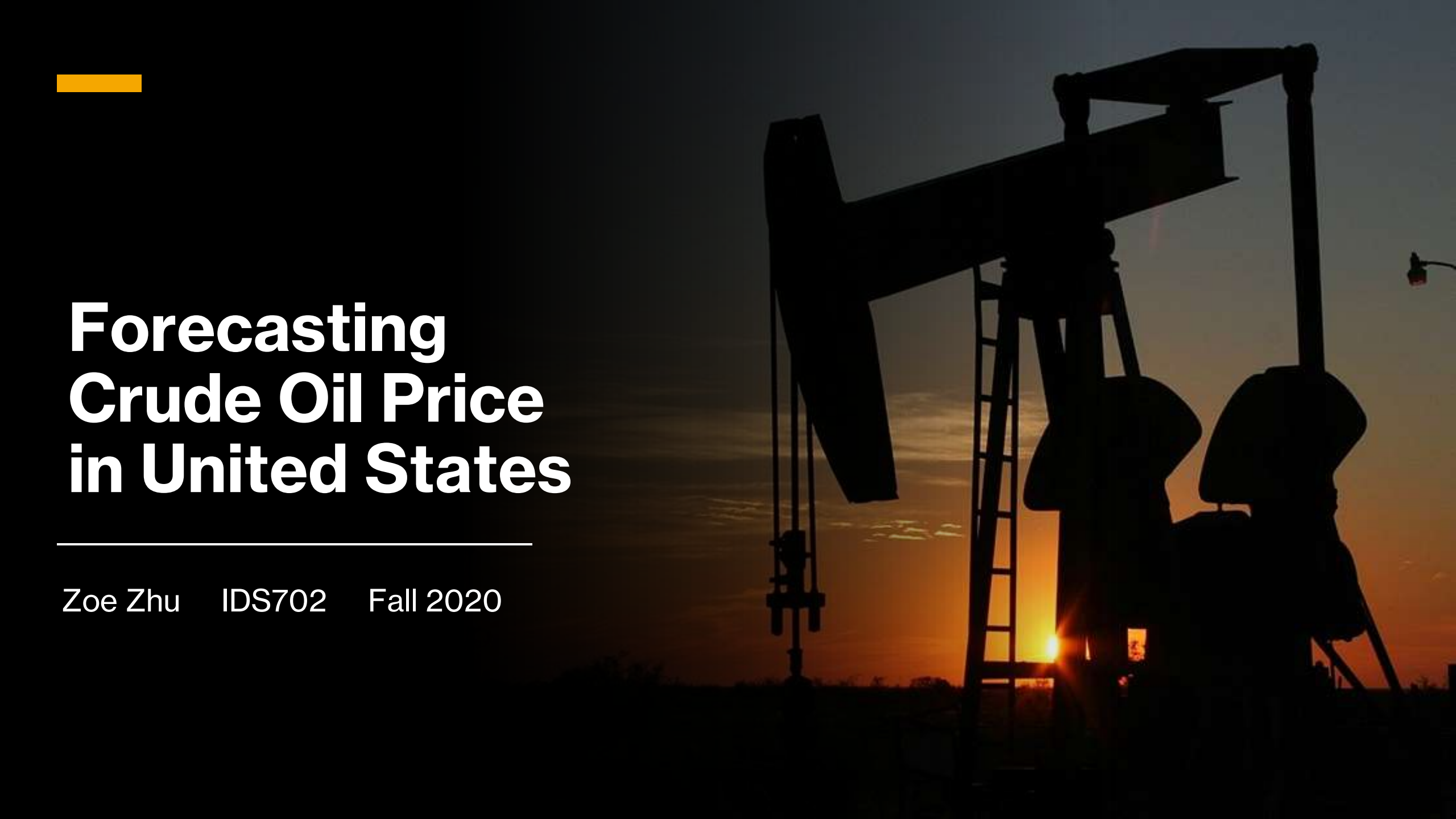
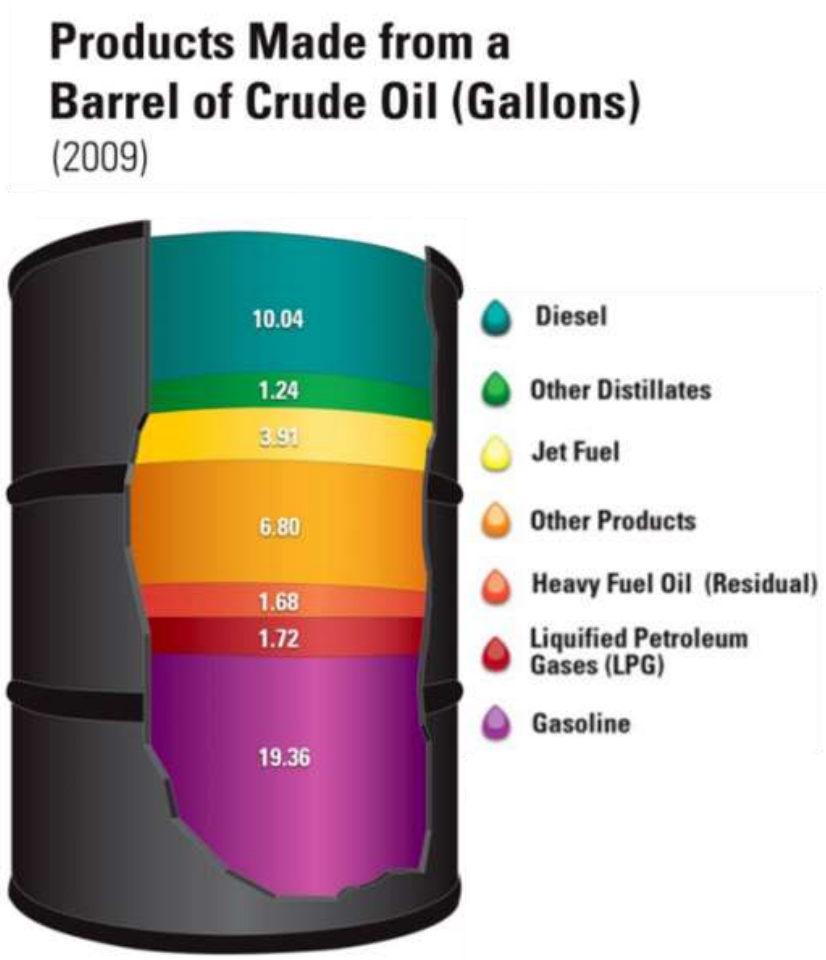
Forecasting Crude Oil Price in United States

