Use Case

Decline Curve Analysis
## (Reservoir Engineering)

Objective

- DCA plays an important role and is one of the most valuable techniques in a reservoir engineer's toolbox because it provides a way to estimate the initial hydrocarbon in place and the hydrocarbon reserves at the time of abandonment, and to forecast future production until economic limits are reached.

- Predicting the Estimated Ultimate Recovery(EUR) of the Oil well.

- Finding out the decline rate in order to make accurate prediction of oil well life.

- The production decline analysis is a traditional method of identifying wells production pattern and predicting its performance and life based on real production data.

What is required?

- Event Contextualization
- Feature Engineering
- Soft Signals-Using Arp's Equation
- Predict & Forecast using the soft sensor

# Decline Curve Analysis

- Data Aggregated:
  - Well active number of Days,
  - Oil Production rate (unit bbls/d)
  - Gas rate
  - Water rate

- The actual decline rate is plotted over the time
- We used three Arps model to fit the decline curve.
- It is observed that Hyperbolic curve fits best for selected well (Subjected to the data)

Actual Decline Curve

Fitting Arps Model

Best fitted Arp Model
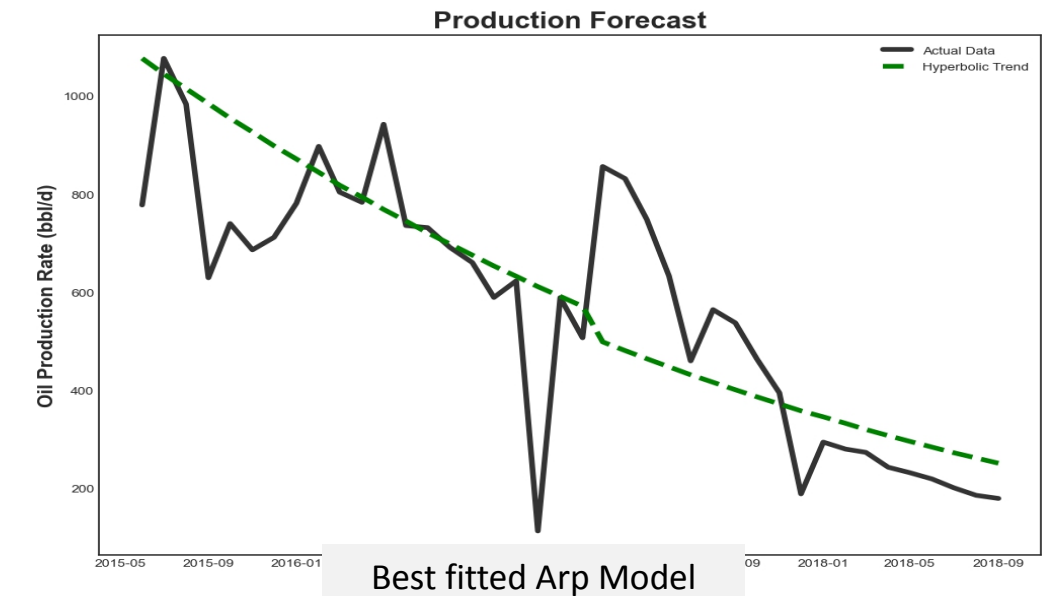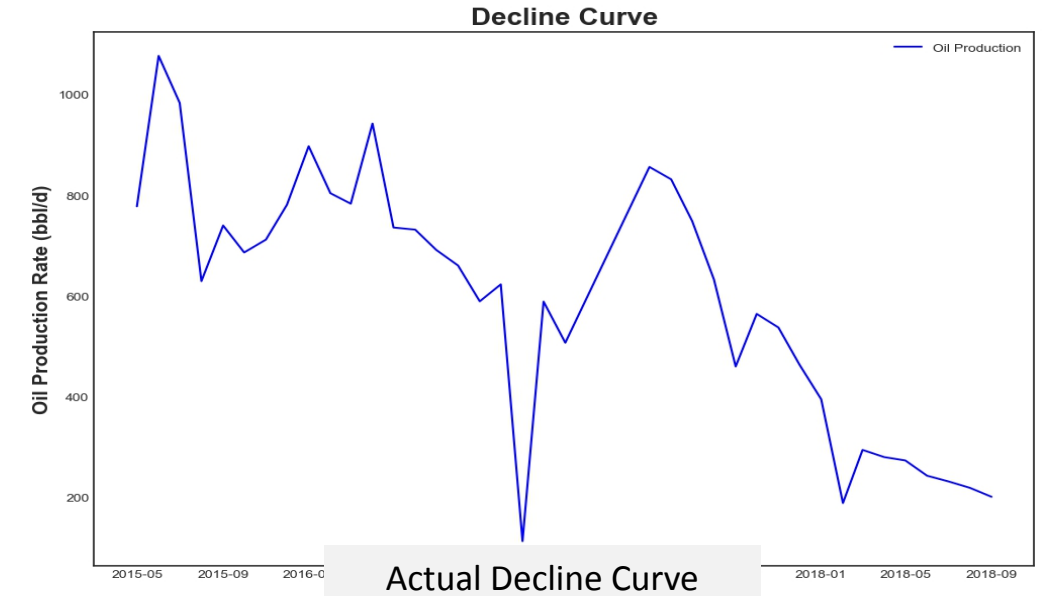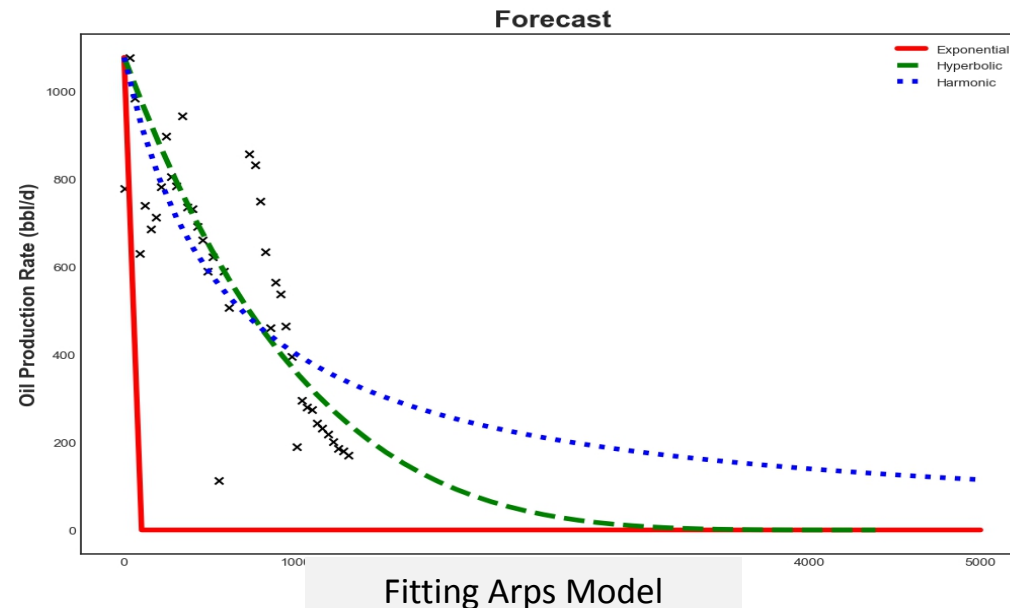
Decline Curve Analysis

