Time Series Analysis

Steps to perform Time Series Analysis

- Importing the data.
- Cleaning(if required) and performing EDA on the data.
- Splitting the data into train(70%) and test(30%).
- Checking for trend and seasonality using seasonal decompose.
- Checking for stationarity using ADF and KPSS test.
- Detrending and de-seasonalizing the data if required.
- Plotting the ACF and PACF plots to get the lag values.
- Model Building(ARIMA(M1), Auto-ARIMA(M2), HOLT/SimpleExpSmoothing/ExponentialSmooting(M3)).
- Evaluating the models using AIC and RMSE values.

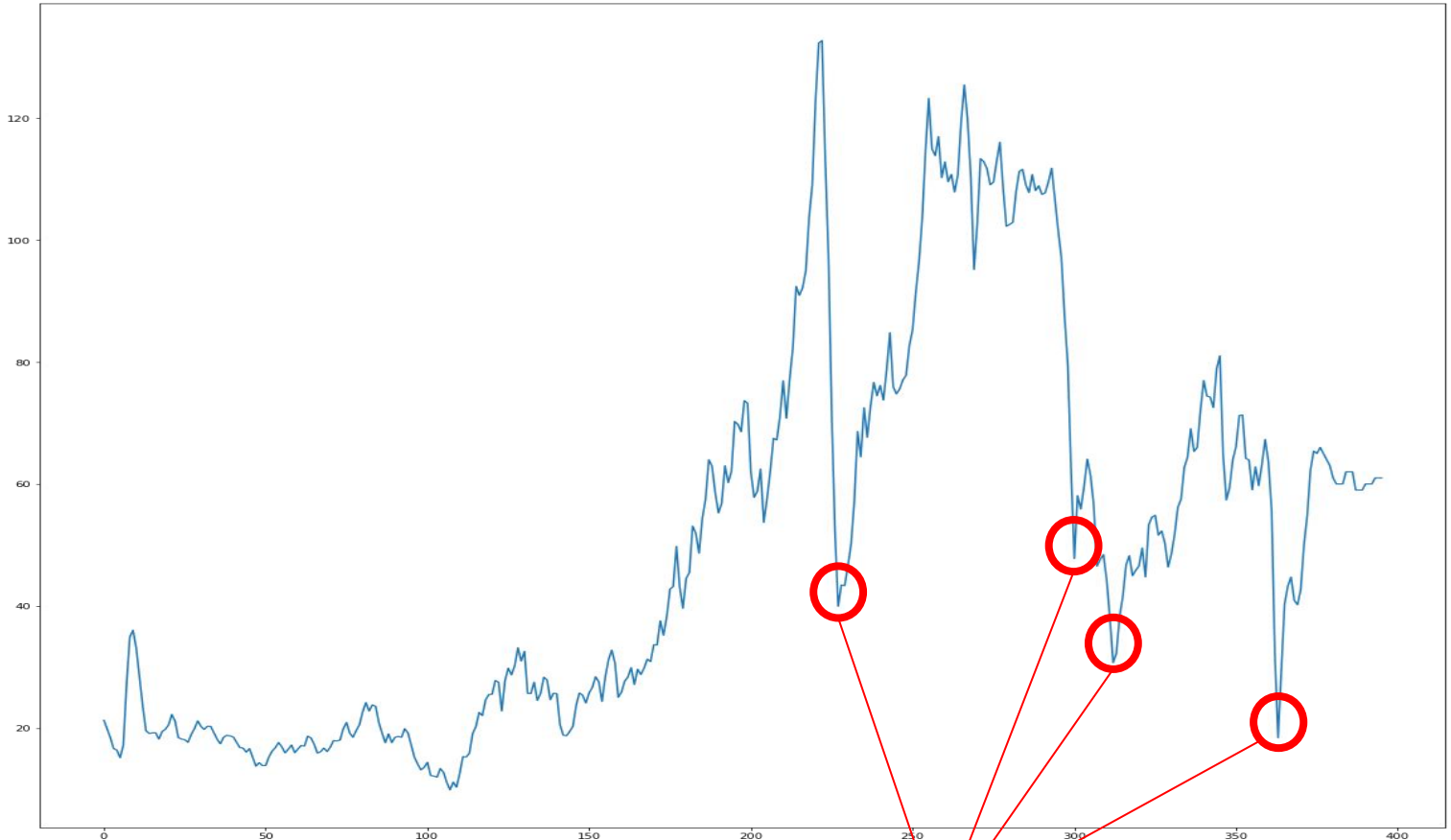
Datasets

- Brent Spot Prices
- Cali Emissions
- Coal Power
- HH Spot Price
- Imports Crude Oil

Brent Spot Prices

Problem Statement

- Using the data of Brent Spot Prices from 1990 to 2012, we need to perform a time series analysis to understand the changes in the price of Brent (Oil) and build a model to forecast the price for last 10 years to check the accuracy of the model.



Analysis & Observations

- Data follows a stochastic trend i.e. the rise and drop in the values is highly dependent on several other factors other than time.
- The data seems to have multiplicative trend(irregular due to anomalies) as well as additive seasonality.
- In order to make the data stationary we detrended the data 1 time and de-seasonalized it 1 time.
- Using ACF and PACF plots, we determined that Auto Regressive(AR(p)) model is suitable for the data.

