

Comparative Risk-Return Analysis of Cryptocurrencies and Indian Stock Indices: Insights for Investors in Emerging and Traditional Markets

Koutha Sridevi, Adakankar Pashupathinath

Associate Professor & Chairperson, BoS of Commerce, Department of Commerce, Mahatma Gandhi University,
Nalgonda, Telangana.

Research Scholar, Department of Commerce, Mahatma Gandhi University, Nalgonda, Telangana.

DOI: <https://doi.org/10.51583/IJLTEMAS.2025.140500111>

Received: 13 June 2025; Accepted: 16 June 2025; Published: 26 June 2025

Abstract: This study examines the risk-return profile of Cryptocurrencies compared to Indian stock Indices, BSE Sensex and Nifty 50, to identify their unique investment characteristics. By analysing data from ten major Cryptocurrencies alongside Sensex and Nifty 50, the study applies statistical measures, including mean, variance, skewness, kurtosis, Jarque-Bera (JB) test, two-sample t-test, ANOVA test and Tukey HSD test. Findings reveal that Cryptocurrencies offer higher returns but are significantly more volatile, while Indian Stock Indices provide moderate, stable returns with implications for risk-seeking versus conservative investors. The Study reveals that Cryptocurrencies are suitable for investors who can tolerate high volatility for potentially higher returns, whereas Traditional Stock Indices are better suited for those prioritising stability and consistent growth.

Keywords: Cryptocurrencies, Indian Stock Indices, Risk-Return Profile, Portfolio Diversification, Volatility, Investor Risk Tolerance

JEL Classification: G11, G15, G32, E44, C58

I. Introduction

Emerging investment alternatives have become more and more popular among investors in recent years as opposed to conventional, lower-return choices. Specifically, Cryptocurrency has gained significant attention from academics, investors, and business experts. Different governments' actions have sparked conversations about Cryptocurrencies. Some have sought to outlaw the trade, others have pushed to legitimize it. According to data, there are over 100 million Cryptocurrency traders in India, making it the largest country in the world, followed by the United States with over 27 million traders.

According to Tschorsch and Scheuermann (2016), Cryptocurrency is a digital currency based on blockchain technology that may be used as a means of trade. The year 2008 saw the launch of Bitcoin, the first Cryptocurrency, by the mysterious persona of Satoshi Nakamoto (Phillip et al., 2018). As the most well-known Cryptocurrency, Bitcoin continues to attract interest from banks, hedge funds, and investment organizations because of its substantial market capitalization (Phillip et al., 2018). Many investors in India are becoming more interested in Cryptocurrencies as a result of their rising popularity. (Jani, 2018). Cryptocurrency values are heavily influenced by psychological and economic aspects, according to Blau et al. (2021). Furthermore, studies reveal that macroeconomic factors influence the price of Cryptocurrencies (Cheng & Yen, 2020). Nonetheless, investors frequently respond inconsistently to news about prices due to the extreme unpredictability of the Cryptocurrency market (Aloosh & Ouzan, 2020).

Macroeconomic variables also exert a significant influence on the Indian stock market, which is among the fastest-growing markets globally (Keswani & Wadhwa, 2021). While Das et al. (2020) stress the influence of investor attitude on the market, Sabaliosis et al. (2021) underline the relevance of psychological variables in determining Cryptocurrency pricing. Furthermore, there is a strong correlation between the price of Bitcoin and other Cryptocurrencies (Bouri et al., 2020). It is clear from the research that psychological and economic factors influence both the stock and Cryptocurrency markets, with macroeconomic variables acting as the main source of systematic risk (Huong & Hoai, 2021).

Many investors could be in dilemma about which course to take amongst the various Investment alternatives, particularly Cryptocurrencies, the BSE SENSEX index, and the NIFTY 50 index. Scholarly research on the Comparative Performance Analysis of the Cryptocurrencies and Indian Stock Market Indices would be beneficial for investors and policymakers alike.

II. Review of Literature

(Liu & Tsyvinski, 2021) explore the unique dynamics driving Cryptocurrency returns, emphasizing their dependence on market-specific factors. Their findings highlight that demand-side dynamics significantly shape cryptocurrency markets.

(Borri, 2019) investigates the conditional tail-risk in the markets for bitcoin, ether, ripple, and litecoin using CoVaR. The study reveals that while these Cryptocurrencies are highly exposed to tail-risk within the crypto market, they exhibit minimal tail-risk connection to global assets such as U.S. equities or gold.

The recent literature provides a nuanced view of Cryptocurrency markets, examining their volatility, investor behaviour, and interaction with traditional financial markets. (Akyildirim et al., 2020) explore the connection between volatility in European and American financial markets, represented by the VSTOXX and VIX indices, and Cryptocurrency price volatility. They find that during periods of high market stress, Bitcoin's volatility positively correlates with traditional market volatility. Similarly, Aloosh and Ouzan (2020) investigate Cryptocurrency price behaviour through a behavioural economics lens, revealing an irrational market tendency where investors exhibit a "small-price bias," with lower-priced Cryptocurrencies experiencing higher volatility due to varying investor responses to news based on asset price.