- Forecasting using ARIMA Model with 95% Confidence interval for next year
- Augmented Dickey Fuller test was performed to test the stationarity of the time series data
- P-value metric was used to evaluate the stationarity

- For enabling the forecast model to perform well, stationarizing the data is a must, which was done by taking the log of the resulting differenced series.

- ARIMA parameters:
  - ARIMA(2,1,2)
  - Utilizing Autoregressive and Moving Average dependency
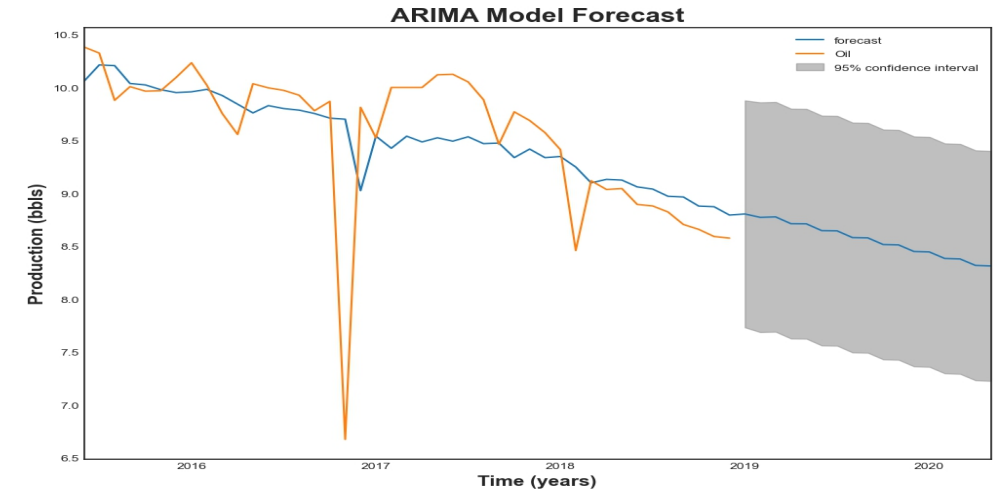
ARIMA Time Series Forecasting

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                        ARIMA Model Results
==============================================================================
Dep. Variable:                  D.Oil   No. Observations:                   43
Model:                 ARIMA(2, 1, 2)   Log Likelihood                 -36.925
Method:                       css-mle   S.D. of innovations              0.547
Date:                Thu, 17 Dec 2020   AIC                             85.849
Time:                        11:52:23   BIC                             96.416
Sample:                    06-01-2015   HQIC                            89.746
                         - 12-01-2018
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
const         -0.0330      0.008     -4.352      0.000      -0.048      -0.018
ar.L1.D.Oil   -0.8399      0.155     -5.429      0.000      -1.143      -0.537
ar.L2.D.Oil    0.1469      0.155      0.946      0.344      -0.157       0.451
ma.L1.D.Oil -6.307e-08      0.121  -5.22e-07      1.000      -0.237       0.237
ma.L2.D.Oil   -1.0000      0.121     -8.285      0.000      -1.237      -0.763
                                     Roots
==============================================================================
                  Real          Imaginary           Modulus         Frequency
------------------------------------------------------------------------------
AR.1           -1.0116           +0.0000j            1.0116            0.5000
AR.2            6.7307           +0.0000j            6.7307            0.0000
MA.1            1.0000           +0.0000j            1.0000            0.0000
MA.2           -1.0000           +0.0000j            1.0000            0.5000
------------------------------------------------------------------------------
```

Model Summary