Exploring Fintech for Teaching Predictive Financial Analytics

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Abstract

Fintech, or Financial Technology, is growing in popularity as financial services becomes highly integrated with back-end information systems and technologies for end-consumer use. Technology that used to be in the background and used only by financial professionals are now available for end-users who need financial services at their fingertip, especially those who invest and trade ubiquitously. As more investors and traders manage their own stock portfolio without the help of human brokers, the need for predictive financial analytics and knowledge to manage a self-maintained financial portfolio is critical. There are a growing number of special services for investors and traders, who demand detailed analyses of their investments and financial derivatives. The objective of this paper is to examine how various services provide predictive financial analytics using data mining, intelligent algorithms, predictive services, and visual analytics to end-users who manage their own financial portfolio. This research endeavors to identify different unique features of predictive analytics used by cutting edge Fintech companies.

Keywords: Predictive analytics, Fintech, Financial Data Mining, Data Pattern Recognition, Stocks and Options trading, Price analytics

1. INTRODUCTION

Due to the massive need to process raw financial and economic data in the global financial market such as daily stocks prices, volume of stocks traded, stock price fluctuations, the movement of major stock indices, there is a growing need for new ways to generate both visual and textual knowledge representations, so that non-professional investors and traders can make more informed and intelligent investment and trading decisions in managing their own finances.

Knowledge representation is how information or data is represented to enable human beings to grasp data and information in meaningful terms. We sometimes think human knowledge is communicated mostly through textual information, but other types of knowledge are more effectively communicated visually in terms of graphs, pictorials, symbols, and images. Information in graphic or symbolic form is not only expressing what is being shown, but how it is being shown to improve the effectiveness and speed of human cognition. And sometimes text, numbers, graphs, animation, and symbols can all be combined in a rich form of knowledge representation to amplify human cognition, speed up the cognitive process, and enhance intelligent perception.

For investors and traders, how massive amounts of financial data is processed and presented in both textual and graphic form is very important for them when making daily buying and selling decisions. The math wizards of Wall Street often referred to as the "quants" (Crooks, Slayton, Burbridge (2011) and Patterson (2010)), use mathematical algorithms (Deng, Wang, Dong, 2012) and fast super-computers (Kelly, 2012) to generate stock price predictions, and are able to process massive amounts of raw financial data

and transform them into intelligent stock price predictions that can be read by both humans and machines. While these data can be presented in both text and visual representations, many investors and traders seem to be able to make more intelligent split-second decisions on the buying and selling of stocks based on easy-to-interpret real-time visual data representations that they see on their screen such as "candlestick charts" (Nisson, 2001)[i].

The problem that analytics software designers are currently facing is determining which features are highly desirable and effective from an end-user's perspective. Because stock traders and investors have a very limited time window to analyze and intelligently digest financial data before they decide to buy or sell stocks and options, the software interface for financial analytics is critical for this particular end-user group. According to Daugherty (2013), Chief Technology Officer of Accenture, "In a recent Accenture Analytics survey of 600 executives representing large organizations in the UK and US … only 20% are "very satisfied" with the business outcomes from their existing analytics programs. These are underwhelming responses to say the least."

The main contribution of this paper is to determine the predictive analytics capabilities of financial technologies used to analyze stock price movements. With the findings of this research, students interested in finance and investing will have a better grasp of how Fintech is used to predict stock price movements.

This paper will be organized starting with discussing Intro (Section1) and research objective (Section 20. After that, Section 3 will be dedicated to the literature review on analytics and knowledge representations, which are related to the research objective. The next 3 sections will discuss three cases of how Fintech uses predictive analytics, and the last section summarizes the study with a concluding discussion.

2. RESEARCH OBJECTIVE

Currently, there is little research that determines how financial technologies (Fintech) are generating predictive analytics and effective knowledge/visual representations from a trader's or investor's perspective. The purpose of this research is to determine how useful these systems are from the end user's perspective. The users of the system are individuals who invest and trade in stocks and options and need the analytical capabilities and visual representations that these intelligent systems can provide to help them make better-informed investments and trading decisions. Yap and Lin (2001) conducted a study introducing the knowledge management capabilities of online brokerage firms including knowledge generation, knowledge mapping, and knowledge representation, but did not elaborate on how users thought these systems helped them with their trading decisions. This research aims to build on that literature in terms of how various knowledge representations are effective in helping traders predict stock price movements.