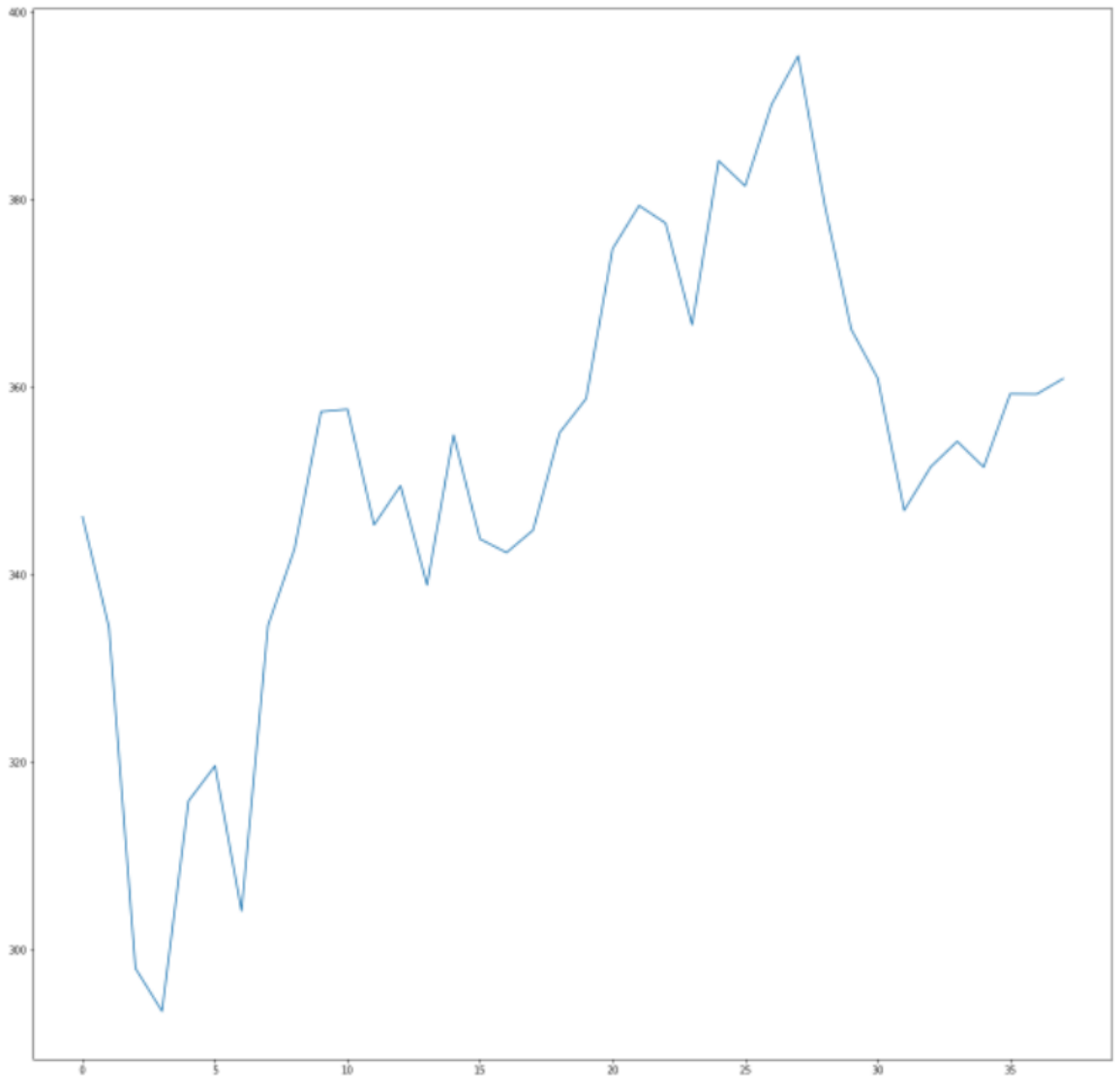
Model Analysis

	Final Model Parameters							RMSE	AIC
	p	**d**	**q**	**P**	**D**	**Q**	**Period**		
M1	1	1	0	0	1	0	12	73.316	1664.555
M2	1	1	0	2	1	1	12	88.48	1540.916
M3 (Exponential Smoothing)	-	-	-	-	-	-	12	73.642	852.002

Cali Emissions

Problem Statement

- Using the yearly(1980 to 2005) data of carbon dioxide emissions in California, we need to perform a time series analysis to understand the changes in the emission and build a model to forecast the emission for the years 2006-2017.



Analysis & Observations

- Data provided is yearly data and shows an increasing trend with a bi yearly seasonality.
- For our models, we have assumed that the data has no seasonality.
- The trend shown is additive.
- In order to make the data stationary we detrended the data 2 times.
- Using ACF and PACF plots, we determined that Auto Regressive(AR(p)) model is suitable for the data.

