Testing Normality for Daily Returns from the Nepalese Stock Market

Rashesh Vaidya¹*
Dilli Raj Sharma²
Jeetendra Dangol³

¹,²Faculty of Management, Tribhuvan University, Kathmandu, Nepal.
³Public Youth Campus, Faculty of Management, Tribhuvan University, Dhobichour, Kathmandu, Nepal.

ABSTRACT

Researchers and investors are interested in the normality of the return from the stock market and the establishment of the Efficient Market Hypothesis (EMH). Nevertheless, a statistical distribution of the normality of the return helps investors predict the stock market return with the help of the basic mean and standard deviation values of the return. Hence, the paper tested the normality of the daily returns from the Nepalese stock market, Nepal Stock Exchange Limited (NEPSE). The paper followed the statistical results and data visualization to determine the normality of the stock market return. The data visualization and statistical results have shown that the daily return from the NEPSE follows a normal distribution. The test statistics for the normality of the data also show a normal distribution for the NEPSE daily return. Similarly, the parameters for the fitted distribution also reflect normality. The daily transaction volume at the stock market normally leads the daily stock market return in normality as well. The fitting of a normal distribution for the daily returns reflects that the Nepalese investors could predict market risk and return using two statistical parameters, i.e., standard deviation and mean, respectively.

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Introduction

After the discovery of normal distribution by French Mathematician de Moivrein (1733), the distribution was first modelled by Bachelier (1900) for return from bonds. However, Pearson (1920) popularized the term ‘normal distribution; and expressed it in the form of a continuous probability density function. Nevertheless, it was Eugene Francis Fama who proposed the efficient market hypothesis (EMH) in his research paper published in 1965 where he found extreme movements in stock market return exhibiting fat tail distribution and away from an assumption of normality. Nevertheless, an assumption of stock market return normality is a basis for the EMH theory.

In context to testing the normality of daily returns from NYSE, Fama (1965) found the Paretian distribution better fitted than a normal distribution. Renwick (1968) found the outliers in frequency distribution fitted on a normal distribution.
Barnea and Downes (1973) stated the distributions of daily stock price changes for the NYSE are symmetrical. Hagerman (1978) found daily returns do not follow a stable normal distribution. Similarly, Fielitz and Rozelle (1983) discovered that NYSE daily return does convey normality.

Aparicio and Estrada (1997) tested the normality for daily returns of four Scandinavian securities markets; where the researchers found the returns best fitted on the scaled-t distribution rather than the normal distribution. Küchler et al. (1999) stated daily DAX returns are better fitted on hyperbolic distribution; rather than on normal distribution. The researcher applied the measure of dispersion, namely, skewness and kurtosis to test the normality of the daily stock market return.

Jonduea and Rocklinger (1999) found generalized Pareto distribution was better fitted than normal distribution in the context of daily returns of six Asian, six eastern European, and seven Latin American nations’ stock markets. Aparicio and Estrada (2001) found scaled-t distribution better suited for 13 European nations’ stock markets’ daily returns, while the normality was seen for the monthly returns of the respective stock markets.


Humala and Rodríguez (2013) found a deviation from normality for daily returns of the General Index of Peru. The paper found with excess kurtosis, clustered return, fat left tails, and unconditional time-varying moments for the market return while, Rodríguez (2017) found Fréchet distribution for daily returns from the Peruvian stock market. Similarly, the paper had shown an unstable negative return under the Hill estimation.

Ivanovski et al. (2015) found non-Gaussian with extremely leptokurtic for the Macedonian Stock Exchange (MSE-100) using the concept of market volatility and kurtosis. Kiragu and Mungåtu (2016) found generalized Pareto better fitted for daily returns from the Nairobi securities exchange. Iván and Zsolt (2016) found BUX daily return followed non-normality with flat-tailed. Corlu et al. (2016) found generalized lambada better fitted than the normal distribution for daily returns from nineteen stock markets around the world.

Borowski (2018) found daily returns for 65 equity indices were not fitted with normal distribution. The paper also concluded that increasing the data compression of the market returns leads to normality. Toth and Jones (2019) also found normal
distribution not a proper model for daily returns of the S&P 500, DJIA, and NASDAQ Composite. However, the Laplace distribution was seen as a better choice to fit the market’s daily returns.

While Harckbart (2019) found Laplace outperformed normal distribution for daily returns of the S&P 500, FTSE 100, Nikkei 225 & IBOVESPA. Tran et al. (2020) found leptokurtic with heavy tail better for DJIA daily returns. Similarly, Odhiambo et al (2020) modeled the returns from Nairobi Securities Exchange, where the lognormal distribution was seen better fitted than the normal distribution. Pekár and Pčolár (2022) found generalized skewed t-distribution for daily returns from 30 stock markets around the world. Hong (2022) also disclosed that the returns from the stocks and markets do not follow normality but an increase in sample size might increase the reliability of the normality test.

