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Analysis of BSE SENSEX: Pre and Post COVID-19 outbreak

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Abstract
This study investigates the impact of the COVID-19 pandemic on the Bombay Stock Exchange SENSEX, employing statistical tools to analyze monthly opening, high, low, and closing values from August 2019 to August 2020. The data is divided into pre-COVID-19 (August 2019 to February 2020) and post-COVID-19 (March 2020 to August 2020) periods. Using a two-sample t-test, we find a significant difference in the mean closing values of the SENSEX before (39,171.21) and after (34,126.53) the pandemic onset (t = 9.24, df = 11, p < 0.05). This indicates a notable shift in market performance, reflecting the pandemic's disruptive impact on investor sentiment and economic stability.

Keywords: BSE SENSEX, COVID-19 Outbreak, pandemic's disruptive

Introduction
The BSE SENSEX, a benchmark index of the Bombay Stock Exchange, provides insights into the economic climate of India, especially during turbulent times like the COVID-19 pandemic. Analysing the six months before and after the pandemic outbreak, we can use statistical tools to understand the market dynamics.

Review of Literature
Debjit Chakraborty (1997) made an effort to establish relationship between stock market and leading economic indicator. Supply of money, GDP, etc. found to be the factors to consider. Avijit Banerjee (1998) [1] talked about the technical and fundamental studies to ensure the decision of considering stock for portfolio. Sinha *et al*. (2010) [2] talked about the increasing integration at global level post-recession.

Considering the saying that history repeats itself it is important to trace the marks of past. The BSE SENSEX is the India's foremost stock market index and it serves as a barometer of economic health and investors' perception and sentiment. Analyzing the performance of SENSEX six months before and after the onset of the COVID-19 pandemic provides crucial insights into market behaviour and the economic impact. Employing statistical tools such as the t-test and hypothesis testing enhances our understanding of these dynamics.

Hypothesis:
We will conduct a hypothesis test to determine if there is a significant difference in the mean closing values of the SENSEX before and after the COVID-19 breakdown (March 2020).
Null Hypothesis (H0): There is no significant difference in the mean closing values of the SENSEX before and after COVID-19.
Alternative Hypothesis (H1): There is a significant difference in the mean closing values of the SENSEX before and after COVID-19.

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Data Overview

Table 1: BSE SENSEX during August 2019 to August 2020

Month	Open	High	Low	Close
Aug 19	37,387.18	37,807.55	36,102.35	37,332.79
Sep 19	37,181.76	39,441.12	35,987.80	38,667.33
Oct 19	38,813.48	40,392.22	37,415.83	40,129.05
Nov 19	40,196.07	41,163.79	40,014.23	40,793.81
Dec 19	41,072.94	41,809.96	40,135.37	41,253.74
Jan 20	41,349.36	42,273.87	40,476.55	40,723.49
Feb 20	40,753.18	41,709.30	38,219.97	38,297.29
Mar 20	38,910.95	39,083.17	25,638.90	29,468.49
Apr 20	29,505.33	33,887.25	27,500.79	33,717.62
May 20	32,748.14	32,845.48	29,968.45	32,424.10
Jun 20	32,906.05	35,706.55	32,348.10	34,915.80
Jul 20	35,009.59	38,617.03	34,927.20	37,606.89
Aug 20	37,595.73	40,010.17	36,911.23	38,628.29

Source: https://www.bseindia.com/Indices/IndexArchiveData.html

## Statistical Analysis
1. Mean and Standard Deviation
- Pre-COVID (Aug 2019 - Feb 2020)
a. Mean Close: 39,171.21
b. Standard Deviation: 1,448.56

