ARIMA - integrated ARMA

ARIMA MODELS IN R

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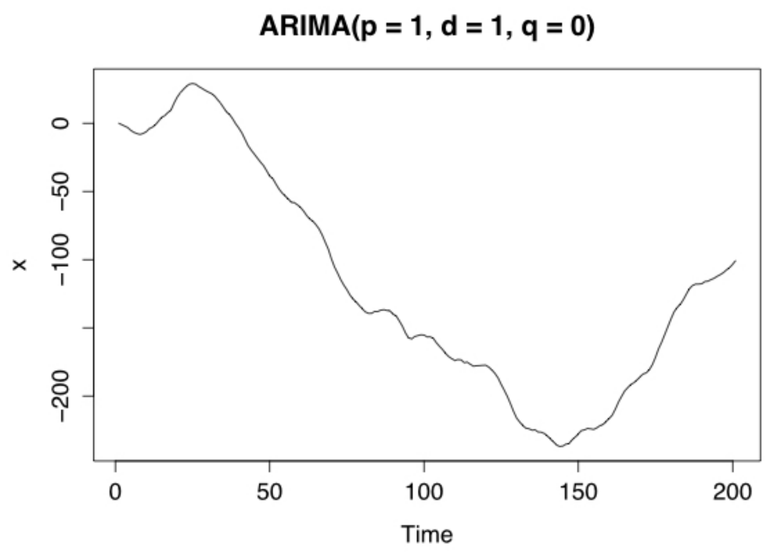
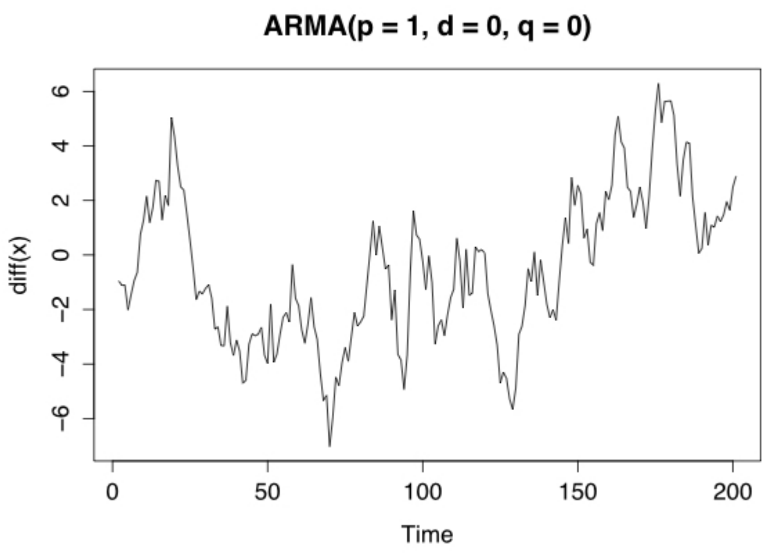
Identifying ARIMA