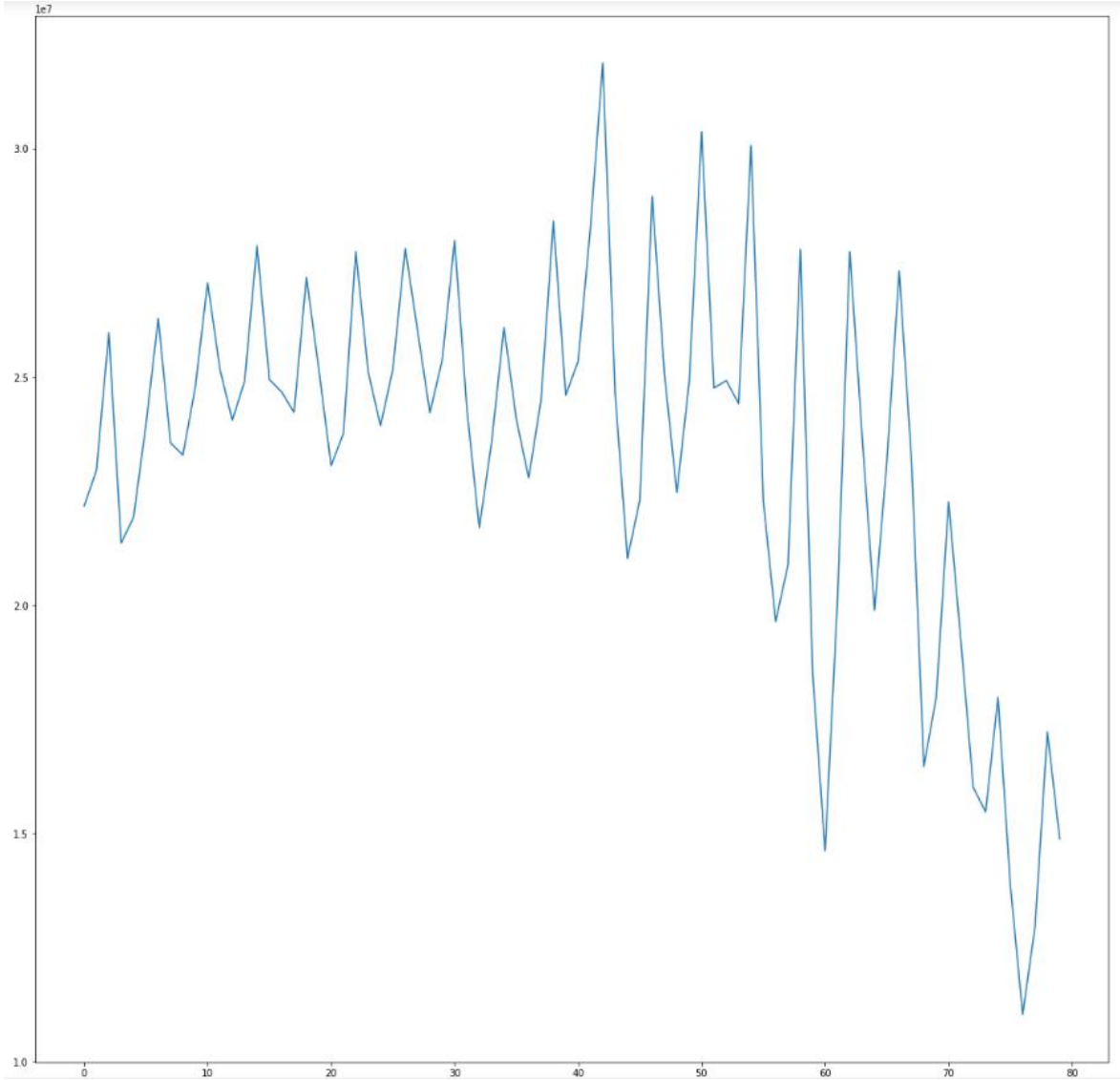
Model Analysis

	Final Model Parameters							RMSE	AIC
	p	d	q	P	D	Q	Period		
M1	0	2	1	-	-	-	0	35.386	195.664
M2	3	2	0	-	-	-	0	47.322	200.126
M3 (Holt)	-	-	-	-	-	-	0	35.128	139.851

Coal Power

Problem Statement

- Using the quarterly data of Coal Consumption to generate electric power, we need to perform a time series analysis to understand the rate of consumption of coal and build a model to forecast the demand for the years 2015-2020.



Analysis & Observations

- Data follows an exponential downward trend with yearly seasonality.
- The data seems to have additive trend as well as additive seasonality.
- In order to make the data stationary we detrended the data 2 times and de-seasonalized it 1 time.
- Using ACF and PACF plots, we determined that Moving Average(MA(q)) model is suitable for the data.