Zoe Zhu IDS702 Fall 2020





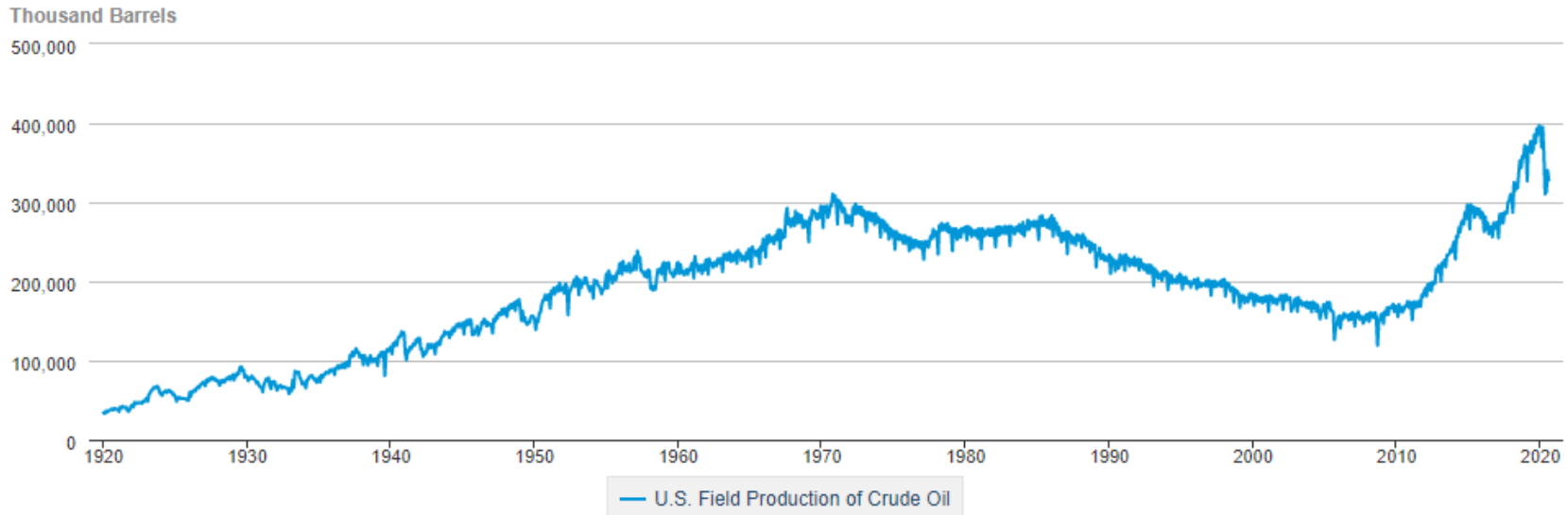
What is Crude Oil?

- **Crude oil:**
  - Fossil fuel, non-renewable
  - A mixture of hydrocarbon deposits & other organic materials
- **Refining:**
  - Transfroming crude oil into more useful products like gasoline, diesel, etc.