In a complementary study, (Bouri et al., 2020) identifies significant jump activity within Cryptocurrency returns, with notable co-jumping behaviour among assets like Ripple, Bitcoin, and Litecoin, except for Ripple and Bitcoin. Cheng and Yen (2020) examine the impact of economic policy uncertainty (EPU) on Cryptocurrency returns, finding that China's EPU index is predictive of Bitcoin's monthly returns but no other Cryptocurrencies.

Further insights into risk dynamics are provided by (Choi et al., 2020), who explore systemic risk within equity markets, using empirical pricing models and the portfolio-mimicking approach. Their findings suggest that systemic risk factors are priced into the market, with investors demanding higher returns for assuming systemic risks. Corbet et al. (2020) add to the macroeconomic perspective, assessing how news sentiment affects Bitcoin returns.

In the Indian context, (Keswani & Wadhwa, 2021) examine the influence of macroeconomic factors on stock market performance, identifying strong long-term relationships between stock prices and indicators. Similarly, Lahiani et al. (2021) analyse the link between Cryptocurrency and Stock Market Returns in BRICS nations and developed countries. Using a nonparametric cumulative dependence measure, they find that indices like the S&P 500, Nasdaq, and DAX 30 can predict stock market returns.

(Malladi & Dheeriyaa, 2021) explore the speculative appeal of Cryptocurrencies through time series analysis. Finally, Jani (2018) provides a broader overview, examining the role of information and communication technology in Cryptocurrency adoption across 21 countries. The study particularly addresses the regulatory environment in India, showing how evolving regulations influence the adoption and legal treatment of Cryptocurrencies.

(Bhandari, 2023) provides an in-depth analysis of Cryptocurrencies as an emerging investment asset class, comparing them with conventional investment vehicles such as stocks, bonds, and real estate. Employing a mixed-methods approach with both primary data and secondary data, the research offers valuable insights into how Cryptocurrencies fit into modern investment portfolios.

In a related study, (Neelam et al., 2023) focus on the relationship between Cryptocurrencies and Indian Stock Indices (SENSEX and NIFTY) over five years (2018-2023). Using statistical tools like t-Tests and Multiple Correlation analysis, the research investigates the correlation and associated risks between these assets. The findings indicate significant value fluctuations in Cryptocurrencies compared to Stock Indices and reveal a positive correlation between the two.

(Wuthisatian, 2022) examines the relationship between Cryptocurrencies and Market Indices using the dynamic conditional correlation (DCC) model. The study finds that, contrary to existing literature, Cryptocurrencies and market indices often move together, limiting diversification benefits.

The study (Comparing Cryptocurrency Indices to Traditional Indices, n.d.) examines the dynamics of Cryptocurrency indices and their implications for index methodologies. Using CRIX and a Total Market Index for Cryptocurrencies, it finds that Crypto indices exhibit strong negative skewness, asymmetry, and significant volatility clustering. Similar traits are seen in equity indices (DAX, CDAX, S&P 500, Wilshire 5000), but to a lesser extent.

Research Gap

An in-depth examination of the Cryptocurrency literature provides valuable insights into the unique risk-return characteristics of Cryptocurrencies in various countries, portfolio diversification opportunities, and challenges associated with market inefficiencies. Despite these extensive examinations, there are still a number of unsolved concerns about the risk-return analysis of the Indian Cryptocurrency business.

Objective of The Study and Hypothesis of The Study

Objective of the study:

To make a comparative risk-return analysis of Cryptocurrencies with BSE Sensex and Nifty 50.

Hypotheses of the Study

H₀: There is no significant difference between the performance of the Cryptocurrencies and the market indices (Nifty 50 and BSE Sensex).

H₁: There is a significant difference between the performance of the Cryptocurrencies and the market indices (Nifty 50 and BSE Sensex).

III. Research Methodology

Both exploratory and descriptive research approaches are used in this study. Furthermore, the study is based on empiricism, using carefully examined facts and inferences from pertinent books and periodicals. Purposive sampling is the sampling strategy used in this study. The interpretation of the mean, median, skewness, and kurtosis are all included in the data analysis. Jarque-Bera (JB) test is used to test the normality of the data and a two-sample t-test, ANOVA test and Tukey HSD test is used to test hypotheses. MS Excel program is used for analysis; it was used to do the JB test, a two-sample t-test, ANOVA test and Tukey HSD test and calculate the mean, median, mode, skewness, and kurtosis.

