

Silver ETFs Price forecast

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Is Silver a good investment

- Silver is seen as a safe haven investment in uncertain times, a hedge against inflation and stocks
- Silver's use as industrial metal in many fields also affects its price performance and outlook
- Silver is cheaper than gold, but more thinly traded, making it more volatile and illiquid.

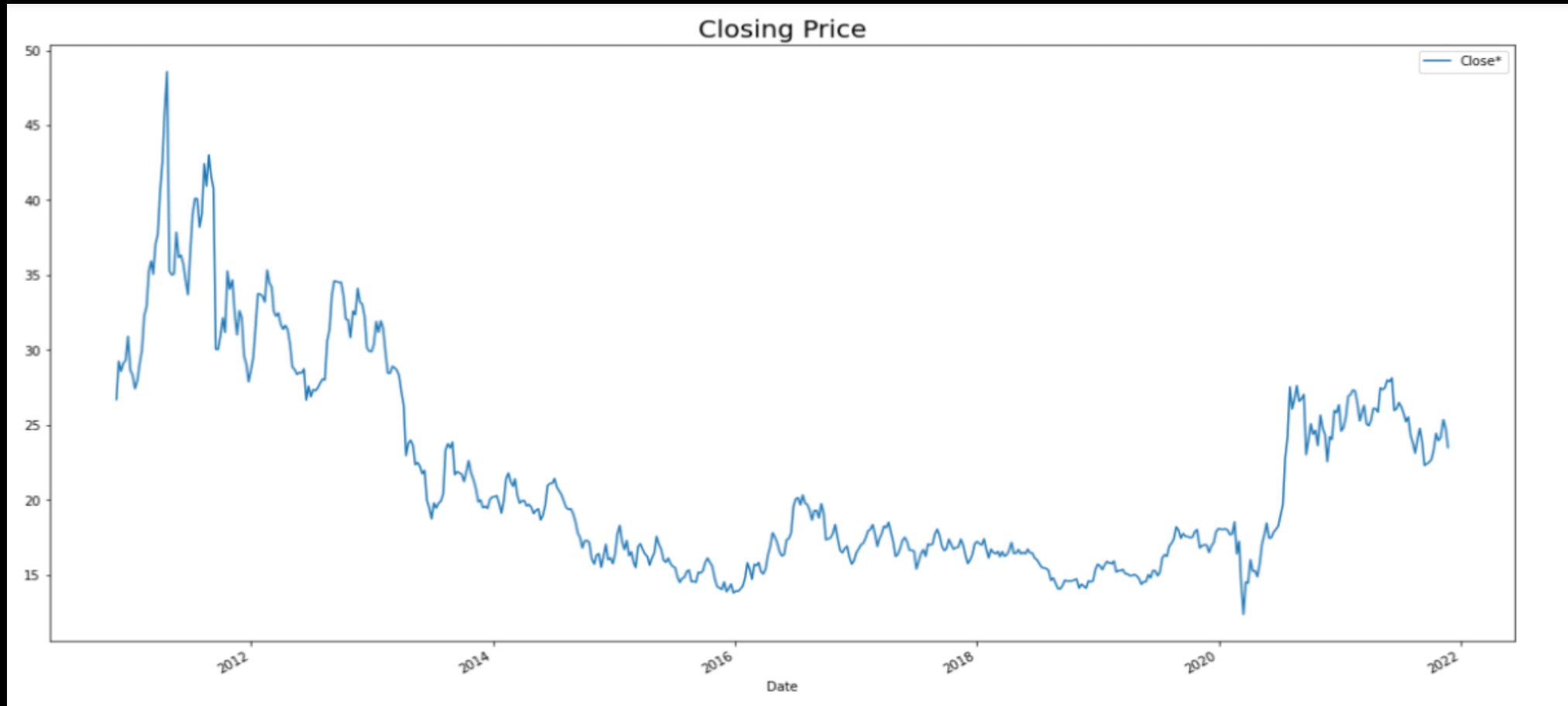
What are the risks of investing in silver ?

