Predicting Stock Volatility with Time-Series Analysis

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Springboard Capstone Project 2

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Goal: The goal of my project will be to attempt to predict changes in volatility in stocks. By looking at data on Microsoft stock I will attempt to predict changes in at the money option volatility. The question to be answered is "Can the volatility of at the money options be predicted by using other information about the underlying stock over a period of time?" From a business perspective, finding a solution to this could lead to the development of profitable trading strategies, or also reduce drawdowns in existing portfolios.

Data: All data is be available from Quandl.com. Quandl provides a great deal of data about thousands of stocks on a daily basis. They also provide data about stock option as part of a premium package. While it would be interesting to apply any techniques devised in this project to multiple stocks (and might also help to avoid overfitting a model), I have chosen to focus on one stock, Microsoft, at least initially. Microsoft option data is provided for free, and thus any work done in the project should be easily reproducible without a subscription.

Methodology: I believe the best way to approach this examination of Microsoft stock is with time series analysis. Some of the factors that can be looked at are stock price, current at the money volatility, historical volatility, prices and volatilities of out of the money options, stock trading volumes. It also may be useful to look at moving averages of a number of these factors, as change in theses data points may be the indicator of change volatility as opposed to the outright data. These factors can all be graphed, hopefully in a way that may show patterns that relate to the at the money option volatility.

The data will have to be cleaned in order to get information about the stock and about the options into a useful form. Since they are provided separately they will have to be shaped so that the dates line up, and that only the necessary columns are included. At this point it will be possible to put the information into a useful DataFrame.

There are multiple methods of time series analysis. I would particularly like to apply auto-ARIMA to the data as a method of analyzing the time series.

Challenges: I forsee several challenges in working with the data, some of which are time series specific. Microsoft stock has been trending up for years, so that trend will need to be removed as part of the modelling process. Also, many stocks exhibit seasonal patterns. The Microsoft data may also need to have this element removed.

Deliverables: As required, I will submit all the Jupyter notebooks I will develop, a final report, and a presentation slide deck.