Data Analysis

Ten Cryptocurrencies and two Market Indices are selected for the comparison based on the risk-return analysis. The data has been collected from the Investing.com India website. For Cryptocurrencies 7 years data from 2017-18 to 2023-24 is collected based on availability. Matching data of BSE Sensex and Nifty 50 for the same time period is considered. Table 1 shows the risk-return analysis of the select ten Cryptocurrencies.

**Table 1: DESCRIPTIVE STATISTICAL ANALYSIS OF THE
SELECT TEN CRYPTOCURRENCIES**

Type of Crypto currency	Mean	Median	Standard Deviation	Kurtosis	Skewness
Bitcoin	68.06	60.04	77.25	-0.17	-0.63
Ethereum	91.65	6.24	184.83	-0.35	1.10
BNB	-7.21	-7.21	23.16	-	-
Solana	-4.86	-4.86	90.93	-	-
Bitcoin Cash	24.95	34.79	85.089	-1.81	0.07
Litecoin	29.85	21.58	60.84	-0.44	-0.07
Monero	9.63	0	61.32	-0.35	0.94
Maker	3.735	3.735	87.68	-	-
Ethereum Classic	69.56	-26.255	236.1	5.77	2.39
Neo	34.21	39.58	76.37	1.45	-0.04

Source: Data Compiled from investing.com and analysed

Bitcoin's average return of 68.06 suggests generally positive performance, but the median return of 60.04 hints that a few high values likely raised the mean. With a high standard deviation of 77.26, Bitcoin's returns fluctuate substantially. The slightly negative kurtosis (-0.17) suggests fewer extreme outliers, while the left-skewed distribution (-0.64) implies more frequent small losses than large gains. Ethereum, achieving the highest average return at 91.65, shows extremely high volatility with a standard deviation of 184.83. The very low median (6.24) indicates that high returns are rare, and negative kurtosis (-0.35) implies fewer extremes despite significant fluctuations; its positive skew (1.10) suggests infrequent but large gains.

BNB has a negative mean return of -7.21, and both mean and median align, reflecting consistent losses. Its volatility is moderate (23.16), lower than Bitcoin or Ethereum. Solana similarly shows negative returns (-4.86), with high volatility (90.93) comparable to Bitcoin. Bitcoin Cash's positive mean (24.96) and a higher median (34.79) suggest regular positive returns with some large losses. High volatility (85.09) and minimal skew (0.07) imply a near-symmetrical return distribution. Litecoin, with a mean of 29.85, exhibits occasional high returns, pulling up the average, and shows moderate volatility (60.84) with slight negative kurtosis (-0.44) and minimal skewness (-0.07), indicating a balanced distribution.

Monero's modest average return (9.64) and median of zero imply mostly small or negative returns, with rare large gains as shown by positive skewness (0.94). Maker's average return is low (3.74) but highly volatile (87.69), suggesting a relatively flat performance with wide fluctuations. Ethereum Classic's high mean return (69.57) contrasts with its negative median (-26.26), indicating that large gains are rare but highly impactful; it has the highest volatility (236.10), high positive kurtosis (5.77), and strong positive skewness (2.39). Neo, with an average return of 34.22 and a median of 39.58, shows generally positive returns and high volatility (76.38), with slight positive kurtosis (1.45) and near-zero skewness (-0.05), suggesting balanced return fluctuations.

The analysis highlights the high volatility of all Cryptocurrencies, with Ethereum, Bitcoin, and Ethereum Classic standing out as particularly volatile, making them highly speculative assets. In terms of return distribution, most Cryptocurrencies exhibit either positive or neutral skewness, meaning that while large losses are possible, they are often balanced or offset by rare but significant gains. However, this also suggests that extreme outcomes, both positive and negative, are common. When it comes to risk, Cryptocurrencies such as Ethereum Classic and Ethereum present a higher level of risk due to their elevated standard deviation and extreme kurtosis, signalling more frequent and unpredictable price swings. For investors, this volatility implies the need for caution, particularly with assets like Ethereum Classic, which, while offering the potential for high returns, also carries a significant risk of loss.

Table 2: DESCRIPTIVE STATISTICAL ANALYSIS OF THE SELECT TEN CRYPTOCURRENCIES, BSE SENSEX AND NIFTY 50

Type of investment	Mean	Median	Standard Deviation	Kurtosis	Skewness
Cryptocurrencies	170.96	141.15	184.48	-1.07	0.67
BSE Sensex	14.057	11.03	11.18	2.93	1.64
Nifty 50	13.75	8.27	12.37	2.77	1.66

Source: Data compiled from investing.com and analysed

Table 2 provides the risk-return analysis of three investment options: Cryptocurrencies, BSE Sensex, and Nifty 50. Cryptocurrencies have a mean of 170.97 and a median of 141.15, with the mean being significantly higher than the median. This indicates the presence of outliers or extreme values that inflate the average. In contrast, BSE Sensex has a mean of 14.06 and a median of 11.03, while Nifty 50 has a mean of 13.75 and a median of 8.27. Both stock indices exhibit a smaller gap between the mean and median, though Nifty 50 shows a more pronounced skew compared to Sensex, suggesting higher variability in returns.

