ARIMA MODELING WITH R

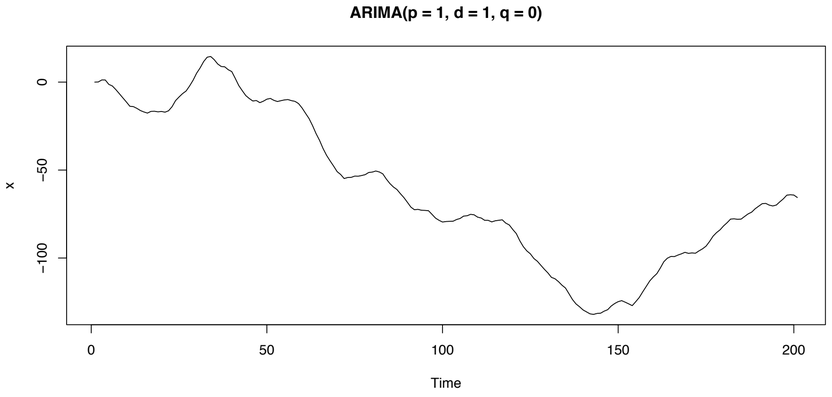
# ARIMA - Integrated ARMA

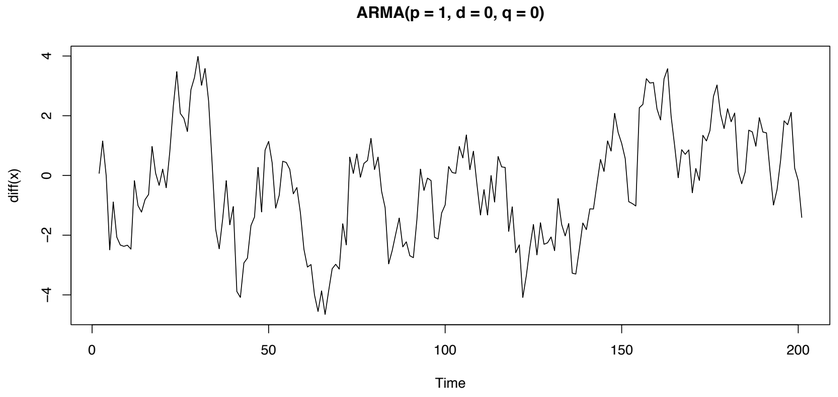
# Identifying ARIMA

- A time series exhibits ARIMA behavior if the differenced data has ARMA behavior

```
> # Simulation  ARIMA(p = 1, d = 1, q = 0)

> x <- arima.sim(list(order = c(1, 1, 0),  ar = .9), n = 200)
> plot(x, main = "ARIMA(p = 1, d = 1, q = 0)")
> plot(diff(x), main = "ARMA(p = 1, d = 0, q = 0)")
```



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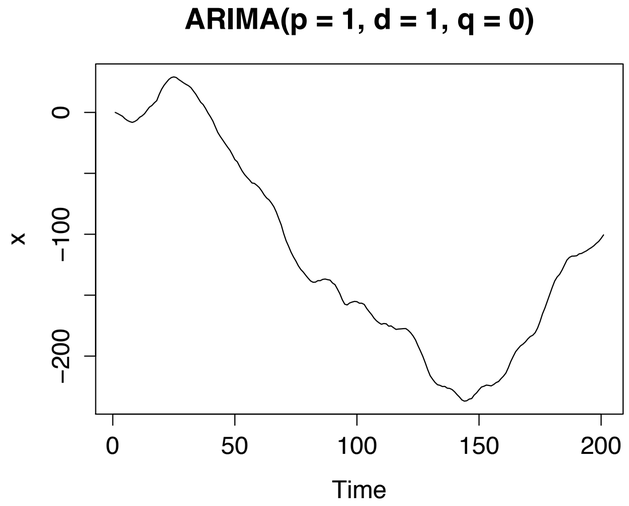


