

How Ten Stocks has been changed in Recent Years

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Abstract: The performance of stocks and portfolios is a major concern for financial analysts as well as stock traders. These analyses involve the consideration of the stock prices in the financial markets over a period of time; in such analyses different statistical tools are used to conduct a comprehensive analysis. The study evaluated the performance of a portfolio from 10 stocks. The portfolio was constructed from different companies occupying various sectors. The study first examined the performance of the individual stocks over a five-year period (March, 2016 to March, 2021) which acted as a basis of performance analysis. The portfolio was then analyzed using descriptive statistics by looking at returns, variance, standard deviation, and Sharpe ratio. Covariance analysis was then carried out to show the relationship between the different stocks. The results indicated that investors or analysts can use different approaches to arrive at their desired investment portfolio. The analysis showed that the minimum variance portfolio is suitable for risk averse investors since it results in low variance. On the other hand, the optimal risky portfolio is suitable for risk loving investors since it results in the highest risk adjusted returns.

1. Introduction

The purpose of this study is to evaluate the performance of a portfolio constructed from 10 stocks drawn from various companies including: NVIDIA Corporation (NVDA), Cisco Systems, Inc. (CSCO), Intel Corporation (INTC), The Goldman Sachs Group, Inc. (GS), U.S. Bancorp (USB), The Toronto-Dominion Bank (TD.TO), The Allstate Corporation (ALL), Procter & Gamble Company (PG), Johnson & Johnson (JNJ), Colgate-Palmolive Company (CL) and a comparison with the S&P 500 (^GSPC) index. First, the study starts by examining the performance of the individual stocks over a five-year period (March, 2016 to March, 2021) to which acts as a basis of performance analysis. This arrangement is made in order to facilitate ease of presentation and understanding of the analysis. The next part of the study involves analysis of the portfolio's performance using descriptive statistics of the stocks and index involved by evaluating the average returns, variance, standard deviation and Sharpe ratios. In the next phase of the study, a covariance model is developed which indicates the existing relationship between different stocks explaining whether they move concurrently or in different directions. Finally, the study takes into consideration the analysis of the relationship of the performance of the portfolio under different combinations of the stocks as to the likely returns which can be achieved where a minimum variance portfolio, optimally risky portfolio, minimum return portfolio and an equal weighted portfolio thus noting the risk versus return in each of the different portfolio combination techniques employed. To visualize the nature of the existing relationship, the study additionally plots different graphs depicting the different frontiers as yielded by each of portfolio combinations in order to determine the portfolio permissible region. Towards the end of the report, recommendations are developed basing our conclusions on outcomes of the model and the exclusive study. To begin with, Descriptive statistics were integral in carrying out the study.

2. The performance of the individual stocks over a five-year period (March, 2016 to March, 2021)

Descriptive statistics involves the use of statistical measures or parameters to summarize insights about a data set usually involving a sample or population; the main measures used in descriptive statistics are mean, median, standard deviation and variance among others [1]. In this study the descriptive parameters used are mean returns, variance and standard deviation.

Table 1. Comparative Analysis

	NVDA	CSCO	INTC	GS	USB	TD CN
Average	2.87%	0.97%	0.87%	1.08%	0.93%	1.29%
Variance	2.59%	0.80%	0.78%	0.73%	0.48%	0.47%
Std dev.	16.08%	8.94%	8.82%	8.52%	6.90%	6.88%
	ALL	PG	JNJ	CL	S&P	
Average	0.96%	0.92%	0.83%	0.72%	0.61%	
Variance	0.53%	0.18%	0.19%	0.20%	0.18%	
Std dev.	7.26%	4.22%	4.34%	4.48%	4.27%	

As shown in Table 1, the average returns, variance and standard deviation of the different stocks used in the study. Stock performance is usually measured in terms of the return versus risk it yields to investors; high yielding stocks are normally preferred to low yielding stocks; however, this is usually depended on the investor risk profile. Risk seeking investors are usually willing to take in more risk per unit increase in returns whereas risk averse investors are keen on the amount of risk exposure as a result of increasing returns [2]. In this case therefore we will evaluate the risk versus return for every stock over the period of analysis.

