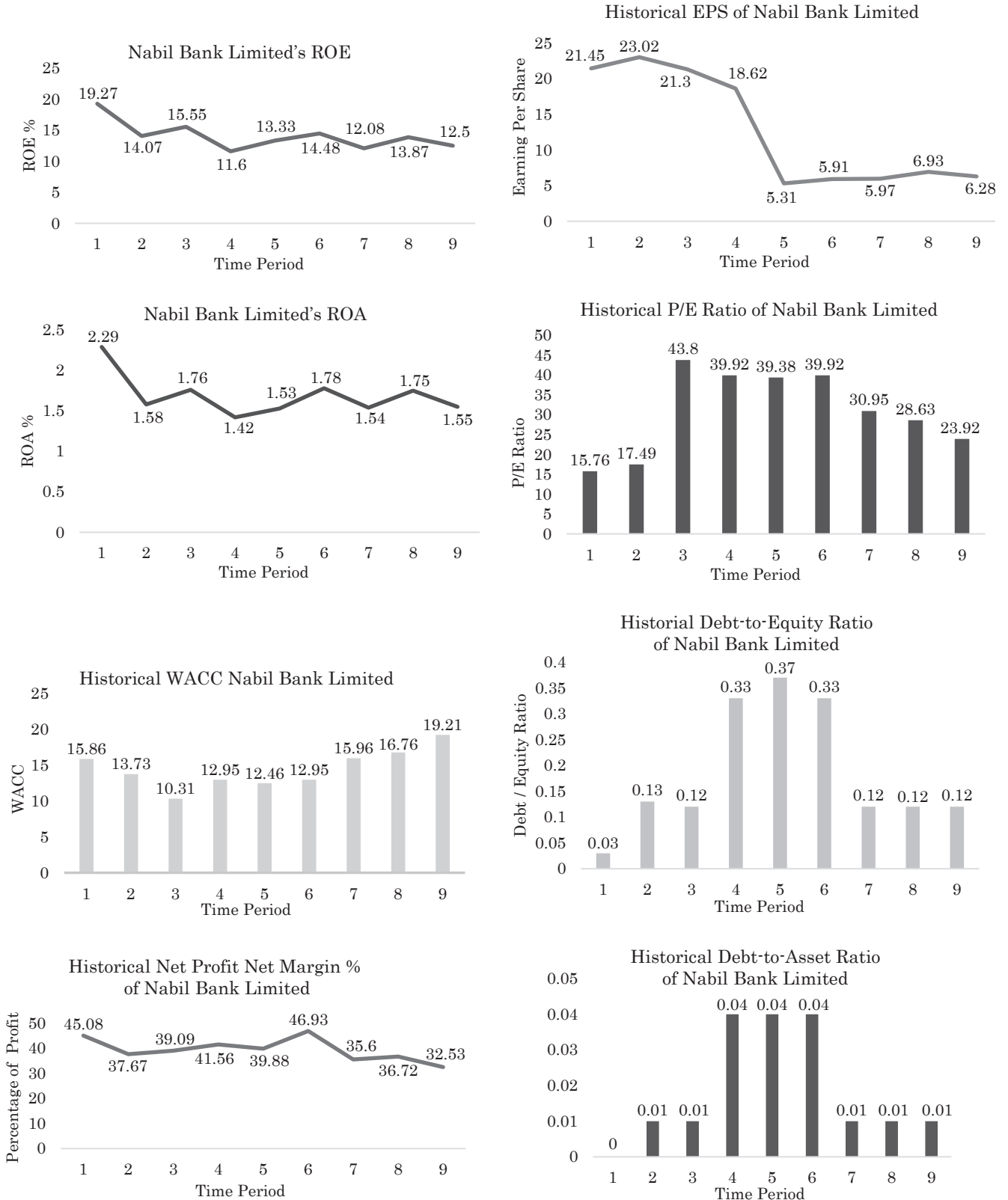

Figure 2: Fundamental Analysis of Stock Statistics

Table 2: Dividend History of Nabil Bank Limited

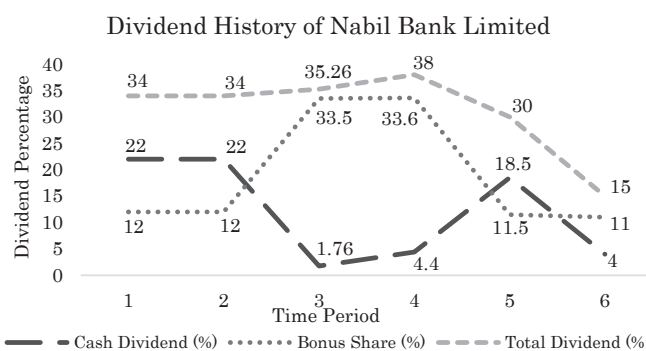| Fiscal Year Nepali Bikram Sambat	Fiscal Year Gregorian Counterpart	Cash Dividend (%)	Bonus Share (%)	Total Dividend (%)
2074/75	2017/2018	22	12	34
2075/76	2018/2019	22	12	34
2076/77	2019/2020	1.76	33.5	35.26
2077/78	2020/2021	4.4	33.6	38
2078/79	2021/2022	18.5	11.5	30
2079/80	2022/2023	0	11	11

Figure 3: Historical Dividend Analysis

(WACC) and Debt-to-Asset ratios require strategic management.

3.2 Key Findings on Technical Analysis

Figure 4's chart displays the daily performance mode of Nabil Bank Limited's stock with multiple technical indicators. Candlestick chart shows a downward trend during late 2023, followed by recovery and sharp bullish breakout in 2024.
