

NATURAL GAS FORECASTING

Rice University FinTech BootCamp

Project 2 , April 13th 2022

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AGENDA

- Introductions/Objective/Data Resources (Parag)
- Identifying Patterns and Correlations/Heatmap (Parag)
- Time Series Forecasting - Prophet (Bolaji)
- Time Series Forecasting - ARIMA (Onur)
- Concluding Remarks/Future Steps (Team)
- Questions

OBJECTIVE

- To develop a machine learning model that will help natural gas supplier/scheduler prepare for better inventory controls in future
- A machine learning tool can come up with automated forecasting models and allow one person to do the work of multiple data scientists

DATA RESOURCES

Natural Gas Data:

- Price, Consumption, Storage, Exports
- U.S. Energy Information Administration (www.eia.gov)

USA Average Temperature Data:

- National Centers for Environmental Information (ncei.noaa.gov)

BASIS

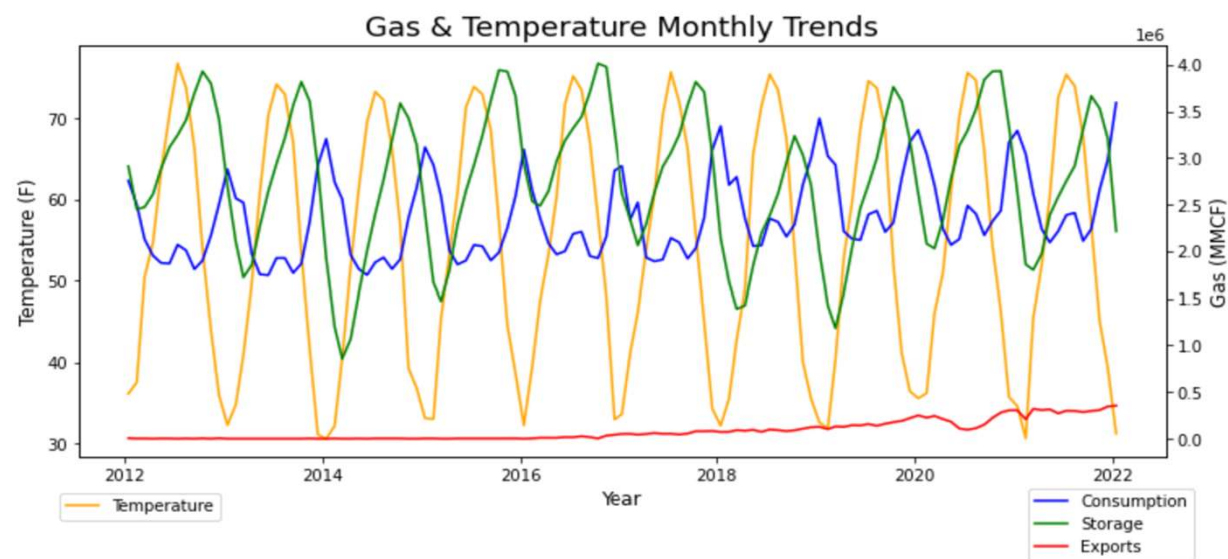
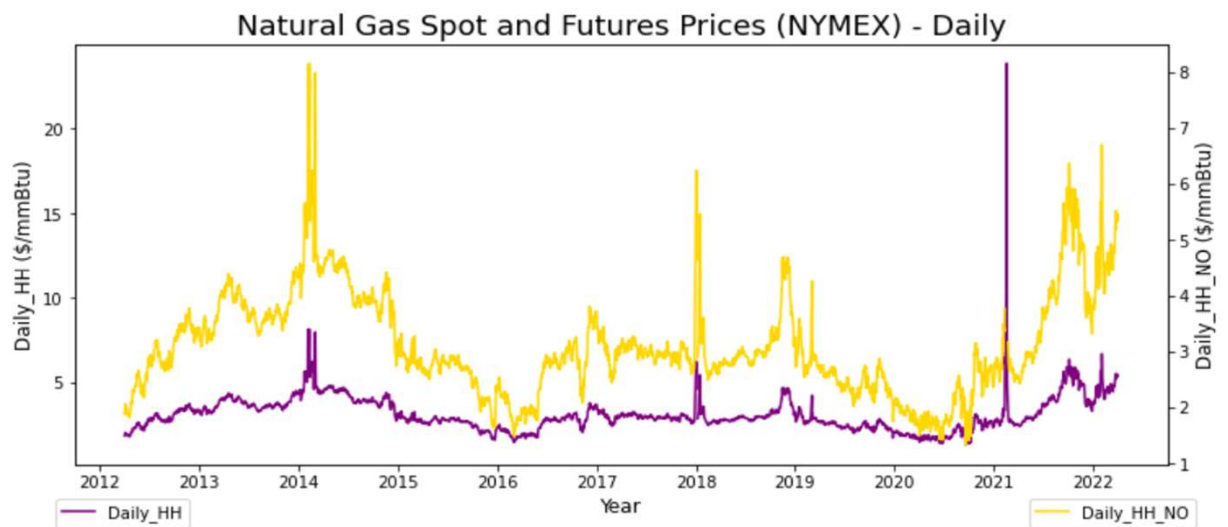
Historical Data:

