Stock Market Simulation

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By

Jennifer Kimball

Quentin Hall

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Approved by Professor Dalin Tang, Project Advisor

Abstract

The goal of this Interactive Qualifying Project (IQP) was to test the effectiveness of three different trading strategies while learning about the stock market and gaining some initial trading experience. The team researched the basics of trading in the stock market and selected three strategies to employ – the buy and hold method, dollar cost averaging, and range trading. Each portfolio began with $100,000 and was jointly managed across the 10-week simulation by both team members. At the conclusion of the simulations, the portfolios posted the following returns: buy and hold – 26.04%, dollar cost averaging – 15.19%, and range trading – 19.59%. All three simulations outperformed the S&P 500, which had a 10.56% return. This IQP served as a great introduction to the fundamentals of trading that the team will carry forward into future investments.

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Chapter 1: Introduction

1.1 Goals

The goal of this Interactive Qualifying Project (IQP) is to improve our understanding of how the stock market operates by conducting market simulations using three different trading methods. To accomplish this goal, we will begin by researching the history of the stock market, including previous crashes and trends, different methods of trading, and various companies. We will then select 8 companies with an initial starting investment of $100,000 and trade them using a simulation engine. Over the course of the 10-week simulation, we will hold as much as we can control constant, which will allow us to better compare the trading methods. Through this IQP, we will improve our ability to analyze market data and hopefully find a profitable trading strategy that we can apply to future investments.

1.2 Stock Market History

The stock market as we know it today has developed over centuries. The early origins of the modern stock market can be traced back to Antwerp in the late 15th century. Merchants there would purchase certain goods in anticipation that their prices would soon rise. They would later sell these goods at higher prices to make a profit. In 1611, the Dutch East India Company became the first publicly traded stock at an exchange in Amsterdam. This was the first site of modern stock trading [1]. In the late 1700s, merchants in New York City created the Buttonwood Tree Agreement, which would later become known as the New York Stock Exchange. Under this agreement, the men would meet to buy and sell stocks. The Philadelphia Stock Exchange was formed soon after. About 100 years later, in 1896, the Dow Jones Industrial Average was created with 12 initial companies. Poor's Publishing began tracking 90 stocks in 1926, but it did not merge with Standard Statistics to become the Standard & Poor's index until 1941. Another U.S. stock

exchange, known as the National Association of Securities Dealers Automated Quotations, or NASDAQ for short, opened in 1971.

1.2.1 Stock Market Crashes

In between these events, the stock market faced some major crashes. A crash is a sudden, sharp drop in stock prices. Crashes are not always predictable, and they can have a wide variety of different causes. There is not necessarily a benchmark for how much prices must fall for it to be considered a crash, but there have been a few events in the last century that are widely referred to as crashes.

The first and most devastating crash of the stock market occurred in 1929. On October 28th and 29th, the market saw nearly 13% and 12% decreases respectively [2]. These two days are now referred to as Black Monday and Black Tuesday, as they constitute the biggest two-day loss in the history of the market. This crash was primarily caused by the booming economic environment of the Roaring '20s. The years before the crash were a prosperous time, as the market increased steadily for years. This success turned out to be based on a lot of speculation, however. The growth of the market early in the '20s encouraged people to borrow money to invest, but by 1929, the stock prices had achieved unsustainable levels. Production declined, unemployment rose, and stock prices were left significantly over their real values. On October 18th, prices began to sharply drop, and a rush of panic selling occurred. This crash was ultimately one of the major causes of the Great Depression. Because unemployment during this time was so widespread (upwards of 30%), most families struggled to make enough money to survive, let alone invest back into the stock market, which is why it took 25 years for the market to recover [3].

Since 1929, there have been a few other crashes that are noteworthy. The next crash came in 1973, and it was surrounded by an economic recession. The price of oil nearly quadrupled as a

result of the oil embargo imposed by Arab oil producers against the U.S. [4]. This was due to the support the U.S. provided Israel in the 1973 Yom Kippur War. At the same time, President Nixon announced that the U.S. would abandon the Bretton Woods system, which required countries to have a fixed conversion rate from their currency to the American dollar. This left the value of the dollar unstable, which contributed to runaway inflation, which in turn contributed to the stock market crash and the economic crisis. It took the market about 21 months to recover from this crash.

In 2000, the NASDAQ lost 77% when the Dotcom Bubble burst [2]. For years leading up to the crash, investors tried to chase the next big thing, investing large amounts into growing internet companies, most of which featured a ".com" in their name. The problem with this was these companies were not proven to be profitable. Eventually, companies like Pets.com ran out of money and closed down, and their stocks crashed. It took the NASDAQ 15 years to recover from this crash.

In 2008, there was another major crash that led to a period known as The Great Recession. This one was caused by a large number of defaults on mortgages from subprime borrowers. When the housing supply outpaced its demand, prices fell, but some subprime borrowers were locked into their mortgages with adjustable rates [5]. The Fed raised the interest rates, effectively trapping these borrowers, as they could not afford their payments, but they could not sell their houses either because of the low demand. This housing bust led to stock prices plummeting and left the economy in a recession.

The next noteworthy crash occurred in 2020, and it was an unusual one. Global governments shut down their economies in an attempt to limit the spread of the COVID-19 virus. The pandemic caused the stock market to fall 33%, but it only took 33 days to recover [2]. After

the crash, the market did very well. Some companies reported record profits due to a widespread shift to working from home.

1.3 Stock Market Background

To fully understand the stock market, it is important to understand its basic components, starting with the definition of a stock. A stock is a small share of a business. When an investor purchases a stock, they become an owner of a small fraction of the company. Each stock listed has a price, but this price is not always a representation of the value of the business. To make money off a stock, an investor must sell it at a higher price than the purchase price. Therefore, it is generally a good idea to buy stocks when they are undervalued. This buying and selling of stocks is known as trading. Stocks are not the only investment that can be purchased on the market, however. There are also bonds, commodities, and various types of funds, but this IQP will focus on stocks.

1.3.1 Factors that Influence the Stock Market

Individual stock prices are the result of supply and demand. The more people want a stock, the higher the price is. When lots of people sell a stock, the price drops. There are external factors that push investors to buy and sell, though. The performance of an individual stock is largely dependent on the health of that company. If the company announces good news, the price generally goes up. But, if profits are lower than expected or there is a scandal within the company, investors may lose confidence and sell the stock, causing the price to drop.

Other factors tend to influence the market as a whole. Two of the major influences that are especially important today are inflation and interest rates. Small amounts of inflation are expected over time, but when there are high amounts of inflation, the market does not respond well. Higher inflation means the money an investor or company currently holds is worth less than it once was.

If the prices of food, gas, and other necessities are higher, then people have less money to spend on expendables and invest in the stock market. To counter inflation, the Federal Reserve often tries to raise interest rates, but this can also hurt stock performance. High interest rates make money more expensive to borrow, so companies become less likely to borrow, as the higher interest payments reduce their profit margins. Companies generally must spend money to make money, so if they do not borrow, that can reduce their profits, but if they do borrow, the interest rates may eat into that profit anyway. This creates an unfavorable situation for the companies and stock prices usually go down to reflect that. Aside from inflation and interest rates, other events such as natural disasters, trade wars, and international affairs can move stock prices as well. Stock prices can also move with no apparent cause, which makes the market very difficult to predict.

1.4 Market Subsections

There are thousands of stocks, so it can be difficult to analyze market data. The market has different levels of organization to make it easier to interpret this data, however. Stocks can be grouped by the exchange they are traded on and the market sector they belong to. Some stocks also belong to indexes, but these will be discussed further in section 1.5.

1.4.1 Stock Exchanges

Stock exchanges are the location where financial instruments, including stocks, bonds, equities, and commodities, are bought and sold. Some exchanges are strictly electronic, while others have specialists who work on the physical trading floor in addition to the electronic functions. The main exchanges are the New York Stock Exchange (NYSE) and the NASDAQ, but the NASDAQ is technically more of a formal market that acts as an exchange. The NYSE makes money from all transactions, in addition to membership fees imposed on companies [6]. For companies to appear on an exchange, they must have completed an Initial Public Offering (IPO)

and meet requirements specific to the exchange. One of the requirements to appear on the NYSE is that the company's price must be listed at a minimum of $4 per share [7].

1.4.2 Market Sectors

One way to organize the stock market is by sector. A sector is a group of stocks that are generally in the same industry. There are currently 11 market sectors – healthcare, materials, real estate, consumer staples, consumer discretionary, utilities, energy, industrials, communication services, financials, and technology. This categorization system makes it easier to compare companies that have similar business models. There are ETFs and mutual funds that are tied to specific sectors of the market, which is helpful for investors who want to target more recessive-proof industries like healthcare and consumer staples.

1.5 Indexes

An index is an organizational tool used to measure the performance of a group of stocks. The three main indexes used to track the market are the NASDAQ Composite, Standard & Poor's 500, and the Dow Jones Industrial Average. Each index tracks a different group of stocks, but several stocks appear in all three. There is a strong correlation between the price valuations of these three indexes, but there are certain situations where one can greatly outperform or underperform the others. The main differences between them are how they are weighted, the industries they cover, and their inclusion criteria for stocks.

1.5.1 NASDAQ Composite

The NASDAQ is comprised of more than 3000 stocks and is a capitalization-weighted index. Market capitalization is calculated by multiplying the price of a share by the total number of shares. The NASDAQ mainly features technology stocks, and its top ten companies are tech companies that account for 46% of the index's overall weight [8]. Investing in the NASDAQ

without a diversified portfolio can be risky since most of its constituents come from the same market sector. This reliance on technology stocks proved helpful during the pandemic, however, as the NASDAQ's value soared. The NASDAQ also saw explosive growth during the dotcom era before the crash.

1.5.2 Standard & Poor's 500

Standard & Poor's 500 (S&P 500) is made up of 500 stocks and weighs those stocks based on market capitalization like the NASDAQ. Out of the three indexes discussed in this section, it is generally considered to be the best reflection of the market's performance. This is because the 500 large, industry-leading stocks make up about 80% of the market's total value [9]. For a stock to appear in the index, it must have a market cap of at least $14.6 billion, have at least 10% of shares outstanding, and be highly liquid, meaning shares can be easily converted into cash [8].

1.5.3 Dow Jones Industrial Average

The Dow Jones Industrial Average, or The Dow for short, is both the oldest and smallest of the three major indexes. Unlike the other two, the Dow weighs its constituents based on price. The Dow is known as a blue-chip index, meaning its companies are household names that are known for their reliability and industry success. There are only 30 stocks in the Dow, and these can be viewed in Table 1.5.3.1. None of these 30 stocks are from the utilities or transportation sectors of the market, but the other nine sectors are represented.

Table 1.5.3.1 – Dow Jones Industrial Average Composition

3M Co.	Goldman Sachs Group Inc.	Nike Inc.
American Express Co.	Home Depot Inc.	Procter & Gamble Co.
Amgen Inc.	Honeywell International Inc.	Salesforce Inc.
Apple Inc.	International Business Machines Corp.	Travelers Companies Inc.
Boeing Co.	Intel Corp.	UnitedHealth Group Inc.
Caterpillar Inc.	Johnson & Johnson	Verizon Communications Inc.
Chevron Corp.	JPMorgan Chase & Co.	Visa Inc.
Cisco Systems Inc.	McDonald's Corp.	Walgreens Boots Alliance Inc.
Coca-Cola Co.	Merck & Co. Inc.	Walmart Inc.
Dow Inc.	Microsoft Corp.	Walt Disney Co.

Chapter 2: Methodology

One of our goals in this project is to become better traders by practicing our skills in a simulation. Many different simulation and investment strategy combinations could be used to accomplish this, but we have selected one simulation engine and three trading strategies. We will use Investopedia to try and accurately compare the buy and hold method, dollar cost averaging, and range trading.

2.1 Stock Simulation Engine

Our main goal in this IQP is to compare trading methods, and there are numerous different ways we could accomplish this. One way would be to invest real money in the stock market using a trading platform such as Fidelity, E*TRADE, or TD Ameritrade. However, since this IQP is an experiment being performed for the sake of research, we do not want to have real money at stake. It would likely influence our decision-making by causing us to trade more conservatively, so we would not be able to compare the methods as accurately. We would also have to trade smaller amounts because we do not have large sums of money to invest.

For these reasons, we have determined it would be best to use a simulation engine. The other alternative to this would have been "imaginary trading," or in essence following the market on a site such as Fidelity or Yahoo Finance and calculating what our gains or losses would have been had we invested real money. We determined that a simulation engine would not only make it easier to keep track of all our investments, but also help us monitor the state of our companies, calculate earning percentages, and keep ourselves accountable.

We considered a few simulation engines but ultimately chose Investopedia. It offers many benefits, such as the ability to follow the market in real time, view the weekly performance of a portfolio, and view company profiles directly on-site. The ability to view company data and trends

as well as investment data all in one place will likely prove to be a time saver throughout this experiment. We also considered using MarketWatch and Wall Street Survivor but found them to be inferior to Investopedia in a few key areas. The interfaces were less user-friendly; it was more difficult to access important metrics, and some features were hidden behind paywalls.

2.2 Investment Strategies

There are many different strategies that can be implemented when trading in the stock market, but they can largely be grouped into two categories – active and passive trading. Active trading incorporates methods such as day trading or scalping that require daily or even hourly attention. These traders aim to make smaller profits on stocks in the very short term and hope that this series of smaller profits sums to something substantial. Passive trading, on the other hand, requires that much less attention be paid to the market. Stocks can be held for years, or even decades at a time without selling. For this experiment, we wanted to test at least one active trading strategy and one passive trading strategy. After doing some research, we decided to select three methods: buy and hold (passive), dollar cost averaging (passive), and range trading (active).

2.2.1 Buy and Hold

Our first simulation is going to be run using the buy and hold method. This is a simple, passive trading strategy in which the money is invested up front and left untouched in the market for an extended period of time. In our case, we will be investing approximately $12,500 in each of our eight stocks at the beginning of the simulation period. We will leave the money untouched in the market, and then sell everything at the end of the ten weeks.

The reason we chose this method was because of its historical success. In the past, the market has recovered from declines. According to an article from Forbes that cites calculations from Nobel Prize-winning economist Robert Shiller, the S&P 500 has delivered an annualized

return of 7.58% (10.51% with dividends invested) since 1971 [10]. This same article cites research from NYU business professor Aswath Damodaran, who calculated that the value of the S&P 500 has doubled 10 times since 1949. He also calculated that since 1928, there were 25 years where the value of the S&P investments dropped, meaning that in the last century, the S&P 500 was profitable in about 75% of the years. The data shows a return greater than 10% in almost 60% of the years covered, so there is certainly evidence to suggest that this has been a historically great method to select.

It is important to keep in mind that historical performance is not always an indicator of future success. It might be more beneficial to look at the recent history of the market instead of focusing on the overarching trends of the past century. Since the coronavirus pandemic began in early 2020, the market has become very volatile. Recent inflation reports and interest rate changes have only added to that volatility. The market is having one of its worst years since its crash in 2008. This means it could either be a very good time to invest, since stock prices are low and they could soon bounce back, or a very bad time to invest if prices continue to drop. We also have to keep in mind that this is a short-term simulation, and we will not have much time to recover our losses if the market continues to drop in the early weeks. It will be interesting to see how large the gap will be between the high and low of our portfolio value over the next ten weeks because of the current volatility. Even though the volatility of the market is a little concerning, we still believe in the historical success of this method and expect it to serve as a good baseline to compare our other methods.

2.2.2 Dollar Cost Averaging

Our second simulation will be run using the dollar cost averaging method. This passive trading strategy is very similar to the buy and hold strategy that will be used in the first simulation.

Unlike the buy and hold simulation, where all the money is invested up front, the dollar cost averaging method spreads out its investment over the duration of the simulation. This is the fundamental principle of the dollar cost averaging method – a fixed amount of money is invested at a regular interval. Examples of typical intervals include daily, weekly, and monthly. The idea behind the method is that by spreading out the investment, it might lower the average cost per share.

The concept can best be explained with a practical example. The example below, displayed in Figure 2.2.2.1, was provided by The Motley Fool. Say you want to invest $10,000 in a stock, but you are not sure if the starting price is a good one. By spreading out the $10,000 into five monthly investments of $2,000 each, you lower your average cost per share from $50 to $35.71. You also end up owning 280 shares of the stock instead of the 200 you would have gotten had you purchased them all in the first month.