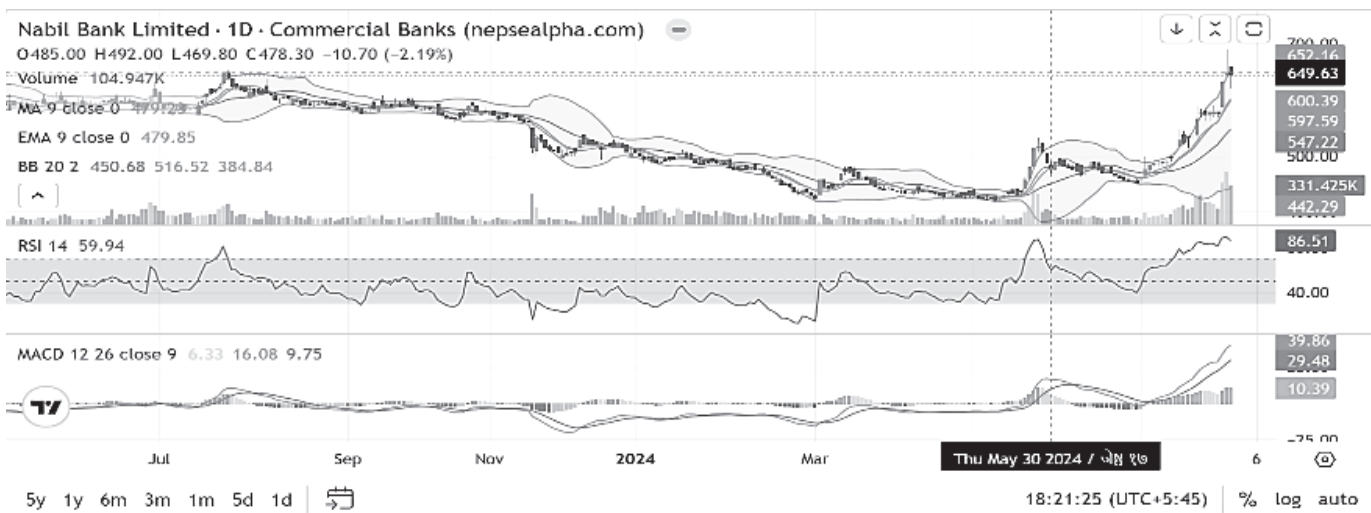
Bollinger Bands (BB 20) indicate higher volatility during the recent uptrend as price moves near the upper band. Moving Averages (MA 9 and EMA 9) confirm upward momentum, acting as dynamic support levels. RSI (Relative Strength Index) currently at 59.94 shows the stock is not overbought but has experienced significant buying pressure. MACD (Moving Average Convergence Divergence) histogram and signal lines indicate a strong bullish signal as MACD line remains above the signal line. Volume spikes correspond to the upward price movement, emphasizing strong market participation during breakout. Overall, trends suggest continued bullish sentiment but with caution for a potential reversal or consolidation.

