Data driven simulation of a Portfolio Allocation Model

1 year long project

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Introduction/abstract

Aim of the project/Problem statement A portfolio is a range of investments held by a person or organization. Optimal Portfolio management is a major problem for people nowadays, with a constant need for lucrative methods of investment. This project aims to simulate the ideal portfolio allocation of stocks in various sectors of the industry. This is facilitated with the help of statistical analysis using python modules. The end result is a calculated weight based portfolio distribution and an expected overall return.

Inspiration The reason this project was chosen is that people always look ahead to maximise returns on their investment. Results that our model provides will help them look at potential investment opportunities in the stock market for long term/short term needs.

Present situation/ Work done previously/ Existing reports For this project, two self crafted model portfolios have been chosen. However, the model works for portfolios with any number of stocks, and checks for the allocation and returns of that portfolio.Presently, there are paid simulations available online. This model follows a related approach.

Method

This project makes use of previous stock data of companies and comprises details of prices per year from 2000. After collecting the data, we calculate the mean value, the standard deviation and the correlation of the stocks using the respective formulae. The next step is the random assignment of weights or an “Initial guess”. This is continuously iterated till the ideal weightage or percentage of investment per company is found out based on the value of the Sharpe ratio, which is the ratio of return to that of the volatility/risk. Finally the overall return and the portfolio volatility is calculated.

For performing the above mentioned task, we make use of the numpy, pandas, stats, matplotlib libraries which are available with python. Pandas is used to form a dataframe of available stock data for easy access and manipulation. Numpy is used to perform mathematical operations on the dataframe and arrange the values in a neat array format. Matplotlib is used to plot the given data and the efficient frontier graph which is computed.

Two portfolios were chosen and analysed using the aforementioned method. The portfolios we chose are as follows:

Portfolio 1

a) Rain Industries Ltd. (RAIN.NS)
b) Sterlite Technologies Ltd. (STRTECH.NS)
c) Graftech International Ltd. (EAF)
d) PSP Projects Ltd. (PSPPROJECT.BO)
e) IDFC First Bank limited (IDFCFIRSTB.NS)
f) Mahindra & Mahindra Limited (M&M.NS)
g) Stitch Fix Inc,. (SFIX)

Portfolio 2

a) Maruti Suzuki India Ltd. (MARUTI.NS)
b) Reliance Industries Ltd. (RELIANCE.NS)
c) Tata Consultancy Services Ltd. (TCS.NS)
d) JSW Steel Ltd. (JSWSTEEL.NS)
e) Indian Railway Catering and Tourism Company Ltd. (IRCTC.NS)
f) HDFC Bank Limited (HDFCBANK.NS)

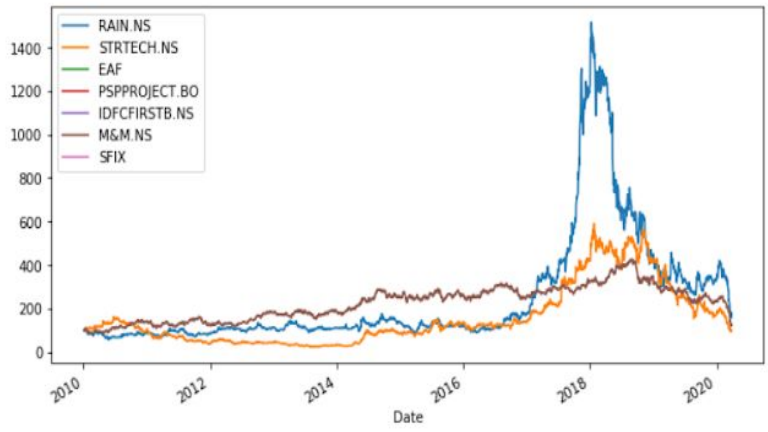
The mentioned portfolios were chosen because of the following reasons:

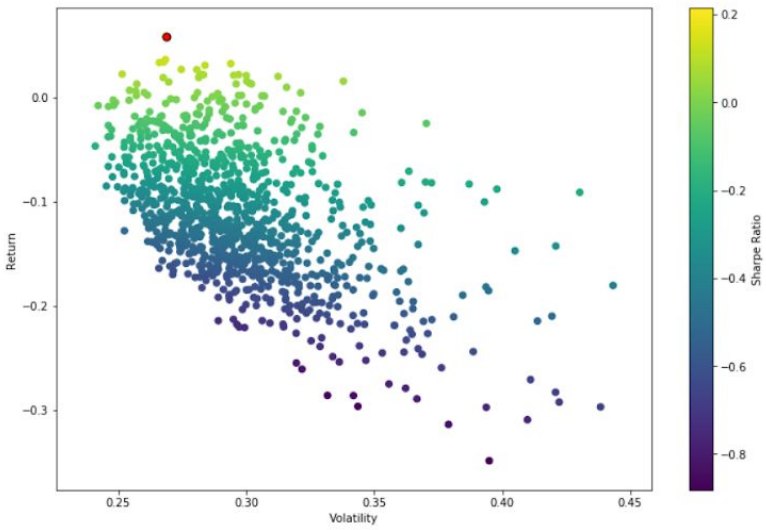
a) Good Price/Earning Ratio
b) Beta coefficient: the beta of an investment is a measure of the risk arising from exposure to general market movements as opposed to idiosyncratic factors. The the market portfolio of all investable assets has a beta of exactly 1. This basically means that if beta>1, the stock is more volatile and is subjected to risk, but offers good returns. If beta<1, stock is less volatile than the market and it is of low risk, but low return too. The above portfolios have a large range of beta values, ensuring there are risk averse, risk neutral and high risk investments.
c) DIversification: A diversified investment is a portfolio of various assets that earns the highest return for the least risk. We have tried our best to ensure asset allocation across various sectors, to ensure that we get the perfect returns.