The standard deviation highlights the level of dispersion in the data. Cryptocurrencies exhibit a high standard deviation of 184.49, reflecting their inherent volatility and wide-ranging values. On the other hand, BSE Sensex and Nifty 50 have much lower standard deviations, 11.18 and 12.38 respectively, signifying more stable performance with less variability in returns. Among the Stock Indices, Nifty 50 has slightly higher variability than Sensex but remains significantly more stable compared to Cryptocurrencies.

The kurtosis further differentiates these investments. Cryptocurrencies have a negative kurtosis of -1.07, indicating a flatter, platykurtic distribution with fewer extreme values than a normal distribution. In contrast, BSE Sensex and Nifty 50 exhibit positive kurtosis values of 2.94 and 2.78, respectively, suggesting leptokurtic distributions characterized by sharper peaks and a tendency for extreme values.

Finally, skewness values provide insights into the asymmetry of the data distributions. Cryptocurrencies have a moderate positive skew of 0.68, suggesting a slight tail toward higher values without excessive skew. However, BSE Sensex (1.65) and Nifty 50 (1.67) show strong positive skewness, indicating that their distributions are heavily influenced by a few higher outliers, with the majority of values clustered at lower levels.

Jarque-Bera (JB) test

JB test is commonly used in research to test for the normality of a dataset. This test checks if sample data has skewness and kurtosis matching a normal distribution. This will help researchers determine whether they can reasonably assume normality in their data. Table 3 shows the JB test results and the later part shows the analysis of the same.

Table 3: JB Test Results

Type of Investment	Mean	Median	Standard Deviation	Kurtosis	Skewness	Jarque Bera Statistic	p-Value
Cryptocurrencies	170.96	141.15	184.48	-1.07	0.67	0.37	0.83
BSE Sensex	14.05	11.03	11.18	2.93	1.64	0.52	0.76
Nifty 50	13.75	8.27	12.37	2.77	1.66	0.41	0.81

Source: Data compiled from investing.com and analysed

The Jarque-Bera (JB) test results indicate that the distributions of Cryptocurrencies, BSE Sensex, and Nifty 50 do not significantly deviate from normality. For Cryptocurrencies, the JB statistic of 0.3708 and a p-value of 0.8308 suggest that the null hypothesis,

which assumes the data follows a normal distribution, cannot be rejected. The skewness of 0.6796 reflects a moderate positive skew, while the kurtosis of -1.0705 indicates a platykurtic distribution, meaning the distribution is flatter than a normal curve. Despite these deviations, the high p-value confirms that Cryptocurrencies' data distribution is sufficiently close to normal.

For the BSE Sensex, the JB statistic is 0.5268 with a p-value of 0.7684, again supporting the null hypothesis of normality. The data exhibits a stronger positive skewness of 1.6466, and the kurtosis is 2.9366, close to the normal value of 3, indicating sharper peaks but without extreme deviations. This suggests that while there is some skewness, the overall distribution remains reasonably normal.

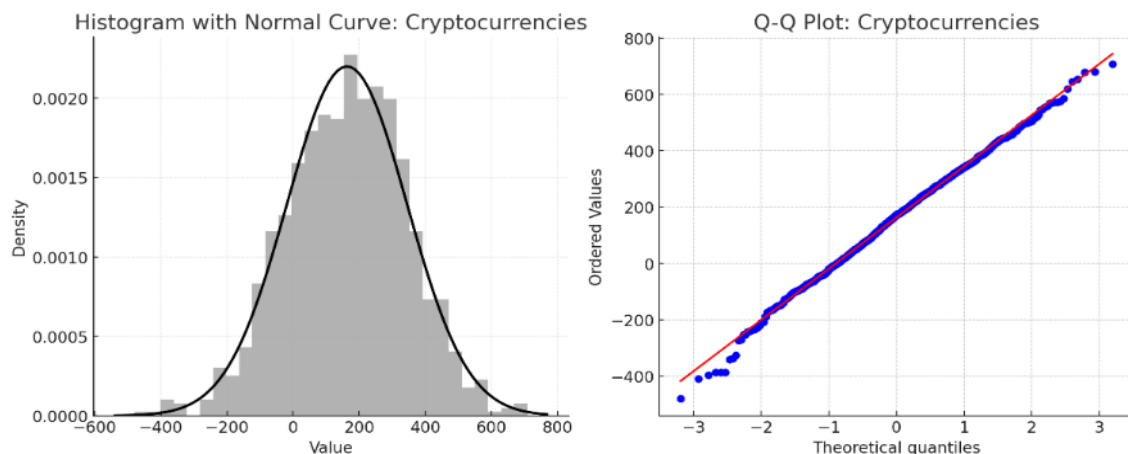
Similarly, the Nifty 50 has a JB statistic of 0.4198 and a p-value of 0.8106, indicating no significant departure from normality. The skewness of 1.6681 reveals a pronounced positive skew, similar to the Sensex, while the kurtosis of 2.7752 shows a leptokurtic distribution, implying sharper peaks but not extreme outliers. Despite these characteristics, the data is sufficiently normal for analytical purposes.