- Sensitive to recession
- Vulnerable to Technology shifts.
- Limited income/appreciation potential
- Unpredictable price moves

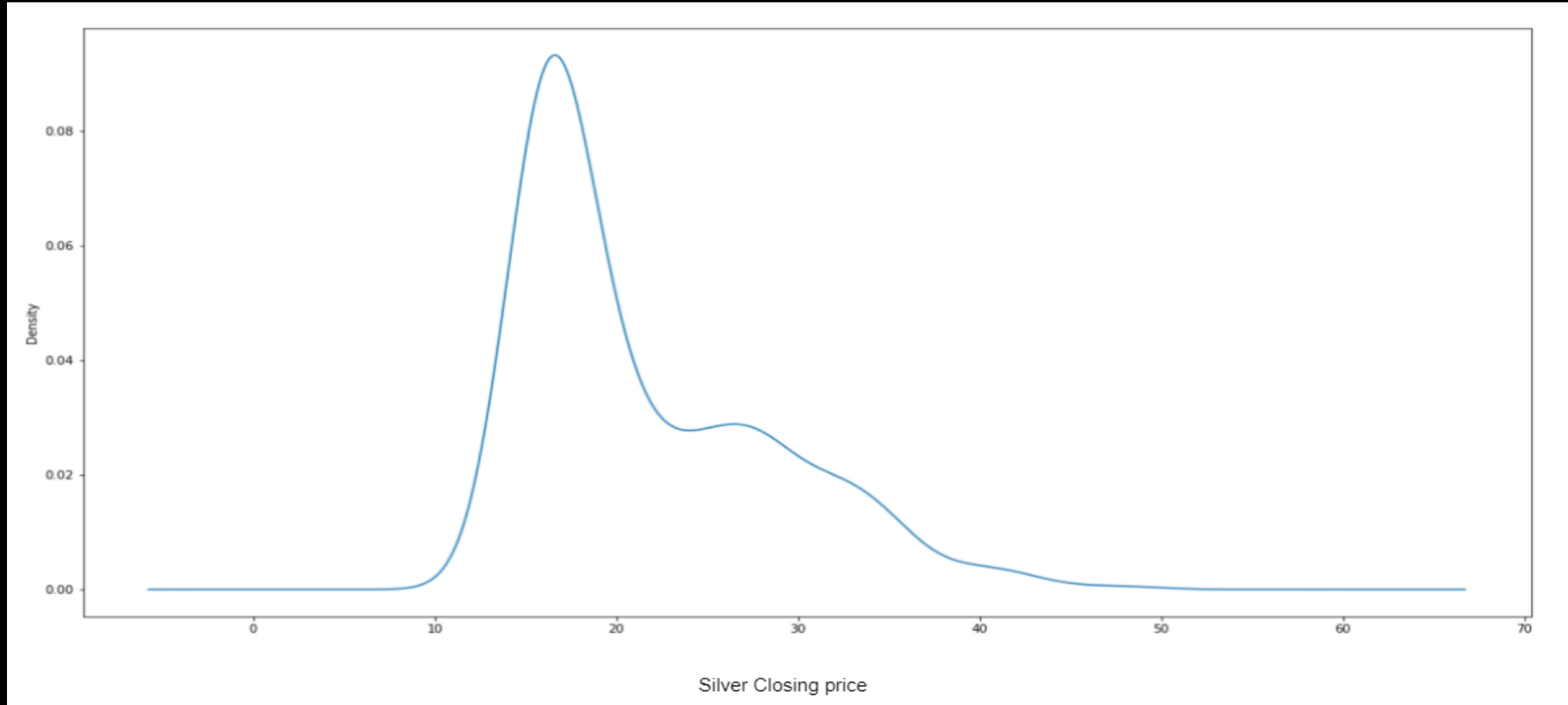
Where the Data are from

- The data was downloaded from the historical prices of silver [Silver Mar 22 \(SI=F\) Stock Historical Prices & Data - Yahoo Finance](#).
- The Closing price was selected for the analysis .
- Span of the analysis 10 years from 2010 to 2021 every week.

