

# **Portfolio diversification to beat market returns**

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Covid-19 pandemic has wreaked havoc around financial markets worldwide. Within a span of days, we saw the S&P drop to historic lows. To offset this Central Bank around the world have started printing money at record levels and other quantitative easing measures. These measures, albeit necessary to keep the world economy afloat has rightfully worried investors. About 35% of all dollars printed by the federal reserve in the USA was just in 2020 (Meehan, 2020). Inflation is on a steep rise and investors need a safe haven to bury their nest egg without losing its value. Throughout this paper I will attempt to find an optimal portfolio that can maximize total return and minimize total risk.

When the first lockdown measures were announced in March 2020, it caught the world off-guard as hardly anybody alive had seen lockdown measure before in their lives and it had understandably scared investors. Within a span of hours, we saw S&P, DOW and Nasdaq drop to record lows (Frazier, 2021). Within the exception of essential businesses like grocery store, everything was ordered to be shut. Within a week millions of people across Canada were out of work and government had to undertake major benefits program like CERB to act as a support. With rising unemployment levels, earnings and growth potential of companies would be affected on a large scale and with people losing jobs, there would be a fight for liquidity as investors rush to the stock market to sell their positions and retrieve whatever amount that would be left of them. In this paper I will attempt to find an optimal portfolio that can weather the storms and generate returns that can beat the market.

## **Methodology**

In order to understand how portfolio diversification could help, we will first need to divide the economy into different sectors as not all areas of the economy have faced the same fate. In fact, some areas like automotive & technology vastly outperformed the S&P in 2020. However, during the initial phase of covid-19 restrictions, only consumer staples and utilities were expected to outperform the stock market index.

Table. 1

Sector	Ticker
Information Tech (IT)	Vanguard InfoTch Idx;ETF (ARCX:VGT)
Real Estate	Vanguard RE Idx;ETF (ARCX:VNQ)
Financials	Sel Sector:Finl S SPDR (ARCX:XLF)
Healthcare	Sel Sector:H Care SPDR (ARCX:XLV)
Energy	Sel Sector:Energy SPDR (ARCX:XLE)
Consumer discretionary	Sel Sector:C Dsc SPDR (ARCX:XLY)
Consumer Staples	Sel Sector:C Stp SPDR (ARCX:XLP)
Utilities	Sel Sector:Util SPDR (ARCX:XLU)
Materials	Sel Sector:Matrls SPDR (ARCX:XLB)
Communications Services	Vanguard Comm Indx;ETF (ARCX:VOX)
S & P (^GSPC)	S&P 500 INDEX

The Table 1 above shows below shows the different sectors of the economy based on the Global Industry Classification Standards (GICS) (Hayes, 2021). It was developed by the S&P as

an industry taxonomy for the global finance community. I have chosen this classification since this is one of the most widely used classification system. To represent these different sectors, I have picked the following ETF(s) as shown under the ticker column in Table 1. Since these ETFs track its corresponding sector, it can present a good picture of the performance of the sector historically and post-covid. In addition to the sectors listed above, I have also included the ^GSPC S&P 500 index (SPX, n.d.). Since, I will be looking at sector performance and attempt to find an optimal portfolio invested in these sectors, I will need to benchmark it against the S&P 500 to see how the sectors have performed compared to the S&P and simulate how an optimal portfolio will perform in future.

The timeline over which these sectors are between January 2005 to October 31, 2021. This timeline covers much of the interesting stock market events in recent memory – including the sub-prime mortgage crisis of 2008, the Euro credit crunch, the nearly 40% growth of the S&P in 2019 and the Covid-19 crash of 2020.

In order to find an optimal portfolio invested in all these sectors we must find a combination of weights that maximize the Sharpe ratio. The Sharpe ratio is used to help investors understand the return of an investment compared to its risk (Fernando, 2021). The ratio is the average return earned in excess of the risk-free rate per unit of volatility or total risk. Volatility is a measure of the price fluctuations of an asset or portfolio (Fernando, 2021).