Normality analysis: Histograms with normal curves with Normal Curves Q-Q plots

Figure 1 shows the Normality of the Cryptocurrencies, Figure 2 shows the Normality of the BSE Sensex and Figure 3 shows the Normality of the Nifty 50 in the graphical format.

The analysis of the normality curves, histograms with normal curves, and Q-Q plots for Cryptocurrencies, BSE Sensex, and Nifty 50 reveals distinct characteristics in the distribution of each of the investment type.

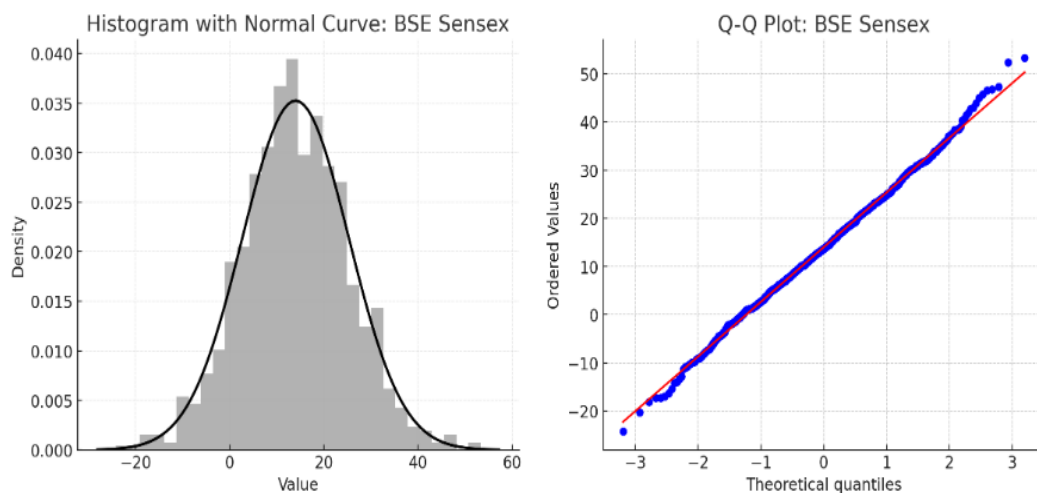
Figure 1: Graphical representation of the Normality of the Cryptocurrencies.



Source: Data compiled and analysed by the researcher

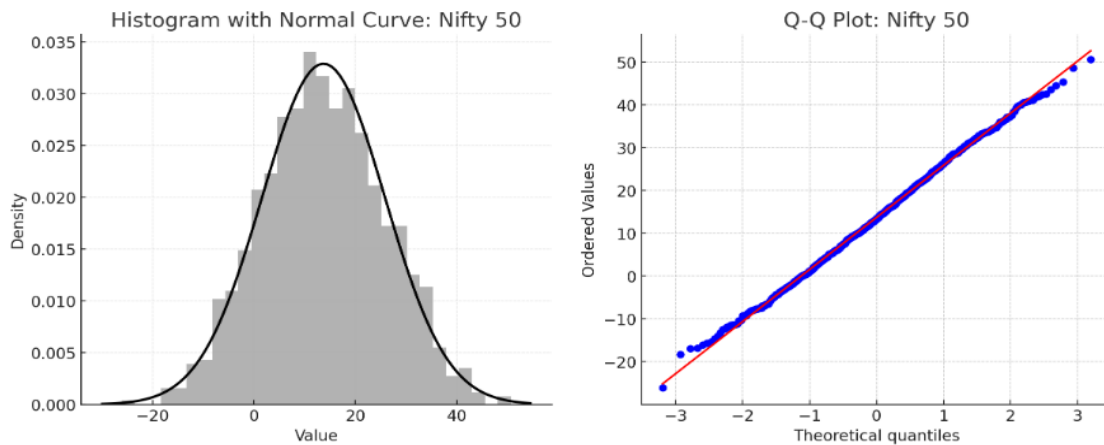
Source: Data compiled and analysed by the researcher

Figure 2: Graphical representation of the Normality of the BSE Sensex



Source: Data compiled and analysed by the researcher

Figure 3: Graphical representation of the Normality of the Nifty 50



Source: Data compiled and analysed by the researcher

The analysis of the histogram with the normal curve and the Q-Q plot for Cryptocurrencies indicates that the data is approximately normally distributed. The histogram displays the distribution of Cryptocurrency values with a black normal curve overlaid. The distribution appears symmetric, with most data points concentrated around the mean and tapering off toward the tails. The close alignment of the histogram bars with the normal curve suggests that the data reasonably adheres to a normal distribution, although slight deviations in the tails might indicate mild skewness or kurtosis.