Technical analysis of Nabil Bank Limited's stock highlights a typical downward predisposition and market sentiment dominated by sellers, suggesting wariness for investors. Main indicators such as candlestick patterns, including bearish signals like the Hanging Man and Shooting Star, and Moving Averages (SMA and EMA) point to unclear buying or selling opportunities, emphasizing the need for vigilance in decision-making processes [6]. Furthermore, Relative Strength Index (RSI) indicates oversold conditions, while MACD and Bollinger Bands suggest a sideways tendency, reinforcing the recommendation for investors to linger on for clearer market signals before making fresh

Figure 4: Technical Analysis Mode

investments.

3.3 Key Findings on Linear Regression Analysis

Figure 5's graph depicts the closing price of Nabil Bank Limited's stock from 2019 to 2024, showing substantial fluctuations over time. Primarily, stock price

Figure 5: Visualization Existing Data with Line Chart

experienced a peak around later 2021, followed by a steep decline that continued into 2024, indicating potential market volatility or underlying company issues. Between, 2019 & 2020, stock prices displayed stability with minor fluctuations, ranging from nearly 820Rs to 660Rs. In 2020, it experienced perceptively volatility, starting near 660Rs peaking near 1700Rs in the near end of 2021, and stabilizing around 1100Rs by the year's end.

Figure 6: Comparison of Actual and Predicted Closing Prices

Reasoning for up-trend for 2021-2022: this surge was largely influenced by the increased bank investments due to COVID-19's impact on financial activities, driving up demand amidst limited supply. During the pandemic era, almost all financial activities experienced a downturn. When financial activities decline, cash flow in the market becomes positive.

Consequently, a significant amount of monies remain deposited in banks that are also invested in the stock market. When financial institutions invest in the stock market, then demand for stocks increases. However, the supply of stocks is limited. Here, the principle of supply and demand comes into play. When the supply is low or limited and demand is high, the price of particular assets rises. Linear Regression (LR) analysis conducted on Nabil Bank Limited's stock data provided insightful findings on bank's stock performance

and model's predictive capabilities.

Initial steps involved meticulous data preparation and cleansing, where necessary libraries such as Pandas, NumPy, and Scikit-Learn were imported for efficient data manipulation and model building. Subsequently, handling missing values and scrubbing dataset ensured the reliability of ensuing analyses, highlighting the importance of these preliminary steps. Dots (data points) on scatter plot as designated in Figure 6 signify a strong linear relationship between the actual terminal prices of Nabil Bank's stock on different days and closing prices predicted by the linear regression model for those same days along with the straight regression line showcase high accuracy in the designed machine learning model. Tight clustering of data points around line suggests that the LR model effectively captures the underlying trend of given data sample.

Figure 7 demonstrates comparison between actual and predicted closing prices for Nabil Bank Limited over the period 2019 to 2024, where the actual prices are represented by a blue (solid) line and the predicted values by a red (dashed) line. Both lines exhibit a high degree of overlap, indicating that the predictive model closely captures the underlying patterns in stock price. A peak is observed in late 2021, where the closing price exceeds the 1600 limit, signaling a period of significant price escalation. Following this, stock enters a sharp downward trend, declining below nearly 600 by the end of 2023, reflecting a bearish phase. Proposed LR based prediction model successfully tracks these major trends, including rapid fluctuations and long-term directional movements.

A perfect alignment between actual and predicted values highlights the model's strong predictive exactness, as evidenced by its ability to replicate not only the macro trends but also the finer variations in price dynamics. This performance suggests the model's suitability for forecasting future stock price behaviors.

