Predicting Which Index Fund Is Profitable To Invest In:

S&P 500 vs. NASDAQ 100

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Aim

The aim of this exploration is to find which index fund, between the S&P 500 and NASDAQ 100, will be the most profitable in the 3 days from October 25, 2022. By modelling and deriving a formula from the trend of historical data from the index funds, I will find the average rate of change for the next 3 days, create a secant for the next 3 days, and take volatility into account. Essentially, the investigation should answer the question “Which index fund should be worth more money over the next 3 days: October 26, 2022; October 27, 2022; and October 28, 2022?”

Rationale

I have grown up around the stock market; my dad has been an investor ever since I was a child, so I grew up thinking it was a complex concept which was a career path for adults. However, as I grow older I realize that my perception of the stock market is very elementary; anyone, such as myself, can use the stock market to make money. As a result, I started playing the investing simulator on Investopedia to learn about the market and build experience for the future. (Investopedia) Through articles within the simulator, I grew an interest to the index funds S&P 500 and NASDAQ 100; however, I always question myself for if I choose the right one. Both index funds are known to be safe and reliable, but I want to know which is more profitable so I can maximize the efficiency with my money. These index funds were chosen because they follow the same trend in stock price, however there are mixed opinions to which is better; one is more volatile, one is safer, etcetera. (Boyle) With this exploration, I hope to gain a deeper understanding of the stock market and draw a line between economics and mathematics.

Data Collection

The stock market, or the market, is a large platform which consists of public financial exchanges. The market remains open on weekdays, from Monday to Friday, and only from the time 9:30 AM to 4 PM in Eastern Standard Time. (Investopedia) This information is crucial for data collection, as the past 90 market days does not equate to 90 days on the calendar, rather relates to approximately 4 calendar months.

Also, this investigation will be investigating the index funds at market close prices. This means that once the market has closed at 4 PM Eastern Standard Time for that market day, the price the stock is valued at on the market is what will be considered. This is important for data collection as it keeps a constant time for when stock prices are collected each market day and removes and unnecessary variables.

I collected the closing prices of the S&P 500 and NASDAQ 100 in the United States Dollar of the last 90 market days by comprising historical data on Yahoo Finance. (Yahoo Finance) The data I collected ranges from June 17, 2022 to October 25, 2022. (Appendix A & B, Yahoo Finance). The reason I chose to analyze the past 90 market days, or approximately 4 calendar months, is because I thought that the coronavirus' economic fallout may have affected the stock prices. I believe that in the last 4 months, financial conditions have improved, and the economy has recovered from the pandemic. Furthermore, the last 90 days is enough data to generate and correlate a trend which the stock prices are following; the trend which will lead to predicting the closing prices for next 3 market days.

Modelling

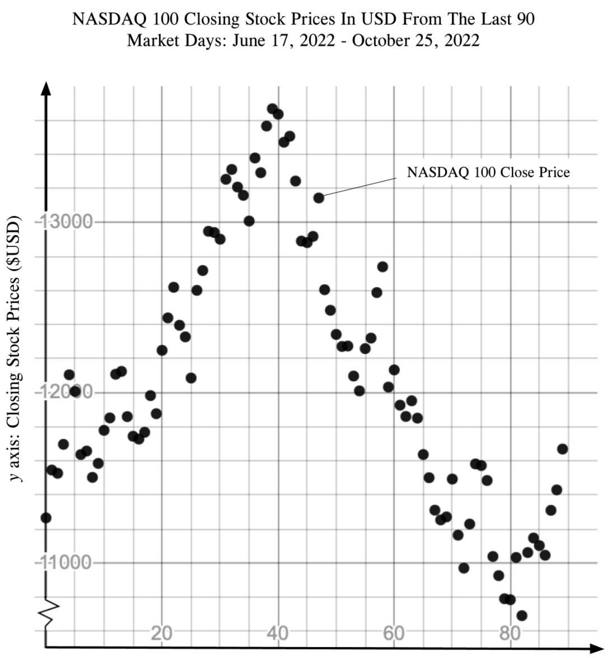
After data has been comprised, numbers 0-89 were assigned to each closing price to represent market days since June 17, 2022. (Appendix A & B, Yahoo Finance) These numbers are on the x axis when plotted on the Cartesian Plane. The function s represents the trend in the S&P 500 stock, and the function n represents the trend in the NASDAQ 100 stock.

Since the x value represents days since June 17, 2022, the number must always be positive. The function determined from the trend is continuous, as the trend is continuous, however, the aforementioned data collection method was at the closing time of the market, so, only the discrete, integer values of x were considered. Furthermore, the aim of the investigation is to predict the closing stock price for the next 3 days; since I have comprised the data for 89 days, the x axis should only contain those days. The minimum x value is 0, as the data was collected. The maximum x value is 92 as it includes the 3 predicting days. The domain of $s(x)$ and $n(x)$ is as follows, and the same domain is followed by all subscripted functions (ex. $s_1(x)$):

$$\{x \in \mathbb{Z}^+ \,|\, 0 \leq x \leq 92\}$$

The y value represents the closing stock price in USD for both models. A stock price can become 0 when it has gone bankrupt, however, a stock price can never be negative. Furthermore, all positive numbers are possibilities for the stock price for both index funds. The range of $s(x)$ and $n(x)$ is as follows, and the same range is followed by all subscripted functions (ex. $s_1(x)$)