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

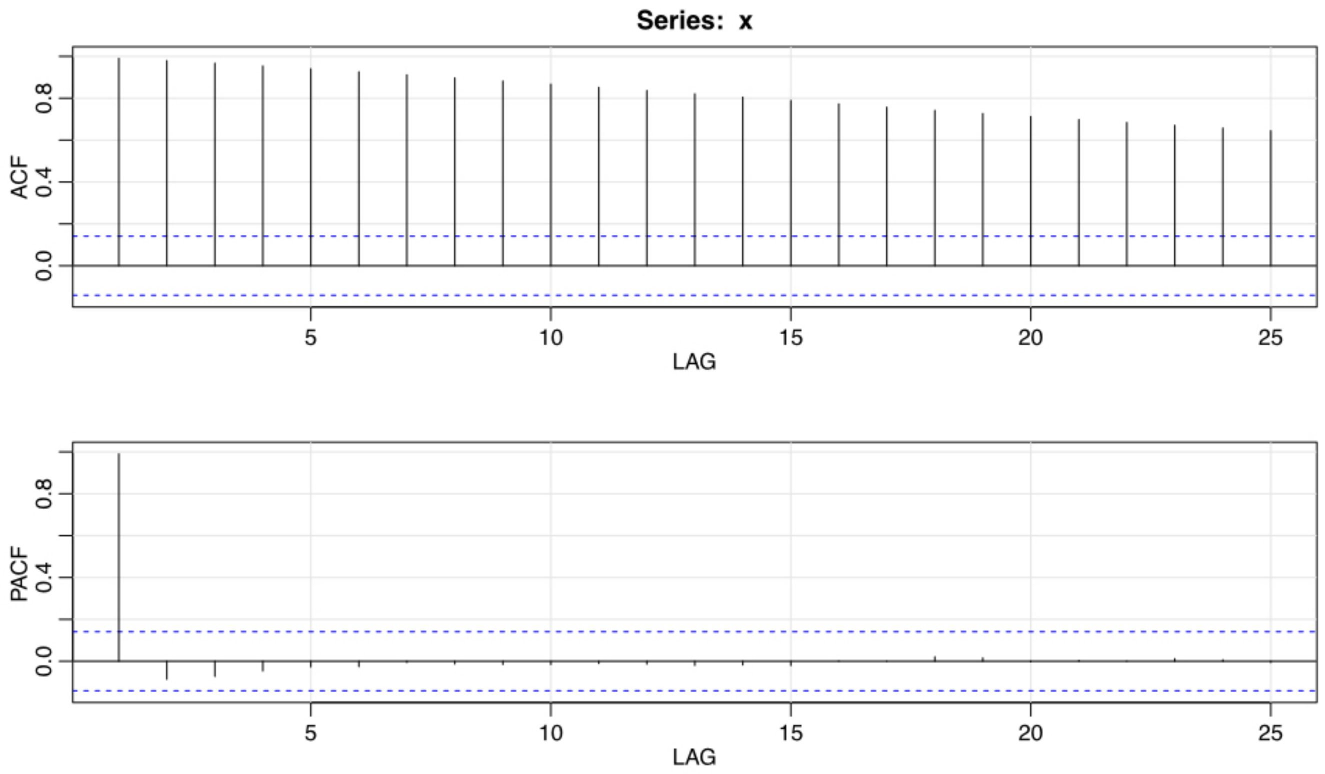
```r
# Simulation  ARIMA(p = 1, d = 1, q = 0)
x <- arima.sim(list(order = c(1, 1, 0),  ar = .9), n = 200)
plot(x, main = "ARIMA(p = 1, d = 1, q = 0)")
plot(diff(x), main = "ARMA(p = 1, d = 0, q = 0)")
```