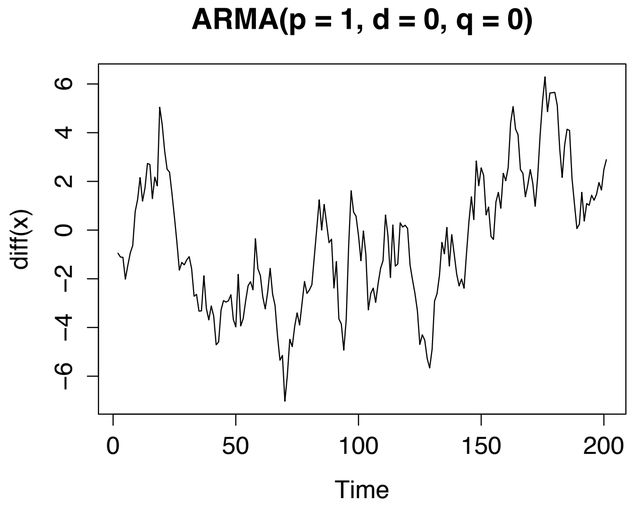

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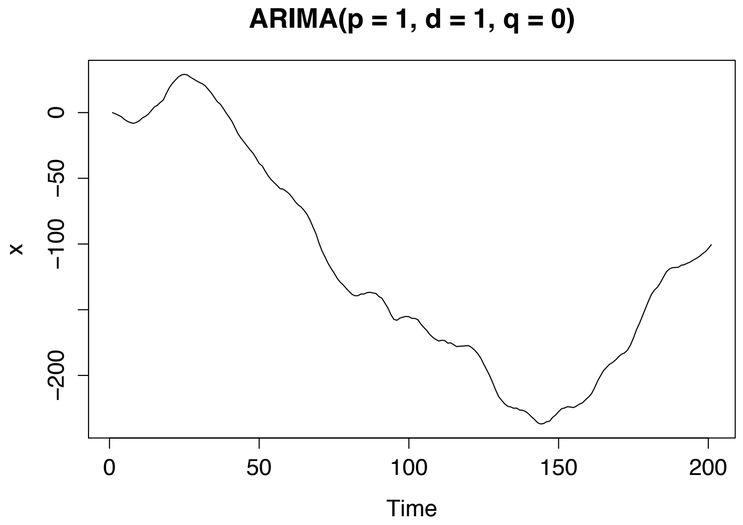
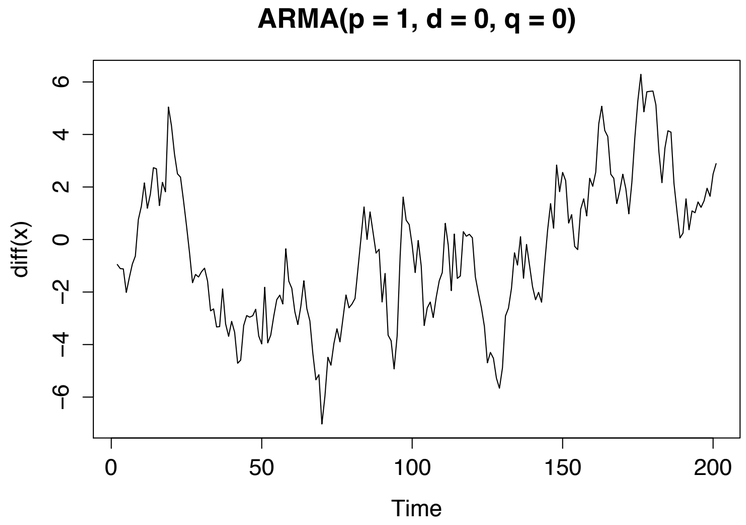
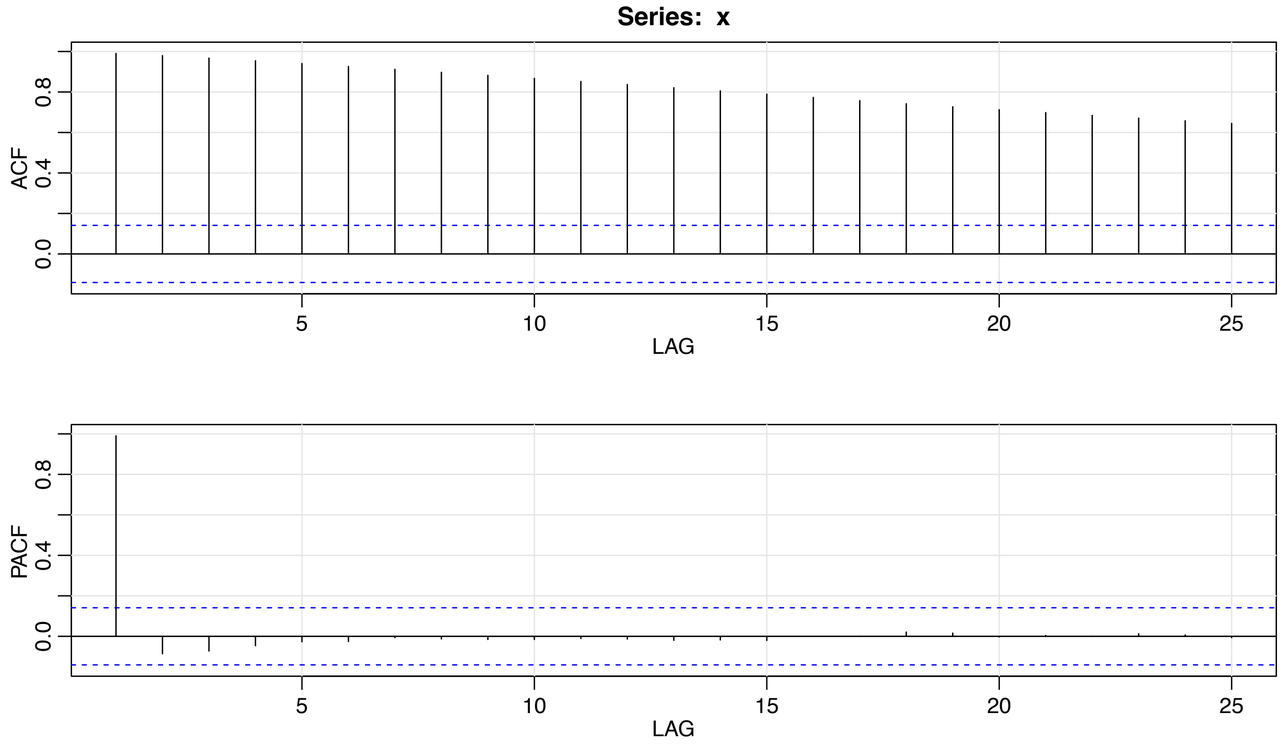