$$\{y \in \mathbb{R} \,|\, y \geq 0\}$$



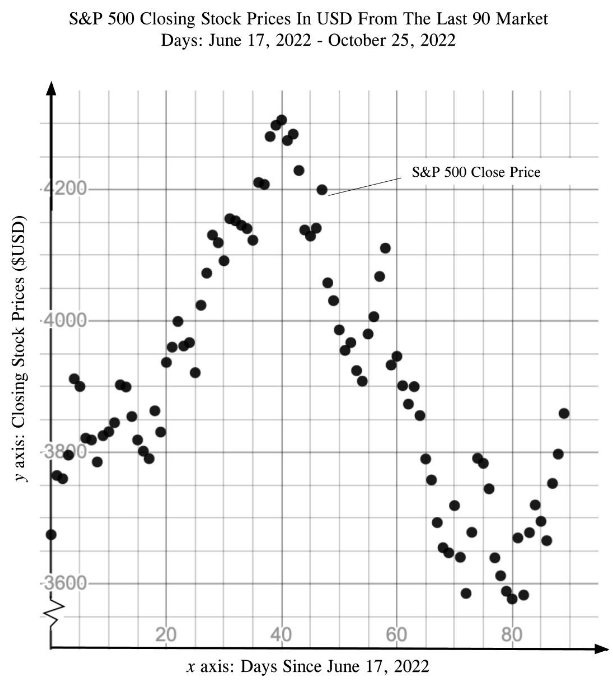


Figure A: Appendix A & B Plotted and Zoomed

After plotting both index funds on two different cartesian planes, it is evident that they both follow similar trends, as mentioned before. However, there is a bias evident as the scale for the *y* axis — the closing stock prices ($USD) — are different between the two*;* the NASDAQ 100's *y* values range from (10500, 13800), while the S&P 500's *y* values range from (3500, 4350).

In order to create the models from these data sets, the functions can be determined through either hand modelling or through a regression. I created regressions through Desmos which also returns an R^2 value, known as the coefficient of determination; a statistical measure that represents the variance for the *y* values that are explained by the *x* values. However, although a high coefficient may represent the given data set to a better capacity, it may not provide a good trend to follow for the prediction. Thus, the models will not be solely analyzed through the R^2 coefficient of determination value, but also logically and practically which suits my aim.

Model One: Polynomial Quadratic Function — Hand Model ($s_1(x)$ and $n_1(x)$)

The data plotted in *Figure A* shows that the data trend starts low, and ends somewhat low. These are the same characteristics evident in a vertically reflected quadratic function — starts low, ends low. I chose to hand model this function, as a quadratic function's transformations are easy to manipulate through vertex form: $a(x-h)^2+k$. Vertex formula is the optimal form to hand model of quadratic function, as the vertex is visibly evident in *Figure A*, and the transformations are easy to manipulate. Furthermore, the data seems to be concave up and starts low and ends low; a quadratic function with a vertical reflection is concave downwards, thus I will require more control for the parameters. Conversely, a regression model would attempt to fit and suit all points of the data sets; however I only need a model the data to identify a trend for a prediction. Thus, a hand model can be more accurate to find a more recent trend which fits more crucial points. The domain and range are the same as $s(x)$ and $n(x)$.

This particular model can be denoted as s_1. For the S&P 500 set of data, the vertex is at day 40, or $x = 40$, as it is a maximum which occurs directly between two minimums. The corresponding closing price, or y value, to this day is 4305.20. Thus, (h, k), the vertex, can be denoted as (40, 4305.20). Therefore, the function so far can be denoted as $s_1(x) = a(x-40)^2 + 4305.20$. Now, the a value can be found substituting any point from the data, such as (17, 3790.38).

$$\text{Let } s_1(17) = 3790.38$$

$$a(17-40)^2 + 4305.20 = 3790.38$$

$$a(-23)^2 + 4305.20 = 3790.38$$

$$529a + 4305.20 = 3790.38$$

$$529a = 3790.38 - 4305.20$$

$$676a = -514.82$$

$$a = \frac{-514.92}{676}$$

$$a \approx -0.762$$

Thus, by substituting a into the function, the quadratic function for the S&P 500 index fund is

$$s_1(x) = -0.762(x - 40)^2 + 4305.20.$$

This same methodology can be applied to the NASDAQ 100 set of data, where n_1 represents this specific model.

