Portfolio Investment Report  
FINANCIAL INFORMATION SYSTEMS

short line

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# **Acknowledgements**

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We would like to additionally mention Akhil Gupta’s efforts for creating a GitHub repo where we could all pool our R scripts and work in a timely manner. This would be followed by accepting the tremendous work that Trisha Chandra and Asmita Kumar put by taking the time to go over many different companies and comparing their performances, as well as pushing their scripts into GitHub. They also contributed in analyzing some of the difficult risk measures needed to consolidate their choices.

The project would not have been possible without Kunal Sharma, whose constant involvement and leadership helped us propel through difficult parts of the project and brainstorming sessions. Last but not the least, we would like to thank Siddharth Dixit for taking the initiative to write down project notes, taking part in project bottleneck solutions and templatizing project submissions.

Of course, to validate several of the solutions we were able to calculate, it was helpful to make use of Yahoo Finance, Fama/French data and the R programming language.

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**Executive Summary**

This project reflects our assigned role as investment analysts or portfolio managers. We were allotted a total of $50,000 and tasked with creating an appropriate portfolio for a moderate risk taker such that we would invest in at least one stock, the S&P 500 stock market index, bonds and options for the short period of 3 months starting January 2018 to March 2018.

Our objective was to preserve our capital and minimize risks as much as possible for a moderate risk taker in the market. Thus, we learnt to select securities to invest in for the portfolio on the basis of their beta - the risk measure and understood the concept and importance of portfolio beta to fulfill investment objective.

We analyzed Factor Models like the Capital Asset Pricing Model (CAPM) and the Fama-French three factor for a variety of stocks from the S&P 500 index. We calculated Beta which is a measure of volatility (systematic risk) in comparison to the market as a whole and performed various technical analysis methodologies. We used bollinger bands to compare volatility of various stocks. We chose companies with moderate to low volatility. We then analyzed capital gains to see the returns of our stocks over 5 years. Based on capital gains, we assigned assets to portfolio and options.

Our team decided to invest $40,000 in a balanced portfolio which included some of the best performing stocks along with stable Government Bonds. We have also included the S&P 500 market index in our portfolio to further lower the risk and volatility of the portfolio. Our portfolio comprises of Visa which have been performing really well at the stock market and as an American multinational financial services corporation, it has a positive Beta. We have carefully picked UnitedHealth Group which is performing really well and has been rated highly by investors.

We analyzed our stock portfolio using Factor Models like the Capital Asset Pricing Model (CAPM) and the Fama-French three factor model to help explain any variation in a security’s return in our portfolio. We also analyzed - CAPM Alpha which could be considered as the contribution of the fund manager to the performance of the fund. Further, we computed the Portfolio Standard Deviation, Historical Value at Risk and Historical Expected Shortfall. On comparing stocks v/s bonds, we realized that stocks would give us high returns with moderate risk and bonds would give us moderate returns on low risk. Further Government Treasury bonds would have less risk than Corporate bonds. Hence, we decided to invest $5,000 in Long Term US Treasury Bonds. We invested $5,000 in P&G’s options and calculated covered call to give us the highest return rate.

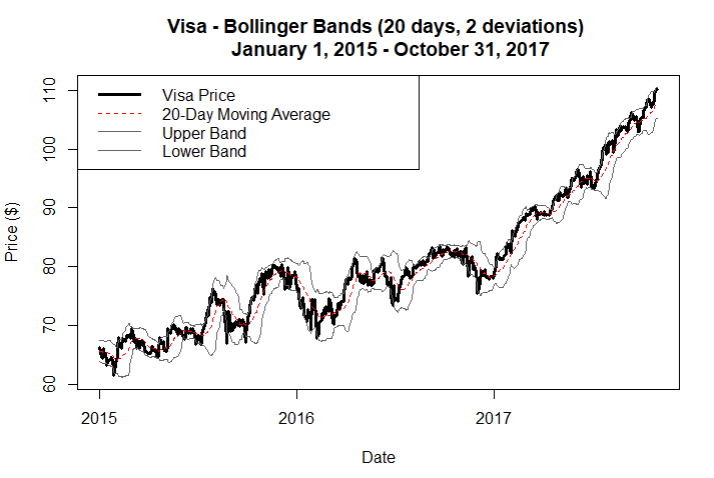
In the conclusion, we summarized everything that we learned during the duration of the project, in particular portfolio formation and diversification, appropriate choice of securities for investment objective, CAPM, Fama -French, options and simulation models.