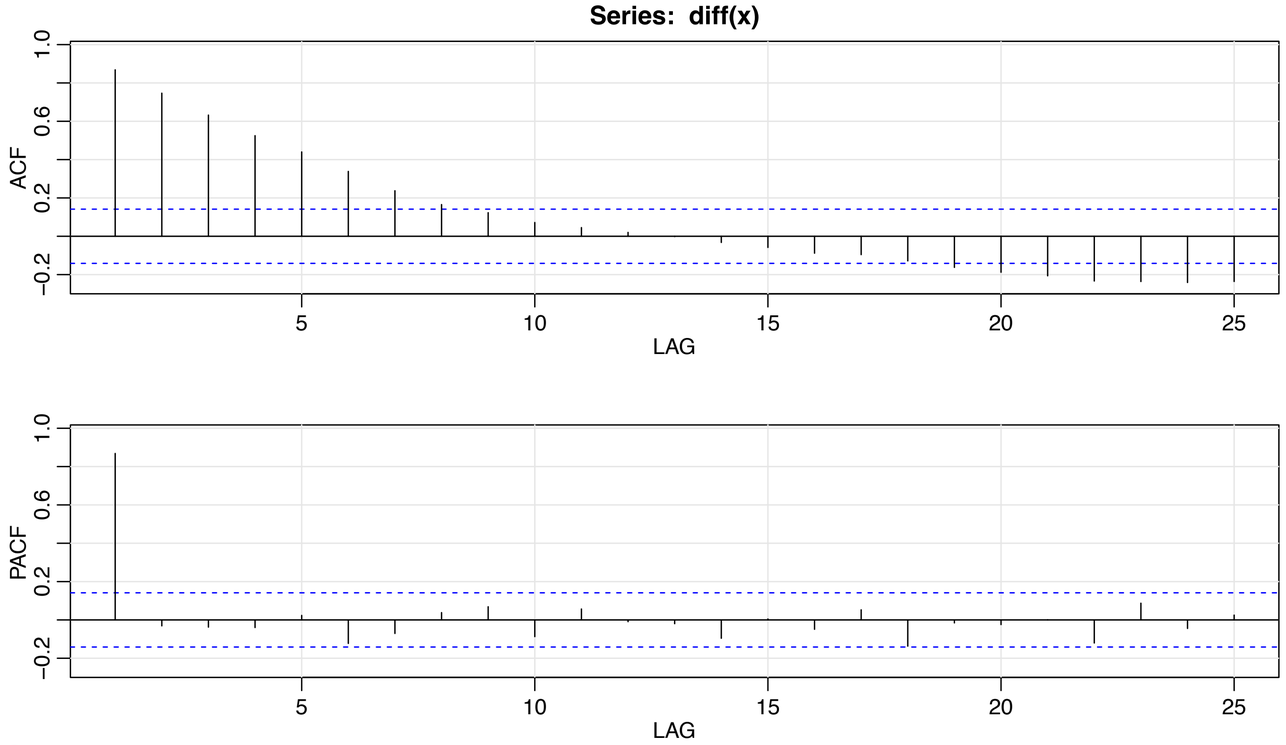
# ACF and PCF of an Integrated ARMA

```
> x <- arima.sim(list(order = c(1, 1, 0),  ar = .9), n = 200)
> acf2(x)
```