$$n_1(x) = -3.78(x - 39)^2 + 13667.07$$

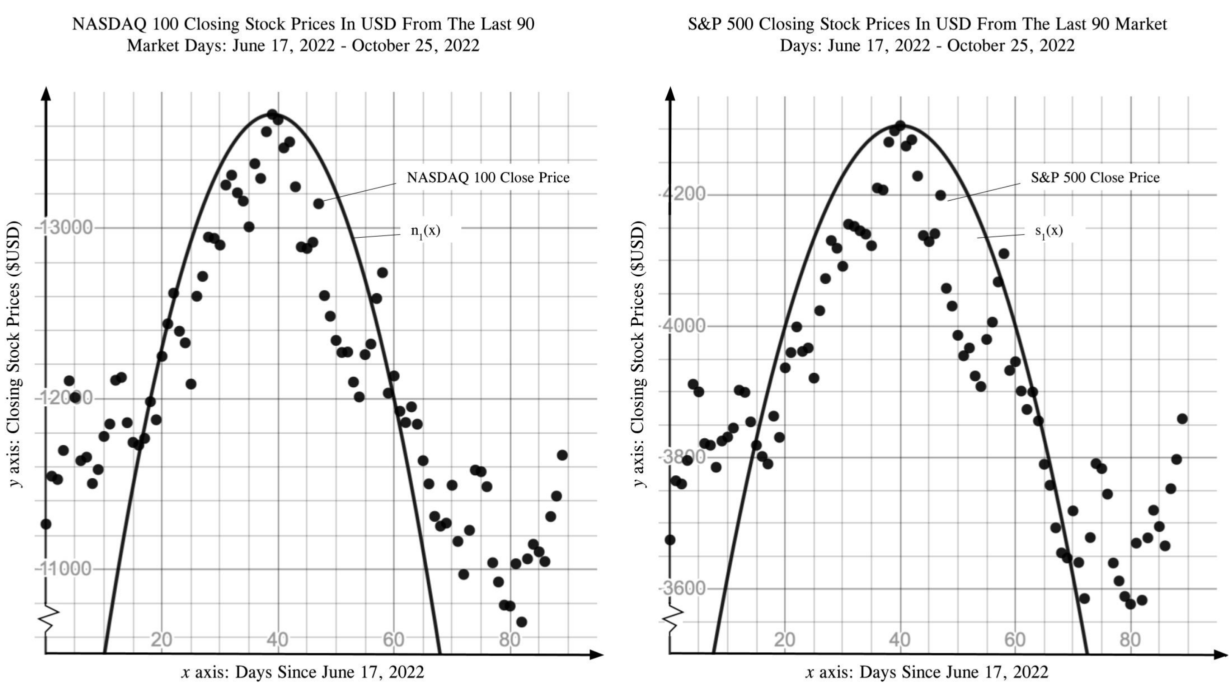


Figure B: Functions $s_1(x)$ and $n_1(x)$

These models and parent function are not suitable or representative for the data. This is because the data is concave up and increasing, then concave up and generally decreasing. This is not possible for a quadratic function; a quadratic can only increase then decrease while staying concave down. This leaves out many points from the model with the quadratic function. For example, by substituting $x = 89$ — the most recent value — to $s_1(x)$ and comparing it to it is evident that the function does not depict the trend well. $s_1(89) \approx 2475.64$, yet, the value on the data set is 3869.11. The same inconsistency between the function and data is experienced by $n_1(x)$. Thus the model does not depict the trend well and it is impossible to make a suitable prediction for the next 3 days with this said model. Therefore, another model is required to depict the data, a model which depicts the data trend as of recently to help reach my aim.

Model Two: Polynomial Quartic Function — Regression ($s_2(x)$ and $n_2(x)$)

Figure A shows that both data sets contain 3 extrema: 2 local minimums and 1 local maximum. For the NASDAQ 100, these are located at $x = 0$, $x = 39$, $x = 80$; for S&P 500, these are located at $x = 0$, $x = 40$, $x = 80$. There are a small amount of data points which move contrasting to the trend to create small turning points, however these turning points will not be considered as they do not depict the general trend of the stock.

The reason I chose to model my data with a polynomial quartic function is because when using it in the form of $ax^4 + bx^3 + cx^2 + dx + g$, it can be calculated how many turning points the function will have by setting the derivative of a function to equate to 0. The derivative of can be taken using the power rule, sum rule, and constant rule: $4ax^3 + 3bx^2 + 2cx + d$. When set to 0 and factored, the zero product rule can determine a maximum of 3 solutions for x, thus, there can be a maximum of 3 turning points in this function. Therefore, in a polynomial quartic function there can be 3 turning points, which suits the data collected, as the data experiences 3 turning points. The regression was done on both data sets, as they follow similar trends. The domain and range are the same as $s(x)$ and $n(x)$.

The following function, $s_2(x)$ represents the S&P 500 data set {Via Desmos Regression}:

$$s_2(x) = 0.000263646x^4 - 0.0433171x^3 + 1.96551x^2 - 17.4174x + 3821.25$$

The following function, $n_2(x)$ represents the NASDAQ 100 data set: {Via Desmos Regression}

$$n(x) = 0.000917469x^4 - 0.148964^3 + 6.46627^2 - 42.558x + 11648.7$$

The values of the parameters within the function are not rounded to keep absolute precision, as these functions will be needed to predict a precise value for the next 3 days.