MONTH	INVESTMENT AMOUNT	PRICE PER SHARE	NUMBER OF SHARES PURCHASED
1	$2,000	$50	40
2	$2,000	$40	50
3	$2,000	$20	100
4	$2,000	$40	50
5	$2,000	$50	40
Total	$10,000	$35.71 (average)	280

Chart and calculations by Matthew Frankel.

Figure 2.2.2.1 – Sample Dollar Cost Averaging Price Breakdown [11]

The above example is profitable because the share price dropped and then rose again, but there is always the possibility that the stock price trends up for months and that by using the dollar cost averaging method, you miss out on potential profits you could have had if you invested all the

money up front. This is especially true if you plan to invest in stocks that offer dividends since you have cash sitting uninvested that is missing out on those dividend payments.

Though there are some drawbacks to this method, there are also many benefits. The main benefit of dollar cost averaging is that it reduces investor stress by avoiding the problem of trying to time the market and reducing the negative effects of market volatility. It removes emotions from investing by making contributions routine and independent of market performance. This convenience is one of the main reasons dollar cost averaging is frequently used in 401k plans. It also helps set good investing habits by investing small amounts on a regular basis.

2.2.3 Range Trading

Our third simulation will be run using the range trading method. Range trading is an active trading strategy in which investors try to buy low and sell high by identifying a range that a stock usually trades between. For example, if you think the stock usually trades between $85 and $95, you will buy at the price of $85 and sell when it reaches $95. You would then repeat the process until you have reason to believe the stock will stop trading in this range. There are many ways to determine ranges, but some of the common strategies include using support and resistance, volume trends, and moving averages.

The first method involves trading at the support and resistance levels. The support is a price that the stock usually does not fall below because buyers become more willing to buy it at the price and sellers are less willing to sell [12]. The resistance is the opposite, where the supply and demand may keep the price from moving higher. A common way to range trade is to set the buy price at the support level and the sell price at the resistance level. An example of a support and resistance graph can be seen below in Figure 2.2.3.1.

Figure 2.2.3.1 – Support and Resistance Band Graph [13]

Another way to set the range is by analyzing trends in volume. Most analysts believe that when the trading volume begins to go up, the price is about to go up [12]. Moving averages can help identify when it is a bad time to range trade. If the current price is near the moving average, it generally is a good time to range trade because the stock is not trending too far in either direction.

Range trading can be difficult to execute well, especially for beginner investors. Researching takes a lot of time, and even when using metrics like support and resistance levels or moving averages, there is no guarantee the stock continues to trade in the range you have identified once purchased. If your range does prove profitable for a few weeks, it is difficult to time the market and figure out when is a good time to modify the range or move on from the stock completely. There is also a chance that emotions can affect the results of your range trading. This is less true when you set a range and stick to it, but if you change your range because you think a

stock is trending upwards and it crashes, you may have strong regrets over not selling when you had the chance for a modest profit.

Range trading may be difficult, but when done well there are many benefits. One of the main benefits of range trading is that it aims for smaller profits across shorter timeframes. This means there is less risk of a dramatic price change wiping out your entire portfolio. Investors also do not have to wait for a trending market to start investing.

2.3 Data Analysis

Since this project is by nature an experiment, we want to be able to compare results at its conclusion. In order to do that, we will use the same table across all ten weeks and all three simulations to track our data. Table 2.3.1 shows an example of this table.

Table 2.3.1 – Sample Weekly Portfolio Analysis Table

Date	Symbol	Buy/ Sell	Price	Shares	Net Proceeds	Cost/ Profit/ Loss	Total Cash	Total Profit
8/20/22							$5,000.00	
8/23/22	HES	BUY	$121.81	10	$1,218.10		$3,781.90	
8/26/22	HES	SELL	$124.20	10	$1,242.00	$23.90	$5,023.90	$23.90
Total Assets as of 8/28/22: $5,023.90								

In the example, we start the week with $5,000 in cash. On August 23rd, we buy 10 shares of HES at $121.81 each for a total of $1,218.10 and then sell them three days later for $1,242, giving us a profit of $23.90. The total cash tracks how much money we have that is not invested in the market, so the price of our HES shares gets subtracted when we buy and then added back in when we sell. The total profit column will be a cumulative total of our profits up to that point. It would be misleading to not represent the value of our total assets as well, since we could have a total profit of $10,000 but be holding assets that are worth $20,000 less than what we bought them

at. The total assets line at the bottom of the table will track our total cash plus the value of our owned stocks.

The end goal of any stock simulation, aside from gaining experience and knowledge, is of course to make money. So, the main statistic we will use to determine which simulation was the most successful at the end is total profit. We will also discuss time, effort, and risk as other important factors when we compare the results of the simulations in Chapter 7.

Chapter 3: Companies Selected

To compare our methods of buying and holding, dollar cost averaging, and range trading, we have selected eight stocks to trade. These stocks are Hess Corporation, Elf Beauty, Eli Lilly and Company, Advanced Micro Devices, General Mills, Amylyx Pharmaceuticals, Etsy, and Apple. When selecting these companies, we primarily looked at historical success and growth potential. It was hard to find stocks that had both historical success and high growth potential, so we focused on balancing out these two attributes across our portfolio. This was mainly to balance volatility. We also tried to avoid having too many stocks in one sector of the market, so we chose stocks in five different sectors – technology, healthcare, consumer discretionary, consumer staples, and energy.

3.1 Hess Corporation

Hess Corporation was founded in 1933 by Leon Hess in Asbury Park New Jersey. The company started off delivering oil to homeowners, but over the years they have expanded their distribution and storage capabilities. In 1960, the Hess Corporation opened its first gas station, and in 1969, it opened its first drill in Alaska [14]. Today, the company has a strong hold over the production of oil and gas production in the Gulf of Mexico and the North Dakota Bakken, and it is a leading supplier to Peninsular Malaysia and Thailand [15].

Hess Corp. is part of the energy sector and part of the integrated oil industry. According to the financial data provided by CNN Business, Hess most recently reported an annual revenue of $7.7 billion and an annual profit of $559 million, with its net profit margin being 7.24% [16]. In the next 12 months, CNN forecasts this stock to have a high of $175, a median of $139, and a low of $105. It opened the year on January 3rd, 2022, with a price of $73.90, and it currently sits at

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$104.60 as of September 25th, 2022 [17]. This means the year-to-date price increase is 41.54%. A stock chart that depicts the price over the past year can be found in Figure 3.1.1.

Figure 3.1.1 – HES Stock Chart [18].

One reason that we chose this stock was that it has gone up consistently over the last year, and we believe that it will follow the forecast of the CNN Business analysts and continue to trend upward. The fact that the analysts at CNN predict the low price for the next year will be $105, and the stock is currently at $104, is very encouraging. The other reason that we picked this stock was that we thought it would be a good candidate for range trading as there are a lot of small fluctuations with this stock that we could take advantage of.

3.2 Elf Beauty

E.L.F Beauty (Eyes.Lips.Face Beauty) was founded in 2004 by Joseph Shamah and Scott Vincent Borba and went public in 2016. In 2020, they expanded the company with the brands W3LL PEOPLE and Keys Soulcare, a lifestyle beauty brand with Alicia Keys [19]. The company sells all different types of make-up and skin care products that are high-quality, clean, and cruelty-free. The major selling point is that Elf's products are affordable for everyone.

Elf Beauty is part of the consumer discretionary sector and the household/personal care industry. According to the financial data provided by CNN Business, Elf Beauty most recently reported an annual revenue of $392.2 million and an annual profit of $21.8 million, with its net profit margin being 5.55% [20]. In the next 12 months CNN forecasts this stock to have a high of $50, a median of $41.5, and a low of $35. The stock opened the year with a price of $33.26, and as of September 25th, the price is currently sitting at $38.66 [21]. This means the year-to-date price increase is 16.24%. Morningstar, a well-known financial research and investment management company, had this stock rated at 4 stars, which means it has historically compensated its purchasers well for the risk they take on. The site also lists the price as undervalued, which means it is a good time to buy [22]. A stock chart that depicts the price over the past year can be found below in Figure 3.2.1.

Figure 3.2.1 – ELF Stock Chart [23]

One reason that we picked this stock is that it is on an upward trend and has high growth potential. As shown in Figure 3.2.1, the price has been steadily increasing since May 2022. We are also hoping that the consumer discretionary sector will perform during the holiday season.

Inflation will negatively affect the ability of the lower middle class to buy gifts in this sector, but the fact that the last two holiday seasons have been impacted by the coronavirus will likely result in the upper middle class and wealthier individuals being willing to spend more. The other reason that we picked this stock was that there was small volatility in the weekly price, and we thought we could take advantage of this with range trading.

3.3 Eli Lilly and Company

Eli Lilly and Company was founded in 1876 by Colonel Eli Lilly. The company's mission statement on its website is as follows: "Lilly unites caring with discovery to create medicines that make life better for people around the world" [24]. It focuses on trying to create and improve medicines that help with Alzheimer's, cancer, diabetes, obesity, and pain. Eli Lilly was the first company to distribute the polio vaccine. Its most well-known drugs are Prozac and Cymbalta, which are for clinical depression, and Trulicity, which is for diabetes [25].

Lilly is in the healthcare sector and the pharmaceutical industry. According to the financial data provided by CNN Business, Eli Lilly and Company most recently reported an annual revenue of $28.3 billion and an annual profit of $5.6 billion, with its net profit margin being 19.71% [26]. In the next 12 months, CNN forecasts this stock to have a high of $412, a median of $351, and a low of $202. Additionally, 13 out of the 22 CNN analysts that reviewed this stock believe now is a good time to buy. The stock opened this year at $274.41 and as of September 25th, currently sits at $311.46. This amounts to a year-to-date price increase of 13.5% [27]. The price change over 2022 is documented in Figure 3.3.1 below.

Figure 3.3.1 – LLY Stock Chart [28]

The main reason that we like this stock is that Eli Lilly is a massive pharmaceutical company, and there will always be a need for medicine. Lilly produces some COVID-19 treatments that are particularly high in demand, and this year's flu season is also predicted to be particularly bad, so this is good for sales forecasts.

3.4 Advanced Micro Devices

AMD, also known as Advanced Micro Devices, was founded in 1969 by Jerry Sanders, Frank Botte, Jack Gifford, Edwin Turney, John Carey, Larry Stenger, Sven Simonsen, and Jim Giles. The company's mission is to "Build great products that accelerate next-generation computing experiences" [29]. AMD makes semiconductor products such as central processing units (CPUs) and graphics processing units (GPUs) and generally releases new versions of these products around every two years.

AMD is in the technology sector and the semiconductor industry. According to the financial data provided by CNN Business, AMD most recently reported an annual revenue of $16.4 billion and an annual profit of $3.2 billion, with its net profit margin being 19.24% [30]. In the

next 12 months, CNN Business analysts forecast this stock to have a high of $200, a median of $120, and a low of $80. Additionally, 25 out of their 40 analysts that reviewed this stock think now is a good time to buy. The stock opened the year at $145.14 and is at $67.96 as of September 25th, so the price has dropped 53.17% [31]. The fluctuations in the price this year can be viewed in Figure 3.4.1.

Figure 3.4.1 – AMD Stock Chart [32]

This is the first stock we have selected that has had a negative return so far this year. We think this stock is about to reach a low and bounce back up. The reason why we like AMD is that the company will soon be releasing a new generation of graphics cards and CPUs that are better than those that Intel, one of its biggest competitors, makes in certain areas. The AMD Ryzen 7000 line, which is 44% faster in threaded applications than Intel's Core i9, is set to release on October 20th [33]. We predict that this will increase the price of the stock.

3.5 General Mills, Inc.

General Mills built its first flour mill in 1866 but did not become an official company until 1928 under the leadership of James Bell. The company makes a wide variety of food products and

consists of over 100 brands located in 100 different countries across six continents [34]. Some of its most popular food brands include Betty Crocker, Cheerios, Pillsbury, and Yoplait.

General Mills is in the consumer staples sector and the food industry. According to the financial data provided by CNN Business, General Mills most recently reported an annual revenue of $19 billion and an annual profit of $2.7 billion, with its net profit margin being 14.25% [35]. In the next 12 months, CNN analysts forecast this stock to have a high of $88, a median of $77, and a low of $63. The stock opened this year at $67.20 and sits at $79.17 as of September 25th, so the stock price has gone up 17.81% this year so far [36]. The price chart for this year can be viewed in Figure 3.5.1.

Figure 3.5.1 – GIS Stock Chart [37]

Inflation reports have not been good this year, but General Mills is in a sector of the market that is usually less affected by it. Even when inflation is bad, families still need consumer staples like bread and milk, so we are predicting that this stock will do well over the foreseeable future until inflation reports improve. We also predict a strong holiday season for General Mills since people tend to cook more around the holidays.

3.6 Amylyx Pharmaceuticals

Amylyx Pharmaceuticals was founded in 2013 by Joshua Cohen and Justin Klee, but the company just recently went public in December of 2021. The mission statement on its website is as follows: "It is our mission to one day end the suffering caused by neurodegenerative diseases. Every day we strive for better therapies. We question the unquestioned, always in search of new solutions" [38]. The company is currently developing a drug for ALS that will soon be evaluated for approval by the FDA.

Amylyx is in the healthcare sector and the pharmaceutical industry. It began trading on January 7th, 2022, at a price of $21, and on September 25th, had reached $27.87 [39]. That amounts to an increase of 32.71%. The price had dropped to as low as $6.80 on May 12th, which means the price has gone up by over 300% in the last four months. The price chart can be viewed in Figure 3.6.1.

Figure 3.6.1 – AMLX Stock Chart [40]

Some investors may see this 300% and think the stock is due to drop soon, but we believe the stock still has a high growth potential and will continue to do well. According to the Motley Fool, Amylyx is still far from being profitable, but the FDA voted 7-2 in early September 2022 to

revisit the approval of the ALS drug Albrioza, which they had voted against in March [41]. If this drug gets approved, it will likely come with a hefty price tag, since it will be one of the only treatments for ALS, a currently fatal disease, on the market. This should help Amylyx start to generate revenue, and this should make the stock price go up. There also appears to be a lot of weekly price fluctuation, which makes this stock a good candidate for range trading.

3.7 Etsy, Inc.

Esty Inc. was founded in 2005 by Rob Kalin, Haim Schoppik, Jared Tarbell, and Chris Maguire, and it went public in 2015. Etsy describes itself as "the global marketplace for unique and creative goods. It's home to a universe of special, extraordinary items, from unique handcrafted pieces to vintage treasures" [42]. Etsy aims to keep human connection at the center of commerce, which is why it is an e-commerce site powered by the people. Sellers post listings for their creations, and millions of buyers purchase them. One of the benefits of Etsy is that there are much lower barriers of entry for sellers, especially when compared to Amazon and other e-commerce sites.

Etsy is in the consumer discretionary sector and the internet retail industry. According to the financial data provided by CNN Business, Esty Inc. most recently reported an annual revenue of $2.3 billion and an annual profit of $493.5 million, with its net profit margin being 21.19% [43]. Morningstar has the stock listed at 5 stars, meaning it has historically delivered a very good risk-adjusted return [44]. The site also has the stock listed as significantly undervalued, which means the analysts believe the price should go up to match their valuation soon. The stock opened the year at $222.35 and is currently priced at $96.47 on September 25th, so the yearly price decrease is 56.61% [45]. The price chart for the year can be viewed in Figure 3.7.1.

Figure 3.7.1 – ETSY Stock Chart [46]

We agree with the Morningstar ratings that say this stock is undervalued, which is one of the reasons why we are planning to purchase it. We also believe that the stock will recover because the Halloween and Christmas seasons are popular times for crafts, and Etsy products can make very good gifts. Etsy has carved out a niche in the e-commerce market and we do not think the value of that is going to be replaced anytime soon.

3.8 Apple Inc.

Apple Inc. was founded in 1976 by Steve Jobs, Steve Wozniak, and Ronald Wayne. Apple is a multinational technology company that specializes in consumer electronics and software. It is a household name that makes many popular devices, including iPhones, iPads, MacBooks, and AirPods.

Apple is in the technology sector and the consumer electronics industry. According to the financial data provided by CNN Business, Apple most recently reported an annual revenue of $365.8 billion and an annual profit of $94.7 billion, with its net profit margin being 25.88% [47].

