# Comprehensive Stock Market Analysis and Forecasting for PSX (Feb 2024 - Feb 2025)

## 1. Overview

This report presents an in-depth analysis of Pakistan Stock Exchange (PSX) data from February 2024 to February 2025 using statistical insights, trend analysis, volatility metrics, and predictive modeling.  
We use Linear Regression, LSTM, and MACD models to forecast stock behavior over the next 30, 60, and 90 days.  
 **Key Objectives**  
- Understanding stock behavior using historical trends.  
- Evaluating market volatility to assess investment risks.  
- Predicting future stock movements using advanced forecasting models.  
- Assessing model performance metrics to determine reliability.  
- Impact of economic, political, and market factors on stock forecasts.

## 2. Key Statistics and Market Trends

**Summary of Stock Performance**  
- Total Data Points: 247  
- Mean Stock Value: 83,958.24  
- Median Stock Value: 78,810.49 (slightly skewed distribution)  
- Standard Deviation: 16,318.50 (indicating moderate volatility)  
- Minimum Stock Price: 59,872.96  
- Maximum Stock Price:117,586.98  
  
 **Stock Value Trend Analysis**  
- Early 2024 - Mid-2024: Gradual price increase with minor fluctuations.  
- Mid-2024 - Late-2024: Strong bullish trend indicating market growth.  
- Late 2024 - Early 2025: Market correction leading to temporary price declines.

## 3. Volatility Analysis and High-Risk Periods

**Key Observations**  
- 7-day Moving Average (Short-Term Trends)  
- 30-day Moving Average (Long-Term Trends)  
- Periods of High Volatility:  
- Nov 2024: High volatility, daily fluctuations exceeded ±4%.  
 - Dec 2024: Market adjustments led to temporary high volatility.  
 - Jan 2025: Market stabilized with reduced volatility.  
  
- Volatility Threshold:

High volatility days were identified when returns exceeded 2 standard deviations above the mean.  
- Rolling 7-Day and 30-Day Volatility:\*

Increasing towards late 2024, peaking in Nov-Dec 2024, then declining into 2025.

## 4. Correlation Analysis

**Stock Market Correlation Matrix**  
- Stock Value is strongly correlated with 7-day and 30-day Moving Averages.  
- Daily Returns show low correlation: meaning fluctuations do not align with stock trends.  
- MACD is weakly correlated\*\* with moving averages, indicating momentum-based trend tracking.  
  
Important Correlation Coefficients:  
- 7-day MA & Current Price (0.9959): Almost identical to stock price movement.  
- MACD & Current Price (0.2472): Weak correlation, meaning MACD is more of a momentum signal than a price predictor.  
- MACD & 30-day MA (-0.3899):

Moderate inverse correlation, showing that MACD can signal long-term trend changes.

## 5. Predictive Modeling Techniques & Performance Evaluation

1**. Linear Regression Model**  
 Model Assumptions  
- Assumes a linear relationship between stock prices and time.  
- Ignores external macroeconomic factors.  
- Not effective in high-volatility markets.  
  
 **Performance Metrics**  
- Mean Absolute Error (MAE):4810.39  
- Mean Squared Error (MSE): 33,399,743.23  
- Root Mean Squared Error (RMSE):5779.25  
- R² Score: 0.8741 (87.41% variance explained)  
  
 **30, 60, 90-Day Forecasts**  
- March 8, 2025: 114,029.09  
- April 7, 2025: 118,317.49  
- May 7, 2025: 122,605.88  
  
 **Limitations**  
- Fails to capture non-linearity and sudden price swings.  
- Overfits in stable markets but underfits in volatile conditions.  
  
 **2. LSTM Model (Deep Learning)**  
Model Characteristics  
- Recognizes non-linear stock patterns and seasonality.  
- Effective in volatile markets.  
  
 **Performance Metrics**  
- Mean Absolute Error (MAE):\*\* 2572.21  
- Mean Squared Error (MSE):\*\* 11,932,558.22  
- Root Mean Squared Error (RMSE):\*\* 3454.35  
- R² Score: 0.9662 (96.62% variance explained)  
  
 **30, 60, 90-Day Forecasts**  
- February 7, 2025:115,861.97  
- March 8, 2025: Higher than Linear Regression  
- May 7, 2025: Higher than Linear Regression

**Limitations**  
- Requires significant computational power (GPU acceleration recommended).  
- Sensitive to hyperparameter tuning, leading to potential overfitting.  
- Cannot instantly react to economic and geopolitical shocks.  
  
 **3. MACD & Signal Line Analysis**- MACD detects trend momentum shifts.  
- Potential bearish crossovers were detected in December 2024.  
- Predictions show declining MACD values, suggesting trend slowdowns.

## 6. Impact of Economic & Political Factors on Predictions

**1. Macroeconomic Indicators**- Inflation & Interest Rates:

Sudden changes disrupt stock prices.  
-GDP Growth & Employment Data:

Affect investor sentiment.  
- Currency Fluctuations:

Exchange rate volatility impacts international investment.  
  
 **2. Political & Regulatory Events**  
- Elections

Cause market uncertainty and high volatility.  
- Government Policies:

New tax laws, trade agreements, and sanctions alter market trends.  
  
 3. Market Sentiment & News Analysis  
- High-frequency trading algorithms react instantly to market news.  
- Media-driven speculation influences buying and selling activity.

## 7. Conclusion & Investment Recommendations

**Key Takeaways**  
- Linear Regression is stable but oversimplifies market trends.  
- LSTM models provide superior predictive accuracy but require computational resources.  
- MACD helps identify market momentum shifts.  
- External economic and political factors significantly impact market behavior.  
  
 **Recommended Investment Strategy**  
- Use a Hybrid Approach:

Combine traditional stock analysis, AI-powered deep learning, and economic monitoring.  
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Short-Term Investors:

Focus on MACD signals and volatility analysis.  
- Long-Term Investors:

Use LSTM model forecasts and macroeconomic trends.  
  
**Final Thoughts**A well-balanced strategy combining data-driven forecasting, technical analysis, and real-world economic insights will maximize investment returns while managing risks.