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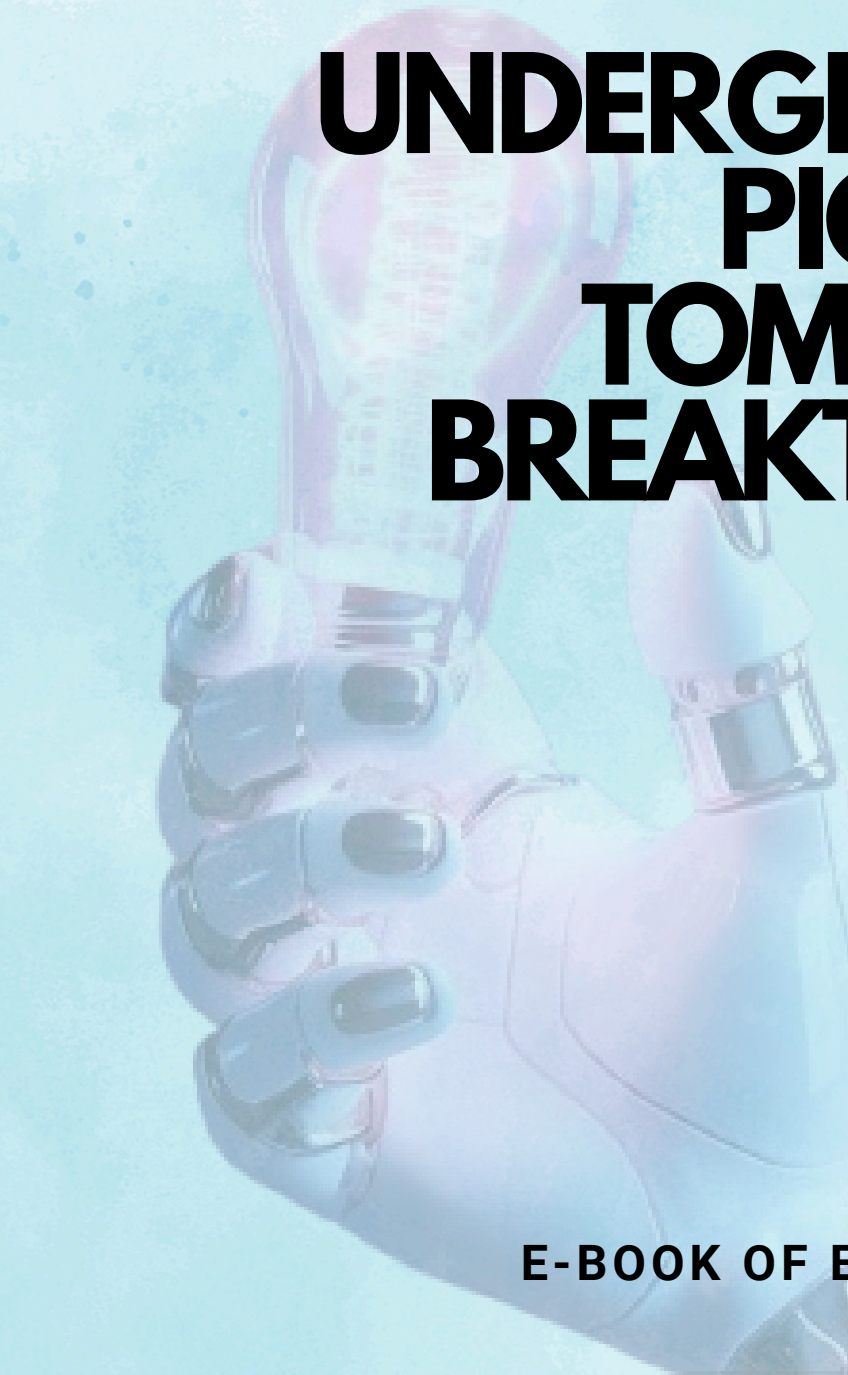

E-BOOK OF EXTENDED ABSTRACTS

FORECASTING STOCK PRICES AND EVALUATING PORTFOLIO OF OIL AND GAS COMPANIES IN MALAYSIA: A GEOMETRIC BROWNIAN MOTION MODEL