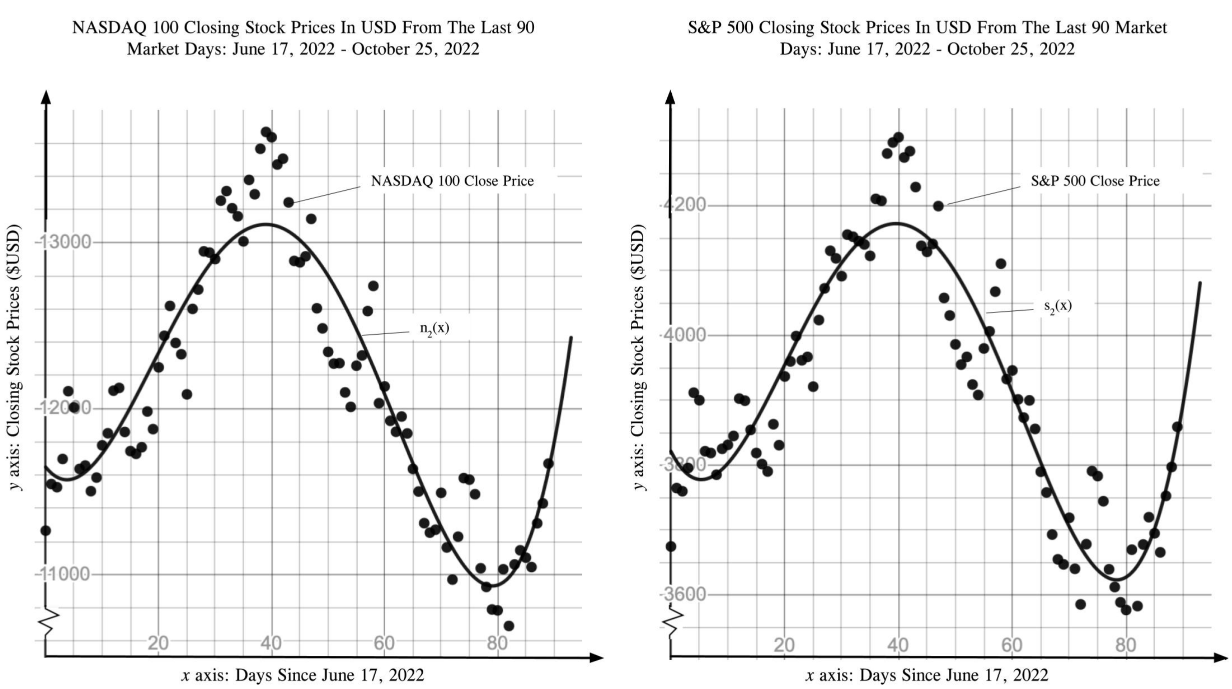


Figure C: Functions $n_2(x)$ and $s_2(x)$

The R^2 value determined by Desmos for $n_2(x)$ is 0.8786, and the R^2 value for $s_2(x)$ is 0.8692. Although the functions include the majority of the given data points, and exhibit a high value as the coefficient of determination, the function does not end realistically. Thus, it makes impractical predictions for the next 3 days. The models depict the data sets experiencing a local maximum or minimum every 39/40 market days (x values). However, these functions at day 93, is nearing a local maximum, especially evident in $s(x)$.

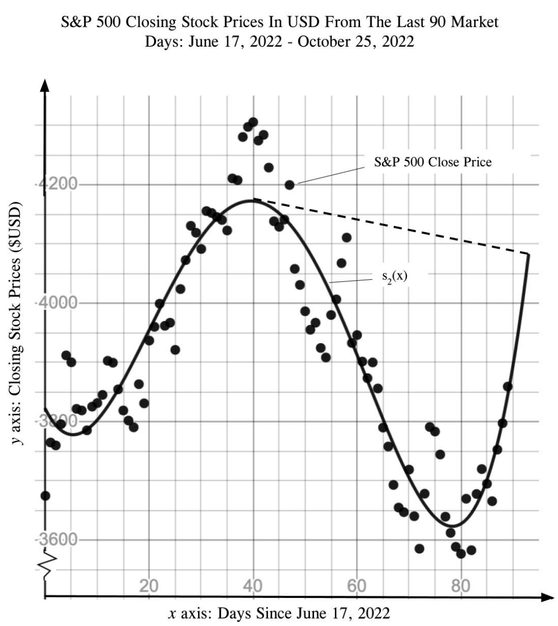


Figure D: Function $s_2(x)$ with a dotted line connecting $s_2(92)$ and $s_2(40)$

$s(93)$ is predicted to be a y value, shown by the dotted line, similar to the local maximum at $x = 40$. If the trend followed the same pattern, the next extrema should be near $x = 120$. Although, the functions depict the data suitably, they do not represent the trend pattern the data is following. Although this polynomial quartic function produces a good coefficient of determination value, it is not suitable for my purpose to predict the next 3 days.

Model Three: Trigonometric Sinusoidal Function — Regression ($s_3(x)$ and $n_3(x)$)

As concluded through $s_2(x)$ and $n_2(x)$, a local maximum and minimum are periodic to around every 39-40 market days since June 17, 2022 (x values). A trigonometric function is a periodic function which fluctuates and reaches similar points over the course of certain x values: the period.

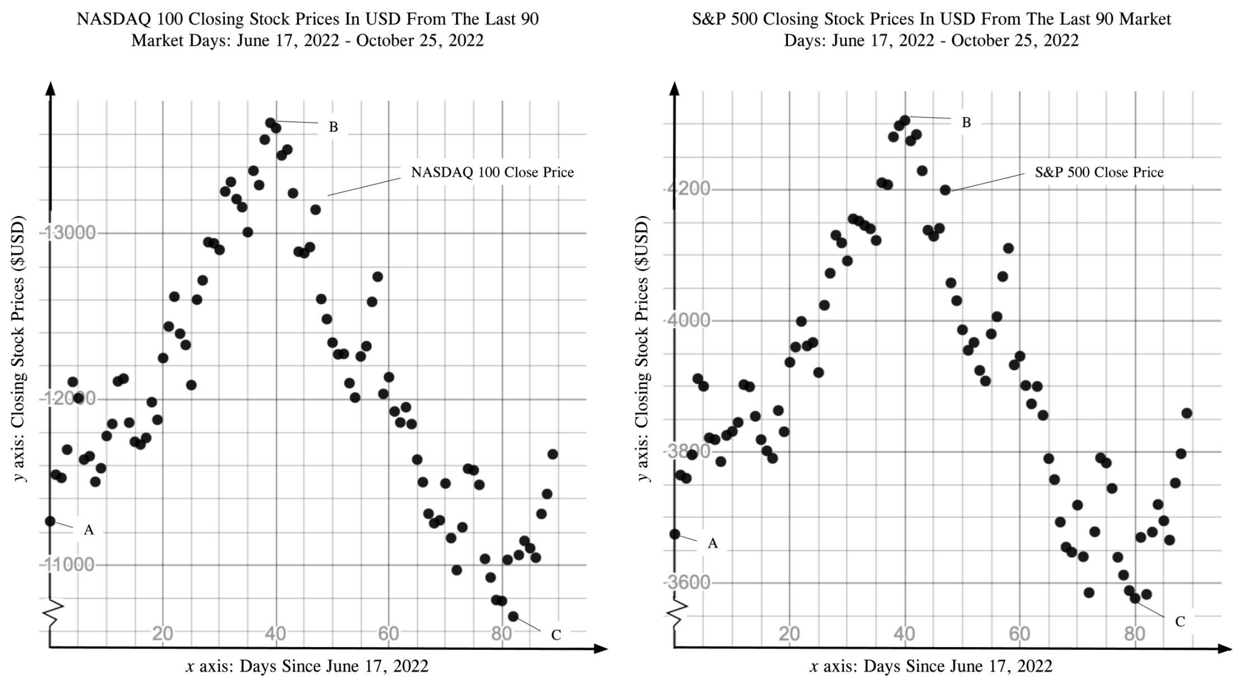


Figure E: Appendix A & B with labeled extrema (A, B, C)

This shows the two data sets such that A and C represent local minimums and B represents the local maximum. It is evident that point C, the second local minimum, is less than point A, the first local minimum for both data sets. This shows that the amplitude of the data essentially increases as the days since June 17, 2022 go on, or the x values increase. Therefore, the x values have to be considered when determining the amplitude of the function. When creating a sinusoidal function with the form $a\sin(b(x-c))+d$, the x value should be placed with the a value, multiplying the parent function, in order to increase the amplitude as the x values increase.