Plot of Silver Closing price

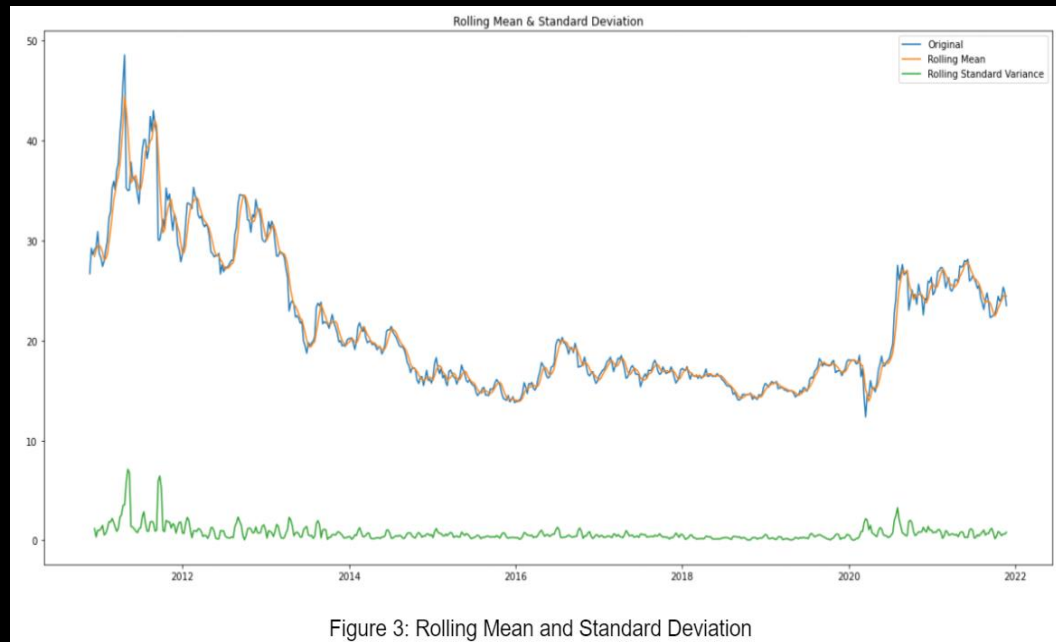


Plot of the Silver Closing Density



Determine whether the series is stationary

Rolling Statistics



The graph of rolling mean and rolling standard deviation is not constant, this shows that our dataset is not stationary.