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ABSTRACT

Forecasting stock prices is crucial in guiding investors, especially in volatile industries such as oil and gas. This study employs the Geometric Brownian Motion (GBM) model to simulate short-term stock price movements of 30 oil and gas companies listed on Bursa Malaysia. The companies were categorised into five portfolios using Altman Z-scores to reflect financial stability. Historical daily closing prices over two months were analysed and forecast accuracy was validated using Mean Absolute Percentage Error (MAPE), Mean Square Error (MSE), and Mean Absolute Deviation (MAD). The results show that Portfolio 5 achieved the highest projected return of 18.01%, making it the most suitable for investment, while Portfolio 1 recorded a negative return of –7.38%. Forecast accuracy validation further revealed that Portfolio 2 produced the most reliable results with the lowest error values, while Portfolio 5, despite its profitability, exhibited weaker accuracy due to the volatility of certain stocks. These findings demonstrate that the GBM model is an effective tool for short-term forecasting and portfolio evaluation, supporting better risk-informed decision-making in Malaysia's oil and gas sector.

Keywords: Geometric Brownian Motion, Stock Forecasting, Portfolio Evaluation, Altman Z-Score, Oil and Gas Sector

INTRODUCTION

The stock market serves as a vital platform for investors to generate returns, however, its inherent volatility poses substantial risks, especially within the Malaysian oil and gas sector, which is highly sensitive to global shocks (Rahim & Liwan, 2024). Due to mitigate these risks, investors rely on effective forecasting and portfolio management strategies (Dai, 2021). While traditional methods like ARIMA and exponential smoothing have been used widely, they are often not great at capturing the random behaviour of volatility stock prices (Mallikarjuna & Rao, 2019).

The Geometric Brownian Motion (GBM) model has become a standard tool in financial mathematics (Abidin & Jaafar, 2012). The GBM model captures both the predictable drift and the random volatility of stock prices, making it very effective for short term forecasting. However, there is a lack of research that applied the GBM model to forecast the collective performance of a portfolio rather than just an individual stocks.

This study addressed this gap by introducing a novel, two step approach, by first using the Altman Z -score to classify 30 oil and gas companies into five portfolios based on their financial stability. Second, applying the GBM model to forecast the future returns for each of these constructed portfolios. This integrated methodology allows this study to evaluate not only which portfolio is likely to yield the highest future

return, but also to analyse the relationship between financially stable portfolios and evaluate both profitability and forecast accuracy.

METHODOLOGY

Daily closing prices of 30 oil and gas companies listed on Bursa Malaysia were collected over a period of two months. Financial ratios required for Altman Z-score calculation were also obtained from company financial statements. The Altman Z-score model was employed to classify the stocks into five groups as portfolio. The Z-score is calculated as follows (Singh & Singla, 2019):

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5 \quad (1)$$

where X_1 is working capital per total assets, X_2 is retained earnings per total assets, X_3 is EBIT per total assets, X_4 is market value equity per total liabilities, and X_5 is sales per total assets. Stocks were then assigned to five portfolios representing varying levels of financial stability.

For stock price forecasting, the GBM model was applied. GBM assumes that stock prices follow a stochastic differential equation (SDE), where S_t represents the the stock price at time t, μ is the drift rate (expected return), σ is the volatility, and W_t is a Wiener process.

$$dS_t = \mu S_t dt + \sigma S_t dW_t \quad (2)$$

The analytical solution of this SDE is:

$$S_t = S_t \, exp\left(\left(\mu - \frac{1}{2}\sigma^2\right)t + \sigma W_t\right) \quad (3)$$

Forecast accuracy was measured using three error metrics. Mean Absolute Percentage Error (MAPE) was computed as,

$$MAPE = \frac{100}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right| \quad (4)$$

Meanwhile Mean Square Error (MSE) and Mean Absolute Deviation (MAD) were defined as

$$MSE = \frac{1}{n}\sum_{t=1}^{n}(A_t - F_t)^2 \quad (5)$$

$$MAD = \frac{1}{n}\sum_{t=1}^{n}|A_t - F_t| \quad (6)$$

where F_t is the price of a stock at time, t and A_t is actual stock price at time .

RESULTS AND DISCUSSION

The results indicate substantial variation in the performance of the constructed portfolios. Table 1 presents the percentage increment in stock prices as projected by the GBM model. Portfolio 5 achieved the highest return of 18.01%, making it the most attractive for investment, while Portfolio 1 showed a decline of 7.38%, signalling poor performance. Portfolios 2, 3, and 4 displayed stable and moderate growth with gains ranging from 5.02% to 7.22%.

