**Project Title: Analysis of XOM Stock Prices**

**Introduction**

This report presents an analysis of the daily adjusted closing stock prices of XOM over a 6-year period. The aim is to understand the trends and patterns in the stock prices and to estimate relevant parameters to model the underlying processes.

**Objectives**

Analyse the trends and patterns in XOM stock prices. Estimate parameters for a non-linear model to describe the observed trend. Assess the presence of autocorrelation in the data. Estimate parameters for a Geometric Brownian Motion model to characterize the underlying stochastic process.

**Findings and Analysis**

The time graph of XOM prices indicates a noticeable increasing trend over the 6-year period. Autocorrelation Function (ACF) plot reveals strong positive correlations, indicating repeating patterns and seasonality in the data. The Non-linear Trend Model assumes that XOM prices follow a non-linear equation: Pt = A exp [Bt + ϑt], where ϑ ∼ N(0, σ^2).

The Estimated parameters are A = 3.7431, B = 0.0005, σ^2 = 0.0827. The Coefficient of determination (R^2) for the model is 0.399. The Durbin-Watson statistic: is 0.005 this indicates a positive autocorrelation may be present in the residuals. The Geometric Brownian Motion (GBM) Model assumes that XOM prices follow GBM: dPt = µPt dt + σPt dWt, where Wt is a Standard Wiener process. The Estimated parameters are µ = 0.00044, σ = 0.0204.

The statistical analyses conducted on the residuals of the data yield valuable insights into their properties. The autocorrelation coefficient, measuring the correlation between log returns and their lagged values, is approximately -0.0307, indicating a weak negative correlation. Basic statistics reveal that the mean of the residuals is approximately 0.00044, with a mode of 0.0 and a median of approximately 0.00029. Additionally, skewness, measuring the asymmetry of the distribution, is -0.1556, suggesting a slight left-skew. The excess kurtosis value of 5.1422 indicates heavier tails in the distribution compared to a normal distribution. Furthermore, the Shapiro-Wilk test, assessing normality, yields a test statistic of 0.9478 and a p-value of approximately 1.04e-22, leading to the rejection of the null hypothesis of normality.

**Conclusion**

The analysis indicates a clear upward trend in XOM stock prices over time. The presence of autocorrelation suggests that future prices may be influenced by past values. The estimated parameters for both the non-linear trend model and the GBM model provide insights into the underlying processes governing XOM stock prices.