- 10 years (2012-2022)

Forecast Data:

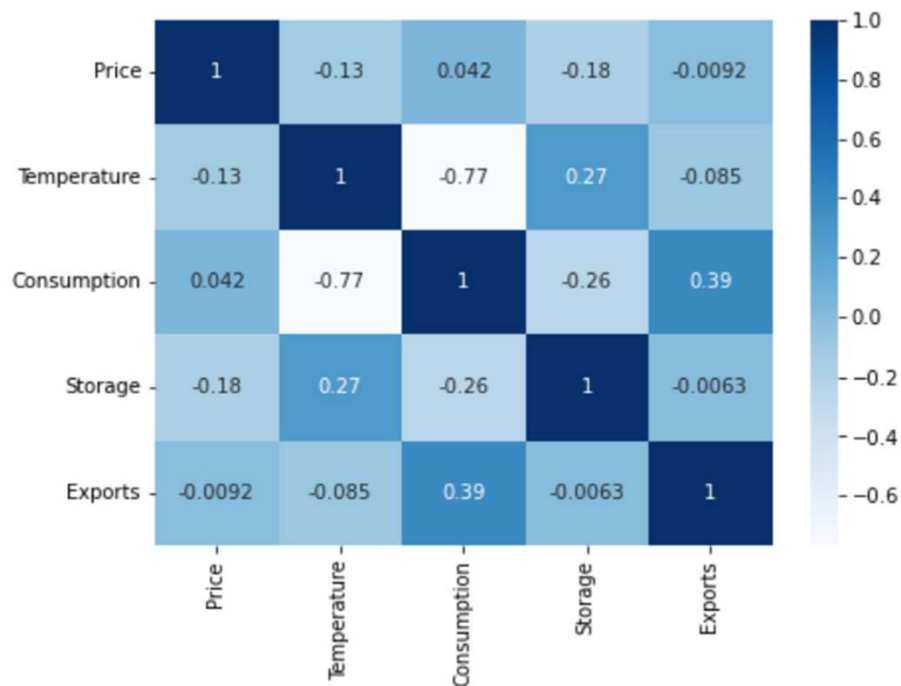
- 3 years

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CORRELATIONS/HEATMAP



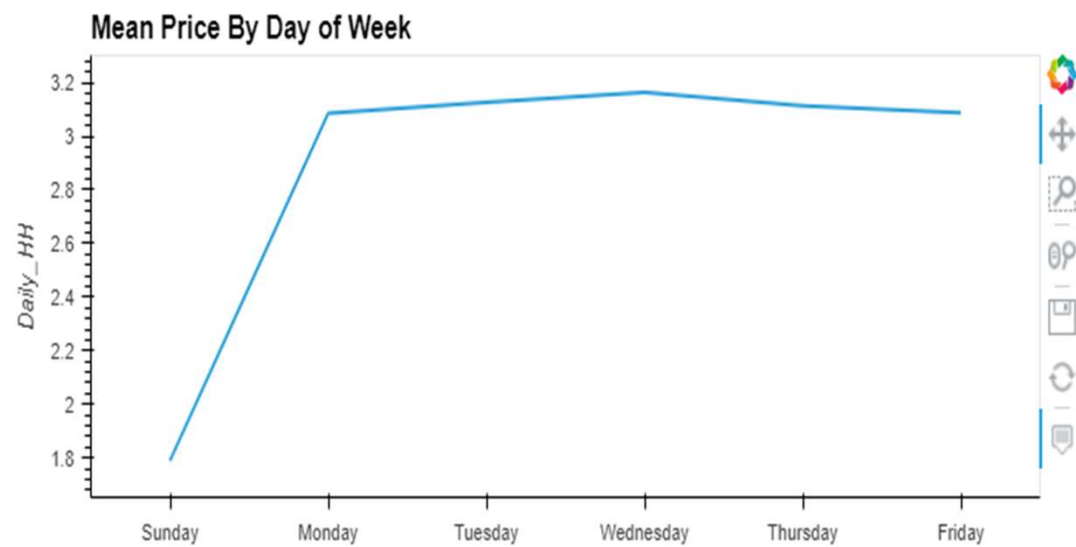
- Temperature ↓ Consumption ↑
- Storage ↑ Temperature ↑
- Storage ↑ Consumption ↓
- Price ↑ Storage & Temperature ↓
- No strong correlation exists between domestic consumption and HH spot price
- Good positive correlation exists between domestic consumption and exports