Table 1: Forecast percentage increment of each portfolio based on GBM model.

Portfolio	Sum of Percentage Increment (%)	Remark
1	-7.38	Loss
2	5.07	Profit
3	7.22	Profit
4	5.02	Profit
5	18.01	Best Profit

Forecast accuracy was assessed for all stocks in the portfolios using MAPE, MSE, and MAD. For instance, PETRON achieved a MAPE of 14.05%, an MSE of 0.0285, and a MAD of 0.0295, reflecting reasonably accurate forecasts with some short-term deviations at Table 2. Other stocks in the portfolios displayed similar patterns: more stable stocks had lower error values, indicating higher reliability, whereas stocks experiencing higher volatility showed larger MAPE and MAD values, highlighting less predictable performance. Consequently, portfolios with predominantly stable stocks demonstrated stronger overall forecast accuracy, while portfolios containing more volatile stocks experienced reduced reliability in their predictions.

Table 2: MAPE, MSE, and MAD values for Petron.

ERROR	VALUE
MAPE	0.1405
MSE	0.0285
MAD	0.0295

The comparison between actual and forecasted values for PETRON, shown in Figure 1, offers additional insight into the performance of the GBM model. Over the two-week horizon, the model closely tracked actual prices, demonstrating its effectiveness in capturing short-term dynamics. However, deviations became more noticeable over longer horizons, indicating that GBM is better suited for short-term forecasting, particularly in highly volatile sectors like oil and gas.

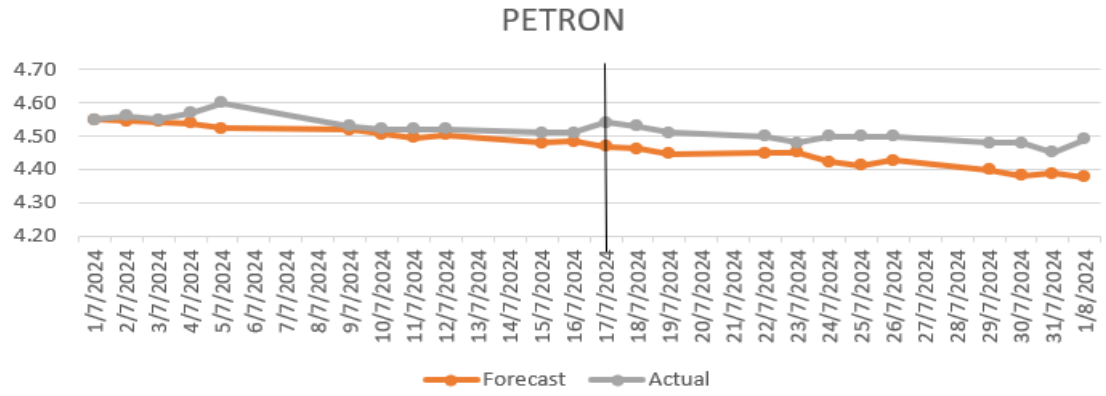

Figure 1: Actual vs. forecast stock prices for PETRON using the GBM model.

Collectively, these findings reveal a trade-off between profitability and accuracy. While Portfolio 5 offered the highest returns, it was also characterised by high volatility. In contrast, Portfolio 2 demonstrated strong accuracy, indicating that investors seeking reliability should prioritise financially stable firms, even if the expected returns are modest.

CONCLUSION

This study successfully demonstrates a novel approach to portfolio evaluation by integrating the Geometric Brownian Motion (GBM) model with the Altman Z-score. While the GBM is standard tool for forecasting individual stock prices, this study uniquely applies it to group of stocks and evaluates the results based on predefined financial stability in which this method is not explored in previous studies. The findings show

that the GBM model is a reliable approach for short-term stock price forecasting and portfolio evaluation in Malaysia's oil and gas sector. Portfolio 5, emerged as the most profitable, while Portfolio 2 was the most accurate. This demonstrates that investors should consider both potential returns and forecast reliability when making decision, particularly in volatile sectors like oil and gas. These results suggest that investors should balance profitability with forecast reliability. Future research, it is recommended to compare the performance of the GBM model with other forecasting tools to improve robustness.

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