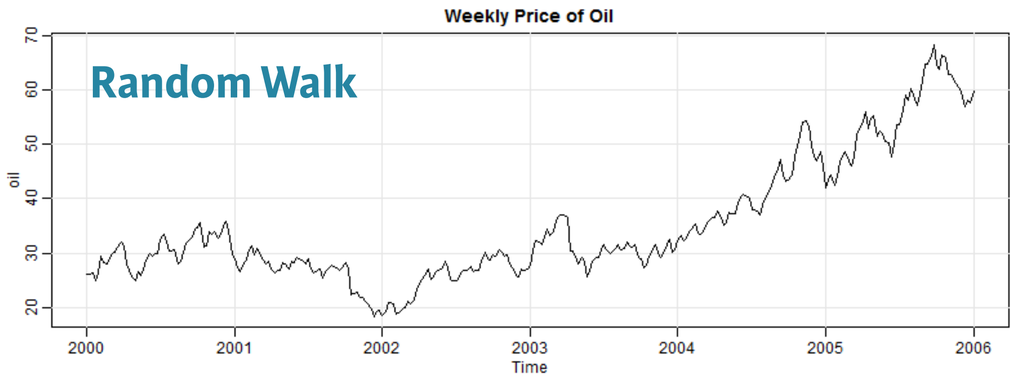
# ACF and PCF of a Differenced ARIMA

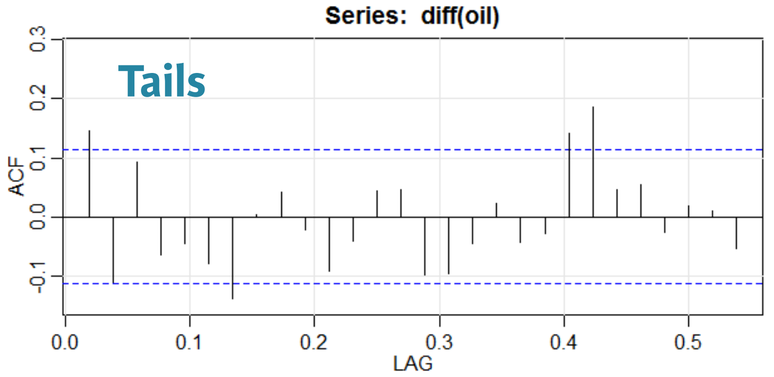
```
> x <- arima.sim(list(order = c(1, 1, 0),  ar = .9), n = 200)
> acf2(diff(x))
```