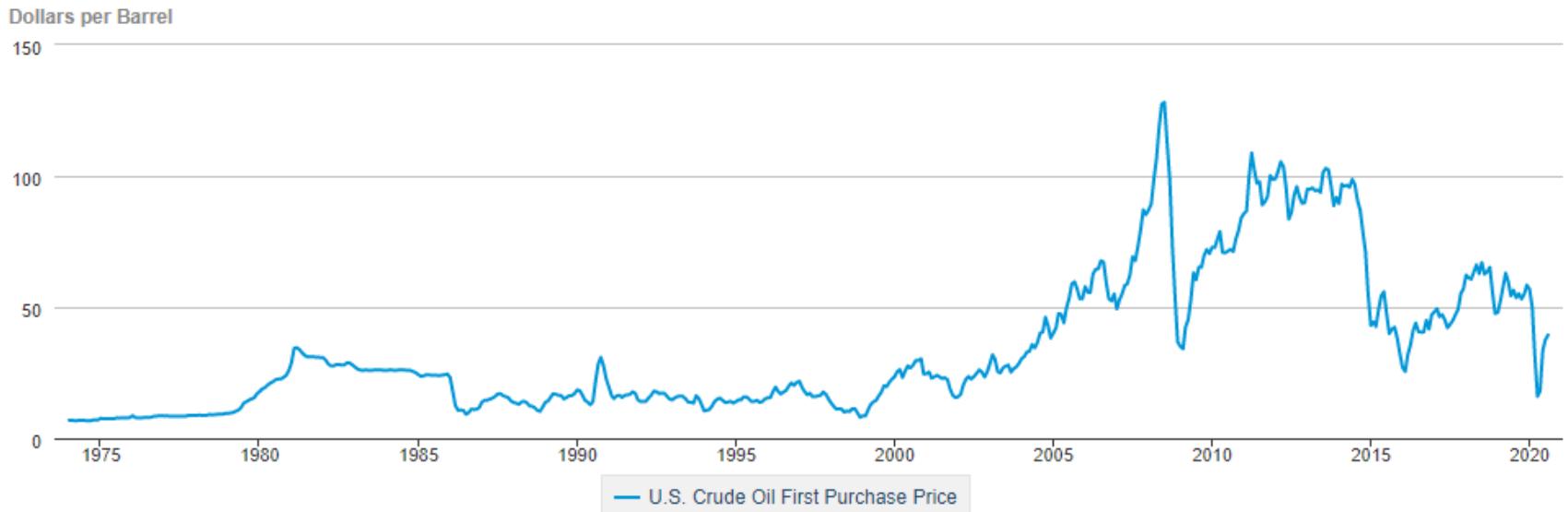
What drives the price?

