Extra Activity - 3

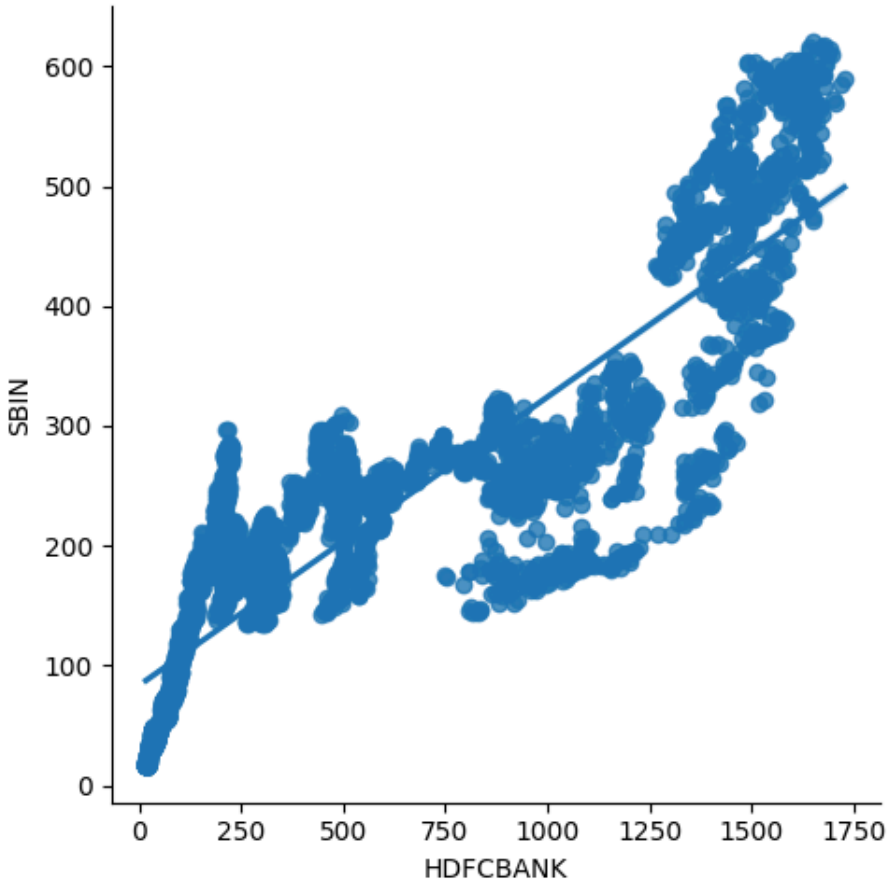
1) The data is collected from Yahoo Finance which contains price data of few Indian Stocks traded at NSE namely Adani Enterprises, Ashok Leyland, Asianpaints, HDFC Bank, Reliance Industries, and SBI. This comprehensive dataset spans from July 1, 2002, to October 18, 2023. The prices are denominated in Indian Rupees and are indexed by the date of each recorded price point.

Date	ADANIENT	ASHOKLEY	ASIANPAINT	HDFCBANK	RELIANCE	SBIN
2002-07-01	-0.010447	0.873074	16.620569	18.097490	33.251774	16.769215
2002-07-02	-0.010529	0.855525	16.794338	17.913774	32.688820	16.751892
2002-07-03	-0.010529	0.856987	16.953176	17.930868	32.817307	16.585619
2002-07-04	-0.010588	1.399429	17.127682	18.571712	32.676567	16.647972
2002-07-05	-0.010565	1.391120	17.940552	18.234201	32.223751	16.717249
...	...	...	...	...	...	...
2023-10-12	2506.350098	174.500000	3159.100098	1549.849976	2349.399902	586.049988
2023-10-13	2454.550049	175.800003	3148.800049	1535.750000	2349.300049	576.150024
2023-10-16	2429.350098	176.300003	3112.050049	1529.599976	2344.050049	575.650024
2023-10-17	2428.399902	176.600006	3113.550049	1541.199951	2355.250000	576.450012
2023-10-18	2406.350098	175.600006	3096.449951	1519.750000	2324.000000	572.650024

