LONDON METROPOLITAN UNIVERSITY

Stock Analysis of Indian Banking Sector

Name	**Tonny K Podiyan**
Student ID	**21052135**
Email ID	**Tok0165@my.londonmet.ac.uk**
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Introduction

The banking sector of the Indian stock market is a vital segment of the overall Indian equity market. It includes a diverse range of banks, such as public sector banks, private sector banks, and foreign banks. These banks offer a wide range of financial products and services, including personal banking, business banking, and corporate banking.

The sector plays a crucial role in the Indian economy as it is responsible for providing credit and liquidity to various sectors of the economy. Public sector banks, which are owned by the government, have a dominant market share in the Indian banking sector, however, private sector banks have been gaining popularity in recent years due to their strong focus on technology and customer service. The performance of the banking sector is closely tied to the overall performance of the Indian economy, and it is closely watched by investors.

For this coursework, we have chosen five stocks from the Indian Banking sector to conduct an in-depth analysis.

HDFC Bank Limited is a prominent private sector bank in India, which is widely recognized for its broad array of financial services and products, including retail banking, corporate banking, and investment banking. As of April 2021, it is India's largest private sector bank by assets and among the top 10 largest banks globally by market capitalization. The bank offers a variety of services and products, such as wholesale banking, retail banking, treasury, auto loans, two-wheeler loans, personal loans, loans against property, consumer durable loans, lifestyle loans, and credit cards.

Kotak Mahindra Bank Limited is a well-known private sector bank in India, offering a wide range of financial products and services like personal banking, business banking, and corporate banking. It is considered one of the premier private sector banks in India. As of November 2021, it is the second-largest private sector bank in India by market capitalization. The bank also offers a variety of digital banking services and has a significant presence in the wealth management, investment banking, and insurance sectors. It has a strong network of branches and ATMs across the country and has been consistently performing well in terms of financial performance and customer satisfaction.

ICICI Bank Limited is a reputable private sector bank in India, renowned for its comprehensive array of banking products and financial services. The bank caters to both corporate and retail customers through its various delivery channels and specialized subsidiaries. ICICI Bank is particularly known for its expertise in areas such as investment banking, life and non-life insurance, venture capital, and asset management. The bank has a strong digital presence and offers a variety of digital banking services, including mobile banking, internet banking, and UPI. It has a wide network of branches and ATMs across the country and has been consistently performing well in terms of financial performance and customer satisfaction.

State Bank of India (SBI) is the largest public sector bank in India, and it has the widest network of branches across the country. It offers a wide range of banking products and financial services to corporate and retail customers through its various delivery channels and specialized subsidiaries in areas like investment banking, life and non-life insurance, and asset management.

IDBI Bank Limited is a public sector bank in India, it provides a wide range of banking products and financial services to both corporate and retail customers through its various delivery channels. The bank is known for its specialized services such as merchant banking, mutual funds, and insurance. IDBI Bank also has a strong digital presence and offers a variety of digital banking services, including

mobile banking, internet banking, and UPI. It has a wide network of branches and ATMs across the country and has been consistently performing well in terms of financial performance and customer satisfaction.

We have used the Google Finance function in Google Sheets to acquire historical data of the stocks from January 3rd, 2022, to December 30th, 2022. This data can be used for further analysis of the performance of the stocks in the specified time frame.

Table 1: Stock Prices of Indian Banks

Date	Closing Price					
	HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI	NIFTY100
03-01-2022	1519.65	1824.45	764.7	470.8	47.45	17651.45
04-01-2022	1528.55	1852.6	772.85	483.5	47.4	17831.5
05-01-2022	1564.85	1922.15	788.05	492.4	50.8	17974.9
06-01-2022	1539.75	1891.9	785.05	491.7	51.35	17889.75
07-01-2022	1550.55	1904.25	793.25	491.25	50.25	17944.4
10-01-2022	1559.15	1947.95	810.75	503.65	51.8	18109.75
11-01-2022	1565.9	1936.8	810.65	505.95	50.9	18181.4
12-01-2022	1556.65	1956.6	823.75	510.25	50.4	18346.95
13-01-2022	1528	1926.35	824.7	511.35	52.4	18385
14-01-2022	1545.15	1938.2	820	508.35	51.6	18348.4
17-01-2022	1521.5	1937.45	819.3	514	52.1	18456.55
18-01-2022	1529.25	1942.15	823.1	506.8	50.7	18302.95
19-01-2022	1518.45	1905.65	808.6	515.8	50.75	18114.85
20-01-2022	1509	1892.6	810.25	511.4	50.55	17915.75
21-01-2022	1521.6	1893.75	804.5	502.7	48.65	17721.3
24-01-2022	1486.65	1830.9	798.45	494.15	45.95	17197
25-01-2022	1488.05	1854.65	801.65	514.65	48.6	17030.45
27-01-2022	1474.95	1889.25	794.65	528.95	49.95	17069.75
28-01-2022	1463.25	1898.3	781.15	523.45	48.5	17289.2
31-01-2022	1485.7	1857.25	788.8	538.3	48.25	17479.65
01-02-2022	1497	1882.3	810.3	532.3	47.95	17464.25
02-02-2022	1531.2	1942.6	813.75	539.8	49.2	17889.15
03-02-2022	1515.35	1909.05	808.95	540.1	51.55	17749.4
04-02-2022	1524	1884.2	805.05	530.3	50.2	17701.2
07-02-2022	1468.15	1828.45	786.4	533.25	49.4	17382.8
08-02-2022	1461.85	1817.8	792.5	531.35	48.7	17298.35
09-02-2022	1497.6	1835	802.8	535.25	48.4	17583
23-12-2022	1597.65	1821.95	878.9	574	48.8	17855.15
26-12-2022	1629.45	1813.55	893.2	597.1	51.85	17834.1
27-12-2022	1631.1	1820.9	900.65	601.9	52.9	18097.75
28-12-2022	1629.8	1820.1	898.95	601.05	53.1	18200.2
29-12-2022	1641.3	1818.75	908.05	611.8	53.8	18124.8
30-12-2022	1628.15	1827.25	890.85	613.7	54.35	18232.3

1.Calculating the expected return of the stocks ,volatility and correlation

To calculate the expected return of the Individual stock we calculate the percentage change in the value of a stock.

for example, if we consider the stock price of HDFC Bank, then on 03-01-2022 it was 1519.65 and on 04-01-2022 was 1528.55 the formula would calculate the change as (1528.55-1519.65)/1519.65 = 0.0058 or 0.58%.

This shows that the stock price of HDFC Bank increased by 0.58% on 04-01-2022 compared to 03-01-2022.

Table 2: Calculating Daily Expected Return of a Stock

Date	Closing Price	Expected Return
	HDFCBANK	
03-01-2022	1519.65	0.005856612
04-01-2022	1528.55	0.023747996
05-01-2022	1564.85	-0.016039876
06-01-2022	1539.75	0.007014126
07-01-2022	1550.55	0.005546419
10-01-2022	1559.15	0.004329282
11-01-2022	1565.9	-0.005907146
12-01-2022	1556.65	-0.018404908
13-01-2022	1528	0.011223822
14-01-2022	1545.15	-0.015305957

Table 3: Calculating Daily Expected Return of Stock (Formula View)

Date	Closing Price	Expected Return
	HDFCBANK	
03-01-2022	1519.65	=(B4-B3)/B3
04-01-2022	1528.55	=(B5-B4)/B4
05-01-2022	1564.85	=(B6-B5)/B5
06-01-2022	1539.75	=(B7-B6)/B6
07-01-2022	1550.55	=(B8-B7)/B7
10-01-2022	1559.15	=(B9-B8)/B8
11-01-2022	1565.9	=(B10-B9)/B9
12-01-2022	1556.65	=(B11-B10)/B10
13-01-2022	1528	=(B12-B11)/B11
14-01-2022	1545.15	=(B13-B12)/B12

We can also use the same formula to determine the expected returns of all the other stocks. It's important to remember that the formula calculates the daily return on the stock. To calculate the annual expected return, we need to multiply the average daily return with 252 (which is the number of trading days in a year)

To calculate Volatility of the stock we take the product of average daily return and square root of 252

Table 4: Annual Expected Return

Stock	Mean	Volatility
HDFCBANK	3.81%	0.24%
KOTAKBANK	-2.96%	-0.19%
ICICIBANK	12.99%	0.82%
SBIN	23.68%	1.49%
IDBI	3.86%	0.24%

Table 5: Annual Expected Return(Formula View)

Stock	Mean	Volatility
HDFCBANK	=AVERAGE(H3:H248)*252	=AVERAGE(H3:H248)*SQRT(252)
KOTAKBANK	=AVERAGE(I3:I248)*252	=AVERAGE(I3:I248)*SQRT(252)
ICICIBANK	=AVERAGE(J3:J248)*252	=AVERAGE(J3:J248)*SQRT(252)
SBIN	=AVERAGE(K3:K248)*252	=AVERAGE(K3:K248)*SQRT(252)
IDBI	=AVERAGE(L3:L248)*252	=AVERAGE(L3:L248)*SQRT(252)

Finding Variance -Covariance Matrix

On the Data tab, in the Analyze group, click Data Analysis.