- Supply
- Global economy
- Political uncertainty

U.S. Field Production of Crude Oil



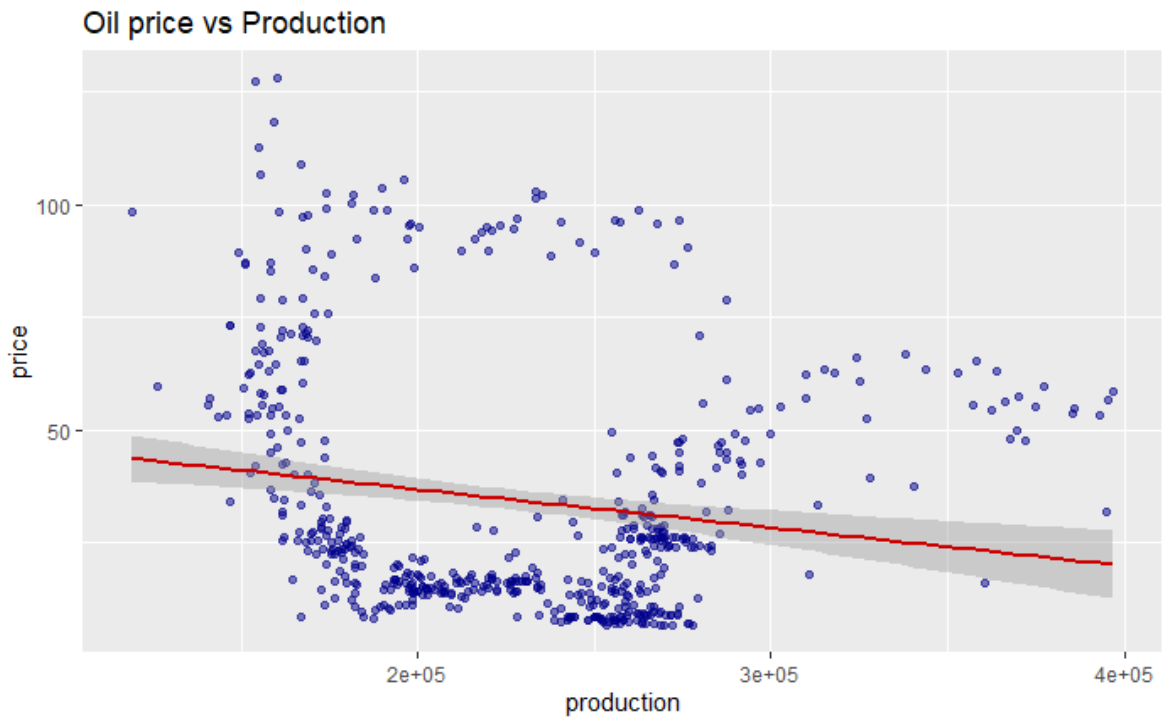
U.S. Crude Oil First Purchase Price

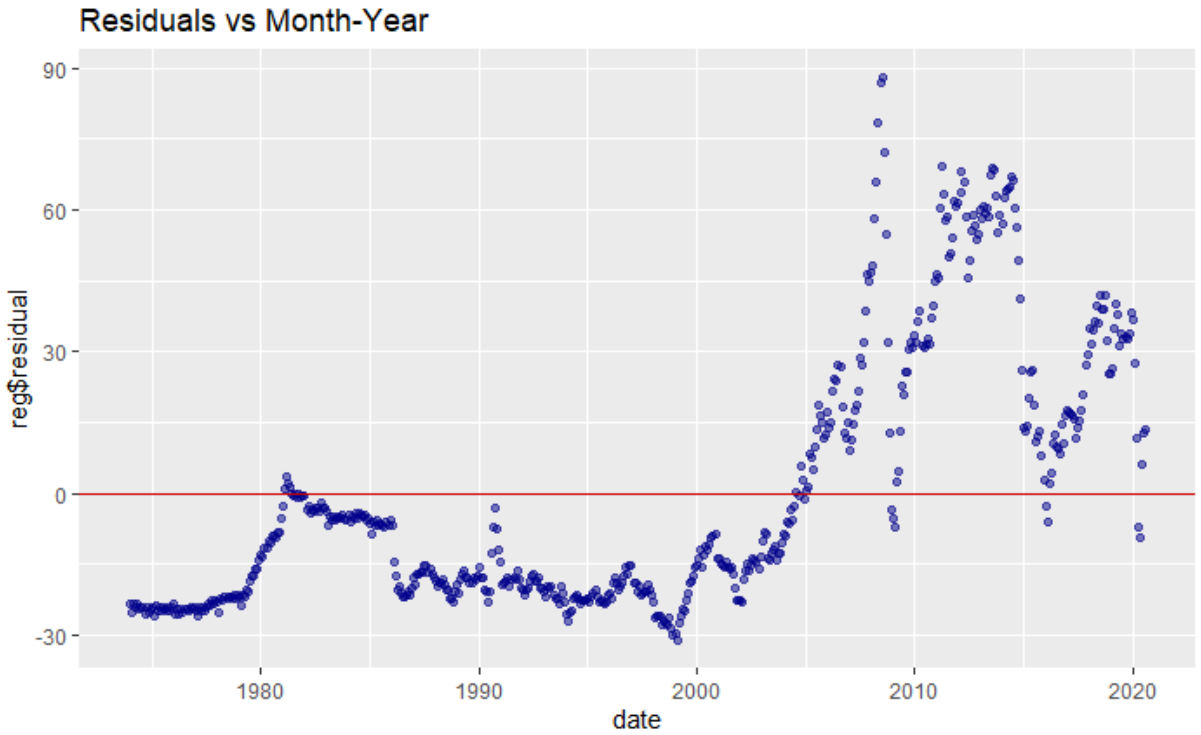


Fitting a linear regression

Oil price vs production

Non-stationary!