Similarly, the Q-Q plot, which compares the ordered values of Cryptocurrency data against the theoretical quantiles of a normal distribution, shows that most points lie closely along the red diagonal line. This indicates a strong alignment with normality. However, there are slight deviations at the extreme ends (tails), where a few points deviate from the diagonal. This suggests potential minor departures from normality in the tails, possibly due to light skewness or outliers.

The histogram illustrates the distribution of BSE Sensex values, with a normal curve (black line) superimposed. The data appears symmetric and closely follows the bell-shaped curve, with most values clustered around the mean and tapering off toward the tails. The alignment between the histogram bars and the normal curve indicates that the BSE Sensex data aligns well with a normal distribution, with minimal visible deviations. Similarly, the Q-Q plot compares the ordered BSE Sensex values against the theoretical quantiles of a normal distribution. Most points lie closely along the red diagonal line, suggesting that the data fits well with a normal distribution. However, slight deviations are observed at the extreme ends (tails), particularly on the upper end, where a few points deviate from the line, possibly indicating mild outliers or light skewness in the tails. Overall, the BSE Sensex data is approximately normally distributed, as evidenced by the close alignment of both the histogram and the Q-Q plot. The minor deviations at the tails are not significant enough to invalidate the assumption of normality but should be noted for analyses sensitive to extreme values, such as statistical tests or outlier detection.

The histogram represents the distribution of Nifty 50 values, with a normal curve (black line) superimposed. The distribution is symmetric and closely follows a bell-shaped curve, with the majority of the data concentrated near the mean and tapering off toward the tails. The close alignment of the histogram bars with the normal curve suggests that the Nifty 50 data adheres well to a normal distribution, with no significant visual deviations. Similarly, the Q-Q plot compares the ordered Nifty 50 values to the theoretical quantiles of a normal distribution. Most points align closely along the red diagonal line, indicating a strong fit to a normal distribution. However, there are minor deviations at the extreme ends (tails), where a few points slightly deviate from the diagonal, which may suggest mild skewness or the presence of minor outliers at the extremes. Overall, the Nifty 50 data is approximately normally distributed, as supported by the histogram's alignment with the normal curve and the Q-Q plot's adherence to the diagonal line. The minor deviations at the tails are not significant enough to invalidate the assumption of normality but may be relevant for analyses sensitive to extreme values, such as those involving tail behaviour. As the JB test revealed that the data is normally distributed we use t-Test to test hypothesis.

Table 4 shows the comparative performance of Cryptocurrencies and BSE Sensex.

Table 4: t-Test results of the Cryptocurrencies & BSE Sensex (Unequal Variances)		
Particulars	Cryptocurrencies	BSE Sensex
Mean	170.96	14.05
Variance	34035.19	125.03
Observations	7	7

Hypothesized Mean Difference	0	
Degrees of freedom	6	
t Stat	2.24	
P(T<=t) one-tail	0.032	
t Critical one-tail	1.94	
P(T<=t) two-tail	0.065	
t Critical two-tail	2.44	
Source: Data compiled and analysed by the researcher		

The statistical analysis compares the returns of Cryptocurrencies and the BSE Sensex using a two-sample t-test assuming unequal variances. Cryptocurrencies have a mean return of 170.97 with a variance of 34,035.20, while the BSE Sensex has a mean return of 14.06 with a variance of 125.03. This indicates that Cryptocurrencies not only have much higher average returns but also exhibit significantly greater variability compared to the BSE Sensex. Both groups have an equal number of observations, with 7 data points each. The null hypothesis assumes no difference in the average returns of Cryptocurrencies and the BSE Sensex. The test statistic is calculated as 2.246 with 6 degrees of freedom, representing the standardized difference between the sample means. In the one-tailed test at a 5% significance level, the p-value of 0.03289 is less than 0.05, and the t-statistic exceeds the critical value of 1.943. This result is statistically significant, leading to the rejection of the null hypothesis and suggesting that Cryptocurrencies have significantly higher returns than the BSE Sensex. In contrast, the two-tailed test at the same significance level yields a p-value of 0.06579, which is greater than 0.05, and the t-statistic does not exceed the critical value of 2.447. Consequently, the results are not statistically significant, and we fail to reject the null hypothesis, indicating insufficient evidence to conclude a significant difference in mean returns in either direction. Overall, while the one-tailed test supports the hypothesis that Cryptocurrencies outperform the BSE Sensex, the two-tailed test suggests the evidence is not strong enough to confirm any significant difference in mean returns at the 5% level. Additionally, Cryptocurrencies are characterized by higher potential returns but much greater volatility compared to the BSE Sensex.