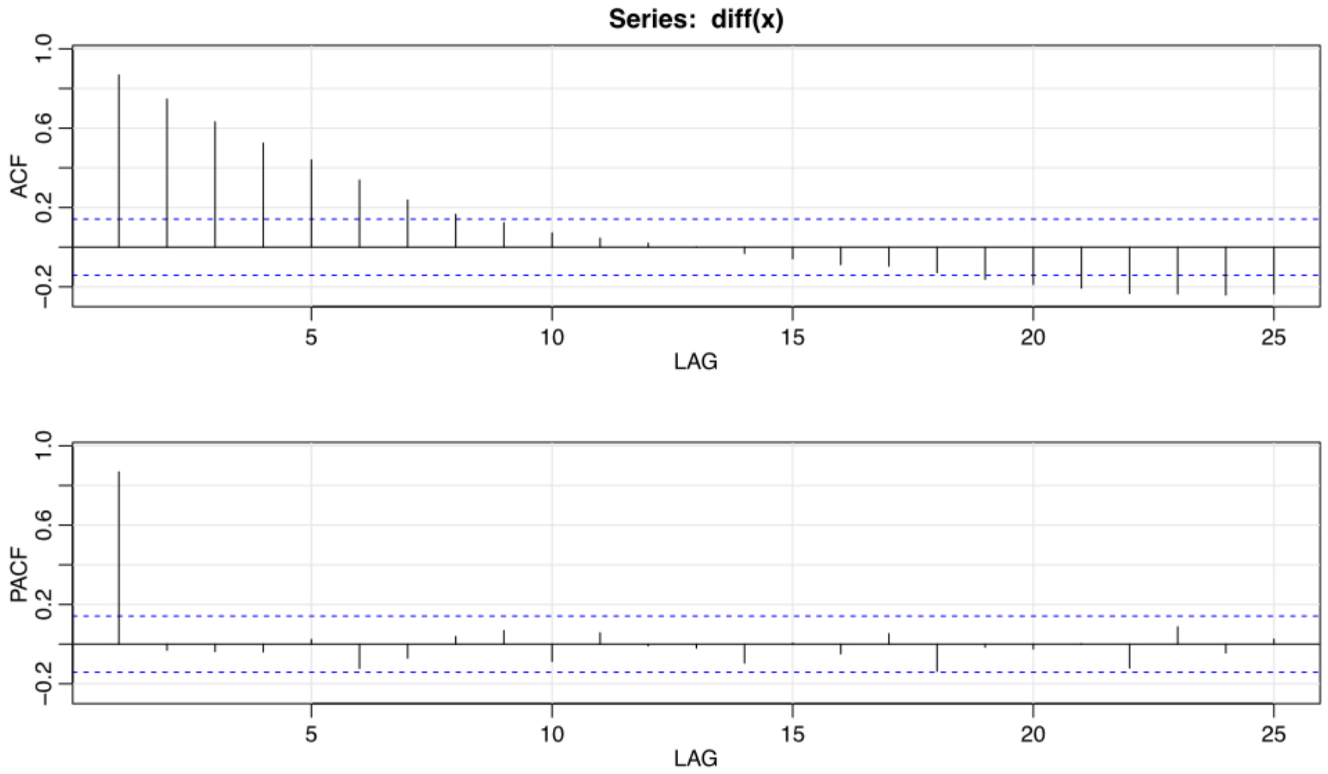
ACF and PCF of an Integrated ARMA

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



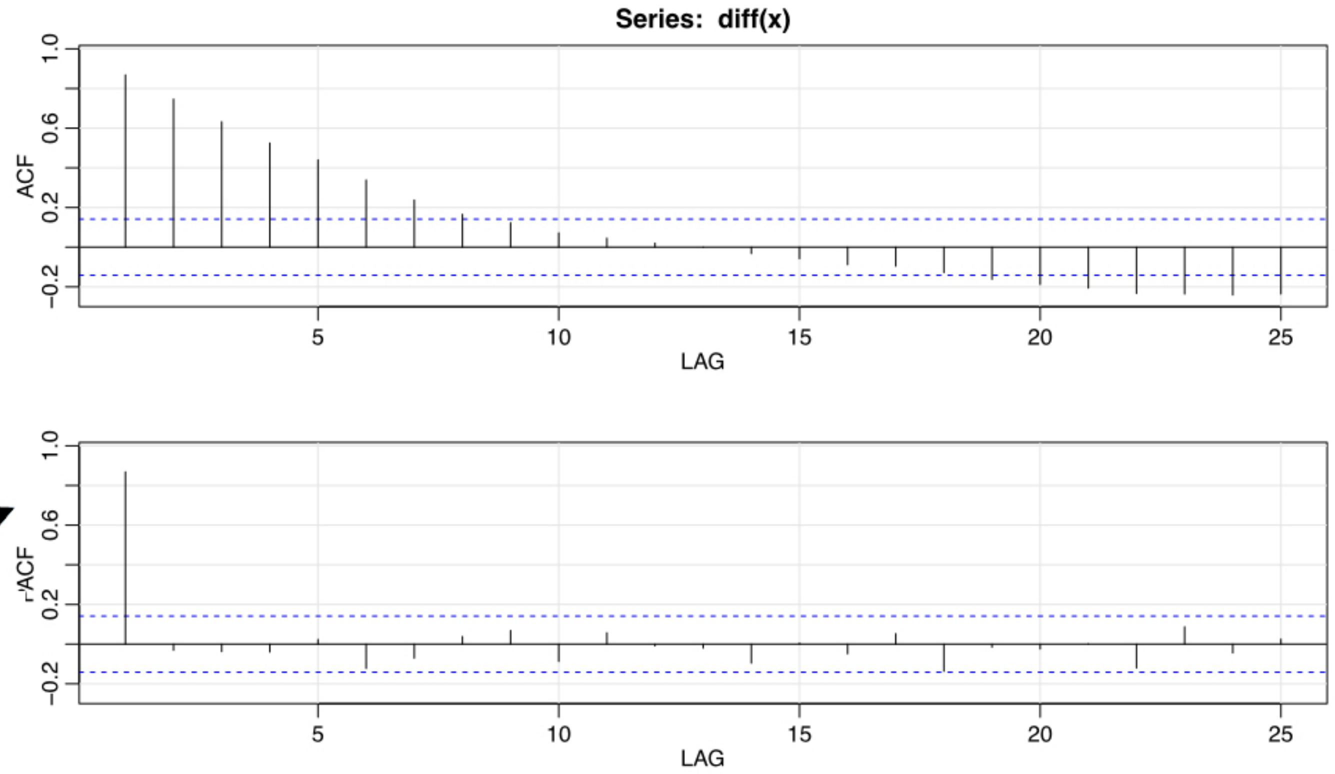
ACF and PCF of a Differenced ARIMA