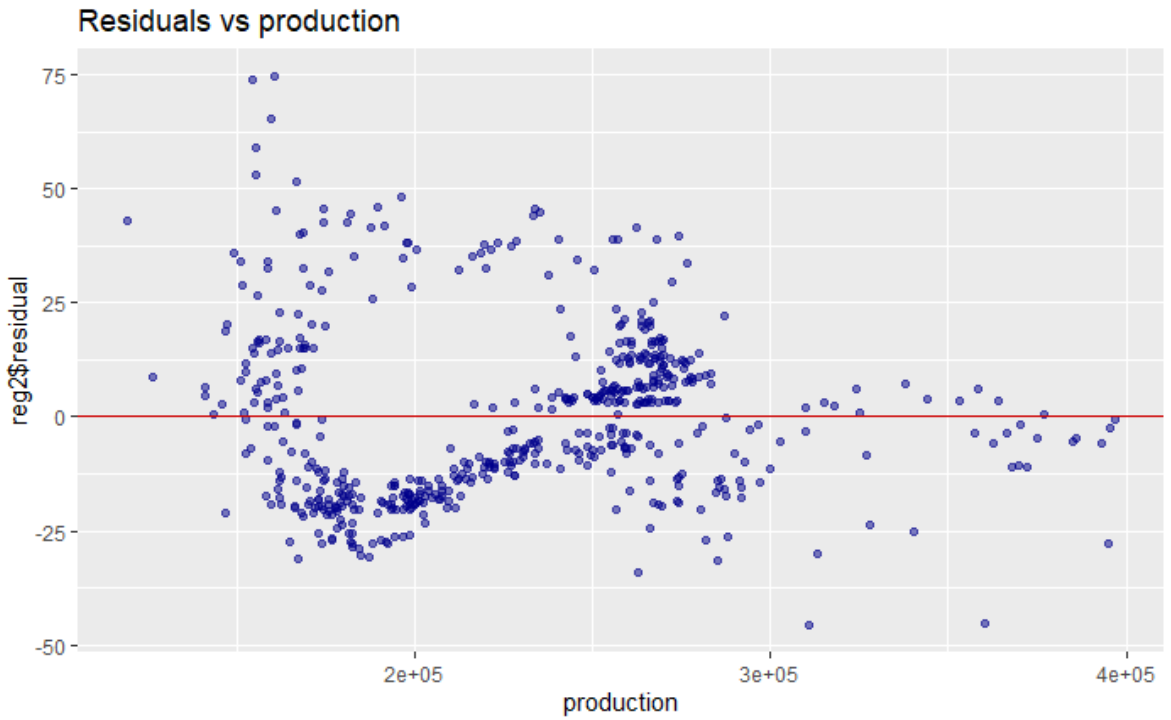


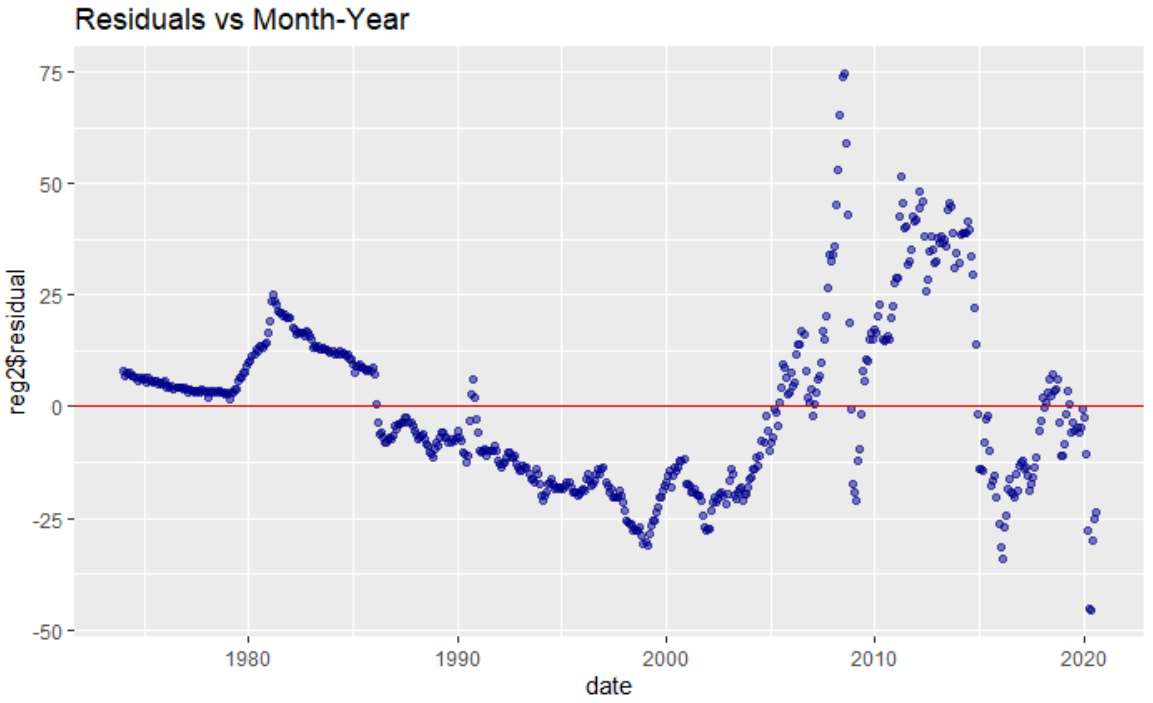


Fitting a linear regression

Oil price vs production & time

Non-stationary!