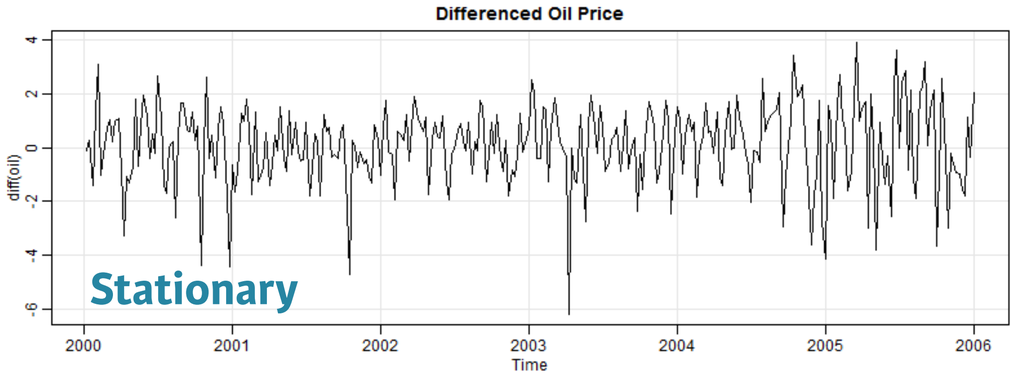


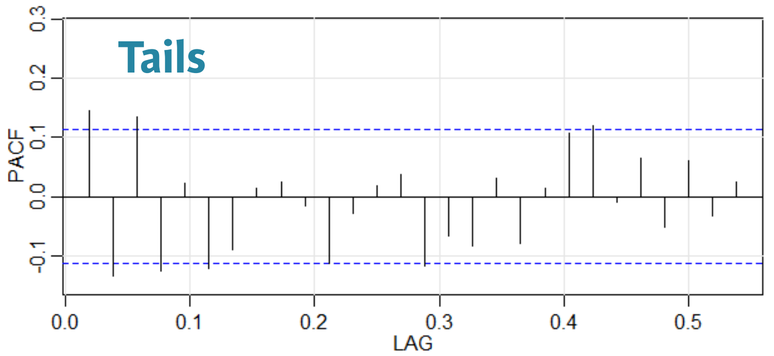

**Indicates an AR(1) for the differenced data**

# Weekly Oil Prices




- Looks like ARIMA(1, 1, 1)

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# Let’s practice!