In addition, a sinusoidal function can depict this data, as the starting point of the data is near the centre: between points B and C, the local maximum and local minimum. The regression was also done on both functions, as they both share the same trend. The domain and range are the same as $s(x)$ and $n(x)$.

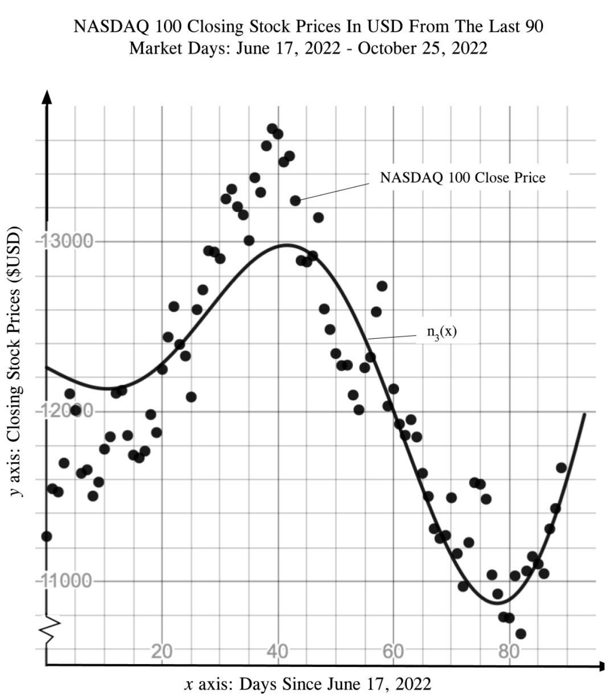
The following function, $s_3(x)$,represents the S&P 500 data set {Via Desmos Regression}:

$$s_3(x) = 4.63691x \sin\left(0.0878477\,(x - 93.073)\right) + 3954.68$$

The following function, $n_3(x)$, represents the S&P 500 data set {Via Desmos Regression}:

$$n_3(x) = -\,18.0375x \sin\left(0.0829073\left(x - 57.107\right)\right) + 12260.30$$

The values of the parameters within the function are not rounded to keep absolute precision, as these functions will be needed to predict a precise value for the next 3 days.



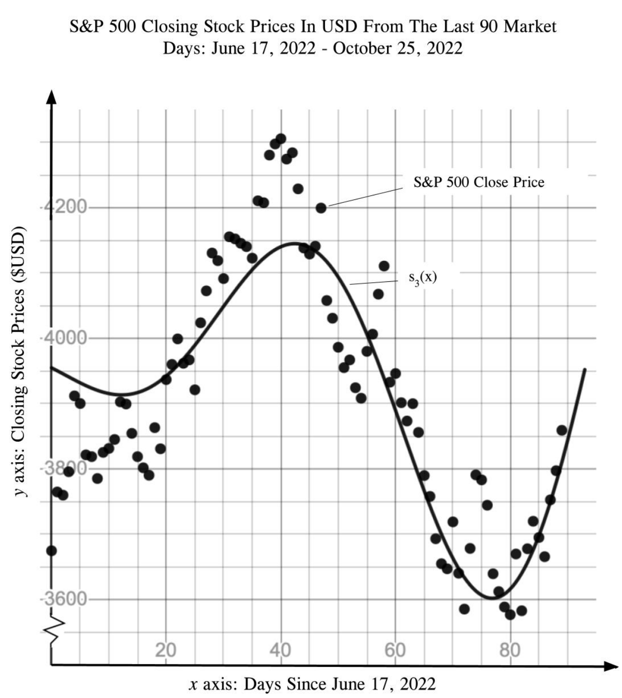


Figure F: Functions $n_3(x)$ and $s_3(x)$

These models are great depictions of both sets of data and solves the problems discovered in $s_1(x)$, $n_1(x)$, $s_2(x)$, and $n_2(x)$. The prior models experienced poor and impractical predictions. This model follows the pattern of the intervals between extrema, and models a viable prediction for the next 3 days. Also, the R^2, coefficient of determination, value is relatively high: $n_3(x)$ is 0.7811, and $s_3(x)$ is 0.7815. Although the values are not as high as $s_2(x)$, and $n_2(x)$, the models are depict the trend for the more recent values to a more practical extent while also taking account the history before. Therefore, a trigonometric sinusoidal function is the most suitable function for both sets of data.

Predicting Profitability Through Rate Of Change

Since I have found a functions to suit my data, $s_3(x)$ and $n_3(x)$, I can find the rate of change to find the trend which the stock is moving in. The higher the rate of change is, the greater jump the price will make over the course of the next three days; therefore, that said fund will be more profitable. To solve through rate of change, I need to find the derivative of both functions, and then substitute the predicted days' x values to the function to find the instantaneous rate of change for that day. For the S&P 500,

$$s_3(x) = 4.63691x \sin\left(0.0878477\,(x - 93.073)\right) + 3954.68$$

$$s_3'(x) = 4.63691\left(\sin\left(0.0878477\,(x - 93.073)\right)\right) + 4.63691x\left(cos\left(0.0878477\,(x - 93.073)\right)(0.0878477)\right)$$

$$s_3'(x) = 4.63691 \sin\left(0.0878477\,(x - 93.073)\right) + 0.4073418786x \cos\left(0.0878477\,(x - 93.073)\right)$$

The values are not rounded to keep precision when finding the rate of change for the predicted days.