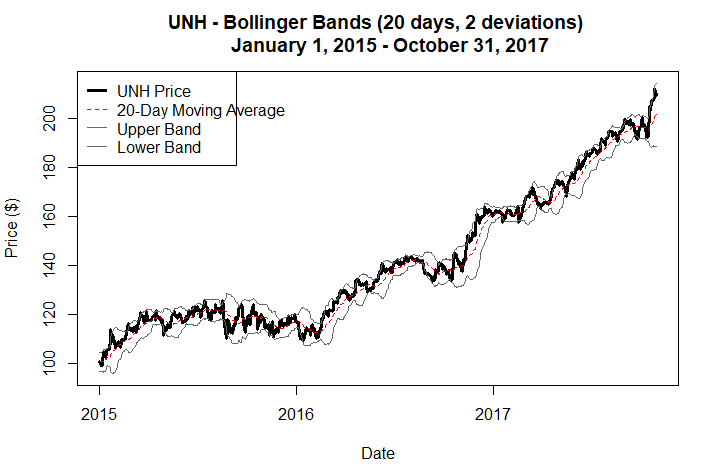
**Technical analysis**

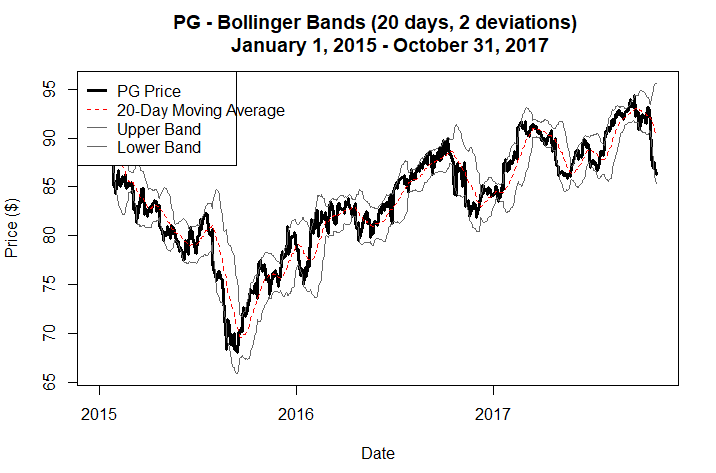
We used various technical analysis methodologies to analyze various stocks and decide which stocks to invest in. These methodologies are described below

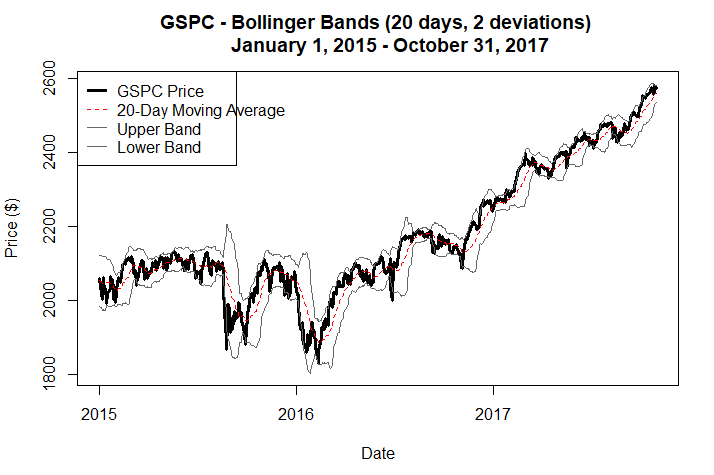
**Bollinger bands:**

There are various technical analysis measures that could have been used to analyze which stocks to invest in. Our investor is moderate risk taker. We mainly used Bollinger Bands to determine risks associated with stocks. We chose 20 companies based on our market research whose stock prices are increasing and which are expected to give high returns. We used Bollinger bands to determine the volatility of stocks. We chose 4 stocks which had moderate volatility. We chose those stocks whose bands neither widened nor narrowed too much showing moderate volatility or moderate risk. Bollinger bands for these companies are shown in Fig. Based on Volatility analysis, we chose VISA, United Healthcare and PG as stocks to invest in.