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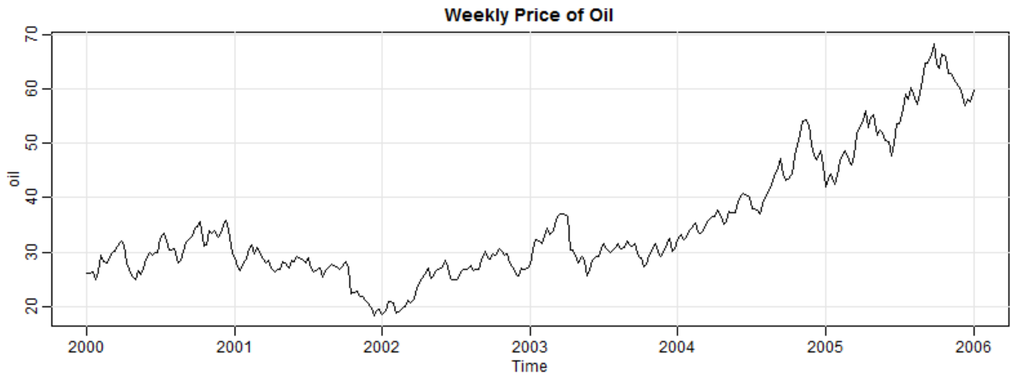
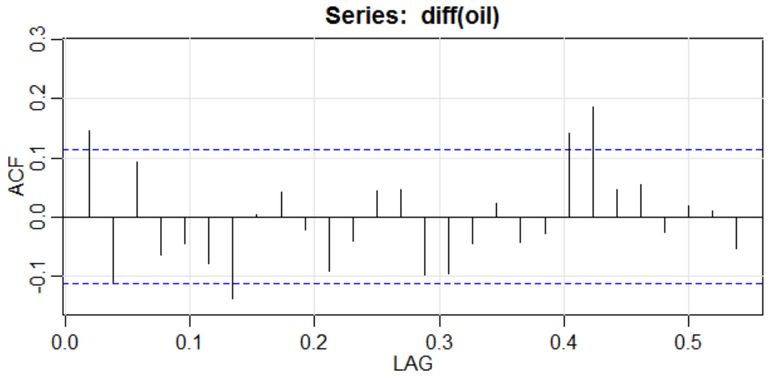
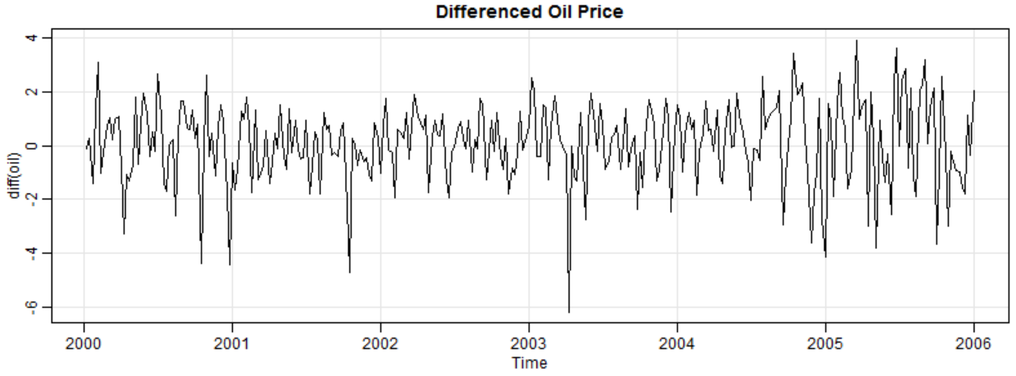
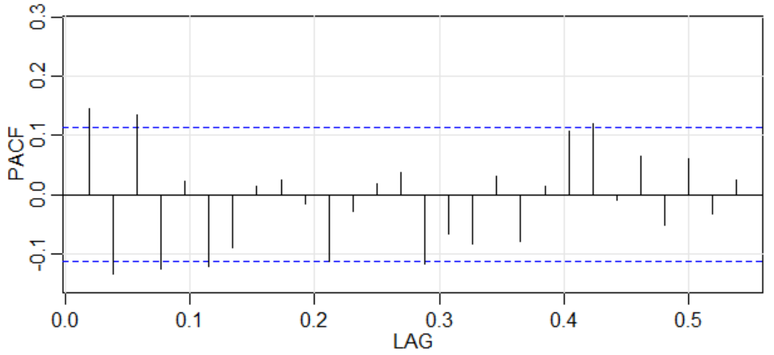
# ARIMA Diagnostics