I can substitute the predicted days to the derivative to find the rate of change of the S&P 500:

$$s_3'(90) \approx 34.10$$

$$s_3'(91) \approx 35.62$$

$$s_3'(92) \approx 36.87$$

To find the rate of change of the NASDAQ 100 stock, I can use my GDC and substitute in the predicted days:

$$n_3(x) = -\,18.0375x \sin\left(0.0829073\left(x - 57.107\right)\right) + 12260.30$$

$$\frac{\mathrm{d}}{\mathrm{d}x} n_3(x)\,\big|_{x=90} \approx 115.97$$

$$\frac{\mathrm{d}}{\mathrm{d}x} n_3(x)\,\big|_{x=91} \approx 122.80$$

$$\frac{\mathrm{d}}{\mathrm{d}x} n_3(x)\,\big|_{x=93} \approx 128.91$$

These values give me the instantaneous rate of change of the function. For this situation, this shows how much the closing price will change for that day. By averaging all the rates of change for the next 3 days, I can find the total price the index fund will change over the course of the three predicted days. For the S&P 500:

$$\frac{34.10 + 35.62 + 36.87}{3} = 35.53$$

For the NASDAQ 100:

$$\frac{115.97 + 122.80 + 128.91}{3} = 122.56$$

Unrounded values were used for the calculations. The reason the values were rounded is because they represent money (USD), thus, only two decimal places are significant.

The average rate of change shows how the stock closing price changed over the 3 days which I have predicted the stock to be at. It is abundantly evident that the NASDAQ 100 is predicted to increase at a higher rate, as the rate of change for those predicted days are averaged to be higher. However, the derivative was used to find these values, therefore, this is only an estimate of the actual values the function experiences for said x value. The definition of a derivative can be known as the instantaneous rate of change of said function; however, a secant's slope represents the average rate of change. By using the chord answer rather than the tangent answer, I can find the actual average of rate of change for both functions.

By creating a secant through $x = 90$ to $x = 92$, the average rate of change can be determined. To calculate the secant, I can use $\frac{\Delta y}{\Delta x}$, specifically, $\frac{s_3(92) - s_3(90)}{92 - 90}$ and $\frac{n_3(92) - n_3(90)}{92 - 90}$.

To find the slope of the secant for the NASDAQ 100 predicted days, it can be calculated by:

$$m_{\text{secant}_{n_3(x)}} \approx \frac{11851.82 - 11606.48}{92 - 90}$$

$$m_{\text{secant}_{n_3(x)}} \approx \frac{245.34}{2}$$

$$m_{\text{secant}_{n_3(x)}} \approx 122.67$$

The same process can be used for the S&P 500 secant slope.

$$m_{\text{secant}_{s_3(x)}} \approx 35.57$$

The NASDAQ 100 still experiences a far greater average rate of change than the S&P 500. However, these values are different than the values calculated through the derivative before. This is because I used the function's values it experienced rather than using the estimation made by the derivative function. Although, ultimately, they both produced the same result: the NASDAQ 100 experiences a greater increased change in closing price over the 3 predicted days.

Volatility and Risk

Although I have predicted which index fund will increase and become more profitable, the NASDAQ 100 may still have a higher risk when investing. Volatility in a stock is a statistical measure and it depicts the dispersion of financial returns relative to a market index or market security. (Rathburn) Volatility represents the risk involved; when investing, there is a known variance to the stock price which may occur. Such variance makes "predictions" to a stock price, or the expected stock price, have a range dependant to historical differences. This volatility can be calculated through the standard deviation of the stock prices. A high volatility correlates to a high deviation and variance, thus, the predicted stock price can vary to a great extent which creates high risk, and vice versa. (Rathburn) Although volatility does not affect the profitability of the stock, I would like to invest in a reliable and safe stock, therefore, I will consider the lower volatile stock to be more preferable when concluding.

After inputting my data into statistical lists on my GDC, I can find the standard deviation of both indexes. This only accounts for recorded values, and is not included the predicted values from my model. This is because I want to use this risk to factor into if my predictions can be correct and are reliable.

For the S&P 500, the standard deviation is

$$\sigma = 193.88$$

The NASDAQ 100's standard deviation is

$$\sigma = 772.96$$

This means that the S&P 500 stock deviates less than the NASDAQ 100, and in turn should mean that it is more reliable and predictable. A greater variance or deviation means that the NASDAQ 100 is more unpredictable, therefore, my predictions are more likely to be incorrect. However, this is false. When creating the model of the stocks, the data is known to follow a trend. This trend fluctuates around a "central line" in my segment of time horizon; this said line can be portrayed as the mean.