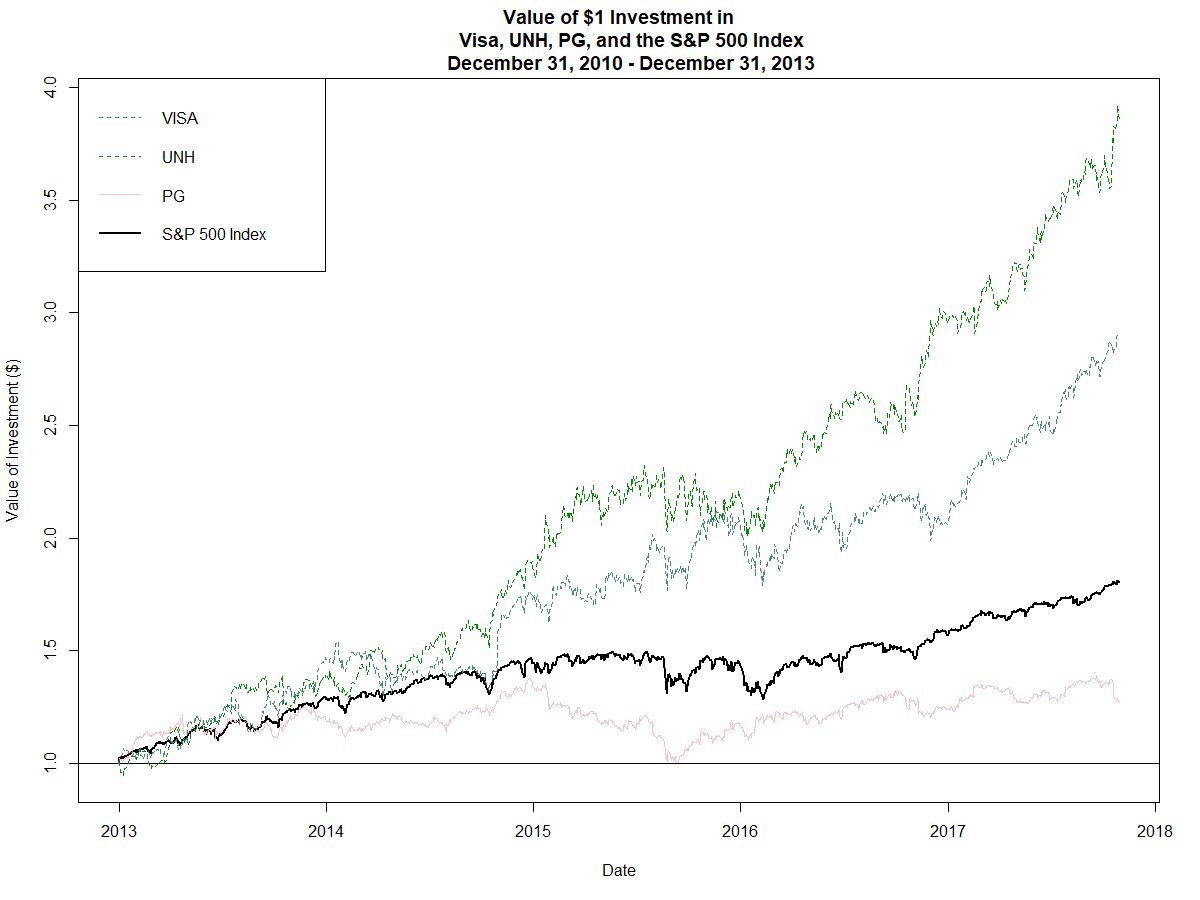






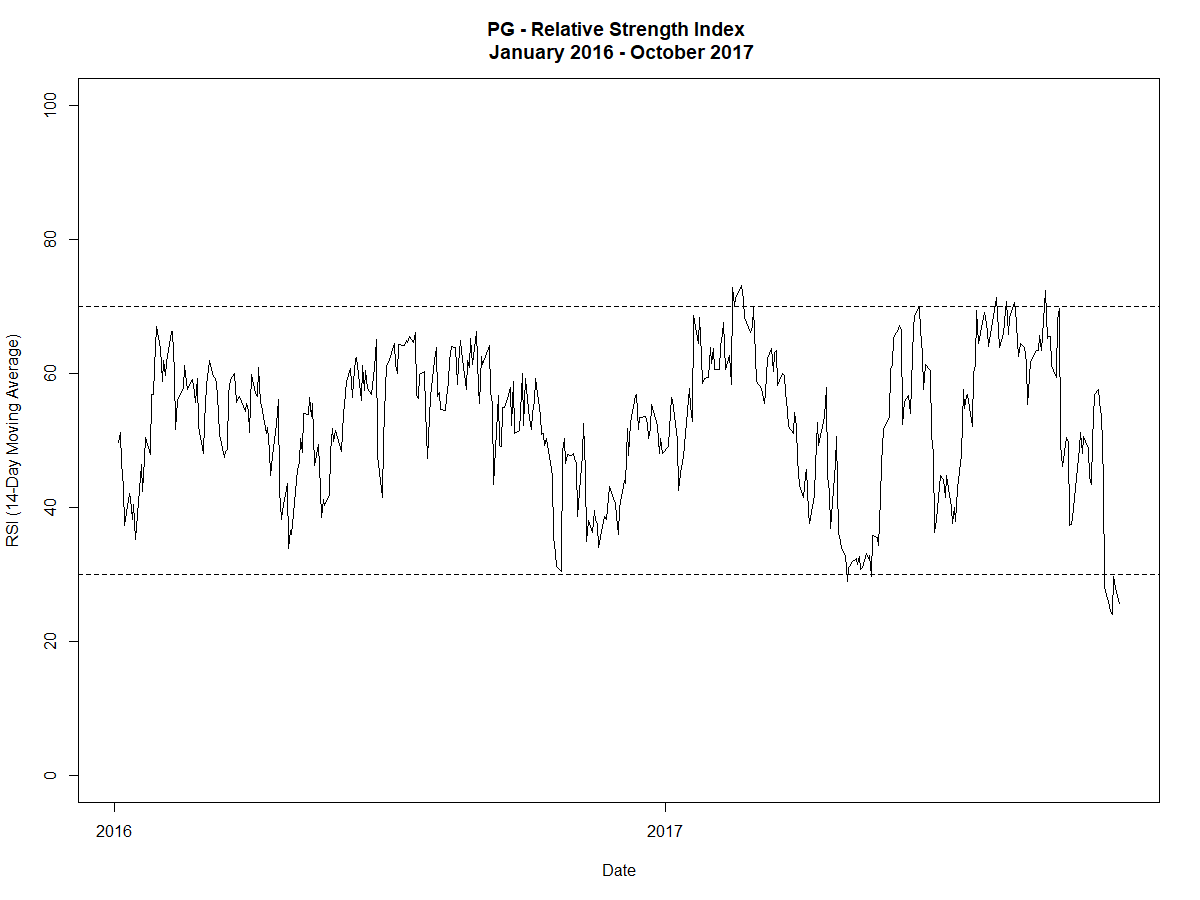
**Capital Gains**

We compared 5-year stocks of VISA, United Healthcare and PG against S&P 500 index to see how they performed in the market. Visa and United healthcare outperformed market index and had very high returns. While PG did not perform too well in the market and had low returns. Capital gains are shown in the figure below.

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**Relative Strength Index(RSI) of PG**

We used RSI to analyze PG stocks. Fig. shows that PG stocks were oversold recently. Its stocks are expected to bounce back soon. This makes PG stocks a good choice for call options investment.