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



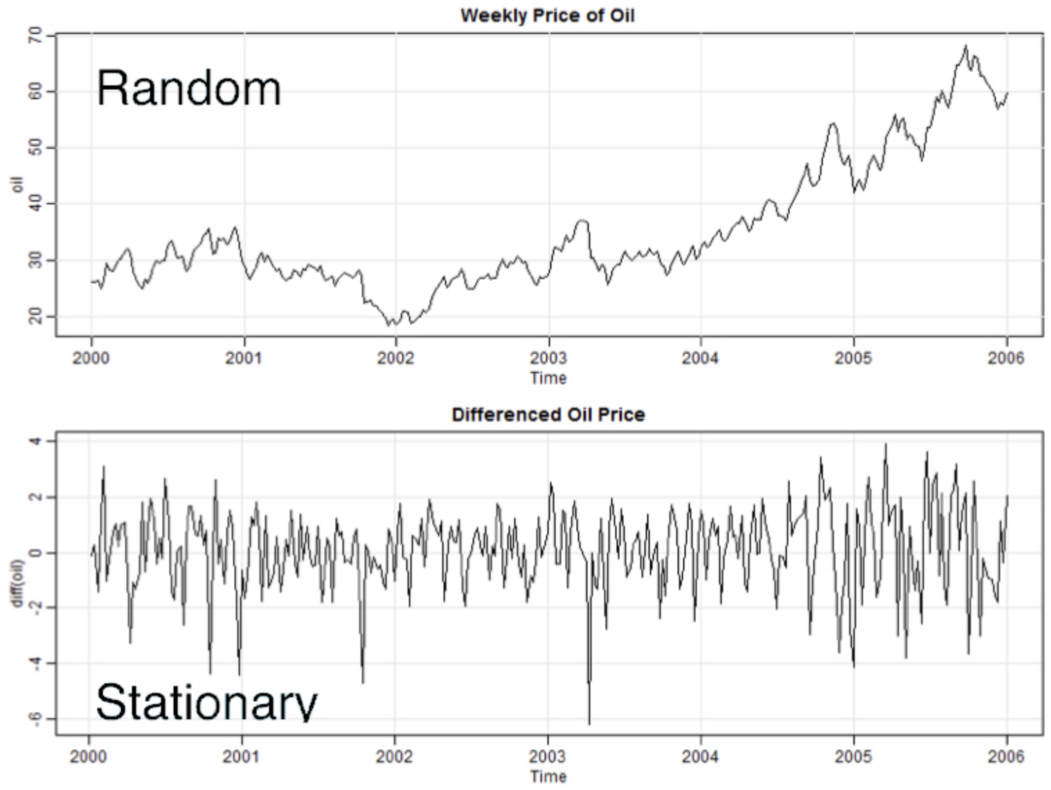
ACF and PCF of a Differenced ARIMA

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

