

# VISUALISING INVESTMENT RETURNS

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## 1 Introduction

Earning money on the stock market is an attraction for most people, you hear stories about people becoming millionaires overnight, but many start investing without much knowledge. One of the most famous books regarding investing in the stock market - "*The Intelligent Investor*" - by Benjamin Graham, first released in 1949 and updated many times since, tries to portray the message that one should not roam the stock market emotionally, but stick to a number of rules. However, many people do not adhere to these rules, and lose an unnecessarily large amount of money.

Two popular ways of trading on the stock market are in shares and in options. Shares are units of ownership in a corporation or financial asset which anybody can buy or sell. Options are somewhat more complicated. An option is the right, but not the obligation, to enter into a contract to buy or sell shares. A contract usually consists of 100 shares of the stock. There are many different types of options, the two most popular are the call and put option. A call option allows the holder to buy the underlying from the seller at a specific price (strike price) at a specific time (expiration date), and a put allows the holder to sell the underlying. Trading in options can often lead to both very high profits and losses relative to trading in shares, which will be shown in the next paragraph.

Assume a speculator has \$4,000 to invest, and obtains some positive information about NewCompany. He expects its stock to rise from \$80 at May 1<sup>st</sup> to \$100 at June 1<sup>st</sup>. Now suppose the stock did indeed rise from 80 to 100, if the speculator traded in stocks, he would obtain a profit of  $\frac{\$4,000}{\$80} * (\$100 - \$80) = \$1,000$ . But if the stock fell to \$70 the holder would lose  $\frac{\$4,000}{\$80} * (\$75 - \$80) = \$250$ . As we can see, the profit (loss) rises (declines) linearly as  $\#Stocks * (S_T - S_t)$ .

Now assume the speculator wanted to trade in options. Assume the price of a call option with strike \$80 is \$4.00, thus the total price is \$400 (100 shares), and the investor buys 10 call options (1,000 shares) at the price of \$4,000. If the price of the stock rises to \$100 at expiration date, the holder would make a profit of  $\$1000 * (\$100 - \$80) - \$4,000 = \$16,000$ , but if the stock price was below the strike price, the option would not be exercised, and the speculator would lose all his money! Thus in short, the profit the speculator makes when buying one call option is  $100 * ((S_T - K)^+ - Price)$ .

From the previous example we can see that trading in options can produce much larger gains, but also much larger losses than trading in shares. As a recap, the table below shows the gains/losses when trading in stocks and options

Date	May 1 <sup>st</sup>	June 1 <sup>st</sup>	June 1 <sup>st</sup>
Stock Price	\$80	\$100	\$75
Profit Stock	\$0	\$1,000	-\$250
Profit Option	-\$4,000	\$16,000	-\$4,000

Table 1: Profits of stock and option

## 2 Project

In this project I will visualise 12 different stocks, where the user is able to pan and zoom. The user then also has the option to click on the stocks and invest in either shares, in random options, and in different option strategies. The program shows the user the payoff function of each of the stocks. For the options, the user has the choice to select the expiration date and strike price. Examples of the strategies are bear, bull, butterfly, straddle and strangle spreads, but there are many more.

To shortly explain a strategy, take the bull spread. This spread expects the stock prices to rise (bullish market). We can formulate the bull spread as a bull call or bull put spread. The bull call spread is created by going long (buying) a call at strike  $K_1$  and shorting (selling) a call at strike  $K_2$ , where  $K_1 < K_2$ . If we again take NewCompany as reference, currently trading at \$80, and assume that a call option with strike  $K_1$  is selling at \$6 and with strike  $K_2$  is selling at \$4.

Following the strategy, the speculator then takes a long position on the  $K_1$  strike price for \$600 and a short position on the  $K_2$  strike price worth \$400. For this strategy the investor must have an initial fund of \$200.

If the stock price of NewCompany is above \$82, the strategy pays off, and the profit will increase linearly until the stock price hits  $K_2$ , then flatten out. Thus the maximum loss is equal to the initial fund, and the maximum profit is equal to  $100 \cdot (K_2 - S_T - \text{funding})$ . We see that when using this strategy, the maximum loss is much less than just only buying call options. Figure one shows the profits for both call options and the combined profit

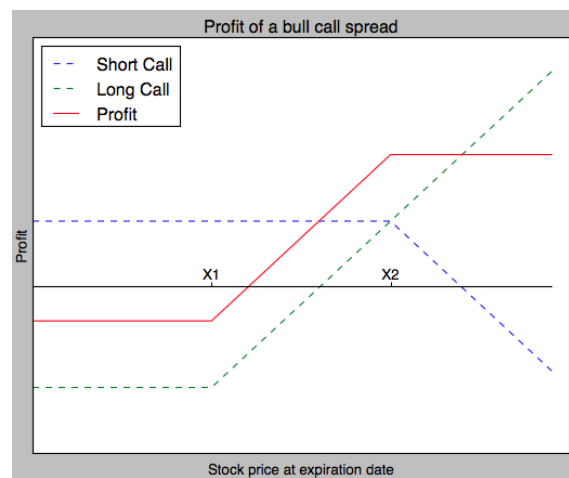


Figure 1: Profit of Bull Call Spread

Data to be used was obtained via Yahoo Finance on January 2<sup>nd</sup> 2015. Yahoo Finance show stock prices which can be downloaded to a csv file, and subsequently transformed to JSON. The option information (strike, maturity and price) was scraped from the options page. This data still has to be changed to JSON. There are 5 expiration dates for the options, one of which was the second of January. If additional stocks are chosen past this date, the time reference for them will have to be different than the already chosen 12 stocks.

This application has four different components. First, the page displays a graph of all the stocks used. Second, the application will allow the user to choose both an amount of shares to invest in or specify his option strike and price for the selected stock. The user may choose some option strategy or blindly invest in some options given some still to be determined initial investment. Third, the application shows the profit/loss graph for the selected options and then allows the user to pick another stock by going back to the first component, or finalize his investment. Finally the result of the users' investment is shown.

Javascript is used to visualise the project, with the D3.js library. Python is used for scraping and simplifying data. External components will then be some module that allows me to pan/zoom/select a stock within the graph.

There may be difficulties in the panning zooming and selecting a certain stock. It is also unsure if the full profit/loss graphs are able to be shown given all the information.