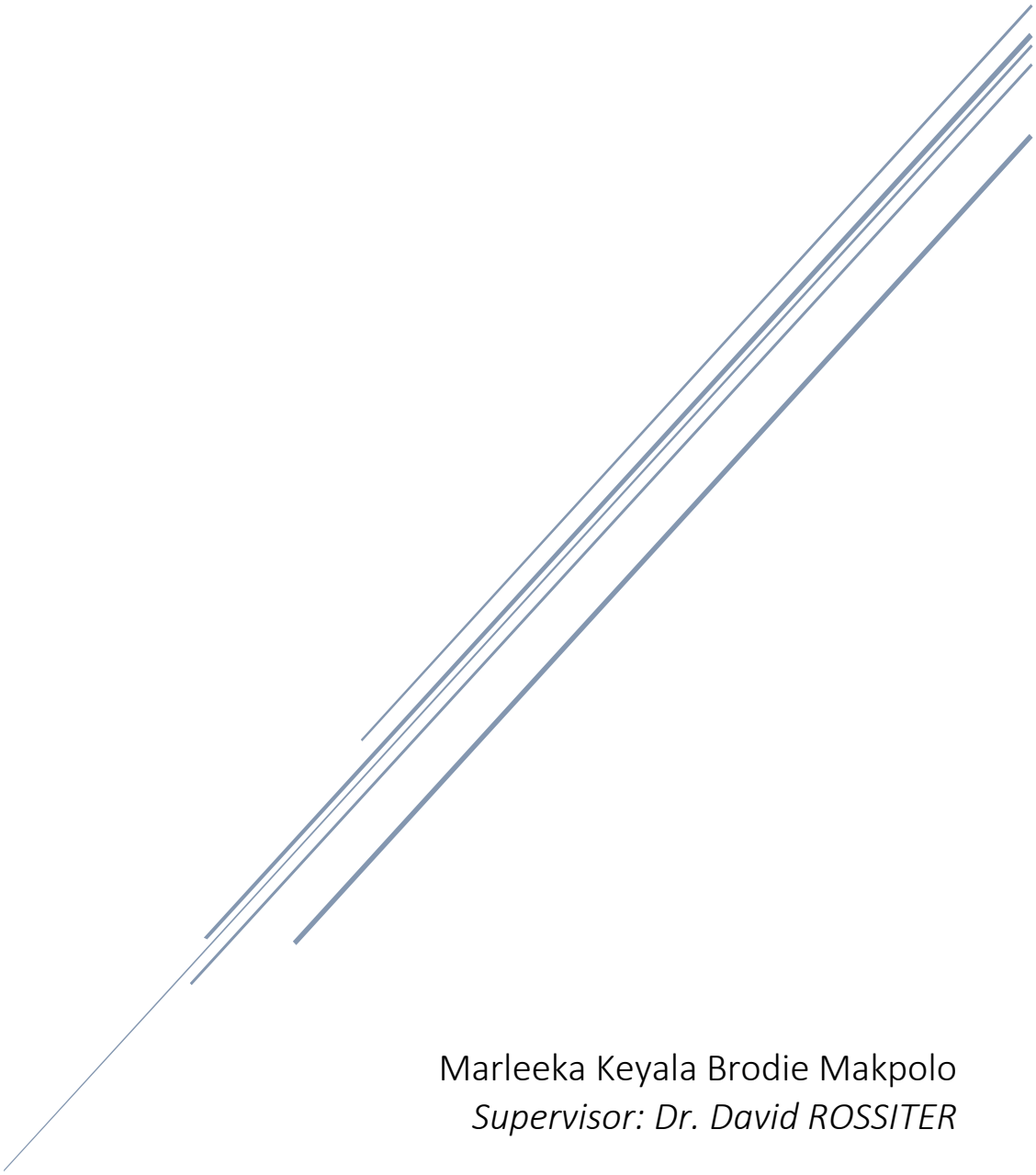
COMP4971F Project Report

(Spring 2018-2019)

THE MAYER MULTIPLE

A Study of a Potential Economic Bubble Indicator



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1. ABSTRACT

Economic bubbles have been a recurring phenomenon in financial markets throughout history. A 'Stock Market Bubble' (also referred to as an 'Economic Bubble or a 'Speculative Bubble') is an economic cycle characterized by the rapid escalation of an asset price followed by its decent. This substantial increase in price occurs when an asset's price strongly exceeds its intrinsic value. Intrinsic value, also called the "true value", is the perceived or calculated value of an asset and can differ from the asset's current market value. Given the difficulty of observing the intrinsic value of real markets, bubbles are often conclusively identified only in retrospect, i.e. once the asset has dropped in price.

Introduced by cryptocurrency investor and Bitcoin-connoisseur Trace Mayer, the Mayer Multiple has been utilized by many Bitcoin traders as the most important technical indicator. The multiple gauges whether the Bitcoin is overbought or oversold depending on the price relative to the 200 Day Moving Average and states that a Mayer Multiple of 2.4 and above means that the Bitcoin has entered speculative bubble territory.

Throughout this paper, we will be attempting to recreate the Mayer Multiple threshold and apply it to previous speculative bubbles.

2. DISCLAIMER

As Mayer mentioned on his website, the below results are based on historical data only and therefore should not be used as predictions for the future price movements of any of the financial assets mentioned in this study.

3. UNDERSTANDING THE MAYER MULTIPLE

The Mayer Multiple was originated to gauge the current price of Bitcoin and determine whether the cryptocurrency was overbought or oversold.

Mayer defined the Mayer Multiple as follows:

$$Mayer\ Multiple = \frac{\text{Bitcoin Market Price}}{\text{200 day Moving Average}}$$

In financial technical analysis, it is generally considered a bullish indicator when prices are above the long-term moving average and bearish when the prices are below this long-term moving average. However, the implications are not that black and white – and if the price is significantly higher than the long-term moving average it's often a sign that the underlying asset has become overvalued or "overbought" [1], and thus "in a speculative bubble".

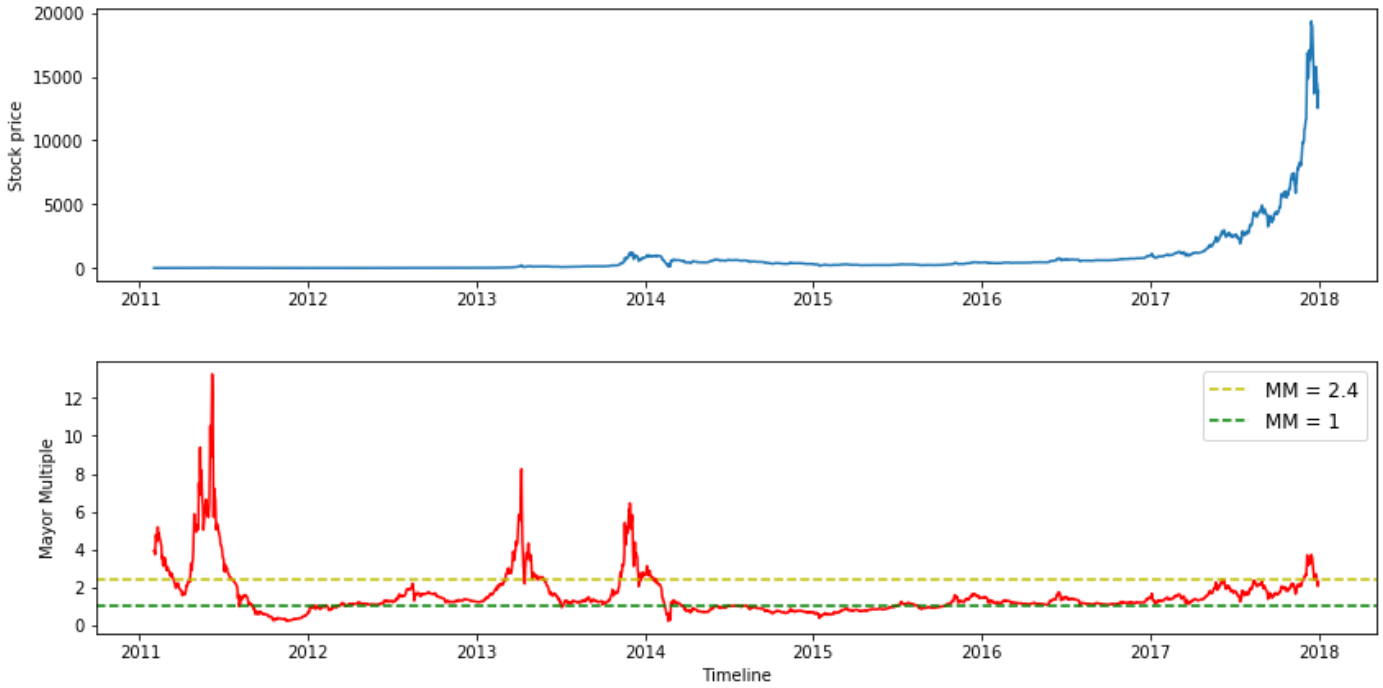


Figure 1: Bitcoin Stock Price (above) vs. Bitcoin Mayer Multiple (below)

By conducting simulations based on historical data, Mayer concluded that any multiple above the 2.4 threshold had historically shown to signify the beginning of a speculative bubble for Bitcoin. As we can see Figure 1 and compare it to the Bitcoin Bubbles in Figure 2, this rule seems to hold. When researching "Bitcoin Bubbles," four bubbles that correspond to the four peaks that emerge from the 2.4 threshold [2].

[1] https://www.coindesk.com/mayer-multiples-the-metric-that-helps-call-bitcoin-bubbles-and-bottoms

[2] https://en.wikipedia.org/wiki/Cryptocurrency_bubble

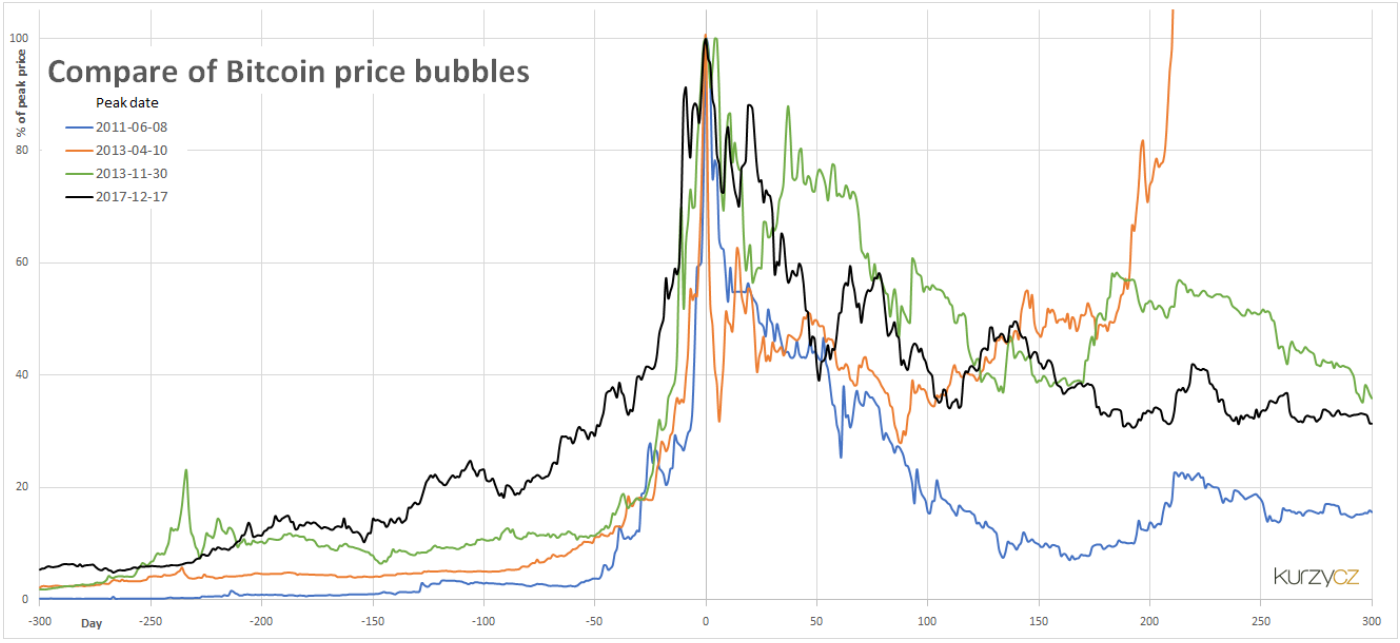


Figure 2: Overlay of all 4 Bitcoin Bubbles

Thus, Mayer mentions that accumulating Bitcoin until the **2.4 threshold** would yield the highest returns as anything above the 2.4 threshold was considered "overbought" and would be a signal to sell (or deemed too risky to buy).

In other words, according to Mayer:

$$\text{If} \quad \frac{Bitcoin\ Market\ Price}{200\ Day\ Moving\ Average} \geq 2.4$$

Then Bitcoin is considered to be overbought and has entered speculative bubble territory.

4. THE ALGORITHMS

Mayer's website did not contain a description of the trading simulation used. However, theinvestorpodcast.com [3] which is a stock investing podcast that studies billionaires and their investment ideas wrote an article on the Mayer Multiple that described the trading algorithm used. Our Mayer Multiple trading algorithm is thus based on the logic described by the article.

4.1. THE MAYER MULTIPLE TRADING SIMULATION ALGORITHM

Imitating the logic of the simulation algorithm defined on the Investor Podcast website, we attempt first to replicate the Bitcoin Mayer Multiple and then determine the Mayer Multiple of other indexes to see if they coincide with known Stock Market Bubbles.

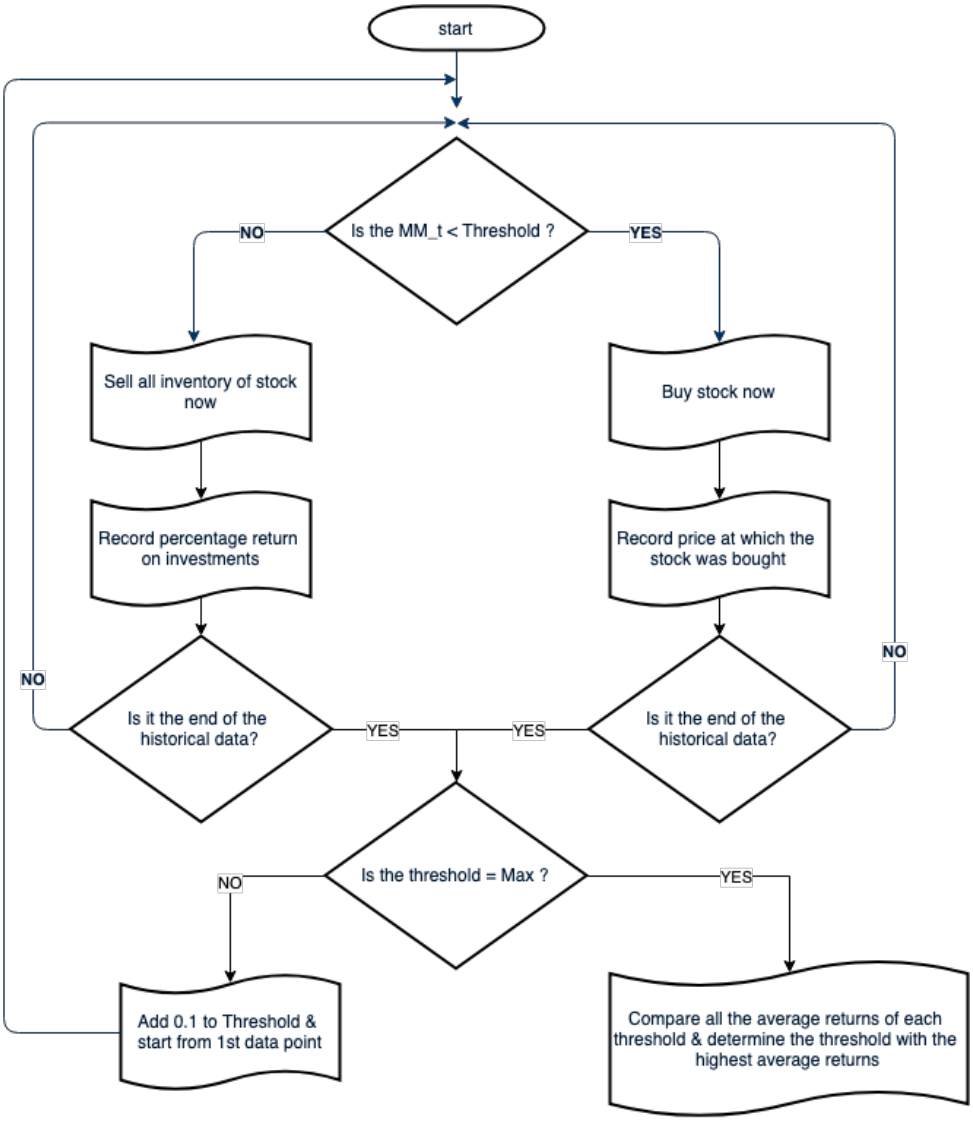


Figure 3: Trading Algorithm Flowchart

Where:

MM_t: The Mayer Multiple on day t
Threshold: The current Mayer Multiple being tested
Max: The maximum possible Mayer Multiple threshold of a given dataset. This variable is calculated at the beginning by scanning all the Mayer Multiples and extracting the maximum value.

[3] https://www.theinvestorspodcast.com/bitcoin-mayer-multiple/

The above loop is iterated through the whole historical data for each threshold. The threshold variable starts at any given stock's minimum Mayer Multiple threshold and increments by 0.1 each time. When the maximum value is reached, the trading simulation stops as we have iterated through every Mayer Multiple. The above algorithm was run on Jupyter Notebooks.

4.2. THE MAYER MULTIPLE FREQUENCY DISTRIBUTION

After further analyzing the Investor Podcast, it seems that there is no mathematical proof of how the 2.4 threshold was determined. The only section mentioning the 2.4 threshold is the Frequency Distribution of the Mayer Multiple (Figure 4) where the value 2.4 represents the Mean + 1 Standard Deviation (row highlighted in red in Figure 4).

Therefore, in order to thoroughly compare our study with that of Mayer's, we will also plot the frequency of each threshold tier as well as calculate corresponding Mean and Standard Deviations in order to determine what value represents Mean + 1 Standard Deviation.