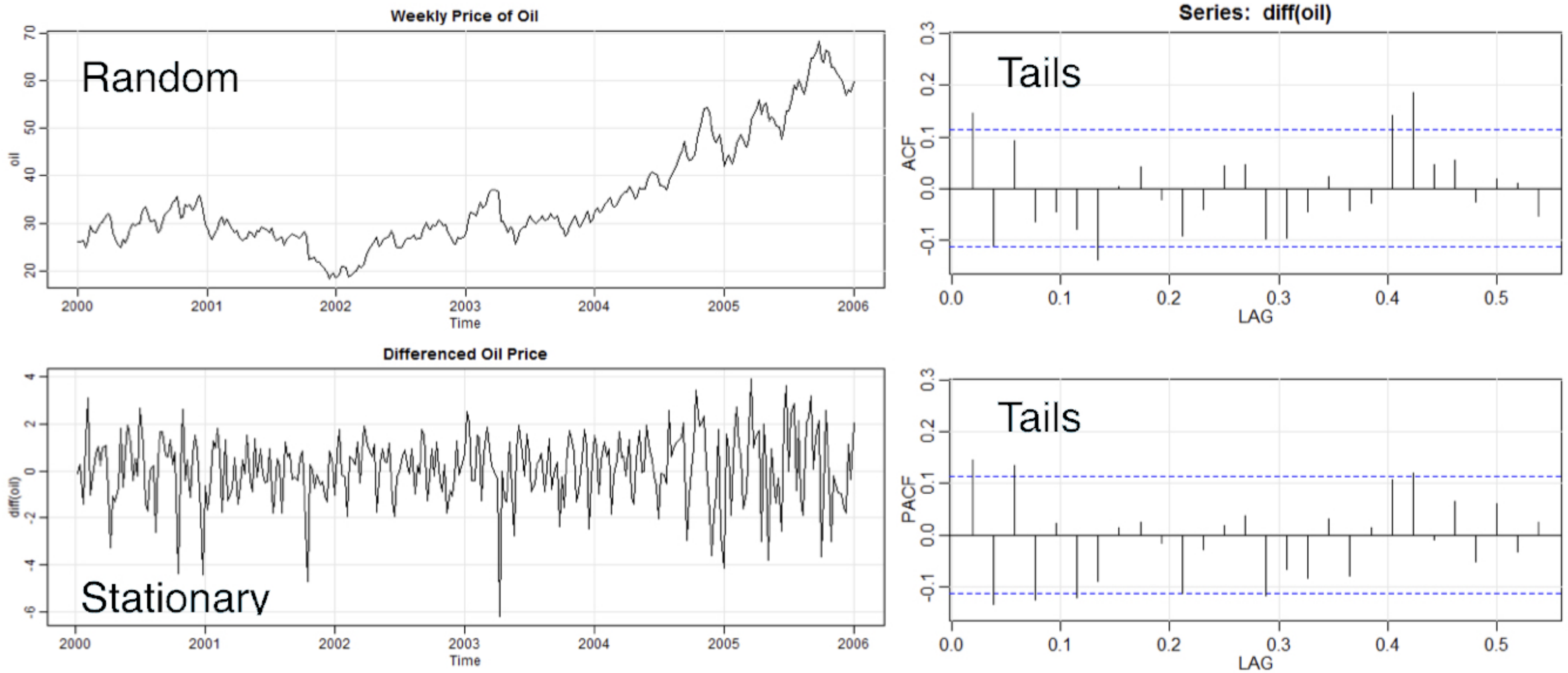


Indicates an AR(1) for the differenced data

Weekly Oil Prices



Weekly Oil Prices



- Looks like `ARIMA(1, 1, 1)`

Let's practice!