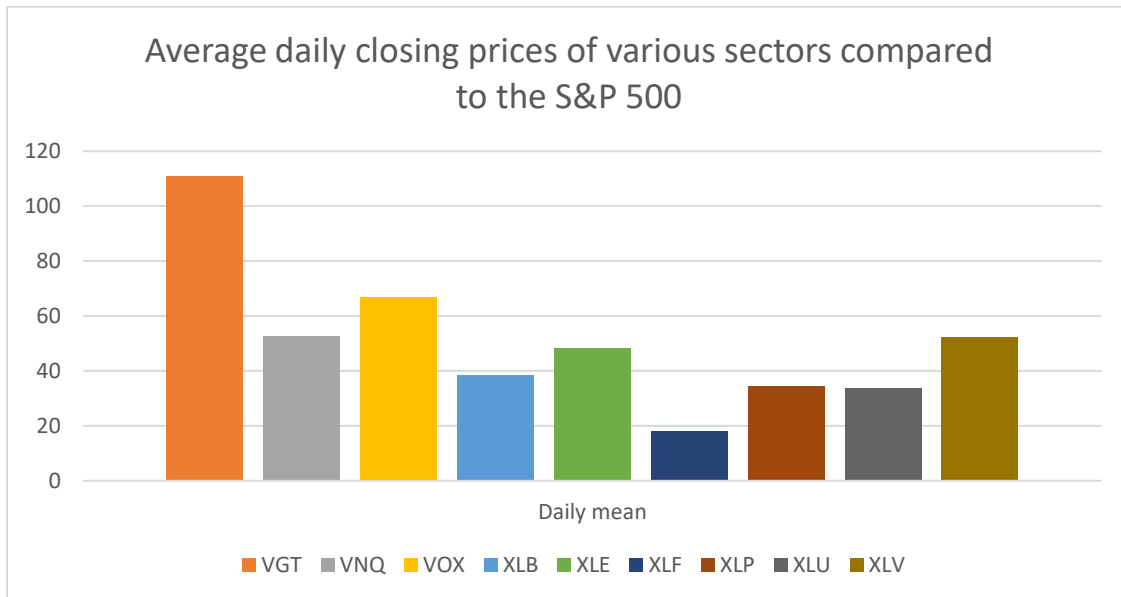
## **Process and Findings**

The first step would be to see how these sectors have performed historically through the selected timeline. The reason we will look at historical performance is to see the effects of the various events on the events in the timeline on the sectors and the recovery of these sectors will

help understand how they might perform in the future. The Table 2. and the graph below shows the average daily returns (adjust daily closing price) of the sectors mentioned above and the S&P 500 index.

Table B.

Ticker	Daily mean
VGT	110.97148
VNQ	52.58831
VOX	66.67717
XLB	38.47402
XLE	48.30209
XLF	17.98773
XLP	34.52795
XLU	33.731
XLV	52.20098



Looking at this table we can now see the \$ average the ETF(s) have performed since January 2005. However, without comparison it would not make much sense, therefore it needs to be compared the S&P 500 benchmark (SPX, n.d.). IT sector (VGT) have outperformed the S&P by more than double its value to the point where there is not even any close second the IT sector. Sectors like XLV (Healthcare) and VNQ (Real estate) have slightly outperformed the S&P. Other sectors like XLU (Utilities), XLF (Financials) and XLB (Materials) have underperformed. It is worth noting that after the sub-prime crisis of 2008 Financials fell to one of the lowest dollar values compared to rest of the sectors and has consistently been trying to catch up to the other sectors since then.

However, looking at just dollar values without looking at the time series trend can be quite misleading. To understand how these sectors have grown (or lost), we need to take a look at the average monthly returns. This is shown on Table 3. Below. Unsurprisingly, IT sector has shown the biggest monthly overall growth of 1.31%. While earlier it was observed that sectors like Utilities (XLU) and XLB (Materials) had underperformed the S&P, it still boasts a net positive monthly return.

Table 3.