There are several websites that offer traders and investors a variety of financial knowledge and data analytics capability to analyze and find price patterns for stocks. These systems can also generate predictive capabilities on how stock prices are behaving, moving, and trending. This study aims to determine to what extent traders value different features of various web-based financial analytics systems and what feature they consider most and least important. With the rapid proliferation of websites offering different financial data services, this study is important in determining how these systems are evolving the way they represent data in both visual and textual forms.

3. LITERATURE REVIEW ON ANALYTICS AND KNOWLEDGE REPRESENTATIONS

According to Passera and Haapio (2013), visual analytics and interfaces play a part in representing complex data structures. In their research, they believe that legal contracts and the contracting process have complex data structures and needs more visual representations to improve knowledge transfer, communication, and provide better clarity on legal contracts. While Passera and Haapio's research focus on legal contracts, the research for this paper rest on the same principle that complex financial data structures can be represented with better clarity using visual data analytics. In a related study, Eppler and Burkhard (2010) in their paper on 'knowledge visualization' talked about how knowledge must be made 'visible' so that it can be better discuss, accessed, managed, and that visual metaphors and conceptual diagrams are core tools for visualization.

In her research, Zoss (2013) recognized that "with the rise of big data initiatives in academia, industry, and the public sector, the need for rapid and reliable pattern and trend analysis that can be easily communicated to a broad audience has created a growing demand for data visualization." Zoss contends that better data constructs, structures, and models will improve the human

cognitive and comprehension process and better absorb the meaning of data patterns. Jung, et. al (2013) added that there has to be an 'aesthetic' element in data visualization so that users feel more engaged and exploratory in the data navigation process. So in addition to how data visualization can improve human cognition, aesthetics in data visualization design helps encourage positive user engagement of the software interface.

Watson (2013), Kotsiantis and Pintelas (2009), and Bruckhaus (2007) emphasize the growing need for predictive data analytics for business applications. In this paper, we further add to the discussion on how financial technologies provide predictive analytics using different techniques and representations to predict stock price movements. In a related study for predicting stock prices, Schumaker and Hsinchun (2012) discussed various ways of mining financial data using "different linguistic representations … such as bag of words, noun phrases, proper nouns and named entities" from different sources of news articles to predict stock price movements. In this research, we focus on Fintech that use numeric algorithms and visual knowledge representations base on the massive amount of data from the stock market to predict stock price movements.

4. FINTECH CASE 1: STOCKFETCHER.COM – PREDICTIVE ANALYTICS USING VISUAL AND STATISTICAL PATTERNS

Stockfetcher.com functions like a data mining engine focused on finding unique visual and statistical patterns that stock traders consider as a signal to buy or sell stocks. The software looks at the movement of a stock's price, the volume of shares traded, and the market's perception on that particular stock. We can look at three examples out of hundreds of different patterns that this technology helps investors. In **Figure 1** (see Appendices for all Figures), it finds a pattern called "Gap Up on Volume" and it has a definition of what that means. It says that the "stock opens more than 5% higher than the previous day and the volume of shares traded is 100% above the average volume traded." It then searches and identifies several stocks that meets this pattern.

In **Figure 2**, it identifies Symantec Corporation's stock as one stock that met this pattern whose price jumped from $22 to $25 or about a 13% increase. The price gap from $22 to $25 can be seen from the candlestick chart. And the average volume of shares traded is around 10 million shares from the chart, but on this particular day that it alerted investors, the volume of shares traded is 40 million shares and it is up 400%. Again, the chart shows the visuals on the trade volume. Why is 'volume traded' an important statistics for traders and investors? It is because when traders see a stock price goes up with very low volume of shares traded, they feel that the price increase may not be sustainable. But a 400% increase in the volume of shares traded means that the price increase is much more sustainable because an incredible number of investors have bought into this event. So, this is an alert to buy the stock.

Another unique pattern this visual data mining technology looks for is called the 'Bollinger Upside Breakout'. It describes this pattern as a stock whose price have crossed the 'upper Bollinger' band (see **Figure 3**). Hayes (2019) defines a Bollinger band as "an upper and lower [price] band along the daily movements of the stock's price …which is a measure of volatility using standard deviation, when the markets become more volatile the bands widen; during less volatile periods, the bands contract .. Bollinger bands was developed by the technical trader John Bollinger." For a visual chart example of a Bollinger band, see **Figure 4**.