TIME SERIES ANALYSIS & FORECASTING

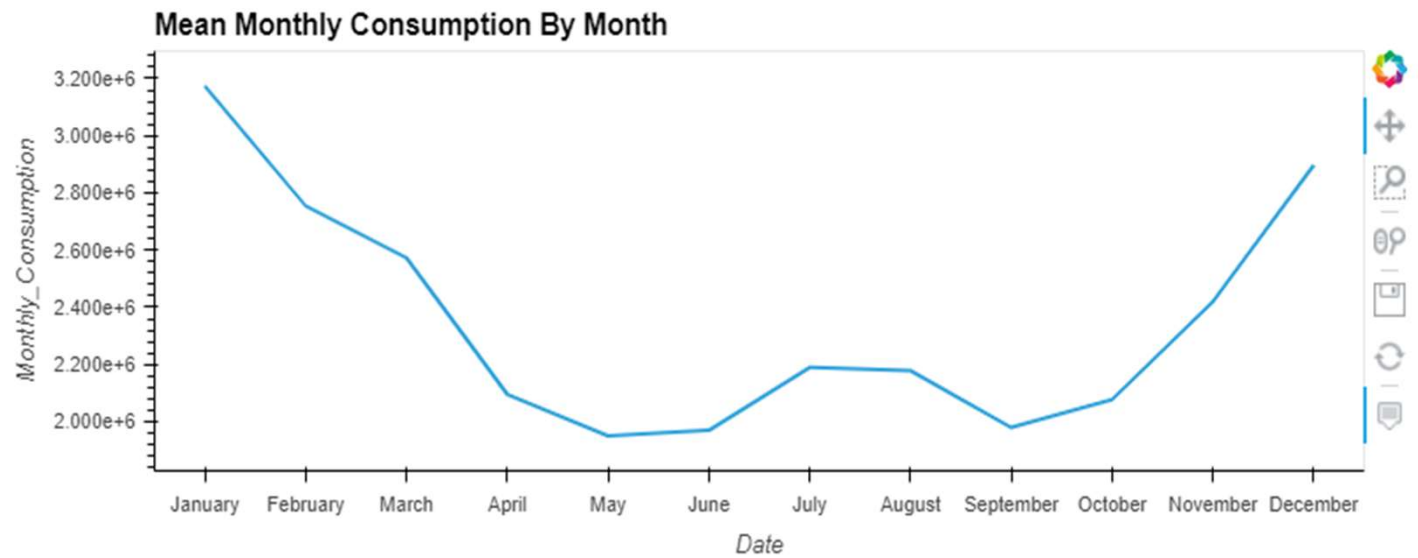
SOFTWARE & LIBRARIES:

- Prophet
- HV Plot
- Hollow-view
- Pandas
- Google Colab

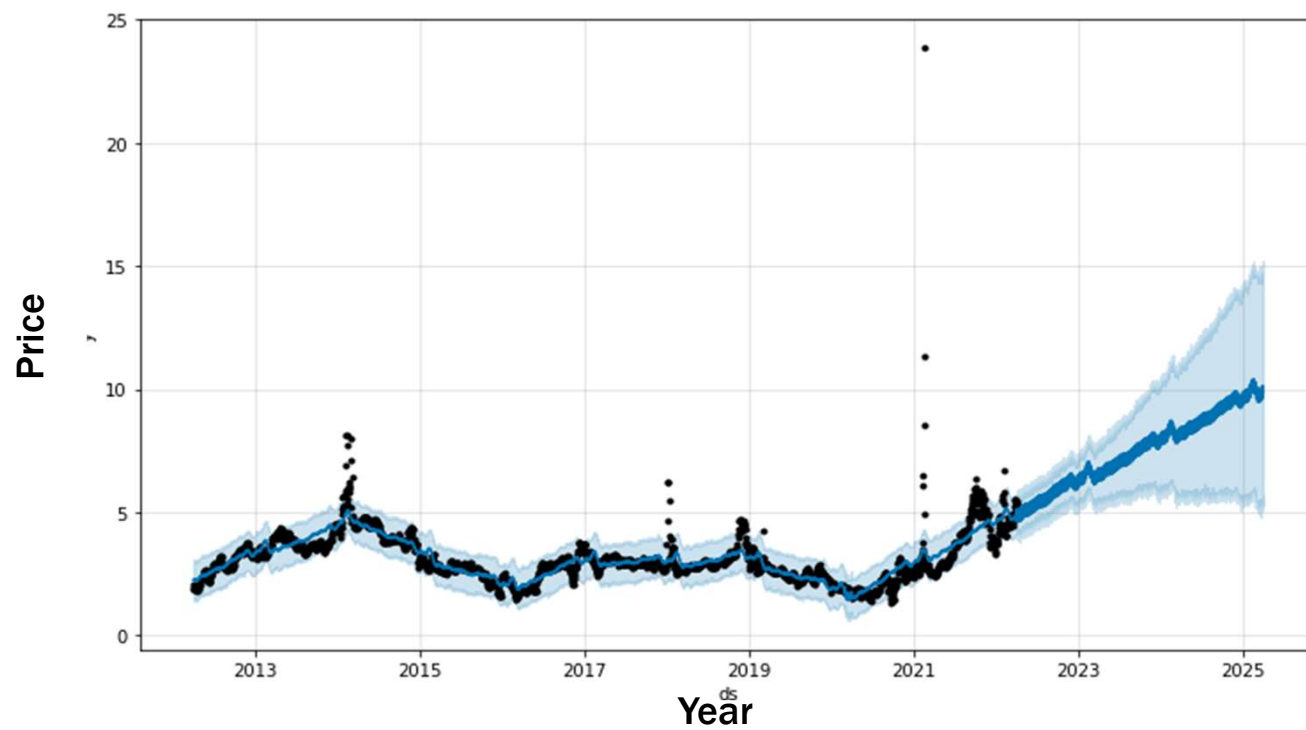
DAILY PRICE BY DAY OF WEEK



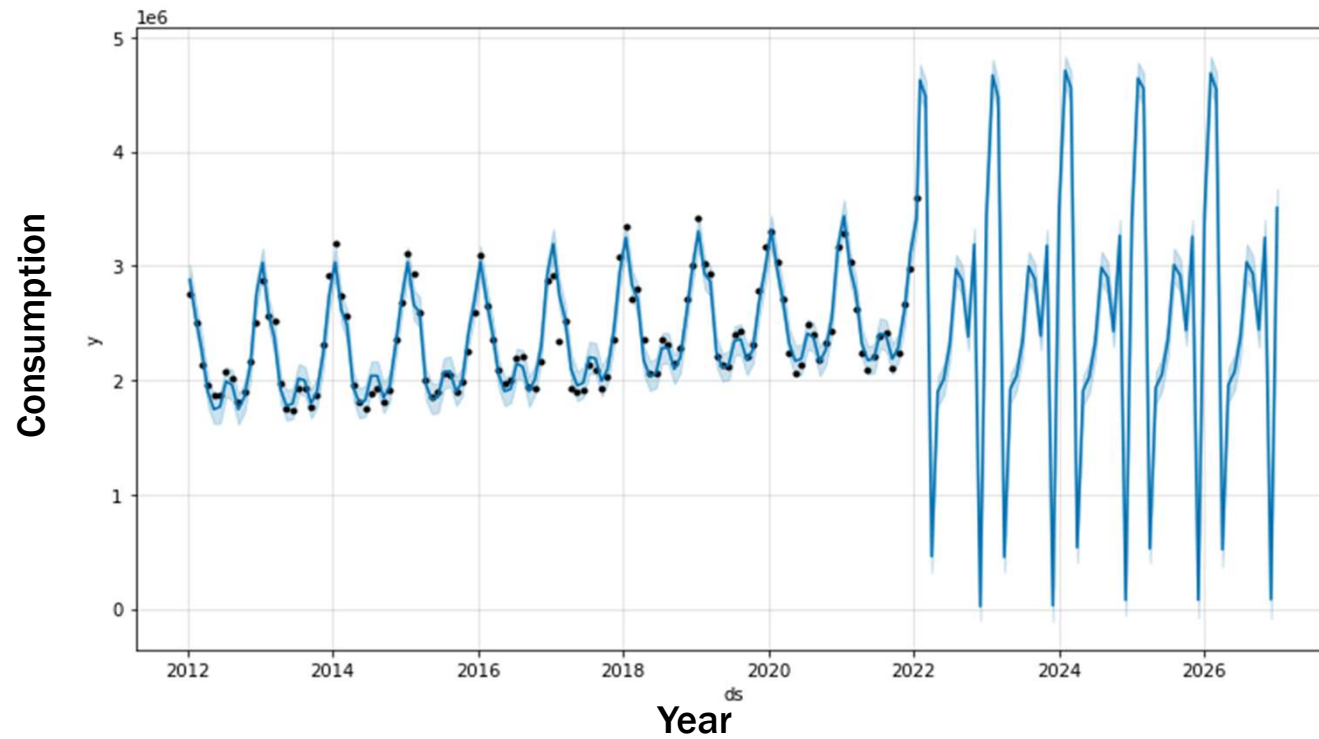
MEAN MONTHLY CONSUMPTION



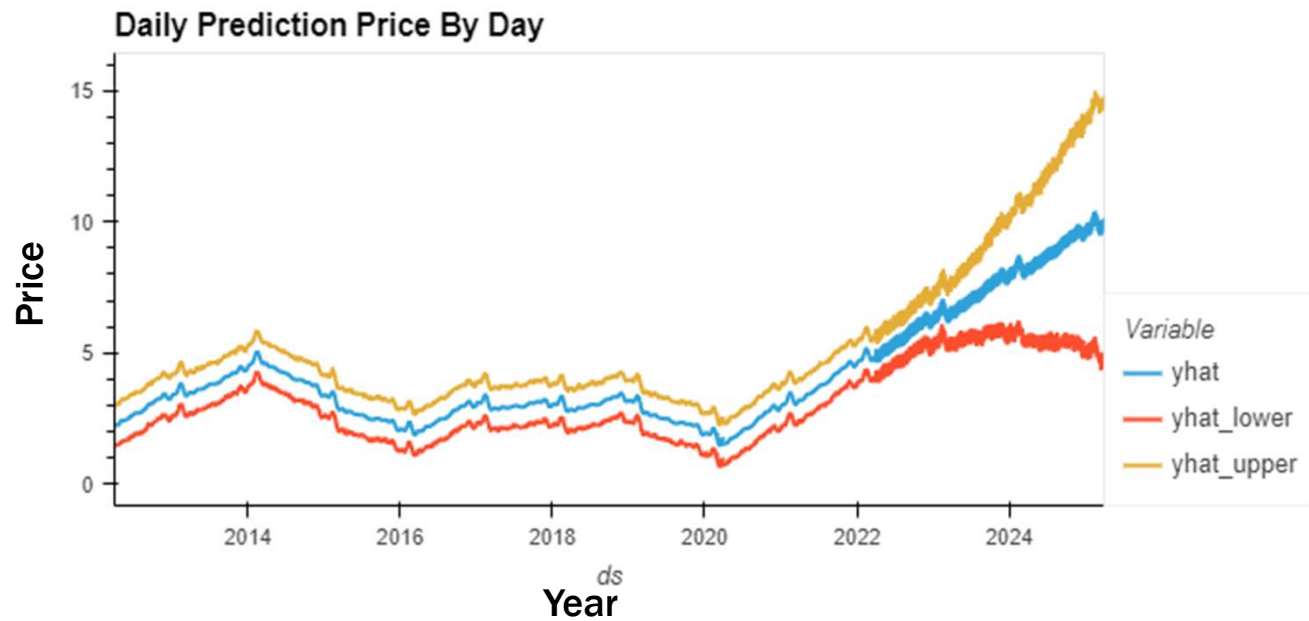
3-YR PRICE FORECAST---PROPHET



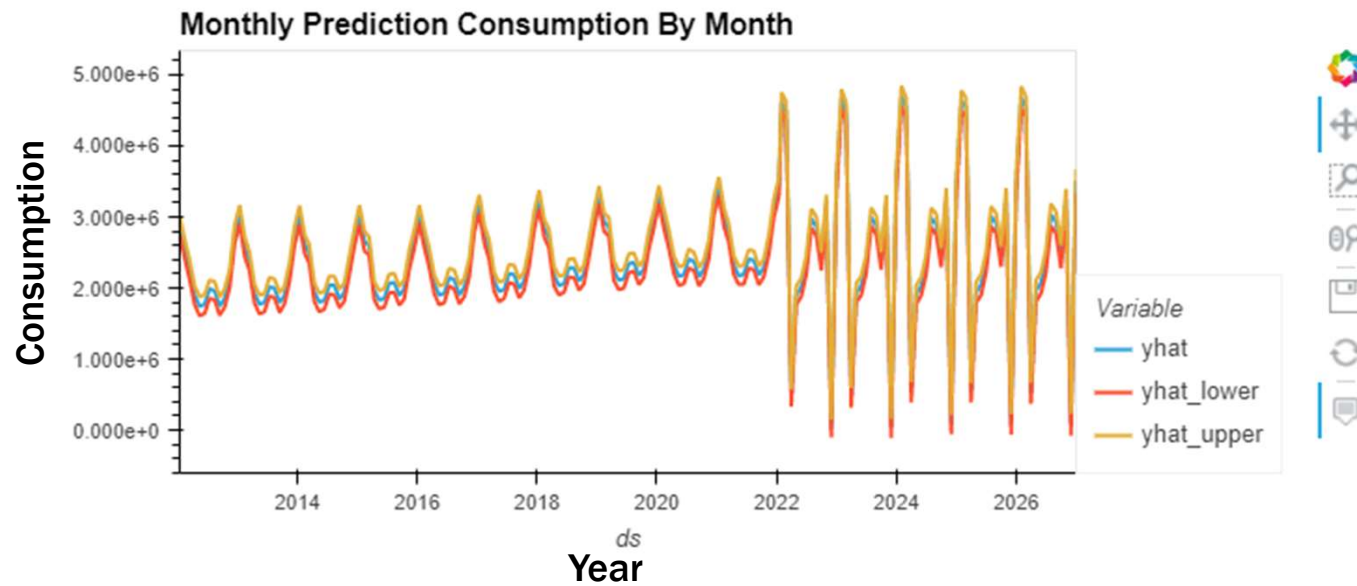
3-YR CONSUMPTION FORECAST---PROPHET



3-YR PRICE PREDICTION WITH BOUNDARIES HV-PLOT



3-YR MONTHLY CONSUMPTION FORECAST WITH BOUNDARIES—HV-PLOT



CONCLUSIONS - PROPHET

Current:

- Day of week with highest price - Wednesday
- Month of year with highest consumption - January

Forecast:

- Price to Increase next 3 years
- Consumption to Increase next 3 years

FORECASTING - ARIMA

- ARIMA, short for 'AutoRegressive Integrated Moving Average'
- Based on the idea that the information in the past values of the time series can alone be used to predict the future values.
- Any 'non-seasonal' time series that exhibits patterns and is not a random white noise can be modeled with ARIMA models
- If a time series, has seasonal patterns, then you need to add seasonal terms and it becomes SARIMA, short for 'Seasonal ARIMA'.