Sector	Average monthly returns $E[r]$
VGT	1.31%
VNQ	0.91%
VOX	0.78%
XLB	0.88%
XLE	0.76%
XLF	0.62%
XLP	0.83%
XLU	0.82%
XLV	0.95%
XLY	1.10%

The next statistic that would be helpful to understand the historical performance of these sector ETFs would be the standard deviation. Standard deviation of returns is a measure of volatility or risk. It measures how much the investment returns deviate from the mean of the probability distribution of investments (Nickolas, 2020). The larger the return standard deviation, the larger the variations you can expect to see in returns. It measures the dispersion of the returns relative to its mean. From a financial standpoint, the standard deviation can help investors quantify how risky an investment is and determine their minimum required return on the investment (Nickolas, 2020). A high portfolio standard deviation highlights that the portfolio risk is high, and return is more volatile in nature and, as such, unstable as well. Table 4 shows the standard deviations of different sectors of S&P500 ETF.

Table 4.

Sector	S.D of monthly returns
VGT	0.0529
VNQ	0.0640
VOX	0.0463
XLB	0.0576
XLE	0.0758
XLF	0.0644
XLP	0.0329
XLU	0.0018
XLV	0.0388
XLY	0.0514

Here we see that, sectors like IT (VGT), communications (VOX) are less risky when compared to the S&P but sectors like real estate (VNQ) and energy (XLE) are riskier than the S&P (SPX, n.d.). Theoretically if an investor invested all their money on the IT sector (VGT), it would have returned the most compared to all else, however, we need to take into account the risk as well. Or theoretically all of the money of an investor could be invested in the sector with the lowest standard deviation, but that would not necessarily maximize returns, even if it has minimal risks. Hence, the optimal portfolio will be a combination of other assets and not just the most return maximizing sector.



Table 5. below shows the variance-correlation matrix.

	vgt	vnq	vox	xlb	xle	xlf	xlp	xlu	xlw	xly
vgt	0.0478895	0.0444227	0.0354852	0.0411238	0.0432778	0.0490932	0.0212292	0.0229272	0.0275098	0.0396936
vnq	0.0444227	0.0940953	0.0424211	0.0492476	0.0526901	0.0766547	0.0273140	0.0348926	0.0300369	0.0487379
vox	0.0354852	0.0424211	0.0412106	0.0356229	0.0399009	0.0460408	0.0199661	0.0230565	0.0243448	0.0346908
xlb	0.0411238	0.0492476	0.0356229	0.0587326	0.0588164	0.0555541	0.0226682	0.0267044	0.0286454	0.0402003
xle	0.0432778	0.0526901	0.0399009	0.0588164	0.0958416	0.0627906	0.0239574	0.0321062	0.0305858	0.0424097
xlf	0.0490932	0.0766547	0.0460408	0.0555541	0.0627906	0.0973904	0.0284204	0.0309991	0.0343906	0.0526984
xlp	0.0212292	0.0273140	0.0199661	0.0226682	0.0239574	0.0284204	0.0203212	0.0191529	0.0179897	0.0218653
xlu	0.0229272	0.0348926	0.0230565	0.0267044	0.0321062	0.0309991	0.0191529	0.0356874	0.0197672	0.0228969
xlw	0.0275098	0.0300369	0.0243448	0.0286454	0.0305858	0.0343906	0.0179897	0.0197672	0.0291711	0.0265119
xly	0.0396936	0.0487379	0.0346908	0.0402003	0.0424097	0.0526984	0.0218653	0.0228969	0.0265119	0.0451554

The table above show cases a variance correlation matrix. The reason to is how much the variance of returns correlates between the different sectors. To build an ideal optimal portfolio, the risks (variance) of the sectors and how they correlate needs to be taken into account. Based on the average monthly returns data posted above in Table A. the best option would be to invest all money into technology sector (VGT) since it boasts the highest returns, however that would also raise the risk of the portfolio. Therefore, the goal is the maximize the returns while minimizing risks as much as possible.

