Introduction:
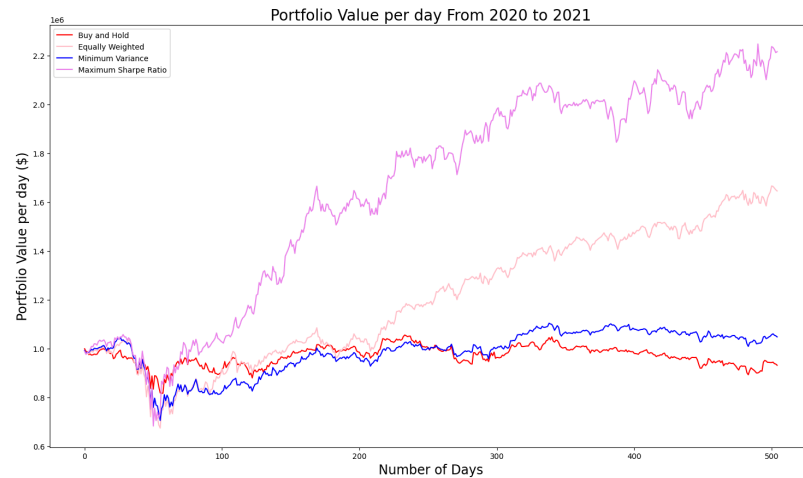The objective of this report is to compare the performance of the following four investment strategies: 1.Buy and hold 2. Equally Weighted 3. Minimum Variance 4. Maximum Sharpe's Ratio

**Overall portfolio value by four investment strategies**

After producing the output of the 12 periods from 2020 and 2021, a plot is concluded to illustrate the daily value of the portfolio for each strategy. The minimum variance and buy and hold strategies seem to operate consistently with little to no swings. Among the strategies illustrated, the Buy and Hold strategy has the lowest finishing portfolio value; this shows that the approach's record suggests stable growth with less active management. The strategy is also frequently used as a benchmark for other strategies. The minimum variance approach is characterized by less volatility and more steady growth, which aligns with its objective of reducing portfolio variation. Higher returns may be possible with an equally weighted portfolio, which maintains an equal weight distribution among its assets and periodically rebalances to keep it that way. The Maximum Sharpe Ratio strategy is projected to have more volatility because of its risk-adjusted return maximization methodology, as evidenced by its more noticeable fluctuations. After market downturns, all methods appear to bounce back, though the growth rate and volatility vary. While the Buy and Hold strategy is the most conservative with the least growth, the Maximum Sharpe Ratio rebounds more strongly, indicating that this strategy may be capitalizing on market swings more successfully.

Performance of two representative strategies
In conclusion, two strategies' performance are representative of which they are more stable and gain a higher profit which are minimum variance portfolio strategy and maximum Sharpe Ratio strategy and to check if one is better than the other. The goal of the Minimum Variance Portfolio Strategy is to reduce portfolio risk for a specific level of projected return. This approach is generally more cautious, preferring investments with lower volatility and thereby lowering the risk of significant losses. The Maximum Sharpe Ratio Portfolio Strategy looks to produce the

