Phase 4 Project

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Project objective:
Provide a time series analysis for the stock price of Amazon

Business Problem

- Banner Financial Analytics was hired by Amazon do conduct a time series analysis on the stock price using 10 years of data taken daily.
  - All data was obtained from the Yahoo Finance APi
    - Brief overview of stock
    - Establish Price Trends
    - Use traditional and nontraditional Time Series Models for analysis

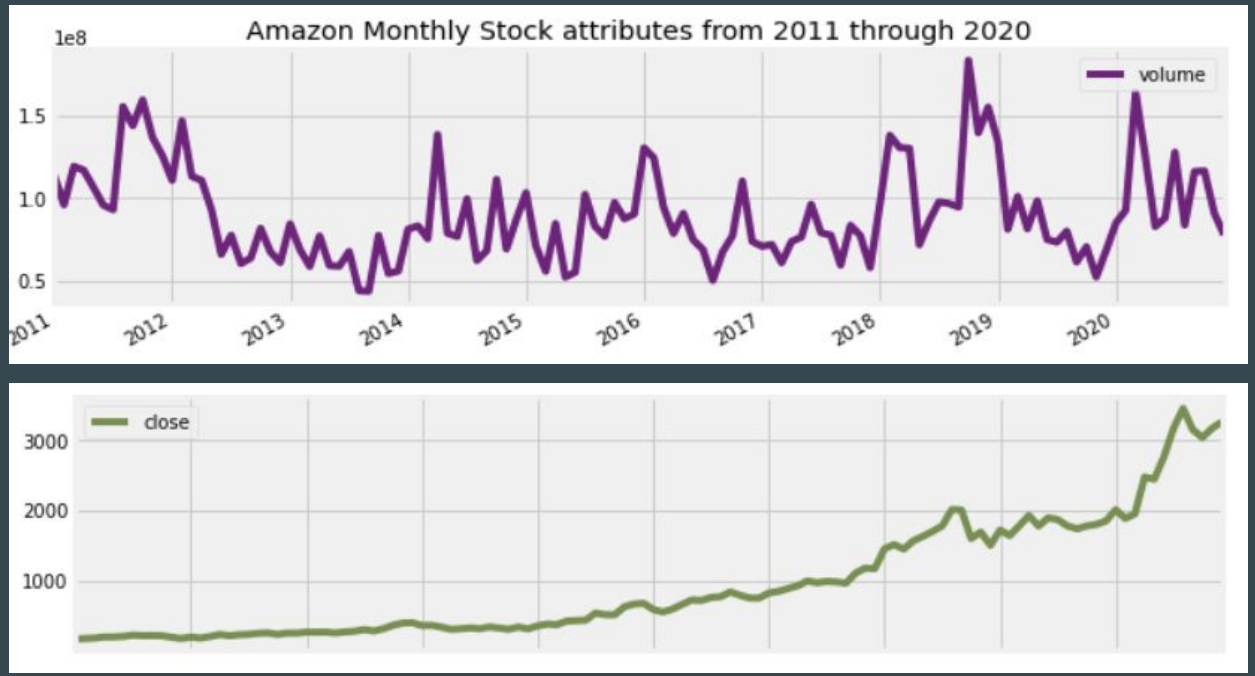
Understanding Amazon stock price 2011-2021

- Top Graph show the volume of trades throughout the past decade.

-Volume can have both a positive and negative effect on price.

-Bottom chart shows the changes in daily closing price for stock.

-Starting in 2016 you can see substantial rise while the largest gain was in 2020.



