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Finding optimum portfolio weights from past risk & returns

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Abstract
This study examines the portfolio risk & return by analysing the past data of stock prices and then finding out the optimum weights of the stocks in the portfolio which can yield maximum possible return with the minimum portfolio risk. Here, two similar stocks are taken i.e., ICICI Bank & HDFC Bank. The data analysed are of last five financial years i.e., from 01 April 2017 to 31 March 2022. The stock prices have been adjusted with the relevant corporate action happened in the concerned period. The average of the daily returns, daily risk in form of standard deviation and covariance were used as a measure to analyse the stocks. The study resulted in finding out the optimum weights of the stocks in the portfolio and showed that by intra-sectoral diversification, the risk can be minimised with a sustainable return.

Keywords: standard deviation, covariance, portfolio, diversification, unsystematic risk

Introduction
When an investor is entering into the market, he or she is concerned about which stock he or she should choose? After selecting the securities, the problem arises as to in what proportion the investment to be made in different securities so that an investor must be able to get maximum possible return with minimum possible risk.
The two stocks were chosen within which the optimum weights were calculated. Both the stocks i.e., ICICI Bank and HDFC Bank are leading stock in the Indian private banking sector. The rationale behind choosing the similar stocks is that when an investor choses more than one stock from a single sector, the allocation of money within that sector between different stocks is a big concern. Therefore, the similar stocks had been taken for the study.
Diversification in the portfolio means allocating the investible funds over the different securities, instead of investing all the money in one asset. It allows the investor to reduce the unsystematic risk involved in a particular security. This diversification can be inter-sectoral and intra-sectoral. Inter-sectoral diversification means selecting the securities from more than sector and intra-sectoral diversification means selecting more than one security within a sector. Both these kinds of diversification become essential in the effective portfolio construction and management.
Finding the optimum weights is important whether it is in the intra-sectoral or inter-sectoral diversification. To find these optimum weights, the methodology used in this study can be used for any stocks.

Objectives of the Study
This study aimed the following objectives –
1. To know the optimum weights of different stocks in the portfolio.
2. To maximise the returns with the minimum possible risk.

Research Methodology
The sample data comprised of stock prices of last five financial years i.e., from 01 April 2017 to 31 March 2022 for which total 1238 daily prices of stock were available. The stocks chosen for the study are ICICI Bank and HDFC Bank. The source of the data was NSE India which is easily accessible for the investors and analyst. The close prices of the stocks were analysed as this price is the representation of entire day movements in the stock. There was no corporate action happened in ICICI Bank in our concerned period and thus there was no need of adjusting the data of ICICI Bank. In case of HDFC Bank, the face value of stock was reduced from Rs 2 to Rs 1 on 19 Sep 2019. This decision was taken by the Board of Directors on 22 May 2019 as per the information submitted to the stock exchange. Accordingly, the share prices of HDFC Bank from 01 April 2017 to 18 Sep 2019 was adjusted by dividing the close prices by 2 as the face value of the stock was reduced by half i.e., from Rs 2 to Rs 1. After adjustment, now the stock prices of HDFC Bank were available for completed five financial years as per the face value of Rs 1.

The daily returns of both stocks were calculated by the following formula –

$$\textbf{\textit{Daily Returns}} = \left(\frac{\textbf{\textit{Close Price of the Current Day}}}{\textbf{\textit{Close Price of the previous day}}} - \mathbf{1}\right) * \mathbf{100}$$

So, for total 1238 days, daily returns were calculated for 1237 days, leaving the first day i.e., 01 April 2017.
After getting the daily returns, the average was computed which was the Daily Average return and this was annualised by multiplying it by 250 (average number of trading days in a year).
Similarly, the standard deviation of all 1237 days of both stocks were calculated by using stdev.s function in MS-Excel which was the Daily Risk and this was annualised by multiplying it by square root of 250.

Table 1

Parameters	ICICI Bank	HDFC Bank
Daily Average Return	0.10%	0.07%
Daily Risk	2.28%	1.61%
Annual Average Return	25.38%	17.76%
Annual Risk	35.99%	25.42%

The Covariance which measures the joint variability of two variables were calculated by using the covariance.s function in MS-Excel. This value was again annualised by multiplying by 250 & the resultant value was 0.05.
To calculate portfolio's return and risk, following formulas were used –

$$Portfolio' Return = R_{ICICI} * W_{ICICI} + R_{HDFC} * W_{HDFC}$$

$$Portfolio's\ Risk = \sqrt{\sigma^2_{ICICI} * W^2_{ICICI} + \sigma^2_{HDFC} * W^2_{HDFC} + 2 * COV(1,2) * W_{ICICI} * W_{HDFC}}$$