Frequency distribution of Multiple

Multiple	Count	Cumulative Count	Percent	Cumulative Percent		
0.4 To 0.5	4.	4.	0.21%	0.21%	3SD	
0.5 To 0.6	24.	28.	1.26%	1.47%	2SD ish	
0.6 To 0.7	70.	98.	3.66%	5.13%		
0.7 To 0.8	136.	234.	7.12%	12.25%		
0.8 To 0.9	126.	360.	6.60%	18.85%		
0.9 To 1	120.	480.	6.28%	25.13%		
1 To 1.1	88.	568.	4.61%	29.74%	1 SD	5-Feb-18
1.1 To 1.2	273.	841.	14.29%	44.03%		
1.2 To 1.3	232.	1,073.	12.15%	56.18%		
1.3 To 1.4	143.	1,216.	7.49%	63.66%		
1.4 To 1.5	107.	1,323.	5.60%	69.27%	Mean	
1.5 To 1.6	84.	1,407.	4.40%	73.66%		
1.6 To 1.7	106.	1,513.	5.55%	79.21%		
1.7 To 1.8	57.	1,570.	2.98%	82.20%		
1.8 To 1.9	30.	1,600.	1.57%	83.77%		
1.9 To 2	33.	1,633.	1.73%	85.50%	1SD	
2 To 2.1	45.	1,678.	2.36%	87.85%		
2.1 To 2.2	39.	1,717.	2.04%	89.90%		
2.2 To 2.3	21.	1,738.	1.10%	90.99%		
2.3 To 2.4	19.	1,757.	0.99%	91.99%		
2.4 To 2.5	20.	1,777.	1.05%	93.04%		
2.5 To 2.6	15.	1,792.	0.79%	93.82%		
2.6 To 2.7	14.	1,806.	0.73%	94.55%		
2.7 To 2.8	16.	1,822.	0.84%	95.39%		
2.8 To 2.9	6.	1,828.	0.31%	95.71%		
2.9 To 3	7.	1,835.	0.37%	96.07%		
3 To 3.1	6.	1,841.	0.31%	96.39%		
3.2 To 3.3	1.	1,842.	0.05%	96.44%		
3.3 To 3.4	3.	1,845.	0.16%	96.60%		
3.4 To 3.5	3.	1,848.	0.16%	96.75%		
3.5 To 3.6	4.	1,852.	0.21%	96.96%		
3.6 To 3.7	3.	1,855.	0.16%	97.12%		
3.7 To 3.8	6.	1,861.	0.31%	97.43%		
3.8 To 3.9	4.	1,865.	0.21%	97.64%	2SD	
3.9 To 4	6.	1,871.	0.31%	97.96%		
4.1 To 4.2	2.	1,873.	0.10%	98.06%		
4.2 To 4.3	4.	1,877.	0.21%	98.27%		
4.3 To 4.4	6.	1,883.	0.31%	98.59%		
4.4 To 4.5	1.	1,884.	0.05%	98.64%		
4.6 To 4.7	2.	1,886.	0.10%	98.74%		
4.9 To 5	1.	1,887.	0.05%	98.80%		
5 To 5.1	1.	1,888.	0.05%	98.85%		
5.1 To 5.2	1.	1,889.	0.05%	98.90%		
5.2 To 5.3	3.	1,892.	0.16%	99.06%		
5.3 To 5.4	3.	1,895.	0.16%	99.21%		
5.4 To 5.5	1.	1,896.	0.05%	99.27%		
5.5 To 5.6	1.	1,897.	0.05%	99.32%		
5.6 To 5.7	2.	1,899.	0.10%	99.42%		
5.7 To 5.8	4.	1,903.	0.21%	99.63%		
5.8 To 5.9	1.	1,904.	0.05%	99.69%		
5.9 To 6	1.	1,905.	0.05%	99.74%		
6.2 To 6.3	2.	1,907.	0.10%	99.84%		
6.3 To 6.4	1.	1,908.	0.05%	99.90%	3SD	
6.9 To 7	1.	1,909.	0.05%	99.95%		
8.2 To 8.3	1.	1,910.	0.05%	100.00%		

Figure 4: Screenshot of Frequency Distribution of Multiples Found on the Investor Podcast Website

5. Assumptions and Graphic Representations

5.1. Plotting the Mayer Multiple

The Mayer Multiples will be plotted on line graphs as follows.

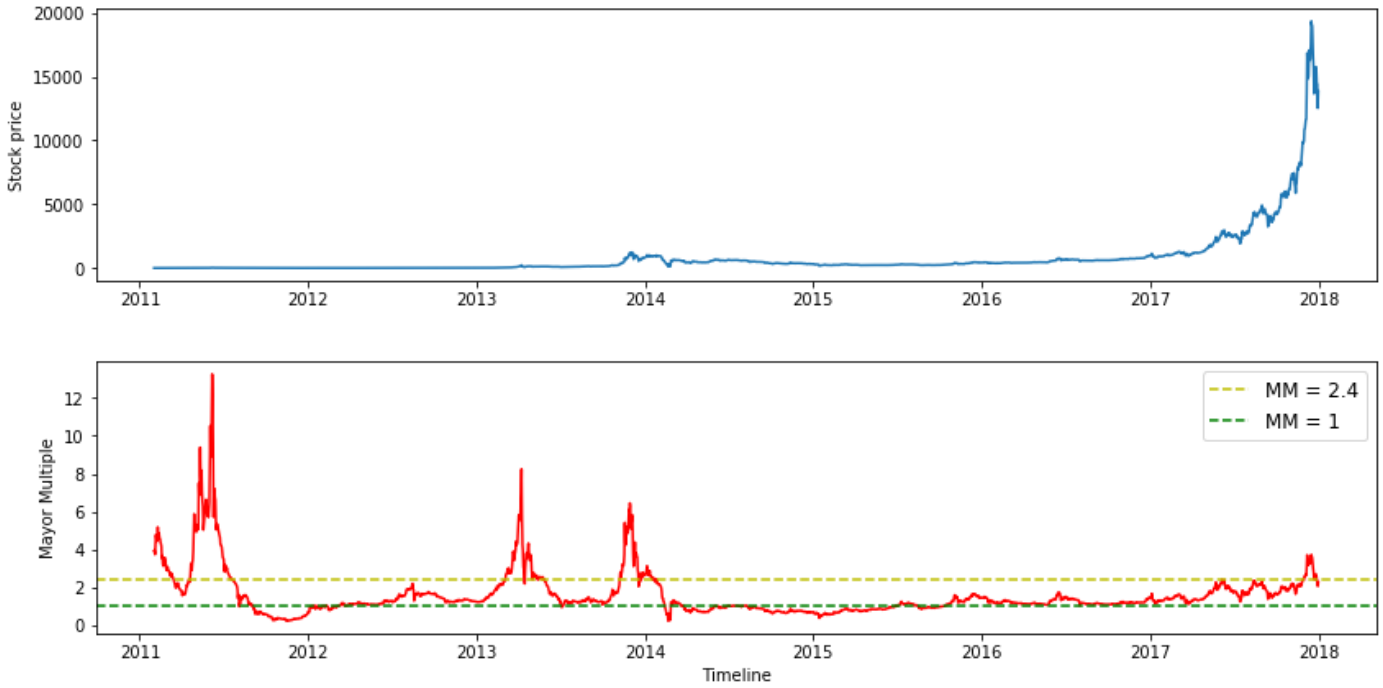


Figure 5: Example of Line Graph Used in this Report

- The timeline of the stock price matches the timeline of the Mayer Multiples
- Daily Closing price is used
- The MM in the legend stands for Mayer Multiple
- The green dotted line always represents a Mayer Multiple of 1
- The yellow dotted line represents the "ideal threshold" calculated by the trading algorithm which corresponds to the Mayer Multiple threshold that has the highest average return on investment

5.2. Plotting the Frequency Distribution

The frequency distribution is represented as follows.

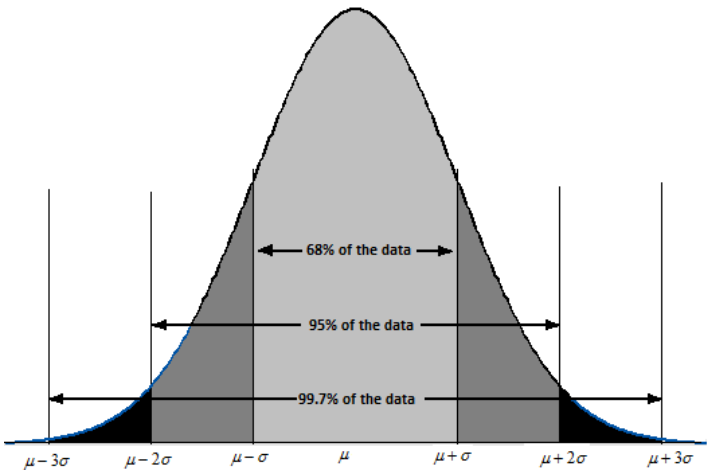


Figure 6: Example of Frequency Distribution Curve

The frequency threshold graphs will be represented as above with the following assumptions:

μ: Mean

σ: Standard Deviation (SD)

6. PRELIMINARY RESULTS: BITCOIN

Let us start our research with the cryptocurrency that ignited the Mayer Multiple: Bitcoin. Shortly after the cryptocurrency's peak of $19,511 at the end of 2017, it plunged, losing approximately 65 percent of its value by February 2018.

It is among a group of cryptocurrencies that have been identified as an economic bubble by at least eight laureates of the Nobel Prize in Economic Sciences [4]. In order to study this speculative bubble, we will be using the daily closing price of the Bitcoin stock extracted from Yahoo Finance. The dataset runs from the 16th July 2010 through to the end of 2017. For this analysis, we chose to disregard data from 2018 and 2019 in order to replicate the same numbers from the Investor Podcast article [5]. After running the trading algorithm for Bitcoin, we obtained the following information.

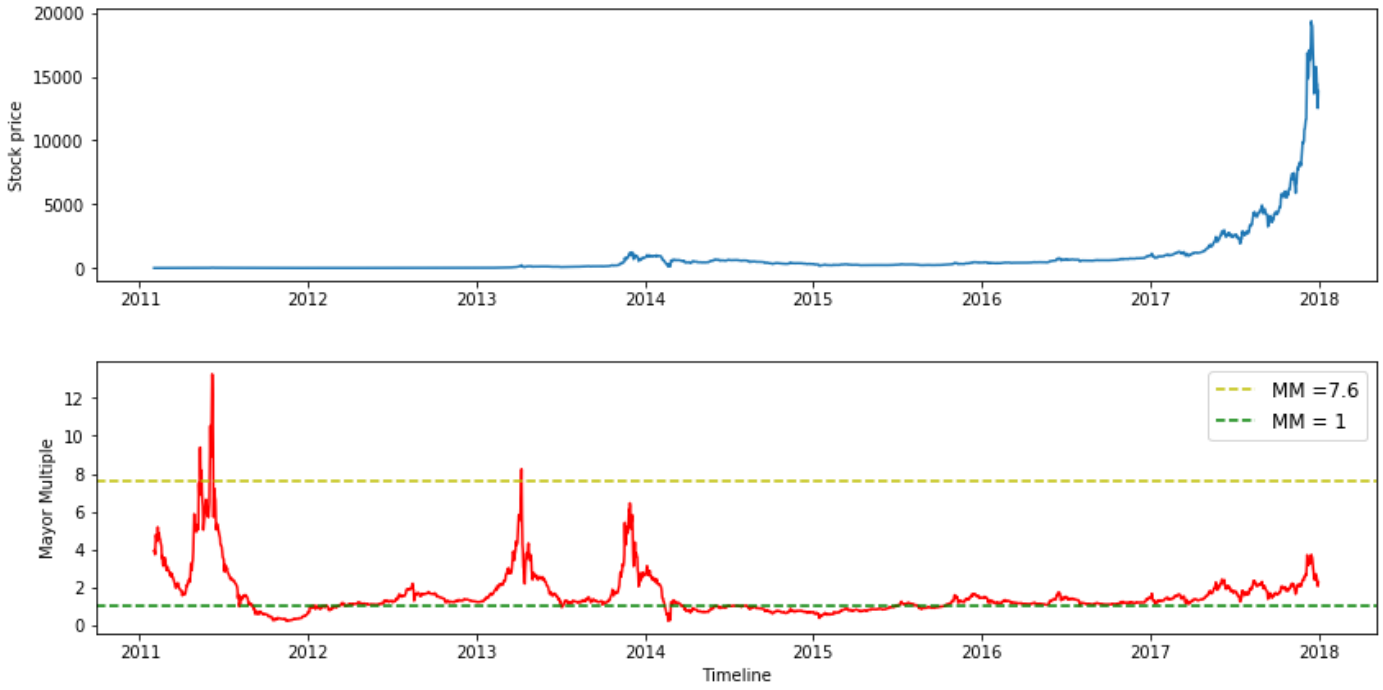


Figure 7: Bitcoin Price vs. Mayer Multiple

[4] https://en.wikipedia.org/wiki/Cryptocurrency_bubble

[5] Please see Appendix 9.1. for data including 2018 and 2019

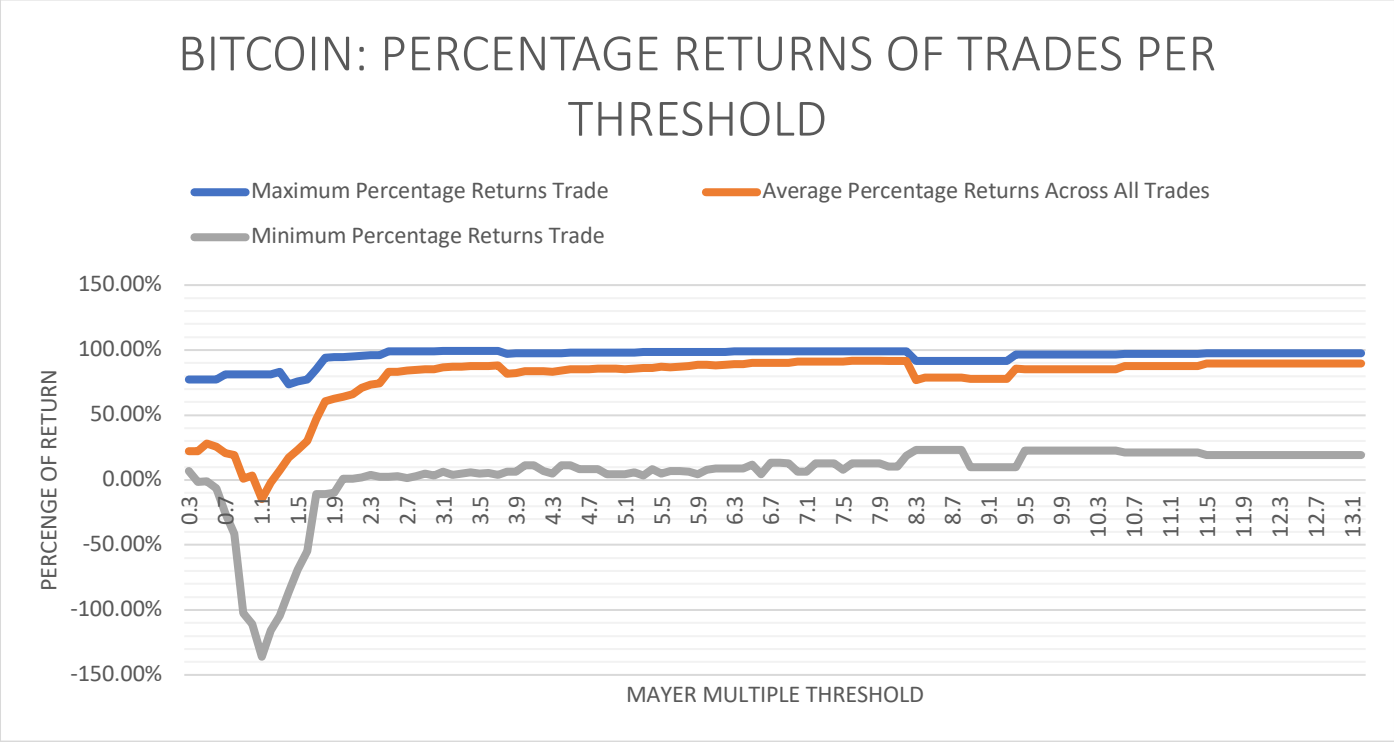


Figure 8: Bitcoin Percentage Returns per Threshold

Figure 8 illustrates the maximum and minimum percentage returns per trade as well as the average percentage return across all the trades for any given Mayer Multiple. As explained in part 4.1., for each threshold our trading algorithm buys, holds or sells according to whether today's Mayer Multiple is higher or lower than the threshold Mayer Multiple. Once we sell what was in inventory, we record the return it produced. This explains why for any given Mayer Multiple threshold tier, there can be multiple returns as there are multiple trades.

From Figure 7 we can observe that our algorithm determines 7.6 as the threshold that yields the highest average percentage returns. In other words, accumulating bitcoin until the Mayer Multiple reaches 7.6 produces the *highest* return on investment *on average*.
However, when we look at Figure 8 and delve deeper into the returns per threshold [6], historical data shows that accumulating bitcoins until it reaches the threshold of 2 has produced positive returns as even the minimum percentage return for all thresholds 2 and above are positive.

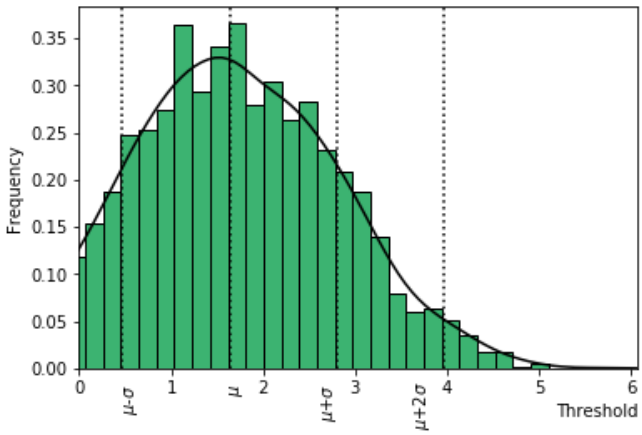


Figure 9: Bitcoin Threshold Frequency Normal Distribution

Indicator	**Mayer Multiple Value**

[6] Please see Appendix 9.2

Mean – 2 SD	-0.68
Mean – 1 SD	0.47
Mean	1.62
Mean + 1 SD	2.77
Mean + 2 SD	3.92

Figure 10: Bitcoin Mean & SD Indicators

As we can see from Figures 9 and 10, the frequency of the thresholds follows a normal distribution. The mean from this study is equal to 1.62 which is close to the mean value indicated by Mayer's frequency distribution table (Figure 4) found on the investor podcast website which considers the Mean to be in the 1.4 – 1.5 range. Our algorithm's Mean + 1 SD value of 2.77 from this study is not too far from the 2.4 Mayer Multiple threshold.

When we plot our indicators on the Mayer Multiple graph for Bitcoin (Figure 10), we can see that our 2.77 value (represented by the blue dotted line) serves the same purpose as the original 2.4 value (represented by the red dotted line): it is able to locate the 4 bubbles whereas the ideal value of 7.6 (represented by the yellow dotted line) is too high and does not highlight the previously known Bitcoin bubbles.