Regarding the average returns, NVDA presented the highest average returns at 2.87% followed by TDCN at 1.29%, GS at 1.08%, CSCO at 0.97%, ALL at 0.96%, USB at 0.93%, PG at 0.92%, INTC at 0.87%, JNJ at 0.83%, CL at 0.72% and lastly over the period the S&P index yielded an average return of 0.61% being the lowest in comparison to the other stocks in the group. The standard deviation and the variance are usually considered as measures of risk; when conducting an investment performance analysis; the risk level enables the client to determine whether the premium they receive in the form of returns provides enough compensation for the risk incurred [3]. In this case, NVDA has the highest risk with a variance of 2.59%, followed by CSCO at 0.80%, INTC at 0.78%, GS at 0.73%, ALL at 0.53%, USB at 0.48%, TDCN at 0.47%, CL at 0.20%, JNJ at 0.19%, PG at 0.18% and S&P 500 at 0.18%. From the analysis it follows that the stocks that yielded high returns equally presented high risk levels. Investors therefore need to choose their stocks for investment depending on their risk appetite.

Importantly, in the analysis of individual stock performances, it is difficult to conduct an assessment of the superior stocks based on the independent analysis of return and risk profiles. Given this limitation there is the need to use other parameters in evaluating performance. The Sharpe ratio provides a risk adjusted mechanism of determining the return of a stock that incorporates the risk element that is associated with stock returns; it assesses how much excess return is earned by the investor for holding a riskier asset [4].

Table 2. Sharpe Ratio

	NVDA	CSCO	INTC	GS	USB	TD CN
Average	2.87%	0.97%	0.87%	1.08%	0.93%	1.29%
Variance	2.59%	0.80%	0.78%	0.73%	0.48%	0.47%
Std dev.	16.08%	8.94%	8.82%	8.52%	6.90%	6.88%
Sharpe ratio	0.1161	0.1085	0.0991	0.1271	0.1343	0.1874
	ALL	PG	JNJ	CL	S&P	Risk free
Average	0.96%	0.92%	0.83%	0.72%	0.61%	1.0013%
Variance	0.53%	0.18%	0.19%	0.20%	0.18%	
Std dev.	7.26%	4.22%	4.34%	4.48%	4.27%	
Sharpe ratio	0.1327	0.2186	0.1901	0.1615	0.1429	

As shown in Table 2, the analysis of the Sharpe ratios for the 10 stocks indicates that PG yielded the highest Sharpe ratio at 0.2186 an indication that it has the highest risk adjusted returns followed by JNJ at 0.1901, TDCN at 0.1874, CL at 0.1615, S&P 500 at 0.1429, USB at 0.1343, ALL at 0.1327, GS at 0.1271, NVDA at 0.1161, CSCO at 0.1085 and lastly INTC at 0.0991. The results of the Sharpe ratio analysis give a strong sentiment that in order to determine the true extent of superiority of a stock's performance it is important to evaluate the risk adjusted returns. In this case it is clear that even though NVDA yielded the highest returns, the high level of risk-variance (evident in the stock price volatility) impacts negatively on its risk adjusted returns. In portfolio construction, there are many variables that play a crucial role.

In the event that a change in one variable leads to an increase in the other then in that case there is a positive covariance, in the contrary there is a negative covariance [5].