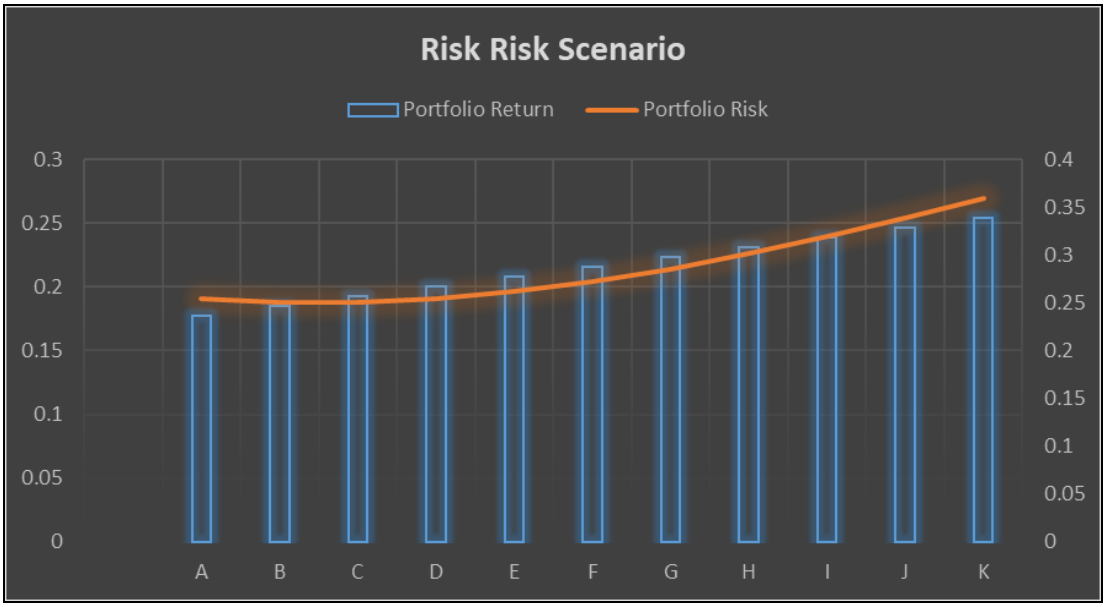
Here,
$R_{ICICI} = Average\ Annual\ Return\ of\ ICICI\ Bank$
$R_{HDFC} = Average\ Annual\ Return\ of\ HDFC\ Bank$
$W_{ICICI} = Weightage\ of\ ICICI\ Bank\ in\ the\ Portfolio$
$W_{HDFC} = Weightage\ of\ HDFC\ Bank\ in\ the\ Portfolio$
$\sigma_{ICICI} = Annual\ Risk\ of\ ICICI\ Bank$
$\sigma_{HDFC} = Annual\ Risk\ of\ HDFC\ Bank$

The portfolio's risk and return were calculated, taking different possible weights of both the stocks as shown below –

Table 2

Risk Risk Scenario				
S.No	Portfolio Weights		Portfolio Return	Portfolio Risk
	ICICI Bank	HDFC Bank		
A	0%	100%	17.76%	25.42%
B	10%	90%	18.53%	25.06%
C	20%	80%	19.29%	25.07%
D	30%	70%	20.05%	25.44%
E	40%	60%	20.81%	26.17%
F	50%	50%	21.57%	27.21%
G	60%	40%	22.33%	28.54%
H	70%	30%	23.09%	30.12%
I	80%	20%	23.85%	31.91%
J	90%	10%	24.62%	33.88%
K	100%	0%	25.38%	35.99%

The calculated risk & return is depicted in the following graph –



Here, the data bars A, B, C shows the different possible combinations of two stocks in the portfolio. Combination A shows 100% weightage of the HDFC Bank in the portfolio whereas Combination K shows 100% weightage of the ICICI Bank in the portfolio.

Result and Analysis

The table above is clearly showing that with the increase in weightage of the ICICI Bank in the portfolio, the returns are also increasing but the risk too. If the investor only rest with the one stock in the sector, he or she may fetch 17.76% return (if invested only in the HDFC Bank as shown by Combination A) or 25.38% return (if invested only in the ICICI Bank as shown by Combination K) with the risk of 25.42% and 35.99% respectively.

Further, if investors opt for intra-sectoral diversification in his or her portfolio, he or she can minimise risks and maximise the return with that level of risk as indicated by Combinations B, C, D, E, F, G, H, I, J and K.

As the objective of the investor is always selecting the portfolio yielding the maximum possible return with the minimum possible risk. Thus, out of all the combinations shown above, the Combination B has the minimum risk of 25.06% with the return of 18.53%.

Although Combination C has the risk of 25.07% which is very near to the minimum possible risk. The return of combination C is 19.29% which is higher than combination B.

So, within the combinations B and C, the risk is increasing by 0.01% while returns are increasing by 0.76%. The increase in return is more than the increase in risk. This means the optimum portfolio weights are somewhere lies between the combination B & C.

Therefore, the investor should go for investing 10-20% of the amount in the ICICI bank and remaining 90-80% in the HDFC Bank.

Conclusion

The Portfolio risks & returns suggested that there can be various possible combinations of the securities in the portfolio. The investor should invest in the optimum weights which can yield the highest return with that given amount of risk. This study also shows that apart from the inter-sectoral diversification in the portfolio which is very much essential in the investments, if the investor performs intra-sectoral diversification i.e., investing in more than one security within the concerned sector, the overall portfolio risk can be reduced along with the increase in overall returns.

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