Augmented Dickey-Fuller Test

Test Statistics	-1.66
P-values	0.45

The obtained p-value (0.45) is greater than the significance level of 0.05

Making Time series Stationary

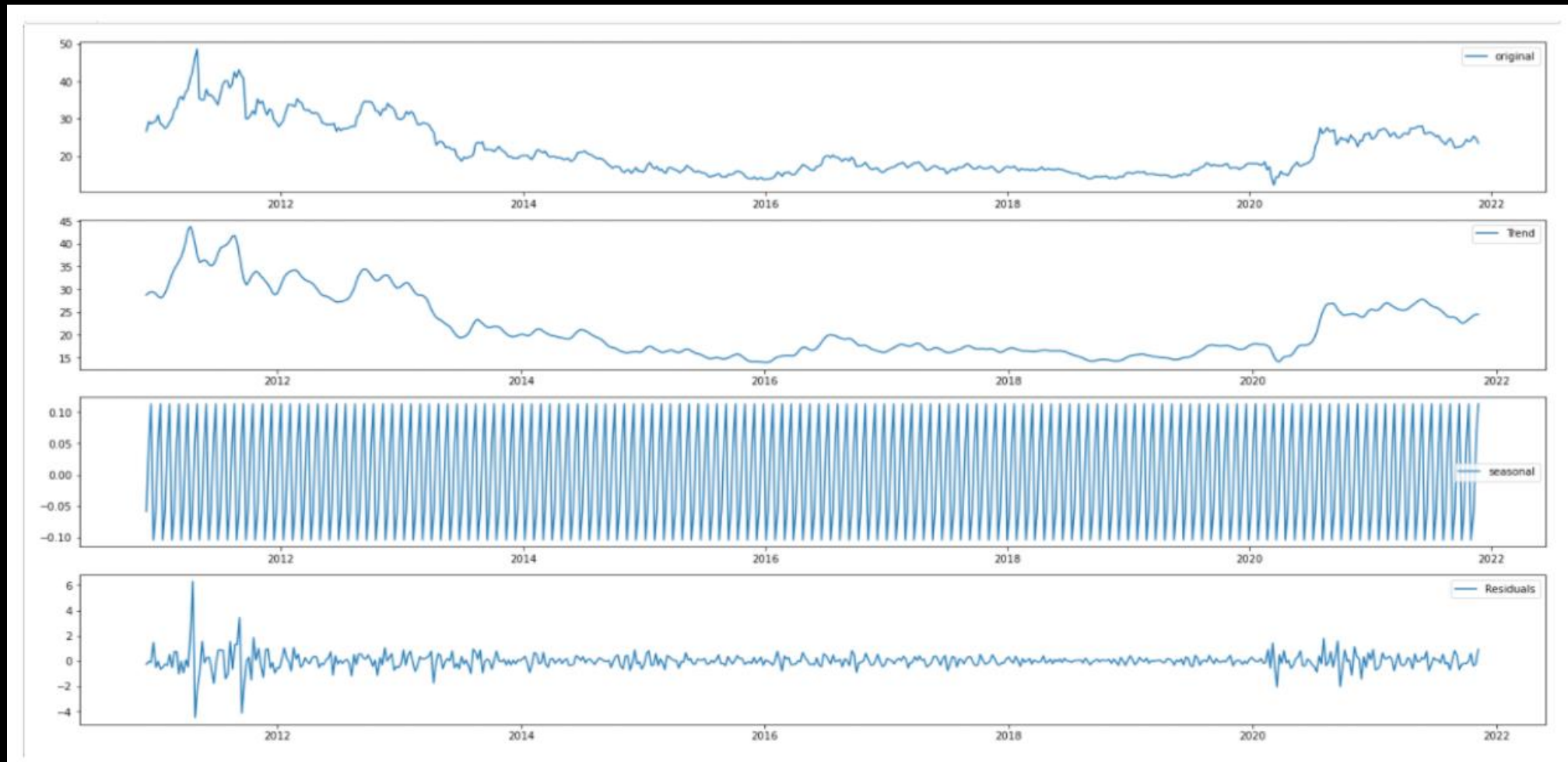
Three Methods

Method	ADF	P-value	Comment
Difference	-6.47	1.35e-08	Can make time series stationary
Square Root	-1.83	0.37	P-value >0.05 no suitable to make time series stationary
Twice Difference	-11.56	3.18e-21	Can make time series stationary

Splitting the data for modeling (train and test)