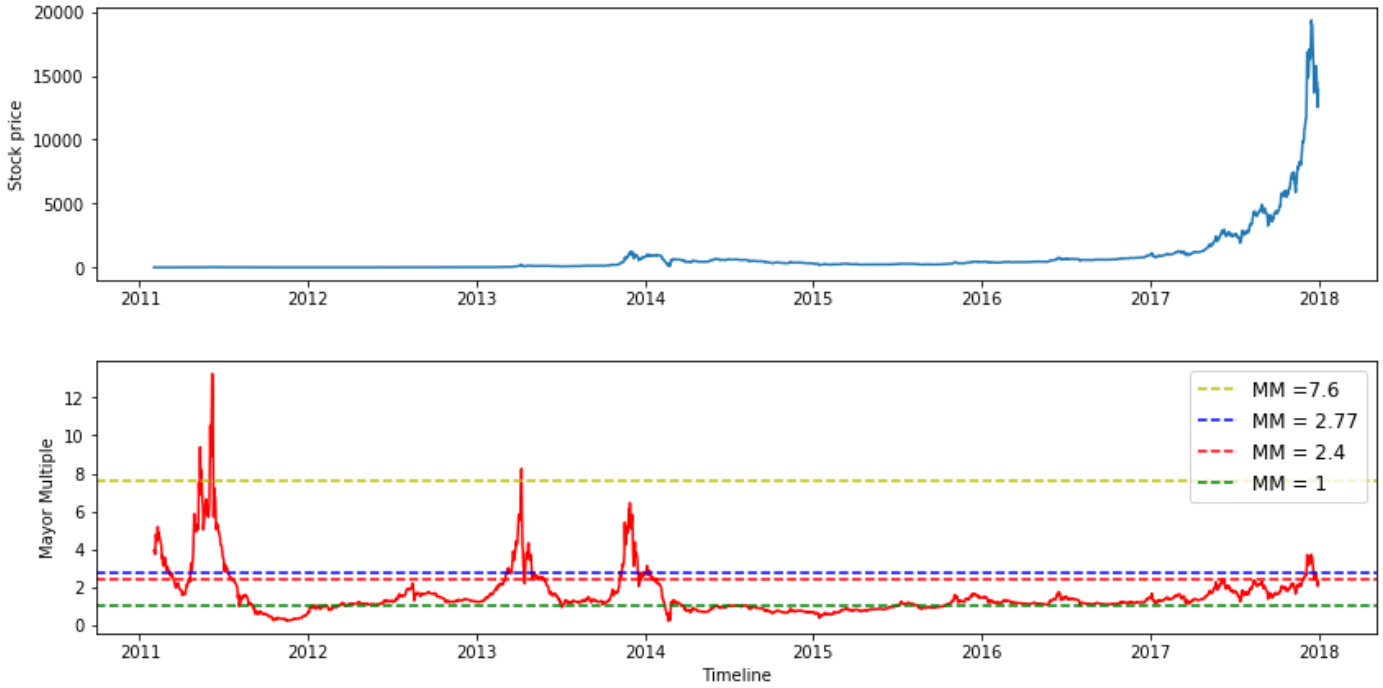


Figure 11: Bitcoin Price vs. Mayer Multiple with Additional Thresholds

7. RESULTS: PREVIOUS ECONOMIC BUBBLES

7.1. Background

For this study we needed to collect data of historical economic bubbles. Unfortunately, data collection proved challenging for all economic bubbles that happened prior to the 20th Century such as the Dutch Tulip Mania (1634-1637), The South Sea Bubble (1716-1720) and the Mississippi Bubble (1716-1720). Data were either too irregular and patchy or simply could not be found. Because of this, we chose to focus on the following four economic bubbles. For each of these economic bubbles we chose four different tradable indexes that would help illustrate the bubble. The idea is that if the index's Mayer Multiple is above a to-be-determined threshold, the index is in a bubble. Indexes were chosen in an attempt to maintain meaningful statistical conclusions, as each index is comprised of a group of stocks. Furthermore, given we want the trading algorithm to be able to pick up any economic bubbles, we will first run the trading simulation over the index as a whole before running it during the economic bubbles' period.

A) Black Tuesday (Index: Dow Jones Industrial Average)

The Wall Street Crash of 1929, also known as Black Tuesday, was a major stock market crash that occurred in late October 1929. The crash followed a speculative boom that had taken hold during the Roaring Twenties; Americans were borrowing money to buy more stocks, causing share prices to rise. These speculations thus fueled further rises and created an economic bubble. The 1929 stock market crash fueled the Great Depression which formed the largest financial crisis of the 20th century.

The *Dow Jones Industrial Average* is chosen to represent this bubble as it is the only one that existed at the time. The DJIA is the oldest index in the world and is composed of 30 large-cap companies. The companies in the index are leaders in their industry and are very large.

B) Japanese Asset Price Bubble (Index: Nikkei Index)

Fueled by an overly simulative monetary policy, this real estate and stock market bubble occurred in Japan between 1989 and 1991. By August 1990, the Nikkei stock index had lost half of its value and even though the Nikkei stock index (Japan's stock market index) bubble officially burst in 1992, the Japanese economy continued to decline for more than a decade.

In order to analyze this bubble, we will be using the *Nikkei 225 Index* daily closing stock price. The dataset runs from the 16th May 1945 to the 13th of March 2019. We will first perform an analysis on the entire index as a whole and then we will perform a separate analysis during the bubble's period 1988-1992.

C) Dot-Com Bubble (Index: Nasdaq Composite)

The Dot-Com bubble, also known as the internet bubble, was a rapid rise in U.S. technology stock equity valuations fueled by investments in Internet-based companies in the late 1990s. In 2001 through to 2002, the bubble burst.

In order to best visualize and analyze this bubble, we chose the *Nasdaq Composite* as it is a good representation of the technology segments of the markets since most of the stocks that compose the Nasdaq Composite are technology and Internet-related.

D) US Housing Bubble (Index: Standard & Poor 500)

The housing bubble was an increase in housing prices fueled by demand and speculation. This economic bubble peaked in early 2006 and started to decline in 2006 through to 2007.

The reason why we are using the *S&P 500 Index* to illustrate the US Housing Bubble is that the S&P 500 covers the biggest 500 stocks on the US market and thus a good indicator of the health of the US market.

7.2. Black Tuesday and The Dow Jones Industrial Average

7.2.1. Dow Jones Index Analysis

Let us first analyze the Dow Jones Index as a whole. This dataset runs from the 12th of December 1914 through to the 27th March 2019.

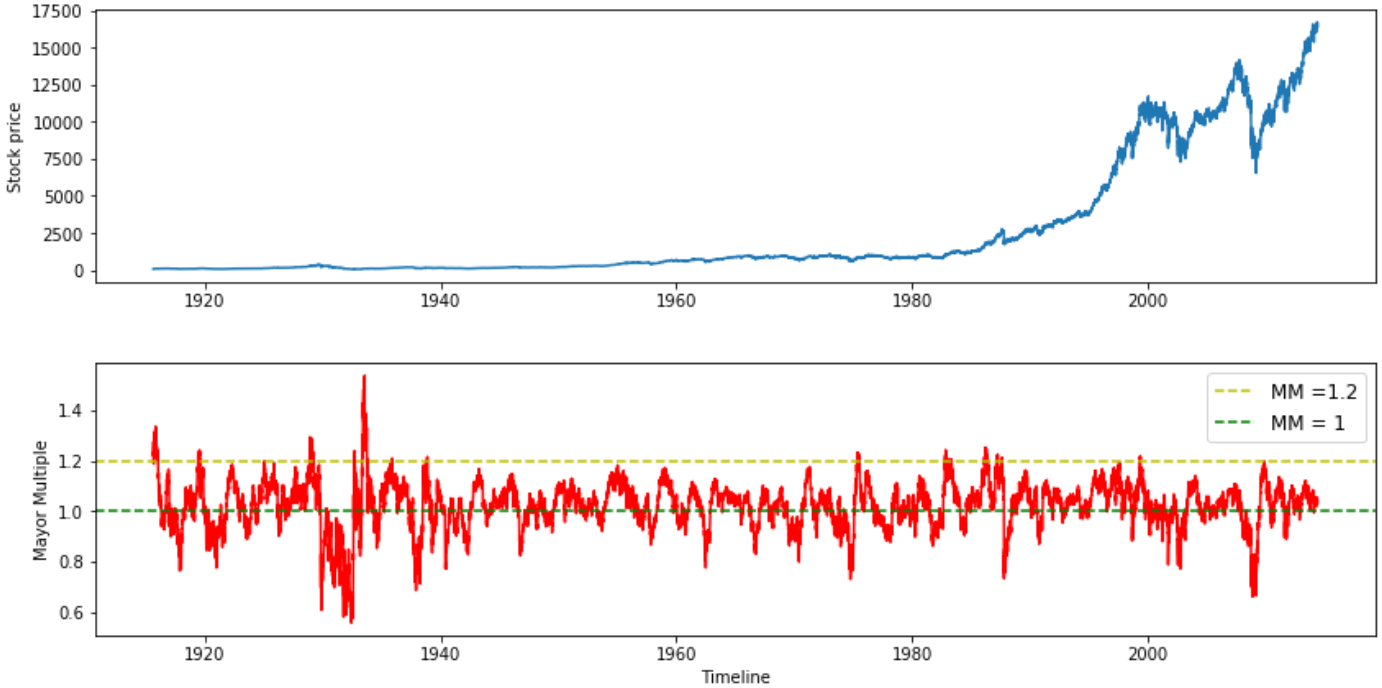


Figure 12: Dow Jones Index Price vs. Mayer Multiple

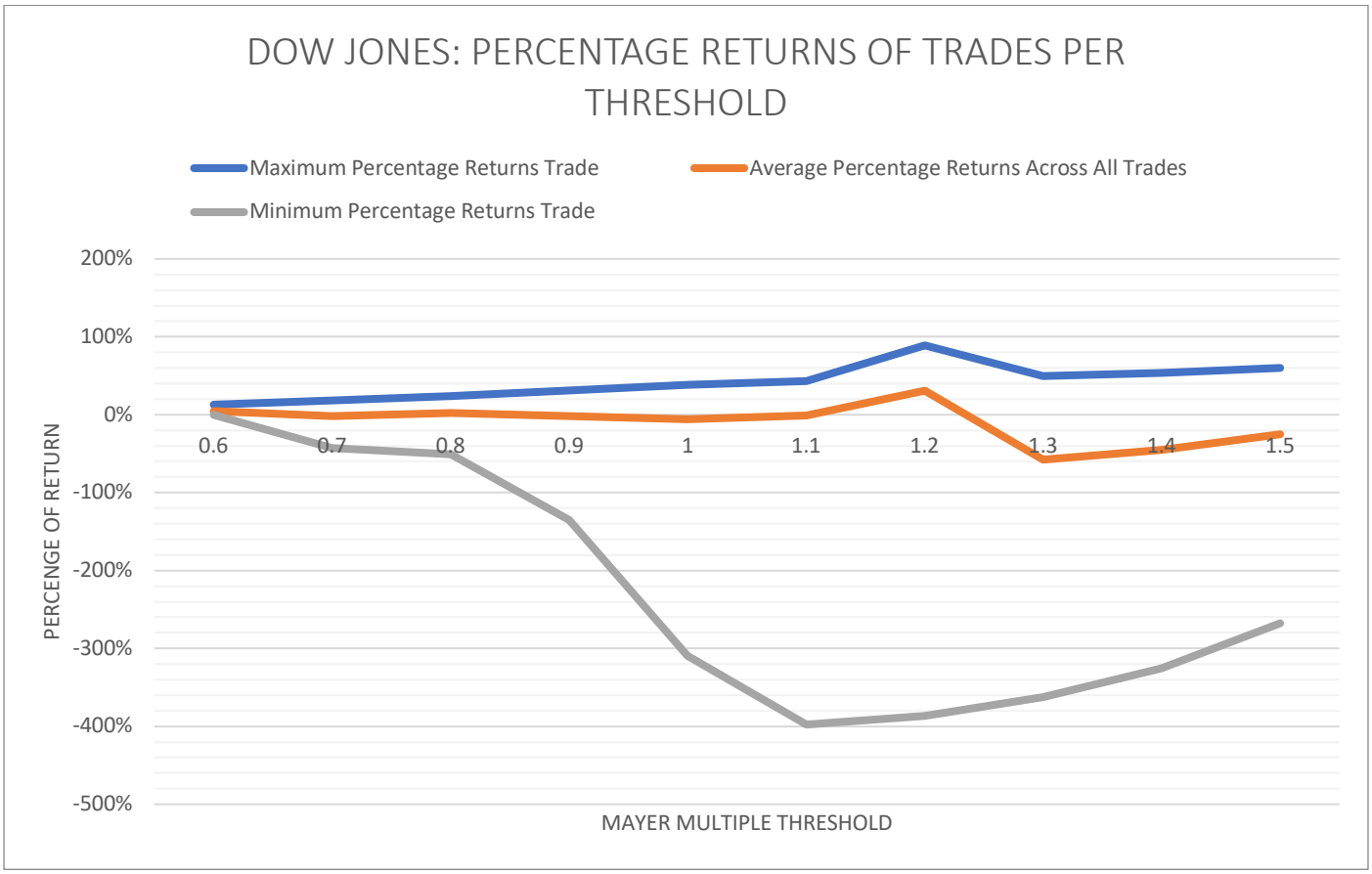


Figure 13: Dow Jones Index Percentage Returns per Threshold

Mayer Multiple Threshold	Maximum Percentage Returns Trade	Average Percentage Returns Across All Trades	Minimum Percentage Returns Trade
0.6	13%	5%	0%
0.7	18%	-2%	-43%
0.8	24%	2%	-51%
0.9	31%	-2%	-135%
1	38%	-6%	-309%
1.1	43%	-1%	-398%
1.2	**89%**	**31%**	**-387%**
1.3	50%	-58%	-362%
1.4	54%	-45%	-325%
1.5	60%	-25%	-267%

Figure 14: Dow Jones Percentage Returns per Threshold Table

As we can see from Figure 12, our algorithm determines 1.2 as the threshold that yields the highest average percentage returns. In other words, throughout history accumulating the Dow Jones Index until the Mayer Multiple reaches 1.2 produces the *highest* return on investment *on average*.
Unfortunately from Figure 14, we can see that the minimum percentage returns for all thresholds are negative, greatly outweighing the maximum percentage returns.

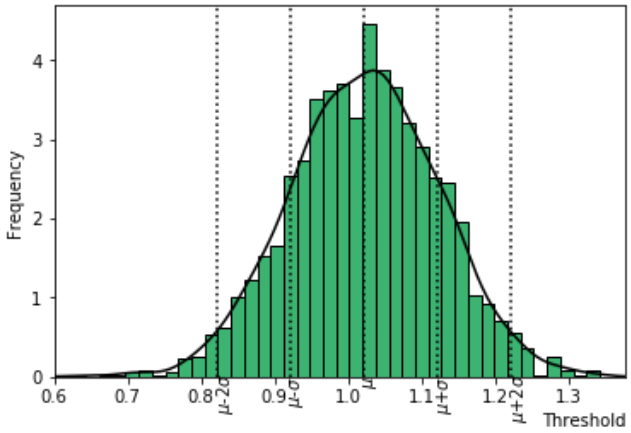


Figure 15: Dow Jones Threshold Frequency Normal Distribution

Indicator	Mayer Multiple Value
Mean – 2 SD	0.82
Mean – 1 SD	0.92
Mean	1.02
Mean + 1 SD	1.12
Mean + 2 SD	1.23

Figure 16: Dow Jones Index Mean & SD Indicators

7.2.2. Black Tuesday Analysis

Next, we chose to analyze the period of the Black Tuesday economic bubble. The dataset runs from the 2nd January 1923 through to the 31st December 1930. We have chosen to widen the period of Black Tuesday in order to compensate for the loss of the first 200 days at the beginning (due to the 200-day Moving Average) and to be sure that both the start and end phases of the bubble are included in the graph.

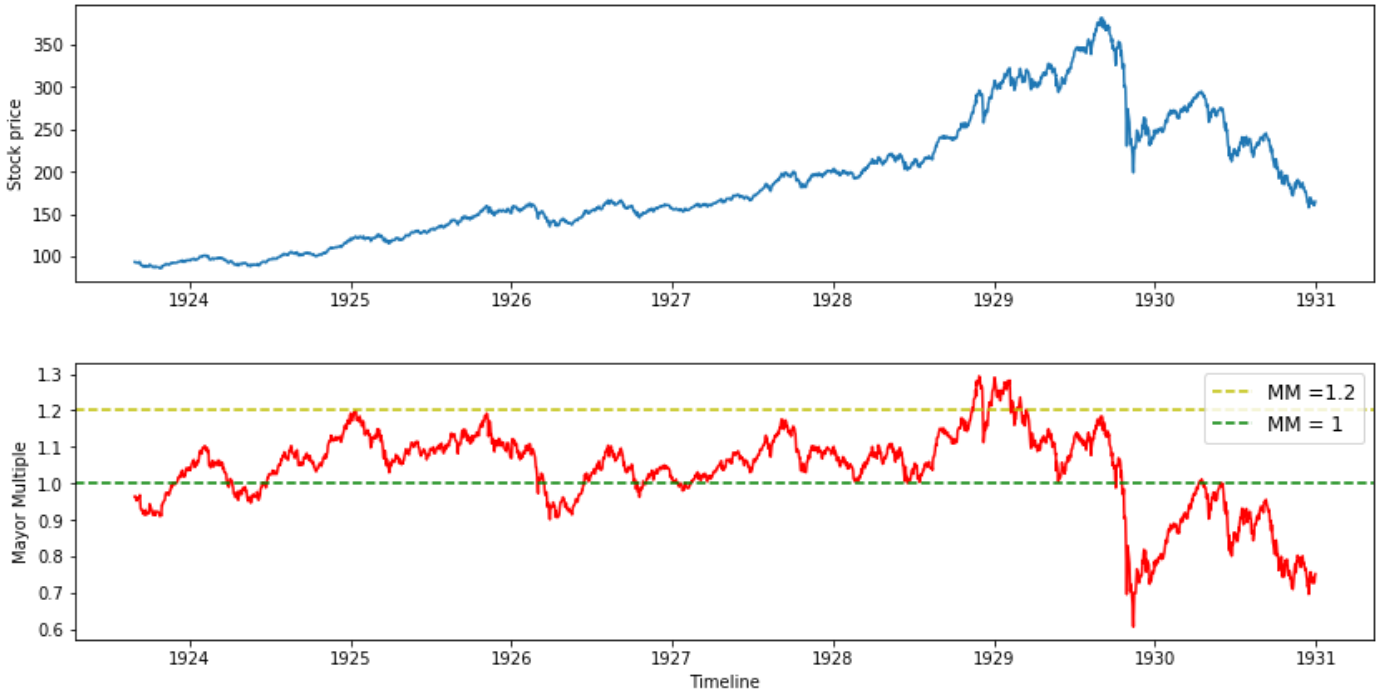


Figure 17: Dow Jones Index Price vs. Mayer Multiple During Black Tuesday Period

From the visualization of the stock price (in blue) in Figure 17, we can indeed see the bubble burst just prior during the end of the year 1929, which coincides with the Tuesday October 24th, 1929 crash.