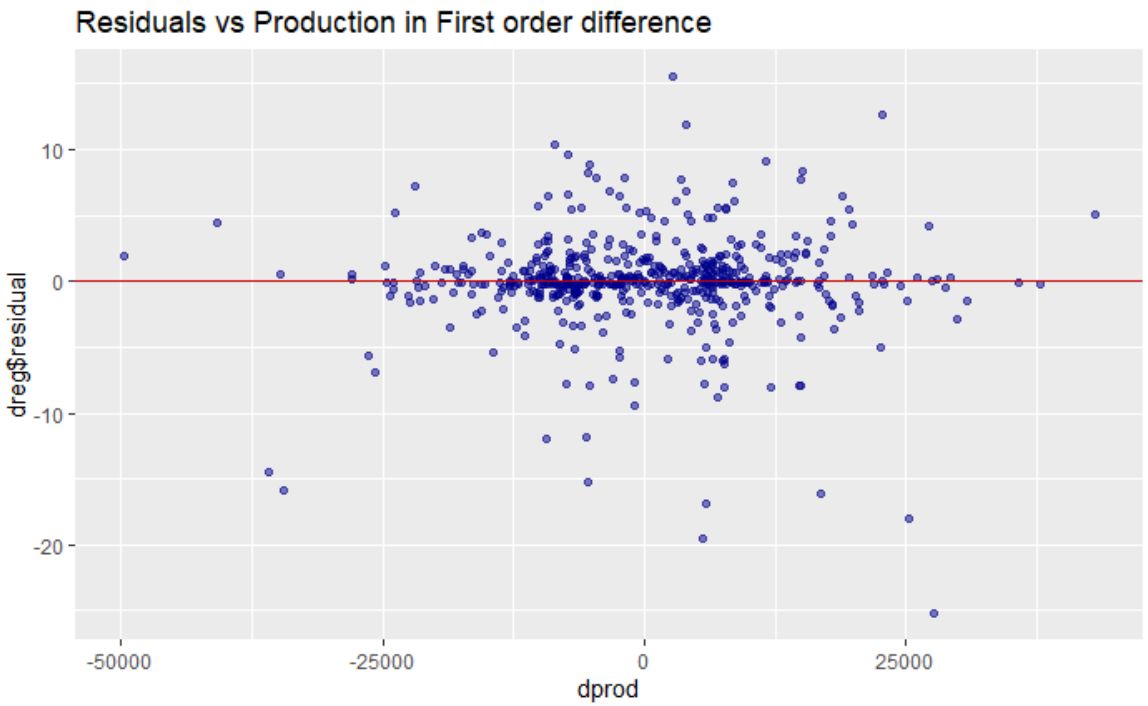


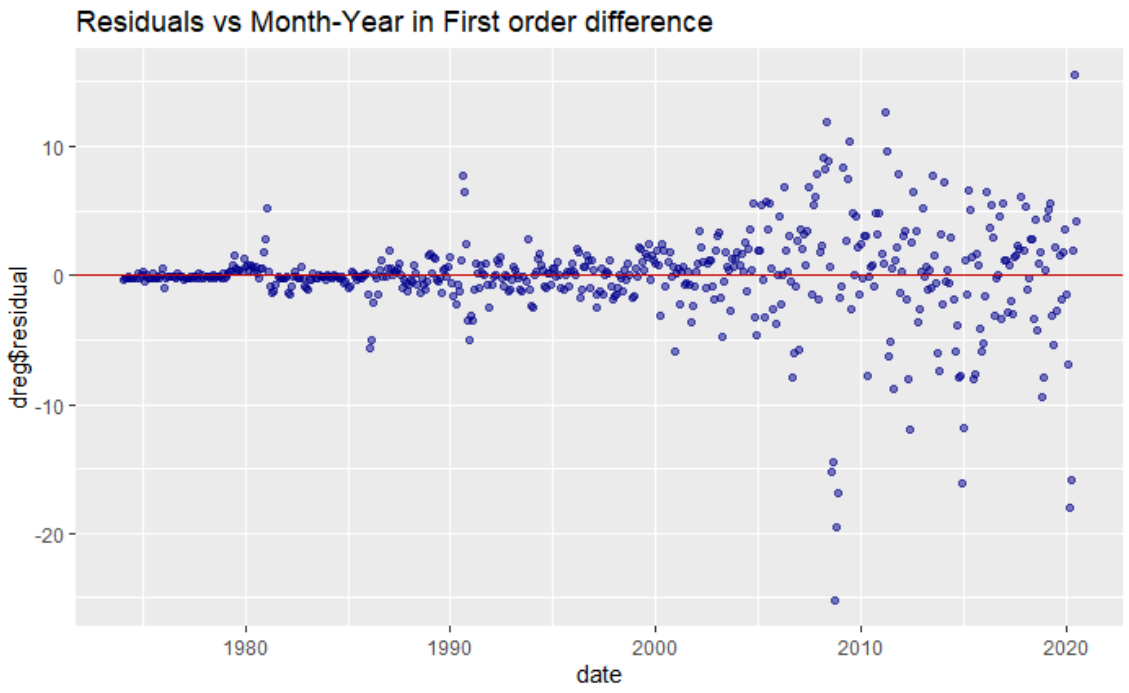


Differencing: first order difference

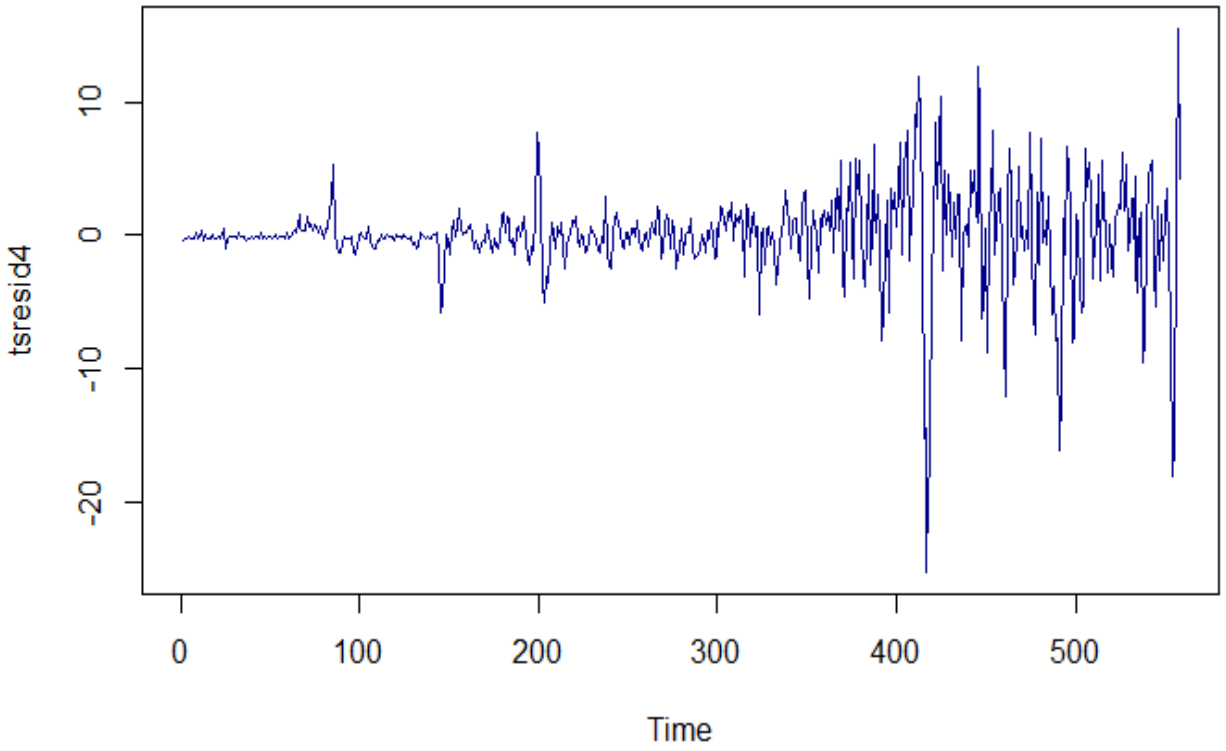
Difference in oil production = production of current month – production of previous month
Difference in oil price = price of current month – price of previous month