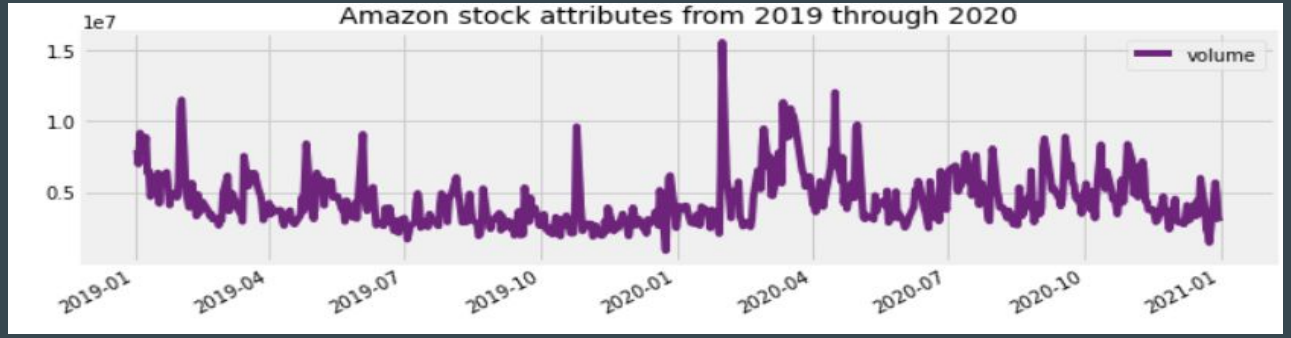
Closer look at recent years 2019-2021

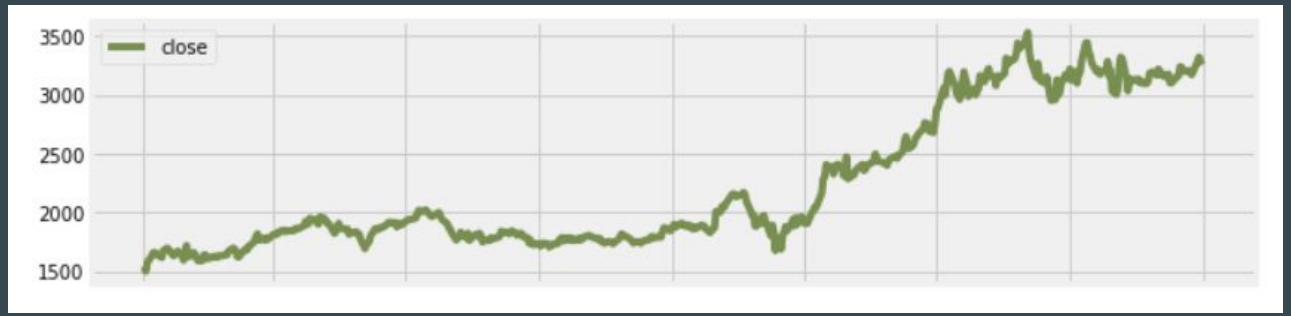
- Volume had largest spike in febuary of 2020 which was correlated with largest price decline.

-Volume then remained consistently high for the next 6 months.

-Those 6 months saw the largest gain in stock price in the company's history.

-Volume has remained relatively high while price has leveled off in the most recent months