Select Covariance from the dropdown

Select the input range as the Daily Expected Return and Output range as desired

Now to annualise the variance- covariance matrix we multiply the obtained matrix values with 252.

Table 6:Variance-Covariance Matrix(Annualised)

Variance -Covariance Matrix (Annualised)					
	HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI
HDFCBANK	0.064634213	0.038696579	0.033644966	0.030933763	0.024643471
KOTAKBANK	0.038696579	0.062556146	0.033456524	0.031734144	0.031215352
ICICIBANK	0.033644966	0.033456524	0.053114693	0.042366791	0.035901154
SBIN	0.030933763	0.031734144	0.042366791	0.069175292	0.052449816
IDBI	0.024643471	0.031215352	0.035901154	0.052449816	0.199247738

Finding Correlation Matrix

On the Data tab, in the Analyze group, click Data Analysis.

Select Correlation from the dropdown

Select the input range as the Daily Expected Return and Output range as desired

Table 7:Correlation Matrix

Correlation Matrix					
	HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI
HDFCBANK	1	0.60856412	0.574224238	0.462621721	0.217157056
KOTAKBANK	0.60856412	1	0.580414811	0.482409992	0.279599595
ICICIBANK	0.574224238	0.580414811	1	0.698944557	0.348983075
SBIN	0.462621721	0.482409992	0.698944557	1	0.44675741
IDBI	0.217157056	0.279599595	0.348983075	0.44675741	1

2. Using solver function to determine portfolio risk and percentage of investment and plotting efficient frontier curve.

To use the Solver function, the following steps can be taken:

First, we need to find the Expected Returns , Standard Deviation and the Sharpe Ratio of our portfolio.

Since we have selected 5 stocks, we give equal weightage of 20% to all 5 stocks

To find the expected return of the portfolio we use the matrix multiplication formula in excel and take the product of Weights Vector and Mean Expected Return Vector of the stocks.

The standard deviation of a portfolio is the square root of the dot product of the weight of stock vector transposed, multiplied by the variance-covariance matrix, and then multiplied by the weight of stock vector.

Sharpe ratio is the ratio of the difference between the expected return of the investment and the risk-free rate, and the standard deviation of the investment's returns.

Table 8: Measure to evaluate the performance of an investment

Risk Free	0.015
Equally Weighted Portfolio	
Assets	Weights
HDFCBANK	0.2
KOTAKBANK	0.2
ICICIBANK	0.2
SBIN	0.2
IDBI	0.2
Sum	1
Expected Returns	0.08276
Std Deviation	0.2152
Sharpe Ratio	0.31476

Table 9: Measure to evaluate the performance of an investment(Formula View)

Risk Free	0.015
Equally Weighted Portfolio	
Assets	Weights
HDFCBANK	0.2
KOTAKBANK	0.2
ICICIBANK	0.2
SBIN	0.2
IDBI	0.2
Sum	=SUM(P13:P17)
Expected Returns	=MMULT(TRANSPOSE(P13:P17),P3:P17)
Std Deviation	=SQRT(MMULT(MMULT(TRANSPOSE(P13:P17),AA3:AE7),P13:P17))
Sharpe Ratio	=(P20-P9)/P21

Now we can successfully start using the solver function.

On the Data tab, in the Analyze group, click Solver.

Now for different values of expected returns we find different combination of weights while keeping the standard deviation to minimum, we set constraints as sum of the portfolio weight equal to 1.

We repeat this process for different returns and plot a scatter plot with Expected Returns on the Y axis and Standard deviation on the X axis. This is our efficient frontier curve, which shows the trade-off between risk and return for different levels of portfolio.

Figure 1: Using Solver Function to find different portfolio weights.

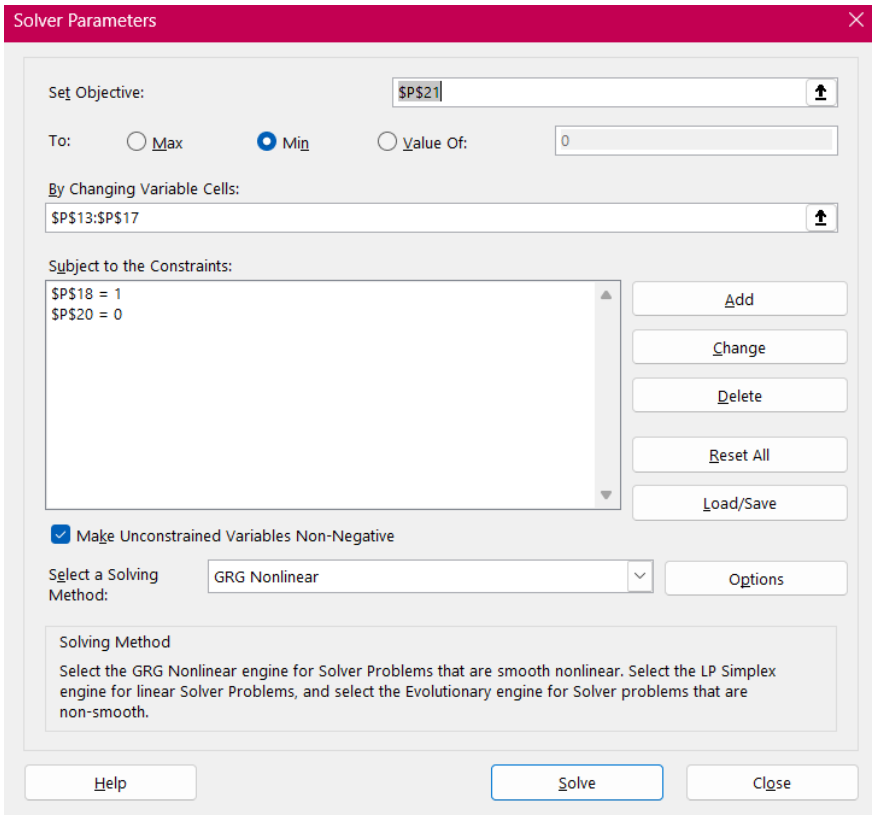
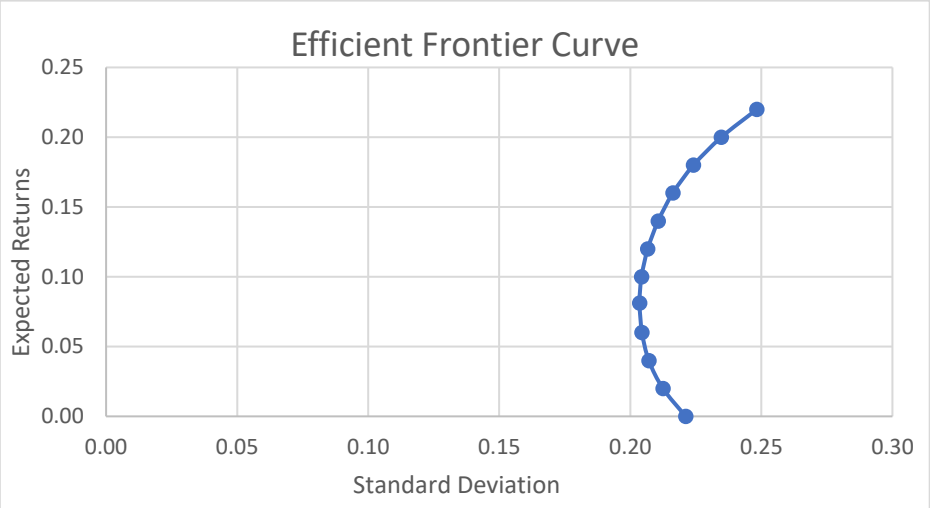


Table 10: Efficient Frontier Data for Bank Portfolio

Weight of Assets					Sum	Expected Returns	Std Deviation
HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI			
0.2815	0.6010	0.0279	0.0000	0.0896	1	0.0	0.2211
0.2709	0.4869	0.1616	0.0000	0.0806	1	0.02	0.2125
0.2603	0.3728	0.2952	0.0000	0.0717	1	0.04	0.2071
0.2488	0.3062	0.3212	0.0660	0.0578	1	0.06	0.2045
0.2366	0.2432	0.3316	0.1464	0.0423	1	0.08	0.2035
0.2257	0.1873	0.3408	0.2177	0.0285	1	0.10	0.2043
0.2141	0.1279	0.3505	0.2936	0.0139	1	0.12	0.2067
0.2025	0.0679	0.3602	0.3694	0.0000	1	0.14	0.2106
0.1889	0.0000	0.3677	0.4434	0.0000	1	0.16	0.2162
0.1070	0.0000	0.3329	0.5601	0.0000	1	0.18	0.2241
0.0250	0.0000	0.2982	0.6768	0.0000	1	0.20	0.2347
0.0000	0.0000	0.1575	0.8425	0.0000	1	0.22	0.2483

Figure 2: Plot of Efficient Frontier Curve



3.Finding Capital Market Line by calculating Sharpe ratios for expected portfolio returns and volatilities using a 1.5% risk-free investment

Table 11: Sharpe Ratio of Portfolio

Weight of Assets					Sum	Expected Returns	Std Deviation	Sharpe Ratio
HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI				
0.28	0.60	0.03	0.00	0.09	1	0.00	0.22	-0.07
0.27	0.49	0.16	0.00	0.08	1	0.02	0.21	0.02
0.26	0.37	0.30	0.00	0.07	1	0.04	0.21	0.12
0.25	0.31	0.32	0.07	0.06	1	0.06	0.20	0.22
0.24	0.24	0.33	0.15	0.04	1	0.08	0.20	0.33
0.23	0.19	0.34	0.22	0.03	1	0.10	0.20	0.42
0.21	0.13	0.35	0.29	0.01	1	0.12	0.21	0.51
0.20	0.07	0.36	0.37	0.00	1	0.14	0.21	0.59
0.19	0.00	0.37	0.44	0.00	1	0.16	0.22	0.67
0.11	0.00	0.33	0.56	0.00	1	0.18	0.22	0.74
0.02	0.00	0.30	0.68	0.00	1	0.20	0.23	0.79
0.00	0.00	0.16	0.84	0.00	1	0.22	0.25	0.83

In table 12 we have calculated Sharpe ratio of the portfolio as the ratio of the difference between the expected return of the investment and the risk-free rate, and the standard deviation of the investment's returns.