An ARIMA model is characterized by 3 terms: p , d , q

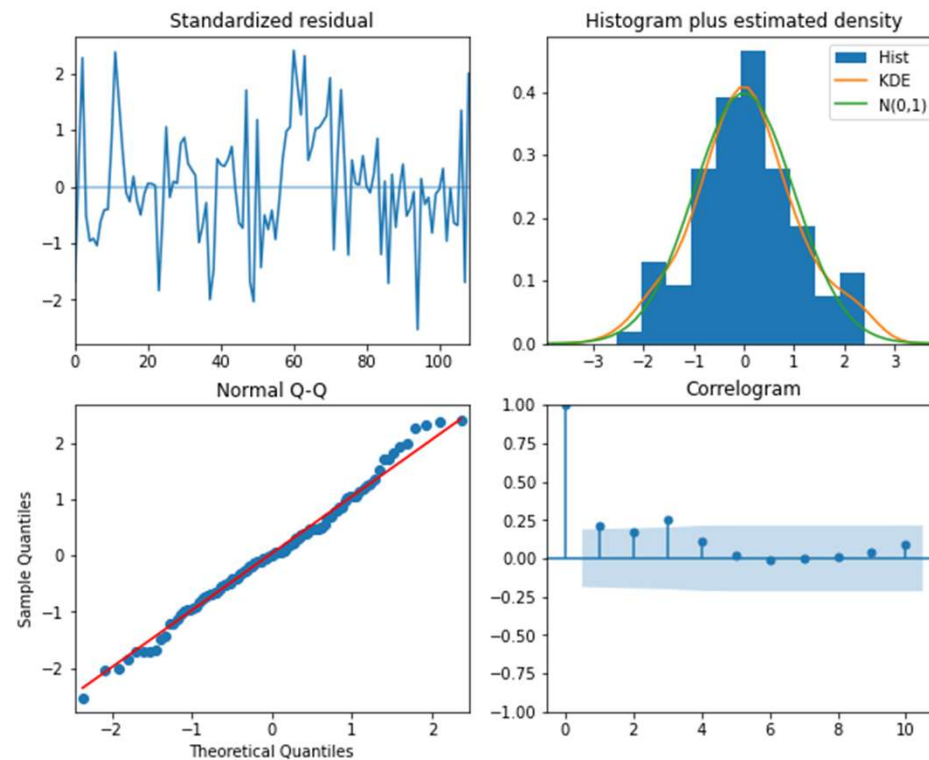
where,

p is the order of the AR term

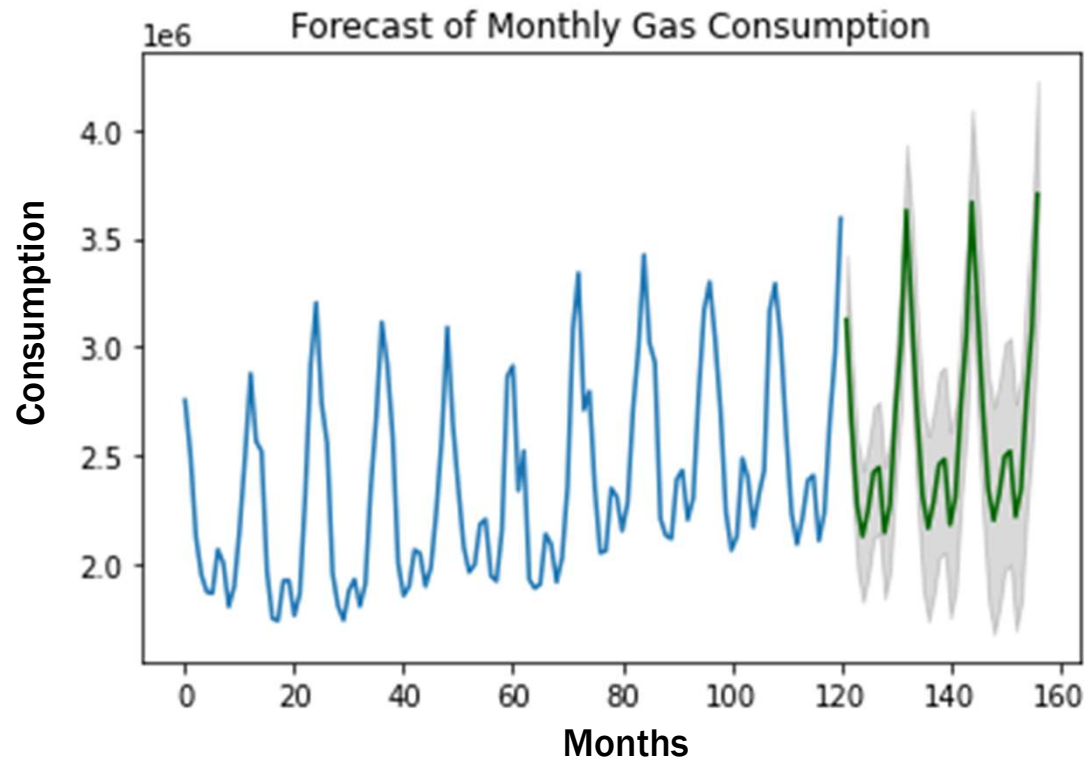
q is the order of the MA term