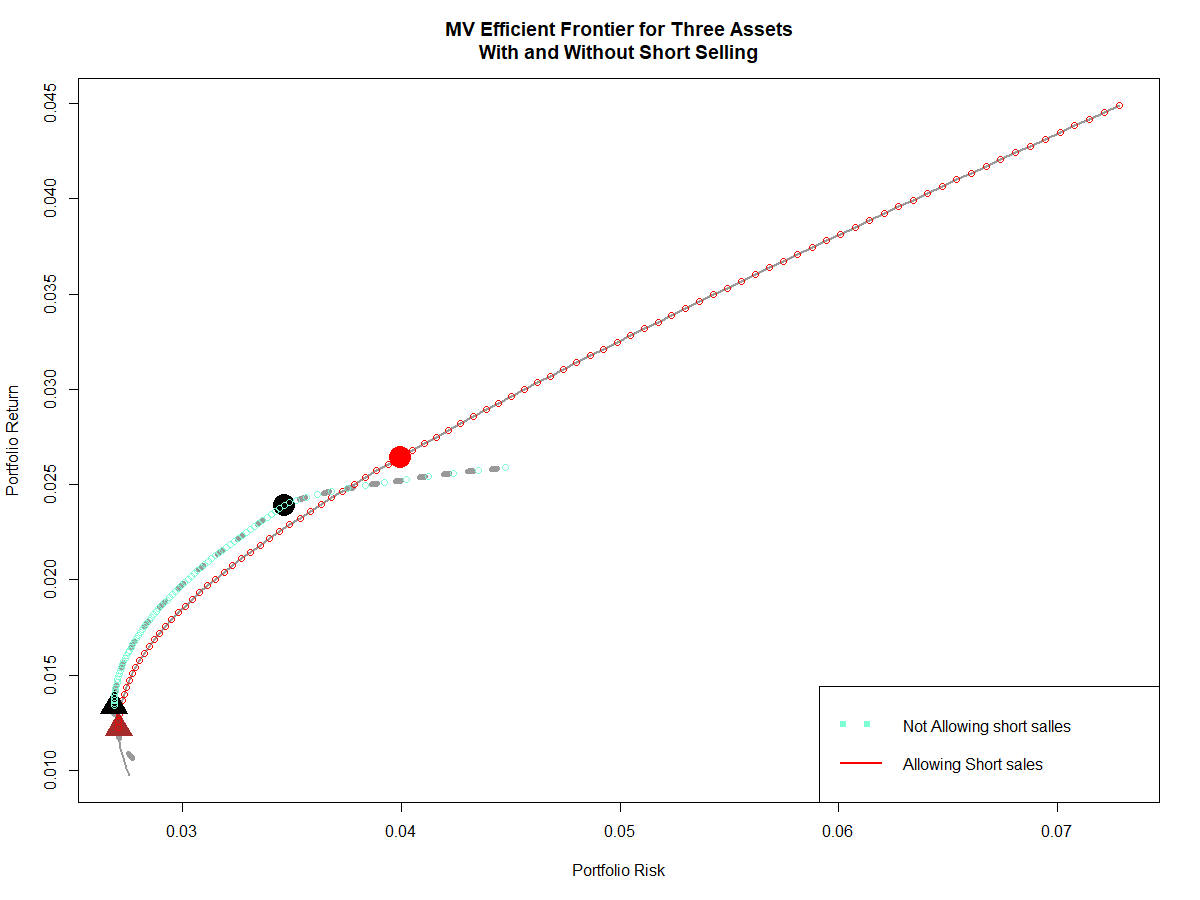
**Selection of stocks and investment**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Stock** | **Visa** | **United Health Group** | **Procter and Gamble** | **S&P 500** |
| **Beta Index** | **1.05** | **0.54** | **0.48** | **1** |
| **Standard Deviation** | **± 1.27** | **± 1.26** | **± 0.88** | **± 0.75** |
| **Variance** | **1.628** | **1.59** | **0.78** | **0.56** |
| **Volatility** | **Moderate** | **Moderate** | **Moderate** | **Low** |

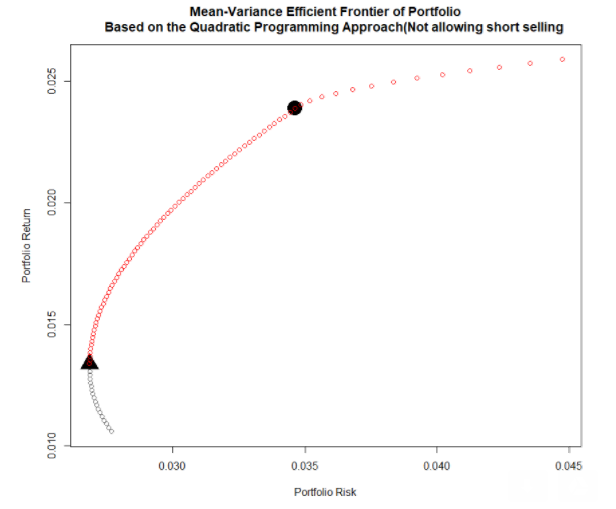
We have decided to make a portfolio of VISA stocks, United healthcare stocks and S&P 500 exchange traded funds or iShares. We expect our portfolio to give higher returns compared to bonds and options. So we are going to invest $ 40,000 in our portfolio, $ 5000 in PG options and $ 5000 in bonds.

**Risk-return trade-off for portfolio**

Since our investor is moderate risk taker, we need to find a point that has moderate risks and has high return associated with it. Choosing such point will give best result for our portfolio without taking much risk. We can obtain such point using Mean Variance efficient frontier. Efficient frontier gives a plot of returns versus risk. We analyzed our portfolio using MV EF with and without short selling. Short selling is borrowing of stocks that a borrower doesn’t own and selling it immediately, hoping to buy it later at a lower price. Borrower earns profit difference between two prices. Short-selling increases returns but has high risk. Difference between returns for portfolio with and without short-selling are shown in the below figure.



MV efficient frontier without short-selling is shown in the figure. We choose a point with high return but relatively low risk. This point is obtained at tangency portfolio shown with a black circle. Tangency portfolio has highest Sharpe ratio. Risk-adjusted performance of the portfolio is the highest at this point.



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confidence](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAeAB4AAD/4RDcRXhpZgAATU0AKgAAAAgABAE7AAIAAAAGAAAISodpAAQAAAABAAAIUJydAAEAAAAMAAAQyOocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEt1bmFsAAAFkAMAAgAAABQAABCekAQAAgAAABQAABCykpEAAgAAAAM5NgAAkpIAAgAAAAM5NgAA6hwABwAACAwAAAiSAAAAABzqAAAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Tangency Portfolio is highlighted in table above. It has the highest Sharpe ratio of 0.6878. This point gives weights for company with highest return for moderate risk. The weight for Visa is 41.22%, UNH is 58.39% and PG is 0.378%. Expected return at this point is 2.388 %.

**FACTOR MODELS**

**SYSTEMATIC RISK AND NON-SYSTEMATIC RISK**

Risk of an asset has mainly two components: systematic risk and nonsystematic risk. Systematic risk is also known as the market risk. It basically represents the uncertainty that’s inherent in the entire market. This systematic risk is represented as Beta in mathematical terms. This beta is undiversifiable risk and hence can’t be diversified away, hence it is the level of risk that investors are compensated from taking on, while the non-systematic risk is the specific risk that is associated to a particular company or industry and it is diversifiable. If beta is greater than 1 is considered aggressive risk, beta of 1 is average risk and a beta of less than 1 is considered not aggressive risk.