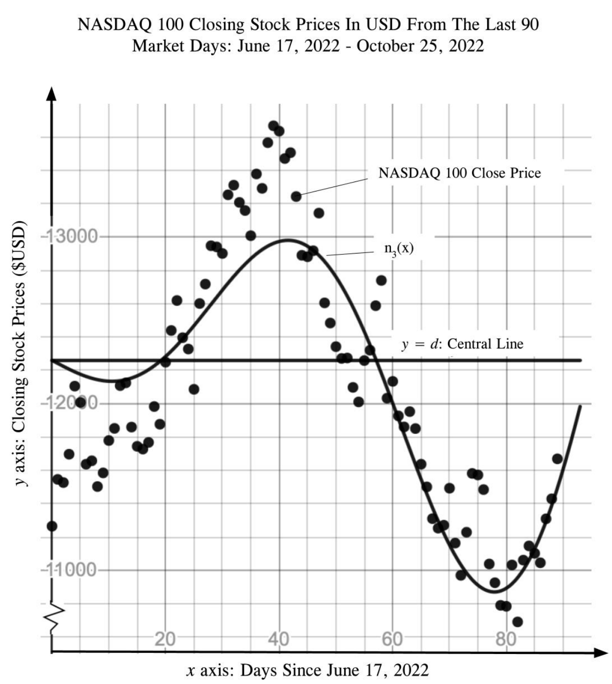


Figure G: Function $n_3(x)$ and $y = d$ {of $n_3(x)$}

Figure G shows the central line which the model $n_3(x)$ fluctuates from — this is also evident in $s_3(x)$. The central line in trigonometric functions is known to be the d value in the form $a\ \sin(b(x-c))+d$. Furthermore, it is already known that the data will fluctuate from the mean, as that is how stocks act, and that is how my model, a trigonometric sinusoidal wave behaves. Therefore, a more accurate and useful measurement of risk in this investigation is the R^2 value the models were given.

The R^2 value portrays how the actual recorded data points differ from my model. The lower the R^2 value my model has, the less suitable it is to represent the data; it also means that it does not touch the actual values, thus the values differ from the model. The R^2 value achieved by my models were 0.7815 and 0.7811. This means that my models were mediocre in representing the data, and thus, there is some room for differentiation and risk. However, as mentioned before, the models represented the recent values more accurately than the older values, thus creating an accurate prediction for the future. Therefore, although an R^2 is given, it is for the entire function and model, thus it is not possible to directly calculate the risk for my 3 predictions. Nevertheless, generally, the S&P 500 is more suited by the model by 0.0004, and thus has a slightly less risk than the predictions made for the NASDAQ 100.

Conclusion

Through my investigation, I have completed my aim to finding which index fund is the most profitable and preferable: NASDAQ 100. Although the S&P 500 fund is slightly less volatile, as its graph has a greater value for its coefficient of determination, and thus has a little less risk —

the profitability of the NASDAQ 100 outweighs the risk. Despite having a 0.0004 lower accuracy for depiction of the trend to its data, the NASDAQ 100 will experience almost 3.45 times the amount of increase in closing price per day (average).

Personally, I am surprised the difference is so large, as the stock prices seemed almost identical to each other in *Figure A* and seemed to follow the same trend. This shows the great danger in bias of graphs: even though the graphs looked almost identical and followed the same trend, due to the difference in range in their scale, the actual values experienced completely different amplitudes and painted a different picture.

I learned that it is very difficult to create a suitable line with predicting economics and the stock market and mathematical modelling. The models and regression tend to suit the historical points rather than creating a practical predication for the future which the trend follows. Although my models $n_3(x)$ and $s_3(x)$ depicted the trend for the next 3 days, if I were to expand the domain, the predictions would be impractical for the long term.

In conclusion, the answer to my question of "Which index fund should be worth more money over the next 3 days: October 26, 2022; October 27, 2022; and October 28, 2022?" is the NASDAQ 100, as the trend depicts that it will experience a higher rate of change in the closing prices over those days.

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Appendix A

S&P 500 Market Close Prices In USD From The Last 90 Market Days: June 17, 2022 - October 25, 2022 (Yahoo Finance)

	Days Since June 17, 2022	Market Close Price ($USD)
Date	x values	y values
Jun 17, 2022	0	3674.84
Jun 21, 2022	1	3764.79
Jun 22, 2022	2	3759.89
Jun 23, 2022	3	3795.73
Jun 24, 2022	4	3911.74
Jun 27, 2022	5	3900.11
Jun 28, 2022	6	3821.55
Jun 29, 2022	7	3818.83
Jun 30, 2022	8	3785.38
Jul 01, 2022	9	3825.33
Jul 05, 2022	10	3831.39
Jul 06, 2022	11	3845.08
Jul 07, 2022	12	3902.62
Jul 08, 2022	13	3899.38
Jul 11, 2022	14	3854.43
Jul 12, 2022	15	3818.80
Jul 13, 2022	16	3801.78
Jul 14, 2022	17	3790.38
Jul 15, 2022	18	3863.16
Jul 18, 2022	19	3830.85
Jul 19, 2022	20	3936.69
Jul 20, 2022	21	3959.90
Jul 21, 2022	22	3998.95
Jul 22, 2022	23	3961.63
Jul 25, 2022	24	3966.84
Jul 26, 2022	25	3921.05
Jul 27, 2022	26	4023.61
Jul 28, 2022	27	4072.43

Jul 29, 2022	28	4130.29
Aug 01, 2022	29	4118.63
Aug 02, 2022	30	4091.19
Aug 03, 2022	31	4155.17
Aug 04, 2022	32	4151.94
Aug 05, 2022	33	4145.19
Aug 08, 2022	34	4140.06
Aug 09, 2022	35	4122.47
Aug 10, 2022	36	4210.24
Aug 11, 2022	37	4207.27
Aug 12, 2022	38	4280.15
Aug 15, 2022	39	4297.14
Aug 16, 2022	40	4305.20
Aug 17, 2022	41	4274.04
Aug 18, 2022	42	4283.74
Aug 19, 2022	43	4228.48
Aug 22, 2022	44	4137.99
Aug 23, 2022	45	4128.73
Aug 24, 2022	46	4140.77
Aug 25, 2022	47	4199.12
Aug 26, 2022	48	4057.66
Aug 29, 2022	49	4030.61
Aug 30, 2022	50	3986.16
Aug 31, 2022	51	3955.00
Sep 01, 2022	52	3966.85
Sep 02, 2022	53	3924.26
Sep 06, 2022	54	3908.19
Sep 07, 2022	55	3979.87
Sep 08, 2022	56	4006.18
Sep 09, 2022	57	4067.36
Sep 12, 2022	58	4110.41
Sep 13, 2022	59	3932.69
Sep 14, 2022	60	3946.01