In Figure 4, StockFetcher.com identifies the Coca Cola stock that has this pattern at this given point in time. The Bollinger band in Figure 4 is depicted in the Blue lines as the upper and lower price limits in the price fluctuations based on past price standard deviations. The visual representation is helpful for traders as they can see how prices fluctuate between the upper and lower price bands. And the reason for this pattern as a 'buy alert' for investors is that Coca Cola's stock reaching a price above $52 means it has breached the upper Bollinger band, or the previous upper standard deviation limit. What this means is that there is a bigger probability that the price will go much higher than the price limit of the current upper Bollinger band. Stock traders call this as a 'break out' or a stock price running to a higher level. StockFetcher.com also has another price pattern called the 'Bollinger Downside Breakdown' that alerts investors if a stock price goes below the Bollinger band, then the price of that stock is about to break down to a much lower price. This is the opposite of the first pattern. StockFetcher.com claims their systems tracks and recognizes 125 unique stock price movement patterns that signals it is time to buy or sell, and alerts investors if these visual and statistical patterns are found by their data mining engine.

5. FINTECH CASE 2: MAXIMIMUM-PAIN.COM – PREDICTIVE ANALYTICS USING FUTURE OPTIONS CONTRACT PRICES

Traders in the stock market try to predict the future prices of stocks by using the money invested in future options contract. Maximum Pain (or Max Pain, in short) is a predictive concept to determine where the future price of a stock may be going based on the amount of money or investments traders and investors pour into stock options contracts. In today's stock market, there are options contracts expiring every Friday for most stocks. Before discussing Max Pain in detail, we want to discuss options briefly to give this concept the proper context.

Call options are future contracts that guarantee traders that they can purchase a stock at a future guaranteed price (or called a strike price). For example, if the current stock price of a company is $100, and a trader bought a call option equivalent to 100 shares that expires in 3 months with a strike price of $115 at a contract price of $2 per share, then that trade is in effect making a bet that the stock will be higher that $117 ($115 + $2) after 3 months. The trader is guaranteed that he can still buy the stock at the price of $115 after 3 months even if the price goes up higher than $115. The $2 price is also called an "options premium" or a fee to party who issued that options contract. For a 100 shares equivalent, $2/share x 100 = $200, and this is the amount the trader pays for the premium call options contract. If after 3 months, the stock does not go up to $117, the trader loses that $200 he spent. However, if after 3 months, the stock price goes up to $127, for example, then the trader gains $10/share ($127-$117 = $10). Since the call option is good for 100 shares, then $10 per share x 100 = $1000. $1000 is the profit of the trader who invested $200 in buy that call options contract.

A Trader can also buy a Put option, which guarantees that the trader can sell a stock at a guaranteed price in the future. Let say a trader invested in a stock when it was $80 per share and bought 100 shares ($80/share x 100 shares = $8,000 invested), and the stock price has gone up to $210 ($210 x 100 = $21,000). So, in paper, the trader has made a profit of $13,000 ($21,000 - $8000 = $13,000). The trader feels that it might go up some more and he does not want to sell the stock, but he wants to be protected if it goes down in the future. So, he purchases a Put Options contract with a strike price of $210 that matures in 3 months and it cost him $10/share premium to own this Put options contract. Considering the $10 price of the option, his break-even price is $200 ($210-$10). This gives him some peace of mind that he can still sell his stock at $210 three months from now in case it goes down. This Put option cost the trader $1000 ($10 x 100) to protect his profit. So, if the stock does indeed go down after 3 months to $140, the trader is still able to sell it at a net price of $200 and keeps a $12,000 profit ($13,000 - $1000 = $12,000) instead of losing $6,000 with the fall from $210 to $140 ($21,000-$14,000=$6000). Although his initial profit was $13,000, he paid $1000 to guarantee that he still has $12000 in profits after 3 months. If the stock goes up to $250 in 3 months, the trader loses the $1000 Put options premium as it expired worthless, but gains $4000 (with the price going up from $210 to $250).