**CAPITAL ASSET PRICING MODEL**

CAPM is static (one period) model. The primary prediction is that a market portfolio of invested wealth is mean-variance efficient resulting in a linear cross sectional relationship between mean excess returns and exposures to the market factor (Fama and French, 1992). Capital asset pricing model describes the relationship between systematic risk or Beta and the expected return for the portfolio of assets that we have considered. The factor models help us assess the systematic risk. The first market model that we have used in our explanation is the CAPM or Capital Asset Pricing Model. It is a single factor model.

CAPM takes the form of the following formula:

rf + Ba \* (rm – rf)

rf = A + Ba \* (rm – rf)

Where

is the expected return

rf is the risk-free return

Ba is the beta of our portfolio = Cov(r ̅, r ̅m)/Var(r ̅m)

A is the alpha value of our portfolio

rm is the expected market return

To determine the Beta value, we run regression of excess portfolio return against excess market return.

**CAPM BETA**

Beta which is the systematic risk is also known as the sensitivity i.e. it determines how sensitive our portfolio’s return is to changes in the market. The results above show that the beta value is 0.76. As the market increases by 1% our portfolio will go up by 0.76% but at the same a 1% decline in the market will lead to a 0.76% decline in our portfolio. Hence, results of CAPM is consistent with our analysis given the consideration of investment for a moderate risk taker. A beta of less than 1 is less affected by adverse market movements, a risk that a moderate risk taker would be willing to take.

**CAPM ALPHA**

Intercept here is the alpha value. Alpha determines the contribution of fund manager to the performance of the portfolio built. The alpha value of 0.0155 means a monthly return of 1.55% beyond what’s expected from its sensitivity to the benchmark. The alpha here statistically significant at 5%.

**ADJUSTED BETA**

Adjusted beta is calculated as

Adjusted Beta = 2/3 \* beta + 1/3 \* market beta of 1

Certain studies show that beta above the market beta of 1 tend to go down in the long run while betas below 1 tend to go up in the long term. To adjust betas to show this reversion to market beta we calculate adjusted which is done by applying a weight of 2/3 to the actual and weight of 1/3 to market beta of 1.

This calculation gives us a beta of 0.845.

**MULTI-FACTOR MODELS**

In a multi-factor model various factors are employed to explain market behavior against the portfolio (assets). It compares two or more factors to analyze the relationship between variables and resulting performance. These models are used to construct portfolios that consider certain characteristics like risk, or to track indexes.

**FAMA AND FRENCH THREE FACTOR MODEL**

The Fama and French Three Factor Model is a multi factor asset pricing model that expands on the [capital asset pricing model (CAPM)](https://www.investopedia.com/terms/c/capm.asp) by adding size and value factors to the [market risk](https://www.investopedia.com/terms/m/marketrisk.asp) factor in CAPM. This model considers the fact that value and [small-cap](https://www.investopedia.com/terms/s/small-cap.asp) stocks outperform markets on a regular basis. By including these two additional factors, the model adjusts for the outperformance tendency, which is thought to make it a better tool for evaluating manager performance.

The below table shows the 3 factors considered in our Fama French Model

|  |  |  |  |
| --- | --- | --- | --- |
| Factors | Definition | Reason to Choose | Source of Data |
| Market  Risk Premium (MRP) | The excess return over risk-free rate on the market portfolio. | The sole factor in the CAPM model, every stock is influenced more or less by the broad market. | S&P 500 as market portfolio and 3-month Treasury bills as risk-free rate [10]. |
| Small Minus Large (SMB) | The difference in returns between small-cap stocks and large-cap stocks. | The small capitalization stocks tend to perform better than large capitalization stocks. | Kenneth R. French Data Library - Fama/French Factors [9]. |
| High Minus Low (HML) | The difference in returns between high-book-to-market stocks and low-book-to-market stocks. | The high-book-to-market stocks tend to perform better than low-book-to-market stocks. | Kenneth R. French Data Library - Fama/French Factors |

TABLE 1

In the FF Model, we have

ri = rf + βi (rm − rF ) + hHML + sSMB

where HML,SMB are defined as in the above table rm-rF = MRP from the above table. We downloaded data from Professor Kenneth French’s Data Library up until August 2017.

**Fama and French Alpha**

Intercept here is the alpha value. Alpha is a risk-adjusted measure of active return on an investment. Similar to the CAPM model, Alpha determines the contribution of fund manager to the performance of the portfolio built. The alpha value we obtained was 0.0143 means a monthly return of 1.43% in excess of the reward for the assumed risk.

**Fama and French Market Betas**

The Fama and French Model essentially has 3 betas- Beta (mrkt), Beta(size) and Beta (value) which we obtained to be 0.73329, 0.20048 and -.032741 respectively of which the Beta(mrkt) was more statistically significant.

The market is described as having a beta of 1. The beta for a stock describes how much the stock's price moves in relation to the market. If a stock has a beta above 1, it's more volatile than the overall market. Hence for our result with a Beta(mrkt) of 0.73329, it's theoretically 27% less volatile than the market.

A positive SMB coefficient would indicate a portfolio that favors small-cap stocks and the returns are attributable to exposure to small stocks.The result we obtained for our portfolio of stocks shows a Beta(size) of 0.20048 which is not statistically significant.

The negative slope on beta(HML) of -0.032741 means that the fund comoves with the short side of HML, i.e. the portfolio has higher expected returns if low book-to-market (i.e., growth) stocks outperform high book-to-market (i.e., value) stocks, suggesting that the portfolio is predominantly growth stocks.