3. Covariance analysis

Table 3. Covariance Analysis Table

	<i>NVDA</i>	<i>CSCO</i>	<i>INTC</i>	<i>GS</i>
NVDA	0.025861	0.007084	0.007332	0.004777
CSCO	0.007084	0.007985	0.00485	0.003685
INTC	0.007332	0.00485	0.007784	0.003168
GS	0.004777	0.003685	0.003168	0.007268
USB	0.001758	0.002023	0.001745	0.002829
TD CN	0.004141	0.002712	0.002524	0.003235
ALL	0.001757	0.001873	0.001839	0.002587
PG	0.000547	0.000818	0.00049	0.000552
JNJ	0.001056	0.000899	0.001241	0.00113
CL	0.000607	0.00066	0.000396	0.000739
S&P	0.003616	0.002416	0.00218	0.002585
	<i>USB</i>	<i>TD CN</i>	<i>ALL</i>	<i>PG</i>
NVDA	0.001758	0.004141	0.001757	0.000547
CSCO	0.002023	0.002712	0.001873	0.000818
INTC	0.001745	0.002524	0.001839	0.00049
GS	0.002829	0.003235	0.002587	0.000552
USB	0.004767	0.002625	0.002579	0.00094
TD CN	0.002625	0.004739	0.002375	0.000816
ALL	0.002579	0.002375	0.005265	0.001047
PG	0.00094	0.000816	0.001047	0.001781
JNJ	0.000687	0.000853	0.001435	0.00086
CL	0.000629	0.00085	0.001296	0.000936
S&P	0.001817	0.00207	0.001923	0.000728
	<i>JNJ</i>	<i>CL</i>	<i>S&P</i>	
NVDA	0.001056	0.000607	0.003616	
CSCO	0.000899	0.00066	0.002416	
INTC	0.001241	0.000396	0.00218	
GS	0.00113	0.000739	0.002585	
USB	0.000687	0.000629	0.001817	
TD CN	0.000853	0.00085	0.00207	
ALL	0.001435	0.001296	0.001923	
PG	0.00086	0.000936	0.000728	
JNJ	0.001887	0.000971	0.000996	
CL	0.000971	0.002003	0.000823	
S&P	0.000996	0.000823	0.001822	

As shown in Table 3, an analysis of the covariance of the various stocks and their relationship with the index – S&P 500 – indicates that all the stocks had a positive covariance relationship with the S&P index. Moving on, correlation analysis is essential in portfolio analysis.

A linear relationship in the range 0 to +1 shows a positive relationship whereas a linear relationship in the range of 0 to -1 shows a negative relationship between the variables [6]. Correlation analysis is important in determining the relationship between the movement of stocks and prediction of future stock price movements.

Table 4. Correlation Analysis Table

	<i>NVDA</i>	<i>CSCO</i>	<i>INTC</i>	<i>GS</i>
NVDA	1	0.492962	0.516776	0.348423
CSCO	0.492962	1	0.615191	0.483784
INTC	0.516776	0.615191	1	0.421242
GS	0.348423	0.433784	0.421242	1
USB	0.158341	0.327964	0.286427	0.480586
TD CN	0.374033	0.440885	0.415627	0.551317
ALL	0.150579	0.238813	0.287287	0.413163
PG	0.080598	0.216884	0.131589	0.153417
JNJ	0.15112	0.231709	0.323782	0.30516
CL	0.084381	0.165126	0.100304	0.193788
S&P	0.526854	0.633303	0.578792	0.710401
	<i>USB</i>	<i>TD CN</i>	<i>ALL</i>	<i>PG</i>
NVDA	0.158341	0.374033	0.150579	0.080598
CSCO	0.327964	0.440885	0.288813	0.216884
INTC	0.286427	0.415627	0.237287	0.131589
GS	0.348423	0.421242	0.418168	0.153417
USB	1	0.552179	0.514733	0.322488
TD CN	0.552179	1	0.475333	0.2808
ALL	0.514733	0.475399	1	0.341905
PG	0.322488	0.2808	0.341905	1
JNJ	0.228994	0.235231	0.455163	0.469173
CL	0.203522	0.275903	0.399034	0.495646
S&P	0.616653	0.70428	0.620825	0.40383
	<i>JNJ</i>	<i>CL</i>	<i>S&P</i>	
NVDA	0.15112	0.084381	0.526854	
CSCO	0.231709	0.165126	0.633308	
INTC	0.323782	0.100304	0.578792	
GS	0.30516	0.193788	0.710401	
USB	0.228994	0.203522	0.616653	
TD CN	0.285231	0.275903	0.70428	
ALL	0.455163	0.399034	0.620825	
PG	0.469173	0.495646	0.40358	
JNJ	1	1	0.53639	
CL	0.499351	1	0.430858	
S&P	0.53689	0.430858	1	