5292 rows × 6 columns

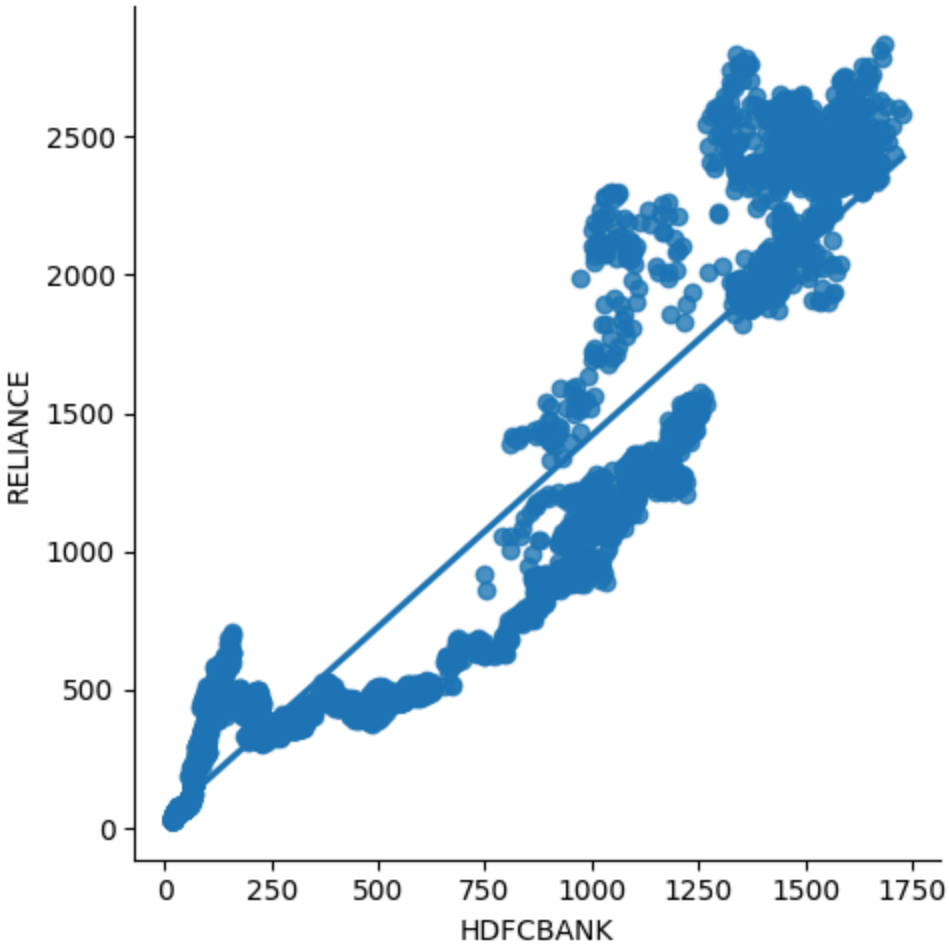
2) The data is transferred to Google Sheet and can be accessed from the following link : Indian_Equities_Prices

3 (i). To perform the activity, HDFC Bank, Reliance Industries, and SBI are chosen as the numerical variables X_1, X_2 and X_3, respectively from the dataset.



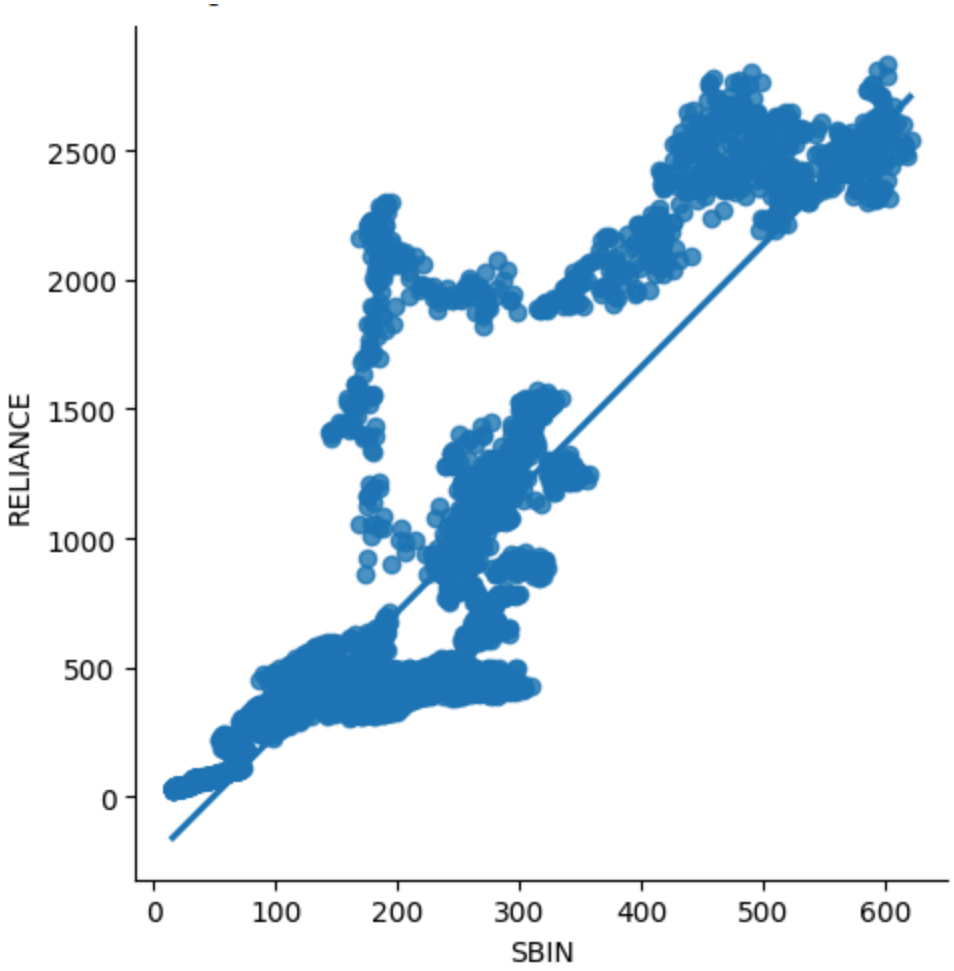
Interpretation:

From the above scatter plot, it is evident that there exists a strong positive association between SBI and HDFC Bank. This indicates a close relationship between the stock prices of these two companies.



Interpretation:

From the above scatter plot, it is evident that there exists a strong positive association between HDFC Bank and RELIANCE. This indicates a close relationship between the stock prices of these two companies.



Interpretation:

From the above scatter plot, it is evident that there exists a strong positive association between SBI and RELIANCE. This indicates a close relationship between the stock prices of these two companies.

On the other hand, we have seen a strong correlation between SBI and HDFC Bank. This implies that if one of them shares a significant relationship with RELIANCE Industries, the other is likely to exhibit a similar trend.

3 (ii). **Calculation of Covariance between pair of variables:**

We can determine the covariance between the pair of variables using the covariance matrix, as illustrated below:

	HDFCBANK	SBIN	RELIANCE
HDFCBANK	263541.605521	63367.804161	364412.311281
SBIN	63367.804161	19267.947659	91416.667390
RELIANCE	364412.311281	91416.667390	565934.939994

Interpretation:

All the stocks have positive covariance, hence we can say that if one makes a move in a particular direction, the other will make a move in the same direction as well. That means:

- If the stock price of HDFCBANK will increase, then the stock price of SBI will also increase. If the stock price of HDFCBANK will decrease, then the stock price of SBI will also decrease.
- If the stock price of HDFCBANK will increase, then the stock price of RELIANCE will also increase. If the stock price of HDFCBANK will decrease, then the stock price of RELIANCE will also decrease.
- If the stock price of SBI will increase then the stock price of RELIANCE will also increase. If the stock price of SBI will decrease, then the stock price of RELIANCE will also decrease.

4 (i). **Calculation of mean and standard deviations:**

Mean and standard deviations for the variables X_1, X_2, and X_3 have been calculated as below:

	Mean	Std Dev.
HDFCBANK	517.529442	513.497646
SBIN	207.986157	138.885710
RELIANCE	752.062935	752.518750

Interpretation:
All the three stocks have varying mean and standard deviation with SBI having the least variability in price and Reliance Industries having the highest. This is due to the fact that a single share price of SBI is much lower which reflects a lower deviation in price in terms of the movement in magnitude.

4 (ii). **Calculation of bounds by using Chebyshev's inequality:**

One of the practical questions that comes to the investors mind is what is the upper and lower bound in the probability that these stocks will make a move of certain standard deviation from the mean.