### The Optimal Portfolio

As discussed earlier I will focus on Sharpe ratio to find the optimal portfolio. The combination of weights that maximize the Sharpe ratio is the optimal portfolio. To find the Sharpe ratio, I will need a risk-free rate (rf). This is taken from the US T-bill yearly rate, which at the time of this writing is 0.05% (Treasury, 2021). I have used R programming language to derive the optimal portfolio. The code used is available in the appendix. I have also rounded the answers to two decimal places to present a more cleaner picture of the data.

Based on the data from the timeline selected above, I will attempt to simulate the performance of 100,000 portfolios. After running the code, the optimal allocation that minimize risk the most is shown in the graph below.



Based on this we see unsurprisingly, Utilities (XLU) and Consumer staples (XLP) are some of the least risky areas of investments. There will always be a need for utilities and consumer staples as well as healthcare (XLU), therefore investing in those sectors will always yield less risk, however, that does not necessarily mean it will yield the highest return. Based the calculations run, we see that the sector with best Sharpe ratio is unsurprisingly the tech sector (VGT). Table 6. shows the weights for 5 different sectors in an optimal portfolio. I have rounded the values to two decimal places so select my sectors, rather than having miniscule values at each tiny sector allocation. A hypothetical \$1,000,000 should be split between 36% in the tech sector, 22% in the

healthcare sector, 21% in the utilities sector, 12% in consumer staples and 9% in consumer discretionary sector.

Table 6

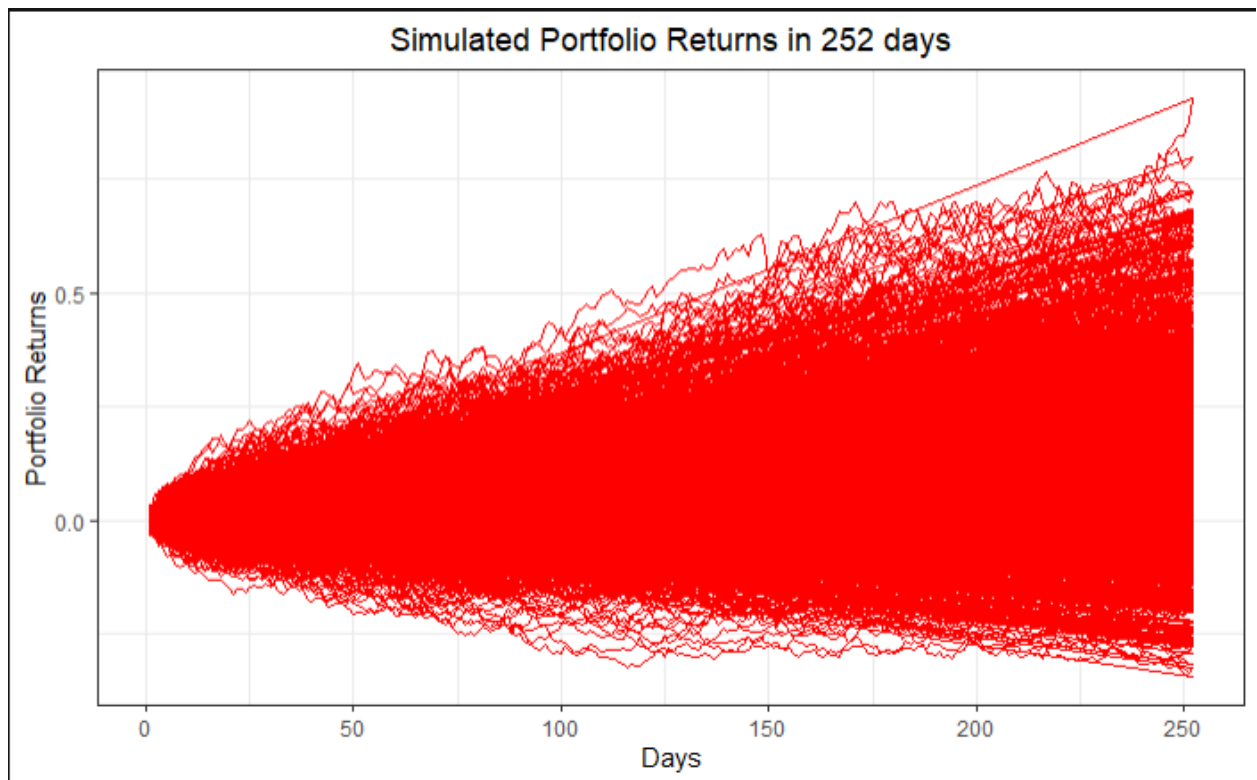
Vanguard InfoTch Idx;ETF (ARCX:VGT)	0.36
Sel Sector:HealthCare SPDR (ARCX:XLV)	0.22
Utilities (ARCX:XLU)	0.21
Consumer staples (ARCX:XLP)	0.12
Consumer discretionary (ARCX:XLY)	0.09