The stock opened the year at $177.83 and has dropped 15.41% to $150.43 as of September 25[48]. The complete price chart for 2022 can be viewed in Figure 3.8.1.
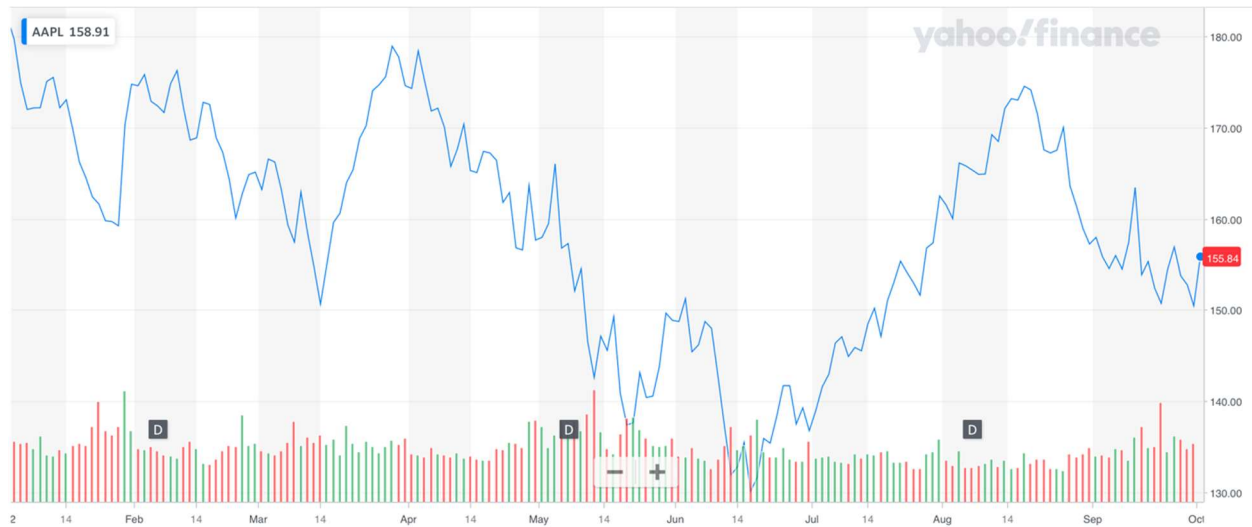
Figure 3.8.1 – AAPL Stock Chart [49]

We like this stock because it has been historically very successful, even though it has been down this year. Its historical success has been documented by CNBC. They claim that if you invested $1,000 when the company first went public in December of 1980, that investment would now be worth $1,635,847 as of September 6th, 2022 [50]. Apple was also the first U.S. company to be valued at both $1 trillion and $2 trillion, so there are lots of reasons to believe this historical success will continue. As can be seen in Figure 3.8.1, there are also lots of fluctuations in price, so it is possible the stock will trend upward for the rest of the year. Apple also announces and releases new products frequently, so hopefully, these bursts in stock price will be helpful for range trading.

Chapter 4: Simulation 1 – Buy and Hold

The first of our three simulations will be run using the buy and hold method. We will use Investopedia to invest a total of $100,000 into the following eight stocks: Apple, AMD, Amylyx, Elf Beauty, Etsy, General Mills, Hess, and Eli Lilly. Because this is a buy and hold simulation, we will invest all of the money up front and let it sit in the market for the duration of the simulation. At the end of week 10, we will sell all of our shares and document the results.

4.1 Week 1

At the beginning of week 1, we made our initial purchases for this buy and hold simulation. We purchased each of our selected eight stocks at as close to a value of $12,500 as we could get while only buying whole shares. This money is now going to sit invested in these stocks for the next 10 weeks until all shares are sold on the final day of week 10.

At the conclusion of week 1, our account value was $99,355.54. This means we lost $644.46, or 0.65%. Though it is disappointing to see a small loss, we still have nine weeks for the market to recover.

Some of our stocks did see gains this week, though. Amylyx, Etsy, Hess, and Eli Lilly all ended the week at higher prices than we purchased them. Hess was our most successful stock this week. On Monday, we purchased 119 shares at $103.74 each for a total investment of $12,345.06. The price closed on Friday at $108.99. This amounts to a 5.06% increase that would net us a $624.75 profit if we sold the stock now. That would go against the guidelines for this method, however, so we will leave the investment untouched.

Our biggest loser this week was Apple. It is currently sitting at a 7.66% decrease and would be a $951.18 loss if we sold it right now. Apple has been a historically very successful stock, so we are optimistic it will recover. The complete transaction record for this week can be found in

Table 4.1.1. Since there will be no more transactions after this week, this simulation's transaction

tables will focus on the changes in each asset value instead.

Table 4.1.1 – Buy and Hold Week 1 Assets

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Asset Value on 10/02/22	Weekly Asset Change	Total Asset Change
9/26/22	AMLX	BUY	$28	448	$12,544	$12,611.20	$67.20	$67.20
9/26/22	AAPL	BUY	$149.66	83	$12,421.78	$11,470.60	($951.18)	($951.18)
9/26/22	ETSY	BUY	$96.07	129	$12,393.03	$12,916.77	$523.74	$523.74
9/26/22	GIS	BUY	$78.99	157	$12,401.43	$12,027.77	($373.66)	($373.66)
9/26/22	AMD	BUY	$67.87	184	$12,488.08	$11,658.24	($829.84)	($829.84)
9/26/22	LLY	BUY	$308.8	40	$12,352	$12,934.00	$582.00	$582.00
9/26/22	ELF	BUY	$38.51	323	$12,438.73	$12,034.98	($403.75)	($403.75)
9/26/22	HES	BUY	$103.74	119	$12,345.06	$12,969.81	$624.75	$624.75
Total Assets as of 10/02/22: $99,355.54								

4.2 Week 2

Since all our money was invested up front, there were no new transactions made this week.

At the end of week 2, our account value was $104,298.52. This means we gained $4,942.98, or

4.739% since last week and we are up about 4.3% overall. There were lots of events in the news

that affected the market this week. Interestingly, we finished the week with a fairly significant

profit, as most of these events should have been bad for the market.

The main driver of the market was the release of the Quarter 3 report by the Bureau of

Labor Statistics. The jobs number increased by 263,000 and the unemployment rate went down to

3.5% from 3.7% [51]. The reason this affected the market is that both of these numbers saw larger

changes than predicted. There is also an inverse relationship between unemployment rates and

inflation. The country has been battling high inflation rates for months now, and the tight labor

markets associated with low unemployment rates can drive up wages, which in turn can drive up

inflation. If interest rates continue to climb, the Fed will have to continue raising interest rates,

making companies less willing to borrow money and consumers less able to afford to invest. After this news, the Dow is now down 20% to date, which is on pace for the worst year since the Great Recession in 2008.

Our only two stocks that dropped in value this week were AMD (-9.37%) and General Mills (-2.21%). We used the opening and closing prices from the week to calculate these numbers, so they do not reflect price fluctuations that occurred between market close on Friday and market open on Monday morning. Though the market as a whole did not see substantial gains this week, it seems that, at least for now, we picked a few stocks right. We own three stocks whose prices have increased by over 10% since we purchased them two weeks ago – Amylyx (12.20%), Etsy (14.96%), and Hess (23.58%). All asset value changes for the week can be found in Table 4.2.1.

Table 4.2.1 – Buy and Hold Week 2 Assets

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Asset Value on 10/09/22	Weekly Asset Change	Total Asset Change
9/26/22	AMLX	BUY	$28	448	$12,544	$14,542.08	$1,930.88	$1,998.08
9/26/22	AAPL	BUY	$149.66	83	$12,421.78	$11,627.47	$156.87	($794.31)
9/26/22	ETSY	BUY	$96.07	129	$12,393.03	$14,246.76	$1,329.99	$1,853.73
9/26/22	GIS	BUY	$78.99	157	$12,401.43	$11,829.95	($197.82)	($571.48)
9/26/22	AMD	BUY	$67.87	184	$12,488.08	$10,752.96	($905.28)	($1,735.12)
9/26/22	LLY	BUY	$308.8	40	$12,352	$13,066.40	$132.40	$714.40
9/26/22	ELF	BUY	$38.51	323	$12,438.73	$12,361.21	$326.23	($77.52)
9/26/22	HES	BUY	$103.74	119	$12,345.06	$15,255.80	$2,285.99	$2,910.74
Total Assets as of 10/09/22: $104,298.52								

If we were not trying to test the effectiveness of different methods, this might be a good time to sell Hess, since a profit upwards of 20% in only two weeks is quite unexpected, especially for such an established stock. However, there is an investment strategy that justifies holding on to it. Known as the 8-week hold rule, this rule suggests that investors hold stocks that gain over 20%

in three weeks or less for 8 weeks from the initial breakout [52]. The idea behind the rule is that many investors may jump ship when the price reaches that high, causing a sharp drop. If you sell during this drop, you may lose out on potential profits. There is usually a good reason why the price increased so suddenly, and if you wait out the initial frantic sell-off, a good stock will continue to grow in value.

4.3 Week 3

In week 3, there were once again, no new transactions made, but Table 4.3.1 documents the changes in asset values. Our account value decreased to $102,558.38, which means we lost $1,740.14, or 1.668% since last week. We are still up $2,558.38, or 2.57%, overall, however.

Table 4.3.1 – Buy and Hold Week 3 Assets

Date	Symbol	Buy/Sell	Price	Shares	Net Cost/Proceeds	Asset Value on 10/16/22	Weekly Asset Change	Total Asset Change
9/26/22	AMLX	BUY	$28	448	$12,544	$15,473.92	$931.84	$2,929.92
9/26/22	AAPL	BUY	$149.66	83	$12,421.78	$11,477.24	($150.23)	($944.54)
9/26/22	ETSY	BUY	$96.07	129	$12,393.03	$11,926.05	($2,320.71)	($466.98)
9/26/22	GIS	BUY	$78.99	157	$12,401.43	$12,200.47	($370.52)	($200.96)
9/26/22	AMD	BUY	$67.87	184	$12,488.08	$10,292.96	($460.00)	($2,195.12)
9/26/22	LLY	BUY	$308.8	40	$12,352	$13,255.60	$189.20	$903.60
9/26/22	ELF	BUY	$38.51	323	$12,438.73	$12,719.74	$358.53	$281.01
9/26/22	HES	BUY	$103.74	119	$12,345.06	$14,588.21	($667.59)	$2,243.15
Total Assets as of 10/16/22: $102,558.38								

This week we had the same number of stocks go up and go down. Amylyx had a particularly good week, ending the week up 7.63%. The total losses were a little bigger than the gains, and this can mostly be attributed to the performance of Etsy this week. At the end of last week, Etsy was up 14.96% overall, but after its 16.91% crash this week, we are now sitting at a 3.77% loss in our investment. There was another release of inflation data this week, and the market

initially did not react well. Consumer prices rose 0.4% in September, which was more than the Dow Jones prediction of 0.3% [53]. The markets now believe the Fed may increase interest rates in November and December by 0.75 percentage points. This news led a lot of investors to sell their online retail stocks. Many of them bounced back, but Etsy did not.

4.4 Week 4

There were no new transactions this week, but the total cash and asset values can be found in Table 4.4.1. At the conclusion of week 4, our account value now sits at $108,216.99. This means we had a significant gain of $5,658.61, or 5.517% since last week. With this gain, we are now up 8.216% since the start of the simulation.

Table 4.4.1 – Buy and Hold Week 4 Assets

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Asset Value on 10/23/22	Weekly Asset Change	Total Asset Change
9/26/22	AMLX	BUY	$28	448	$12,544	$16,253.44	$779.52	$3,709.44
9/26/22	AAPL	BUY	$149.66	83	$12,421.78	$12,223.41	$746.17	($198.37)
9/26/22	ETSY	BUY	$96.07	129	$12,393.03	$13,017.39	$1,091.34	$624.36
9/26/22	GIS	BUY	$78.99	157	$12,401.43	$12,095.28	($105.19)	($306.15)
9/26/22	AMD	BUY	$67.87	184	$12,488.08	$10,822.88	$529.92	($1,665.20)
9/26/22	LLY	BUY	$308.8	40	$12,352	$13,630.80	$375.20	$1,278.80
9/26/22	ELF	BUY	$38.51	323	$12,438.73	$13,423.88	$704.14	$985.15
9/26/22	HES	BUY	$103.74	119	$12,345.06	$16,134.02	$1,545.81	$3,788.96
Total Assets as of 10/23/22: $108,216.99								

Etsy had a particularly volatile week, having a good day on Monday before dropping 6% on Wednesday, and then recovering all that loss by Friday. The company announced that earnings reports for the quarter will be reported in early November, and the associated optimism likely spurred some of the recovery. Elf Beauty also announced it would release the quarterly earnings reports in the first week of November. Elf has a track record of beating earnings expectations, and

experts predict the company will triumph again [54]. This likely caused the stock to rally, as it ended the week up 5.245%. Apple seems to have finally turned the corner, ending the week up 6.424%, while AMD continues to lose us money every week.

4.5 Week 5

There were again no new transactions this week, but the asset value changes can be found in Table 4.5.1. At the end of week 5, we now have an account value of $111,944.10. This means we had a modest gain of $3,727.11, or 3.44%, since last week. With the gains from this week, we are now up 11.94% since the start of the simulation.

Table 4.5.1 – Buy and Hold Week 5 Assets

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Asset Value on 10/30/22	Weekly Asset Change	Total Asset Change
9/26/22	AMLX	BUY	$28	448	$12,544	$16,289.28	$35.84	$3,745.28
9/26/22	AAPL	BUY	$149.66	83	$12,421.78	$12,926.42	$703.01	$504.64
9/26/22	ETSY	BUY	$96.07	129	$12,393.03	$12,630.39	($387.00)	$237.36
9/26/22	GIS	BUY	$78.99	157	$12,401.43	$12,806.49	$711.21	$405.06
9/26/22	AMD	BUY	$67.87	184	$12,488.08	$11,409.84	$586.96	($1,078.24)
9/26/22	LLY	BUY	$308.8	40	$12,352	$14,396.00	$765.20	$2,044.00
9/26/22	ELF	BUY	$38.51	323	$12,438.73	$14,153.86	$729.98	$1,715.13
9/26/22	HES	BUY	$103.74	119	$12,345.06	$16,715.93	$581.91	$4,370.87
Total Assets as of 10/30/22: $111,944.10								

This was a good week for the market overall, as the Dow, S&P, and NASDAQ were all up over 2%. The only two stocks that went down were Amylyx and Etsy. Amylyx was sitting at an all-time high after riding the news of the FDA approval for its ALS drug Albrioza, so it was bound to come down a little bit eventually. Etsy has struggled recently but has bounced back a bit. The company promoted vice president of engineering Rachana Kumar, who has been with the company

for eight years, to chief technical officer [55]. This week's loss was likely caused by the slight uncertainty related to that C-suite shakeup.

Apple, which was one of our worst-performing stocks before this week, had a particularly good week, ending the week up 5.72%. The stock had its best day since April 2020 as it was up 7.5% on Friday. Apple's September earnings modestly beat expectations, and investors reacted positively [56]. AMD is also finally turning things around. At the end of week 3, the stock was down 17.58%, but it has since recovered and is now only down 8.63% after gaining 5.87% this week. The Bureau of Labor Statistics released the Employment Cost Index on Friday morning, which reported higher-than-expected consumer spending metrics and slowing wage inflation [57]. The market reacted positively to this as well. Hess also released its quarterly earnings on Wednesday, October 26th, and the stock, which opened at $138.83, reached a high of $145.31 as it rallied in response.

4.6 Week 6

The total cash and asset values for week 6 can be found in Table 4.6.1. At the conclusion of this week, we now have an account value of $111,570.69. This means we had a slight loss of $373.41, or 0.33%, since last week. Even with the losses from this week, we are still up 11.57% since the start of the simulation.