As shown in Table 4, an analysis of the correlation between the stocks and the S&P index indicates that GS had the strongest correlation with the index at 0.71 followed by TDCN at 0.70, CSCO at 0.63, ALL at 0.621, USB at 0.617, INTC at 0.58, JNJ at 0.54, NVDA at 0.53, CL at 0.43 and lastly PG at 0.40. All the stocks exhibited a positive correlation with the index.

4. Results and analysis

Investors and stock traders use different methods when coming up with optimal portfolios. The decision analysis on the mix of stocks is usually dependent on the term of the investment portfolio and most importantly the risk versus return preferences of the investor. The client profile which outlines the objectives and desires of the investor thus play a big role in determining the optimal mix of securities for the investor in a group of stocks. The main portfolio construction strategies employed are equally weighted portfolio construction strategy, minimum variance portfolio construction strategy,

optimal risky portfolio construction strategy and minimum return portfolio construction strategy with the most popular portfolio construction strategies being the optimal risky portfolio construction strategy and the minimum variance portfolio construction strategy.

In this study there is a set of guidelines that have been issued regarding the construction of the different portfolios that are required for this study; these set of guidelines have been incorporated in the portfolios construction as is discussed in the following pages.

The key instructions issued with regard to the portfolio analysis are the creation of portfolios that are optimized for the Markowitz model and the Index Model. The use of the optimization inputs is targeted at realizing the permissible portfolios which will include the efficient frontier, minimal risk portfolio, optimal risky portfolio and the minimal return portfolio.

Given these constraints the three key portfolios that we need to construct are the minimal risk or variance frontier, the minimal return frontier and the efficient risky portfolio. In the construction of the different portfolios, the excel analysis starts with the construction of the equally weighted portfolio; from this portfolio a rebalancing is performed to realize the construction of other mix of portfolios. Firstly, the equally weighted portfolio.

The equally weighted portfolio is constructed by allocating the same amount of funds for each of the stocks that make up an investor’s portfolio (equal asset allocation). For example, if an investor intends to invest funds in five stocks, then each stock will be allocated $(100\%/5) = 20\%$ of the total funds available for investment. This strategy is favored by many investors due to its simplicity and the analogy presented by empirical research that it yields superior returns [7].

Table 5. Equally Weighted Portfolio

	Weights	Average return
NVDA	10%	2.87%
CSCO	10%	0.97%
INTC	10%	0.87%
GS	10%	1.08%
USB	10%	0.93%
TD CN	10%	1.29%
ALL	10%	0.96%
PG	10%	0.92%
JNJ	10%	0.83%
CL	10%	0.72%
Risk free rate		1.0013%
Mean return		1.1447%
Variance		0.2452%
Standard deviation		4.9523%
Sharpe ratio		0.0289

As shown in Table 5, the results of the analysis for the equally weighted portfolio reveals that each of the 10 stocks will have a weighting of 10%. In modelling the portfolio, the results will be based on the weightings and the average returns of each stock. Over the period of analysis, the portfolio yielded a mean return of 1.1447%, variance of 0.2452%, standard deviation of 4.9523% and a Sharpe ratio of 0.0289.

Secondly, the minimum variance portfolio construction strategy involves the construction of a portfolio of assets that will ensure the lowest risk (variance); this approach to portfolio construction is best suited for risk averse investors who are more concerned about the level of risk posed by an investment portfolio [8].