Based on the information we have it is possible to create an efficient frontier. In the graph above we can observe 100,000 possible portfolios. A risk averse investor will demand the highest return for their investment. Therefore, that investor will try to obtain portfolio that is on the efficient frontier. In the graph there are two red portfolios. The lower one shows the minimum variance portfolio and the one above it is the optimal portfolio, the one with the highest Sharpe ratio. The optimal portfolio has return of 11.32% and a standard deviation of 16%.

### Monte-Carlo Simulation

Now that we have the optimal portfolio and its weights, we need to understand how this portfolio will perform. We calculated the optimal portfolio using past data available, so the next question that needs to be answered is whether it is worth of an investor to divide their money in the weighting allocation of this portfolio. To do this I have used Monte Carlo simulation technique to track the portfolio's expected performance. Monte Carlo simulations are used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables (Kenton, 2021). It is a technique used to understand the impact of risk and uncertainty in prediction and forecasting models (Kenton, 2021).



In the graph above a simulated performance of the portfolio over a course of 252 days (# of days the NYSE is open for trading) (NYSE, 2021). In a hypothetical scenario where an investor has \$1,000,000 to invest, they can expect a return between ~\$825,000 and ~\$1,250,000. An average value is expected to be ~\$1,037,500. The next step would be to construct a confidence interval since we want to be able to say how true this simulation will be to the growth trends established in the past. After running the calculation, we can say with 97.5% confidence that the portfolio with return at least 13.92% in the first year.

### Reflection and Conclusion

The results of the calculation point towards a high percentage of allocation on the technology sector and lower in consumer discretionary sector. This should not come as a surprise since the past decade of economic growth has been largely focused on technology sector.

Companies like Shopify and Tesla has skyrocketed in value and have pushed tech sector to new heights.

Another sector that has a high allocation is the healthcare sector. This result is also unsurprising. The world has just passed through a pandemic that impacted millions worldwide. The demand for health services and lifesaving medicine are needed the most during these times. Healthcare stocks saw a surge because of their involvement in developing a vaccine for the COVID-19 virus. Therefore, investment in healthcare is very promising given how the development of pandemic progresses further and future medical research. Similar weight is given to the utilities sector. This is evidently one of the safest sectors since demand for utilities will always exist and we are even observing traditional oil and gas companies invest more heavily in renewable energy sector.

The sectors with the lower weights are consumer staples and consumer discretionary. While growth among these sectors is not as high as tech sector, having these sectors in one's portfolios helps mitigate risk which are brought on as a result of adding the other sectors. Consumer discretionary is one of the sectors that suffered the heaviest blows due to the covid-19 lockdowns. This sector comprises of non-essential products and the lockdowns consumer spending fell to one of the lowest rates in history. Adding to this, unemployment peaked to record levels, therefore an average citizen simply will not have as much after-tax income left for spending on non-essential items (Service, 2021). These sectors are important to keep track of since as economy recovers and consumer spending and confidence rises, so will the growth in the consumer discretionary sector.

The historical average of the S&P 500 has been around 8% since the adoption of the 500 stock method in 1957 (Maverick, 2021). With the sector allocations chosen above our Monte Carlo

estimates a high return of nearly 30%. Even taking into account a potential loss year, the mean estimate of our model is nearly 14% which is about 6% higher than the average return of the S&P. While passive investor can invest in index funds and make returns on par with the S&P, active investors can beat the market with properly allocation funds to different sectors.

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