1). Calculation of bounds for SBI

(a) What is the **upper bound** on the probability that SBI will make a move of more than Rs.300 from its mean in the coming time given the data?

$$P(|X-\mu| \geq k\sigma) \leq \frac{1}{k^2}$$
$$\text{For SBI } \mu = 207.91 \text{ and } \sigma = 138.8$$
$$\Rightarrow P(|X-207.91| \geq 300) \leq \frac{1}{k^2}$$
$$\Rightarrow P(|X-207.91| \geq 1.44 * 207.91) \leq \frac{1}{1.44^2}$$
$$\Rightarrow P(|X-207.91| \geq 1.44 * 207.91) \leq 0.48$$

Interpretation:
The chance that SBI will make a move above Rs.300 from mean is at most 0.48. Hence, there is a somewhat low probability that there will be a move of that magnitude in SBI.

b). What is the **lower bound** on the probability of SBI to make a move of less than Rs.300 from its mean in the coming time given the data?

$$P(|X-\mu| \geq k\sigma) \leq \frac{1}{k^2}$$

$$\text{For SBI } \mu = 207.91 \text{ and } \sigma = 138.8$$

$$\Rightarrow P(|X-207.91| < 300) > 1 - \frac{1}{k^2}$$

$$\Rightarrow P(|X-207.91| < 1.44 * 207.91) > 1 - \frac{1}{1.44^2}$$

$$\Rightarrow P(|X-207.91| < 1.44 * 207.91) > 0.52$$

Interpretation:

The chance that SBI will make a move less than Rs.300 from mean is at least 0.52. Hence there is more than 50% chance that there will be less Rs.300 move in any upcoming days in SBI.

2). Calculation of bounds for HDFC

c). What is the **upper bound** on the probability of HDFC Bank to make a move of more than Rs.600 from its mean in the coming time given the data?

$$P(|X-\mu| \geq k\sigma) \leq \frac{1}{k^2}$$

$$\text{For HDFC Bank } \mu = 517.52 \text{ and } \sigma = 513.49$$

$$\Rightarrow P(|X-517.52| \geq 600) \leq \frac{1}{k^2}$$

$$\Rightarrow P(|X-517.52| \geq 1.16 * 513.49) \leq \frac{1}{1.16^2}$$

$$\Rightarrow P(|X-517.52| \geq 1.16 * 513.49) \leq 0.74$$

Interpretation:

The chance that HDFC Bank will make a move above Rs.600 from mean is at most 0.74. Hence there is a high probability that there will be a move of that magnitude in HDFC Bank.

d). What is the **lower bound** on the probability of HDFC Bank to make a move less than Rs.600 from its mean in the coming time given the data?

$$P(|X-\mu| < k\sigma) > 1 - \frac{1}{k^2}$$
$$\text{For HDFC Bank } \mu = 517.52 \text{ and } \sigma = 513.49$$
$$\Rightarrow P(|X - 517.52| < 600) > 1 - \frac{1}{k^2}$$
$$\Rightarrow P(|X - 517.52| < 1.16 * 513.49) > 1 - \frac{1}{1.16^2}$$
$$\Rightarrow P(|X - 517.52| < 1.16 * 513.49) > 0.26$$

Interpretation:
The chance that HDFC Bank will make a move less than Rs.600 from mean is at least 0.26. Hence it's not very likely that there will be a move of Rs.600 in HDFC Bank.

3). Calculation of bounds for Reliance

e). What is the **upper bound** on the probability that Reliance industries will make a move of more than Rs. 800 from its mean in the coming time given the data?

$$P(|X-\mu| \geq k\sigma) \leq \frac{1}{k^2}$$
$$\text{For Reliance } \mu = 752.06 \text{ and } \sigma = 752.51$$
$$\Rightarrow P(|X - 752.06| \geq 800) \leq \frac{1}{k^2}$$
$$\Rightarrow P(|X - 752.06| \geq 1.06 * 752.51) \leq \frac{1}{1.06^2}$$
$$\Rightarrow P(|X - 752.06| \geq 1.06 * 752.51) \leq 0.88$$

Interpretation:
The chance that Reliance Industries will make a move above Rs.800 from mean is at most 0.88. Hence there is a high probability that there will be a move of that magnitude in Reliance Industries stock price.

f). What is the **lower bound** on the probability of Reliance industries making a move of less than Rs.600 from its mean in the coming time given the data?

$$P(|X-\mu| < k\sigma) > 1 - \frac{1}{k^2}$$

$$\text{For Reliance } \mu = 752.06 \text{ and } \sigma = 752.51$$

$$\Rightarrow P(|X - 752.06| < 800) > 1 - \frac{1}{k^2}$$

$$\Rightarrow P(|X - 752.06| > 1.06 * 752.51) < 1 - \frac{1}{1.06^2}$$

$$\Rightarrow P(|X - 752.06| < 1.06 * 752.51) > 0.12$$

Interpretation:

The chance that Reliance Industries will make a move less than Rs.800 from mean is at least 0.12. Hence the chance of making a move lower Rs. 800 is likely and more than 12% in Reliance Industries stock price.