Table 4.6.1 – Buy and Hold Week 6 Assets

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Asset Value on 11/06/22	Weekly Asset Change	Total Asset Change
9/26/22	AMLX	BUY	$28	448	$12,544	$15,397.76	($891.52)	$2,853.76
9/26/22	AAPL	BUY	$149.66	83	$12,421.78	$11,485.54	($1,440.88)	($936.24)
9/26/22	ETSY	BUY	$96.07	129	$12,393.03	$12,687.15	$56.76	$294.12
9/26/22	GIS	BUY	$78.99	157	$12,401.43	$12,412.42	($394.07)	$10.99
9/26/22	AMD	BUY	$67.87	184	$12,488.08	$11,442.96	$33.12	($1,045.12)
9/26/22	LLY	BUY	$308.8	40	$12,352	$14,296.40	($99.60)	$1,944.40
9/26/22	ELF	BUY	$38.51	323	$12,438.73	$15,710.72	$1,556.86	$3,721.99
9/26/22	HES	BUY	$103.74	119	$12,345.06	$17,437.07	$721.14	$5,092.01
Total Assets as of 11/06/22: $111,570.69								

This was a shaky week for the market overall, mostly because of an interest rate announcement from the Fed. The market expected the Fed to raise the interest rates by 75 basis points again, so the raise was not the problem. What tanked the market was the press conference afterward. Many people were hoping the rate hikes would start to slow down soon, but Charles Schwab reported that Federal Reserve Chair Jerome Powell said "It is very premature to be thinking about pausing… very premature" [58]. The reason people fear continued rate hikes is because of the effect they have on the treasury yield curve. Recessions generally follow the long-term yield dropping below the short-term yield, and this may soon be the case.

After its good week last week, Apple had its worst week in years, ending the week down 9.74%. One reason was Spotify's public attack on Apple. Spotify is attempting to bring audiobooks into its business model by selling them within its app. The problem with this plan is that Apple charges 30% of revenue for in-app purchases in its App Store, and Spotify does not want to pay this fee. Spotify reportedly came up with multiple workarounds that seemingly fit within Apple's terms and conditions, but Apple rejected them all [59]. In response, Spotify publicly slammed

Apple for its anti-competitive practices. Another reason the stock dropped was because of a Covid outbreak at one of Apple's major suppliers, Foxconn. Foxconn is the site of the biggest iPhone assembly plant in China, but because of China's strict stance on Covid cases, it had to shut the factory doors for a week [60]. This is particularly problematic because the factory will likely be behind in fulfilling orders for the holiday season.

Many of our companies released earnings reports for Quarter 3 this week, and some of their stocks responded positively. Elf Beauty had a great week after the release of its earnings report. The company reported adjusted earnings of 36 cents per share, which was significantly above the projected 16 cents per share [61]. The reports of net sales for the quarter also came in 33% above the projection. As a result of its third-quarter success, Elf Beauty raised its projected fiscal outlook for 2023, and investors took this as a great sign, sending the stock price surging. It increased about 10% after hours on Wednesday, the day the earnings were released, and then shot up 15% on Thursday. At the Friday close, the stock finished the week up 11%. Etsy also rallied over 10% after the release of its earnings report but finished the week at about the same price it started.

4.7 Week 7

At the end of week 7, our total assets are now worth $116,172.34, which is $4,601.65 more than the $111,570.69 they were worth last week. This means we are up an impressive 16.172% since the start of the simulation. The individual breakdown of our assets can be found below in Table 4.7.1.

Table 4.7.1 – Buy and Hold Week 7 Assets

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Asset Value on 11/13/22	Weekly Asset Change	Total Asset Change
9/26/22	AMLX	BUY	$28	448	$12,544	$15,232.00	($165.76)	$2,688.00
9/26/22	AAPL	BUY	$149.66	83	$12,421.78	$12,425.10	$939.56	$3.32
9/26/22	ETSY	BUY	$96.07	129	$12,393.03	$14,917.56	$2,230.41	$2,524.53
9/26/22	GIS	BUY	$78.99	157	$12,401.43	$12,128.25	($284.17)	($273.18)
9/26/22	AMD	BUY	$67.87	184	$12,488.08	$13,316.08	$1,873.12	$828.00
9/26/22	LLY	BUY	$308.8	40	$12,352	$14,092.00	($204.40)	$1,740.00
9/26/22	ELF	BUY	$38.51	323	$12,438.73	$16,017.57	$306.85	$3,578.84
9/26/22	HES	BUY	$103.74	119	$12,345.06	$17,324.02	($113.05)	$4,978.96
Total Assets as of 11/13/22: $116,172.34								

This was a very volatile week for the market, but a few of our stocks came out on the right side of that. Wednesday, November 9th, was the day after Election Day, and the results were unclear. Senate races in a few key swing states, including Arizona and Nevada, were still uncalled, and Georgia was headed to a runoff, leaving control of the Senate uncertain. A few House elections were still uncalled as well, and a majority had not been officially determined. The market did not respond well to this uncertainty, mostly because investors were not expecting it. The "red wave" of Republican voters that was supposed to take back control of the Senate never materialized.

It did not take long for the market to turn around, however. The very next day, the U.S. Bureau of Labor Statistics released the Consumer Price Index report. The CPI is a generalized statistic that measures what services and goods cost. Last month, it rose 0.4%, which is its lowest increase since January [62]. This inspired hope that inflation has peaked and will now begin to slow down. The S&P 500 rose 4%, the Nasdaq rose 5.5%, and AMD and ETSY both shot up over 10% within the first hour the market opened.

AMD had a particularly good week, finally ending the week at a price higher than what we bought it at. The stock increased 14.96%, mostly on Thursday and Friday, both because of the CPI

report and an announcement from the company. AMD announced a new generation of EPCY data center chips. This new generation, which is being referred to as "Genoa," reportedly uses 54% less power than rival Intel chips but also performs 2.8 times better [63]. This news left investors optimistic about AMD's market share going forward.

4.8 Week 8

This week, the value of our total assets increased by $3,071.82, or 2.644%, to $119,244.16. This means we are up 19.244% since the start of the simulation. The individual breakdown of our assets can be found below in Table 4.8.1.

Table 4.8.1 – Buy and Hold Week 8 Assets

Date	Symbol	Buy/Sell	Price	Shares	Net Cost/Proceeds	Asset Value on 11/20/22	Weekly Asset Change	Total Asset Change
9/26/22	AMLX	BUY	$28	448	$12,544	$15,675.52	$443.52	$3,131.52
9/26/22	AAPL	BUY	$149.66	83	$12,421.78	$12,557.07	$131.97	$135.29
9/26/22	ETSY	BUY	$96.07	129	$12,393.03	$14,695.68	($221.88)	$2,302.65
9/26/22	GIS	BUY	$78.99	157	$12,401.43	$12,721.71	$593.46	$320.28
9/26/22	AMD	BUY	$67.87	184	$12,488.08	$13,536.88	$220.80	$1,048.80
9/26/22	LLY	BUY	$308.8	40	$12,352	$14,466.80	$374.80	$2,114.80
9/26/22	ELF	BUY	$38.51	323	$12,438.73	$17,735.93	$1,718.36	$5,297.20
9/26/22	HES	BUY	$103.74	119	$12,345.06	$17,134.81	($189.21)	$4,789.75
Total Assets as of 11/20/22: $119,244.16								

This was a very uneventful week for the market compared to the last few. Elf Beauty (9.93%) and General Mills (4.46%) made moderate gains, AMD (-2.19%) and HES (-0.11%) suffered small losses, and our other four stocks saw small gains. Elf continues to thrive, likely still because of its earnings report from a few weeks ago. Apple is still dealing with production issues related to its newest iPhone products, but that did not seem to affect the stock negatively this week.

Enough outstanding elections from last week were called to resolve last week's election uncertainty, giving Republicans control of the House and Democrats control of the Senate. The market has historically performed well after the Midterm elections, and we are hoping that will be the case again this year. The Washington Post printed a claim from analysts that studied Bloomberg stock market data from the past 60 years that said: "the S&P 500 'has historically outperformed the market in the 12-month period after a midterm election, with an average return of 16.3%'" [64].

There did not seem to be any other overarching current events or news within certain companies that would explain these changes. It is not a reasonable assumption that you will always know why the market moves the way it does, because if you did, the market would become much easier to predict. In past weeks, we have reported why we believed the market had moved, with support from other sources of course, but we never know with absolute certainty.

4.9 Week 9

At the end of week 9, the value of our total assets increased to $122,511.10, which is $3,266.94, or 2.739%, more than last week. This means we are up 22.511% since the start of the simulation. The individual breakdown of our assets can be found below in Table 4.9.1.

Table 4.9.1 – Buy and Hold Week 9 Assets

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Asset Value on 11/27/22	Weekly Asset Change	Total Asset Change
9/26/22	AMLX	BUY	$28	448	$12,544	$17,360.00	$1,684.48	$4,816.00
9/26/22	AAPL	BUY	$149.66	83	$12,421.78	$12,293.13	($263.94)	($128.65)
9/26/22	ETSY	BUY	$96.07	129	$12,393.03	$15,519.99	$824.31	$3,126.96
9/26/22	GIS	BUY	$78.99	157	$12,401.43	$13,026.29	$304.58	$624.86
9/26/22	AMD	BUY	$67.87	184	$12,488.08	$13,825.76	$288.88	$1,337.68
9/26/22	LLY	BUY	$308.8	40	$12,352	$14,610.00	$143.20	$2,258.00
9/26/22	ELF	BUY	$38.51	323	$12,438.73	$17,929.73	$193.80	$5,491.00
9/26/22	HES	BUY	$103.74	119	$12,345.06	$17,266.44	$131.63	$4,921.38
Total Assets as of 11/27/22: $122,511.10								

It is generally true that no news is good news, and such was the case with the market this week. Like last week, it was another fairly quiet week that saw steady gains. It was also a short week, as the market was closed on Thursday, November 24th for Thanksgiving and closed early the next day for Black Friday. Minutes released from the Federal Reserve's recent meeting on Wednesday suggest a slowdown in rate hikes may be coming soon, and while this did not send the market surging, it likely contributed to the week of steady growth [65]. Etsy, Elf, and General Mills each gained around 3% over the course of the week, while Hess, Eli Lilly, and AMD posted smaller gains. Amylyx had a surprise breakout week, surging 10.12%, while unsurprisingly, Apple struggled again due to Chinese protests worsening supply chain issues.

Next week marks the end of this simulation, where we currently plan to sell at the end of the day on Friday. Pending an extreme collapse, we are set to make a solid return from our investments in this simulation. Hopefully, Black Friday sales will be better than expected and the Jobs Report that comes out next Friday will have a positive impact on the market.

4.10 Week 10

The value of our assets increased by $3,532.86, or 2.884%, to a value of $126,043.96. This was the final week of the buy and hold simulation, meaning we made 26.04% on our investment. Table 4.10.1 below shows the final values of our assets.

Table 4.10.1 – Buy and Hold Week 10 Assets

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Asset Value on 12/04/22	Weekly Asset Change	Total Asset Change
9/26/22	AMLX	BUY	$28	448	$12,544.00	$17,575.04	$215.04	$5,031.04
9/26/22	AAPL	BUY	$149.66	83	$12,421.78	$12,268.23	($24.90)	($153.55)
9/26/22	ETSY	BUY	$96.07	129	$12,393.03	$18,123.21	$2,603.22	$5,730.18
9/26/22	GIS	BUY	$78.99	157	$12,401.43	$13,583.64	$557.35	$1,182.21
9/26/22	AMD	BUY	$67.87	184	$12,488.08	$13,796.32	($29.44)	$1,308.24
9/26/22	LLY	BUY	$308.8	40	$12,352.00	$14,990.40	$380.40	$2,638.40
9/26/22	ELF	BUY	$38.51	323	$12,438.73	$17,848.98	($80.75)	$5,410.25
9/26/22	HES	BUY	$103.74	119	$12,345.06	$17,138.38	($128.06)	$4,793.32
Total Assets as of 12/04/22: $126,043.96								

Table 4.10.2 documents the final transactions we made. This table tracks the profit made from each stock as well as the cumulative profit. The reason that the total asset value does not equal the sum of the original $100,000 and the total profit is because of extra cash that was added into the account by Investopedia as the simulation went on, likely to represent dividend payments. This cash only changes the asset value by a very small amount, but it is worth mentioning since this occurred in the other two simulations as well. That cash is added into the cell that contains the cash generated by the last transaction in the table.

Table 4.10.2 – Buy and Hold Transactions for Week 10

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/ Loss	Total Cash	Total Profit
							$719.76	
12/02/22	AMLX	SELL	$39.23	448	$17,575.04	$5,031.04	$18,294.80	$5,031.04
12/02/22	AAPL	SELL	$147.81	83	$12,268.23	($153.55)	$30,563.03	$4,877.49
12/02/22	ETSY	SELL	$141.90	129	$18,123.21	$5,730.18	$48,686.24	$10,607.67
12/02/22	GIS	SELL	$86.52	157	$13,583.64	$1,182.21	$62,269.88	$11,789.88
12/02/22	AMD	SELL	$74.98	184	$13,796.32	$1,308.24	$76,066.20	$13,098.12
12/02/22	LLY	SELL	$374.76	40	$14,990.40	$2,638.40	$91,056.60	$15,736.52
12/02/22	ELF	SELL	$55.26	323	$17,848.98	$5,410.25	$108,905.58	$21,146.77
12/02/22	HES	SELL	$144.02	119	$17,138.38	$4,793.32	$126,043.96	$25,940.09
Total Assets as of 12/04/22: $126,043.96								

This was a fairly good week for the market, mostly due once again to news surrounding inflation. On Wednesday, November 30th, Federal Reserve chairman Jerome Powell gave a speech on the current state of inflation. He suggested that smaller interest rate increases are likely coming soon, possibly as early as December. Chairman Powell also said, "despite some promising developments, we have a long way to go in restoring price stability," and added that monetary policies will stay restrictive until real signs of progress emerge on inflation [66]. The market responded positively to this news, as the Dow closed up 2.18% and the NASDAQ 4.41%.

Not all inflation news was good this week, however, as the market dropped after the release of the Jobs Report on Friday morning. The unemployment rate remained at the same 3.7%, hourly wages increased 0.6%, and labor force participation went down [67]. The fact that the average hourly wage increased was a bad sign for investors since higher wages and low unemployment are usually a sign of high inflation. Although the market dropped Friday morning, it recovered most of its losses by the close.

One stock that had a particularly strong week for us was Etsy, ending the week up 16.88%. Part of this success was likely due to Chairman Powell's comments on Wednesday, but better-than-expected sales and a strong Cyber Weekend performance are likely the reasons the stock is up 40% over the last month and has significantly outperformed the market.