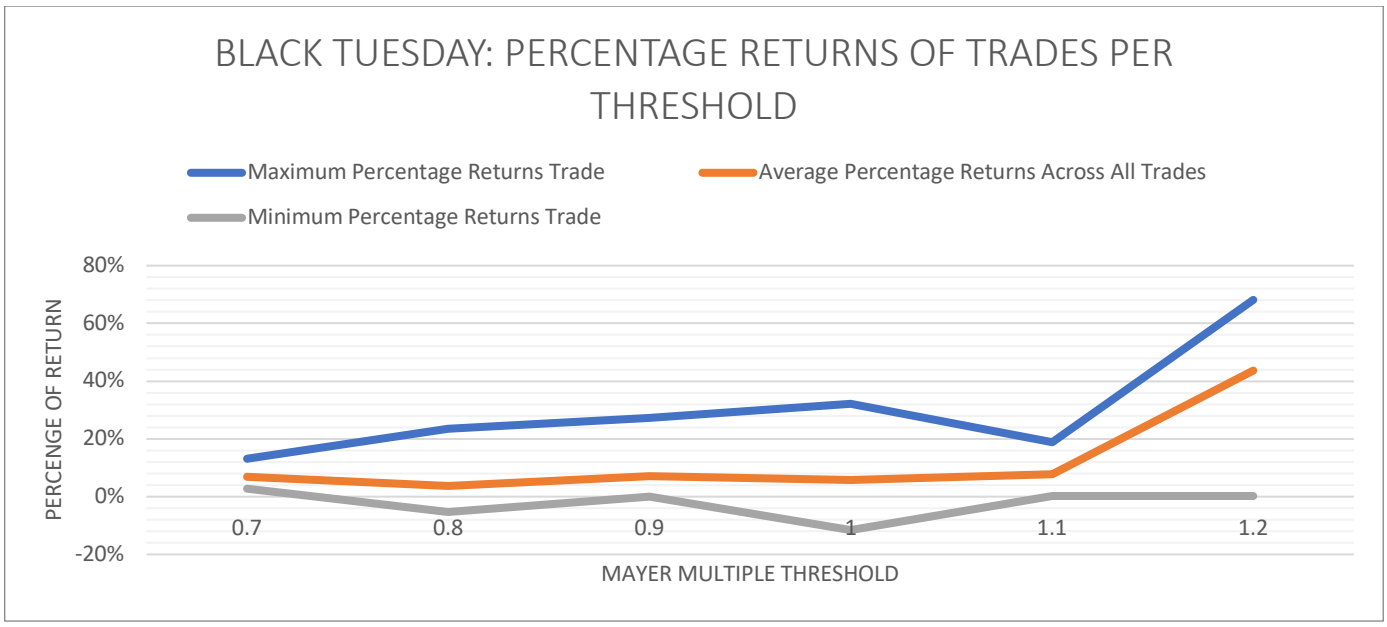


Figure 18: Dow Jones Index Percentage Returns per Threshold Graph During Black Tuesday Period

Mayer Multiple Threshold	Maximum Percentage Returns Trade	Average Percentage Returns Across All Trades	Minimum Percentage Returns Trade
0.7	13%	7%	3%
0.8	24%	4%	-5%
0.9	27%	7%	0%
1	32%	6%	-12%
1.1	19%	8%	0%
1.2	**68%**	**44%**	**0%**

Figure 19: Dow Jones Index Percentage Returns per Threshold Table During Black Tuesday Period

As we can see from Figure 19, our algorithm determines 1.2 as the threshold that yields the highest average percentage returns. In other words, throughout the above period accumulating the Dow Jones Index until the Mayer Multiple reaches 1.2 produces the *highest* return on investment *on average*. It is important to note that this threshold is equal to the threshold determined from the entire dataset (Figure 14).
However, once we delve deeper into Figure 19, we can observe that accumulating the Dow Jones until it reaches the threshold of 1.1 has produced positive returns as even the minimum percentage return for all thresholds 1.1 and above are positive.

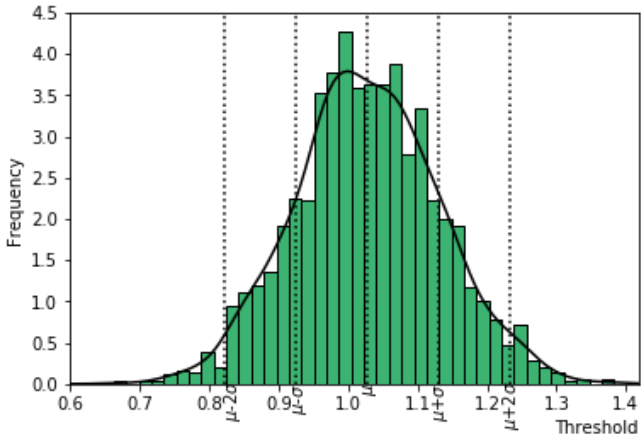


Figure 20: Dow Jones Index Threshold Frequency Normal Distribution During Black Tuesday Period

Indicator	Mayer Multiple Value
Mean – 2 SD	0.82
Mean – 1 SD	0.92
Mean	1.02
Mean + 1 SD	1.12
Mean + 2 SD	1.23

Figure 21: Dow Jones Index Price Mean & SD Indicators During Black Tuesday Period

The mean and standard deviation indicators for the Black Tuesday (Figure 21) are to the indicators of the whole Dow Jones Index (Figure 16) when rounded to the nearest 0.01 value.
The Mayer Multiple does not seem to work as seamlessly in illustrating the Black Tuesday economic bubble, as the peak in Mayer Multiple does not coincide with the peak of the stock bubble (Figure 12). Although we can see the Mayer Multiple follow the Index's price closely (Figure 17), the same cannot be said for the bigger picture (Figure 12). In order to be able to create a threshold rule similar to the 2.4 threshold for Bitcoin, we need to be able to observe a pattern during the larger timeline.

7.3. Japanese Asset Price Bubble and Nikkei Index

7.3.1. Nikkei Index Analysis

Let us first analyze the Nikkei Index as a whole. This dataset runs from the 16th of May 1949 through to the 13th March 2019.

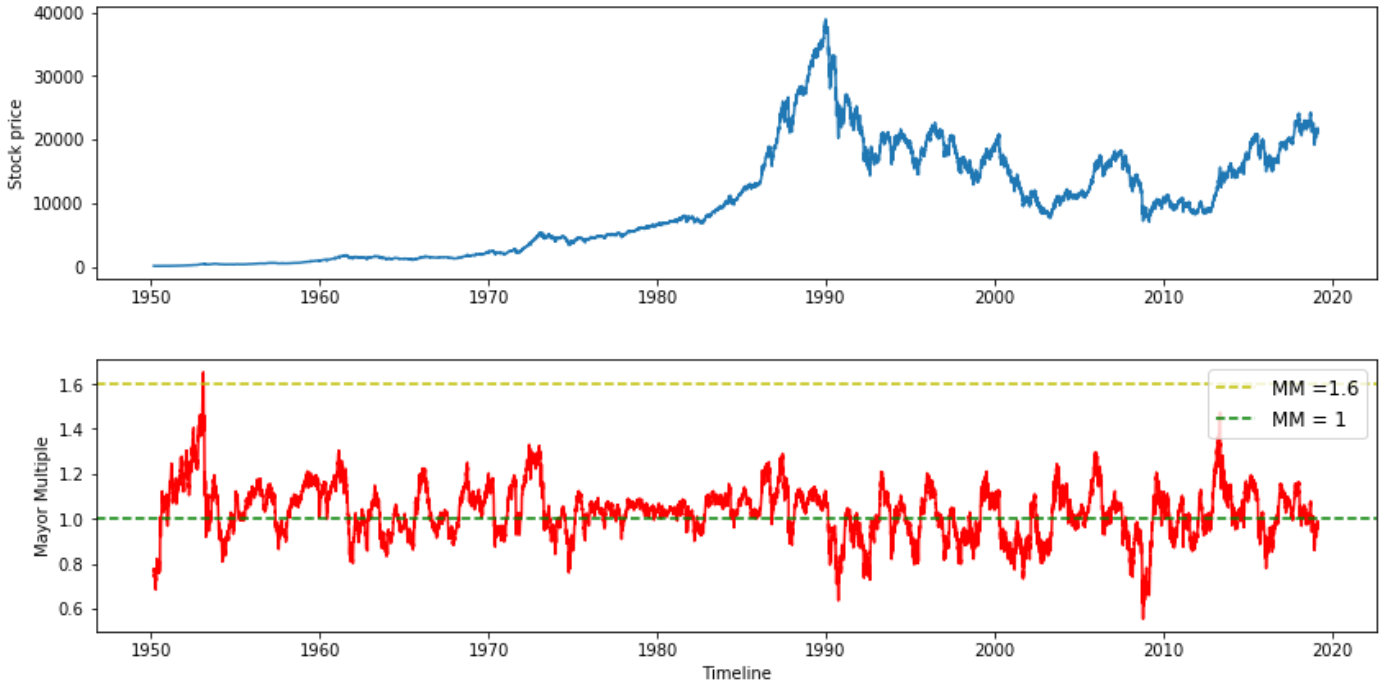


Figure 22: Nikkei Index Price vs. Mayer Multiple

From the visualization of the stock price (in blue) in Figure 22, we can indeed see the bubble burst just prior to the end of the 1980s, which coincides with the Japanese Asset Price Bubble period.

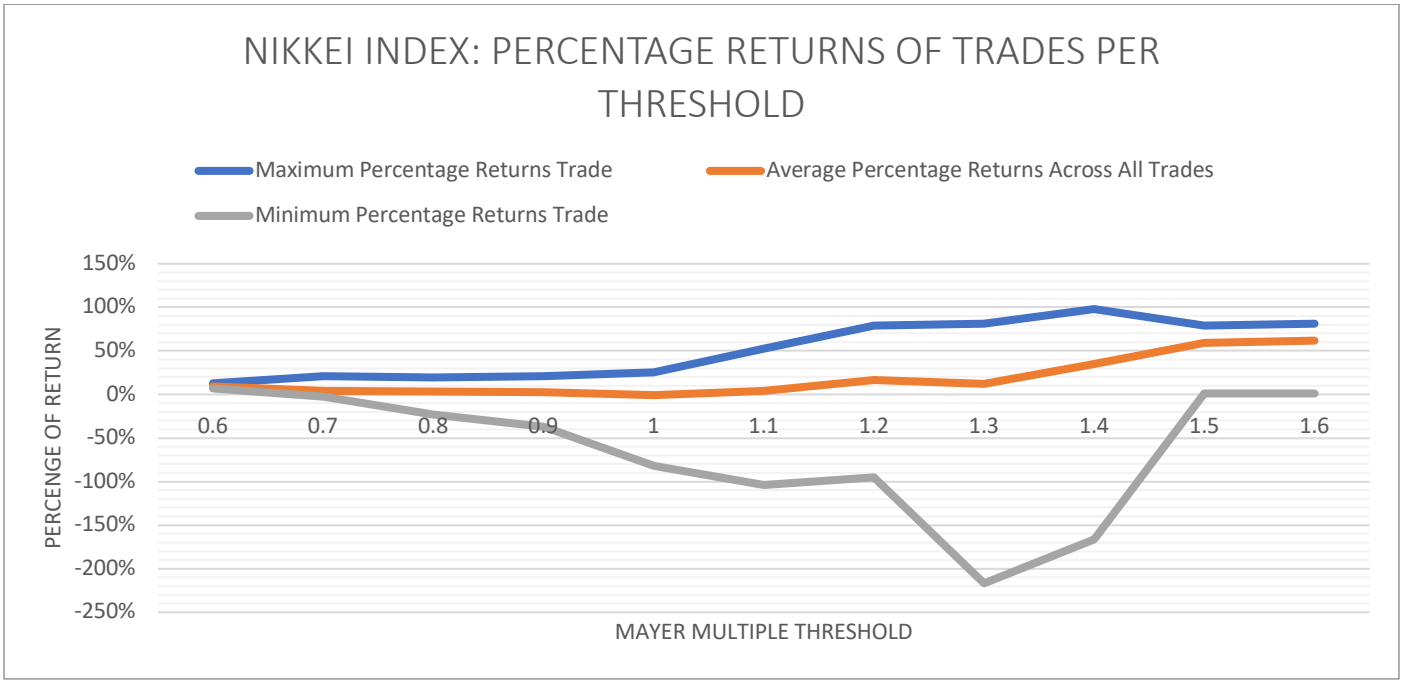


Figure 23: Nikkei Index Percentage Returns per Threshold Graph

Mayer Multiple Threshold	Maximum Percentage Returns Trade	Average Percentage Returns Across All Trades	Minimum Percentage Returns Trade
0.6	13%	9%	7%
0.7	21%	4%	-3%
0.8	19%	3%	-23%
0.9	21%	3%	-37%
1	25%	-1%	-82%
1.1	52%	4%	-104%
1.2	79%	17%	-95%
1.3	81%	12%	-217%
1.4	98%	35%	-166%
1.5	79%	59%	1%
1.6	81%	62%	1%

Figure 24: Nikkei Index Percentage Returns per Threshold Table

As we can see from Figure 22 and 24, our algorithm determines 1.6 as the threshold that yields the highest average percentage returns. In other words, the historical data shows that accumulating the Nikkei Index until the Mayer Multiple reaches 1.6 produces the *highest* return on investment *on average*.

However, once we delve deeper into the returns per threshold (Figure 24), accumulating the Nikkei until it reaches the threshold of 1.5 has produced positive returns as even the minimum percentage return for all thresholds 1.5 and above are positive.

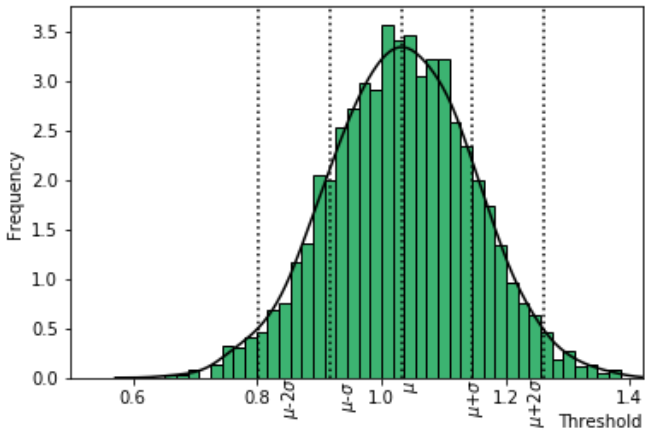


Figure 25: Nikkei Index Threshold Frequency Normal Distribution

Indicator	Mayer Multiple Value
Mean – 2 SD	0.80
Mean – 1 SD	0.92
Mean	1.04
Mean + 1 SD	1.16
Mean + 2 SD	1.28

Figure 26: Nikkei Index Mean & SD Indicators

7.3.2. Japanese Asset Price Bubble Analysis

Next, let us analyze the period of the Japanese Asset Price economic bubble. The dataset runs from the 4th January 1988 through to the 30th December 1992. We have chosen to widen the bubble period in order to compensate for the loss of the first 200 days at the beginning (due to the 200-day Moving Average) and to be sure that both the start and end phases of the bubble are included in the graph.

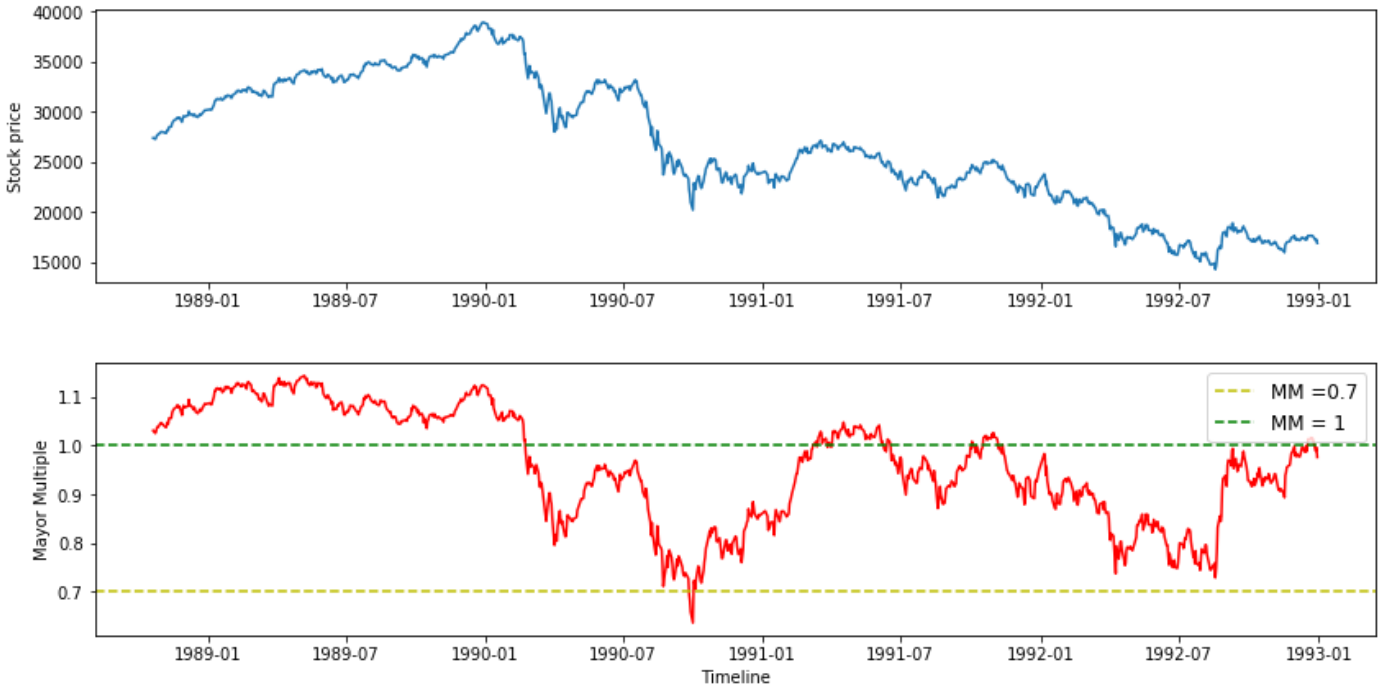


Figure 27: Nikkei Index Price vs. Mayer Multiple During the Japanese Asset Price Bubble Period

From the visualization of the stock price (in blue) in the above graph, we can see the bubble start to burst at the end of 1989, which coincides with the definition of the Japanese Asset Price Bubble.