In the context of South Asia, Saini and Dhankar (2011) and Joshi and Tiwari (2012) found non-normality for the daily return from BSE. The paper of Joshi and Tiwari (2012) concluded that the Weibull distribution better fits the transformed log-return daily return from BSE SENSEX. Khan and Huq (2012) found daily returns from DGEN, DES 20, and DSI are not normally distributed. Dangol (2012) also found non-normality for the NESPE daily return, while testing the random walk behaviour for the Nepalese stock market. Chandrasekara and Tilakaratne (2014) found scaled t-distribution better fitted for daily returns from the Sri Lankan stock market. Ghufran et al. (2016) found non-normality for KSE-100 daily returns due to excess kurtosis and negative skewness. The paper also stated that the high volatility at KSE-100 also did not allow fitting the return from the market on the normal distribution.

Hence, the researchers became interested to know whether the return from the stock market is distributed normally or not. The reason behind this assumption is when the asset’s return follows normality; the portfolio constructed also follows normality. Similarly, if the return from the stock follows a normal distribution, an investor could predict the future return with the help of only two statistical parameters; namely, mean and standard deviation. Finally, while building a portfolio, an investor must go through the statistical dependence of returns across the stocks, but the dependencies are complex if the returns from stocks are normally distributed, the straightforward correlation coefficient between the stocks' returns could be summarized by the investor.

In context to Nepal Stock Exchange Limited (NEPSE), also the investors could able to estimate risk and return from the daily trading at NESPE floor, after determining the normality of return from the market. Hence, as stated earlier, if, the daily return from the NEPSE perfectly fit on normal distribution, with just two parameters of return, namely; mean and standard deviation of daily returns help to predict the daily market return. The investors could easily extract the daily return from the market and simply calculate two parameters, which help to determine the portfolio diversification on daily basis as well. Similarly, the calculated mean and standard deviation from normal distribution enable to represent both risk and return
within a clearly defined range. Against this backdrop, the paper tries to test the normality of the daily return from the only secondary market of Nepal, Nepal Stock Exchange Limited.

Method

The paper used the daily NEPSE Index calculated and published by the only secondary market of Nepal, Nepal Stock Exchange Limited (NEPSE). The paper considered the daily stock market return calculated from the published NEPSE daily closing index by NEPSE. Paper used a total of 5361 days return from the fiscal year 1998-99 to the end of the fiscal year 2022. The fiscal year in Nepal ends in mid-July of the Georgian calendar.

The paper followed descriptive statistics and data visualization to test the normality of the stock market's daily returns. Similarly, the paper adopted normality test statistics, *Jarque-Bera Statistics* (1987), *Shapiro-Wilk Statistics* (1965), and *Kolmogorov-Smirnov Test* (1933, 1948). The paper used the Percent versus Percent (P-P) Plot, Quartile versus Quartile (Q-Q) Plot developed by Wilk and Gnanadesikan (1968), as well as Zipf’s Plot (Log-Log Plot) developed by Zipf (1949) to visualize the test normality for the NEPSE daily return data. At the same time, a popularly known bell-shaped curve presentation termed by Jouffret (1872) has also been considered in the paper to visualize the normality of the daily returns from NEPSE.

Results

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
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<tr>
<td>Standard Error</td>
<td>0.02</td>
</tr>
<tr>
<td>Median</td>
<td>0.00</td>
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<tr>
<td>Standard Deviation</td>
<td>1.28</td>
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<tr>
<td>Sample Variance</td>
<td>1.65</td>
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<tr>
<td>Kurtosis</td>
<td>7.34</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.36</td>
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<tr>
<td>Range</td>
<td>19.45</td>
</tr>
<tr>
<td>No. of observations</td>
<td>5361</td>
</tr>
</tbody>
</table>

Table 1 shows the return from the NEPSE daily trading close to normality. The values of mean and median are seen similar with minimal differences. The NEPSE daily mean return and median return are seen 0.05 percent and nil respectively. The value of kurtosis (7.34) is also higher than 0.264 which shows more peaked than the normal distribution, termed as leptokurtic. The distribution for the NEPSE daily return is observed symmetrical as the value of skewness is closer to zero (0.36).
The paper tested the normality for the NEPSE daily returns using three widely used test statistics for testing the normality of the return data. Table 2 shows the very high value of the Jarque-Bera Statistics (JB Statistics) for the return data. The JB Statistics value is significant, justifying normality for the NEPSE daily returns. The Kolmogorov-Smirnov Test (K-S Test) also reflects normality for the NEPSE daily return which is higher than 0.05 and significant. Nevertheless, Shapiro-Wilk Statistics (SW Test) does not reflect normality for the NEPSE daily return with a p-value (0.000) less than 0.05, as this test is normally used for a small sample size of less than fifty. Among the three test statistics used, two of them verified the NEPSE daily return data fitted on a normal distribution.