**Comparison of CAPM and Fama And French Models**

The betas and p-values suggest that the returns of our portfolio is sensitive to the changes in the market. The CAPM beta was low at 0.763, but the FF beta is even lower at 0.733. Since FF is a three-factor model, the calculation of the cost of equity has to be with all three factors. We cannot simply use the 0.663 beta with the ERP to calculate a cost of equity. In addition, the output shows that FF regression is a slightly better model than the CAPM in explaining the variation in our portfolio’s returns based on having a higher Adjusted R-Squared of 42.9% as opposed to the CAPM Adjusted R-Squared of 39.2% thus showing that we are not penalized for adding additional factors.

**Risks**

**Portfolio Risk**

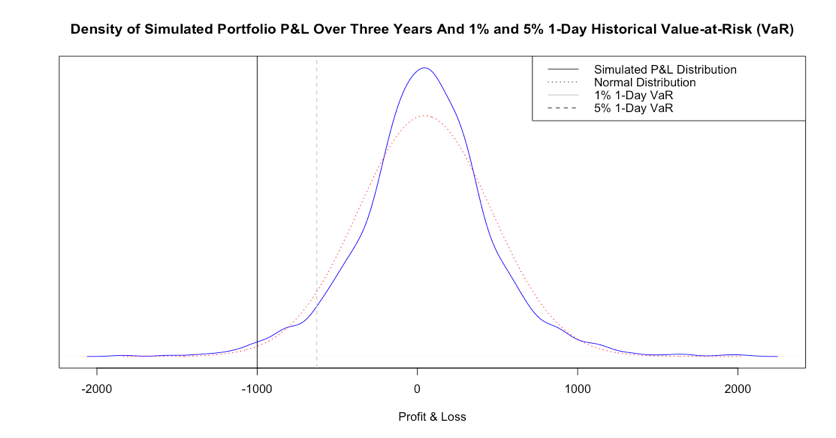
While investing one strategy is to picking investments with the highest potential return with the lowest potential risk. More risk usually means higher returns, but it can also mean bigger losses if you do not sell in time. To help minimize our risk and still maximize returns, we calculated our portfolio standard deviation. Our stock portfolio consisting of stocks from UnitedHealth Group , Visa and The S&P index gives us an annualized standard deviation of 16.51% on a return of 2.4%.Hence, our average return would fall between -14.11% to 18.91%.

**Historical Value At Risk**

Historical VaR uses a mix of current weights in the portfolio and a simulation of historical returns of the securities in the portfolio to construct a simulated series of portfolio Profits & Losses (P&L). Given its use of historical returns data, Historical VaR works better when we have lots of data. We used historical stock data from 2012 to 2017.

The Historical VaR that we obtained for a $40,000 investment in the stock portfolio was $1000 at the 1% Significance or 99% Confidence level and $628 at the 5% Significance or 95% Confidence level. Hence, there is a 99% Confidence that we will not exceed a loss of $1000 and a 95% Confidence that we will not exceed a loss of $628.

The below figure shows the results of our plot. The chart shows that the simulated P&L distribution (blue) is more peaked than what a normal distribution (red) with the same mean and standard deviation would show. This means that there are more observations that are around the mean or average P&L in the simulated P&L.



**Historical Expected Shortfall**

The Historical ES is calculated by taking the average portfolio loss that falls short of the Historical VaR estimate. Hence from our estimates for the stocks portfolio, we find that the 1% 1-Day Historical ES is equal to $ 4,644. This result means that we have 1% probability that the loss in our portfolio would exceed the VaR, but, when it does, we expect that, on average, we would lose $ 4,644. Similarly, the 5% 1-Day Historical ES is equal to $ 3,366. This result means that we have a 5% probability that the loss in our portfolio would exceed the VaR, but, when it does, we expect that, on average,we would lose $ 3,366.

**Options Pricing - Selection and Returns**

The set of companies considered for options investment ranged from companies that had a high volatility and hence a chance of providing higher returns on either puts or calls, to companies that have lower historical volatility but at the cost of lesser returns. After going through companies such as Goldman Sachs, Black Rock and Electronic Arts, we decided to go ahead with Proctor & Gamble, based on the following factors:

1. Stability: The historical volatility rate was lower as compared to the other companies.
2. The R command used to get future options strike prices and other details (getOptionChain) only gave values of February 2018 options expiration date for some of these firms. Which means that the calculations were only possible once we found a company which could have an expiry for February.
3. Recent Drift: The rate of change of the stocks in the last 3 months wasn’t extreme (extremely high or low).

After this, we take the last 5 years of stock data for P&G to calculate the historical volatility, which is obtained as 5.371%. This value is used in the Black Scholes - Options Pricing model function to obtain values of calls and puts at the strike price below and above the close price of valuation date.

Hence we come with current stock price as $ 90.37 and the two strike prices above and below it as $95 and $90. This results in the following table values after the BSM-OPM:

|  |  |  |
| --- | --- | --- |
| Options Pricing Model | $90 | $95 |
| Call | $74.17 | $73.72 |
| Put | $73.51 | $78.05 |

After making the three month simulations, we get the following returns after 3 months (by February 2018):

1. Covered Call: 1.67% return
2. Protective Put: 0.23% return
3. Covered Call and a Protective Put: 0.277% return

Hence, we suggest the client to invest $5,000 into the covered call to obtain $83.46 after 3 months using a Covered Call.

**Stocks Simulation - Returns and Value at Risk**

We chose the Monte Carlo simulation method to produce these values for each stock:

1. Value at risk at 1 percentile (99% chance the stock won’t fall below this value)
2. Value at risk at 5 percentile (95% chance of the same)
3. Mean return of simulated value (Approximately what can we expect the return to be?)

Of course, we had to make certain assumptions, such as:

1. The stocks distribution through Monte Carlo will be along normal distribution paths.
2. The drift will be calculated by taking the last 3 months close price into account,
3. The sigma will be calculated from the historical volatility of each of the companies after taking their last 5 year’s data.