ARIMA MODELS IN R

ARIMA diagnostics

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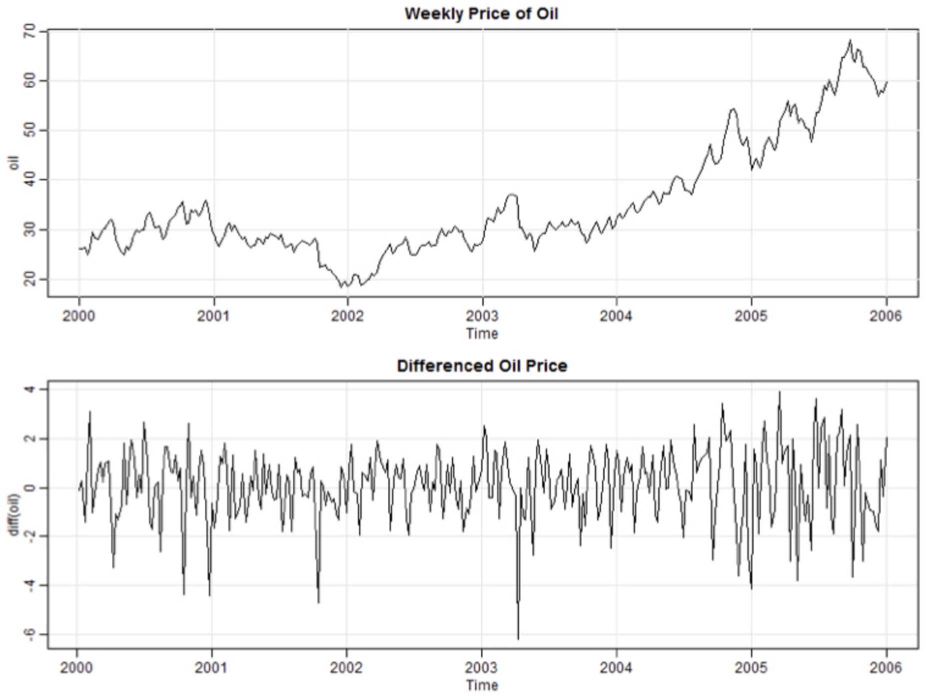
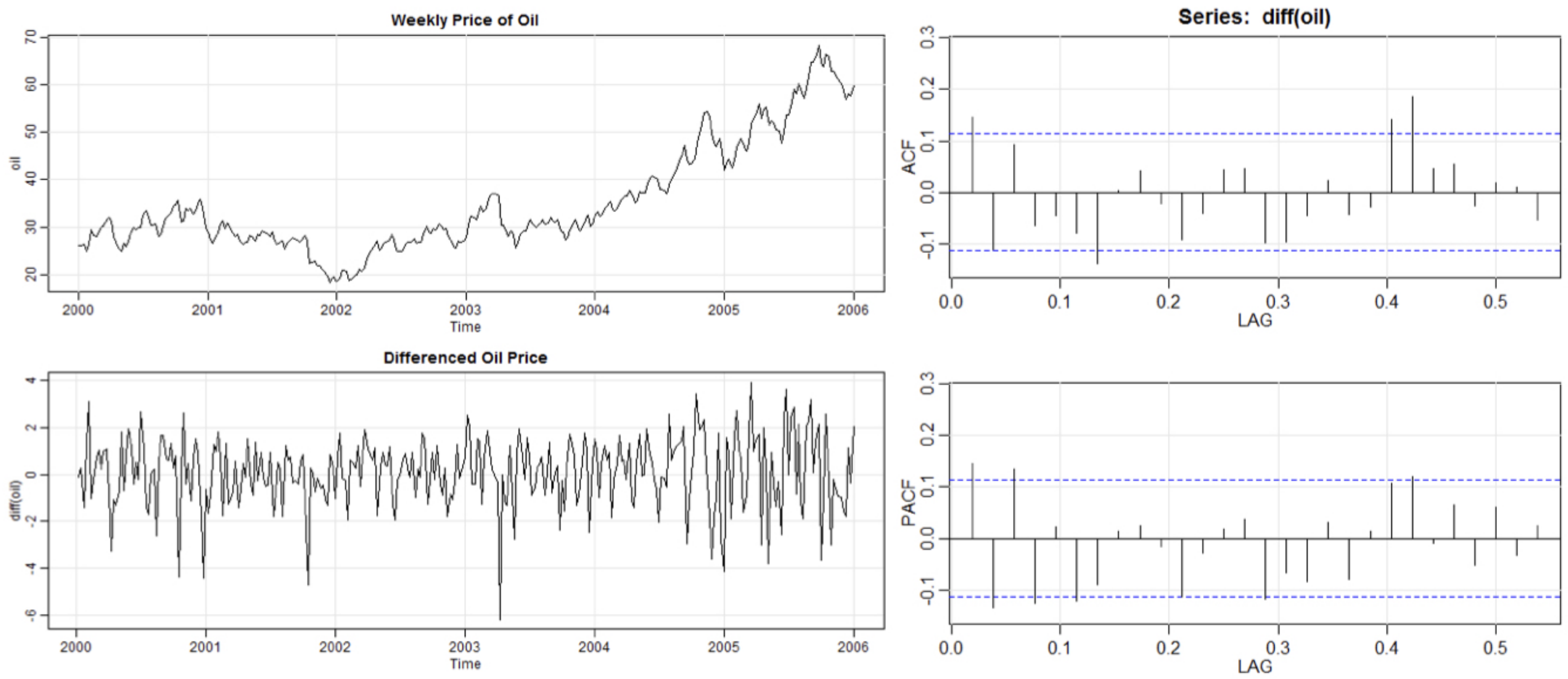
Weekly Oil Prices ARIMA(1, 1, 1)?