As can be seen from these examples, traders use call options and put options to leverage and hedge on future stock prices. Many traders do not even trade stocks, but just trade or buy and sell call and put options. Options Traders usually have more expertise and experience than regular stock traders and they largely determine the value and price of options contracts based future uncertainties and the volatility of stock prices. Many of these options traders are institutional investors with a large amount of money invested and they use these options contracts to hedge again future price increases or decreases. Since the future options market are closely watched by stock market investors, the aggregate amount of money spent on options contracts is used as a predictive data and tool by many traders and investors about where the stock prices are going into the future.

The max pain strike price is the strike price at which the least amount of call and put options are paid out for that particular options expiration date. The predictive analytics model combines all the money invested in both call and put options and the max pain system determines the strike price where the least amount of options money is invested. The reason why the market feels this is where the future stock price is heading is because options traders are unwilling to pay a higher options premium for this strike price, and this means options traders foresee that the future price of the stock can indeed fall into this price range. Traders view max-pain strike price as the equilibrium level where stock prices might be heading.

The system Maximum-Pain.com determines the amount of money invested in both Call and Put

options. Their systems takes all the data invested in options and creates a chart that shows how much money in invested in both Call options and Put options, and determines where the Max-Pain strike price is. In **Figure 5**, the chart shows red and green bars as put and call options investments, respectively. The yellow line is the max-pain strike price showing the total minimum dollar invested in both call and put options. These are the options contract invested in the stock of the company called Beyond Meat (BYND) and the Max Pain strike price was determined by the system during June 29, 2019 to be $152.50 for Friday July 5, 2019. In **Figure 6**, the stock price of Beyond Meat closed at $152.63 on July 5, 2019, which is about 0.13 cents away from the Max-Pain strike price. Max Pain is best used as a weekly predictor of where stocks may be heading by the end of the week when options expired every Friday.

While in this instance, Max Pain was able to predict the price on July 5, it was because there was no major news or events from June 29 to July 5 regarding this particular stock. Max Pain is more of a technical prediction and assumes no major fundamental changes in the company's finances (like bankruptcy or loss of a major customer) and no major event has occurred from the time the system makes a prediction to the date the prediction (like a war breaking out or a global crisis). So, Max Pain is used for very short-term technical predictions, possibly good for a week or two into the future.

6. FINTECH CASE 3 – STOCKCONSULTANTS.COM – PREDICTIVE ANALYTICS USING PAST PRICE FLUCTUATIONS

Stockconsultant.com is another provider of advance financial analytics that help traders make short term predictions as to where stock prices are moving based on statistical probability and past statistical and data patterns of stock price movements.

For example, if we look at the chart generated by StockConsultants.com for Tesla's stock (TSLA). They have generated pink and blue lines with corresponding prices (see **Figure 7**). Their analytics systems have identified these price points as critical based on past trading data. The pink lines are called 'resistance levels' while the blue lines are called 'support levels'. Tesla's stock has been on a decline for the past three months from the $300 level to below $200. And as the analytics has indicated in the chart, the price has found "support" at $183.96, which is where the stock price has bounced back upwards. "Support" here means that at this price level, a lot of buyers came in to support the price and the sellers lost all power to bring the price down further. As the price moved up, the analytics system also found another price support level at $194.71. So, this means that prices below the $200 level is attractive to buyers of Tesla stocks. Their systems rates these support levels from a strength of 1 to 10, based on the volume of shares bought. And the support level at $183.96 is rated at "5", while the support level at $194.71 is rate at "8". So as soon as buyers felt there was strong support at the $183 level, it created a stronger buying pressure at the $194 level, which pushed the stock price back up above the $200 level. Based on past data, the financial analytics system also determined that there are resistance levels. Resistance levels are the opposite of Support levels. Resistance means that when the stock hits a resistance price level, it has a hard time breaking above that price range. As indicated in the chart, the Tesla stock tried to climb above $227 twice. The first time it failed and lingered around $214 - $227. And as of this writing, it has actually succeeded in breaking the $227 resistance level. So, if the Tesla stock must go up further, it will need to break the next resistance level which is at $242.77 as indicated in the Stockconsultant.com chart. And if it does indeed succeed and go above the $242.77 level, stock buyer's confidence will increase and the next resistance level at $271.88, which has a strength of "10". Because Tesla has just recovered from a steep downturn, the upward recovery is predicted to face several levels of price resistance.