Figure 8 code snippet within the context LR modeling shows input features contain the values of dataset's 'Previous Close' column, serving as independent variables for the model. Dependent target variable: covers the values of 'Close' column, representing the definite closing prices to be predicted by the offered model.

Outputs (Figure 9) display the results of a linear regression model applied to predict stock prices. Model coefficient is approximately 0.997, indicating a strong linear relationship; indicates how much the predicted closing price is expected
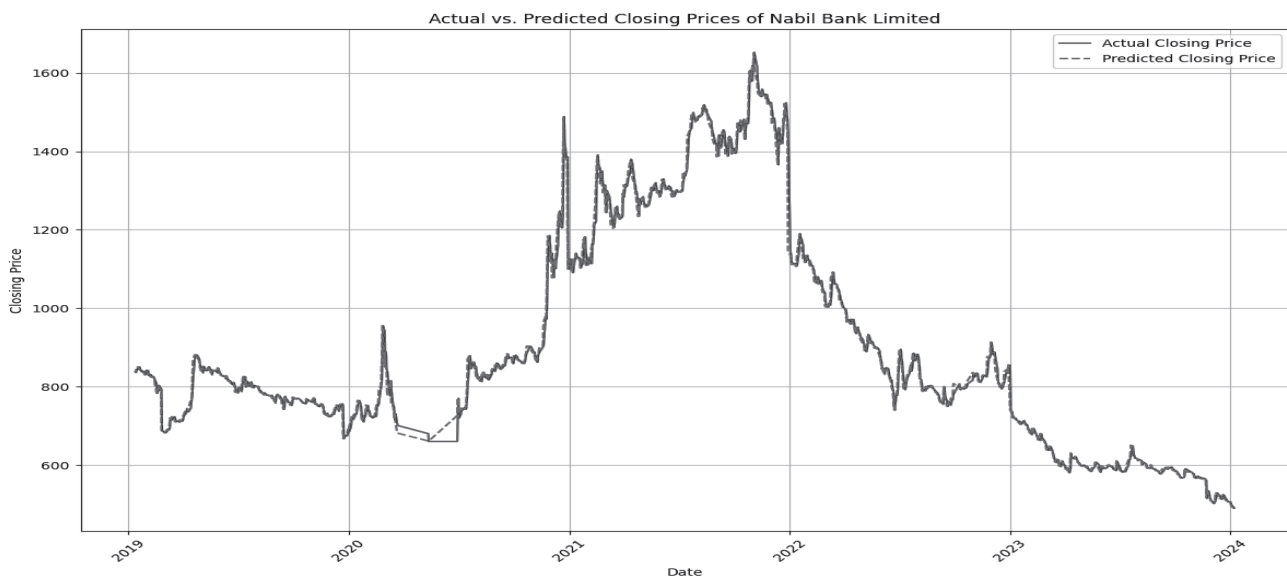

Figure 7: Actual v/s Predicted Closing Prices Analysis on Linear Regression Model Fit

```
1    # LR Model Building
2    # Prepare features and target variable
3    X = nabil_df[['Previous Close']]
4    y = nabil_df['Close']
5
6    # Model Training
7    # Split stock.csv dataset into training & testing sets
8    X_train, X_test, y_train, y_test = train_test_split
9    (X, y, test_size=0.2, random_state=42)
10
11   # Initialize and train the LR model
12   linear_model = LinearRegression()
13   linear_model.fit(X_train, y_train)
```

Figure 8: Model Building and Training

```
# Printing the model coefficients: MAE and R^2
print("Model Coefficients:", linear_model.coef_)
print("Intercept:", linear_model.intercept_)
mae = mean_absolute_error(y_test, y_pred)
print("Mean Absolute Error:", mae)
print("Coefficient of Determination:", r2)

Output:
Model Coefficients: 0.9968879
Intercept: 3.1812606825958483
Mean Absolute Error: 9.95173441454608
Coefficient of Determination: 0.9960976910894296
```

Figure 9: Linear Regression Model's Statistical Benchmarks Validation

to increase for every one-unit increment in actual price.