The Capital Market Line (CML) is a graphical representation of the relationship between risk and return in the capital markets. It is a key concept in modern portfolio theory and is used to help investors determine the optimal risk-return trade-off for their investment portfolio. The CML is a straight line that is plotted on a graph with standard deviation on the x-axis and expected return on the y-axis. It represents all possible portfolios that can be created by combining the market portfolio with a risk-free asset. The slope of the CML represents the market risk premium, which is the excess return of the market portfolio over the risk-free rate. The y-intercept represents the risk-free rate.

The CML is significant because it helps investors understand the trade-off between risk and return. The CML shows that as an investor increases their exposure to the market, the expected return of their portfolio increases, but so does the volatility or risk. The CML also highlights the fact that investors can earn higher returns by taking on more risk, but only up to a point. Beyond a certain level of risk, returns will not increase proportionately. The CML also helps investors evaluate the performance of their portfolio relative to the market.

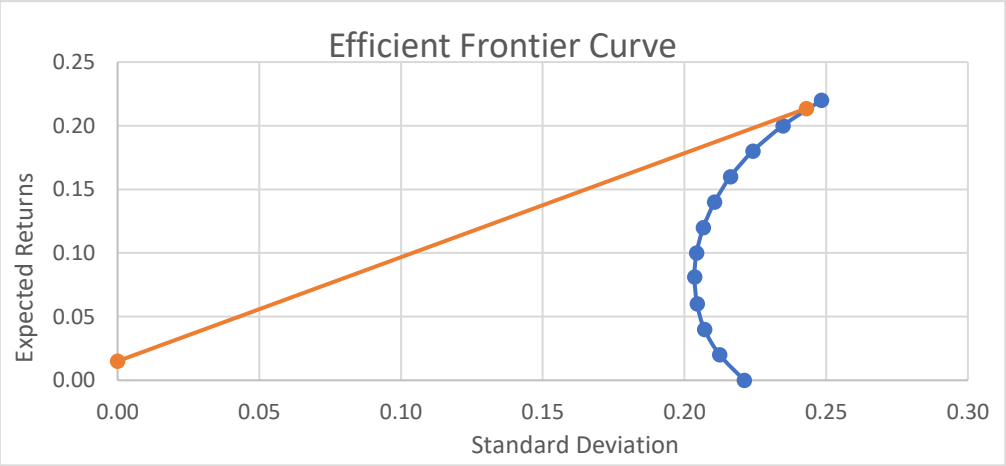
In summary, the Capital Market Line is a useful tool for understanding the relationship between risk and return in the capital markets, and it helps investors make informed decisions about their investment portfolio.

The Capital Market Line is drawn by plotting the risk-return data for a risky portfolio and a risk-free asset on a graph with volatility (or standard deviation) on the x-axis and returns on the y-axis. The Capital Market Line is represented as a line that goes through the point for the risk-free asset and is tangent to the efficient frontier of risky portfolios. The slope of the line is the market risk premium (the excess return of the market over the risk-free rate) and the y-intercept is the risk-free rate. The equation of the line is returns = risk-free rate + market risk premium * volatility.

For the below values we plot the Capital Market Line.

	Volatility	Returns
Risky Portfolio	0.243	0.2135
Risk Free	0	0.015

Figure 3: Drawing Capital Market Line



The equation of the Capital Market Line is determined by the slope and y-intercept of the line. The slope of the Capital Market Line is the market risk premium, which is the excess return of the market over the risk-free rate. The Y-intercept is the risk-free rate. So, the equation of the Capital Market Line is:

Returns = Risk-Free Rate + Market Risk Premium * Volatility

In this case, Risk-Free Rate =0.015 and Market Risk Premium can be calculated as (Returns of Risky Portfolio - Risk-Free Rate) / Volatility of Risky Portfolio

so, the equation of the Capital Market Line is:

Returns = 0.015 + (0.2135 - 0.015) / 0.243 * Volatility

This equation shows the expected return for any given level of volatility, assuming that the market follows the Capital Market Line.

4.Calculating Beta and VaR(5%) for portfolio and discussing its significance.

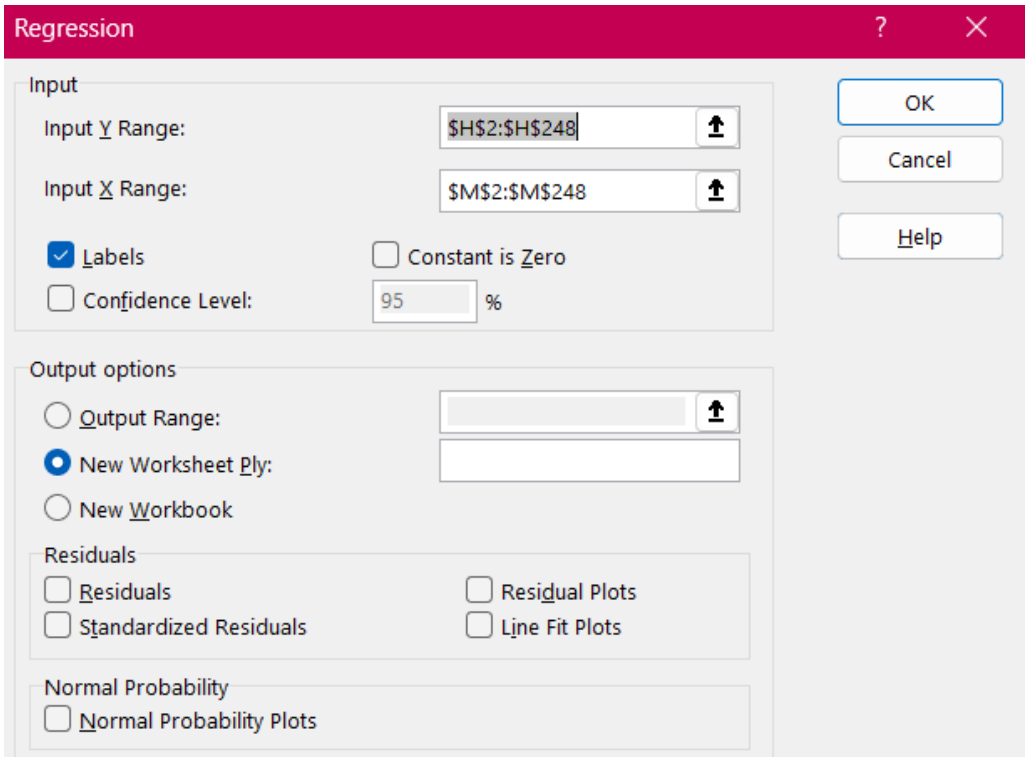
To calculate the beta of a portfolio, the beta of each individual stock must be determined. This can be done by using the regression method. The steps to perform this calculation include:

On the Data tab, in the Analyze group, click on Data Analysis.

Select Regression from the dropdown options.

In the input range, select the daily expected return of the stock as the y-range and the daily return of the market, in this case the NIFTY 100, as the x-range. Since the data is for Indian stocks, the NIFTY 100 is used as the market benchmark.

Figure 4: Using regression function to calculate Beta of a stock.



We repeat this process for all the stocks in the portfolio and find the betas respectively.

Figure 5: Beta of HDFC Bank

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.5693							
R Square	0.3242							
Adjusted R Square	0.3214							
Standard Error	0.0132							
Observations	246.0000							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1.0000	0.0205	0.0205	117.03	0.0000			
Residual	244.0000	0.0426	0.0002					
Total	245.0000	0.0631						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.0001	0.0008	0.1089	0.9134	-0.0016	0.0018	-0.0016	0.0018
NIFTY100	**0.8313**	0.0768	10.8180	0.0000	0.6799	0.9826	0.6799	0.9826

We have obtained the below Beta Values for the remaining stocks:

Table 12: Beta of all the stocks in the portfolio

Assets	β
HDFCBANK	0.831259787
KOTAKBANK	0.7623628
ICICIBANK	0.730453341
SBIN	0.783547076
IDBI	1.015233417

Now the Beta of the portfolio Is calculated by summing the product of the weight of each stock in the portfolio and its individual beta value. This calculation results in the portfolio's beta, which provides insight into how the portfolio is likely to perform in comparison to the overall market.