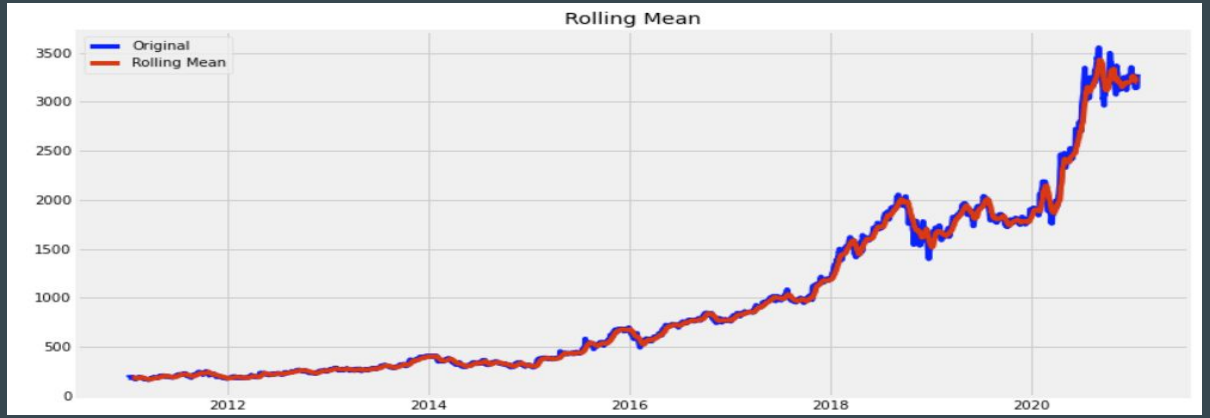
Assessing Trends

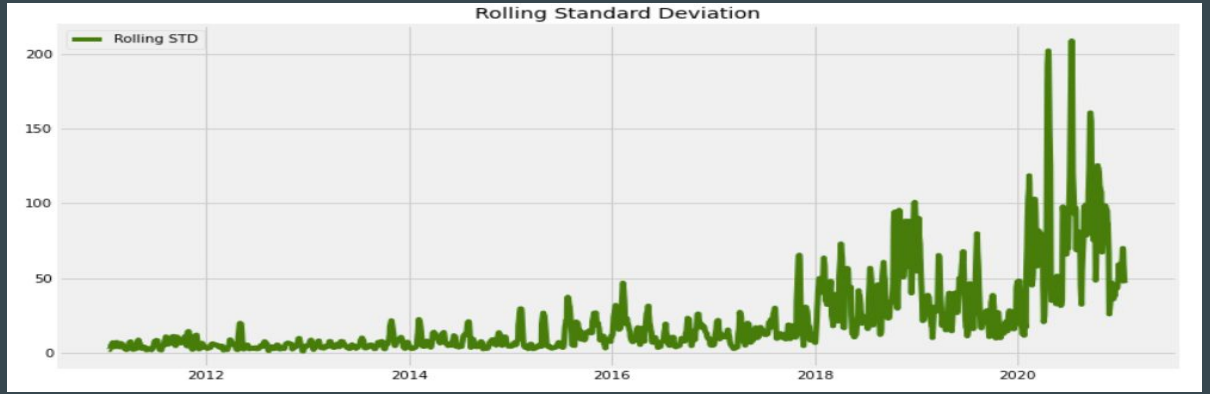
- Rolling mean or Moving average is a calculated to establish trends.

-Calculated continuously over entire data set.

-Used to smooth out noise. Notice how red line is smoother that the actual observed prices

-The rolling Standard Deviation is used as a measurement of volatility and takes into account the rolling averages and time.





Time Series Modeling: ARMA, ARIMA, SARIMA, Facebook Prophet

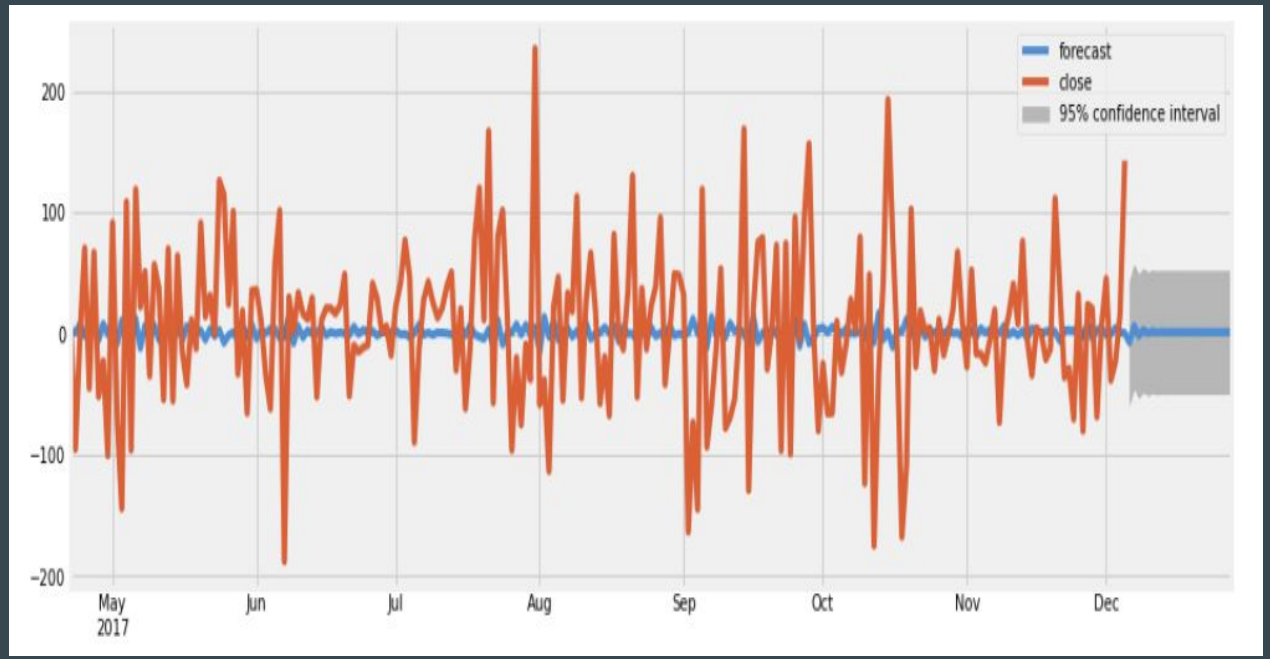
ARMA - Autoregressive Moving Average

- Model is used to describe weakly stationary time series in two seperate polynomials.

-The first is Autoregression

-The second is moving average

-Requires differencing of dependent variable, in the case the closing price prior to modeling.