Table 5 shows the comparative performance of Cryptocurrencies and NIFTY 50.

Table 5: t-Test results of the Cryptocurrencies & Nifty 50 (Unequal Variances)		
Particulars	Cryptocurrencies	Nifty 50
Mean	170.96	13.75
Variance	34035.19	153.2
Observations	7	7
Hypothesized Mean Difference	0	
df	6	
t Stat	2.249	
P(T<=t) one-tail	0.032	
t Critical one-tail	1.94	
P(T<=t) two-tail	0.065	
t Critical two-tail	2.44	
Source: Data compiled and analysed by the researcher		

The analysis compares the mean returns of Cryptocurrencies and Nifty 50, revealing that Cryptocurrencies have a much higher average return (170.97) compared to Nifty 50 (13.75), suggesting greater potential profitability. However, Cryptocurrencies also exhibit significantly higher variance (34,035.20) than Nifty 50 (153.21), indicating greater volatility and variability in returns. With both groups having the same sample size of 7 observations, the analysis assumes a hypothesized mean difference of 0, meaning the null hypothesis assumes no difference in average returns between the two groups. The degrees of freedom for the test is 6. The t-statistic of 2.25 measures the observed difference in means relative to data variability. For a one-tailed test at a 5% significance level, the p-value (0.0327) is less than 0.05, and the t-statistic exceeds the critical value (1.943), allowing us to reject the null hypothesis and conclude that Cryptocurrencies have significantly higher average returns than Nifty 50. However, for a two-tailed

test, the p-value (0.0655) is greater than 0.05, and the t-statistic does not exceed the critical value (2.447), leading us to fail to reject the null hypothesis, indicating insufficient evidence to conclude a significant difference in either direction. Overall, while Cryptocurrencies show potential for higher returns, their significantly greater risk must also be considered. The one-tailed test supports Cryptocurrencies' higher returns, but the two-tailed test suggests this conclusion is not definitive when considering both directions of potential differences.

Table 6: ANOVA test results of the Cryptocurrencies, BSE Sensex and Nifty 50

SUMMARY						
Groups	Count	Sum	Average	Variance		
Cryptocurrencies	7	1196.78	170.96	34035.2		
BSE Sensex	7	98.4	14.057	125.03		
Nifty 50	7	96.28	13.75	153.2		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	115121.11	2	57560.55	5.032	0.018	3.55
Within Groups	205880.6	18	11437.81			
Total	321001.71	20				
Source: Data compiled and analysed by the researcher						

The summary statistics show that Cryptocurrencies have the highest average return, followed by the BSE Sensex and Nifty 50. Cryptocurrencies have an average return of 170.97, significantly higher than the BSE Sensex (14.06) and Nifty 50 (13.75). However, Cryptocurrencies also exhibit much higher variance (34,035.2), indicating greater volatility compared to the BSE Sensex (125.03) and Nifty 50 (153.21), which suggests higher risk associated with this investment.

The ANOVA test reveals that there is a statistically significant difference in the average returns of Cryptocurrencies, BSE Sensex, and Nifty 50 at the 5% significance level. The F-statistic of 5.0325 exceeds the critical value of 3.55, and the p-value (0.01836) is less than 0.05, leading us to reject the null hypothesis that all group means are equal. This suggests that at least one of the investment options has a significantly different average return compared to the others. However, ANOVA does not specify which groups differ, so further analysis with a post-hoc test, such as Tukey's HSD, would be necessary to identify exactly which pairs of groups have significantly different mean returns.

Table 7: Tukey HSD test results of the Cryptocurrencies, BSE Sensex and Nifty 50

Group 1	Group 2	Mean Difference	Tukey's HSD Statistic	Significant
Cryptocurrencies	BSE Sensex	156.91	2.74	No
Cryptocurrencies	Nifty 50	157.21	2.75	No
BSE Sensex	Nifty 50	0.3	0.01	No
Source: Data compiled and analysed by the researcher				

The detailed analysis of the Tukey HSD test reveals interesting insights into the differences between the groups. For the comparison between Cryptocurrencies and BSE Sensex, the mean difference is 156.91, indicating that, on average, Cryptocurrency values are significantly higher than BSE Sensex values. However, the Tukey's HSD statistic of 2.74 falls below the critical threshold for significance, meaning the difference is not statistically significant. This is likely due to the high variability (standard deviation) within the Cryptocurrency group. Similarly, for Cryptocurrencies versus Nifty 50, the mean difference of 157.21 also shows much higher average values for Cryptocurrencies. However, the HSD statistic of 2.75, like the previous comparison, is below the critical threshold, indicating no significant difference. Again, this reflects the high variability in Cryptocurrencies, which diminishes the confidence in detecting meaningful differences despite the large mean disparities.