Sep 15, 2022	61	3901.35
Sep 16, 2022	62	3873.33
Sep 19, 2022	63	3899.89
Sep 20, 2022	64	3855.93
Sep 21, 2022	65	3789.93
Sep 22, 2022	66	3757.99
Sep 23, 2022	67	3693.23
Sep 26, 2022	68	3655.04
Sep 27, 2022	69	3647.29
Sep 28, 2022	70	3719.04
Sep 29, 2022	71	3640.47
Sep 30, 2022	72	3585.62
Oct 03, 2022	73	3678.43
Oct 04, 2022	74	3790.93
Oct 05, 2022	75	3783.28
Oct 06, 2022	76	3744.52
Oct 07, 2022	77	3639.66
Oct 10, 2022	78	3612.39
Oct 11, 2022	79	3588.84
Oct 12, 2022	80	3577.03
Oct 13, 2022	81	3669.91
Oct 14, 2022	82	3583.07
Oct 17, 2022	83	3677.95
Oct 18, 2022	84	3719.98
Oct 19, 2022	85	3695.16
Oct 20, 2022	86	3665.78
Oct 21, 2022	87	3752.75
Oct 24, 2022	88	3797.34
Oct 25, 2022	89	3859.11

Appendix B

Nasdaq 100 Market Close Prices In USD From The Last 90 Market Days: June 17, 2022 - October 25, 2022 (Yahoo Finance)

	Days Since June 17, 2022	Market Close Price ($USD)
Date	x values	y values
Jun 17, 2022	0	11265.99
Jun 21, 2022	1	11546.76
Jun 22, 2022	2	11527.71
Jun 23, 2022	3	11697.68
Jun 24, 2022	4	12105.85
Jun 27, 2022	5	12008.24
Jun 28, 2022	6	11637.77
Jun 29, 2022	7	11658.26
Jun 30, 2022	8	11503.72
Jul 01, 2022	9	11585.68
Jul 05, 2022	10	11779.90
Jul 06, 2022	11	11852.59
Jul 07, 2022	12	12109.05
Jul 08, 2022	13	12125.69
Jul 11, 2022	14	11860.28
Jul 12, 2022	15	11744.99
Jul 13, 2022	16	11728.53
Jul 14, 2022	17	11768.40
Jul 15, 2022	18	11983.62
Jul 18, 2022	19	11877.50
Jul 19, 2022	20	12249.42
Jul 20, 2022	21	12439.68
Jul 21, 2022	22	12619.41
Jul 22, 2022	23	12396.47
Jul 25, 2022	24	12328.41
Jul 26, 2022	25	12086.90
Jul 27, 2022	26	12601.47
Jul 28, 2022	27	12717.87

Jul 29, 2022	28	12947.97
Aug 1, 2022	29	12940.78
Aug 02, 2022	30	12901.60
Aug 03, 2022	31	13253.26
Aug 04, 2022	32	13311.04
Aug 05, 2022	33	13207.69
Aug 08, 2022	34	13159.16
Aug 9, 2022	35	13008.17
Aug 10, 2022	36	13378.32
Aug 11, 2022	37	13291.99
Aug 12, 2022	38	13565.87
Aug 15, 2022	39	13667.18
Aug 16, 2022	40	13635.21
Aug 17, 2022	41	13470.86
Aug 18, 2022	42	13505.99
Aug 19, 2022	43	13242.90
Aug 22, 2022	44	12890.54
Aug 23, 2022	45	12881.79
Aug 24, 2022	46	12917.86
Aug 25, 2022	47	13143.58
Aug 26, 2022	48	12605.17
Aug 29, 2022	49	12484.32
Aug 30, 2022	50	12342.70
Aug 31, 2022	51	12272.03
Sep 01, 2022	52	12274.62
Sep 02, 2022	53	12098.44
Sep 06, 2022	54	12011.31
Sep 07, 2022	55	12259.39
Sep 08, 2022	56	12321.19
Sep 09, 2022	57	12588.29
Sep 12, 2022	58	12739.72
Sep 13, 2022	59	12033.62
Sep 14, 2022	60	12134.40

Sep 15, 2022	61	11927.49
Sep 16, 2022	62	11861.38
Sep 19, 2022	63	11953.27
Sep 20, 2022	64	11851.54
Sep 21, 2022	65	11637.79
Sep 22, 2022	66	11501.65
Sep 23, 2022	67	11311.24
Sep 26, 2022	68	11254.11
Sep 27, 2022	69	11271.75
Sep 28, 2022	70	11493.83
Sep 29, 2022	71	11164.78
Sep 30, 2022	72	10971.22
Oct 3, 2022	73	11229.73
Oct 04, 2022	74	11582.54
Oct 05, 2022	75	11573.18
Oct 06, 2022	76	11485.50
Oct 07, 2022	77	11039.47
Oct 10, 2022	78	10926.97
Oct 11, 2022	79	10791.35
Oct 12, 2022	80	10785.62
Oct 13, 2022	81	11033.58
Oct 14, 2022	82	10692.06
Oct 17, 2022	83	11062.53
Oct 18, 2022	84	11147.74
Oct 19, 2022	85	11103.38
Oct 20, 2022	86	11046.71
Oct 21, 2022	87	11310.33
Oct 24, 2022	88	11430.26
Oct 25, 2022	89	11669.99