d is the number of differencing required to make the time series stationary

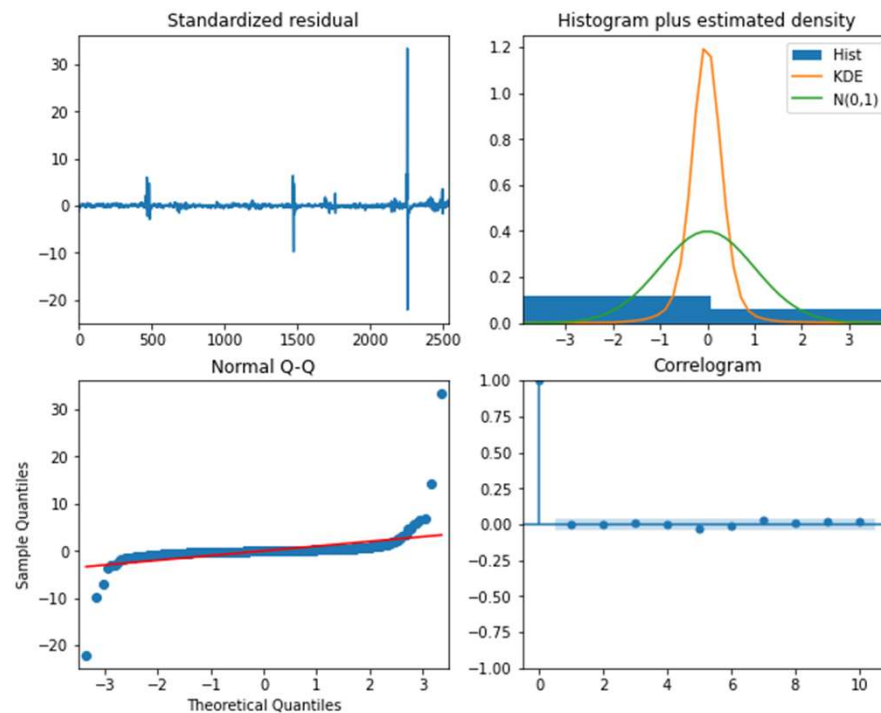
ARIMA DIAGNOSTICS FOR MONTHLY GAS CONSUMPTION



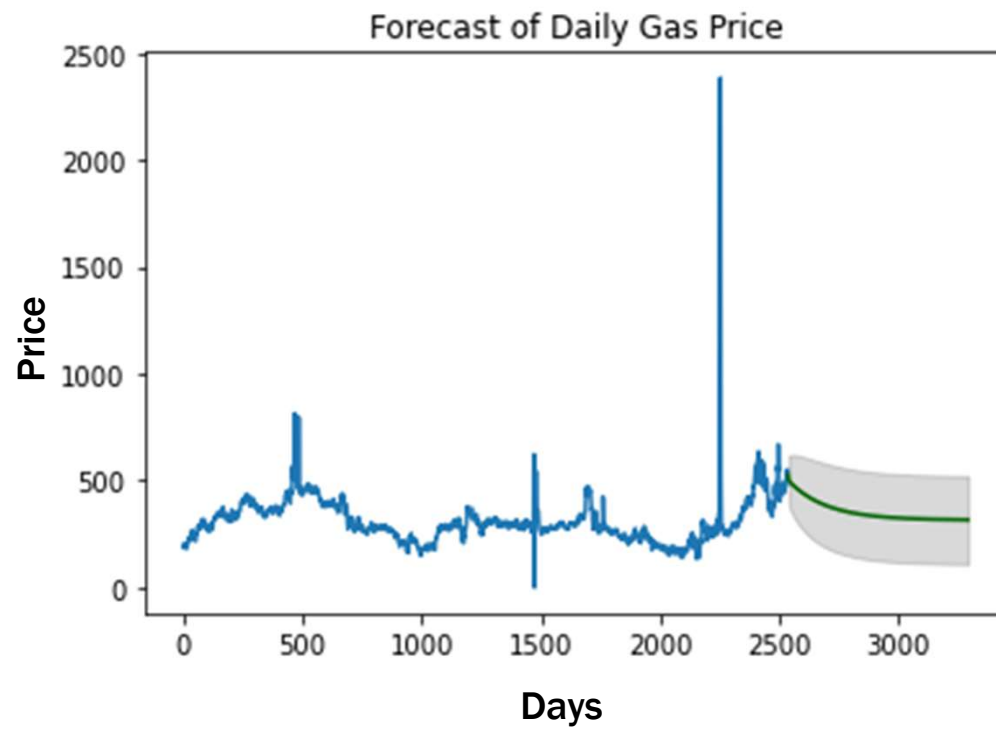
ARIMA FORECAST FOR MONTHLY GAS CONSUMPTION