In contrast, the comparison between BSE Sensex and Nifty 50 reveals a mean difference of only 0.30, showing that the two stock indices are nearly identical on average. The extremely low HSD statistic of 0.01 confirms the small difference and indicates no significant difference between the groups. This reflects their closely related market behaviours and distribution characteristics.

From these results, several key insights emerge. Although Cryptocurrencies exhibit much higher mean values than both BSE Sensex and Nifty 50, the differences are not statistically significant due to the high variability within the Cryptocurrency group. This suggests that variability plays a crucial role in making significant differences despite large mean disparities. On the other hand, the small mean difference and negligible HSD statistic between BSE Sensex and Nifty 50 confirm that the two stock indices are statistically similar, highlighting their consistent and closely aligned market performance.

IV. Result and Discussion

The descriptive analysis highlights key distinctions between Cryptocurrencies and Stock Indices. Cryptocurrencies, with a mean return of 170.97, offer significantly higher returns compared to traditional stock indices but exhibit extreme volatility, as reflected by their high variance of 34,035.20. Notably, Ethereum and Ethereum Classic stand out as key outliers, displaying elevated returns alongside pronounced skewness and kurtosis, indicative of sporadic but impactful gains or losses. This distribution underscores the inherent risk of extreme price swings and non-uniform return behaviour across different cryptocurrencies.

In contrast, Stock Indices such as the BSE Sensex (mean: 14.06) and Nifty 50 (mean: 13.75) provide stable performance with much lower volatility. Both indices exhibit leptokurtic distributions, characterized by sharp peaks and occasional outliers, while closely aligning with normality assumptions, indicating fewer extreme fluctuations in returns.

Statistical testing further reveals important insights. Normality tests, including the Jarque-Bera (JB) test, confirm sufficient adherence to normal distribution for Cryptocurrencies and Stock Indices alike. Cryptocurrencies display moderate skewness (0.68) and platykurtic behaviour (-1.07), whereas Stock Indices show strong positive skewness (~1.65) and leptokurtic traits (~2.9). A two-sample t-test comparing Cryptocurrencies to BSE Sensex reveals significant results in a one-tailed test ($p = 0.03289$), supporting higher returns for Cryptocurrencies, but not in a two-tailed test ($p = 0.06579$), indicating insufficient evidence for conclusive differences in both directions. Similar results were observed for Cryptocurrencies versus Nifty 50.

ANOVA Results reveal significant differences in mean returns across groups ($F = 5.0325$, $p = 0.01836$). Tukey's HSD test shows high mean differences (~156) between Cryptocurrencies and stock indices; however, the substantial variability within Cryptocurrencies limits statistical significance. In contrast, BSE Sensex and Nifty 50 demonstrate nearly identical performance, with a negligible mean difference of 0.30 and an insignificant HSD value.

V. Conclusion

While Cryptocurrencies promise higher returns, their volatility and susceptibility to extreme events pose significant risks. Indian Stock Indices offer a steadier performance, making them reliable for conservative investment strategies. Investors must weigh these trade-offs based on their financial goals and risk tolerance. Further studies could refine these findings by including post-hoc tests and exploring additional macroeconomic or psychological factors impacting these markets.

Limitations of The Study

The study has a few limitations that must be acknowledged. First, it is confined to a specific set of Cryptocurrencies and Indian Stock Indices, potentially missing broader trends and nuances present in global markets. Additionally, the analysis is based on a specific time frame, which may overlook long-term trends, market cycles, or structural changes affecting returns and volatility. Key macroeconomic variables such as inflation, interest rates, and geopolitical events are excluded, though they could significantly impact asset performance. The lack of diversification in the selected Cryptocurrencies, especially with high-return outliers like Ethereum and Ethereum Classic, may skew the results and fail to represent the broader Cryptocurrency market.

Moreover, while the Jarque-Bera test suggests a reasonable approximation of normal distribution, financial returns often exhibit non-normal characteristics, such as fat tails, which may not be adequately captured. The study's reliance on historical data limits its predictive capability for future risks and returns, given the dynamic nature of financial markets. It employs basic statistical measures like mean, variance, skewness, and kurtosis, potentially overlooking more advanced risk metrics such as Value at Risk (VaR) or Conditional VaR. Behavioural factors like investor sentiment and psychological biases, which significantly influence both Cryptocurrency and stock market behaviour, are not considered.

Furthermore, the study assumes market efficiency, positing that prices fully reflect all available information—a condition that may not hold, especially in less regulated Cryptocurrency markets. Lastly, the analysis does not explore the correlation or interaction between Cryptocurrencies and Stock Indices, which could offer valuable insights into their roles in portfolio diversification.

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