Table 13: Calculating Beta of Portfolio

VALUE =A3*$N$3+B3*$N$4+C3*$N$5+D3*$N$6+E3*$N$7

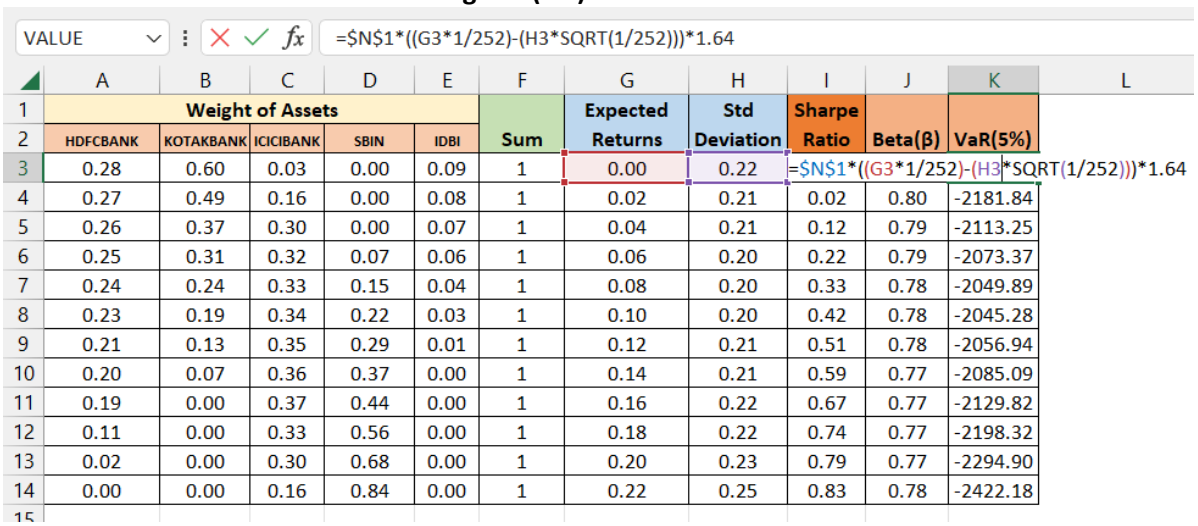
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Weight of Assets					Sum	Expected Returns	Std Deviation	Sharpe Ratio	Beta(β)	VaR(5%)		Investment	100000
2	HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI								Assets	β
3	0.28	0.60	0.03	0.00	0.09	1	=A3*$N$3+B3*$N$4+C3*$N$5+D3*$N$6+E3*$N$7						HDFCBANK	0.831259787
4	0.27	0.49	0.16	0.00	0.08	1	0.02	0.21	0.02	0.80	-2181.84		KOTAKBANK	0.7623628
5	0.26	0.37	0.30	0.00	0.07	1	0.04	0.21	0.12	0.79	-2113.25		ICICIBANK	0.730453341
6	0.25	0.31	0.32	0.07	0.06	1	0.06	0.20	0.22	0.79	-2073.37		SBIN	0.783547076
7	0.24	0.24	0.33	0.15	0.04	1	0.08	0.20	0.33	0.78	-2049.89		IDBI	1.015233417
8	0.23	0.19	0.34	0.22	0.03	1	0.10	0.20	0.42	0.78	-2045.28			
9	0.21	0.13	0.35	0.29	0.01	1	0.12	0.21	0.51	0.78	-2056.94			
10	0.20	0.07	0.36	0.37	0.00	1	0.14	0.21	0.59	0.77	-2085.09			
11	0.19	0.00	0.37	0.44	0.00	1	0.16	0.22	0.67	0.77	-2129.82			
12	0.11	0.00	0.33	0.56	0.00	1	0.18	0.22	0.74	0.77	-2198.32			
13	0.02	0.00	0.30	0.68	0.00	1	0.20	0.23	0.79	0.77	-2294.90			
14	0.00	0.00	0.16	0.84	0.00	1	0.22	0.25	0.83	0.78	-2422.18			
15														

Beta is a measure of the volatility of a stock or portfolio in relation to the overall market. It is used in the Capital Asset Pricing Model (CAPM) to calculate the expected return on an asset. A beta of 1 indicates that the asset's price will move with the market, while a beta less than 1 means it is less

volatile than the market, and a beta greater than 1 indicates higher volatility. Beta is significant because it helps investors understand the risk of an investment in relation to the market and make informed decisions about portfolio construction and asset allocation. In our case the value of Beta ranges from 0.77 to 0.80 .This suggests that the assets in our portfolio have a moderate level of systematic risk, meaning that they are likely to be affected by market movements to some degree. This is generally considered to be a desirable characteristic for a portfolio, as it indicates that the assets have the potential to provide a relatively high rate of return for the level of risk taken on.

Now for an investment amount of **100000**, the VaR(5%) is calculated by multiplying the investment amount by a factor that considers the expected return and standard deviation of the investment. This factor is determined by using the formula: VaR(5%) = Investment Amount * ((Expected Return * (1/252) - (Standard Deviation * (Square root of (1/252)))) * 1.64). This formula is used to determine the amount of money that an investment is likely to lose, with a confidence level of 95%, over a given period.

Table 14: Calculating VaR(5%) for investment value of 100000



VALUE =$N$1*((G3*1/252)-(H3*SQRT(1/252)))*1.64

	A	B	C	D	E	F	G	H	I	J	K	L
1	Weight of Assets						Expected	Std	Sharpe			
2	HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI	Sum	Returns	Deviation	Ratio	Beta(β)	VaR(5%)	
3	0.28	0.60	0.03	0.00	0.09	1	0.00	0.22	=$N$1*((G3*1/252)-(H3*SQRT(1/252)))*1.64			
4	0.27	0.49	0.16	0.00	0.08	1	0.02	0.21	0.02	0.80	-2181.84	
5	0.26	0.37	0.30	0.00	0.07	1	0.04	0.21	0.12	0.79	-2113.25	
6	0.25	0.31	0.32	0.07	0.06	1	0.06	0.20	0.22	0.79	-2073.37	
7	0.24	0.24	0.33	0.15	0.04	1	0.08	0.20	0.33	0.78	-2049.89	
8	0.23	0.19	0.34	0.22	0.03	1	0.10	0.20	0.42	0.78	-2045.28	
9	0.21	0.13	0.35	0.29	0.01	1	0.12	0.21	0.51	0.78	-2056.94	
10	0.20	0.07	0.36	0.37	0.00	1	0.14	0.21	0.59	0.77	-2085.09	
11	0.19	0.00	0.37	0.44	0.00	1	0.16	0.22	0.67	0.77	-2129.82	
12	0.11	0.00	0.33	0.56	0.00	1	0.18	0.22	0.74	0.77	-2198.32	
13	0.02	0.00	0.30	0.68	0.00	1	0.20	0.23	0.79	0.77	-2294.90	
14	0.00	0.00	0.16	0.84	0.00	1	0.22	0.25	0.83	0.78	-2422.18	
15												

The VaR(5%) for each asset can be calculated by multiplying the weight of the asset with the overall VaR(5%) value. For example, the VaR(5%) for HDFCBANK is 0.281473352 * -2284.224876 = -644.237555. Similarly, the VaR(5%) for KOTAKBANK is 0.601022877 * -2284.224876 = -1372.898779 and so on.

Table 15: VaR(5%) for each asset in Portfolio

Weight of Assets						VaR(5%) for each asset				
HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI	VaR(5%)	HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI
0.2815	0.6010	0.0279	0.0000	0.0896	-2284.22	-642.9484	-1372.871	-63.7490	0.000	-204.6561
0.2709	0.4869	0.1616	0.0000	0.0806	-2181.84	-591.0164	-1062.370	-352.5063	0.000	-175.9444
0.2603	0.3728	0.2952	0.0000	0.0717	-2113.25	-550.0505	-787.834	-623.8710	0.000	-151.4893
0.2488	0.3062	0.3212	0.0660	0.0578	-2073.37	-515.9210	-634.883	-666.0049	-136.742	-119.8226
0.2366	0.2432	0.3316	0.1464	0.0423	-2049.89	-484.9076	-498.573	-679.6800	-300.067	-86.6640
0.2257	0.1873	0.3408	0.2177	0.0285	-2045.28	-461.5375	-383.150	-696.9334	-445.345	-58.3180
0.2141	0.1279	0.3505	0.2936	0.0139	-2056.94	-440.3364	-263.076	-720.9944	-603.996	-28.5380
0.2025	0.0679	0.3602	0.3694	0.0000	-2085.09	-422.1466	-141.663	-751.0702	-770.213	0.0000
0.1889	0.0000	0.3677	0.4434	0.0000	-2129.82	-402.3580	0.000	-783.0514	-944.415	0.0000
0.1070	0.0000	0.3329	0.5601	0.0000	-2198.32	-235.1236	0.000	-731.8407	-1231.354	0.0000
0.0250	0.0000	0.2982	0.6768	0.0000	-2294.90	-57.3653	0.000	-684.2451	-1553.290	0.0000
0.0000	0.0000	0.1575	0.8425	0.0000	-2422.18	0.0000	0.000	-381.5913	-2040.588	0.0000

5. Finding volatility of HDFC Bank using GARCH(1,1) Model

Code Used:

Untitled1*

Source on Save

```r
# Load the rugarch package
library(rugarch)

# Read in the HDFC Bank stock data
stockdata <- read.csv("C:\\Users\\tonny\\Downloads\\HDFCBank_stcokdata.csv", header = TRUE)

# Convert the date column to a date object
stockdata$Date <- as.Date(stockdata$Date, format = "%d-%m-%Y")

# Specify the GARCH(1,1) model specification
spec <- ugarchspec(variance.model = list(model = "sGARCH", garchOrder = c(1,1)))

# Fit the GARCH(1,1) model to the stock data
fit <- ugarchfit(data = stockdata$Price, spec = spec)

# Print the summary of the fitted model
print(summary(fit))

# Perform volatility forecasting using the fitted model
forecast <- ugarchforecast(fit, n.ahead = 10)

# Print the forecasted volatility
print(forecast@forecast$sigmaFor)
```

Output:

R 4.0.2 · ~/R/

```
> # Load the rugarch package
> library(rugarch)
>
> # Read in the HDFC Bank stock data
> stockdata <- read.csv("C:\\Users\\tonny\\Downloads\\HDFCBank_stcokdata.csv", header = TRUE)
>
> # Convert the date column to a date object
> stockdata$Date <- as.Date(stockdata$Date, format = "%d-%m-%Y")
>
> # Specify the GARCH(1,1) model specification
> spec <- ugarchspec(variance.model = list(model = "sGARCH", garchOrder = c(1,1)))
>
> # Fit the GARCH(1,1) model to the stock data
> fit <- ugarchfit(data = stockdata$Price, spec = spec)
>
> # Print the summary of the fitted model
> print(summary(fit))
   Length     Class      Mode
        1 uGARCHfit        S4
>
> # Perform volatility forecasting using the fitted model
> forecast <- ugarchforecast(fit, n.ahead = 10)
>
> # Print the forecasted volatility
> print(forecast@forecast$sigmaFor)
     1970-09-05 01:00:00
T+1             18.60901
T+2             18.74102
T+3             18.86895
T+4             18.99298
T+5             19.11325
T+6             19.22990
T+7             19.34307
T+8             19.45288
T+9             19.55945
T+10            19.66290
>
```

This code is using the R programming language and the rugarch package to perform analysis and forecasting on stock data for HDFC Bank.

The first line reads in a CSV file containing HDFC Bank stock data, with the file path specified, and assigns it to the variable "stockdata".

The second line converts the "Date" column of the dataframe to a date object, using the format specified.

The third line specifies a GARCH(1,1) model, which is a type of time series model commonly used in finance to model volatility. The "sGARCH" model is a variation of the GARCH model that is used to model volatility in the presence of leverage effects.

The fourth line fits this GARCH(1,1) model to the "Price" column of the stock data using the ugarchfit() function.

The fifth line prints a summary of the fitted model.

The sixth line forecasts the volatility of the stock data using the fitted model and the ugarchforecast() function, and the number of days ahead to forecast is set to 10.

The seventh line prints the forecasted volatility.

6.Learnings and Findings:

Based on the historical stock data of Indian banking stocks that have been analysed, various performance measurements such as expected returns, volatility, correlation, beta, and value at risk have been calculated. Using this information, an efficient frontier curve and a capital market line have been created, which can be used to assist a potential investor in choosing the best efficient portfolio.

The efficient frontier curve is a graph that shows the possible combinations of risk and return for different portfolios of stocks. The curve helps investors identify the portfolios with the highest expected return for a given level of risk. The capital market line is a line that represents the trade-off between risk and return for the overall market.

Regarding beta, which is a measure of a stock's volatility in relation to the market as a whole, it is used to help investors understand how a stock may perform in different market conditions. A beta of 1 indicates that the stock's price will move with the market, while a beta less than 1 means it is less volatile than the market, and a beta greater than 1 indicates higher volatility than the market.

Value at risk (VaR) is a statistical measure of the risk of a portfolio, which helps investors understand the potential loss of the portfolio at a given confidence level, in this case, 95%.

Additionally, the GARCH(1,1) model and the rugarch package in R have been used to forecast future volatility for HDFC Bank.

In summary, through the analysis, a set of portfolios with a good balance of risk and return have been found, along with information on stock's volatility and potential loss. This can assist a potential investor in making a decision on which portfolio to invest in.

Excel File

Date	Closing Price					
	HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI	NIFTY100
03-01-2022	1519.65	1824.45	764.7	470.8	47.45	17651.45
04-01-2022	1528.55	1852.6	772.85	483.5	47.4	17831.5
05-01-2022	1564.85	1922.15	788.05	492.4	50.8	17974.9
06-01-2022	1539.75	1891.9	785.05	491.7	51.35	17889.75
07-01-2022	1550.55	1904.25	793.25	491.25	50.25	17944.4
10-01-2022	1559.15	1947.95	810.75	503.65	51.8	18109.75
11-01-2022	1565.9	1936.8	810.65	505.95	50.9	18181.4
12-01-2022	1556.65	1956.6	823.75	510.25	50.4	18346.95
13-01-2022	1528	1926.35	824.7	511.35	52.4	18385
14-01-2022	1545.15	1938.2	820	508.35	51.6	18348.4
17-01-2022	1521.5	1937.45	819.3	514	52.1	18456.55
18-01-2022	1529.25	1942.15	823.1	506.8	50.7	18302.95
19-01-2022	1518.45	1905.65	808.6	515.8	50.75	18114.85
20-01-2022	1509	1892.6	810.25	511.4	50.55	17915.75
21-01-2022	1521.6	1893.75	804.5	502.7	48.65	17721.3
24-01-2022	1486.65	1830.9	798.45	494.15	45.95	17197
25-01-2022	1488.05	1854.65	801.65	514.65	48.6	17030.45
27-01-2022	1474.95	1889.25	794.65	528.95	49.95	17069.75
28-01-2022	1463.25	1898.3	781.15	523.45	48.5	17289.2
31-01-2022	1485.7	1857.25	788.8	538.3	48.25	17479.65
01-02-2022	1497	1882.3	810.3	532.3	47.95	17464.25
02-02-2022	1531.2	1942.6	813.75	539.8	49.2	17889.15
03-02-2022	1515.35	1909.05	808.95	540.1	51.55	17749.4
04-02-2022	1524	1884.2	805.05	530.3	50.2	17701.2
07-02-2022	1468.15	1828.45	786.4	533.25	49.4	17382.8
08-02-2022	1461.85	1817.8	792.5	531.35	48.7	17298.35
09-02-2022	1497.6	1835	802.8	535.25	48.4	17583
10-02-2022	1525.1	1867.2	805.5	540.55	48.55	17665.7
11-02-2022	1518.85	1828.25	790.8	529.6	47.65	17541.65
14-02-2022	1473.7	1746.85	753.7	501.4	45.15	17026.4
15-02-2022	1517.8	1813.1	776.05	524.8	47.2	17037.6
16-02-2022	1515.75	1830.05	764.05	516.7	48.75	17481.65
17-02-2022	1506.5	1817.3	750.35	512.95	47.7	17457.2
18-02-2022	1512.35	1826.55	748.9	515.3	47.3	17439.05
21-02-2022	1522.1	1827.1	754.45	511.85	46.05	17251.85
22-02-2022	1510.7	1841.75	751.3	498.4	44.15	17009.3
23-02-2022	1500.9	1886.1	744.6	498.7	45.1	17240
24-02-2022	1419.4	1794.85	707.4	472.65	41.15	16384.45
25-02-2022	1456.1	1856.7	730.05	482.95	43.7	16676.6
28-02-2022	1426.25	1842.75	742.7	483.2	44	16568.45
02-03-2022	1374.25	1806	714.85	474.25	43.1	16732.05
03-03-2022	1371	1792.25	698.3	467.4	43.3	16708.1
04-03-2022	1366.5	1752.15	688.05	461.95	42.1	16384.25
07-03-2022	1324.8	1711.9	653.75	440.3	40.9	15938.75
08-03-2022	1327.8	1723.1	665	440.3	41.9	15901.1
09-03-2022	1371.15	1739.1	667.45	451.7	42.9	16245.75
10-03-2022	1392.7	1754.35	676.6	468.7	43	16689.8
11-03-2022	1396.8	1763	677.9	470.35	42.95	16717
14-03-2022	1442.55	1788.75	696.15	485.15	43	16833.1
15-03-2022	1424	1733.75	697.35	485.85	42.75	16764.25
16-03-2022	1448.15	1760.5	708	492.75	43.35	17052.6
17-03-2022	1480.05	1820	720.1	501.9	42.85	17394.25
21-03-2022	1486.5	1777.1	710.75	490.6	44.75	17306.6