Time Series Decomposition



Modeling

ARIMA

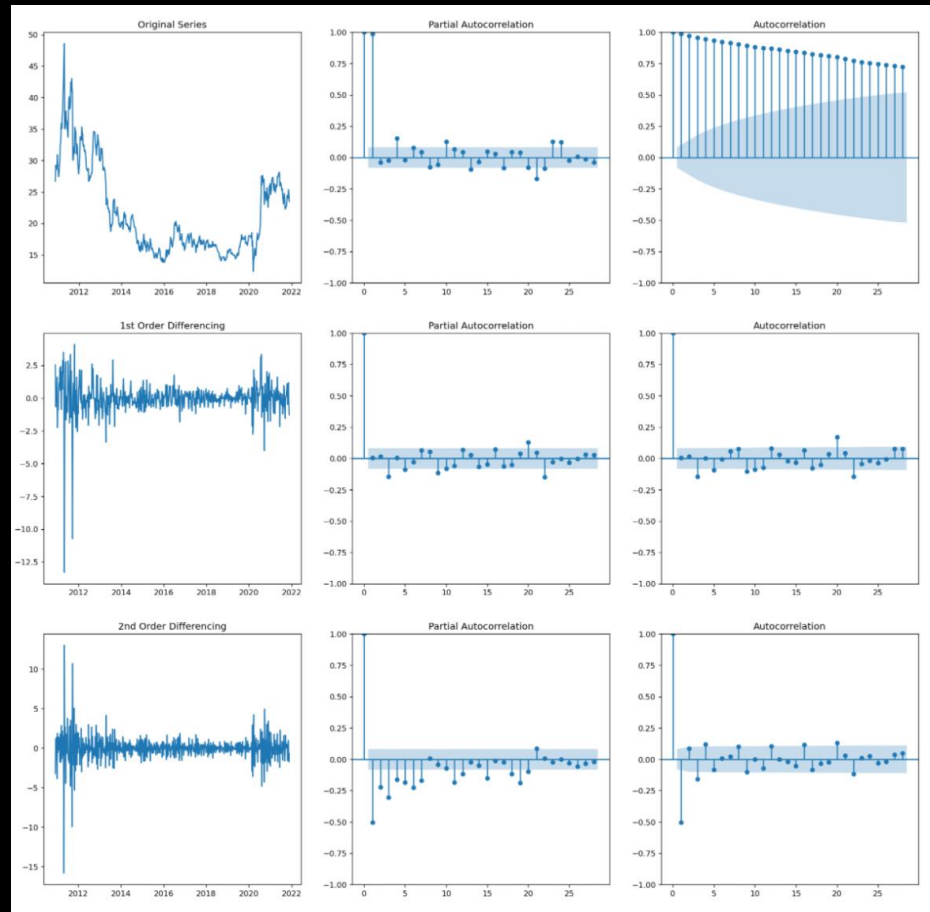
ARIMA, short for 'Auto Regressive Integrated Moving Average', predicts the target variable using a regression based on the prices in previous time steps.

The initial ARIMA model was run with no seasonality

SARIMA

Seasonal ARIMA, is an extension of ARIMA that explicitly supports univariate time series data with a seasonal component.

ARIMA Model order Selection with ACF and PACF



ARIMA model order Selection with the ACF(Autocorrelation Function) and PACF (Partial Autocorrelation Function)
Model order parameters:

- **d** is the minimum number of differencing needed
- **p** is the order of the 'Auto Regressive' (AR) term. It refers to the number of lags of Y to be used as predictors
- **q** is the order of the 'Moving Average' (MA) term. It refers to the number of lagged forecast errors that should go into the ARIMA Model.

The results show that the ACF cuts off after lag 1 and the PACF tails off. This may indicate that a Moving Average Model with an order of 1 MA might be the best

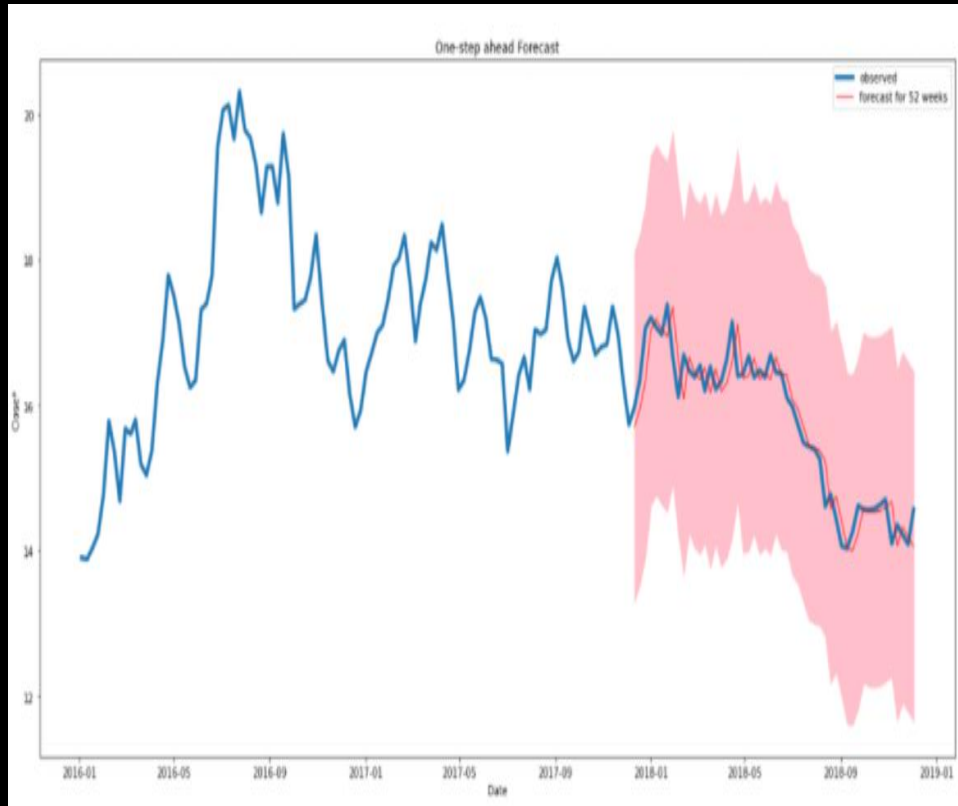
Model Order Selection using AIC (Akaike Information Criterion)