Table 6. Minimum Variance Portfolio

	<i>Weights</i>	<i>Average return</i>
NVDA	0.00%	2.87%
CSCO	0.63%	0.97%
INTC	4.57%	0.87%
GS	1.22%	1.08%
USB	7.82%	0.93%
TD CN	0.55%	1.29%
ALL	0.00%	0.96%
PG	32.90%	0.92%
JNJ	26.51%	0.83%
CL	25.80%	0.72%
Risk free rate		1.0013%
Mean return		0.8478%
Variance		0.1168%
Standard deviation		3.4169%
Sharpe ratio		-0.0449

As shown in Table 6, based on the results of the analysis; the mix of the stocks in the portfolio will consist of 0.63% CSCO, 4.57% INTC, 1.22% GS, 7.82% USB, 0.55% TDCN, 32.90% PG, JNJ 26.51%, CL 25.80%. Further analysis reveals that the mean return using the minimum variance portfolio is 0.8478%, variance is at 0.1168% and the standard deviation at 3.4169%. The portfolio construction resulted in a negative Sharpe ratio of -0.0449.

Figure 1 displays the minimum variance efficient frontier as plotted based on the above data on standard deviation and mean returns

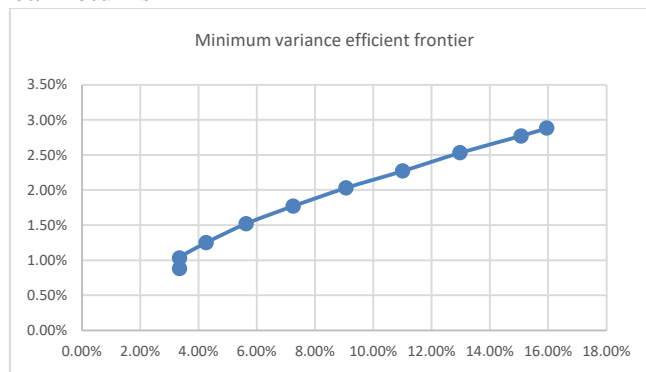


Fig. 1. Minimum variance efficient frontier

Importantly, it is essential to look at the construction of an optimal risky portfolio as portrayed in Table 7.

Table 7. Optimal Risky Portfolio

	<i>Weights</i>	<i>Average return</i>
NVDA	45.44%	2.87%
CSCO	0.00%	0.97%
INTC	0.00%	0.87%
GS	0.00%	1.08%
USB	0.00%	0.93%
TD CN	39.40%	1.29%
ALL	0.00%	0.96%
PG	102.91%	0.92%
JNJ	12.25%	0.83%
CL	0.00%	0.72%
	2.00	
Risk free rate		1.0013%
Mean return		2.8626%
Variance		1.1063%
Standard deviation		10.5180%
Sharpe ratio		0.1770

The optimal risky portfolio strategy is modelled with the aim of obtaining superior returns with little regard for the risk level of the formed portfolio; this strategy is most synonymous with risk-seeking investors who are likely to undertake high risk projects for as long as the return level is justifiable [8].

The results of the analysis indicate that the mix of stocks that will form part of the optimal risky portfolio are as follows; NVDA 45.44%, TDCN 39.40%, PG 102.91%, JNJ 12.25%; these weights are in accordance with the adjustment of the constraints to reflect an aspect in which the total weightings equal 2 ($\sum w_i \leq 2$) as highlighted in the requirements section. The mean return of the portfolio during the period of analysis was 2.8626% with a variance of 1.1063%, a standard deviation of 10.5180% and a Sharpe ratio of 0.1770.

Figure 2 displays the optimal risky portfolio efficient frontier as plotted based on the above data on standard deviation and mean returns.