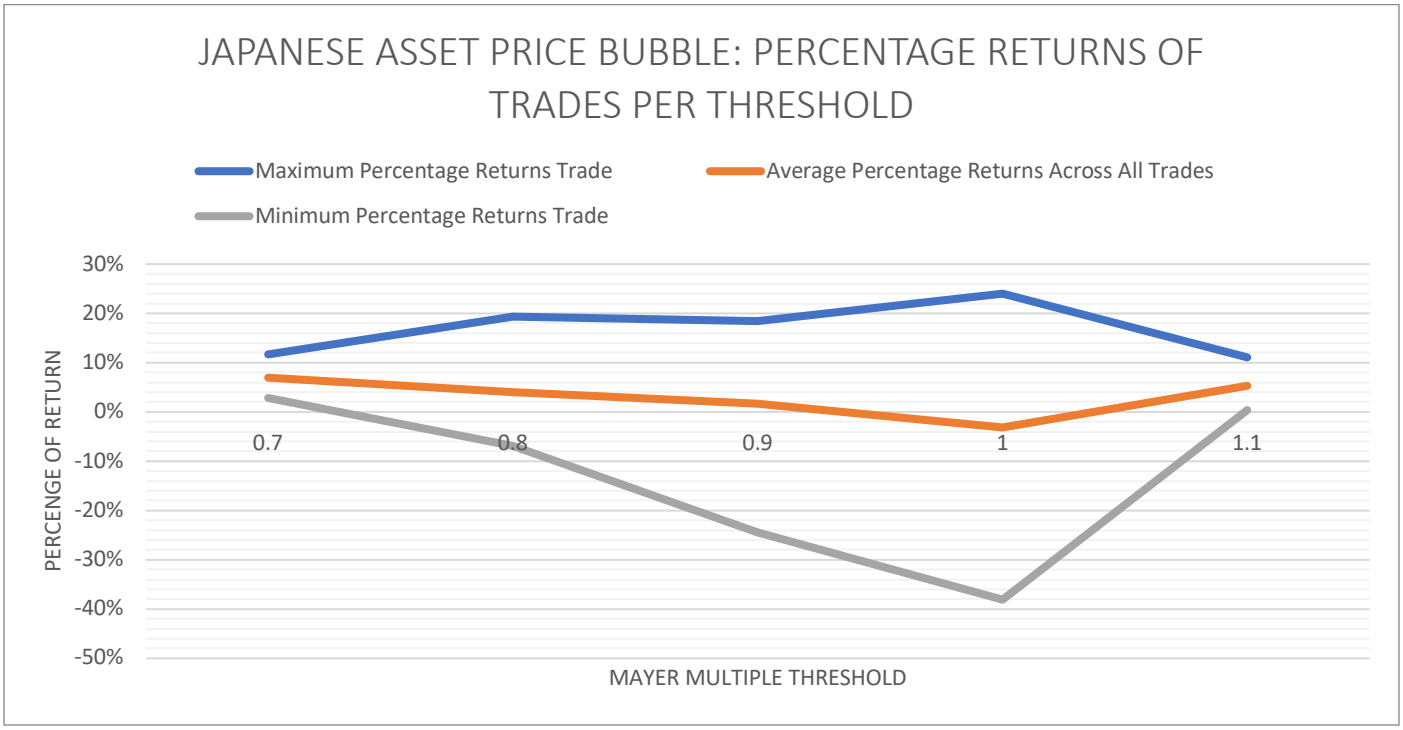


Figure 28: Nikkei Index Percentage Returns per Threshold Graph During the Japanese Asset Price Bubble Period

Mayer Multiple Threshold	Maximum Percentage Returns Trade	Average Percentage Returns Across All Trades	Minimum Percentage Returns Trade
0.7	**12%**	**7%**	**3%**
0.8	19%	4%	-7%
0.9	18%	2%	-24%
1	24%	-3%	-38%
1.1	11%	5%	0%

Figure 29: Nikkei Index Percentage Returns per Threshold Table During the Japanese Asset Price Bubble Period

As we can see from Figure 29, our algorithm determines 0.7 as the threshold that yields the highest average percentage returns. In other words, throughout the above period accumulating the Nikkei Index until the Mayer Multiple reaches 0.7 produces the *highest* return on investment *on average*. Although the 0.7 threshold produces the highest return on average, as we can see from Figure 27 during the Japanese Asset Price Bubble period, most of the Mayer Multiples are above 0.7 making the trading strategy profitable for only a short period of time. A Mayer Multiple of 0.7 does not help locate any bubbles as it is too low.

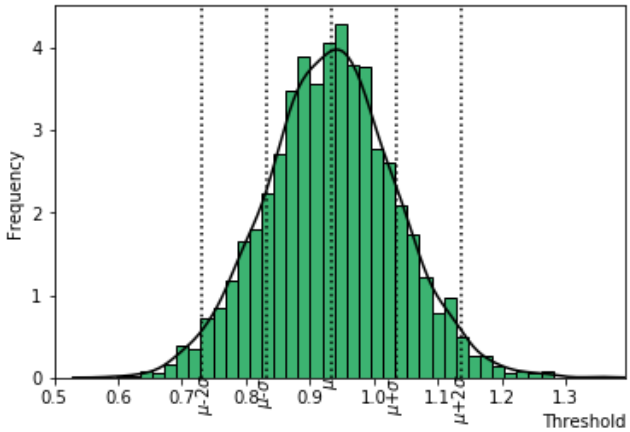


Figure 30: Nikkei Index Threshold Frequency Normal Distribution During the Japanese Asset Price Bubble Period

Indicator	Mayer Multiple Value
Mean – 2 SD	0.73
Mean – 1 SD	0.83
Mean	0.93
Mean + 1 SD	1.03
Mean + 2 SD	1.13

Figure 31: Nikkei Index Mean & SD Indicators During the Japanese Asset Price Bubble Period

The mean and standard deviation indicators for the Nikkei Index during the Japanese economic bubble (Figure 31) are close but not equal to the indicators of the Nikkei Index as a whole (Figure 26).
The Mayer Multiple of the Nikkei Index does not seem to work at localizing the Japanese Economic Bubble. The extracted Mayer Multiple values are too low to determine any usable patterns.

7.4. Dot-com Bubble and Nasdaq Composite

7.4.1. Nasdaq Composite Analysis

Let us first analyze the Nasdaq Composite as a whole. This dataset runs from the 5th of February 1971 through to the 20th May 2019.

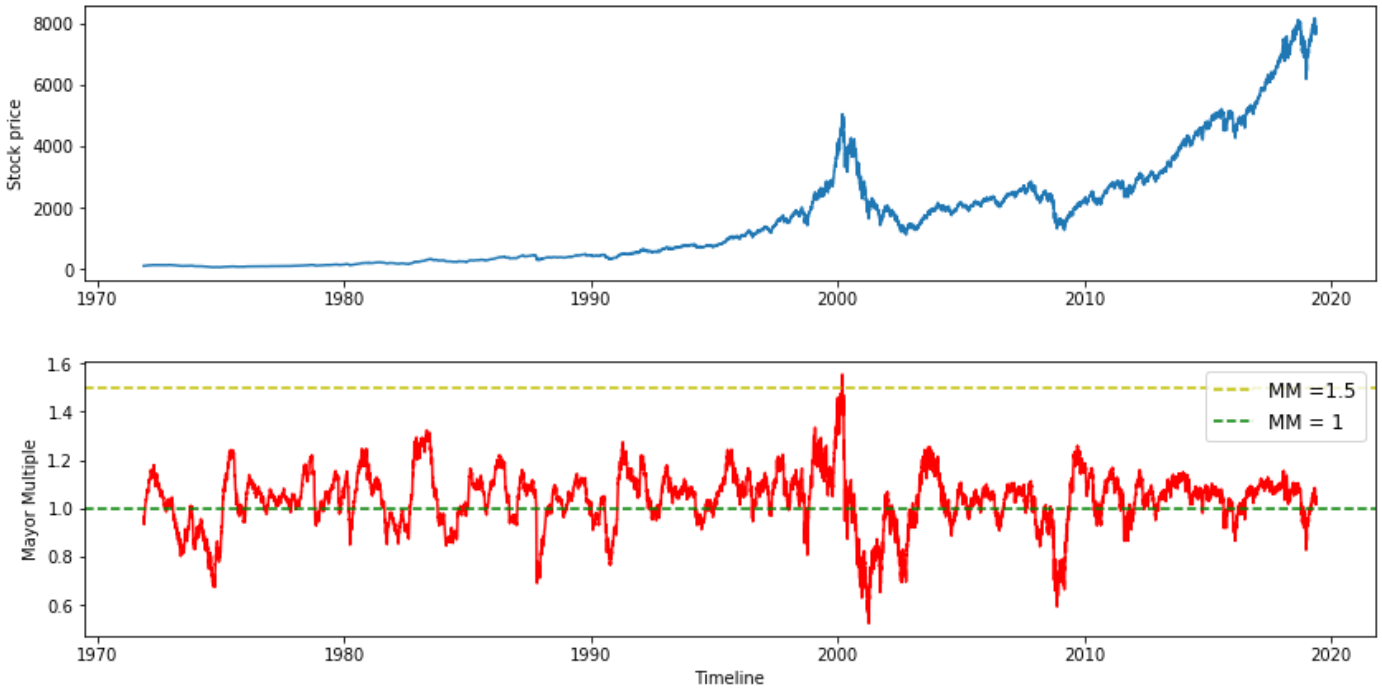


Figure 32: Nasdaq Composite Price vs. Mayer Multiple

From the visualization of the stock price (in blue) in Figure 32, we can observe the start and end phase of the Dot-com Bubble around the year 2000 mark.

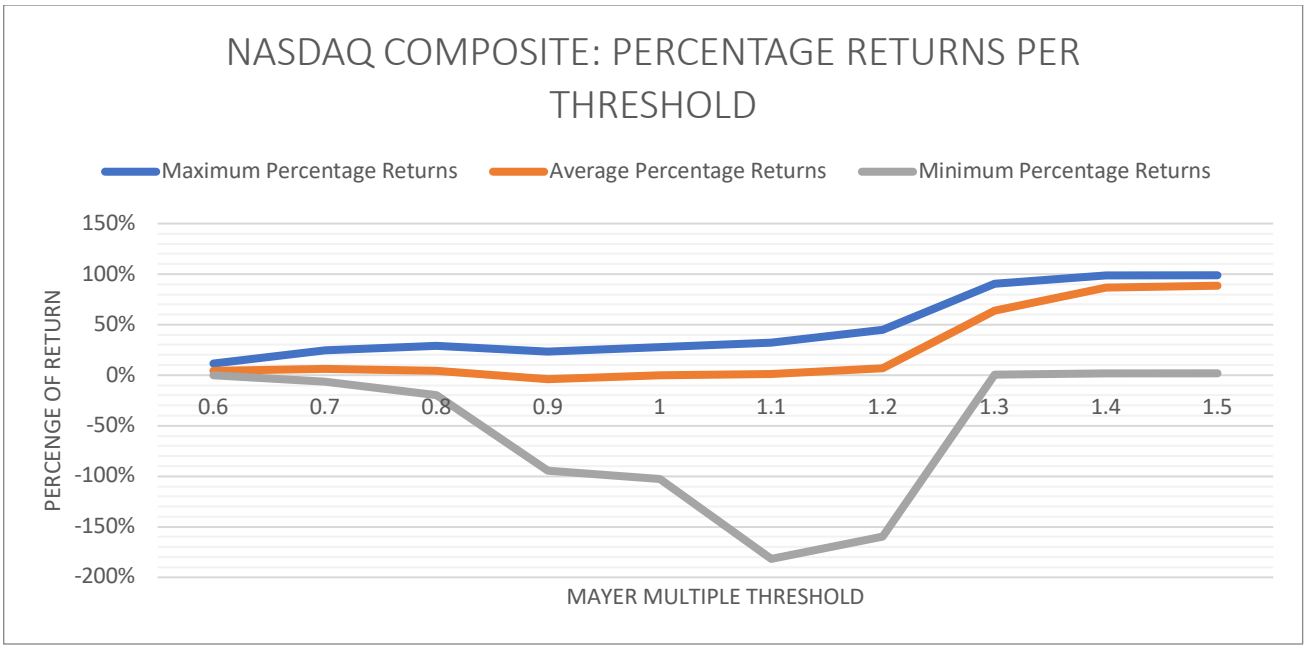


Figure 33: Nasdaq Composite Percentage Returns per Threshold Graph

Mayer Multiple Threshold	Maximum Percentage Returns Trade	Average Percentage Returns Across All Trades	Minimum Percentage Returns Trade
0.6	12%	4%	0%
0.7	25%	6%	-6%
0.8	29%	4%	-20%
0.9	23%	-4%	-94%
1	28%	0%	-103%
1.1	32%	1%	-182%
1.2	45%	7%	-160%
1.3	91%	64%	0%
1.4	99%	86%	2%
1.5	**99%**	**89%**	**2%**

Figure 34: Nasdaq Composite Percentage Returns per Threshold Table

As we can see from Figure 32 and 34, our algorithm determines 1.5 as the threshold that yields the highest average percentage returns. In other words, throughout history accumulating the Nasdaq Composite until the Mayer Multiple reaches 1.5 produces the *highest* return on investment *on average*.
However, once we delve deeper into the returns per threshold (Figure 34), accumulating the Nasdaq until it reaches the threshold of 1.3 has produced positive returns as even the minimum percentage return for all thresholds 1.3 and above are positive or equal to zero.

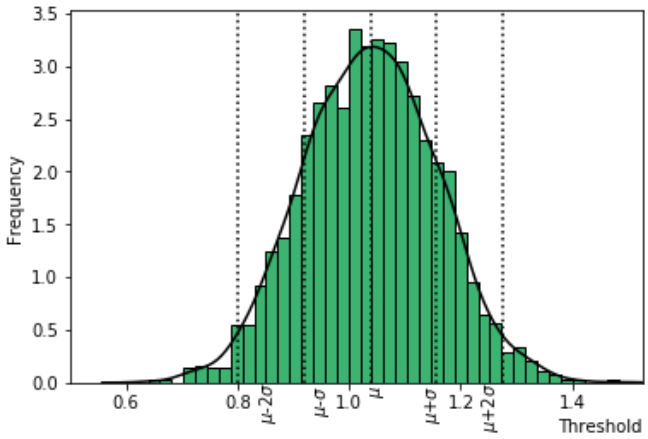


Figure 35: Nasdaq Composite Threshold Frequency Normal Distribution

To use the 1.5 threshold as a trading strategy would not be very profitable as the Nasdaq only reaches a Mayer Multiple of 1.5 once (Figure 32). It is interesting to note however that the peak in the Mayer Multiple does in fact coincide with the bubble's peak.

Indicator	Mayer Multiple Value
Mean – 2 SD	0.79
Mean – 1 SD	0.91
Mean	1.03
Mean + 1 SD	1.15
Mean + 2 SD	1.27

Figure 36: Nasdaq Composite Mean & SD Indicators

7.4.2. Dot-com Bubble Analysis

Next, let us analyze the period of the Dot-com economic bubble. The dataset runs from the 3rd June 1996 through to the 30th August 2002. We have chosen to widen the period in order to compensate for the loss of the first 200 days at the beginning (due to the 200-day Moving Average) and to be sure that both the start and end phases of the bubble are included in the graph.

Figure 37: Nasdaq Composite Price vs. Mayer Multiple During the Dot-com Bubble Period

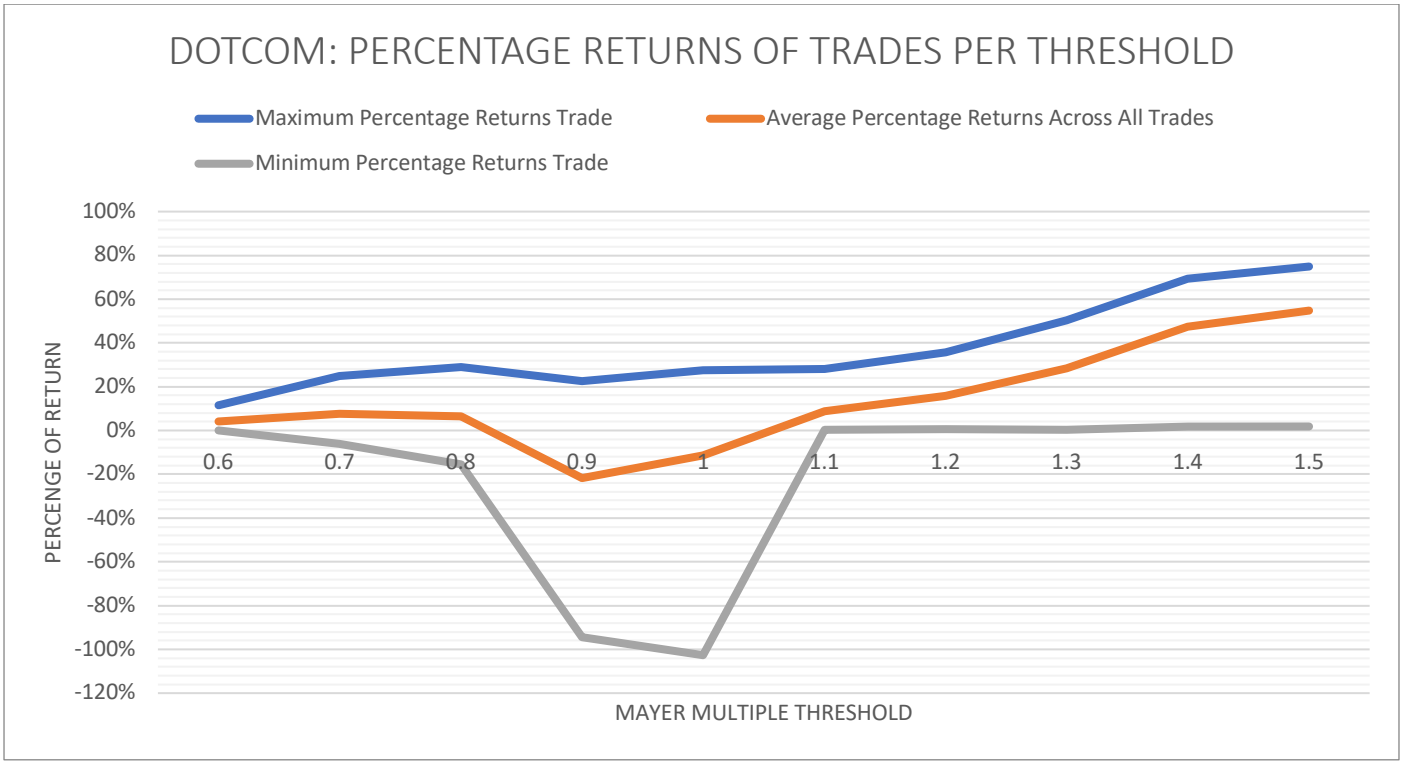


Figure 38: Nasdaq Composite Percentage Returns per Threshold Graph During the Dot-com Bubble Period

Mayer Multiple Threshold	Maximum Percentage Returns Trade	Average Percentage Returns Across All Trades	Minimum Percentage Returns Trade
0.6	12%	4%	0%
0.7	25%	8%	-6%
0.8	29%	6%	-16%
0.9	22%	-22%	-94%
1	28%	-11%	-103%
1.1	28%	9%	0%
1.2	36%	16%	1%
1.3	50%	28%	0%
1.4	69%	47%	2%
1.5	**75%**	**55%**	**2%**

Figure 39: Nasdaq Composite Percentage Returns per Threshold Table During the Dot-com Bubble Period

As we can see from the three figures above, our algorithm determines 1.5 as the threshold that yields the highest average percentage returns. In other words, throughout the above period accumulating the Nasdaq Composite until it the Mayer Multiple reaches 1.5 produces the *highest* return on investment *on average*. It is important to note that this threshold is equal to the threshold determined from the entire dataset.
However, once we delve deeper into the returns per threshold (Figure 39), accumulating the Nasdaq until it reaches the threshold of 1.1 has produced positive returns as even the minimum percentage return for all thresholds 1.1 and above are positive.