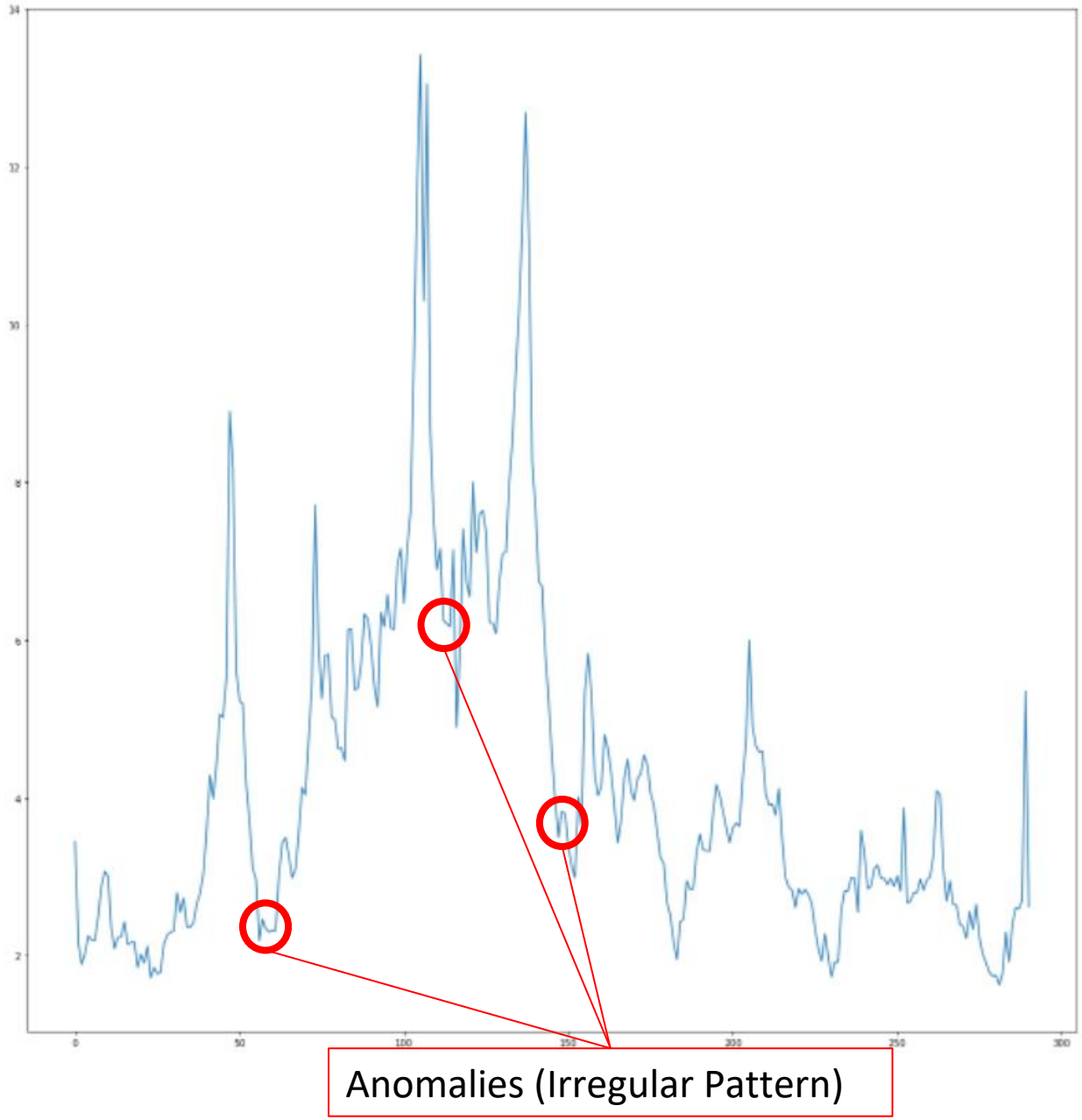
Model Analysis

	Final Model Parameters							RMSE	AIC
	p	**d**	**q**	**P**	**D**	**Q**	**Period**		
M1	0	2	1	0	1	0	4	6111549.003	1545.793
M2	0	2	1	0	1	0	4	6111549.003	1545.793
M3 (Exponential Smoothing)	-	-	-	-	-	-	4	9034610.355	1567.361

HH Spot Price

Problem Statement

- Using the monthly data of Henry Hub Natural Gas Spot Prices from 1997 to 2013, we need to perform a time series analysis to understand the changes in the price of Natural Gas and build a model to forecast the price for the years 2014 - 2021 to check the accuracy of the model.



Analysis & Observations

- The data follows an irregular trend due to the anomalies present in the data.
- In order to make the data stationery we de-seasonalized the data once.
- And by plotting the ACF & PACF plot determined that Auto Regressive(AR(p)) model is suitable for the data.