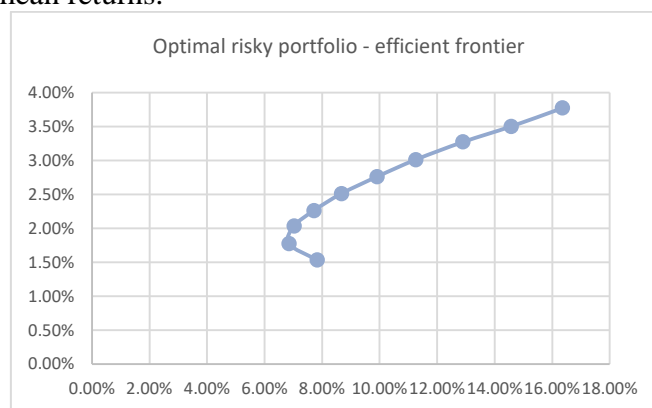


Fig. 2. Optimal risky portfolio-efficient frontier

Lastly is the construction of the minimal return portfolio that evaluates the least return that an investor in the portfolio of assets is likely to realize from the portfolio. This is likened to an assessment of the worst-case scenario. The minimal return portfolio is considered to be of importance in determining the lowest return an investor will get hence assessing whether it will be worth the risk assumed [9].

Table 8. Minimal Return Portfolio

	<i>Weights</i>	<i>Average return</i>
NVDA	5.34%	2.87%
CSCO	0.00%	0.97%
INTC	3.77%	0.87%
GS	0.00%	1.08%
USB	4.39%	0.93%
TD CN	8.28%	1.29%
ALL	0.00%	0.96%
PG	40.83%	0.92%
JNJ	18.85%	0.83%
CL	18.55%	0.72%
Risk free rate		1.0013%
Mean return		1.0000%
Variance		0.1275%
Standard deviation		3.5704%
Sharpe ratio		-0.0004

As shown in Table 10, the results indicate that the weight of the different stocks in the portfolio were as follows; NVDA 5.34%, INTC 3.77%, USB 4.39%, TDCN 8.28%, PG 40.83%, JNJ 18.85% and CL 18.55%. The mean return yielded by the portfolio over the period was 1%, the variance was 0.1275% and the standard deviation was 3.5704%. The Sharpe ratio yielded by the portfolio was -0.0004.

To show the interaction of these portfolios, is essential to look at the capital market line. The capital market line represents the combination of portfolios that ensure optimization of both risk and return; the capital market line theoretically represents that lead to an optimal combination of risky assets in a portfolio and the risk-free rate of return this showing the permissible regions that can be explored by financial analysts or investors to maximize their returns while minimizing risk [10].

For various range and combinations of the stocks, it is evident that the stock from NVDA which showed a return of 2.87% had the highest portfolio return showing a minimum return portfolio of 2.75%. other stocks had relatively almost equal portfolio performance indicating that NVDA stocks could be most preferred in any combination to achieve an optimal portfolio returns and for the purposes of diversification of such a portfolio.

Based on the results of the analysis, an investor should consider the optimal risky portfolio strategy as it presents the possibility of achieving the maximum return at an optimized risk level (lowest risk realizable). The key limitations of the study are that; the constraints put forward may result in a portfolio which does not have the maximum possible return and secondly, the concept of borrowing at the risk-free rate in order to invest in stocks may not always be practical (viable) due to the risk that is associated with stock investments.

5. Conclusion

The purpose of this study was to evaluate the performance of a portfolio constructed from 10 stocks drawn from various companies. The study used different statistical tools such as; descriptive statistics, Sharpe ratio and covariance analysis to model the performance of the portfolio under different weightings namely; minimum variance portfolio, optimally risky portfolio, minimum return portfolio and an equal weighted portfolio. The results of the analysis indicate that investors or analysts can use different approaches to arrive at their desired investment portfolio. However, it is important to construct a client profile so as to determine the level of risk that an investor will be willing to assume for a given risk level. As shown by the results of the study; the minimum variance portfolio is suitable

for risk averse investors since it results in low variance, the optimal risky portfolio is ideal for risk seeking investors since it results in the highest risk adjusted returns (Sharpe ratio), the equal weighted portfolio is suitable for investors in search of simple models for portfolio construction and the minimum return method can be used to evaluate the minimum returns that should be expected from a portfolio. Lastly the last graph depicting the capital market line versus a plot of the portfolio construction models forms a good basis for evaluating the permissible optimal portfolio regions.

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