4.11 Summary of the Last 10 Weeks

By the end of the buy and hold simulation, our initial $100,000 had grown to $126,043.96. This means we made $26,043.96, or 26.04%. The simulation platform we used, Investopedia, also calculated an extrapolated annual return, which was 246.39%. Most of the work for this simulation was deciding which stocks to select, but after the initial purchases, it was very low-effort, and it significantly outperformed the S&P 500. Figure 4.11.1 below, provided by Investopedia, shows the return of our simulation (blue line) compared to the S&P 500 (black line).
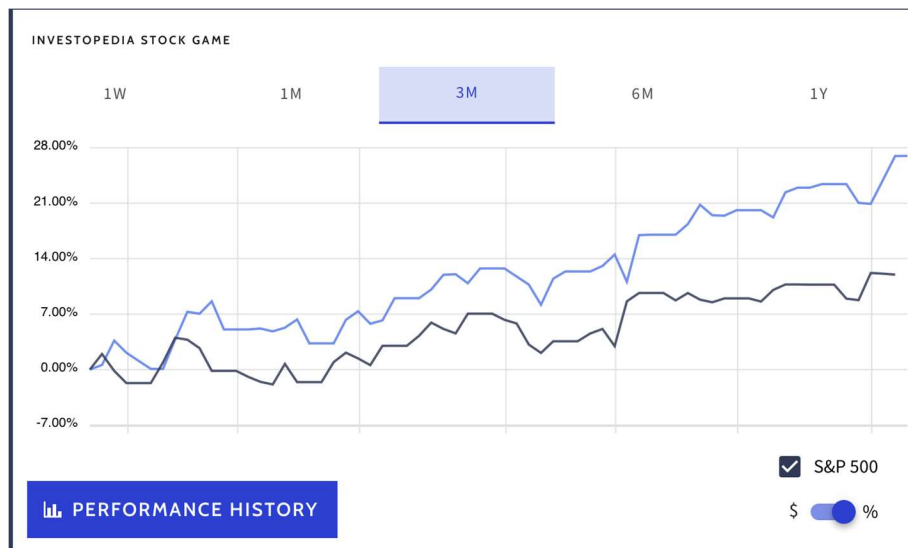
Figure 4.11.1 – Buy and Hold S&P 500 Returns Comparison

Seven of our stocks positively contributed to the $26,043.96, while Apple posted a slight loss at -1.24%. Additionally, half of our stocks posted returns of over 38% at the end of the ten weeks. Amylyx, Elf, Etsy, and Hess posted those large returns, and Etsy had the best overall return

at 46.24%. Because of these high returns, the average return was 26.10%. Figure 4.11.2 compares

the returns of the eight stocks.
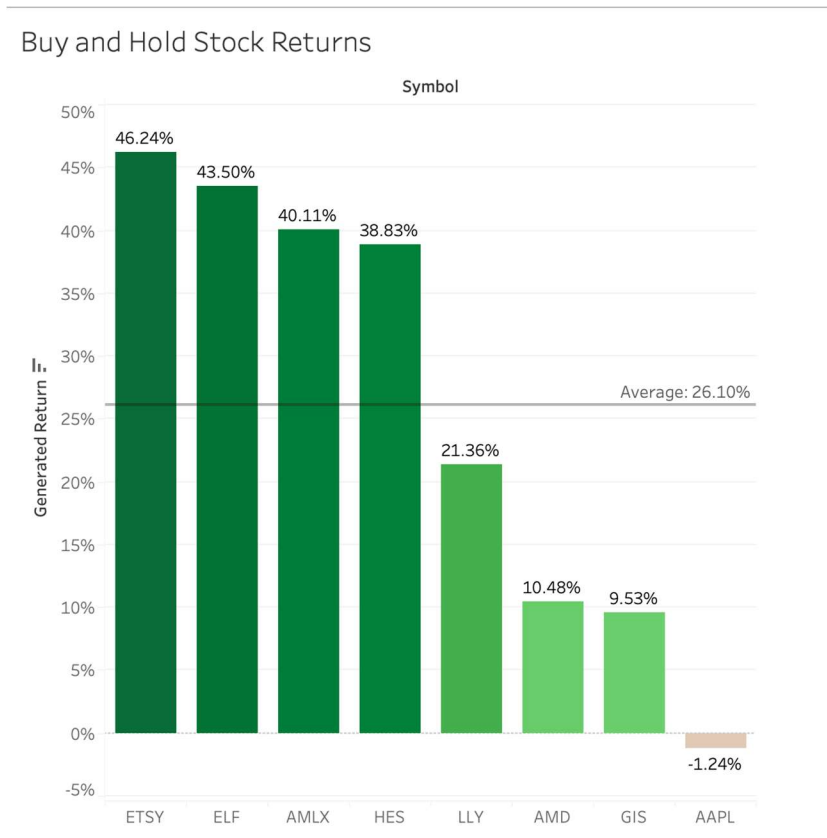
Figure 4.11.2 – Buy and Hold Stock Returns

Chapter 5: Simulation 2 – Dollar Cost Averaging

In our second concurrent simulation, we will use Investopedia to invest a total of $100,000 into the following eight stocks: Apple, AMD, Amylyx, Elf Beauty, Etsy, General Mills, Hess, and Eli Lilly. But this time, instead of investing it all up front, we will break up the money into ten weekly amounts of $10,000. Each week we will invest $1,250 into each company. We will let the money sit in the market until the end of week 10 when we will sell all our shares.

5.1 Week 1

At the beginning of the week, we purchased each of the 8 stocks at as close to a value of $1,250 as we could get while only buying whole shares. We ended the week at a small loss of $63.20, or 0.63%. This leaves our account value at $99,936.80. Because the money has only been invested for one week, the results of this simulation are almost identical to those of the buy and hold simulation. Apple suffered a particularly bad loss this week at 7.66%, but since the price is now lower, the beginning of next week will be a good time to invest more money into it. The complete transaction record for this week can be found in Table 5.1.1.

Table 5.1.1 – Dollar Cost Averaging Transactions for Week 1

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/Loss	Total Cash	Total Profit
9/25/22							$100,000	
9/26/22	AMLX	BUY	$28	45	$1,260		$98,740	
9/26/22	AAPL	BUY	$149.70	8	$1,197.28		$97,542.72	
9/26/22	ETSY	BUY	$96.07	13	$1,248.91		$96,293.81	
9/26/22	GIS	BUY	$78.99	16	$1,263.84		$95,029.97	
9/26/22	AMD	BUY	$67.87	19	$1,289.53		$93,740.44	
9/26/22	LLY	BUY	$308.8	4	$1,235.2		$92,505.24	
9/26/22	ELF	BUY	$38.51	32	$1,232.32		$91,272.92	
9/26/22	HES	BUY	$103.74	12	$1,244.88		$90,028.04	
Total Assets as of 10/02/22: $99,936.80								

5.2 Week 2

At the beginning of week 2, we purchased another $1250 worth of each of the eight stocks. Our portfolio performed slightly better than last week, ending the week with a gain of $599.50, or 0.596%. This pushes our account to $100,536.30. Interestingly, the stocks that are up overall are up less than those in the buy and hold simulation, but the stocks that are down overall are also down less. So far, it seems as if the dollar cost averaging approach may be better than the buy and hold approach at reducing the effects of volatility, but not necessarily making more money. Of course, it has only been two weeks and it is too early to draw this conclusion, but it is something to revisit in later weeks. The complete transaction record for this week can be found in Table 5.2.1.

Table 5.2.1 – Dollar Cost Averaging Transactions for Week 2

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/Loss	Total Cash	Total Profit
10/02/22							$90,028.40	
10/03/22	AAPL	BUY	$141.40	8	$1,131.20		$88,896.84	
10/03/22	AMD	BUY	$65.74	17	$1,117.58		$87,779.26	
10/03/22	AMLX	BUY	$30.39	35	$1,063.65		$86,715.61	
10/03/22	ELF	BUY	$38.59	29	$1,119.11		$85,596.50	
10/03/22	ETSY	BUY	$104.42	10	$1,044.20		$84,552.30	
10/03/22	GIS	BUY	$77.51	14	$1,085.14		$83,467.16	
10/03/22	HES	BUY	$115.42	10	$1,154.20		$82,312.96	
10/03/22	LLY	BUY	$321.86	4	$1,287.44		$81,025.52	
Total Assets as of 10/09/22: $100,536.30								

5.3 Week 3

At the beginning of the week, we once again invested another $10,000. Our portfolio suffered a small loss this week of $428.48, or 0.426%. This knocked our account value down to $100,107.82. Like our buy and hold simulation, most of our portfolio's performance this week can be attributed to Etsy's crash. AMD has also performed poorly throughout the simulation so far, as it is currently sitting at a price 11.54% lower than where we bought it. Since both stocks are so

low, the beginning of next week could turn out to be a good time to buy. The complete transaction record for the week can be found in Table 5.3.1.

Table 5.3.1 – Dollar Cost Averaging Transactions for Week 3

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/ Loss	Total Cash	Total Profit
10/09/22							$81,025.52	
10/10/22	AAPL	BUY	$140.42	9	$1,263.78		$79,761.74	
10/10/22	AMD	BUY	$57.31	22	$1,260.82		$78,500.92	
10/10/22	AMLX	BUY	$31.94	39	$1,245.66		$77,255.26	
10/10/22	ELF	BUY	$38.13	33	$1,258.29		$75,996.97	
10/10/22	ETSY	BUY	$111.21	11	$1,223.31		$74,773.66	
10/10/22	GIS	BUY	$75.74	17	$1,287.58		$73,486.08	
10/10/22	HES	BUY	$128.45	10	$1,284.50		$72,201.58	
10/10/22	LLY	BUY	$326.23	4	$1,304.92		$70,896.66	
Total Assets as of 10/16/22: $100,107.82								

5.4 Week 4

At the beginning of the week, we once again invested another $10,000. Our portfolio gained $2,480.26, or 2.48%. This increases our account value to $102,480.26. This portfolio is currently significantly underperforming compared to the buy and hold and range trading portfolios. This week, the value of our assets in this simulation increased about half as much as our assets in the buy and hold simulation, even though we own all the same stocks. It will be interesting to see if this is still true at the end of the simulation. This simulation also seems to be the least volatile, however. The value of our assets has not changed by more than $2500 in a single week, and in most weeks, it has moved less than $1000. The assets in our buy and hold and range trading simulations, however, have increased by over $5,000 in a single week. The lack of volatility is likely because cash still makes up a high percentage of our assets. The transaction record for this week can be found in Table 5.4.1.

Table 5.4.1 – Dollar Cost Averaging Transactions for Week 4

Date	Symbol	Buy/Sell	Price	Shares	Net Cost/Proceeds	Profit/Loss	Total Cash	Total Profit
10/16/22							$70,896.66	
10/17/22	AAPL	BUY	$141.07	9	$1,269.63		$69,627.03	
10/17/22	AMD	BUY	$57.35	22	$1,261.70		$68,365.33	
10/17/22	AMLX	BUY	$35.2	36	$1,267.2		$67,098.13	
10/17/22	ELF	BUY	$40.09	31	$1,242.79		$65,855.34	
10/17/22	ETSY	BUY	$95.22	14	$1,333.08		$64,522.26	
10/17/22	GIS	BUY	$78.15	16	$1,250.40		$63,271.86	
10/17/22	HES	BUY	$124.81	10	$1,248.10		$62,023.76	
10/17/22	LLY	BUY	$332.79	4	$1,331.16		$60,692.60	
Total Assets as of 10/23/22: $102,480.26								

5.5 Week 5

At the beginning of the week, we once again attempted to invest another $10,000, but there was a problem with the trade requests, and they did not go through. So, for this week, we were forced to invest on Tuesday morning instead of the usual Monday morning. The value of our portfolio increased by $1,332.09, or 1.3%, and now sits at $103,812.35. The only stock that would lose us money if we sold it right now would be Etsy, which is valued at 3.29% less than what we have invested into it.

This week again provides evidence for our theory that dollar cost averaging results in smaller gains, but also smaller losses. This portfolio is valued at least $7,000 less than those in our other two simulations. Our best-performing stocks, Hess and Amylyx, are only up 16.34% and 12.78%, but in the buy and hold simulation, they are up 35.41% and 29.86%. But on the other hand, AMD is up in this simulation but still down over 8% in the buy and hold simulation. Lowering the average price per share has proved beneficial for that stock, but since Hess and Amylyx have trended upward for most of the simulation, we have lost out on some potential profit by not buying all of our shares at the beginning. We will be able to make more definitive

conclusions at the end of week 10, but for now, the complete transaction record for the week can be found in Table 5.5.1.

Table 5.5.1 – Dollar Cost Averaging Transactions for Week 5

Date	Symbol	Buy/Sell	Price	Shares	Net Cost/Proceeds	Profit/Loss	Total Cash	Total Profit
10/23/22							$60,692.60	
10/25/22	AAPL	BUY	$150.09	8	$1200.72		$59,491.88	
10/25/22	AMD	BUY	$58.77	21	$1234.17		$58,257.71	
10/25/22	AMLX	BUY	$36.96	34	$1256.64		$57,001.07	
10/25/22	ELF	BUY	$42.05	30	$1261.50		$55,739.57	
10/25/22	ETSY	BUY	$102.09	12	$1225.08		$54,514.49	
10/25/22	GIS	BUY	$77.42	16	$1238.72		$53,275.77	
10/25/22	HES	BUY	$136.25	9	$1226.25		$52,049.52	
10/25/22	LLY	BUY	$346.52	4	$1386.08		$50,663.44	
Total Assets as of 10/30/22: $103,812.35								

5.6 Week 6

At the beginning of the week, we again invested another $10,000, and these transactions can be found in Table 5.6.1. The value of our portfolio decreased by $206.73, or 0.2%, and now sits at $103,605.62. The two stocks that would lose us money if we sold them right now are Apple (-5.06%) and Etsy (-2.30%).

Table 5.6.1 – Dollar Cost Averaging Transactions for Week 6

Date	Symbol	Buy/Sell	Price	Shares	Net Cost/ Proceeds	Profit/Loss	Total Cash	Total Profit
10/30/22							$50,663.44	
10/31/22	AAPL	BUY	$153.16	8	$1,225.24		$49,438.20	
10/31/22	AMD	BUY	$60.75	20	$1,215.00		$48,223.20	
10/31/22	AMLX	BUY	$36.12	35	$1,264.20		$46,959.00	
10/31/22	ELF	BUY	$43.82	29	$1,270.78		$45,688.22	
10/31/22	ETSY	BUY	$98.00	13	$1,273.94		$44,414.28	
10/31/22	GIS	BUY	$80.93	15	$1,213.95		$43,200.33	
10/31/22	HES	BUY	$139.01	9	$1,251.09		$41,949.24	
10/31/22	LLY	BUY	$358.65	3	$1,075.95		$40,873.29	
Total Assets as of 11/06/22: $103,605.62								

The value of our dollar cost averaging portfolio still sits significantly lower than those in our other two simulations. Once again, the value of our total assets changed a negligible amount this week. The value of this portfolio does not seem to change with the market as much as our other portfolios. This means there is less volatility, but also less potential for earnings. Hess is up over 40% in our buy and hold simulation, but since it has just been going up, we own fewer shares since we have purchased them over many weeks at higher prices. This simulation was less affected by Apple's bad week, but when there are losses, it seems to be more difficult to recover them.

5.7 Week 7

At the beginning of week 7, we invested another $10,000. These transactions can be found in Table 5.7.1. The value of our portfolio increased by $3,260.86, or 3.147%, to $106,866.48. This is the biggest weekly change we have seen so far in this simulation, likely because we had three big gaining stocks (AAPL – 9.13%, AMD – 14.96%, and ETSY – 15.42%), and no other stock lost more than 2%. The value of this portfolio still sits about $9,000 behind the other two, but the

6.86% gain is still respectable. It is a lower profit, but this method is the least affected by the volatility of the market, which is also important to consider when evaluating the different methods.

Table 5.7.1 – Dollar Cost Averaging Transactions for Week 7

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/Loss	Total Cash	Total Profit
11/06/22							$40,873.29	
11/07/22	AAPL	BUY	$137.11	9	$1,233.99		$39,639.30	
11/07/22	AMD	BUY	$62.93	20	$1,258.60		$38,380.70	
11/07/22	AMLX	BUY	$34.53	36	$1,243.08		$37,137.62	
11/07/22	ELF	BUY	$48.81	26	$1,269.06		$35,868.56	
11/07/22	ETSY	BUY	$100.19	13	$1,302.47		$34,566.09	
11/07/22	GIS	BUY	$78.89	16	$1,262.24		$33,303.85	
11/07/22	HES	BUY	$147.02	9	$1,323.18		$31,980.67	
11/07/22	LLY	BUY	$358.00	4	$1,432.00		$30,548.67	
Total Assets as of 11/13/22: $106,866.48								

5.8 Week 8

At the beginning of week 8, we invested another $10,000. These transactions can be found below in Table 5.8.1. The value of our portfolio increased from $106,866.48 to $109,119.74. This amounts to an increase of $2,253.26 or 2.108%. This is our third biggest weekly gain so far in this simulation, which is a bit odd considering no stocks besides ELF had particularly strong weeks. We are currently at a point where all eight of our stocks are up over 3% for the duration of the simulation, so now we just have to hope that the market does not drop in our last two weeks. It would have been fine in this simulation if the market had dropped in the previous weeks, since that would help lower our average cost per share, but now there would not be enough time for the assets to recover.

Table 5.8.1 – Dollar Cost Averaging Transactions for Week 8

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/ Loss	Total Cash	Total Profit
11/13/22							$30,548.67	
11/14/22	AAPL	BUY	$148.97	8	$1,191.76		$29,356.91	
11/14/22	AMD	BUY	$75.22	17	$1,278.74		$28,078.17	
11/14/22	AMLX	BUY	$34.26	36	$1,233.36		$26,844.81	
11/14/22	ELF	BUY	$49.65	25	$1,241.25		$25,603.56	
11/14/22	ETSY	BUY	$114.31	11	$1,257.41		$24,346.15	
11/14/22	GIS	BUY	$77.50	16	$1,262.24		$23,106.15	
11/14/22	HES	BUY	$144.70	9	$1,302.30		$21,803.85	
11/14/22	LLY	BUY	$359.07	4	$1,436.28		$20,367.57	
Total Assets as of 11/20/22: $109,119.74								

5.9 Week 9

At the beginning of week 9, we invested our ninth installment of $10,000. These transactions can be found below in Table 5.9.1. The value of our portfolio increased from $109,119.74 to $111,794.81, which amounts to an increase of $2,675.07 or 2.452%. At this stage of the simulation, AAPL is up 1.77%, but all other stocks have gained more than 5.8%. We additionally have five out of the eight stocks with greater than 10% returns. The value of our total assets in this simulation still lags significantly behind that of our assets in the buy and hold simulation. Our current profit sits about 50% lower than the buy and hold. We will likely end the simulation in a similar position because both simulations contain the same stocks. If this simulation performs well next week, the buy and hold simulation will as well.