# Weekly Oil Prices ARIMA(1, 1, 1)?



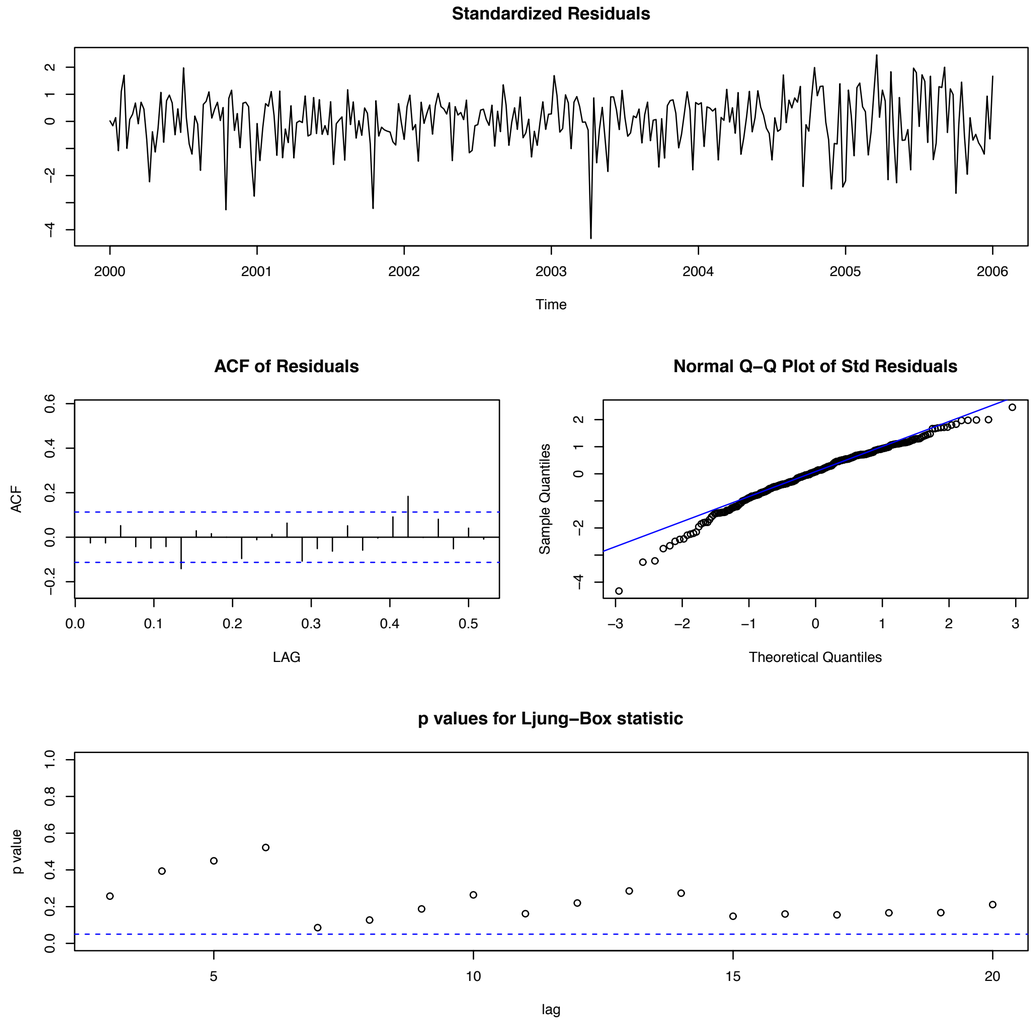



# Weekly Oil Prices ARIMA(1, 1, 1)?

```
> oil <- window(oil, end = 2006)
> x <- sarima(oil, p = 1, d = 1, q = 1)
> x$ttable

         Estimate     SE t.value p.value
ar1       -0.4987 0.0995 -5.0131  0.0000
ma1        0.7316 0.0734  9.9732  0.0000
constant   0.1091 0.0936  1.1664  0.2443
```

# Weekly Oil Prices ARIMA(1, 1, 1)!



# Overfit: ARIMA(2, 1, 1) and ARIMA(1, 1, 2)

```
> oil_fit1 <- sarima(oil, p = 2, d = 1, q = 1)
> oil_fit1$ttable

         Estimate     SE t.value p.value
ar1       -0.4704 0.1117 -4.2121  0.0000
ar2       -0.0738 0.0652 -1.1319  0.2586
ma1        0.6771 0.0986  6.8696  0.0000
constant   0.1088 0.0878  1.2391  0.2163


> oil_fit2 <- sarima(oil, p = 1, d = 1, q = 2)
> oil_fit2$ttable

         Estimate     SE t.value p.value
ar1       -0.3664 0.1816 -2.0178  0.0445
ma1        0.5777 0.1818  3.1777  0.0016
ma2       -0.0836 0.0837 -0.9989  0.3186
constant   0.1088 0.0884  1.2306  0.2194
```

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# Let’s practice!