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RMSE for arma_close_diff : 25.754738610935593
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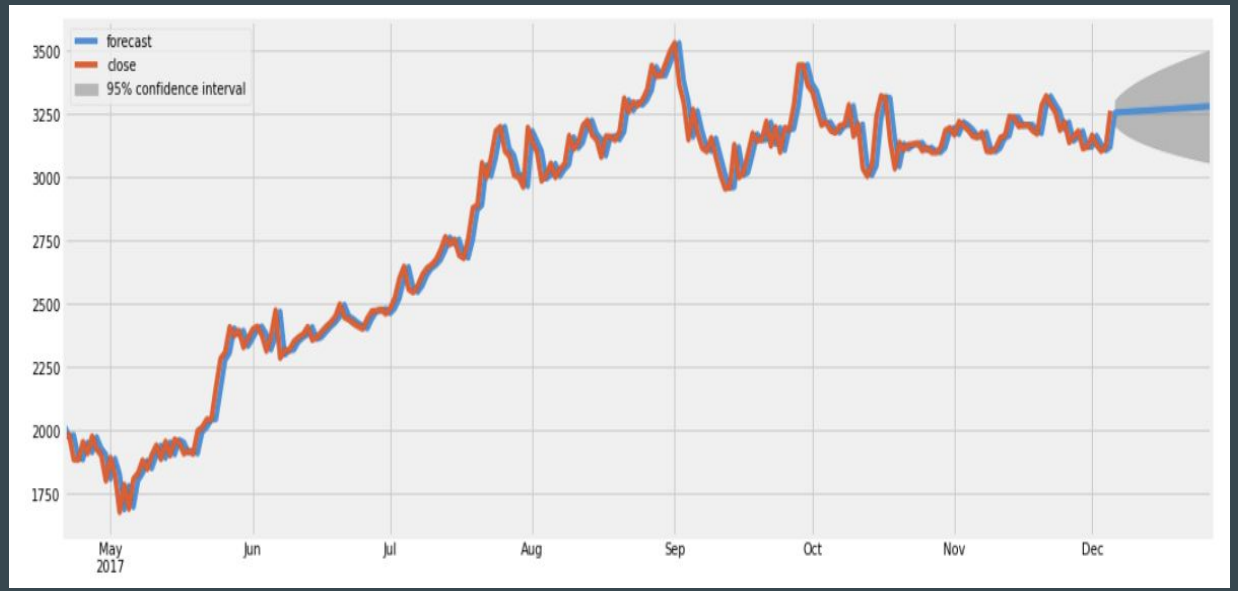
ARIMA - Autoregressive Integrated Moving Average

- Model is a generalization of the previous ARMA model.

-Model can be applied to non-stationary data where the initial differencing step is actually applied one or more times within the model.

-This is the what is meant by the integration addition.

- Note RMES has actually increased by a substantial amount. (due to the substantial price increase over the decade)

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RMSE for Arima_close : 1257.9588662401404
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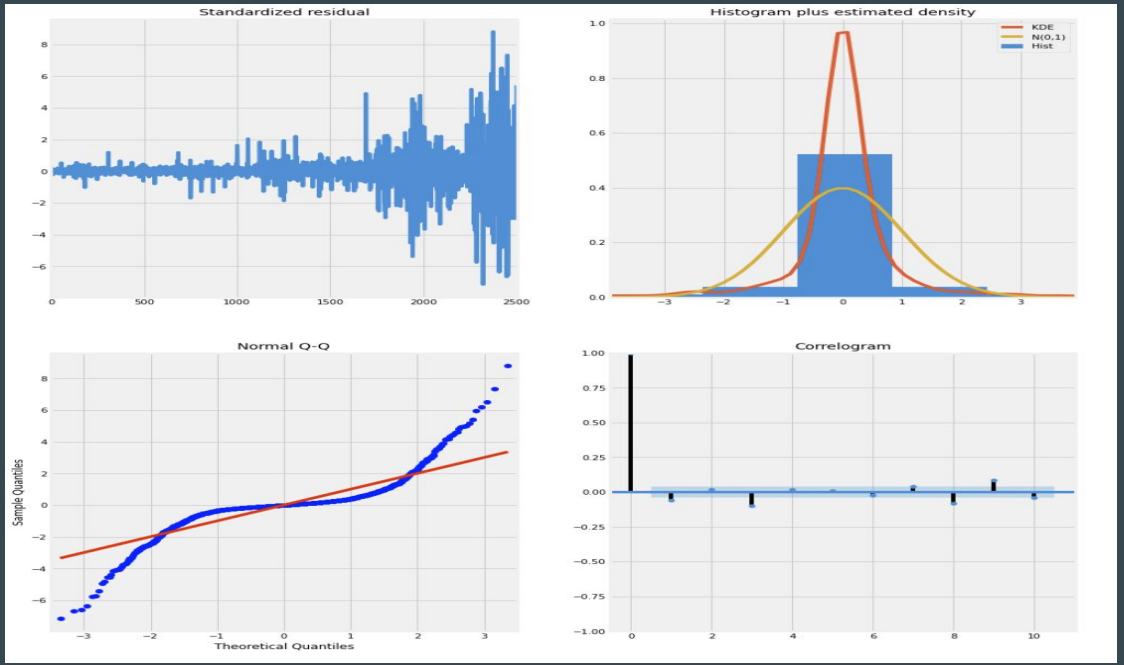
SARIMA - Seasonal Autoregressive Integrated Moving Average

- Model is useful for predicting seasonal time series.