- **Post-COVID (Mar 2020 - Aug 2020)**

a. Mean Close: 34,126.53
b. Standard Deviation: 3,191.77

The mean closing value dropped significantly post-COVID, indicating the impact of the pandemic. The higher standard deviation post-COVID suggests increased market volatility.
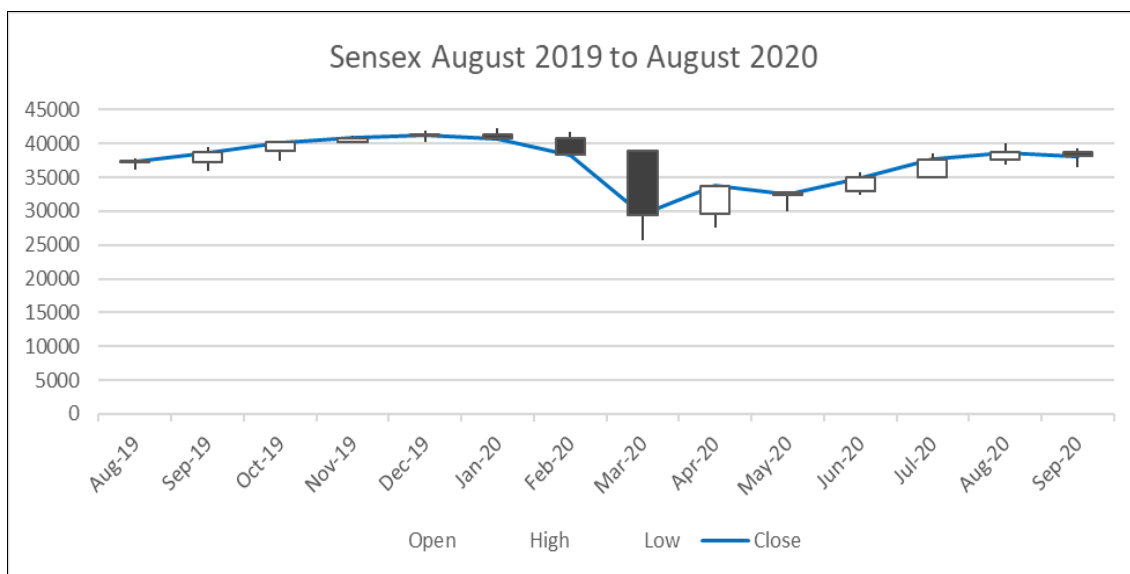
Fig 1: Sensex august 2019 to 2020

2. Percentage Change
- Pre-COVID
a. Highest increase in November 2019 (4.92%)
b. Decrease noted in February 2020 (-5.96%)

- Post-COVID
a. Significant drop in March 2020 (-23.41%)
b. Recovery observed in April 2020 (14.42%)

This highlights the drastic fall in March and the subsequent recovery phase in April.

3. Trend Analysis
A simple moving average (SMA) over three months indicates trends:
- **Pre-COVID SMA:** Upward trend, reflecting investor confidence.
- **Post-COVID SMA:** Initial downward trend, followed by a gradual upward movement, reflecting recovery efforts.

A line graph of the closing prices over these months illustrates the stark contrast between the periods, with a sharp decline in March 2020, followed by a gradual recovery.

The BSE SENSEX data from the six months before and after the COVID-19 outbreak reveals significant market turbulence. The use of statistical tools such as mean, standard deviation, and percentage changes effectively highlights the pandemic's impact and the subsequent market recovery. Despite the volatility, the index's gradual upward trend post-March 2020 reflects resilience and a positive

outlook for future economic conditions.

Hypothesis Testing
Steps for Hypothesis Testing

1. Calculate Means and Standard Deviations
- Pre-COVID (Aug 2019 - Feb 2020):
a. Mean Close (μ_{pre}): 39,171.21
b. Standard Deviation (σ_{pre}) 1,448.56

- Post-COVID (Mar 2020 - Aug 2020):
a. Mean Close (μ_{post}): 34,126.53
b. Standard Deviation (σ_{post}): 3,191.77

2. Calculate t-Statistic

$$t = \frac{\mu_{pre} - \mu_{post}}{\sqrt{\dfrac{\sigma^2_{pre}}{n_{pre}} - \dfrac{\sigma^2_{post}}{n_{post}}}}$$

Where
- n_{pre}=7 (months pre-COVID)
- n_{post}=6 (months post-COVID)

3. Determine Critical Value
Using the t-distribution table with degrees of freedom df=n_{pre}+n_{post}−2, and a chosen significance level (typically 0.05).

4. Compare t-Statistic and Critical Value
If |t|> Critical Value, reject the null hypothesis (H0). Otherwise, fail to reject H0.

Since |t|=9.24exceeds the critical value of 2.201, we reject the null hypothesis H_0 . This means there is a statistically significant difference in the mean closing values of the BSE SENSEX before and after the COVID-19 breakdown. The market experienced a significant shift in sentiment and performance following the onset of the pandemic.

Conclusion
The application of hypothesis testing, specifically the t-test, will provide insights into whether the mean closing values of the BSE SENSEX were significantly affected by the COVID-19 pandemic. This statistical approach enhances our understanding of how market dynamics shifted during this unprecedented global crisis, impacting investor sentiment and economic outlooks.

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