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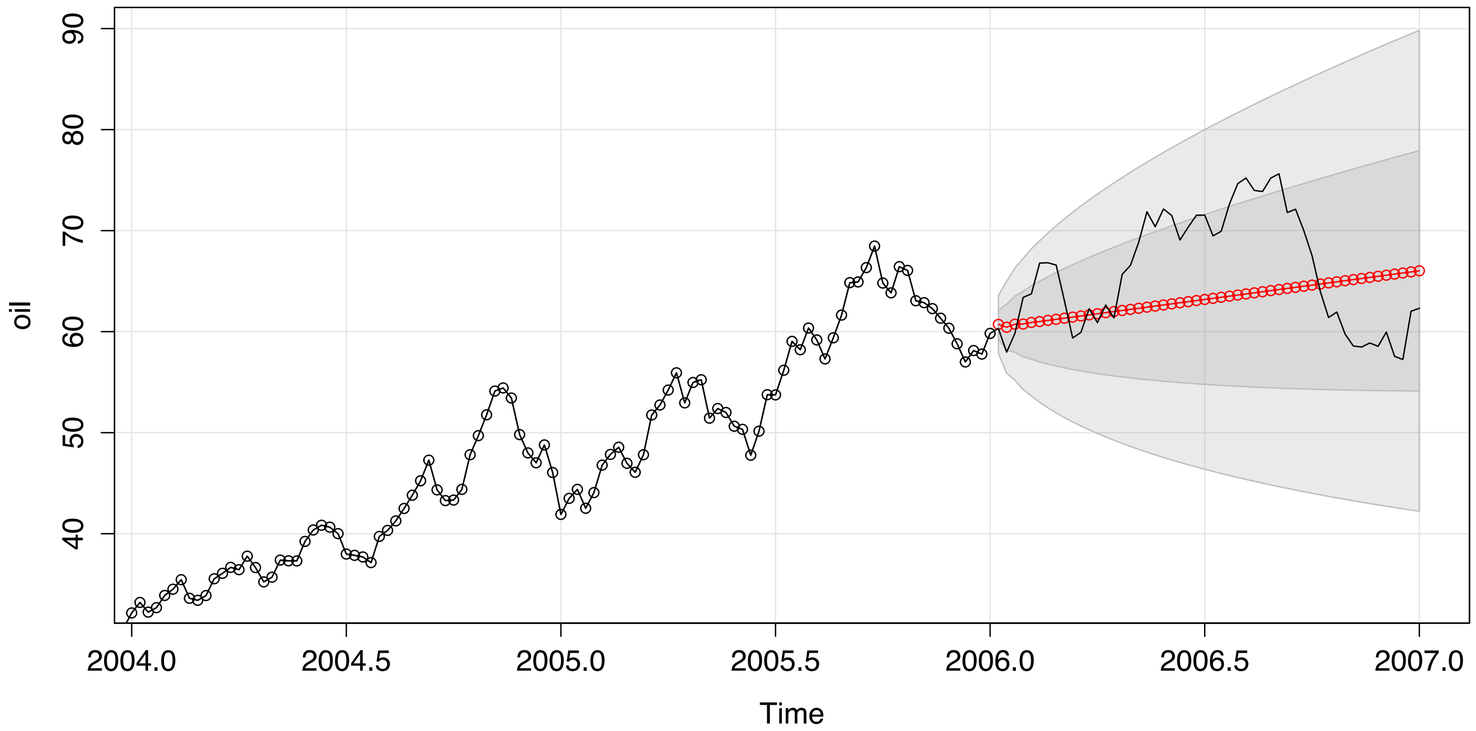
# Forecasting ARIMA

# Forecasting ARIMA Processes

- The model describes how the dynamics of the time series behave over time
- Forecasting simply continues the model dynamics into the future
- Use `sarima.for()` to forecast in the `astsa-package`

# Forecasting ARIMA Processes

```
> oil  <- window(astsa::oil, end = 2006)
> oilf <- window(astsa::oil, end = 2007)
> sarima.for(oil, n.ahead = 52, 1, 1, 1)
> lines(oilf)
```



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