best return for a given level of volatility, or conversely, the least volatility for a given level of predicted return. Its goal is to maximize return per unit of risk taken.
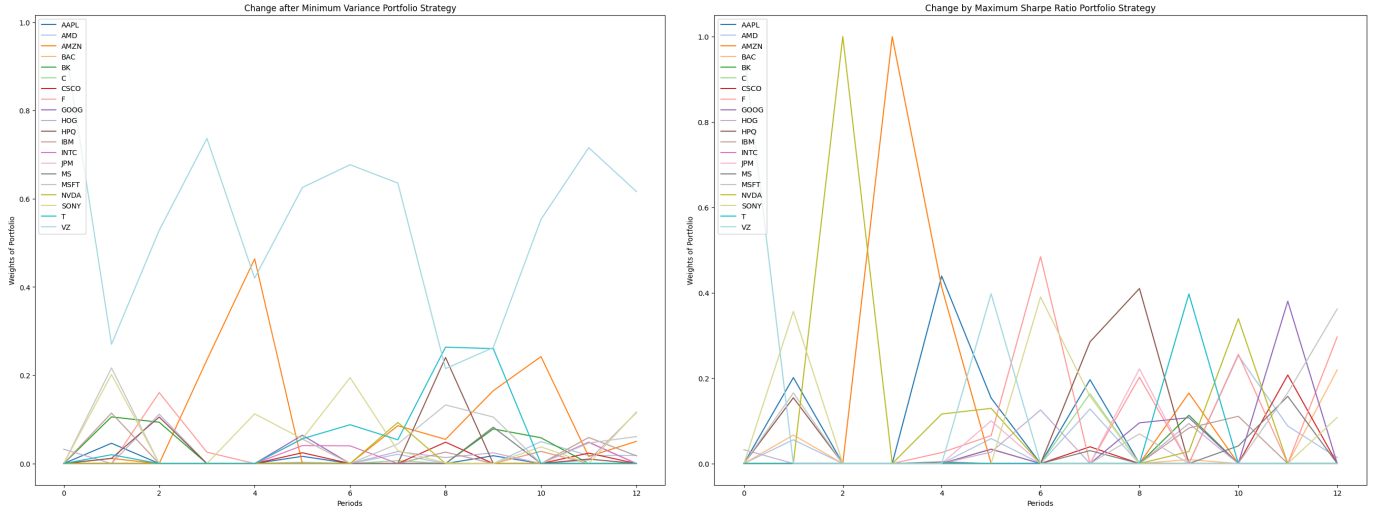
Minimum Variance Portfolio Strategy : $min_w\ w^T Q w$,where w is the weight of each asset

$$s.t. \sum_{i=1}^{n} w_i = 1, w_i \geq 0$$ Q is the covariance matrix of asset

return. All weights of each asset sum to 1.

Maximum Sharpe Ratio Portfolio Strategy: $max_w\ \dfrac{\mu^T w - r_f}{\sqrt{w^T Q w}}$

$$S.t. \sum_{i=1}^{n} w_i = 1, l \leq AW \leq u\ \ ,$$

where $\mu^T w$ is the portfolio return. r_f is risk free rate(2.5%). $\sqrt{w^T Q w}$ is the portfolio risk which w is the weight of each asset.

Commenting on the minimum variance portfolio strategy in figure 3, the weights of the assets vary significantly throughout different time periods. Since there are several assets in the portfolio with significant weights at any given time, it appears that diversification is maintained in the portfolio for the most part. Different assets (such the one shown by the blue line at period 10) gain dominance in the portfolio at different times. This can be a reaction to certain market circumstances in which the asset is thought to have a lower relative risk. This shows that when volatility or asset correlations vary, the Minimum Variance approach is actively adjusting weights by a considerable amount. Period-to-period weight adjustments suggest that the approach rebalances the portfolio somewhat frequently. This might indicate increased transaction costs, which would have to be taken into account when assessing the strategy's net performance. Over the eras, a few assets have consistently had low weights. This could imply that certain assets are less preferred in a Minimum Variance strategy due to their higher volatility or lower

predicted returns. All things considered, the weight distribution reflects shifting market situations where the assets' risk-return profile changes.

Commenting on the maximum Sharpe Ratio strategy in figure 4, the weight of each asset varies significantly from one period to the next, making the strategy extremely dynamic. This implies a proactive management approach that regularly modifies roles in order to maximize the Sharpe Ratio. Occasionally, the strategy is overly focused on a particular asset (such as the increases in AMD and AMZN). Even though some assets occasionally account for a sizable amount of the portfolio, this is probably a reasonable risk based on the anticipated Sharpe Ratio. The diversification of the technique appears to change throughout time.The strategy appears to be highly responsive to market conditions, as evidenced by the notable shifts in asset weights, which could be an attempt to take advantage of the assets' shifting risk-reward profiles. The assets with the biggest peaks in this strategy may be those that have seen a stretch of exceptionally high returns or low risk, temporarily elevating their appeal. Such abrupt changes in weight carry the risk of overfitting to historical data. If the technique is based on previous data, there could be a risk that it won't work as effectively during out-of-sample times.