22-03-2022	1494.15	1807.85	718.2	493.7	45.3	17195.6
23-03-2022	1479.25	1769.75	718.3	490.65	44.8	17399.8
24-03-2022	1442.65	1714.15	704.2	487.1	45.2	17301.8
25-03-2022	1430.9	1722.25	699.25	490.7	45.1	17287.85
28-03-2022	1432.8	1725.2	710.35	497.5	44.25	17213.8
29-03-2022	1451.8	1730	715.3	495	42.75	17438.4
30-03-2022	1476.95	1763.1	730.9	494.3	43	17589.15
31-03-2022	1470.35	1753.85	730.3	493.55	42.8	17627.35
01-04-2022	1506	1776.65	736.25	508.2	44.15	17631.1
04-04-2022	1656.8	1836.05	746.6	512.4	44.95	17994.9
05-04-2022	1608.25	1802.2	741.8	509.4	45.2	18159.85
06-04-2022	1550.85	1779.4	741.6	513.95	48.75	18042.85
07-04-2022	1516.75	1766.45	748.55	514.95	47.75	17906.1
08-04-2022	1514.65	1784.5	754.3	516.1	47.55	17906.55
11-04-2022	1496.15	1783.45	759.6	514.9	47.35	17992.95
12-04-2022	1493.5	1801.85	763.85	512.85	45.95	17786.95
13-04-2022	1464.95	1779.6	762.25	517.7	47.35	17816.2
18-04-2022	1395.45	1750.4	757.8	509.5	47.05	17440.6
19-04-2022	1342.2	1707.5	766.3	511.8	45.95	17199.5
20-04-2022	1354.3	1721.3	755.55	509.3	46.55	17353.9
21-04-2022	1374.35	1760.85	762.35	516.3	46.45	17578
22-04-2022	1355.6	1727.75	747.65	500.6	46	17518.85
25-04-2022	1365.75	1728.85	752.2	494.75	44.85	17236.45
26-04-2022	1372.05	1742.7	753.75	505.5	45.25	17429.85
27-04-2022	1372.55	1741.5	736.7	497.25	47.3	17321.1
28-04-2022	1371.35	1765.65	747.15	507.5	46.35	17429.2
29-04-2022	1384.6	1790.75	743.3	496.3	45.3	17404.9
02-05-2022	1403.7	1774.35	741	491	45.5	17269.85
04-05-2022	1356	1775.6	724.25	479.65	43.2	16944.55
05-05-2022	1352.95	1797.6	728.8	480	41.4	16978.65
06-05-2022	1317.6	1775.3	719.25	483.95	41.15	16654.25
09-05-2022	1319.85	1767.5	710.35	475.9	40.4	16441.4
10-05-2022	1341.05	1797.15	711.3	475.2	40.05	16426.9
11-05-2022	1348.6	1809.95	714.2	476.55	38.75	16204.25
12-05-2022	1303.05	1760.9	695.8	462.65	36.65	15946.15
13-05-2022	1291.35	1779.55	677.35	444.65	36.25	15941.1
16-05-2022	1305.1	1812.85	683	455	37.25	15946.8
17-05-2022	1314	1840.3	710	467.3	38.25	16152.5
18-05-2022	1313.9	1846.8	707.35	458	38.1	16461.6
19-05-2022	1287.05	1783.4	690.3	447.5	36.25	16015.3
20-05-2022	1320.95	1829.15	709.55	462.4	36.7	16253.55
23-05-2022	1304	1854.3	711.05	460.9	36.55	16382.1
24-05-2022	1318.95	1882.6	708.15	462.05	35.6	16262.35
25-05-2022	1328.8	1907.55	713.35	454.1	33.5	16167.5
26-05-2022	1366.7	1908.65	728.5	468.9	33.15	16046.55
27-05-2022	1392.05	1946.2	739.8	468.95	34.75	16388.7
30-05-2022	1401.55	1903.2	748.5	474.6	35.95	16672.6
31-05-2022	1388.95	1846.85	752.85	468.1	36.65	16702.45
01-06-2022	1394.85	1865.1	752.65	468.3	36.75	16601.85
02-06-2022	1385.1	1857.65	749.75	469.85	36.95	16613.65
03-06-2022	1380.3	1858.65	744.3	464.5	36.45	16705.75
06-06-2022	1378.45	1869.3	746.75	463.7	37.05	16565.5
07-06-2022	1362.6	1858.15	735.25	463.4	37.3	16489.15
08-06-2022	1367.4	1845.5	729.5	471.3	37.45	16425.8
09-06-2022	1377.7	1865.2	732.75	466.95	37.45	16374.45

10-06-2022	1351.1	1791.8	720	461.85	36.7	16322.55
13-06-2022	1326.6	1737.35	688	445.85	34.85	15850.85
14-06-2022	1312	1739.7	685.5	448.1	34.6	15822.6
15-06-2022	1307.45	1736.65	687.25	451.35	34.35	15858.35
16-06-2022	1281.3	1675.8	678.5	441.6	33.65	15518
17-06-2022	1289.75	1673.6	686.85	441	33.45	15344.55
20-06-2022	1322.15	1679.2	685.95	434.7	31.55	15336.05
21-06-2022	1336.55	1681.5	696.1	450.75	32.15	15558.7
22-06-2022	1330.25	1669.7	686.6	447.65	31.55	15528.55
23-06-2022	1335.15	1684.1	699.15	451.4	31.55	15515.8
24-06-2022	1353.8	1698.4	713.45	454.25	31.55	15773.65
27-06-2022	1356.25	1691.55	717.35	461.2	31.55	15974.4
28-06-2022	1345.9	1668.8	710.3	464.25	31.25	15857
29-06-2022	1343.95	1642.45	702.75	459.1	30.8	15845.45
30-06-2022	1348	1661.1	707.2	465.9	30.8	15881
01-07-2022	1353.75	1667.75	703.9	466.85	30.8	15679.3
04-07-2022	1355.65	1670.9	720.1	473.45	30.8	15844.65
05-07-2022	1352.6	1663.05	719.45	472.15	30.75	15973.35
06-07-2022	1371.25	1704.5	725.95	479.95	30.75	15990.15
07-07-2022	1395.8	1738.5	742	486.75	31.6	16251.65
08-07-2022	1397.1	1744.75	755.7	488.55	31.6	16353.1
11-07-2022	1406.15	1741.25	769.5	488.2	32.7	16331.2
12-07-2022	1391.8	1718.95	759.9	484.95	32.35	16293.8
13-07-2022	1357.85	1742.05	753.2	486.5	33.85	16220.15
14-07-2022	1351.05	1770.05	752.4	479.35	33.5	16115.65
15-07-2022	1362.05	1787.7	751.2	479.1	35.25	16204.05
18-07-2022	1347.55	1845.65	772	490.3	36.3	16415.15
19-07-2022	1348.05	1834.95	780.65	497.95	36.15	16460.95
20-07-2022	1365.05	1827.75	783.1	508.6	36.2	16744.3
21-07-2022	1360.75	1800.55	786	512.05	36.8	16737.8
22-07-2022	1392.5	1827.1	800.05	513.7	36.6	16872.4
25-07-2022	1396.6	1795.55	800.9	517.8	35.2	16825.45
26-07-2022	1393.75	1761.6	796.3	514.2	35.1	16710
27-07-2022	1404.4	1754.1	800.5	528.2	35	16687.25
28-07-2022	1416.85	1828.5	814.6	532.45	35.25	16985.15
29-07-2022	1434.2	1810.35	818.6	528.35	35.35	17266
01-08-2022	1446.15	1855.75	823.4	533.75	36.5	17396
02-08-2022	1430.25	1884.6	817.75	542.1	36.4	17489.8
03-08-2022	1433.6	1851.1	824.8	540.85	41.25	17487.7
04-08-2022	1431.9	1835.55	820.25	533.25	41.75	17420.4
05-08-2022	1427.05	1833.9	838.2	531.05	40.75	17625.35
08-08-2022	1462.05	1844.5	836.95	520.4	40.9	17621.15
10-08-2022	1466.3	1828.35	848.75	514.7	40.85	17695.8
11-08-2022	1485.7	1853.5	859.7	524.75	40.7	17883.1
12-08-2022	1485.15	1841.2	874.4	530.7	39.85	17857.75
16-08-2022	1502.15	1846.35	879.25	525.95	40.3	18028.1
17-08-2022	1509.9	1839.7	883.25	528.15	40.6	18125.85
18-08-2022	1511.7	1904.5	885.1	532.35	40.75	18156.3
19-08-2022	1493.05	1877	870.4	520.35	39.85	18026.6
22-08-2022	1470.35	1832.05	852.25	511.3	39.15	17767.25
23-08-2022	1465.8	1855.75	863.9	521.9	39	17644.6
24-08-2022	1472.85	1867.6	873.3	519.3	40.1	17790.9
25-08-2022	1464.85	1868.75	872.35	520.4	43.05	17813.8
26-08-2022	1465.1	1902.05	870.85	523.8	45.75	17855.95
29-08-2022	1439.4	1850	855.85	514.85	45.1	17486.85