Results

Portfolio 1

```
enter no. of stocks:-
 7
enter stock ticker:- RAIN.NS
enter stock ticker:- STRTECH.NS
enter stock ticker:- EAF
enter stock ticker:- PSPPROJECT.BO
enter stock ticker:- IDFCFIRSTB.NS
enter stock ticker:- M&M.NS
enter stock ticker:- SFIX

 Maximum Sharpe Ratio in the array: 0.21588687432071482
```

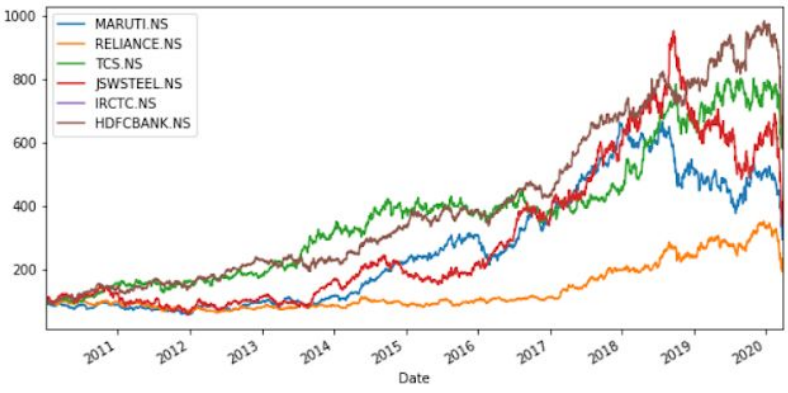


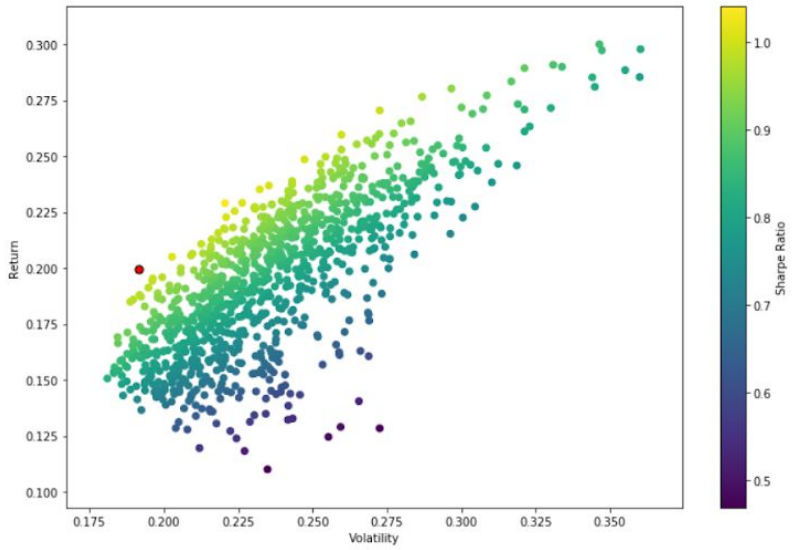



```
Weight of RAIN.NS          is 8.21   %
Weight of STRTECH.NS       is 21.36  %
Weight of EAF              is 1.02   %
Weight of PSPPROJECT.BO    is 43.84  %
Weight of IDFCFIRSTB.NS    is 8.11   %
Weight of M&M.NS           is 16.64  %
Weight of SFIX             is 0.83   %

The EXPECTED return is 17.99 %
```

Portfolio 2

```
enter no. of stocks:-
 6
enter stock ticker:- 'MARUTI.NS'
enter stock ticker:- 'RELIANCE.NS'
enter stock ticker:- 'TCS.NS'
enter stock ticker:- 'JSWSTEEL.NS'
enter stock ticker:- 'IRCTC.NS'
enter stock ticker:- 'HDFCBANK.NS'

 Maximum Sharpe Ratio in the array: 1.04057501317
```






```
Weight of MARUTI.NS       is 3.51   %
Weight of RELIANCE.NS     is 3.57   %
Weight of TCS.NS          is 34.33  %
Weight of JSWSTEEL.NS     is 0.73   %
Weight of IRCTC.NS        is 6.01   %
Weight of HDFCBANK.NS     is 51.86  %


The EXPECTED return is 8.79333980439 %
```

The red point on the graph denotes the ideal sharpe ratio where returns and volatility is balanced. The respective weights of investment for a company are computed at that point.

From the images, it can be seen that the model predicts the ideal allocation for optimal returns.

Obstacles faced:

The primary obstacles faced in the project were data mining, and correct manipulation of that date using Python. Debugging the code for logic/data errors was time consuming.

Conclusion:

From the findings above, we can see that for any portfolio, the ideal method of allocation to achieve the best returns with an optimal risk has been computed. This can further be applied to a company's revenue model and profits to assess their shortcomings and thereby enable proper corrections.

Future work

In the future, a machine learning model with a better optimization of the return prediction can be made.
The current model can also work for returns of bonds, derivatives and currency markets.
A model of the future projections of a company based on returns and profits of all previous quarters can also be prepared.

References

1. https://finance.yahoo.com/

2. https://www.researchgate.net/publication/271068315_A_Monte_Carlo_simulation_technique_to_determine_the_optimal_portfolio

3. https://www.jstor.org/stable/3094492

4. http://redfame.com/journal/index.php/aef/article/download/3376/3735