Table 5.9.1 – Dollar Cost Averaging Transactions for Week 9

Date	Symbol	Buy/Sell	Price	Shares	Net Cost/Proceeds	Profit/Loss	Total Cash	Total Profit
11/20/22							$20,367.57	
11/21/22	AAPL	BUY	$150.16	8	$1,201.28		$19,166.29	
11/21/22	AMD	BUY	$72.21	17	$1,277.57		$17,888.72	
11/21/22	AMLX	BUY	$35.09	36	$1,263.24		$16,625.48	
11/21/22	ELF	BUY	$55.09	23	$1,267.07		$15,358.41	
11/21/22	ETSY	BUY	$112.20	11	$1,234.20		$14,124.21	
11/21/22	GIS	BUY	$81.50	15	$1,222.50		$12,901.71	
11/21/22	HES	BUY	$139.73	9	$1,257.57		$11,644.14	
11/21/22	LLY	BUY	$360.39	4	$1,441.56		$10,202.58	
Total Assets as of 11/27/22: $111,794.81								

5.10 Week 10

At the beginning of the week, we bought approximately $1,250 worth of each of our eight stocks, and at the end of the week, we sold all of our shares right before market close on Friday. These transactions can be viewed in Table 5.10.1. This left our account value at $115,191.05, which was $3,396.24, or 3.038%, more than last week. Unlike the buy and hold simulation, at the close of week 10, every stock generated a positive return on investment.

Table 5.10.1 – Dollar Cost Averaging Transactions for Week 10

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/ Loss	Total Cash	Total Profit
11/27/22							$10,202.58	
11/28/22	AAPL	BUY	$145.14	9	$1,306.26		$8,896.32	
11/28/22	AMD	BUY	$73.81	17	$1,254.77		$7,641.55	
11/28/22	AMLX	BUY	$38.25	33	$1,262.25		$6,379.30	
11/28/22	ELF	BUY	$55.37	23	$1,273.51		$5,105.79	
11/28/22	ETSY	BUY	$120.20	10	$1,202.00		$3,903.79	
11/28/22	GIS	BUY	$83.00	16	$1,328.00		$2,575.79	
11/28/22	HES	BUY	$139.96	9	$1,259.64		$1,316.15	
11/28/22	LLY	BUY	$363.45	3	$1,090.35		$225.80	
12/02/22	AAPL	SELL	$147.81	84	$12,416.04	$194.98	$12,641.84	$194.98
12/02/22	AMD	SELL	$74.98	192	$14,396.16	$1,997.16	$27,038.00	$2,192.14
12/02/22	AMLX	SELL	$39.23	365	$14,318.95	$1,959.51	$41,356.95	$4,151.65
12/02/22	ELF	SELL	$55.26	281	$15,528.06	$3,092.38	$56,885.01	$7,244.03
12/02/22	ETSY	SELL	$140.49	118	$16,577.82	$4,233.28	$73,462.83	$11,477.31
12/02/22	GIS	SELL	$86.52	157	$13,583.64	$1,191.27	$87,046.47	$12,668.58
12/02/22	HES	SELL	$144.02	96	$13,825.92	$1,274.21	$100,872.39	$13,942.79
12/02/22	LLY	SELL	$374.76	38	$14,240.88	$1,219.94	$115,191.05	$15,162.73
Total Assets as of 12/04/22: $115,191.05								

5.11 Summary of the Last 10 Weeks

By the end of the dollar cost averaging simulation, our initial $100,000 had grown to $115,191.05. This means we made $15,191.05, or 15.19%. Our extrapolated annual return calculated by Investopedia was 84.88%. This simulation required fairly minimal effort, as we just had to remember to set up the purchases over the weekends before the market opened on Mondays. Figure 5.11.1 below, provided by Investopedia, shows the return of our simulation (blue line) compared to the S&P 500 (black line).
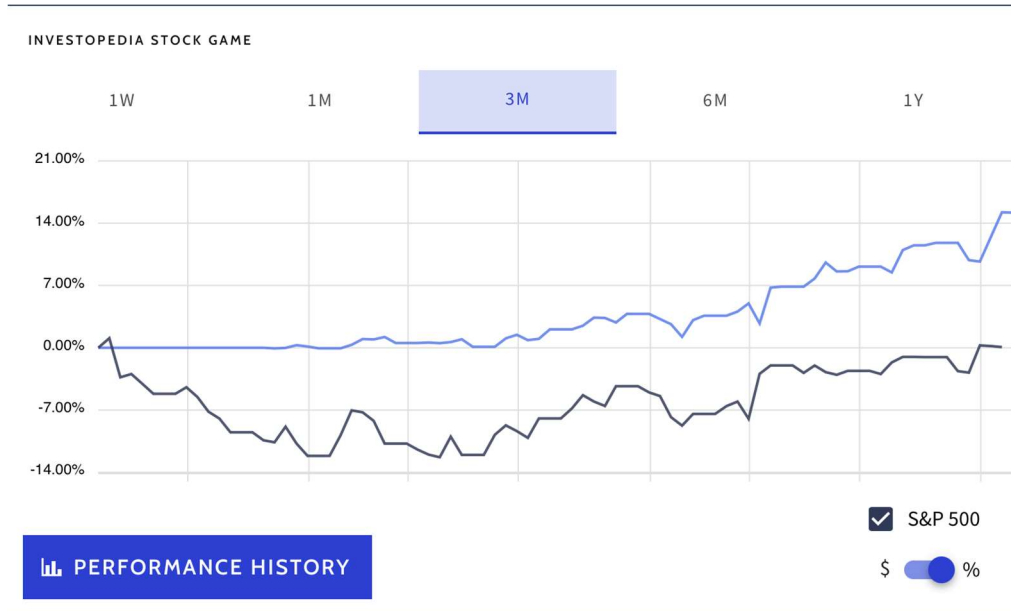
Figure 5.11.1 – Dollar Cost Averaging S&P 500 Returns Comparison

In this simulation, the stock that generated the highest return was Etsy at 34.29%. The lowest generated return was by Apple, but it was for a positive 1.06%. This means all stocks contributed positively towards the profit we made. The average return was 15.23%, which is interesting because the total profit ended up being around 15%. Figure 5.11.2 shows the returns of all eight stocks.

Dollar Cost Average Stock Returns
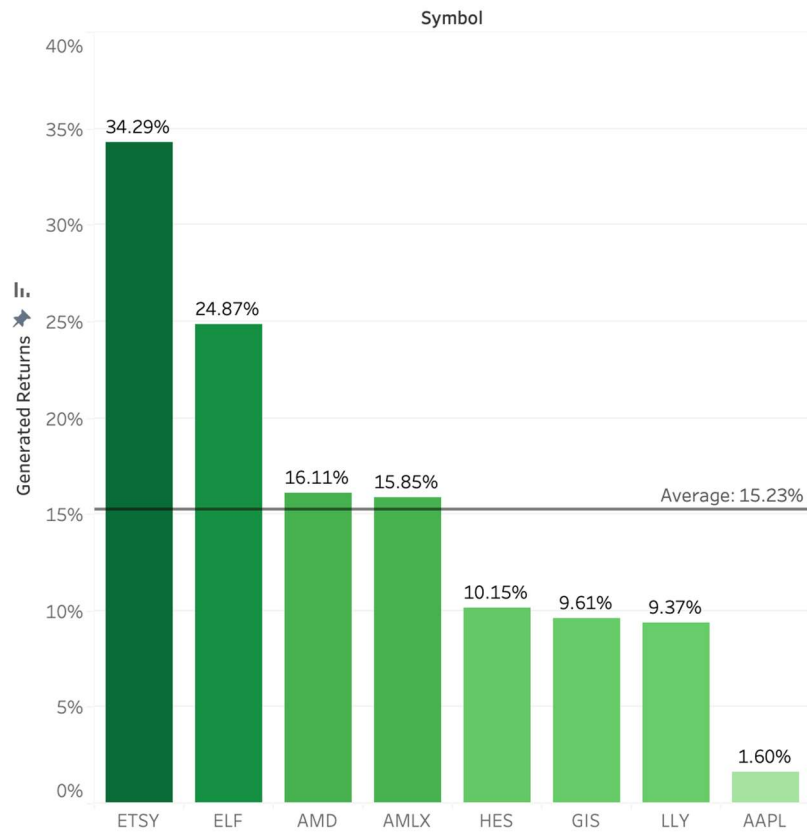
Figure 5.11.2 – Dollar Cost Averaging Stock Returns

Chapter 6: Simulation 3 – Range Trading

In our third concurrent simulation, we will use Investopedia to invest a total of $100,000 into the following eight stocks: Apple, AMD, Amylyx, Elf Beauty, Etsy, General Mills, Hess, and Eli Lilly. We will initially dedicate around $12,500 to each of the eight stocks. Each stock will start with a designated buy price and sell price. If the price is at the lower buy price, we will purchase the stock. Then, when the price reaches the sell price, we will sell it. The ranges for each stock may be adjusted when we see fit. At the end of week 10, we will sell any remaining shares we hold.

6.1 Week 1

At the beginning of the week, we started by purchasing shares of four stocks – Eli Lilly, Amylyx, Etsy, and Elf Beauty. The other stocks were sitting at prices that were too high to purchase. On Tuesday, September 27th, we purchased shares of Hess and Apple at prices of $103.33 and $150.32, respectively. On Wednesday, September 28th, Eli Lilly hit its sell price. We purchased it at the beginning of the week for $306.25 and sold 40 shares at $333.12, netting us a quick profit of $998.65. We also purchased AMD and General Mills on Thursday when they hit their buy prices. The complete record of transactions for the week can be found in Table 6.1.1.

Table 6.1.1 – Range Trading Transactions for Week 1

Date	Symbol	Buy/Sell	Price	Shares	Net Cost/Proceeds	Profit/Loss	Total Cash	Total Profit
9/25/22							$100,000	
9/26/22	LLY	BUY	$306.25	40	$12,250		$87,750	
9/26/22	AMLX	BUY	$27.94	446	$12,641.24		$75,288.76	
9/26/22	ETSY	BUY	$96.5	130	$12,545		$62,743.76	
9/26/22	ELF	BUY	$38.7	323	$12,500.1		$50,243.66	
9/27/22	HES	BUY	$103.33	120	$12,399.6		$37,844.06	
9/27/22	AAPL	BUY	$150.32	82	$12,326.24		$25,517.82	
9/28/22	LLY	SELL	$333.12	40	$13,324.8	$1,074.80	$38,842.62	$1,074.80
9/29/22	GIS	BUY	$77.94	166	$12,938.04		$25,904.58	
9/29/22	AMD	BUY	$66.53	189	$12,574.17		$13,330.41	
Total Assets as of 10/02/22: $100,156.97								

At the end of the week, our total assets were worth $100,156.97. Even though we generated a cash profit of $998.65 from the Eli Lilly sale, the value of the stocks we still own decreased. For example, if we sold Apple right now, it would be for a $993.84 loss.

We are still learning how to fine-tune the ranges, and we should get better at figuring out when to buy and sell with more experience. We did mess up the range for Hess, accidentally setting it to $101 instead of $100. We impulse bought it at $103 when we realized the range was messed up, when it would have been smarter to wait to buy it until the next day when it hit the desired buy price.

6.2 Week 2

Our portfolio performed much better this week, as the value of our assets currently sits at $104,375.70. We sold Amylyx three times, Hess once, and General Mills once. The complete record of our transactions from this week can be found in Table 6.2.1. We were able to profit from Amylyx's success multiple times because we adjusted the range. On Monday morning, we sold the shares we were holding when they hit $30. Later that morning, we bought the stock back for

$28.60 and then sold it when it hit $30.00 again the next day. We raised the buy price after that, predicting that the stock would continue to go up. We purchased it for $29.45 on Wednesday and then sold it on Thursday when it hit $32.03. In total, the Amylyx transactions netted us a cash profit of $2,830.74. Amylyx hit an all-time high this week, likely because its drug designed to treat ALS gained FDA approval.

Table 6.2.1 – Range Trading Transactions for Week 2

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/ Loss	Total Cash	Total Profit
10/02/22							$13,330.41	$1,074.80
10/03/22	AMLX	SELL	$30.09	446	$13,420.14	$958.90	$26,750.55	$2,033.70
10/03/22	AMLX	BUY	$28.60	493	$14,099.80		$12,650.75	
10/03/22	HES	SELL	$115.70	120	$13,884.00	$1,484.40	$26,534.75	$3,518.1
10/04/22	AMLX	SELL	$30.00	493	$14,790.00	$690.20	$41,324.75	$4,208.30
10/04/22	ETSY	SELL	$109.55	130	$14,241.50	$1,696.50	$55,566.25	$5,904.8
10/04/22	GIS	SELL	$79.27	166	$13,158.82	$220.78	$68,725.07	$6,125.58
10/05/22	AMLX	BUY	$29.45	458	$13,488.10		$55,236.97	
10/05/22	GIS	BUY	$77.76	176	$13,685.76		$41,551.21	
10/06/22	AMLX	SELL	$32.03	458	$14,669.74	$1,181.64	$56,220.95	$7,307.22
Total Assets as of 10/09/22: $104,375.70								

One of the issues with range trading is that is difficult to identify when the stock will hit its peak. We sold Hess when it hit its sell price of $115.70 on Monday, but by Friday morning its price had gone up to $131.02. We still made a profit of $1,484.40, but this could have been almost doubled if we had sold it at its peak. The price chart for the past two weeks can be viewed below in Figure 6.2.1. The intersection of the dotted lines is about the price and time at which we sold, but the price continued to increase after that.

Figure 6.2.1 – HES Stock Chart 9/26/22 – 10/8/22 [68]

Of course, even professional investors have not figured out a surefire formula to predict when a stock price will change direction. Selling it too early is also better than holding on to it for too long. If the price is set too high and the stock experiences a sharp drop after a steady gain, there is a chance the price drops below the purchase price. This would put us at a loss when we could have had a decent-sized profit instead. The Etsy stock also continued to increase another six dollars after we sold it, but we were still able to net a profit of $1,696.50.

6.3 Week 3

Amylyx, Elf, and Eli Lilly proved profitable in week 3, and these sales brought our total profit to $9,355.41. Our asset value is only sitting at $104,506.36, however, because of Apple and AMD's struggles throughout this simulation, as well as Etsy's dismal week.

We took the same approach with Etsy this week as we did with Amylyx last week, and this turned out to be a mistake. Last week, we were able to profit off Amylyx by raising the buy price when the stock was on an upswing. Last week, we sold Etsy when it hit $109.55, which was a substantial increase from the $96.50 we bought it at in week 1. We predicted that Etsy would continue to do well because the Halloween season is a popular time to buy crafts. After purchasing

Etsy when it was down at $107, the price continued to drop for the rest of the week. The complete record of our transactions for the week can be found in Table 6.3.1.

Table 6.3.1 – Range Trading Transactions for Week 3

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/Loss	Total Cash	Total Profit
10/09/22							$56,220.95	$7,307.22
10/10/22	ETSY	BUY	$107.00	129	$13,800.42		$42,420.53	
10/11/22	AMLX	BUY	$33.71	465	$15,675.15		$26,745.38	
10/11/22	AMLX	SELL	$35.03	465	$16,288.95	$613.80	$43,034.33	$7,921.02
10/11/22	AMLX	BUY	$33.24	479	$15,921.96		$27,112.37	
10/11/22	ELF	SELL	$40.80	323	$13,178.40	$678.30	$40,290.77	$8,599.32
10/11/22	ELF	BUY	$39.32	295	$11,599.40		$28,691.37	
10/13/22	AMLX	SELL	$34.05	479	$16,309.95	$387.99	$45,001.32	$8,987.31
10/13/22	LLY	BUY	$321.90	45	$14,486.40		$30,514.92	
10/13/22	LLY	SELL	$330.1	45	$14,854.5	$368.10	$45,369.42	$9,355.41
Total Assets as of 10/16/22: $104,506.36								

6.4 Week 4

Our portfolio performed well again in week 4, as the value of our total assets increased by $3,959.83, or 3.789%. Our assets are now worth $108,466.19, which is 8.466% above where we started. We were able to make a $600 profit by buying and selling Hess two days apart, as well as a small $250 profit by flipping Lilly over the course of three days. Our complete transaction record for this week can be found in Table 6.4.1.