30-08-2022	1486.1	1915.45	887.3	531.25	43.95	17766.85
01-09-2022	1472.15	1902.85	874.35	533.3	44.05	17850.15
02-09-2022	1485.5	1918.85	872.4	536.7	43.2	17871.2
05-09-2022	1495.05	1937.9	882.45	538.9	43.3	17922.95
06-09-2022	1489.35	1915.7	883.65	537.8	43.45	17955.25
07-09-2022	1482.3	1908.25	876.2	532.85	43.75	17874.65
08-09-2022	1497.6	1930.05	898.8	544.65	43.75	18067.85
09-09-2022	1498.6	1926.35	901.25	553.35	43.7	18148.5
12-09-2022	1493.55	1924	907.2	554.9	43.8	18255.55
13-09-2022	1513.1	1923.4	910	558	44.35	18393.45
14-09-2022	1528.65	1954.7	918.1	571.75	46.25	18147.6
15-09-2022	1520.7	1934.15	917.6	572.15	46.1	18282.75
16-09-2022	1492.75	1930.3	909.1	561.8	44.65	17898.3
19-09-2022	1502.6	1929.5	899.2	572.25	44.5	17828.75
20-09-2022	1520.7	1939.75	916.75	574.05	45.25	18161.35
21-09-2022	1518.35	1918.5	915.25	569.7	44.15	18041.15
22-09-2022	1486	1892.75	903.4	567.3	44.05	17914.15
23-09-2022	1446.15	1862.7	882.25	550.6	42.6	17686.05
26-09-2022	1426.65	1829	861.05	543.3	40.25	17329.3
27-09-2022	1413.85	1799.3	852.55	536.5	40.45	17290.85
28-09-2022	1389.55	1792.6	849.5	524.85	40.1	17179.25
29-09-2022	1382.35	1765.3	843.9	521.75	40.15	17139.25
30-09-2022	1421.35	1819.2	862	530.6	41.25	17080.65
03-10-2022	1413.2	1783.9	848.35	519.75	41.2	17137.3
04-10-2022	1453	1822.25	867.65	532.7	42.7	17444.4
06-10-2022	1437	1818.9	885.45	537.3	42.35	17647.4
07-10-2022	1430.8	1825.4	882.55	530.2	42.7	17532.9
10-10-2022	1415	1808.25	881.75	530.75	46.55	17380.6
11-10-2022	1400.65	1787.9	870.6	527.4	44.6	17251.15
12-10-2022	1409.8	1810.2	868.35	533.8	44	17249.9
13-10-2022	1393.6	1801.5	853.6	521.45	42.65	17247.4
14-10-2022	1439	1834	870.25	527.2	42.5	17418.55
17-10-2022	1446.55	1858.15	885.2	543.65	42.85	17335.5
18-10-2022	1443.85	1859.7	896.9	562.45	43.4	17681.85
19-10-2022	1458.65	1869.35	892.1	553.4	44	17721.25
20-10-2022	1448.8	1863.55	888.65	555.4	44.95	17665.9
21-10-2022	1438.6	1902.65	907.15	560.85	44.3	17751.25
25-10-2022	1450.9	1846.6	925.05	578.55	45.05	17871
27-10-2022	1454.4	1865	924.4	579.65	45.2	17899.65
28-10-2022	1458.7	1884.25	907.85	570.75	44.45	17950.1
31-10-2022	1496.7	1901.95	908.7	573.8	43.9	18125.1
01-11-2022	1513.25	1909.2	908.6	576.9	43.75	18290.35
02-11-2022	1514.2	1909.95	904.7	573.85	43.45	18287.35
03-11-2022	1507.55	1900.15	908.65	584.9	44.5	18198
04-11-2022	1497.15	1899.95	905.3	593.95	45.3	18254.65
07-11-2022	1508.8	1882.6	917.5	614.15	46.6	18309.4
09-11-2022	1508.35	1893.4	910.5	615.55	49.5	18363.85
10-11-2022	1524.75	1912.15	910.7	605.75	49.45	18202.15
11-11-2022	1611.15	1899.1	906.55	601.3	47.85	18498.9
14-11-2022	1615.05	1922.8	894.95	592.55	47.05	18547.05
15-11-2022	1619	1912.4	911.7	600.85	47.4	18516.8
16-11-2022	1632.9	1965.9	913.6	599.75	46.8	18546.95
17-11-2022	1618.15	1950.55	919.8	599.05	46.7	18501.15
18-11-2022	1613.9	1959.55	920.35	602.7	48.35	18385.45
21-11-2022	1597.35	1944.1	921.4	598.1	49.85	18305.75

22-11-2022	1595	1939.75	923.7	599.1	49.1	18307.85
23-11-2022	1599.15	1953.35	927.45	607.65	48.55	18411.1
24-11-2022	1625.15	1944.85	938.85	609.35	48.95	18462.95
25-11-2022	1617.65	1928.4	930.3	607.4	50.95	18583.85
28-11-2022	1600.25	1928.15	937.4	608.6	52.85	18521.6
29-11-2022	1597.85	1925.55	946.75	608.55	54.3	18689.6
30-11-2022	1608.45	1947.05	952.9	602.45	53.45	18762.6
01-12-2022	1619.5	1934.3	940.2	608.1	53.15	18939.6
02-12-2022	1607.1	1930.8	930.6	607.55	53.9	18812.6
05-12-2022	1612.95	1938.45	933.6	617.3	54.25	18755.5
06-12-2022	1611.15	1935.25	922.65	608.95	58.7	18760.2
07-12-2022	1610.45	1911.45	922.15	607.05	58.85	18721.85
08-12-2022	1619.5	1897	931.9	611.65	58	18739
09-12-2022	1631.05	1888.05	929.9	616.5	54.75	18594.7
12-12-2022	1643.75	1865.75	930.3	613.05	55.3	18536.45
13-12-2022	1648.3	1868.5	932.95	616.75	58.1	18688.95
14-12-2022	1662.25	1873.2	921.75	625.5	57.25	18817.35
15-12-2022	1631.8	1863.2	908.8	615.95	58.75	18576
16-12-2022	1639.65	1840.55	902	603.35	57.2	18432
19-12-2022	1644.75	1858.15	906.45	604.45	57.2	18419.45
20-12-2022	1633.4	1847.1	909.7	604.45	55.9	18391.2
21-12-2022	1617.6	1814.6	892.25	593.4	53.7	18324.4
22-12-2022	1612.05	1826.05	890.65	593.4	51.8	18212.5
23-12-2022	1597.65	1821.95	878.9	574	48.8	17855.15
26-12-2022	1629.45	1813.55	893.2	597.1	51.85	17834.1
27-12-2022	1631.1	1820.9	900.65	601.9	52.9	18097.75
28-12-2022	1629.8	1820.1	898.95	601.05	53.1	18200.2
29-12-2022	1641.3	1818.75	908.05	611.8	53.8	18124.8
30-12-2022	1628.15	1827.25	890.85	613.7	54.35	18232.3

Expected Returns					
HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI	NIFTY100
0.005822512	0.015194861	0.010545384	0.026266805	-0.001054852	0.0100973
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0.00696527	0.006485493	0.01033722	-0.000916031	-0.021890547	0.003045518
0.005515826	0.022433841	0.021584952	0.024620272	0.02992278	0.009130441
0.00431062	-0.005756919	-0.000123358	0.004545904	-0.017681729	0.003940841
-0.005942248	0.010119595	0.015902883	0.008427242	-0.009920635	0.009023298
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-0.015543871	-0.000387107	-0.000854388	0.010992218	0.009596929	0.005859708
0.005067844	0.002419998	0.004616693	-0.014206788	-0.027613412	-0.00839209
-0.007112516	-0.01915357	-0.017932229	0.017448623	0.000985222	-0.010383746
-0.006262425	-0.006895276	0.002036409	-0.008603833	-0.003956479	-0.011113127
0.008280757	0.000607261	-0.007147296	-0.017306545	-0.039054471	-0.010972671
-0.023509232	-0.03432738	-0.007577181	-0.017302439	-0.058759521	-0.030487876
0.000940829	0.012805651	0.003991767	0.039832896	0.054526749	-0.009779542
-0.008881657	0.018314146	-0.00880891	0.027034691	0.027027027	0.002302318
-0.0079959	0.004767423	-0.017282212	-0.010507212	-0.029896907	0.012692895
0.015110722	-0.022102571	0.009698276	0.027586847	-0.005181347	0.010895527
0.00754843	0.013308187	0.026533383	-0.011271839	-0.006256517	-0.000881801
0.022335423	0.031040873	0.004239631	0.013894035	0.025406504	0.023751827
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0.005675853	-0.013188621	-0.00484442	-0.018480106	-0.02689243	-0.002722979
-0.038041072	-0.030490306	-0.023715666	0.005532114	-0.016194332	-0.018316957
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0.018031604	0.017245073	0.003351955	0.009804828	0.003089598	0.004681388
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0.003868152	0.005064192	-0.001936173	0.00456045	-0.00845666	-0.001040768
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0.027731031	0.000576324	0.020796156	0.031563233	-0.010558069	-0.007537446
0.018210553	0.019294009	0.015274398	0.000106621	0.046043165	0.02087719
0.00677821	-0.022593527	0.011623246	0.011904762	0.033379694	0.017027938
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-0.007039203	-0.004010443	-0.003867956	0.003298925	0.00541272	0.000710259
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0.007476228	0.01056187	0.004435346	-0.009315773	0	-0.003135983
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-0.018468265	-0.031340835	-0.046511628	-0.035886509	-0.053084648	-0.029758656
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0.006551657	-0.001314532	0.012156948	-0.001360544	-0.005979073	-0.011303688
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0.013776038	0.008419689	0.020043451	0.006274078	0	0.016346882
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0.003004451	0.0112275	0.006292421	0.014595407	0	0.002238524
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0.001401542	0.001885212	0.022496875	0.013940226	0	0.010435699
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0.01758848	0.019557089	0.021630728	0.013970211	0.026898734	0.016090674
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0.008787098	0.040689089	0.017309109	0.00798197	0.007092199	0.01753885
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0.004787607	-0.012306104	-0.007538803	-0.020883401	-0.027097902	-0.0078125
0.003100775	0.009471786	0.004909261	0.001819836	0	-0.000681345
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-0.003442821	0.006270365	-0.001796441	0	-0.036679537	-0.006144132
-0.009013238	-0.002250336	-0.013368984	-0.033797909	-0.06147541	-0.020013834
0.019515788	-0.0046318	0.016009852	0.038686987	0.058823529	-0.001180323
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-0.008076651	0.004651799	-0.019307403	0.003095975	0.010119595	0.005896129