Stockconsultant.com financial analytics system also provides recommendations in a simplified language that is understood by stock traders. In **Figure 8**, it says that there is a "rally" in the Short term direction, but is "near overbought", because the stock has climbed from a $183 - $194 price range in early June to $233 in the first week of July. So, the 'overbought' sign just means that the steep climb up in the stock price may taper off the stock's price increase further, and for the intermediate trend, the stock price may move 'sideways' according to the system's recommendation instead of going up or down. The financial analytics system then conclude in **Figure 9**, that the stock is 65% mildly bullish, which means that based on the price trend, the volume of stocks bought, and the $227 price resistance being broken, the probability of the stock price going up some more has a slightly higher probability. Again, these are short term predictive suggestions that may reverse if new

events and new data arises. However, by July 12, Tesla's stocks furthered climbed to $245 as the rally continued, confirming the 65% bullish probability that the price from $233 could still go up.

7. CONCLUSION AND SUMMARY

In conclusion, several Financial Technology (Fintech) applications have been developed that can be used by students of Finance to create their own predictive analytics model in assessing where certain stock prices may be heading in the short term. The paper explores only a few of these predictive Fintech applications, but there are several more that needs to be assessed. In the stock market, they say there is a 50-50 chance that stocks can either go up or down. So, if a predictive analytics systems can predict 65% or higher accuracy, then traders consider it as a useful tool. Everyone working in investments and Wall Street are always predicting where stocks, options, and futures are going, and more Fintech tools for analytics are now available for end-users. Using intelligent systems that gather massive amounts of data from minute-to-minute stock price changes, the volume of stocks traded, the volume of stock options contract traded, these intelligent systems intelligently mine these data with algorithms to find patterns, calculate probabilities, and also convert it into better knowledge representations like intelligent charts that recommends where traders may buy or sell stocks and options.