Auto arima function selects the parameters automatically based on the results of the test, in this case the Augmented Dickey-Fuller test.

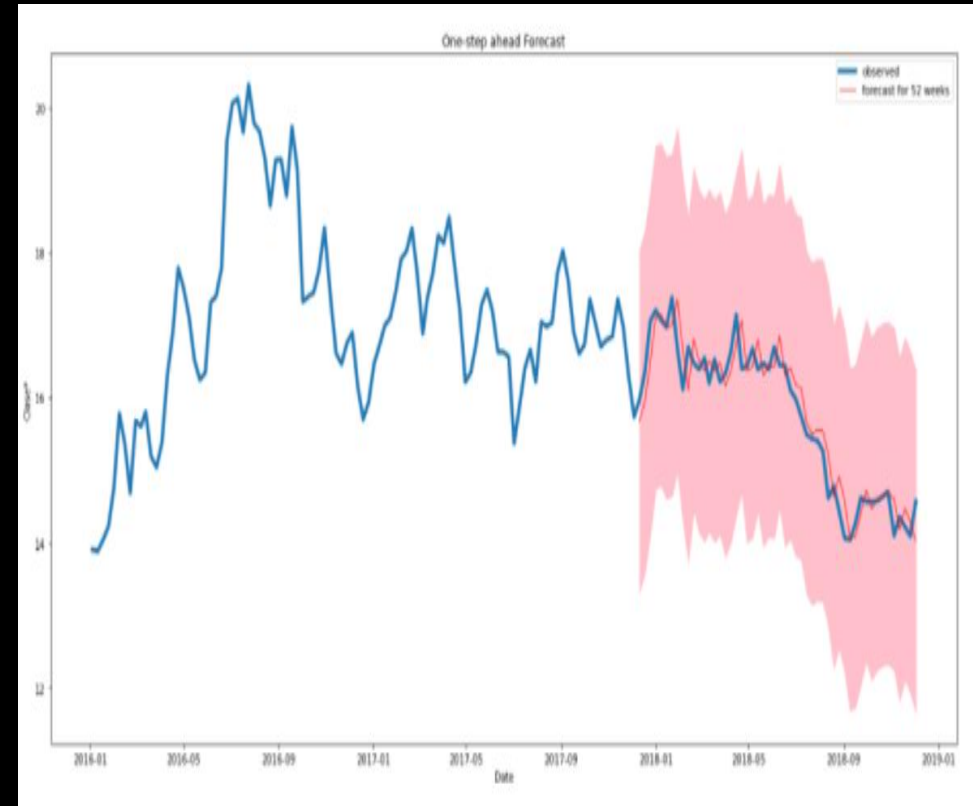
Best Model Arima	(0,1,0)(0,0,0)[0]	AIC=1793
Best Model Sarima	(1,0,0)(1,1,1)[4]	AIC=1784