The Values at Risk were calculated as follows:

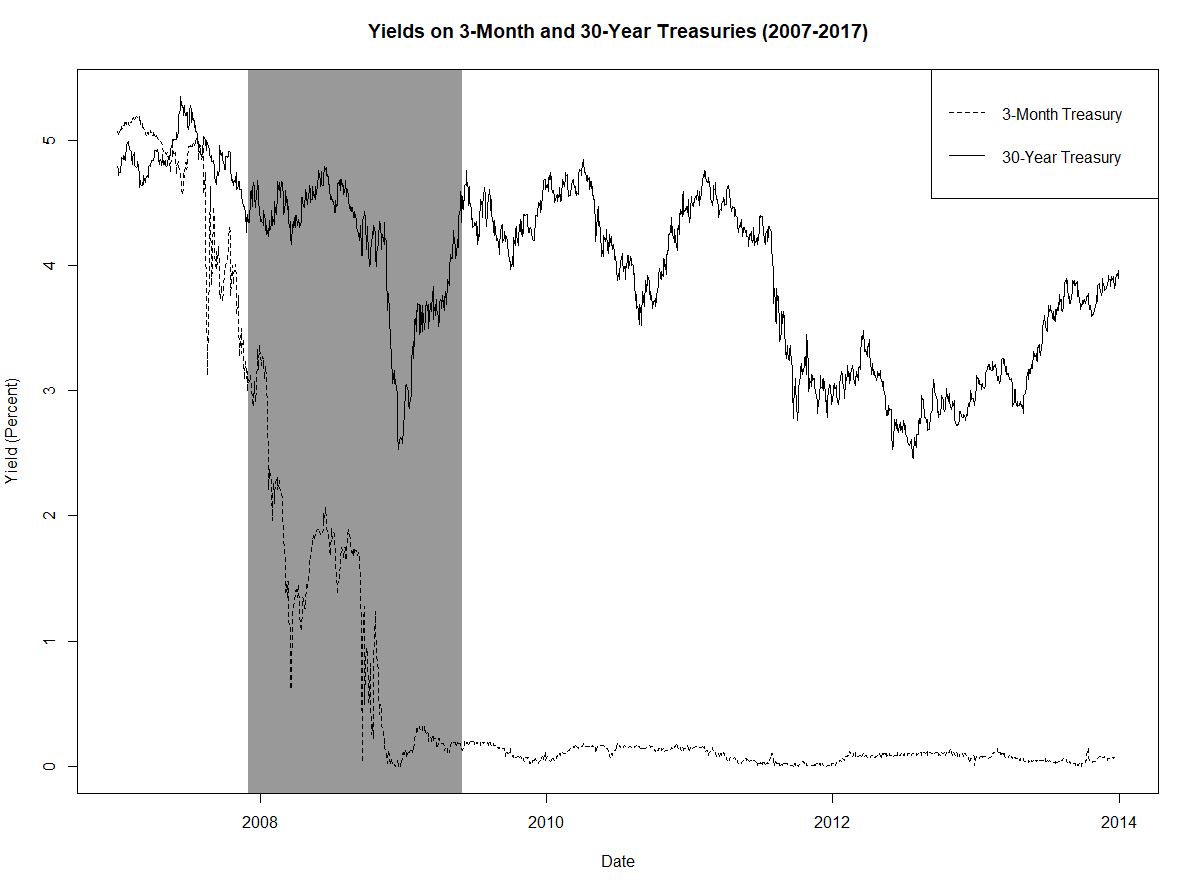
|  |  |  |  |
| --- | --- | --- | --- |
| Value at Risk | Visa | United Healthcare | S&P 500 |
| 1 %ile | 94.18 | 180.4 | 2517 |
| 5 %ile | 99.37 | 192.9 | 2564 |
| Starting Price | 111.40 | 220.15 | 2651 |

Hence we can we can see that even though Visa and United Healthcare might grow a lot (from our past analysis), they still stand to lose the most, about 20% of their worth in the worst case scenario. However, S&P500 is very stable and it will only drop a little even in the worst case scenario.

Their percentage mean returns were calculated from the predicted values and it was found that the three would (after applying weights) grow 2.46% in the next three months, which means if we invest $40,000, we would get $984 in return.