By comparing the two chosen strategies, it appears that the Maximum Sharpe Ratio approach causes some assets to be given more extreme weights at different times and exhibits more noticeable spikes. This suggests a more aggressive approach that alters the allocation in a big way to optimize return on risk. Minimum Variance strategy seems to have a slightly smoother transition between periods. This implies that over time, the Minimum Variance method is more stable. Over time, the Minimum Variance method appears to sustain a more diversified portfolio across various assets. The weight changes in maximum sharpe ratio decreasing diversity during those periods and perhaps signaling increased risk in the event that those specific assets underperform. The Maximum Sharpe Ratio approach may result in greater transaction costs, which could have an impact on net returns, if there is a correlation between increased weight variability and higher portfolio turnover. The Minimum Variance strategy may offer superior protection against downside risk in a down market or a market with significant levels of uncertainty, but the aggressive stance of the Maximum Sharpe Ratio may be more advantageous in these situations.

New Strategies(Buy and hold equally weighted strategy)
Now, we want to test for different variations of our new strategies which are combining buy and hold and equal weighted strategies. After we've got the Amount of Asset in each stock with Equal Weight and Hold Strategy and output the portfolio values in 12 periods, we plot a line chart comparing the new five strategies. Comment on the new strategy, this approach performs better in the end than the typical buy and hold strategy, indicating that equal weighting in a buy and hold setting may produce superior outcomes than a non-weighted buy and hold strategy. The Buy and Hold Equally Weighted Portfolio continues to perform better than the active strategies (Minimum Variance and Maximum Sharpe Ratio), notwithstanding the improvement. In

conclusion, the second plot's inclusion of the Buy and Hold Equally Weighted Portfolio demonstrates that it can be superior to the straightforward Buy and Hold approach. Still, carefully controlled strategies—that is, the Maximum Sharpe Ratio in particular—produce superior outcomes.This may imply that while simple rules such as equal weighting can improve passive strategies, active portfolio management based on risk-return optimization measurements (such as Sharpe Ratio) may be able to provide superior performance in terms of portfolio value increase over an extended period of time.

Portfolio Value per day From 2020 to 2021
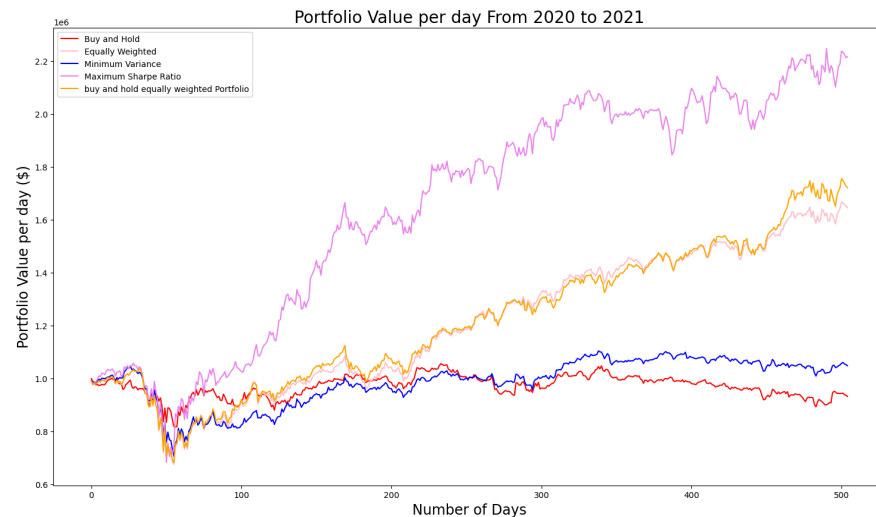
Suggestions of improvements

Among all five strategies, there still exists some weakness. Here are some suggestions of improvements of the trading strategies. They are management of transaction fees, risk-adjusted returns and leverage and shorting. Consider Management of Transaction fees which Buying and selling frequently is a feature of active methods, which can lead to high transaction costs. Should these expenses be substantial, they may counteract the benefits of proactive management. Think about putting in place a rebalancing threshold, whereby the portfolio is only adjusted when the weights stray from the goal by a specific percentage. Consider Risk-Adjusted Returns which although the Maximum Sharpe Ratio approach yields the highest final value, it is important to take into account the risk incurred in order to attain these returns. A more impartial assessment of performance might be obtained by including additional risk-adjusted performance measures, such as the Sortino Ratio, which concentrates on downside volatility. Consider leverage and Shorting which examines how leverage can be used to boost returns in risk-adjusted strategies that regularly outperform. Likewise, think about using shorting as a tactic to protect long positions or profit from falling asset prices.