Fit to Prediction

ARIMA



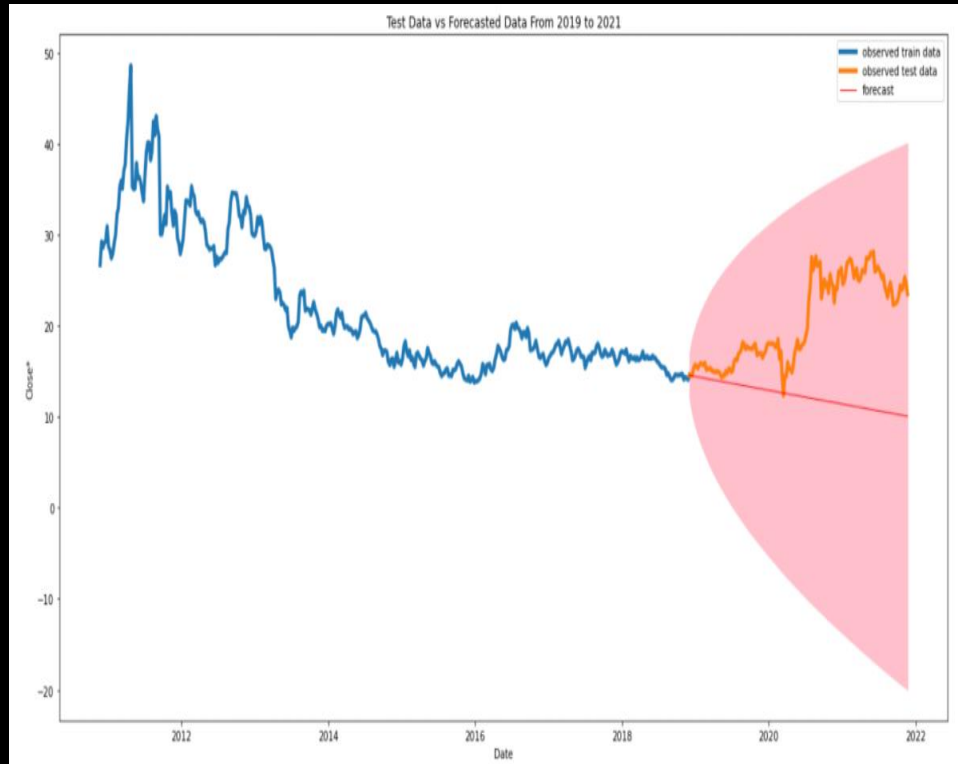
SARIMA



The prediction for the last 52 weeks (one Year) of the training data aligns close to the real data in both Arima and Sarima Models.