Table 6.4.1 – Range Trading Transactions for Week 4

Date	Symbol	Buy/Sell	Price	Shares	Net Cost/Proceeds	Profit/Loss	Total Cash	Total Profit
10/16/22							$45,369.42	$9,355.41
10/17/22	ELF	SELL	$40.83	295	$12,044.85	$445.45	$57,414.27	$9,800.86
10/17/22	AMLX	BUY	$35.99	400	$14,396.00		$43,018.27	
10/17/22	HES	BUY	$124.95	115	$14,369.25		$28,649.02	
10/18/22	LLY	BUY	$332.74	40	$13,309.60		$15,339.42	
10/19/22	ELF	BUY	$40.66	350	$14,231.00		$1,108.42	
10/19/22	HES	SELL	$130.19	115	$14,971.85	$602.60	$16,080.27	$10,403.46
10/21/22	LLY	SELL	$339.03	40	$13,561.20	$251.60	$29,641.47	$10,655.06
Total Assets as of 10/23/22: $108,466.19								

One thing that is interesting to note from this week is our relative lack of profits generated compared to the success of the market. The value of our total assets, which include the stock holdings, increased by almost $6,000, but our total profit only increased by around $1,200. This might mean our ranges are probably too narrow and we have been missing out on some substantial profits by selling too soon. It could also be that the success of some of our stocks has been working against us. If there is less volatility, and the stock does not drop down to the buy price, we might be missing out on some profits. We will continue to monitor the ranges and may need to make some more serious adjustments after next week.

6.5 Week 5

The value of our portfolio increased by $1,901.28 in week 5, or 1.75%, to $110,367.47. We have made $11,802.06 from the range trades, and the remaining difference can be explained by fluctuations in the shares we still hold. This week, we only made three transactions. We sold ELF at $41.56 a share for a small profit of $315 and AMLX at $38.07 a share for a profit of $832. We then purchased AMLX again when it dropped to $37.65 per share. The complete transaction record can be viewed in Table 6.5.1.

Table 6.5.1 – Range Trading Transactions for Week 5

Date	Symbol	Buy/Sell	Price	Shares	Net Cost/Proceeds	Profit/Loss	Total Cash	Total Profit
10/23/22							$29,641.47	$10,655.06
10/24/22	ELF	SELL	$41.56	350	$14,546.00	$315.00	$44,187.47	$10,970.06
10/25/22	AMLX	SELL	$38.07	400	$15,228.00	$832.00	$59,415.47	$11,802.06
10/25/22	AMLX	BUY	$37.65	405	$15,248.25		$44,167.22	
Total Assets as of 10/30/22: $110,367.47								

One thing we have noticed in the last two weeks is that our profits are getting much smaller. There have been a few times when we have bought things at prices very close to where we recently sold them in an attempt to make a bigger profit off a trending stock, essentially shifting the range up in hopes the stock price will continue to increase. One example of this would be our Amylyx transactions this week, where we rebought shares after the price had only dropped by 50 cents. We have been fairly successful in shifting the ranges in small amounts, so the profits we have made have been small, and each shift has come with some risk. Figure 6.5.1 below shows the trend in the price for Amylyx over the past month, and it is easy to see why we keep shifting the range up to try and chase the trend.

Figure 6.5.1 – AMLX Stock Chart October 2022 [69]

A lot of our stocks have seen modest price increases, as evidenced by our buy and hold simulation portfolio, which is up more than 11% overall. The market has been up overall during the month of October, and it is not the same landscape as it was when we set the original ranges five weeks ago. Now seems to be a good time to change, so we are going to reset all of the ranges before the start of week 6.

6.6 Week 6

The value of our portfolio increased $111,157.08 this week, or 0.715%, to $111,157.08. We have made $12,968.46 from the range trades, and the remaining difference can be explained by fluctuations in the shares we still hold. This week, we only made four transactions. We sold General Mills at $81.60 a share for a profit of $675.84. We also bought and sold Eli Lilly in the span of about 24 hours for a $490.56 profit. The complete transaction record can be viewed in Table 6.6.1.

Table 6.6.1 – Range Trading Transactions for Week 6

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/ Loss	Total Cash	Total Profit
10/30/22							$44,167.22	$11,802.06
10/31/22	GIS	SELL	$81.60	176	$14,361.60	$675.84	$58,528.82	$12,477.90
11/01/22	LLY	BUY	$348.41	42	$14,633.22		$43,895.60	
11/02/22	LLY	SELL	$360.09	42	$15,123.78	$490.56	$59,019.38	$12,968.46
11/02/22	ELF	BUY	$41.66	335	$13,956.10		$45,063.28	
Total Assets as of 11/06/22: $111,157.08								

After adjusting our ranges last week, we think we are in a much better position to make bigger profits. AMD seems to be on an upward trend, so hopefully, its price will soon rise above where we bought it, which will allow us to sell it for a profit. We are hoping Apple recovers so we can turn a profit before the end of the simulation as well. Even though Elf was up 11% this week,

it still has not hit our sell price. We are hoping to sell it early next week for a more substantial profit.

6.7 Week 7

This week, we made three trades, and the value of our total assets increased by $4,685.93, or 4.216%, to $115,843.01. This means we are currently sitting at a 15.843% gain overall. Our total cash profit from the trades rose $3,008.81 this week to $15,977.27, and it would have been much higher had we not completely botched our handling of ETSY. We sold it all the way back in week 2 at $109.55 per share for a $1,696.50 profit and then bought it back at the beginning of week 3 at $107.00 per share. Our first mistake was thinking the stock was going to continue trending up. After we bought it, the price dropped down to $87.54 on November 2nd, which is below the $96.50 we bought it at originally. We have been holding the stock for about a month at this point, and our goal was just to make another small profit off it and then stop trading it. Our sell limit was set at $110, but when we saw the price finally surging on Wednesday, we felt like we had to sell it before the day was over in case the price fell the next morning. We tried to drop our sell limit to $109, but there was a problem with it for some reason, and it ended up selling at $108.62 for a measly $211.56 profit. Not only did the price end up hitting $110 that same day, but the next day it rose to $115. This just goes to show that it is impossible to tell when a stock has reached its peak, and this is one of the main drawbacks of range trading. All transactions from the week can be found below in Table 6.7.1.

Table 6.7.1 – Range Trading Transactions for Week 7

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/Loss	Total Cash	Total Profit
11/06/22							$45,063.28	$12,968.46
11/07/22	ELF	SELL	$50.01	335	$16,753.35	$2,797.25	$61,816.63	$15,765.71
11/10/22	ETSY	SELL	$108.62	129	$14,011.98	$211.56	$75,828.61	$15,977.27
11/11/22	LLY	BUY	$348.68	50	$17,434.12		$58,394.49	
Total Assets as of 11/13/22: $115,843.01								

6.8 Week 8

This week, we only made one trade, but the value of our assets still increased by $1,518.64, or 1.311%. After holding AMD for seven weeks, it finally reached a price where we could sell it for a decent profit. We purchased 189 shares for $66.53 each on September 29th and sold them for $75.12 each on November 14th. This amounted to a $1,555.50 profit, which means we made about 13% on the stock. Our total cash profits from the range trades grew to $17,532.77 as a result. This transaction can be viewed below in Table 6.8.1.

Table 6.8.1 – Range Trading Transactions for Week 8

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/ Loss	Total Cash	Total Profit
11/13/22							$58,394.49	$15,977.27
11/14/22	AMD	SELL	$75.12	189	$14,196.74	$1,555.50	$72,591.23	$17,532.77
Total Assets as of 11/20/22: $117,361.65								

Now that there are only two weeks left in the simulation, we are beginning to change the way we trade. For stocks like HES and ELF, which are both up over 38% since the start of the simulation, we no longer know the range in which the stock will trade. If we were not tied to the stocks for the duration of the simulation, we likely would have moved on from those two. Our experiences with AMLX show what can happen when you try to chase a stock outside of the set range. We had made over $2,500 on the stock by week 5, which amounts to about a 20% return

on our investment. Then we got greedy and tried to chase another profit, predicting the stock would continue past its all-time high weeks after its FDA approval news had sent the stock soaring. Over the last few weeks, AMLX has been hovering slightly lower than we bought it, and we just have to wait and hope the price rises enough to make one last small profit or break even since we reinvested the profits from the trades back into the stock.

For the last two weeks, our plan is to try to scrape small profits out of LLY, AAPL, and AMLX. We likely will not make any more purchases unless a stock price drops significantly in the next week and we think it will be able to recover in the last week. We are quite satisfied with the profits we have made over the last eight weeks with these stocks, and we think it is better to play it safe with the 17% we have made than to risk going for bigger profits without enough time to recover. It will be interesting to see where the market goes next week, as it is a short week because of Thanksgiving. Hopefully, Black Friday will provide a boost for Apple, but it probably will not affect our pharmaceutical stocks too much. The short-term benefits of Black Friday will likely be felt more in the other two simulations, where we are holding more consumer discretionary stocks, than in this one.

6.9 Week 9

This week, the value of our portfolio increased by $2,350.09, or 2%, to a value of $119,711.74. We made $2,182.93 in cash profit this week, which increased our cash profits by 12.451%. These profits came from making four trades this week, which was a larger number than expected. These trades can be viewed below in Table 6.9.1.

Table 6.9.1 – Range Trading Transactions for Week 9

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/ Loss	Total Cash	Total Profit
							$72,591.23	$17,532.77
11/21/22	HES	BUY	$137.13	105	$14,398.65		$58,192.58	
11/22/22	HES	SELL	$148.55	105	$15,597.75	$1,199.10	$73,790.33	$18,731.87
11/23/22	AMLX	SELL	$38.04	405	$15,406.20	$157.95	$89,196.53	$18,889.82
11/25/22	LLY	SELL	$365.20	50	$18,260.00	$825.88	$107,456.53	$19,715.70
Total Assets as of 11/27/22: $119,711.74								

We started the week by buying HES, which was not something we had originally planned on doing. The price was a low $137.13 on Monday morning, and we figured we still had two weeks to make a profit at that point, so we decided to buy. It ended up selling the next day at $148.55 per share, netting us an 8.33% profit.

Another surprise this week was that AMLX sold. We were worried that we bought the stock too high back on October 25th. We repurchased it very quickly after we sold it near the all-time high, taking a risk that it would continue its upward trend. It quickly declined and did not show any signs of a surge in the past few weeks, so we were planning to hold it for as long as we could in hopes we would not have to sell at a loss that would eat into the profits we had already made with it. Miraculously, the stock rallied over 10% this week, and we were able to sell it for a small 1.03% gain. The stock did end up going past $39, but we had no way of predicting that ahead of time.

We also were able to sell LLY at the end of the week. The only asset we now hold going into week 10 is AAPL, and we are hoping to make a tiny profit. If the stock does not go above our purchase price, we will sell it at the end of the day on Friday.

6.10 Week 10

The value of our portfolio decreased by $113.16 this week. This is because our only holding was Apple, and we were unable to sell it for a profit. This transaction can be viewed in Table 6.10.1.

Table 6.10.1 – Range Trading Transactions for Week 10

Date	Symbol	Buy/ Sell	Price	Shares	Net Cost/ Proceeds	Profit/ Loss	Total Cash	Total Profit
							$107,456.53	$19,715.70
12/02/22	AAPL	SELL	$146.73	82	$12,031.86	($294.38)	$119,598.58	$19,421.32
Total Assets as of 12/04/22: $119,598.58								

Our only goal for this week was to sell Apple. We wanted to avoid purchasing any more stocks in case there was a sudden drop in the market and the simulation would end before we could make our money back. Apple has not performed well throughout the simulation and has appeared in the news for a variety of different reasons. This week was unfortunately no exception. Supply chain issues continued to trouble the company, and reports that the new iPhone 14 and iPhone 14 Pro were on backorder past Christmas were not good for sales. In addition, Apple got called out publicly by another major company, in a similar fashion to their spat with Spotify a few weeks back. Meta CEO Mark Zuckerberg called out Apple's restrictive app store policies [70]. It does not end there, however, as another powerful CEO, Elon Musk, also called out the company. Musk accused Apple CEO Tim Cook of threatening to pull Twitter from the app store, but the two met and publicly cleared up the misunderstanding [71]. All the bad press was not great for the stock, and it never rose above the price we bought it at. We held it until late Friday afternoon and finally sold it for a $294.38 loss.

6.11 Summary of the Last 10 Weeks

By the end of the range trading simulation, our initial $100,000 had grown to $119,598.58. This means we made $19,598.58, or 19.59%. Our extrapolated annual return as calculated by Investopedia was 161.34%. This simulation required a lot of cognitive effort to determine when to buy and sell. It was also difficult to decide if we should trade some of the stocks once they started trading above the initial ranges. If we were trading in real life, we probably would have moved on to some different stocks after the first few weeks. We also missed out on a lot of potential profits in the last few weeks because we were afraid that if any prices dropped right after we bought the stocks, we would run out of time to gain the money back. Figure 6.11.1 below, provided by Investopedia, shows the return of our simulation (blue line) compared to the S&P 500 (black line).
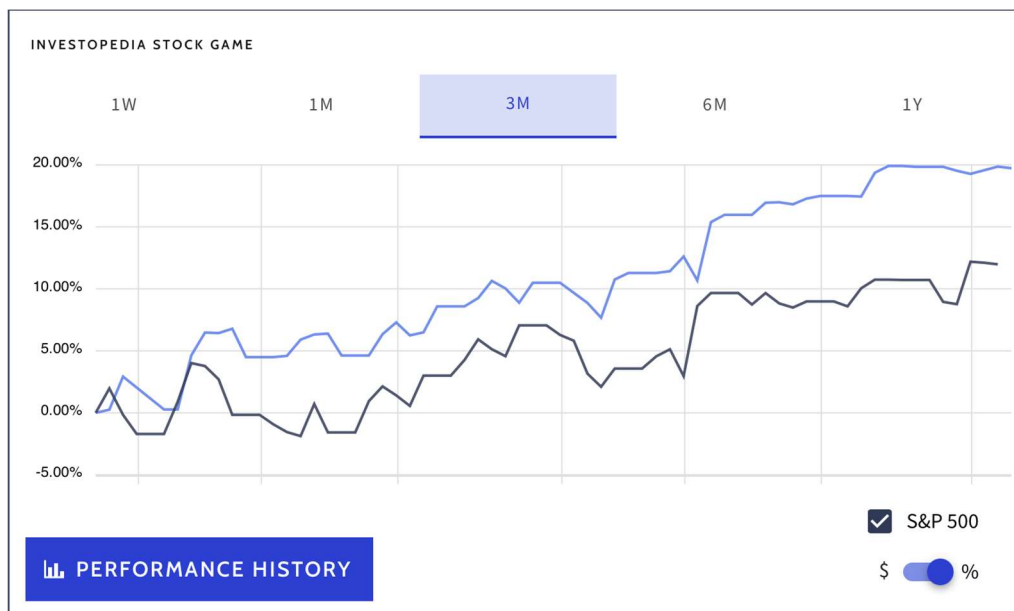

Figure 6.11.1 – Range Trading S&P 500 Returns Comparison

In this simulation, the stock that generated the highest return was Amylyx at 36.01%, while Apple posted the worst return at -2.39%. The average was 15.21%. Etsy's return of 15.21% shows how difficult range trading can be. It was the best performer in the other two simulations with

returns of over 34%, but we were only able to trade it for a 15.21% return. All final stock returns

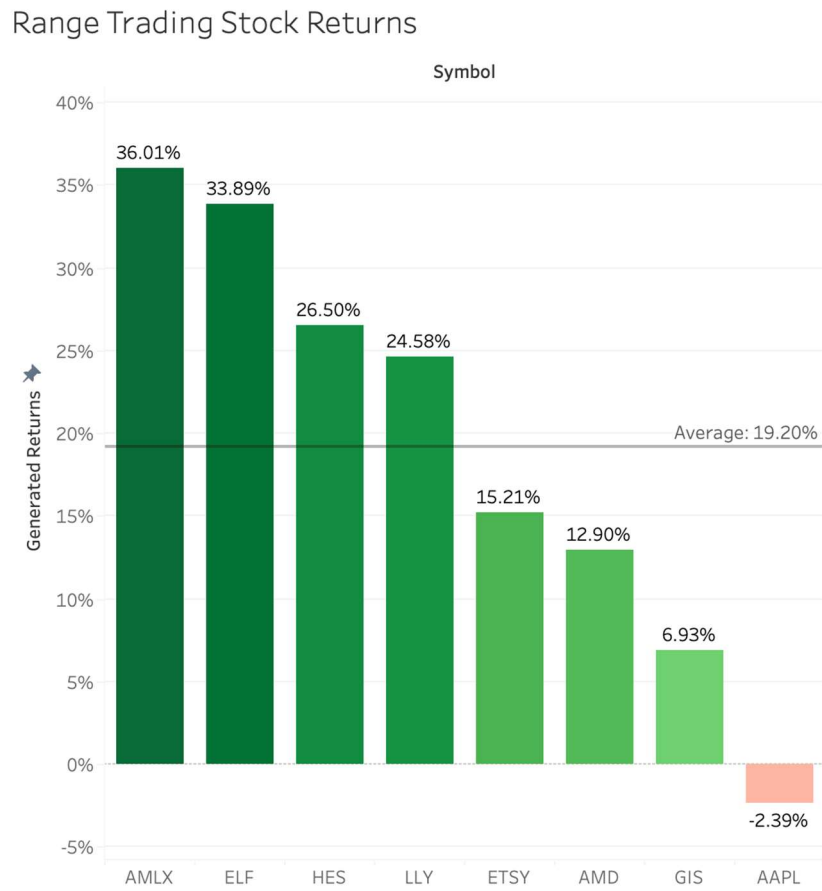for this simulation can be viewed in Figure 6.11.2.