Stock	Mean	Volatility
HDFCBANK	3.81%	0.24%
KOTAKBANK	-2.96%	-0.19%
ICICIBANK	12.99%	0.82%
SBIN	23.68%	1.49%
IDBI	3.86%	0.24%

Risk Free	0.015

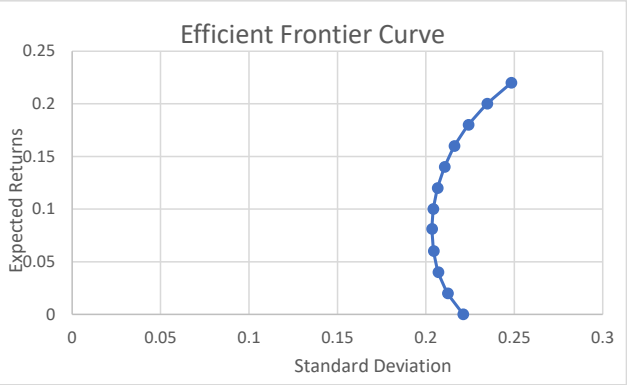
Equally Weighted Portfolio	
Assets	Weights
HDFCBANK	0.281473352
KOTAKBANK	0.601022877
ICICIBANK	0.027908366
SBIN	0
IDBI	0.089595404
Sum	0.999999999

Y	Expected Returns	-1.99113E-08
X	Std Deviation	0.221103328
	Sharpe Ratio	-0.067841674

Covariance Matrix					
	HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI
HDFCBANK	0.064634213	0.038696579	0.033644966	0.030933763	0.024643471
KOTAKBANK	0.038696579	0.062556146	0.033456524	0.031734144	0.031215352
ICICIBANK	0.033644966	0.033456524	0.053114693	0.042366791	0.035901154
SBIN	0.030933763	0.031734144	0.042366791	0.069175292	0.052449816
IDBI	0.024643471	0.031215352	0.035901154	0.052449816	0.199247738

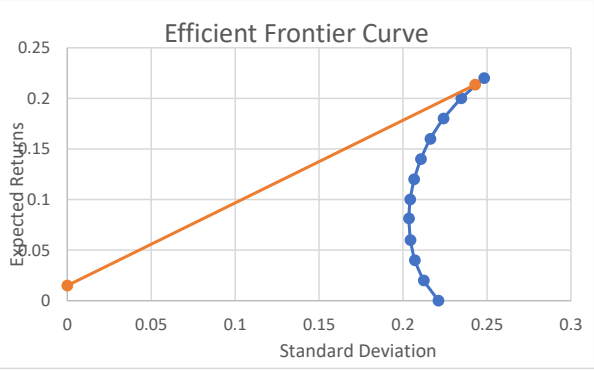
Correlation Matrix					
	HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI
HDFCBANK	1	0.60856412	0.574224238	0.462621721	0.217157056
KOTAKBANK	0.60856412	1	0.580414811	0.482409992	0.279599595
ICICIBANK	0.574224238	0.580414811	1	0.698944557	0.348983075
SBIN	0.462621721	0.482409992	0.698944557	1	0.44675741
IDBI	0.217157056	0.279599595	0.348983075	0.44675741	1

Weight of Assets					Sum	Expected Returns	Std Deviation	Sharpe Ratio	Beta(β)	VaR(5%)
HDFCBANK	KOTAKBANK	ICICIBANK	SBIN	IDBI						
0.28147335	0.60102288	0.02790837	0	0.0895954	1	0	0.22110333	-0.0678417	0.80352097	-2284.2249
0.27088018	0.48691532	0.161564	0	0.0806405	1	0.02	0.21245249	0.02353467	0.79626182	-2181.8369
0.26028712	0.3728078	0.29521943	0	0.07168565	1	0.04	0.20707296	0.12073039	0.7890027	-2113.245
0.24883161	0.30620772	0.32121792	0.06595165	0.0577911	1	0.06	0.20447351	0.22007741	0.78526747	-2073.3741
0.23655276	0.24321917	0.33156868	0.14638202	0.04227736	1	0.08119509	0.2035357	0.32522595	0.7818721	-2049.8919
0.22565935	0.18733343	0.34075137	0.21774245	0.02851341	1	0.1	0.20427429	0.41610719	0.77885978	-2045.2842
0.21407343	0.12789664	0.35051783	0.2936381	0.013874	1	0.12	0.20666247	0.50807483	0.77565582	-2056.9407
0.20245943	0.06794081	0.3602096	0.36939017	0	1	0.14000012	0.21064731	0.59340952	0.77264282	-2085.0923
0.18891604	0	0.36766003	0.44342394	0	1	0.16000014	0.2162371	0.67056088	0.77304033	-2129.8246
0.10695609	0	0.3329093	0.56013463	0	1	0.18000016	0.22412692	0.73619074	0.77097485	-2198.3187
0.02499685	0	0.2981589	0.67684425	0	1	0.2	0.23473552	0.78812104	0.76890938	-2294.9007
0	0	0.15754049	0.8424595	0	1	0.22	0.24831544	0.82556286	0.77518266	-2422.1793



Investement	100000
Assets	β
HDFCBANK	0.83125979
KOTAKBANK	0.7623628
ICICIBANK	0.73045334
SBIN	0.78354708
IDBI	1.01523342

	Volatility	Returns
Risky Portfolio	0.243	0.2135
Risk Free	0	0.015



SUMMARY OUTPUT OF HDFC BANK

Regression Statistics	
Multiple R	0.569346844
R Square	0.324155829
Adjusted R Square	0.321385976
Standard Error	0.013219861
Observations	246

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.02045271	0.02045271	117.0299687	1.54917E-22
Residual	244	0.042642593	0.000174765		
Total	245	0.063095304			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	9.17894E-05	0.000842886	0.108899056	0.913372058	-0.001568471	0.00175205	-0.001568471	0.00175205
NIFTY100	**0.831259787**	0.076840154	10.81803904	1.54917E-22	0.679905123	0.98261445	0.679905123	0.98261445

SUMMARY OUTPUT OF KOTAKBANK

Regression Statistics	
Multiple R	0.530759876
R Square	0.281706046
Adjusted R Square	0.278762218
Standard Error	0.013407829
Observations	246

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.017202863	0.017202863	95.69379611	2.80143E-19
Residual	244	0.043863851	0.00017977		
Total	245	0.061066714			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.000172307	0.00085487	-0.201559537	0.840429014	-0.001856174	0.00151156	-0.001856174	0.00151156
NIFTY100	**0.7623628**	0.077932715	9.782320589	2.80143E-19	0.608856083	0.915869517	0.608856083	0.915869517

SUMMARY OUTPUT OF ICICI BANK

Regression Statistics	
Multiple R	0.551895079
R Square	0.304588179
Adjusted R Square	0.30173813
Standard Error	0.012156281
Observations	246

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.015792915	0.015792915	106.8712284	5.19438E-21
Residual	244	0.036057143	0.000147775		
Total	245	0.051850058			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.000463241	0.000775073	0.597674275	0.550611577	-0.001063446	0.001989928	-0.001063446	0.001989928
NIFTY100	**0.730453341**	0.07065812	10.33785415	5.19438E-21	0.59127564	0.869631043	0.59127564	0.869631043

SUMMARY OUTPUT OF SBIN BANK

Regression Statistics	
Multiple R	0.518753419
R Square	0.26910511
Adjusted R Square	0.266109639
Standard Error	0.01422248
Observations	246

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.0181722	0.0181722	89.83733176	2.3904E-18
Residual	244	0.049356061	0.000202279		
Total	245	0.067528262			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.000883675	0.000906812	0.97448531	0.330780725	-0.000902503	0.002669852	-0.000902503	0.002669852
NIFTY100	**0.783547076**	0.082667856	9.478255734	2.3904E-18	0.62071339	0.946380761	0.62071339	0.946380761

SUMMARY OUTPUT OF IDBI BANK

Regression Statistics	
Multiple R	0.396041397
R Square	0.156848788
Adjusted R Square	0.153393251
Standard Error	0.025925181
Observations	246

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.030507677	0.030507677	45.3905585	1.15213E-10
Residual	244	0.163996068	0.000672115		
Total	245	0.194503745			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	8.0223E-05	0.001652965	0.048532775	0.961331347	-0.003175677	0.003336123	-0.003175677	0.003336123
NIFTY100	**1.015233417**	0.150689552	6.737251554	1.15213E-10	0.718415085	1.31205175	0.718415085	1.31205175