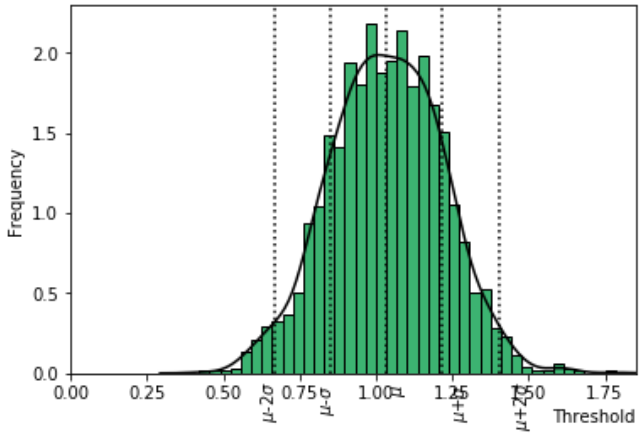


Figure 40: Nasdaq Composite Threshold Frequency Normal Distribution During the Dot-com Bubble Period

Indicator	Mayer Multiple Value
Mean – 2 SD	0.65
Mean – 1 SD	0.84
Mean	1.03
Mean + 1 SD	1.21
Mean + 2 SD	1.40

Figure 41: Nasdaq Composite Mean & SD Indicators During the Dot-com Bubble Period

The mean indicator for Dot-com is equal to the mean indicator of the whole Nasdaq Composite when rounded to the nearest 0.01 value. The other indicators are very close.
As we can see from Figure 37, the Mayer Multiple threshold of 1.5 does seem to be able to locate the peak of the bubble. There are 7 days where the Mayer Multiple is above the 1.5 threshold and the dates coincide with the peak of the Dot-com bubble.

7.5. US Housing Bubble and the S&P 500 Index

7.5.1. S&P 500 Index Analysis

Let us first analyze the S&P 500 Index as a whole. This dataset runs from the 30th of December 1927 through to the 27th March 2019.

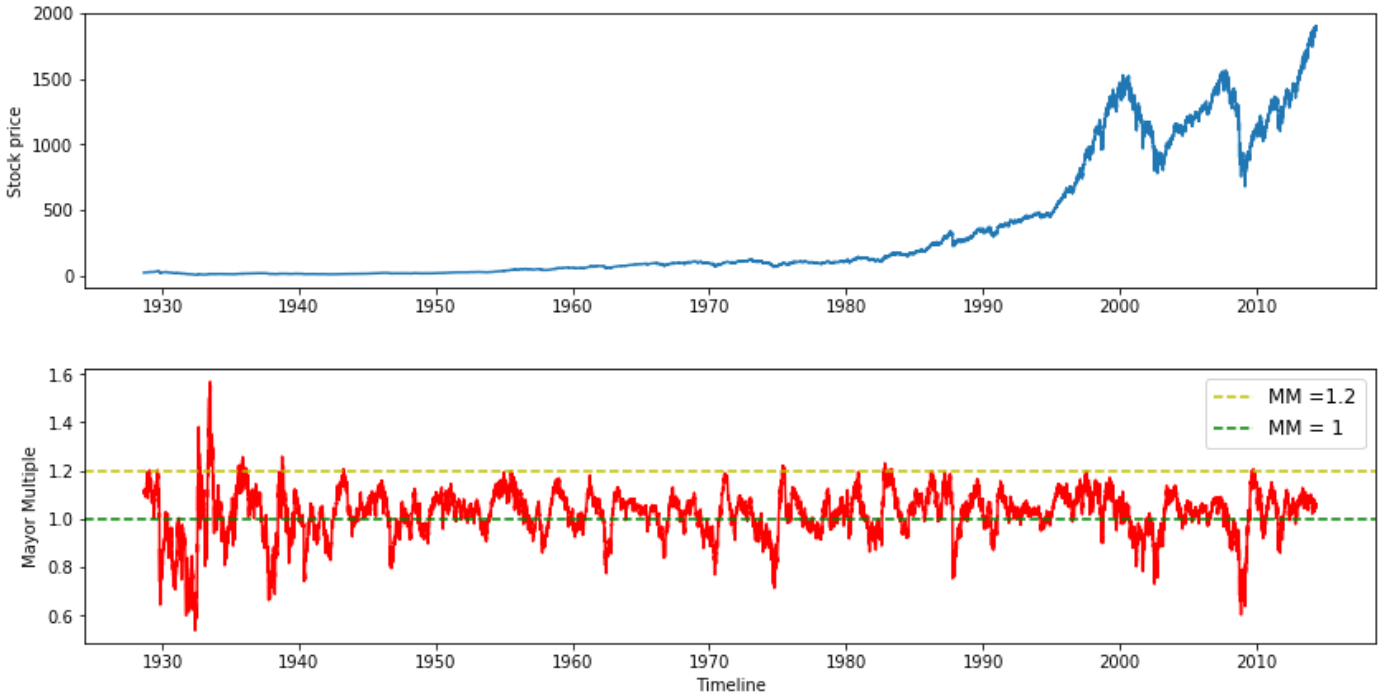


Figure 42: S&P 500 Index Price vs. Mayer Multiple

From the visualization of the stock price (in blue) in Figure 42 we can observe two bubbles: The Dot-com Bubble near the year 2000 mark as well as the US Housing Bubble which is the following increase and decrease in price.

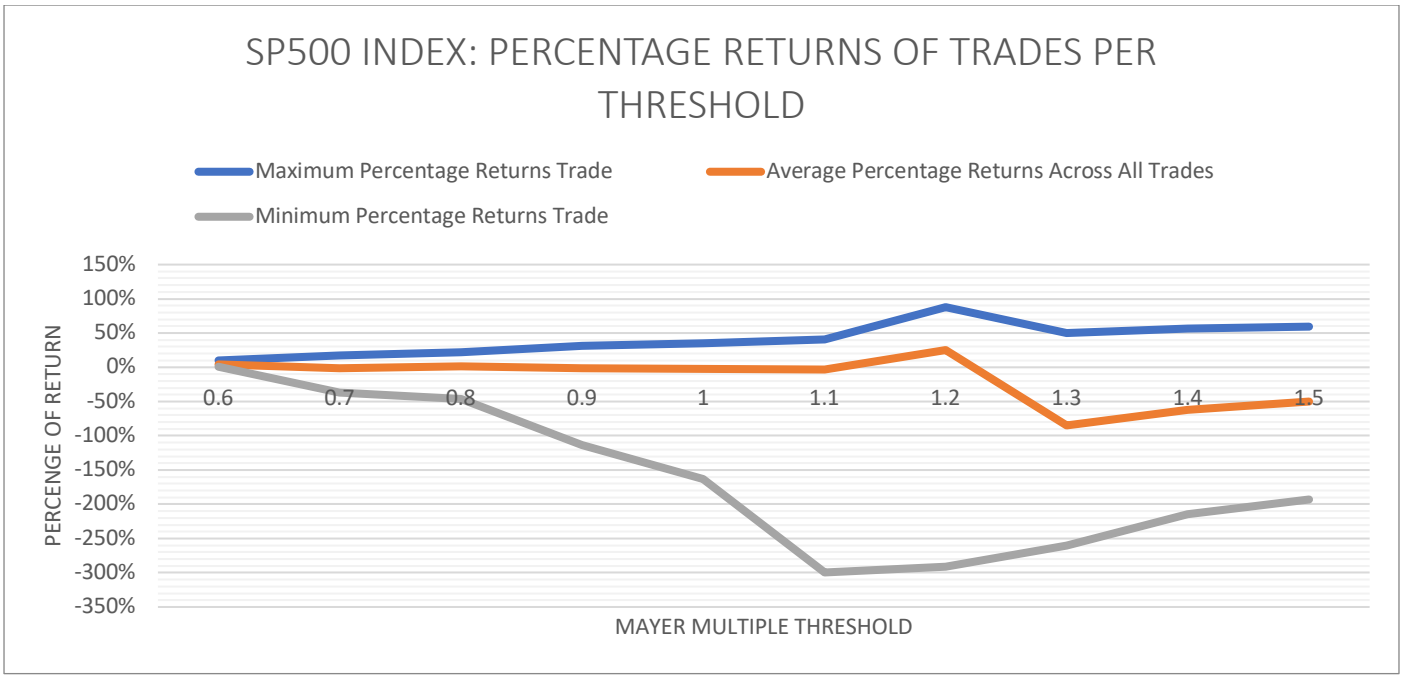


Figure 43: S&P 500 Percentage Returns per Threshold Graph

Mayer Multiple Threshold	Maximum Percentage Returns Trade	Average Percentage Returns Across All Trades	Minimum Percentage Returns Trade
0.6	10%	5%	1%
0.7	17%	-1%	-37%
0.8	22%	1%	-47%
0.9	31%	-2%	-114%
1	35%	-3%	-163%
1.1	41%	-3%	-300%
1.2	**88%**	**25%**	**-291%**
1.3	50%	-85%	-260%
1.4	57%	-62%	-215%
1.5	60%	-50%	-193%

Figure 44: S&P 500 Percentage Returns per Threshold Table

As we can see from the above three figures, our algorithm determines 1.2 as the threshold that yields the highest average percentage returns. In other words, throughout history accumulating the S&P 500 Index until the Mayer Multiple reaches 1.2 produces the *highest* return on investment *on average*.
However, once we delve deeper into the returns per threshold (Figure 44), we can see that no matter the threshold, the trading strategy can still produce incredibly negative returns.

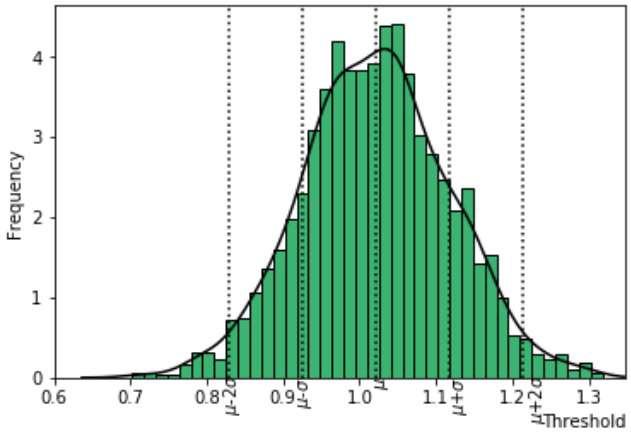


Figure 45: S&P 500 Threshold Frequency Normal Distribution

Indicator	Mayer Multiple Value
Mean – 2 SD	0.82
Mean – 1 SD	0.92
Mean	1.02
Mean + 1 SD	1.12
Mean + 2 SD	1.21

Figure 46: S&P 500 Mean & SD Indicators

7.5.2. US Housing Bubble

Next, let us analyze the period of the Dot-com economic bubble. The dataset runs from the 2nd January 2004 through to the 31st December 2009. We have chosen to widen the period in order to compensate for the loss of the first 200 days at the beginning (due to the 200-day Moving Average) and to be sure that both the start and end phases of the bubble are included in the graph.

Figure 47: S&P 500 Index Price vs. Mayer Multiple During the US Housing Bubble Period

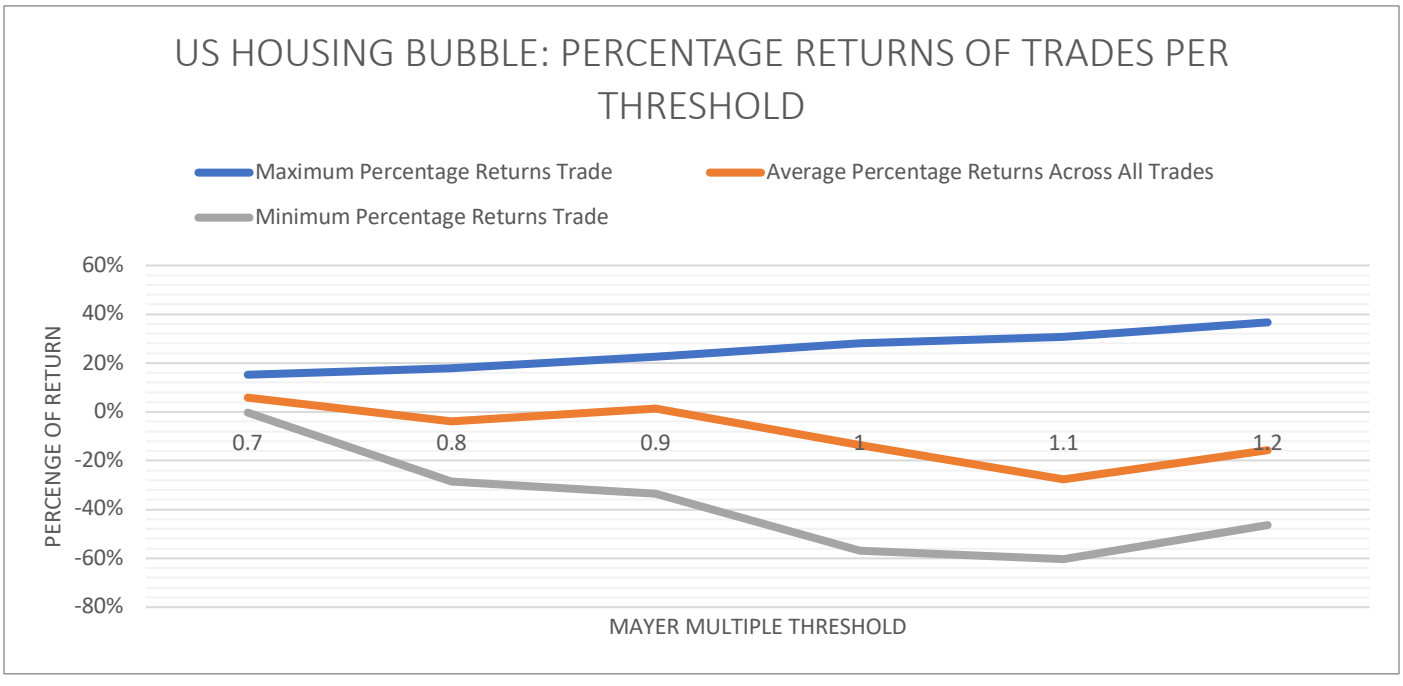


Figure 48: S&P 500 Index Percentage Returns per Threshold Graph During the US Housing Bubble Period

Mayer Multiple Threshold	Maximum Percentage Returns Trade	Average Percentage Returns Across All Trades	Minimum Percentage Returns Trade
0.7	**15%**	**6%**	**0%**
0.8	18%	-4%	-28%
0.9	23%	1%	-34%
1	28%	-14%	-57%
1.1	31%	-28%	-60%
1.2	37%	-16%	-46%

Figure 49: S&P 500 Index Percentage Returns per Threshold Table During the US Housing Bubble Period

As we can see from Figures 47 and 49, our algorithm determines 0.7 as the threshold that yields the highest average percentage returns. In other words, throughout the above period accumulating the S&P 500 until it the Mayer Multiple reaches 0.7 produces the *highest* return on investment *on average* Although this is true, the 0.7 threshold is quite low and thus the number of days where the Mayer Multiple is below 0.7 is quite small (Figure 47).

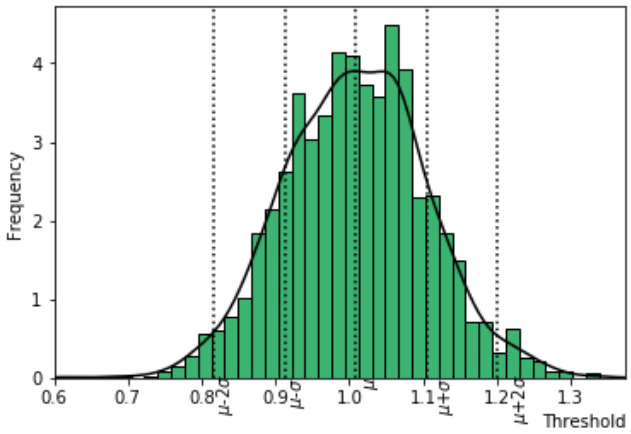


Figure 50: S&P 500 Index Threshold Frequency Normal Distribution During the US Housing Bubble Period

Indicator	Mayer Multiple Value
Mean – 2 SD	0.81
Mean – 1 SD	0.91
Mean	1.00
Mean + 1 SD	1.10
Mean + 2 SD	1.20

Figure 51: S&P 500 Index Mean and SD Indicators During the US Housing Bubble Period

Interestingly, the Mayer Multiple for the S&P 500 does follow the S&P500 price quite closely during the US Housing Bubble Period (Figure 47). However, once we zoom out and study the whole S&P500 dataset, the Mayer Multiple ratios are quite irregular (Figure 42).

7.6. COMPARISON OF ALL ECONOMIC BUBBLE RESULTS

Data Set	Mayer Multiple "Highest Return on Average Threshold"	Mayer Multiple "All the Percentage Returns are >= 0"	Mean	Mean + 1SD
Dow Jones Industrial Average	1.2	N/A	1.02	1.12
Black Tuesday Bubble Period (using DJIA)	1.2	1.1	1.02	1.12
Nikkei Index	1.6	1.5	1.04	1.16
Japanese Asset Price Bubble Period (using Nikkei)	0.7	1.1	0.93	1.03
Nasdaq Composite	1.5	1.3	1.03	1.15
Dot-Com Bubble Period (using Nasdaq)	1.5	1.1	1.03	1.21
S&P 500 Index	1.2	N/A	1.02	1.12
US Housing Bubble Period (using S&P 500)	0.7	N/A	1.00	1.2

Figure 52: Economic Bubble Mayer Multiple Indicator Summary

7.7. CYRPTOCURRENCY RESULT: ETHEREUM

Although the Mayer Multiple thresholds was able to determine some patterns in the above four economic bubbles, nothing seemed to be as concrete as the Bitcoin bubble. This is most likely due to the particularity of Bitcoin. To further study the Mayer Multiple, we chose to apply the same trading algorithm to another famous cryptocurrency, Ethereum, in the hopes of being able to observe underlying patterns. The Ethereum dataset runs from the 6th of August 2015 to the 18th of May 2019.