In a linear regression model, an intercept is a point where regression line crosses the y-axis, representing the expected value of dependent variable (y) when all independent variables (x) are zero. It serves as the baseline for predictions when the independent variables do not have any effect. Intercept value is 3.18. This implies if actual price is zero, predicted closing price starts from 3.18. Practically, this is an abstract point because stock prices are never zero but it helps define the initial point of linear relationship.

Mean Absolute Error (MAE) is a measure of how off our predictions are on average. In this case, our predictions are off by approximately 9.95 units, suggesting minimal prediction error, while Coefficient of Determination (R^2) is 0.996, indicating excellent model fit as an R^2 of 1 is like a perfect fit and here we have obtained an R2 of roughly 0.996 meaning that proposed LR model explains about 99.66% of variation. Thus LR analysis on Nabil Bank Limited's stock data demonstrated strong predictive capabilities; for instance, a high R^2 denotes that the model rendered a lot of variation in stock price predictions. Our study highlighted key trends and fluctuations in stock prices from 2019 to 2024, with notable impacts from COVID-19 era, emphasizing model's ability to capture market dynamics.

Refinements and extensions, such as incorporating real-time data and advanced machine learning algorithms, are recommended to further improve accuracy and adaptability to changing market conditions [7].

4. Synopsis and Future Directions

4.1 Concluding Remarks

Finding's analysis of Nabil Bank Limited highlights its strong financial health and long-term investment potential, with stable ROE and consistent dividend payments, but advises vigilance due to declining EPS, rising WACC, and bearish technical indicators, recommending investors adopt a wait-and-see approach while closely monitoring essential financial metrics.

Descriptive statistics and data visualization played a crucial role in understanding the dataset. Key metrics like mean values, standard deviations, and the distribution of prices were calculated, offering a comprehensive overview of the data. Graphical interpretations revealed significant trends and fluctuations in stock prices from 2019 to 2024. For instance, the stock price showed a slight decrease in early 2019, followed by low fluctuations until the end of the year. A notable upward trend was observed in 2020, peaking around 1700 in late 2021 before settling at approximately 1100 by the end of 2022 year. Impact of 2019's virus pandemic was a noteworthy factor influencing these trends, highlighting the interplay between market dynamics and external events.

Core of the proposed study was the machine learning mediated model building and training phase, where linear regression was employed to forecast future stock performance. Model validation further reinforced these findings, with statistical calculations confirming the model's accuracy and reliability. Regression coefficients indicated a significant relationship between features and predicted output, while the intercept provided a baseline prediction when all features were zero. Analysis of predicted stock prices revealed minimal variation between predicted and actual closing prices, showcasing the model's effectiveness in capturing trends and making reliable forecasts. Hence, visualization of actual versus predicted prices further confirmed the model's strong predictive capabilities.

Designed model demonstrated high efficacy implying a strong relevant and precise prediction performance. Mean Absolute Error (MAE) of approximately 9.95 units suggested a close alignment between predicted and actual values. Additionally, a measure how well given statistical model predicts an outcome i.e., Coefficient of Determination (R^2) is approximately 0.9961,

meaning the model explained about 99.61% of variation in the predicted output, highlighting its forecast robustness.

In a nutshell, this research underscores the critical integration of fundamental and technical analyses with quantitative modeling to inform investment decisions effectively. This holistic approach balances intrinsic value assessments with market-driven insights that's crucial in navigating volatile stock markets. Continued refinement and adaptation of forecasting models are essential to align with dynamic market conditions, ensuring relevance and accuracy in guiding investor strategies. By advancing forecasting methodologies and incorporating comprehensive data analysis, future research directions can further refine stock price predictions for Nabil Bank Limited and contribute to the stability and efficiency of financial markets. This multifaceted approach enhances decision-making capabilities, supporting investors in optimizing their portfolios and achieving long-term financial goals effectively.

4.2 Outlook

Future enhancements include real-time data integration, advanced machine learning techniques, sentiment analysis, and macroeconomic variables to enhance predictive models' accuracy, utility and empower investors with timely insights and informed and up-to-date investment decisions. Consistent refinement and adaptation to changing market conditions are essential to maintain the model's relevance and effectiveness in guiding investment decisions.

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