**Bonds**

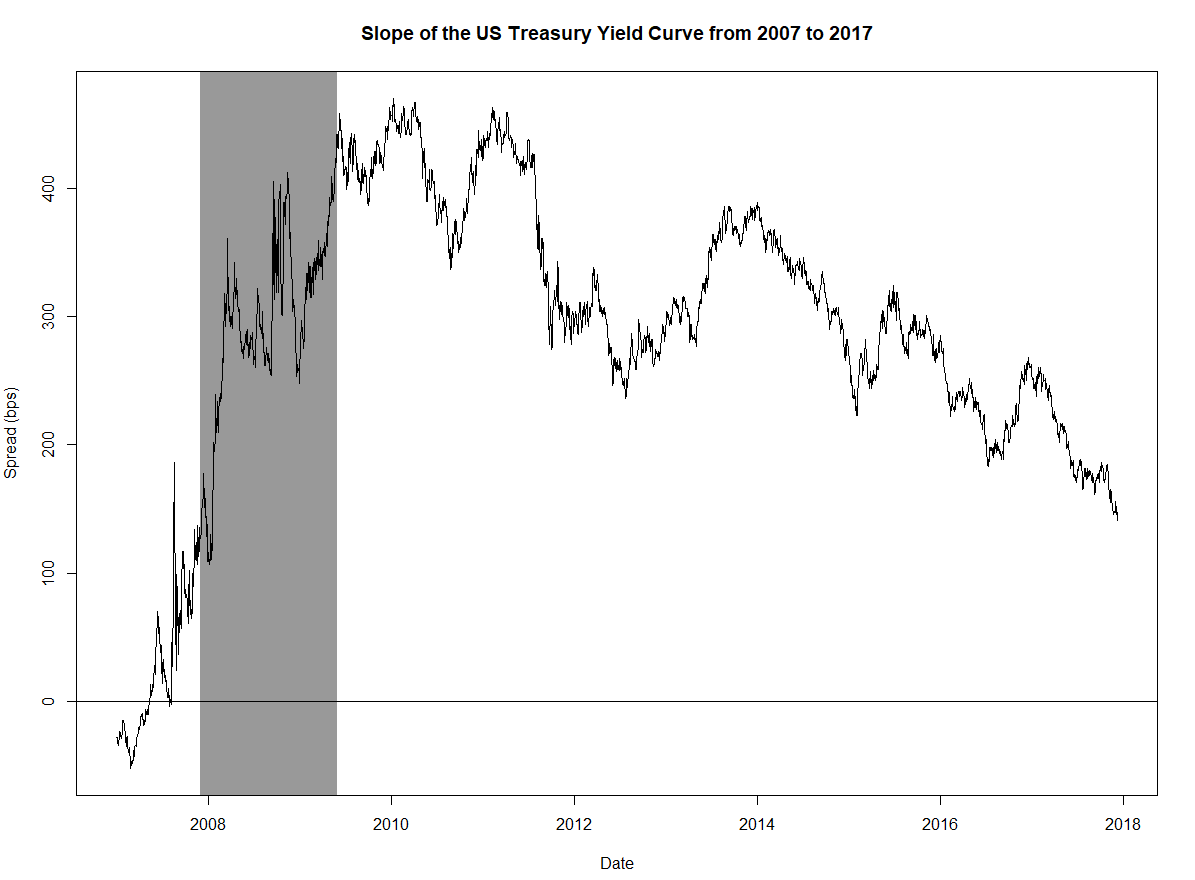
Fixed income investments generally pay a return on a fixed schedule, though the amount of the payments can vary. Individual bonds may be the best known type of fixed income security, but the category also includes bond funds, ETFs, CDs, and money market funds. In recent years, the extremely low rates on U.S. Treasuries and other lower-risk investments have fueled rising demand for high-yielding investments. Fixed income bonds are a great option to invest when it comes to minimizing risks and concentrating on long term returns.



This can be confirmed from the Shapes of the treasury yield curve. To device our asset allocation strategy we wanted to mitigate the risks and ensure that the client has some assets which will yield long term returns while also reducing his risks.

However, there are other strategies which help the investors to invest for short time. For instance, If T-bill rates for 3-months is substantially lower than 6-month rates, an investor who expects to hold a T-Bill for 3 months may instead purchase a 6-month T-Bill and sell it in 3 months to take advantage of the higher yields on the longer dated instrument.

So based on our portfolio, after risk assessment and return simulation, we have decided to invest $5000 in US Security Bonds to get a simulated return of $42.8 in three months $606 in an period of 5 years.



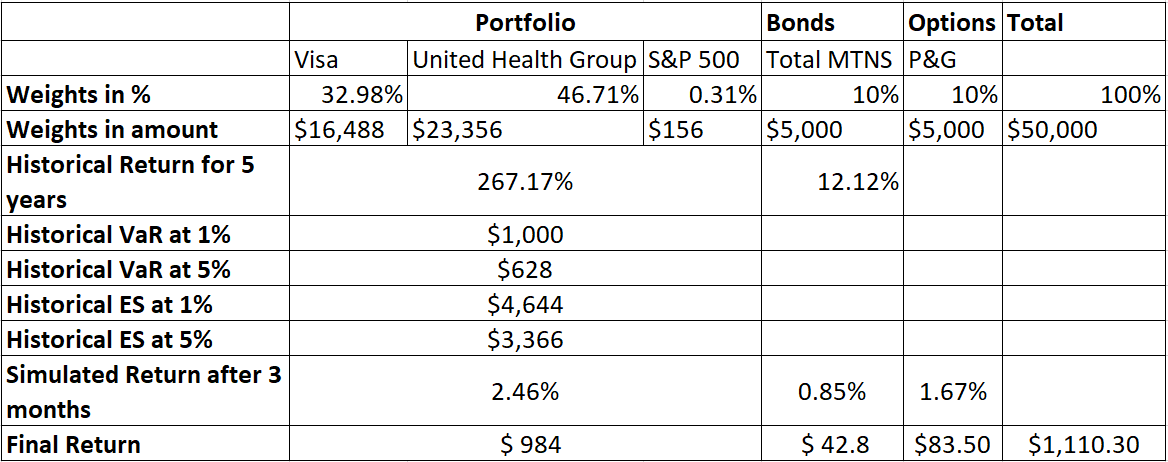
**Conclusion**

Having to start from $50,000, we thought of a finite number of ways to invest this amount. Even though the Mean-Variance Effective Frontier gives us weights for various stocks, we used RSI, Bollinger Bands and Capital Gains to integrate these weights with the amounts to be invested in Bonds and Options. Its easy to see that, for short term periods, we get the highest returns in Stocks among the companies we analyzed. Consecutively, the Bonds and Options have lower returns but can be considered to be safer investments.

The following table shows our distribution of weights and amounts:

For the overall portfolio, we invest in:

1. Stocks:
   1. Visa: 32.98%, $16,488 invested to yield:



This final portfolio of Stocks, S&P Market Index, Bonds and Options gives us a final net profit of $1110.3.

**Recommendations**

1. Bonds: A much higher return can be obtained if we have a long term bonds instead of short term bonds. Hence, we would suggest investing in a 10 year bond.
2. We would suggest not selling call options on expiry if the PG stock price falls.
3. 3 months might be a short time for all of bonds, stocks and options. Hence, we should invest for longer in bond, as well as intermediate time periods in stocks and options to diversify our portfolio returns.
4. We need to keep changing the companies in which we invest, the outcome changes based on market conditions from time to time. Hence, a more diverse portfolio made of multiple bonds, stocks and options would be a safer idea.

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