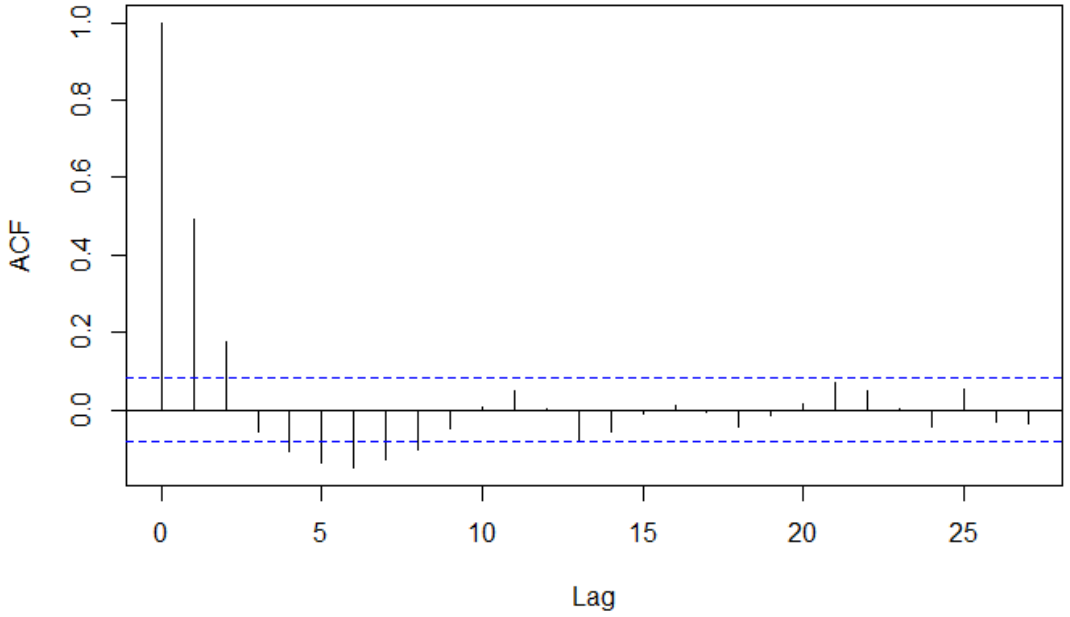
(Weak) Stationary!

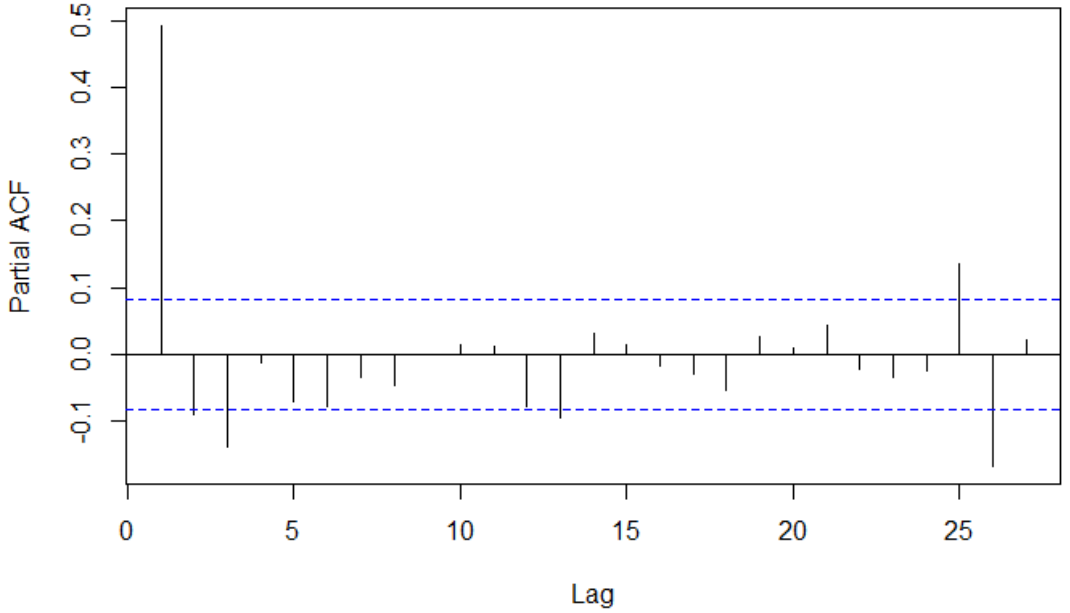




First order difference Residuals







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Call:
lm(formula = dprice ~ dprod + date, data = oil2)

Residuals:
     Min       1Q   Median       3Q      Max
-25.1847  -0.8277  -0.0128   1.1303  15.5236

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.048e-01  3.494e-01   0.586    0.558
dprod       -4.625e-06  1.310e-05  -0.353    0.724
date        -1.499e-05  3.146e-05  -0.476    0.634

Residual standard error: 3.64 on 555 degrees of freedom
Multiple R-squared:  0.0006602, Adjusted R-squared:  -0.002941
F-statistic: 0.1833 on 2 and 555 DF,  p-value: 0.8325


Series: oil2$dprice
Regression with ARIMA(2,0,1) errors

Coefficients:
          ar1      ar2      ma1  xreg1  xreg2
      1.3786  -0.5126  -0.8651      0      0
s.e.  0.0686   0.0387   0.0709      0      0