-Straight forward extension of the previous ARIMA model.

-This model was tuned with GridSearch for optimal parameter inputs.

-Note RMSE is lower than previous ARIMA model but actually slightly higher than original ARMA model.



RMSE for sarima_model : 26.44342221927052

Facebook Prophet

-Prophet provides completely automated forecasts that can be specifically tuned for greater analysis.
- Can show both patterns and trends
-Very useful for future forecasting.
-This model is taking into account data from 2018-present day while forecasting 150 days into the future.
-Blue line represents predicted values.
-Black dots represent all REAL values
-Blue Shading represents a 95% confidence interval.

Facebook Prophet - Forecast components

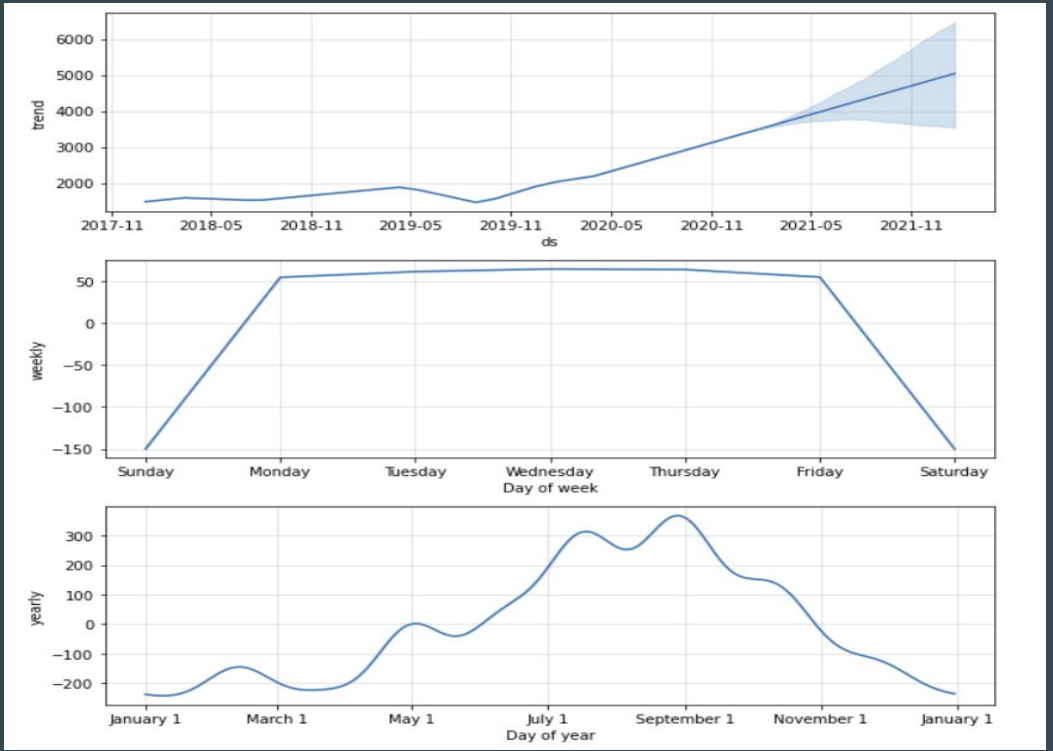
-Using forecast function to forecast one year into the the future

-Charts Representing principle components in forecasting model.

-Markets are not open on the weekend.

-Weekly and Daily are inverse of each other

-Interesting that yearly has a spike in the late summer months



Business Conclusions/Future Work

- BANNER FINANCIAL ANALYTICS
  - Based on financial modeling WOULD recommend an investment into Amazon
  - Facebook Prophet overall yielded the best forecasts, predictions, and visualizations.
  - In terms of traditional autoregressive models, ARMA performed the best in terms of RMSE
    - These models can be used in conjunction with other machine learning models and stacked in the future.
- Future work would include creating additional predictive models with Neural Networks
  - Narrowing the focus to more smaller time increments(minute by minute data) to allow more accurate short term predictions.

Thanks For Listening

https://github.com/Banner10/Phase_4_TimeSeries