Table 3 shows the estimated parameters of the NEPSE daily returns when fitted to the probability distribution function (pdf). The two major parameters, i.e., scale (σ) and location (μ) emerged to verify the return follows the normality. Hence, the best-fitted distribution for NEPSE daily return is normal.

Figure 1 depicts the histogram for the NEPSE daily return. Figure 1 clearly shows the bell-shaped formation, as stated by Jouffret (1872). Therefore, the NEPSE daily return follows the normal distribution.
Figure 2. NEPSE Daily Returns’ P-P Plot

The scatted P-P Plot for NEPSE daily return, as seen in Figure 2 is tightly patterned in ‘S-shaped’ not deviating from the 45-degree straight line. Since the scatted plot has not departed from the 45-degree straight line, the return is said to follow the normal distribution.

Figure 3. NEPSE Daily Returns’ Q-Q Plot

The perfect data is fitted on the 45 degrees of a straight line in the Q-Q plot. The ‘S-shaped’ plotted value is not highly scattered from the 45-degree straight line, therefore, the NEPSE daily returns follow the normal distribution.

Figure 4. NEPSE Daily Returns’ Zipf’s Plot

The Zipf’s Plot, also known as the Log-log plot is used to determine the power-law distribution, exponential distribution, and normal distribution for the plotted data. The curvature of the plotted graph turning towards the rank axis reflects the
normal distribution. Figure 4 clearly shows a perfect curvature turning towards the rank axis. Hence, the NEPSE daily returns follow the property of normal distribution.

**Discussion**

In the context of the Nepalese stock market, Dangol (2012) tested the normality for the daily returns from the NEPSE while testing the random walk theory. The paper did not find normality for NEPSE daily return, but the current research discovered the daily return follows normality.

Similarly, concerning other South Asian stock markets, Saini and Dhankar (2011) and Joshi and Tiwari (2012) found non-normality for the daily return from BSE. Khan and Huq (2012) also found the Bangladeshi stock market returns were away from normality. At the same time, Chandrasekara and Tilakaratne (2014) and Ghufran et al. (2016) revealed non-normality for the daily returns from the Sri Lankan and Karachi Stock Exchange respectively.

Brada et al. (1966) argued that excessive transaction numbers, i.e. trade volume also lead to the normality of the daily stock market return. Similarly, Chiόn and Véliz C. (2008) stated that the extension of the return data timeline also lead to normality. Therefore, the large set of data is assumed to follow an assumption of normality.

Samunderu and Murahwa (2021) found the kurtosis for the returns from the sampled equities are beyond the standard of normal distribution. The value of kurtosis for the respective sampled equities is either greater or less than three. Hence, a value at risk (VaR) was found to be suitable to measure the financial risk. The paper also argued that the two parameters namely; mean and standard deviation as well as measure of dispersions namely, skewness and kurtosis also help to determine the normality of the market return.

Shehadeh et al. (2022) detected outliers in the fourteen international stock markets' return which lead to impossibility of normality. An unconditional standard deviation for magnitude and severity of outliers on average also do not let the return from fitting in normal distribution. Although, the NEPSE daily returns were not seen with large numbers of extreme values, hence, normality was seen fitted for the returns.

Hence, the paper tested the normality for the daily return data set of the Nepalese stock market, NEPSE. The paper focused on the normality test as the investor wants to track the rate of returns from the stock market. For instance, if the return is best-fitted on normal distribution, investors could simplify their prediction using just two parameters of statistics, i.e., mean and standard deviation of the market return.

**Conclusions**

The statistical test and data visualization are used in the paper to test the normality of the NEPSE daily returns. The paper concluded that the daily returns from the Nepalese stock market, NEPSE follow the normal distribution. A basic graphical
representation also let an investor to go for portfolio diversification as well as to get an insight of nature of return distribution from the market. The mathematical and statistical justification of return distribution further helps investor to assure future return. Therefore, an investor could estimate the risk (i.e., standard deviation value) and return (i.e., mean value) from the daily trading at the NEPSE floor.

The normality of the daily returns from NEPSE daily trading helps an active investor on a larger scale. The paper adds a benchmark that conversions of return into log-normal to determine the distribution nature of the stock market does not lead to an accurate prediction for the future market trend. Hence, the statistical manipulation of the return data is not a correct way to predict the market but the use of statistical instruments should be applied to enhance the validity and reliability of the results. Nevertheless, the investor should not rely only on exploiting the signals from the historical data sequences but also look at other information regarding the specific stock, the market as a whole, and other factors that influence stock market fluctuation.

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