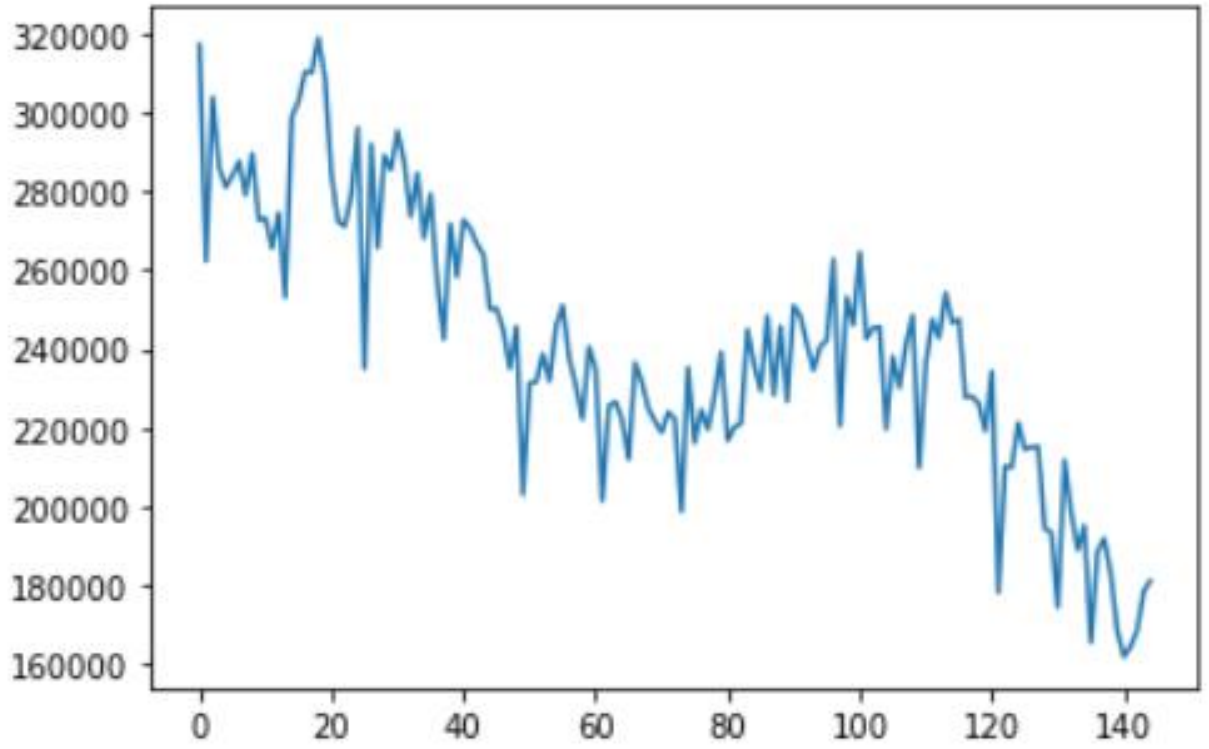
Model Analysis

	Final Model Parameters							RMSE	AIC
	p	d	q	P	D	Q	Period		
M1	1	0	0	0	1	0	12	1.620	620.329
M2	1	0	0	2	1	0	12	1.129	550.853
M3 (Holt)	-	-	-	-	-	-	12	0.849	-65.376

Imports Crude Oil

Problem Statement

- Using the data of the imports of Crude Oil in the US, we need to perform a time series analysis to understand the quantity of oil imported and build a model to forecast the demand for the years 2018-2020.



Analysis & Observations

- The data has a linear downward trend and seasonality of 12 periods
- In order to make the data stationary we detrended the data 1 time and de-seasonalized it 1 time.
- Using ACF and PACF plots, we determined that Auto Regressive(AR(p)) model is suitable for the data.
- And Considering the AIC values generated for models AUTO-ARIMA gives the best model.

Model Analysis

	Final Model Parameters							RMSE	AIC
	p	**d**	**q**	**P**	**D**	**Q**	**Period**		
M1	1	1	0	0	1	0	12	45113.227	1902.175
M2	1	1	0	1	1	1	12	39719.881	1890.671
M3 (Exponential Smoothing)	-	-	-	-	-	-	12	57311.833	1915.297

THANK YOU