Forecast of the silver price and compare to test data

ARIMA



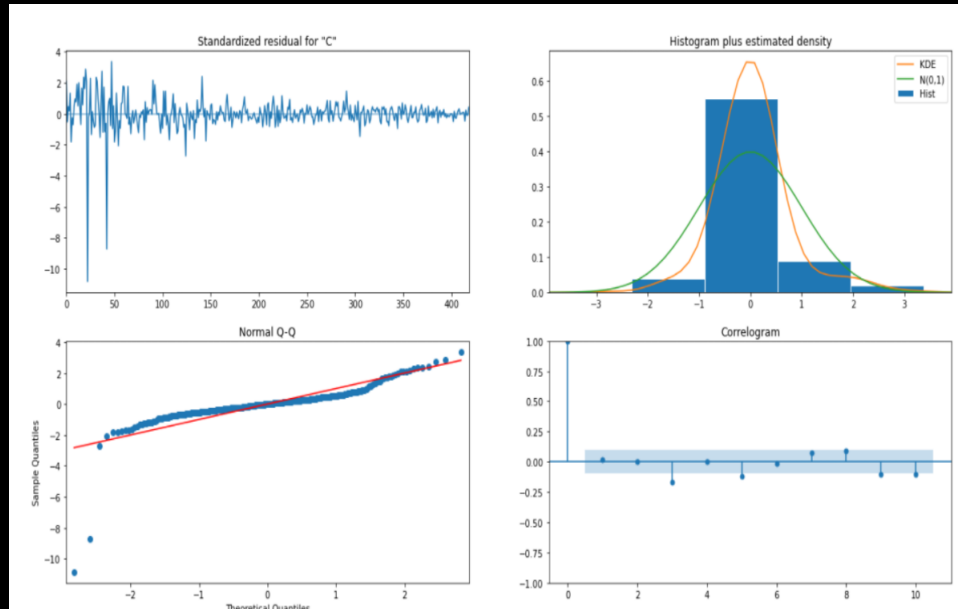
SARIMA



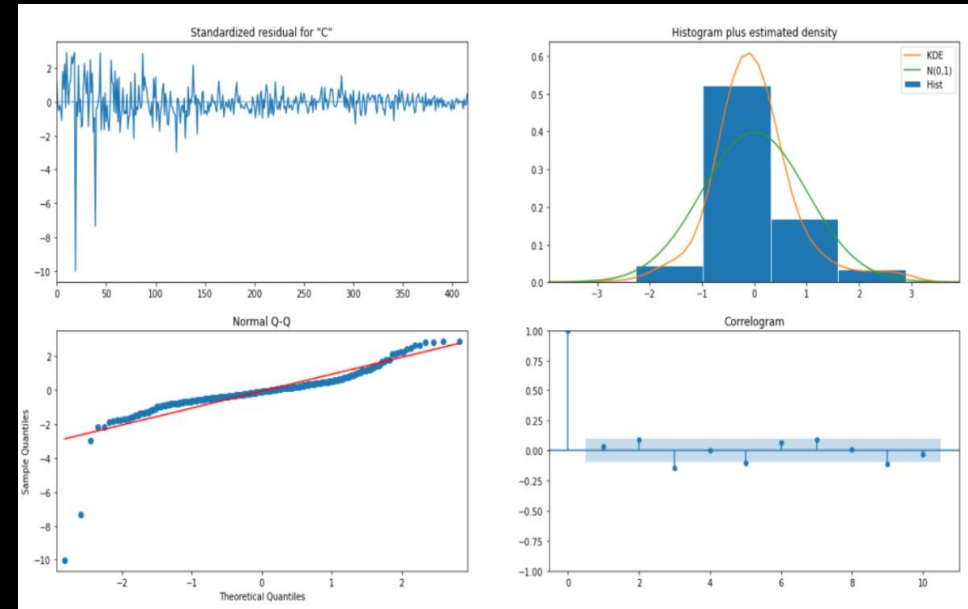
Arima model the trend is downward while the Sarima model is almost flat but closer to the actual trend and the confidence interval appears narrower for Sarima than for Arima

Model Diagnostics

ARIMA



SARIMA



Standardized Residual Plot: The residual errors seem to fluctuate around a mean of zero and have a uniform variance for both models, although a little closer for Sarima than Arima.

Histogram Plus Estimated Density: The density plot suggests normal distribution. The green line shows a normal distribution of the residuals with mean zero and the orange line should be close to the green line. In this case both models are not close, but Sarima is closer than the Arima model.

Normal Q-Q: Shows how the distribution of the residuals compares to a normal distribution. In This case most of the residual for both models are on the line.

Correlogram t: The Correlogram, aka, ACF plot shows the residual errors are not autocorrelated. Any autocorrelation would imply that there is some pattern in the residual errors which are not explained in the model. Overall, it seems to be a good fit.

Scoring Metrics : MAE, RMSE

MODEL	MAE	RMSE
ARIMA	8.11	9.99
SARIMA	5.50	7.12

Conclusion

This project focused on SILVER weekly commodity pricing forecasting. The goal for this project is to understand and apply ARIMA, SARIMA time-series models in forecasting the price of silver.

By looking at the plot of the ARIMA Model we can observe a downward trend in the forecast window which is not aligned with the trend of the test data.

The SARIMA model, which is the ARIMA Model that includes seasonality, shows an improved forecast although not the correct trend which is upward. The accuracy metrics confirm that the Sarima Model is more accurate.

Future work would include refining this model (for example to make the residuals normally distributed) and using other modeling tools such as Facebook prophet and LSTM.