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Appendices and Figures

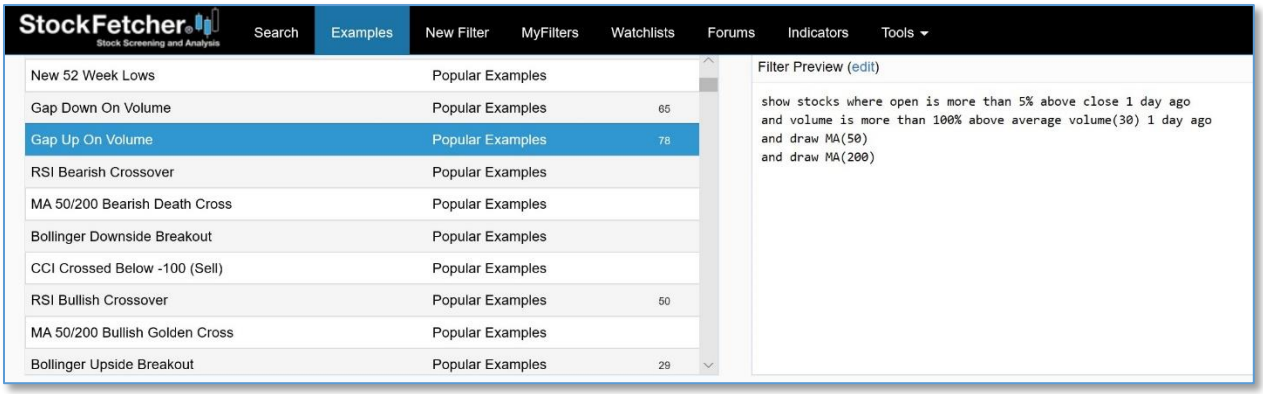

Figure 1 - Gap Up Volume Pattern

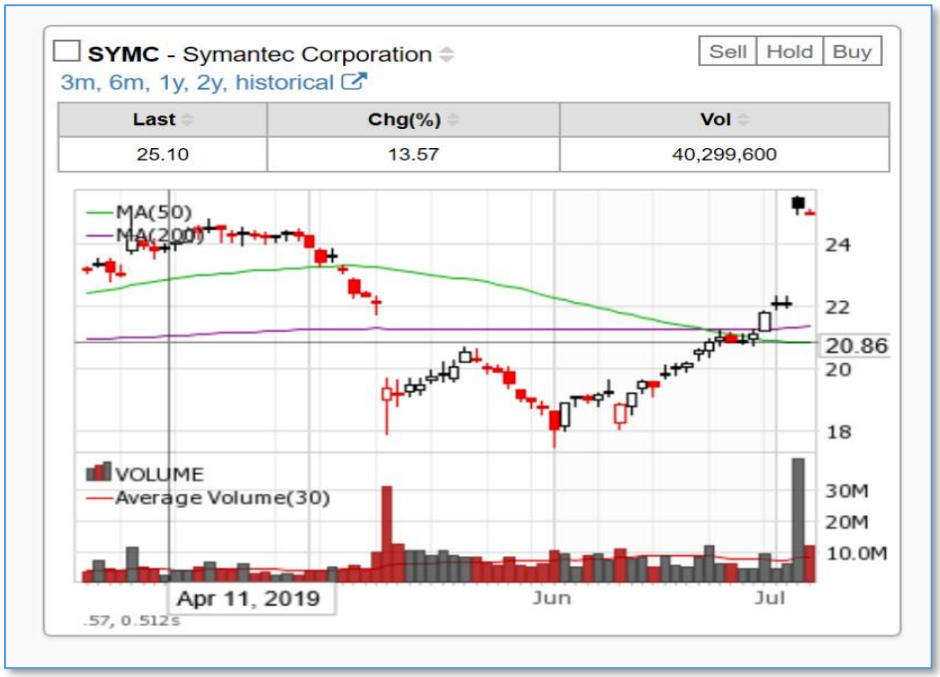

Figure 2 – Example of a Gap Up Volume Pattern using candlestick charts

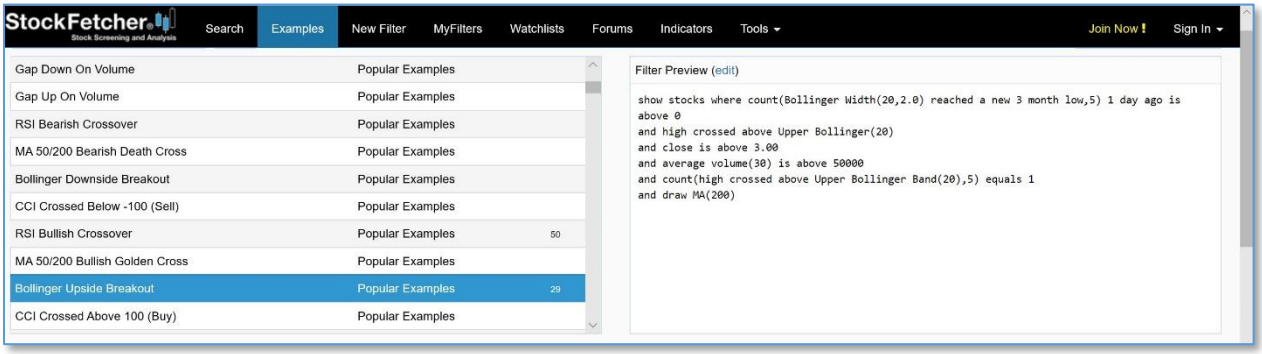

Figure 3. Bollinger Upside Breakout Pattern

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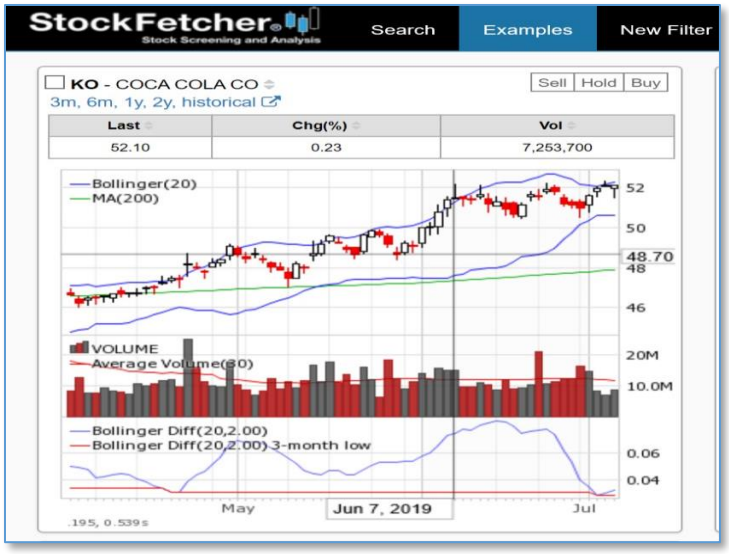