Figure 6.11.2 – Range Trading Stock Returns

Chapter 7: Analysis and Comparison

The main purpose of our experiment was to determine which of our three trading strategies generates the greatest returns. Now that our simulations are complete, we can compare their results to determine which one performed the best. In addition to testing the trading methods, the other overarching goal of this project was to acquire knowledge and skills relating to investing that could be applied to our own future investments. So, when evaluating the results, we will be looking at the risk involved and the effort required for each simulation, in addition to their profits, since those are important factors to consider when evaluating investment strategies for personal use outside of simulations.

7.1 Buy and Hold Analysis

Before starting the buy and hold simulation, our research led us to believe that this was a low-risk strategy. This is because the market has historically gone up over time and recovered from crashes. This method generally has more potential for high returns over long-term investment periods, because investors hold their assets through the best days of the market. Research from Bank of America shows that if an investor missed out on the ten best days in each decade from 1930 to early 2021, that return would be 28%, which pales in comparison to the 17,715% return they would have if the money had been left untouched in the market [72].

Through our simulation, we have learned the buy and hold method can be effective as a short-term trading strategy with the right stocks and good timing. This simulation's return of 26.04% was the greatest of the three simulations. The buy and hold method also produced the four largest stock returns, which were ETSY at 46.24%, ELF at 43.5%, AMLX at 40.11%, and HES at 38.83%. As shown below in Table 7.1.1, these four stocks each made up about 20% of the total profits for the simulation, or 80% together, while the other four stocks only combined for the last

20%. This means that had we not chosen some of those high-earning stocks and instead selected different ones, the results of this simulation could have been very different.

Table 7.1.1 – Buy and Hold Stock Summary

Symbol	Shares	Buy Price	Sell Price	Profit	Return	% of Total Profit
AAPL	83	$149.66	$147.81	($153.55)	-1.24%	-0.59%
AMD	184	$67.87	$74.98	$1,308.24	10.48%	5.04%
AMLX	448	$28.00	$39.23	$5,031.04	40.11%	19.39%
ELF	323	$38.51	$55.26	$5,410.25	43.50%	20.86%
ETSY	129	$96.07	$141.90	$5,730.18	46.24%	22.09%
GIS	157	$78.99	$86.52	$1,182.21	9.53%	4.56%
HES	119	$103.74	$144.02	$4,793.32	38.83%	18.48%
LLY	40	$308.80	$374.76	$2,638.40	21.36%	10.17%

This simulation was much easier and less stressful than the other two, especially compared to the range trading, because it only required us to make one investment up front. The market had good days and bad days in response to news about inflation and the Jobs Reports, among other things, but the bad days did not stress us out too much since we knew there was nothing we could do to help our portfolio. Because of our positive experiences with this simulation, both of us will strongly consider employing this strategy in our future investments.

7.2 Dollar Cost Averaging Analysis

Dollar cost averaging is usually a very low-risk strategy. If you have the money to invest up front like we did in this simulation and choose to employ a dollar cost averaging strategy, you risk benefiting less from strong market days by failing to invest at the start. But on the other hand, you could end up with a higher cost per share by investing at a bad price at the start. This is why dollar cost averaging is seen more commonly with 401k plans, because the employee avoids the decisions of when, how much, and how often to invest. This automatic investment would have removed most of the stress from our simulation. The most stressful part was remembering to set

up the Monday morning purchases over the weekend since Investopedia did not have a way to set up weekly transactions.

The dollar cost averaging method has the potential for higher earnings than the buy and hold method if the average cost per share gets lowered. Table 7.2.1 below highlights which simulation had the lower average cost per share for each stock.

Table 7.2.1 – Average Price Per Share Comparison

Symbol	Buy and Hold	Dollar Cost Averaging
AAPL	$149.66	**$145.49**
AMD	$67.87	**$64.58**
AMLX	**$28.00**	$33.86
ELF	**$38.51**	$44.26
ETSY	**$96.07**	$104.62
GIS	$78.99	**$78.93**
HES	**$103.74**	$127.93
LLY	**$308.80**	$342.66

Dollar cost averaging was successful in lowering our average price per share of Apple, AMD, and General Mills. Our average cost per share of AAPL stock was $145.49 in this simulation compared to $149.66 in the buy and hold, which made this the only simulation in which Apple contributed positively towards our total profit. This increased our return from -1.24% in the buy and hold to 1.6% in this simulation. Our average cost per share of AMD also dropped from $67.87 to $64.58, so the return of 16.11% in this simulation beat the 10.48% in the buy and hold simulation. For General Mills, the difference between share prices and returns was much smaller. The average costs per share were $78.99 and $78.93, while the returns were 9.53% and 9.61%. While we were successful in lowering our average cost per share for three stocks, we missed out on potential profits with the other five. Table 7.2.2 below shows the differences in profit between the simulations, which are labeled as BAH (buy and hold) and DCA (dollar cost averaging).

Table 7.2.2 – Profit Comparisons

Symbol	BAH Profit	DCA Profit	Difference in Profit (DCA – BAH)
AAPL	($153.55)	$194.98	$348.53
AMD	$1,308.24	$1,997.16	$688.92
AMLX	$5,031.04	$1,959.51	($3,071.53)
ELF	$5,410.25	$3,092.38	($2,317.87)
ETSY	$5,730.18	$4,233.28	($1,496.90)
GIS	$1,182.21	$1,191.27	$9.06
HES	$4,793.32	$1,274.21	($3,519.11)
LLY	$2,638.40	$1,219.94	($1,418.46)

If we add these differences in profit together, we can see that the three stocks with a lower average cost per share made $1,046.51 more in this simulation than in the buy and hold simulation. However, the five stocks that had lower average costs per share in the buy and hold simulation made $11,823.87 less while implementing dollar cost averaging. This large difference in profits was partially due to the unexpectedly strong performances of Elf Beauty, Etsy, and Amylyx. Each of these three stocks saw gains of over 40% across the ten weeks, and Hess was close behind at around 38%. It is unusual to see strong results like these that account for half of a portfolio, so dollar cost averaging should not be discounted as a viable method because of these results. We were still able to make $15,191.05 and garner a 15.19% return in a short ten-week period. Our ability to successfully lower our average cost per share for three stocks shows that dollar cost averaging is a viable investment strategy, and it is one that both of us will likely implement in our own future investments.

7.3 Range Trading Analysis

Range trading is usually considered the riskiest of the three strategies we experimented with. It is very difficult to time the market, as it is impossible to know when a stock has hit its peak

and if it will continue to trade in the same range. If the method is executed in an impossibly perfect way, an investor would only purchase stocks whose prices are going up and would therefore miss out on all the dips in the market. This means the method has the potential for very high rewards, but it can be difficult to obtain them. Range trading requires a lot of time and effort to frequently monitor the performance of the stock and adjust the range as necessary. We found this to be true in our simulation. We never had strong evidence to suggest which way the stock price was going to go the next day, so it was very difficult to time our transactions. There were times when we bought back too soon after selling, and there were also times when we were too hesitant to buy, especially in the later weeks. One prominent example of this was our failure to buy back Etsy.

We bought Etsy for the second time in week 3 at $107 a share after selling it the previous week for $109.55 a share. When we did not see the growth we were expecting after holding it for a few weeks, we decided to lower the sell price and sell it at $108.62 in week 7. Because we sold it for such a small profit, we were afraid to buy it back even when it started showing signs of bigger growth. By the end of week 10, the price had shot up to $141.90 and we had missed out on a huge profit. Etsy was our best-performing stock in the other two simulations, but just an average-performing stock in this one. Table 7.3.1 shows the profit we made off Etsy in each simulation. We made over three times as much money using the buy and hold method and over twice as much using dollar cost averaging.

Figure 7.3.1 – ETSY Profits by Trading Strategy

Even with our mishandling of Etsy, we still managed to make $19,598.58, or 19.59%, using this method. Through our experience with this simulation, we have learned that range trading is not for the faint of heart. It requires investors to spend large amounts of time and effort to play a difficult guessing game. Neither of us have plans to use this strategy for our investments in the near future, mainly because we do not have the time, but we have learned that it can be a very profitable method.

7.4 Comparison

The original goals of our experiment were to compare the results of these three simulations to find a profitable method of trading that we could use for personal investments in the future. Therefore, each simulation was a success because all three were profitable and taught us more about investing.

We can definitively conclude that the buy and hold method was the most successful of the three, however. Not only was it the most profitable, but it was a low-risk strategy and required the least amount of effort when compared to the others. For these reasons, it is the method that both of us are most excited about trying out with some real investments.

The buy and hold simulation made a profit of $26,043.96, which was 71.44% more than the $15,191.05 made in the dollar cost averaging simulation and 32.89% more than the $19,598.58 made with range trading. This simulation additionally led in other statistics relating to returns, such as the median stock return. A more in-depth view of these statistics can be found in Table 7.4.1.

Table 7.4.1 – Return Comparisons

Method	Profit	Return	Average Return	Median Return	Extrapolated Annual Return
Buy and Hold	$26,043.96	26.04%	26.10%	30.10%	246.39%
Dollar Cost Averaging	$15,191.05	15.19%	15.23%	13.00%	84.88%
Range Trading	$19,598.58	19.59%	19.20%	19.90%	161.34%

From our experiment, we learned that stock choice is very important, and what makes a good stock in one simulation does not necessarily transfer to another. One example of this that we discussed previously was Etsy in section 7.3. Etsy was a great stock to buy and hold because its price increased by over 40% by the end of the simulation. It was not a great stock to range trade, however, since the price soared above the top end of the range about halfway through and never came back down. Figure 7.4.1 shows how the price of Etsy moved throughout the simulation.

Figure 7.4.1 – ETSY Stock Chart [73]

In contrast to Etsy, there were stocks such as Apple, AMD, and General Mills that performed very similarly in all three simulations. Figure 7.4.2 is an image of a heat map that compares the returns of all eight stocks across the three simulations.

Symbol	BH Return	DCA Return	RT Return
AAPL	-1.24%	1.60%	-2.39%
AMD	10.48%	16.11%	12.90%
AMLX	40.11%	15.85%	36.01%
ELF	43.50%	24.87%	33.89%
ETSY	46.24%	34.29%	15.21%
GIS	9.53%	9.61%	6.93%
HES	38.83%	10.15%	26.50%
LLY	21.36%	9.37%	24.58%

Figure 7.4.2 – Heat Map of Stock Returns

When we analyze the results of our simulations, it is clear that both the time constraint of ten weeks and the specific ten weeks we picked had big impacts on the results. The predetermined window affected how we handled our range trades in the later weeks, which affected the results of that simulation. We made significantly fewer trades after week 7, and this was because we were afraid of buying a stock and watching the price drop without enough time left in the simulation for

it to recover and net us a profit. Figure 7.4.3 shows the profit from each simulation broken down by week. The red diamond marks the point at the end of week 7 where the profits from the range trading simulation were approximately equal to those of the buy and hold. This shows that range trading can be just as profitable as the buy and hold method over short periods.
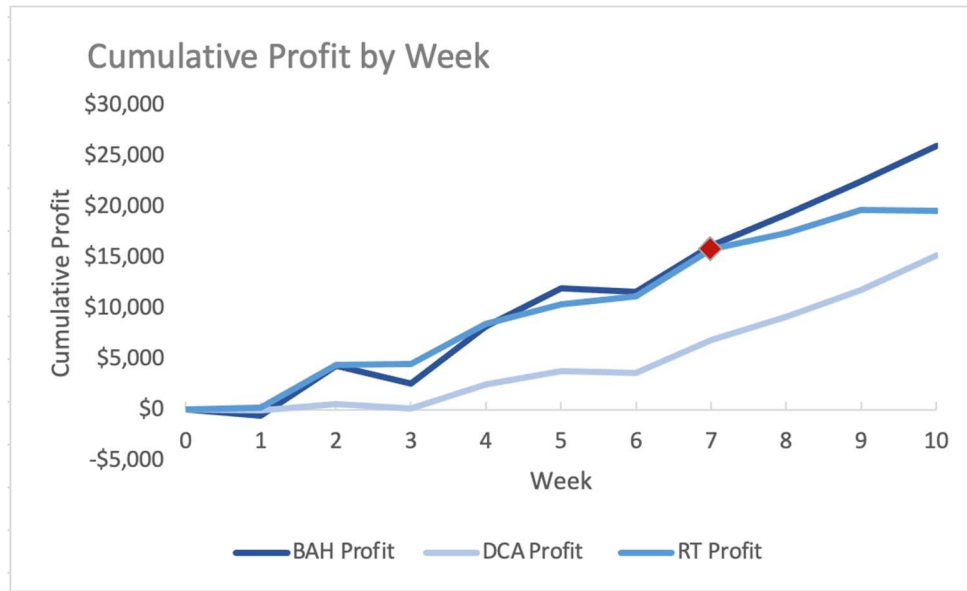

Figure 7.4.3 – Profit by Week Breakdown

We also happened to select a great ten weeks to perform the simulation. Right after we ended the simulation, the market started to decline. Figure 7.4.4 shows what the value of our buy and hold portfolio would be from October 14th to January 11th. The peak in value occurs on December 2nd, which coincidentally happened to coincide with the last day of our simulation.

Figure 7.4.4 – Extended Buy and Hold Portfolio Values

We chose a good time to invest in our simulations, but the state of the market can have a huge impact on the results of experiments like these. For this reason, the results of our experiment are not conclusive for determining the overall effectiveness of these three methods in all trading environments.

Chapter 8: Conclusion

Our main goal of this experiment was to make money, so the simulation that best accomplished that was the buy and hold simulation. Our other goals were to mitigate risk and keep stress and effort levels to a minimum, and the buy and hold simulation seemed to accomplish those goals best as well. However, all three simulations were successful, and there is no guarantee that had we performed the simulation over a different ten weeks or with a different eight stocks the buy and hold simulation would have been the definitive winner. We have learned that there is no single best strategy when investing. Making money is the universal goal, but there are a lot of other factors to keep in mind when choosing an investment strategy, such as the preferred type of investment, risk tolerance, and willingness to invest time and effort. So, while buy and hold may have been the strategy that worked best for us under the market conditions of our simulations, there is no guarantee that these results will still hold under different conditions. What is important is to choose an investment strategy that has the most potential to help you achieve your individual investment goals.

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