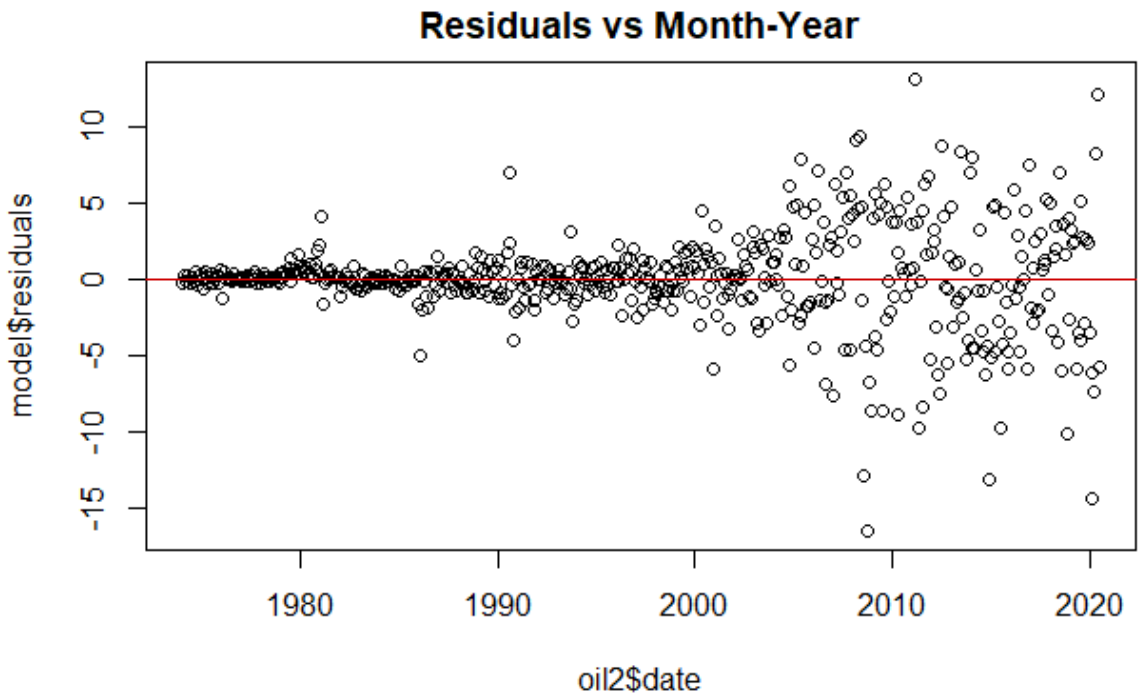
sigma^2 estimated as 9.688:  log likelihood=-1423.07
AIC=2858.15   AICc=2858.3   BIC=2884.1
```

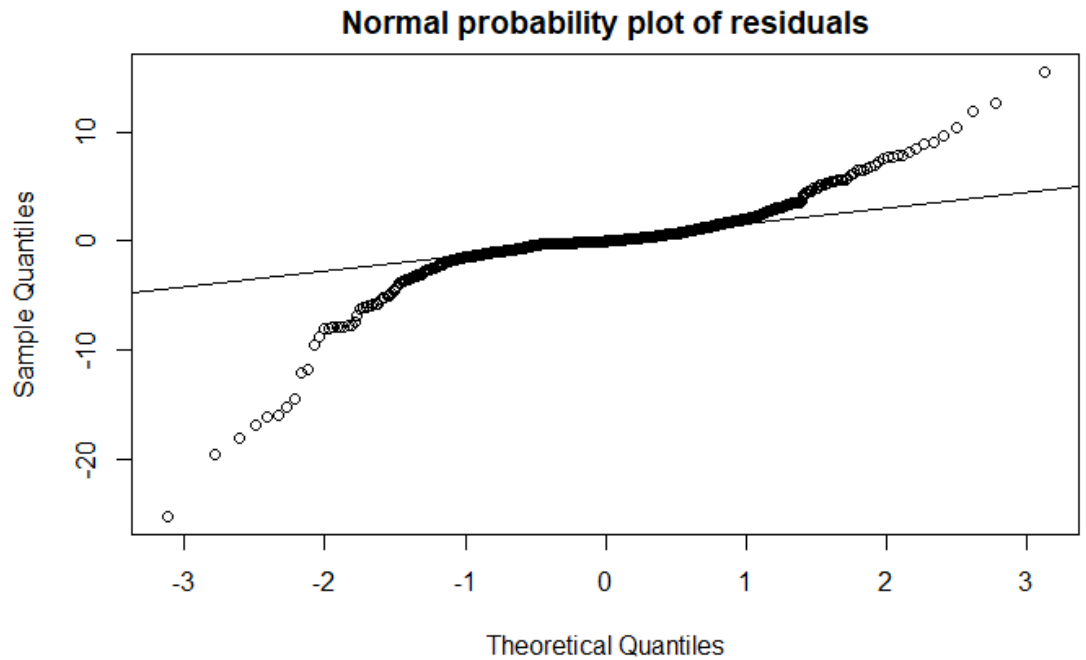
Fitting ARIMA Model

ARIMA(2,0,1)

For Residuals

Model assumptions





What's next?

1

Add an indicator variable for Financial crisis of 2007–2008

2

Split data for model fitting & forecasting

- Exclude data after Mar 2020 (influenced by covid-19 pandamic)

Thank you for watching!

Reference

What is Crude Oil?
https://www.youtube.com/watch?v=2WRy1ekd2eU

Crude Oil Prices Explained - WTI vs Brent
https://www.youtube.com/watch?v=Yp4wFZeY0fk

Oil and petroleum products explained - *Refining crude oil*
https://www.eia.gov/energyexplained/oil-and-petroleum-products/refining-crude-oil-the-refining-process.php