Figure 4. Coca Cola Stock hits the upper Bollinger Band at $52 (Upper Blue Line)

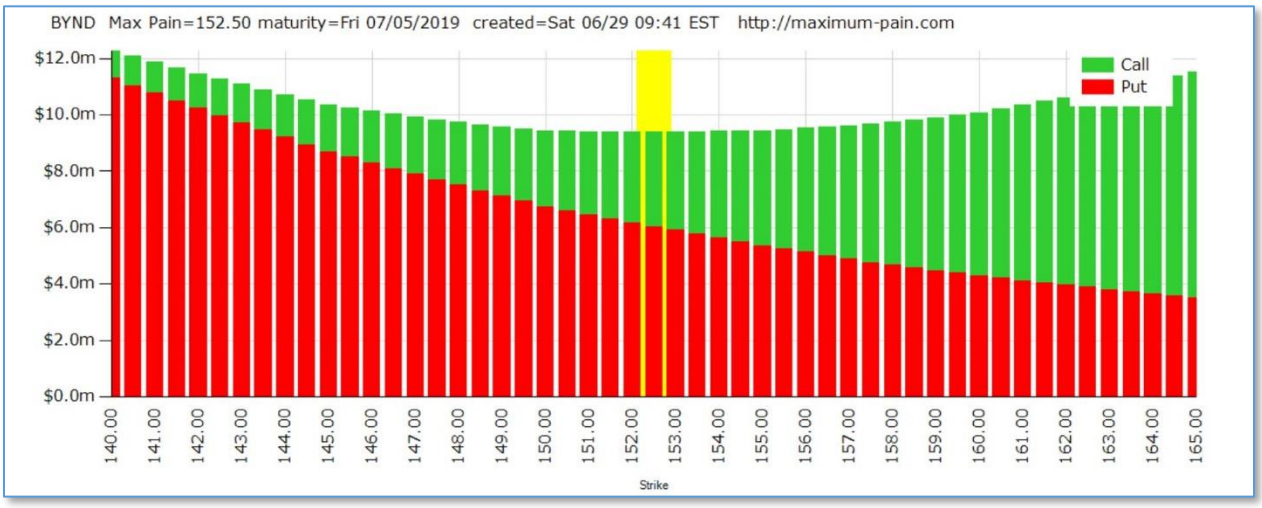

Figure 5. Max Pain Chart of the stock options of Beyond Meat for July 5, 2019 is $152.50 and the forecast was created on June 29, 2019 or 7 days before.

Figure 6. Beyond Meat stock price closed at $152.63 or very near the Max Pain strike price of $152.50.

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Figure 7. Visual chart identifying support levels (blue line) and resistance levels (red lines)

Figure 8. The data on stock price movements and algorithms are translated into a more simplified language that traders understand.

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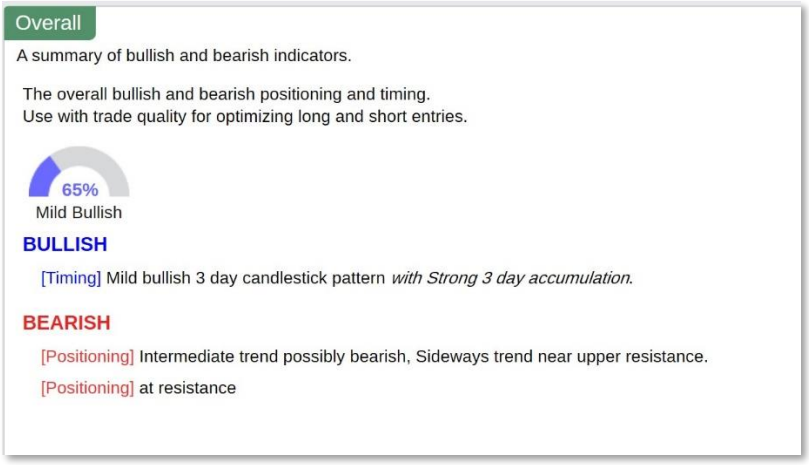

Figure 9. Stockconsultant.com has a concluding statement regarding how 'bullish' or 'bearish' their predictive systems is with a probability number. In this case, their system view the stock as 65% bullish, therefore predicting a price increase in the short term.

[i] Candlestick charts are charts that use candle-like visuals to depict where a stock's price open and close on a trading day, and it also depicts the highest and lowest price of the day.