7.7.1. Ethereum Analysis

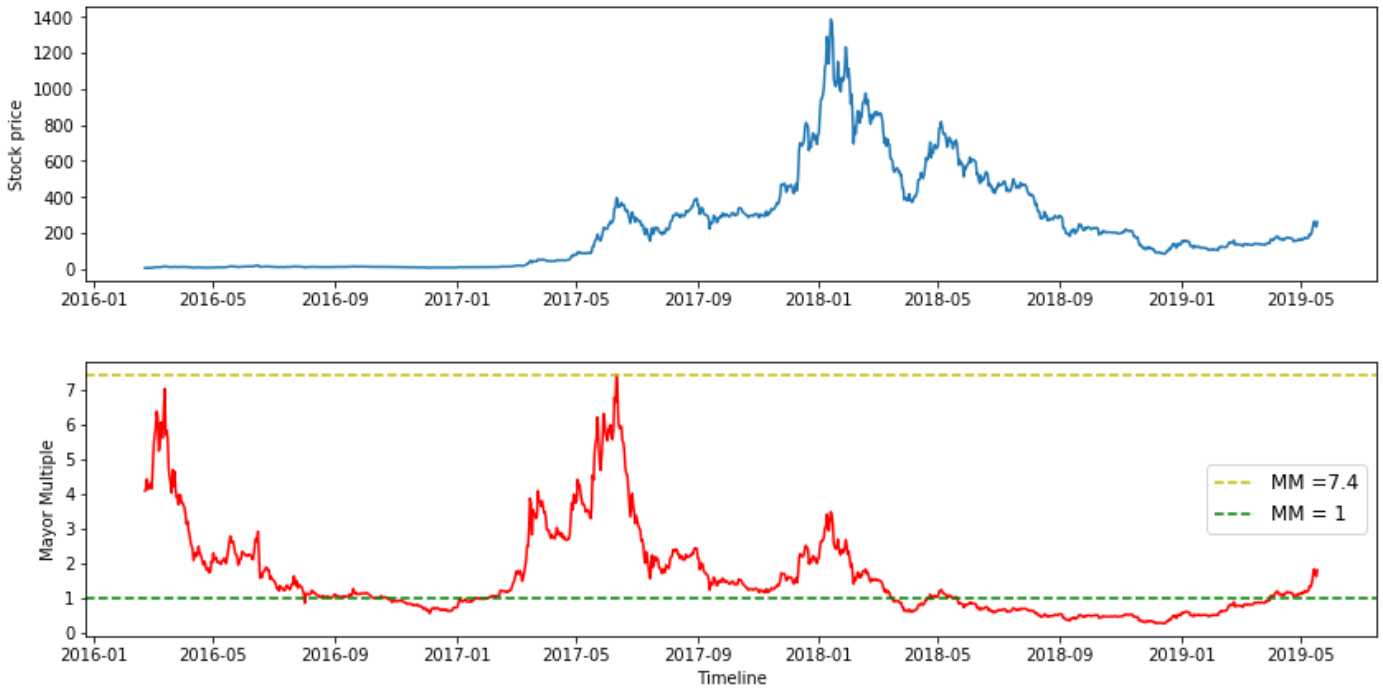


Figure 53: Ethereum Price vs. Mayer Multiple

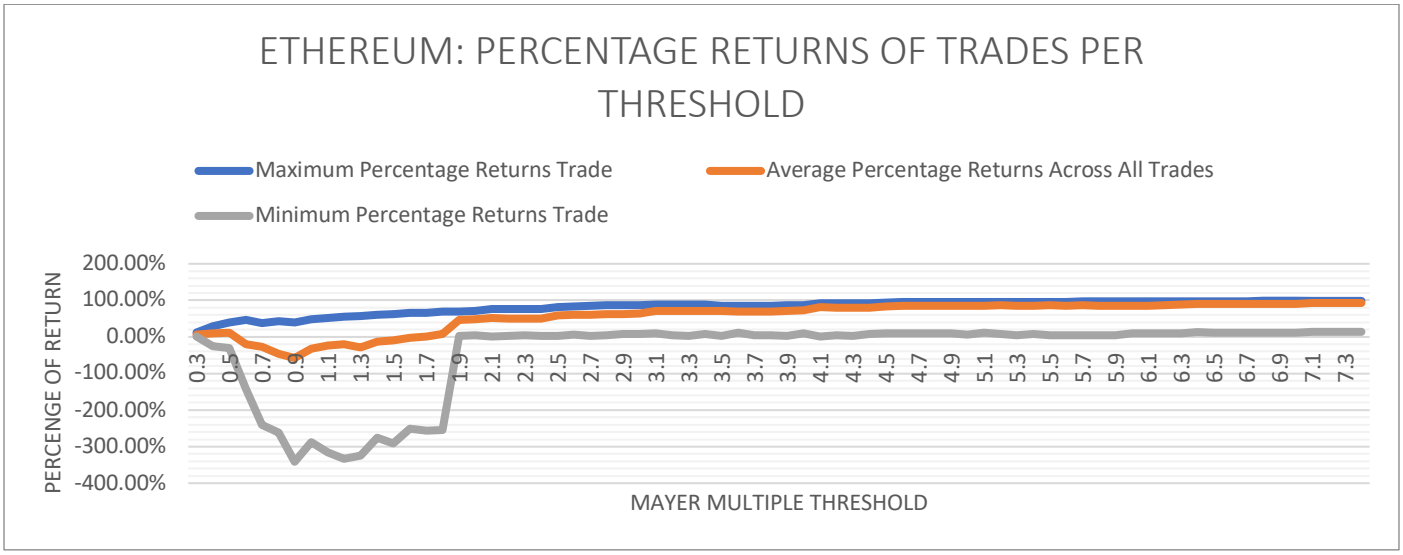


Figure 54: Ethereum Percentage Returns per Threshold

As we can see from the above graphs, our algorithm determines 7.4 as the threshold that yields the highest average percentage returns. In other words, accumulating Ethereum until it the Mayer Multiple reaches 7.4 produces the *highest* return on investment *on average*.

However, once we delve deeper into the returns per threshold [7], historical data shows that accumulating Ethereum until it reaches the threshold of 1.9 has produced positive returns as even the minimum percentage return for all thresholds 2 and above are positive.

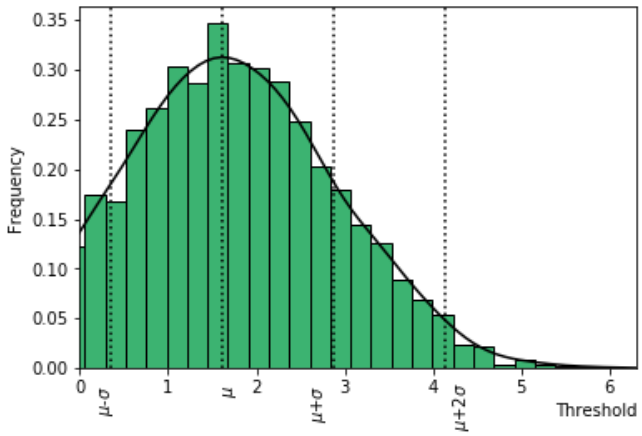


Figure 55: Ethereum Threshold Frequency Normal Distribution

Indicator	Value
Mean – 2 SD	-0.92
Mean – 1 SD	0.35
Mean	1.62
Mean + 1 SD	2.88
Mean + 2 SD	4.15

Figure 56: Ethereum Mean & SD Indicators

As we can see from the graph and table above, the frequency of the thresholds follows a normal distribution. The mean is equal to 1.62 which is close to the mean value we found for Bitcoin. Our algorithm's Mean + 1 SD value is 2.88 which, again, is not too far from Bitcoin's 2.77.

Figure 57: Ethereum Price vs. Mayer Multiple with Additional Thresholds

[7] Please see Appendix 9.3

When we plot our indicators on the Mayer Multiple graph for Ethereum, we can see that our 2.88 value (represented by the blue dotted line) locates three bubble periods. The second and third bubble seem to coincide to large price increases of Ethereum. Whereas the value of 7.4 (represented by the yellow dotted line) is too high and only highlights a small period.

8. CONCLUSION AND FINAL OBSERVATIONS

In conclusion, it seems that the calculation of the 2.4 threshold has been solely based on the normal distributions of the frequencies of the Mayer Multiple threshold (Figure 4) instead of the trading algorithm described on the Investor Podcast website. Through our research, our trading algorithm, which attempted to replicate Mayer's trading algorithm, produced a threshold of 7.6. Whereas our study's Mean + SD Mayer Multiple threshold for Bitcoin is 2.77 which is closer to Mayer's 2.4.

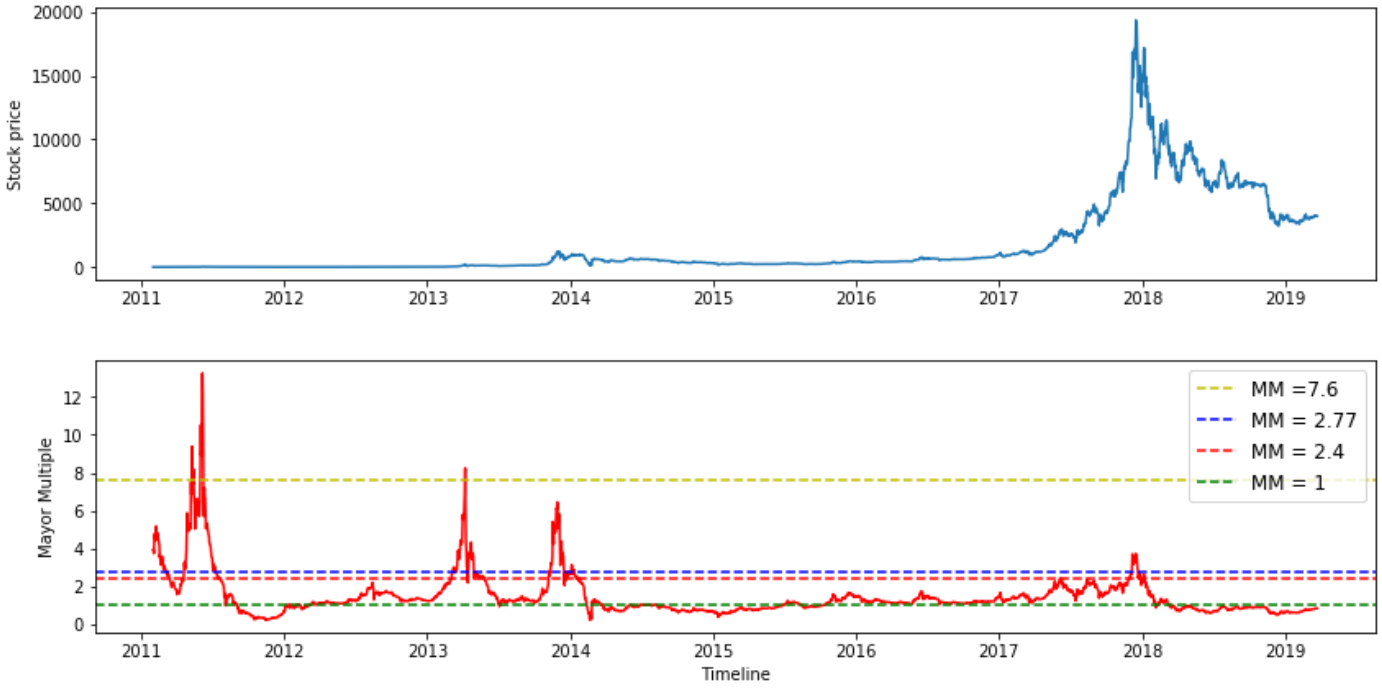
From this study, we can observe that the Mayer Multiple cannot be used in order to detect past stock price bubbles when looking at the entire historical data of a stock index. This is due to the large amount of data present in the longer periods. The Mayer Multiple does seem to pick up on price patterns when used for smaller periods, however this is not useful when wanting determine stock price bubbles as the entire history of an index or stock needs to be taken into consideration as one is unable to guess a bubble's period prior to it happening.

However, the Mayer Multiple does perform better with cryptocurrencies and based on historical analysis can produce positive returns (in the case of Bitcoin and Ethereum). Going forward it would be interesting to apply this study to currency pairs and other cryptocurrencies to establish whether the Mayer Multiple can be used as a trading strategy for these types of assets.

9. APPENDIX

9.1. Bitcoin Graph Including 2018 and 2019

Bitcoin graph including years 2018 and 2019 (data running from the 16th July 2010 to the 24th of March 2019)



9.2. Bitcoin Table of Returns

Mayer Multiple Threshold	Maximum Percentage Returns Trade	Average Percentage Returns Across All Trades	Minimum Percentage Returns Trade
0.3	77.11%	22.19%	6.91%
0.4	77.11%	22.15%	-1.70%
0.5	77.11%	27.85%	-1.18%
0.6	77.11%	25.82%	-6.57%
0.7	81.19%	20.72%	-25.55%
0.8	81.19%	19.37%	-41.29%
0.9	81.19%	0.94%	-102.41%
1	81.19%	3.38%	-110.96%
1.1	81.19%	-14.67%	-136.03%
1.2	81.19%	-2.20%	-115.64%
1.3	83.15%	7.17%	-104.64%
1.4	73.58%	17.00%	-86.33%
1.5	75.88%	23.37%	-68.84%
1.6	77.50%	30.00%	-54.65%
1.7	85.34%	46.86%	-10.64%
1.8	93.87%	60.84%	-10.64%
1.9	94.53%	62.72%	-9.85%
2	94.75%	63.93%	1.15%

2.1	95.09%	65.87%	1.21%
2.2	95.44%	71.07%	1.98%
2.3	96.11%	73.38%	3.83%
2.4	96.11%	74.49%	2.46%
2.5	98.97%	83.47%	2.67%
2.6	99.01%	83.46%	2.93%
2.7	99.19%	84.38%	1.68%
2.8	99.19%	84.58%	3.09%
2.9	99.19%	85.25%	4.96%
3	99.19%	85.16%	3.20%
3.1	99.34%	86.83%	6.22%
3.2	99.34%	87.27%	4.10%
3.3	99.34%	87.26%	4.90%
3.4	99.34%	87.86%	5.79%
3.5	99.34%	87.83%	4.79%
3.6	99.34%	87.75%	5.28%
3.7	99.34%	88.04%	3.93%
3.8	97.11%	81.58%	6.24%
3.9	97.39%	82.36%	6.24%
4	97.69%	83.77%	11.10%
4.1	97.69%	83.77%	11.10%
4.2	97.69%	83.72%	6.95%
4.3	97.69%	83.47%	4.77%
4.4	97.69%	84.24%	11.36%
4.5	98.03%	85.21%	11.36%
4.6	98.03%	85.01%	8.38%
4.7	98.03%	85.01%	8.38%
4.8	98.26%	85.76%	8.38%
4.9	98.26%	85.71%	4.21%
5	98.26%	85.73%	4.62%
5.1	98.26%	85.44%	4.62%
5.2	98.26%	85.53%	5.94%
5.3	98.48%	86.19%	3.54%
5.4	98.48%	86.38%	8.41%
5.5	98.48%	86.99%	5.05%
5.6	98.48%	86.84%	6.68%
5.7	98.48%	87.00%	6.68%
5.8	98.74%	87.69%	6.43%
5.9	98.74%	88.68%	4.20%
6	98.74%	88.50%	8.05%
6.1	98.74%	88.38%	8.75%
6.2	98.74%	88.67%	8.75%
6.3	98.91%	89.13%	8.75%
6.4	98.91%	89.13%	8.75%
6.5	98.91%	90.25%	11.67%

6.6	98.91%	90.08%	4.55%
6.7	98.91%	90.33%	13.44%
6.8	98.91%	90.32%	13.44%
6.9	98.91%	90.22%	12.70%
7	99.11%	91.09%	6.50%
7.1	99.11%	91.04%	6.50%
7.2	99.11%	91.24%	12.70%
7.3	99.11%	91.24%	12.70%
7.4	99.11%	91.24%	12.70%
7.5	99.11%	91.23%	7.78%
7.6	99.11%	91.77%	12.95%
7.7	99.11%	91.77%	12.95%
7.8	99.11%	91.77%	12.95%
7.9	99.11%	91.77%	12.95%
8	99.11%	91.66%	10.34%
8.1	99.11%	91.66%	10.34%
8.2	99.11%	91.70%	18.48%
8.3	91.71%	76.88%	23.17%
8.4	91.71%	78.65%	23.17%
8.5	91.71%	78.65%	23.17%
8.6	91.71%	78.65%	23.17%
8.7	91.71%	78.65%	23.17%
8.8	91.71%	78.65%	23.17%
8.9	91.71%	78.09%	9.97%
9	91.71%	78.09%	9.97%
9.1	91.71%	78.09%	9.97%
9.2	91.71%	78.09%	9.97%
9.3	91.71%	78.09%	9.97%
9.4	96.40%	85.64%	9.97%
9.5	96.40%	85.30%	22.45%
9.6	96.40%	85.30%	22.45%
9.7	96.40%	85.30%	22.45%
9.8	96.40%	85.30%	22.45%
9.9	96.40%	85.30%	22.45%
10	96.40%	85.30%	22.45%
10.1	96.40%	85.30%	22.45%
10.2	96.40%	85.30%	22.45%
10.3	96.40%	85.30%	22.45%
10.4	96.40%	85.30%	22.45%
10.5	96.40%	85.30%	22.45%
10.6	97.16%	87.60%	21.03%
10.7	97.16%	87.60%	21.03%
10.8	97.16%	87.60%	21.03%
10.9	97.16%	87.60%	21.03%
11	97.16%	87.60%	21.03%

11.1	97.16%	87.60%	21.03%
11.2	97.16%	87.60%	21.03%
11.3	97.16%	87.60%	21.03%
11.4	97.16%	87.60%	21.03%
11.5	97.70%	89.42%	19.19%
11.6	97.70%	89.42%	19.19%
11.7	97.70%	89.42%	19.19%
11.8	97.70%	89.42%	19.19%
11.9	97.70%	89.42%	19.19%
12	97.70%	89.42%	19.19%
12.1	97.70%	89.42%	19.19%
12.2	97.70%	89.42%	19.19%
12.3	97.70%	89.42%	19.19%
12.4	97.70%	89.42%	19.19%
12.5	97.70%	89.42%	19.19%
12.6	97.70%	89.42%	19.19%
12.7	97.70%	89.42%	19.19%
12.8	97.70%	89.42%	19.19%
12.9	97.70%	89.42%	19.19%
13	97.70%	89.42%	19.19%
13.1	97.70%	89.42%	19.19%
13.2	97.70%	89.42%	19.19%