ARIMA DIAGNOSTICS FOR DAILY PRICES

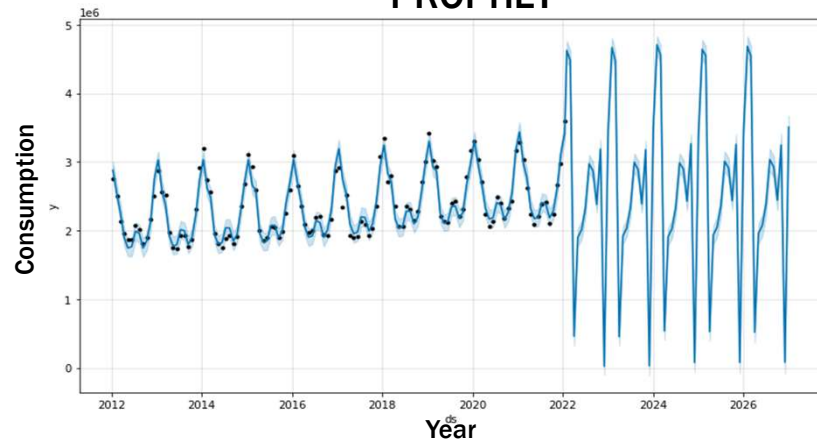


ARIMA FORECAST FOR DAILY PRICES

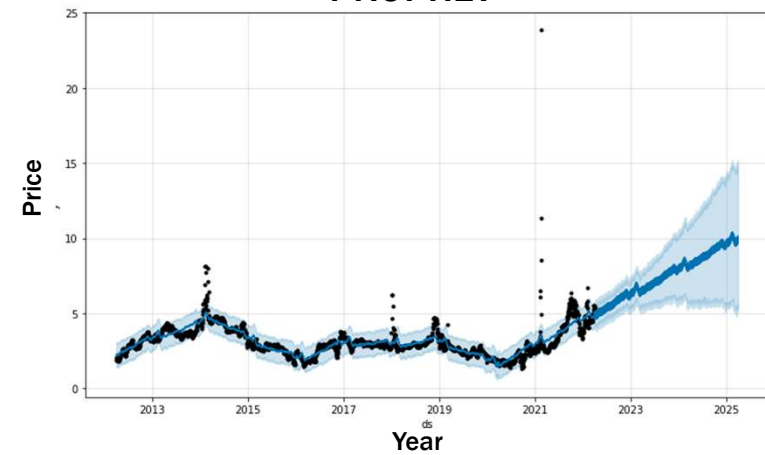


CONCLUDING REMARKS

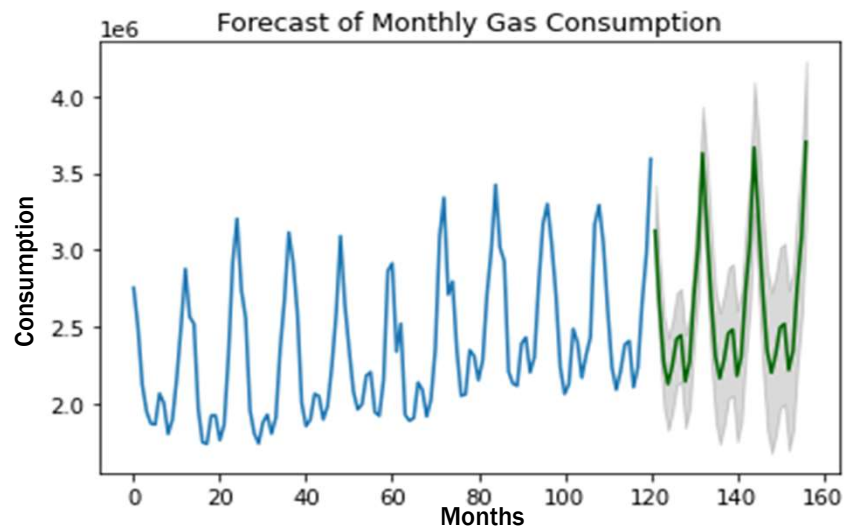
PROPHET



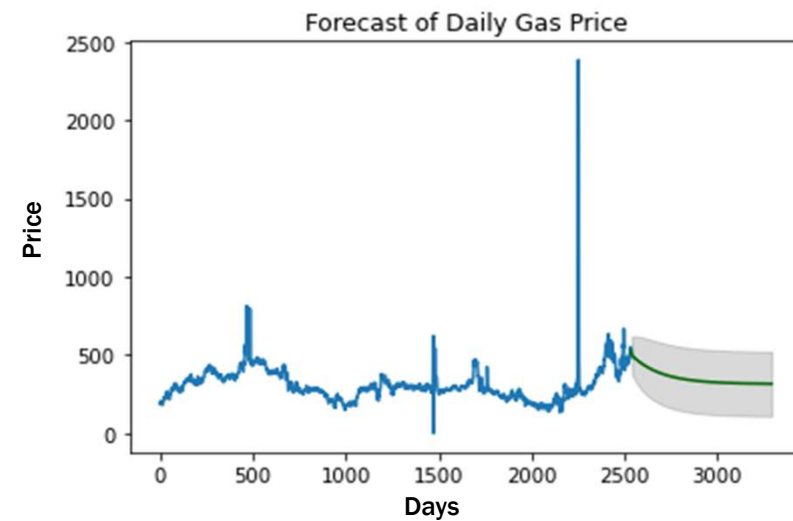
PROPHET



ARIMA



ARIMA



FUTURE STEPS

- Machine learning model for natural gas consumption can be updated monthly
- Machine learning model for natural gas price can be updated daily/weekly
- Although Henry Hub (HH) spot price was used in this analysis additional model using domestic gas price can also be developed
- Impact of LNG exports in next 3 to 5 years may impact the natural gas forecasting scenarios

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