9.3. Ethereum Table of Returns

Mayer Multiple Threshold	Maximum Percentage Returns Trade	Average Percentage Returns Across All Trades	Minimum Percentage Returns Trade
0.3	12.09%	6.74%	1.07%
0.4	29.11%	9.64%	-25.23%
0.5	39.96%	10.83%	-30.77%
0.6	46.30%	-20.21%	-141.91%
0.7	37.52%	-27.68%	-240.01%
0.8	43.78%	-46.83%	-260.82%
0.9	40.17%	-57.60%	-341.45%
1	49.13%	-31.72%	-288.55%
1.1	52.21%	-22.65%	-315.41%
1.2	54.65%	-20.46%	-333.16%
1.3	56.40%	-28.04%	-324.33%
1.4	61.36%	-13.67%	-276.03%
1.5	61.88%	-9.92%	-291.15%
1.6	66.26%	-1.86%	-250.54%
1.7	66.26%	0.67%	-256.15%
1.8	68.81%	8.44%	-255.35%
1.9	68.81%	45.75%	2.79%
2	71.30%	48.17%	3.89%
2.1	76.49%	52.14%	1.74%
2.2	76.49%	50.24%	1.99%
2.3	76.49%	49.99%	4.28%
2.4	76.49%	49.78%	3.00%
2.5	80.98%	58.24%	3.26%
2.6	83.49%	60.20%	6.15%
2.7	84.56%	61.00%	2.38%
2.8	86.10%	62.92%	3.89%
2.9	86.10%	62.44%	7.18%
3	86.10%	64.85%	7.18%
3.1	87.94%	70.91%	9.65%
3.2	87.94%	70.68%	3.71%
3.3	87.94%	70.32%	3.59%
3.4	87.94%	70.51%	8.43%
3.5	85.30%	70.21%	3.19%
3.6	85.30%	69.72%	11.34%
3.7	85.30%	68.88%	5.31%
3.8	85.30%	68.69%	3.88%
3.9	87.42%	71.12%	2.82%
4	87.42%	72.10%	9.41%
4.1	92.92%	80.90%	1.75%
4.2	92.92%	80.08%	4.25%
4.3	92.92%	79.51%	2.92%

4.4	92.92%	79.31%	8.51%
4.5	94.62%	82.80%	10.19%
4.6	95.48%	84.99%	10.19%
4.7	95.48%	85.59%	9.39%
4.8	95.48%	85.60%	9.39%
4.9	95.48%	85.62%	9.39%
5	95.48%	85.44%	5.80%
5.1	95.48%	85.32%	10.97%
5.2	95.83%	86.12%	7.72%
5.3	95.83%	85.93%	3.85%
5.4	95.83%	85.80%	7.72%
5.5	96.05%	86.17%	5.37%
5.6	96.05%	85.63%	5.37%
5.7	96.53%	85.99%	4.51%
5.8	96.53%	85.57%	4.51%
5.9	96.53%	85.23%	3.94%
6	96.53%	85.62%	9.45%
6.1	96.53%	85.51%	9.45%
6.2	97.07%	86.61%	9.45%
6.3	98.01%	89.41%	9.45%
6.4	98.01%	89.54%	12.83%
6.5	98.01%	89.67%	11.67%
6.6	98.01%	89.67%	11.67%
6.7	98.01%	89.51%	11.67%
6.8	98.30%	90.52%	11.67%
6.9	98.30%	90.52%	11.67%
7	98.30%	90.52%	11.67%
7.1	98.58%	92.87%	13.93%
7.2	98.58%	92.87%	13.93%
7.3	98.58%	92.87%	13.93%
7.4	98.58%	92.87%	13.93%

9.4. Formulas Used to Calculate Mean and Standard Deviation

Weighted Mean: $$\bar{x}_w = \frac{\sum_{i=1}^{n}(w_i * x_i)}{\sum_{i=1}^{n}(w_i)}$$

Where:

$\bar{x}_w$ *is the weighted mean variable*
w_i *is the allocated weighted value*
x_i *is the observed values*

Weighted Standard Deviation: $$\sqrt{\frac{\sum_{i=1}^{N} w_i(x_i - \bar{x})^2}{\frac{(M-1)}{M}\sum_{i=1}^{N} w_i}}$$

Where:

N *is the number of observations*
M *is the number of nonzero weights*
$\bar{x}_w$ *is the weighted mean variable*
w_i *is the allocated weighted value*
x_i *is the observed values*

9.5. Percentage Returns Per Year

In order to better illustrate the percentage of return per threshold, the below tables represent the percentage returns divided by the number of years (number of days divided by 365.25).

Bitcoin

Data Period: 16/07/2010 – 31/12/2017
Number of Days: 2725
Number of Years: 7.46

Mayer Multiple Threshold	Maximum Annual Percentage Returns Trade	Average Annual Percentage Returns Across All Trades	Minimum Annual Percentage Returns Trade
0.30	10.34%	2.97%	0.93%
0.40	10.34%	2.97%	-0.23%
0.50	10.34%	3.73%	-0.16%
0.60	10.34%	3.46%	-0.88%
0.70	10.88%	2.78%	-3.43%
0.80	10.88%	2.60%	-5.53%
0.90	10.88%	0.13%	-13.73%
1.00	10.88%	0.45%	-14.87%
1.10	10.88%	-1.97%	-18.23%
1.20	10.88%	-0.29%	-15.50%
1.30	11.15%	0.96%	-14.03%
1.40	9.86%	2.28%	-11.57%
1.50	10.17%	3.13%	-9.23%
1.60	10.39%	4.02%	-7.33%
1.70	11.44%	6.28%	-1.43%
1.80	12.58%	8.16%	-1.43%
1.90	12.67%	8.41%	-1.32%
2.00	12.70%	8.57%	0.15%
2.10	12.75%	8.83%	0.16%
2.20	12.79%	9.53%	0.27%
2.30	12.88%	9.84%	0.51%
2.40	12.88%	9.99%	0.33%
2.50	13.27%	11.19%	0.36%
2.60	13.27%	11.19%	0.39%
2.70	13.30%	11.31%	0.23%
2.80	13.30%	11.34%	0.41%
2.90	13.30%	11.43%	0.66%
3.00	13.30%	11.42%	0.43%
3.10	13.32%	11.64%	0.83%
3.20	13.32%	11.70%	0.55%
3.30	13.32%	11.70%	0.66%
3.40	13.32%	11.78%	0.78%
3.50	13.32%	11.77%	0.64%
3.60	13.32%	11.76%	0.71%

3.70	13.32%	11.80%	0.53%
3.80	13.02%	10.94%	0.84%
3.90	13.05%	11.04%	0.84%
4.00	13.10%	11.23%	1.49%
4.10	13.10%	11.23%	1.49%
4.20	13.10%	11.22%	0.93%
4.30	13.10%	11.19%	0.64%
4.40	13.10%	11.29%	1.52%
4.50	13.14%	11.42%	1.52%
4.60	13.14%	11.40%	1.12%
4.70	13.14%	11.40%	1.12%
4.80	13.17%	11.50%	1.12%
4.90	13.17%	11.49%	0.56%
5.00	13.17%	11.49%	0.62%
5.10	13.17%	11.45%	0.62%
5.20	13.17%	11.46%	0.80%
5.30	13.20%	11.55%	0.47%
5.40	13.20%	11.58%	1.13%
5.50	13.20%	11.66%	0.68%
5.60	13.20%	11.64%	0.90%
5.70	13.20%	11.66%	0.90%
5.80	13.24%	11.75%	0.86%
5.90	13.24%	11.89%	0.56%
6.00	13.24%	11.86%	1.08%
6.10	13.24%	11.85%	1.17%
6.20	13.24%	11.89%	1.17%
6.30	13.26%	11.95%	1.17%
6.40	13.26%	11.95%	1.17%
6.50	13.26%	12.10%	1.56%
6.60	13.26%	12.08%	0.61%
6.70	13.26%	12.11%	1.80%
6.80	13.26%	12.11%	1.80%
6.90	13.26%	12.09%	1.70%
7.00	13.29%	12.21%	0.87%
7.10	13.29%	12.20%	0.87%
7.20	13.29%	12.23%	1.70%
7.30	13.29%	12.23%	1.70%
7.40	13.29%	12.23%	1.70%
7.50	13.29%	12.23%	1.04%
7.60	13.29%	12.30%	1.74%
7.70	13.29%	12.30%	1.74%
7.80	13.29%	12.30%	1.74%
7.90	13.29%	12.30%	1.74%
8.00	13.29%	12.29%	1.39%
8.10	13.29%	12.29%	1.39%

8.20	13.29%	12.29%	2.48%
8.30	12.29%	10.31%	3.11%
8.40	12.29%	10.54%	3.11%
8.50	12.29%	10.54%	3.11%
8.60	12.29%	10.54%	3.11%
8.70	12.29%	10.54%	3.11%
8.80	12.29%	10.54%	3.11%
8.90	12.29%	10.47%	1.34%
9.00	12.29%	10.47%	1.34%
9.10	12.29%	10.47%	1.34%
9.20	12.29%	10.47%	1.34%
9.30	12.29%	10.47%	1.34%
9.40	12.92%	11.48%	1.34%
9.50	12.92%	11.43%	3.01%
9.60	12.92%	11.43%	3.01%
9.70	12.92%	11.43%	3.01%
9.80	12.92%	11.43%	3.01%
9.90	12.92%	11.43%	3.01%
10.00	12.92%	11.43%	3.01%
10.10	12.92%	11.43%	3.01%
10.20	12.92%	11.43%	3.01%
10.30	12.92%	11.43%	3.01%
10.40	12.92%	11.43%	3.01%
10.50	12.92%	11.43%	3.01%
10.60	13.02%	11.74%	2.82%
10.70	13.02%	11.74%	2.82%
10.80	13.02%	11.74%	2.82%
10.90	13.02%	11.74%	2.82%
11.00	13.02%	11.74%	2.82%
11.10	13.02%	11.74%	2.82%
11.20	13.02%	11.74%	2.82%
11.30	13.02%	11.74%	2.82%
11.40	13.02%	11.74%	2.82%
11.50	13.10%	11.99%	2.57%
11.60	13.10%	11.99%	2.57%
11.70	13.10%	11.99%	2.57%
11.80	13.10%	11.99%	2.57%
11.90	13.10%	11.99%	2.57%
12.00	13.10%	11.99%	2.57%
12.10	13.10%	11.99%	2.57%
12.20	13.10%	11.99%	2.57%
12.30	13.10%	11.99%	2.57%
12.40	13.10%	11.99%	2.57%
12.50	13.10%	11.99%	2.57%
12.60	13.10%	11.99%	2.57%

12.70	13.10%	11.99%	2.57%
12.80	13.10%	11.99%	2.57%
12.90	13.10%	11.99%	2.57%
13.00	13.10%	11.99%	2.57%
13.10	13.10%	11.99%	2.57%
13.20	13.10%	11.99%	2.57%

Dow Jones

Data Period: 12/12/1914 – 27/03/2019
Number of Days: 38091
Number of Years: 104.29

Mayer Multiple Threshold	Maximum Annual Percentage Returns Trade	Average Annual Percentage Returns Across All Trades	Minimum Annual Percentage Returns Trade
0.6	0.12%	0.04%	0.00%
0.7	0.18%	-0.02%	-0.41%
0.8	0.23%	0.02%	-0.48%
0.9	0.30%	-0.02%	-1.29%
1	0.37%	-0.06%	-2.97%
1.1	0.41%	-0.01%	-3.81%
1.2	0.85%	0.30%	-3.71%
1.3	0.48%	-0.55%	-3.47%
1.4	0.52%	-0.43%	-3.12%
1.5	0.58%	-0.24%	-2.56%

Black Tuesday

Data Period: 02/01/1923 – 31/12/1930
Number of Days: 2920
Number of Years: 7.99

Mayer Multiple Threshold	Maximum Annual Percentage Returns Trade	Average Annual Percentage Returns Across All Trades	Minimum Annual Percentage Returns Trade
0.7	1.64%	0.87%	0.35%
0.8	2.96%	3.70%	-0.67%
0.9	3.41%	7.05%	-0.01%
1	4.02%	5.67%	-1.45%
1.1	2.37%	7.87%	0.03%
1.2	8.53%	43.66%	0.04%

Nikkei

Data Period: 16/05/1949 – 13/03/2019
Number of Days: 25503
Number of Years: 69.82

Mayer Multiple Threshold	Maximum Annual Percentage Returns Trade	Average Annual Percentage Returns Across All Trades	Minimum Annual Percentage Returns Trade
0.6	0.18%	0.13%	0.10%
0.7	0.30%	0.06%	-0.04%
0.8	0.28%	0.05%	-0.33%
0.9	0.30%	0.04%	-0.53%
1	0.36%	-0.01%	-1.17%
1.1	0.75%	0.06%	-1.49%
1.2	1.13%	0.24%	-1.36%
1.3	1.16%	0.17%	-3.11%
1.4	1.40%	0.50%	-2.38%
1.5	1.13%	0.85%	0.02%
1.6	1.16%	0.88%	0.01%

Japanese Asset Price Bubble

Data Period: 04/01/1988 – 30/12/1992
Number of Days: 1822
Number of Years: 4.99

Mayer Multiple Threshold	Maximum Annual Percentage Returns Trade	Average Annual Percentage Returns Across All Trades	Minimum Annual Percentage Returns Trade
0.7	2.34%	1.39%	0.57%
0.8	3.88%	0.79%	-1.37%
0.9	3.71%	0.32%	-4.91%
1	4.81%	-0.63%	-7.63%
1.1	2.22%	1.05%	0.09%

Nasdaq

Data Period: 05/02/1971 – 20/05/2019
Number of Days: 17636
Number of Years: 48.28

Mayer Multiple Threshold	Maximum Annual Percentage Returns Trade	Average Annual Percentage Returns Across All Trades	Minimum Annual Percentage Returns Trade
0.6	0.24%	0.09%	0.00%
0.7	0.52%	0.13%	-0.13%
0.8	0.60%	0.09%	-0.41%
0.9	0.48%	-0.08%	-1.96%
1	0.58%	0.00%	-2.13%
1.1	0.67%	0.02%	-3.76%
1.2	0.93%	0.14%	-3.31%
1.3	1.88%	1.32%	0.01%
1.4	2.04%	1.79%	0.04%
1.5	2.05%	1.83%	0.04%

Dotcom

Data Period: 03/06/1996 – 30/08/2002
Number of Days: 2279
Number of Years: 6.24

Mayer Multiple Threshold	Maximum Annual Percentage Returns Trade	Average Annual Percentage Returns Across All Trades	Minimum Annual Percentage Returns Trade
0.6	1.85%	0.66%	-0.02%
0.7	3.99%	1.20%	-1.00%
0.8	4.63%	1.04%	-2.49%
0.9	3.60%	-3.49%	-15.14%
1	4.41%	-1.84%	-16.45%
1.1	4.52%	1.39%	0.07%
1.2	5.73%	2.53%	0.10%
1.3	8.06%	4.55%	0.05%
1.4	11.10%	7.58%	0.27%
1.5	12.00%	8.78%	0.29%

S&P 500

Data Period: 30/12/1927 – 27/03/2019
Number of Days: 33325
Number of Years: 91.24

Mayer Multiple Threshold	Maximum Annual Percentage Returns Trade	Average Annual Percentage Returns Across All Trades	Minimum Annual Percentage Returns Trade
0.6	0.11%	0.05%	0.01%
0.7	0.19%	-0.01%	-0.40%
0.8	0.25%	0.02%	-0.51%
0.9	0.34%	-0.02%	-1.25%
1	0.39%	-0.03%	-1.79%
1.1	0.45%	-0.04%	-3.28%
1.2	0.96%	0.28%	-3.19%
1.3	0.55%	-0.93%	-2.85%
1.4	0.62%	-0.68%	-2.35%
1.5	0.65%	-0.55%	-2.11%

US Housing Bubble

Data Period: 02/01/2004 – 31/12/2009
Number of Days: 2190
Number of Years: 6.00

Mayer Multiple Threshold	Maximum Annual Percentage Returns Trade	Average Annual Percentage Returns Across All Trades	Minimum Annual Percentage Returns Trade
0.7	3%	1%	0%
0.8	3%	-1%	-5%
0.9	4%	0%	-6%
1	5%	-2%	-9%
1.1	5%	-5%	-10%
1.2	6%	-3%	-8%

Ethereum

Data Period: 06/08/2015 – 18/05/2019
Number of Days: 1381
Number of Years: 3.78

Mayer Multiple Threshold	Maximum Annual Percentage Returns Trade	Average Annual Percentage Returns Across All Trades	Minimum Annual Percentage Returns Trade
0.3	3.20%	1.78%	0.28%
0.4	7.70%	2.55%	-6.67%
0.5	10.57%	2.87%	-8.14%
0.6	12.25%	-5.35%	-37.54%
0.7	9.93%	-7.32%	-63.49%
0.8	11.58%	-12.39%	-69.00%
0.9	10.63%	-15.24%	-90.33%
1	13.00%	-8.39%	-76.34%
1.1	13.81%	-5.99%	-83.44%
1.2	14.46%	-5.41%	-88.14%
1.3	14.92%	-7.42%	-85.80%
1.4	16.23%	-3.62%	-73.02%
1.5	16.37%	-2.62%	-77.02%
1.6	17.53%	-0.49%	-66.28%
1.7	17.53%	0.18%	-67.76%
1.8	18.20%	2.23%	-67.55%
1.9	18.20%	12.10%	0.74%
2	18.86%	12.74%	1.03%
2.1	20.23%	13.79%	0.46%
2.2	20.23%	13.29%	0.53%
2.3	20.23%	13.22%	1.13%
2.4	20.23%	13.17%	0.79%
2.5	21.42%	15.41%	0.86%
2.6	22.09%	15.93%	1.63%
2.7	22.37%	16.14%	0.63%
2.8	22.78%	16.65%	1.03%
2.9	22.78%	16.52%	1.90%
3	22.78%	17.16%	1.90%
3.1	23.27%	18.76%	2.55%
3.2	23.27%	18.70%	0.98%
3.3	23.27%	18.60%	0.95%
3.4	23.27%	18.65%	2.23%
3.5	22.57%	18.57%	0.85%
3.6	22.57%	18.44%	3.00%
3.7	22.57%	18.22%	1.41%
3.8	22.57%	18.17%	1.03%
3.9	23.13%	18.81%	0.75%

4	23.13%	19.07%	2.49%
4.1	24.58%	21.40%	0.46%
4.2	24.58%	21.18%	1.12%
4.3	24.58%	21.03%	0.77%
4.4	24.58%	20.98%	2.25%
4.5	25.03%	21.91%	2.70%
4.6	25.26%	22.48%	2.70%
4.7	25.26%	22.64%	2.48%
4.8	25.26%	22.65%	2.48%
4.9	25.26%	22.65%	2.48%
5	25.26%	22.60%	1.54%
5.1	25.26%	22.57%	2.90%
5.2	25.35%	22.78%	2.04%
5.3	25.35%	22.73%	1.02%
5.4	25.35%	22.70%	2.04%
5.5	25.41%	22.80%	1.42%
5.6	25.41%	22.65%	1.42%
5.7	25.54%	22.75%	1.19%
5.8	25.54%	22.64%	1.19%
5.9	25.54%	22.55%	1.04%
6	25.54%	22.65%	2.50%
6.1	25.54%	22.62%	2.50%
6.2	25.68%	22.91%	2.50%
6.3	25.93%	23.65%	2.50%
6.4	25.93%	23.69%	3.39%
6.5	25.93%	23.72%	3.09%
6.6	25.93%	23.72%	3.09%
6.7	25.93%	23.68%	3.09%
6.8	26.01%	23.95%	3.09%
6.9	26.01%	23.95%	3.09%
7	26.01%	23.95%	3.09%
7.1	26.08%	24.57%	3.69%
7.2	26.08%	24.57%	3.69%
7.3	26.08%	24.57%	3.69%
7.4	26.08%	24.57%	3.69%