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

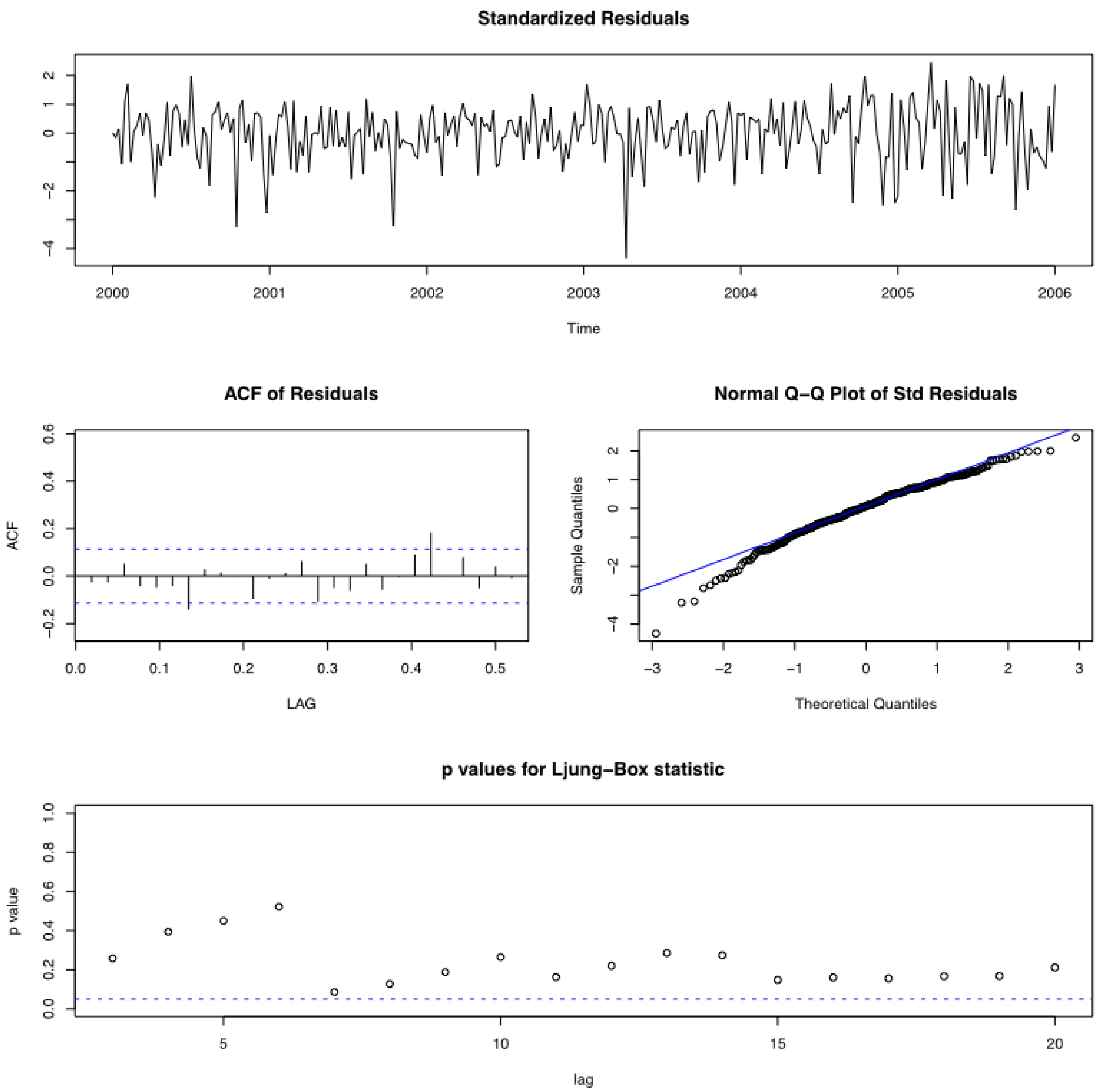


Weekly Oil Prices ARIMA(1, 1, 1)?

```
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
```

Let's practice!

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Forecasting ARIMA

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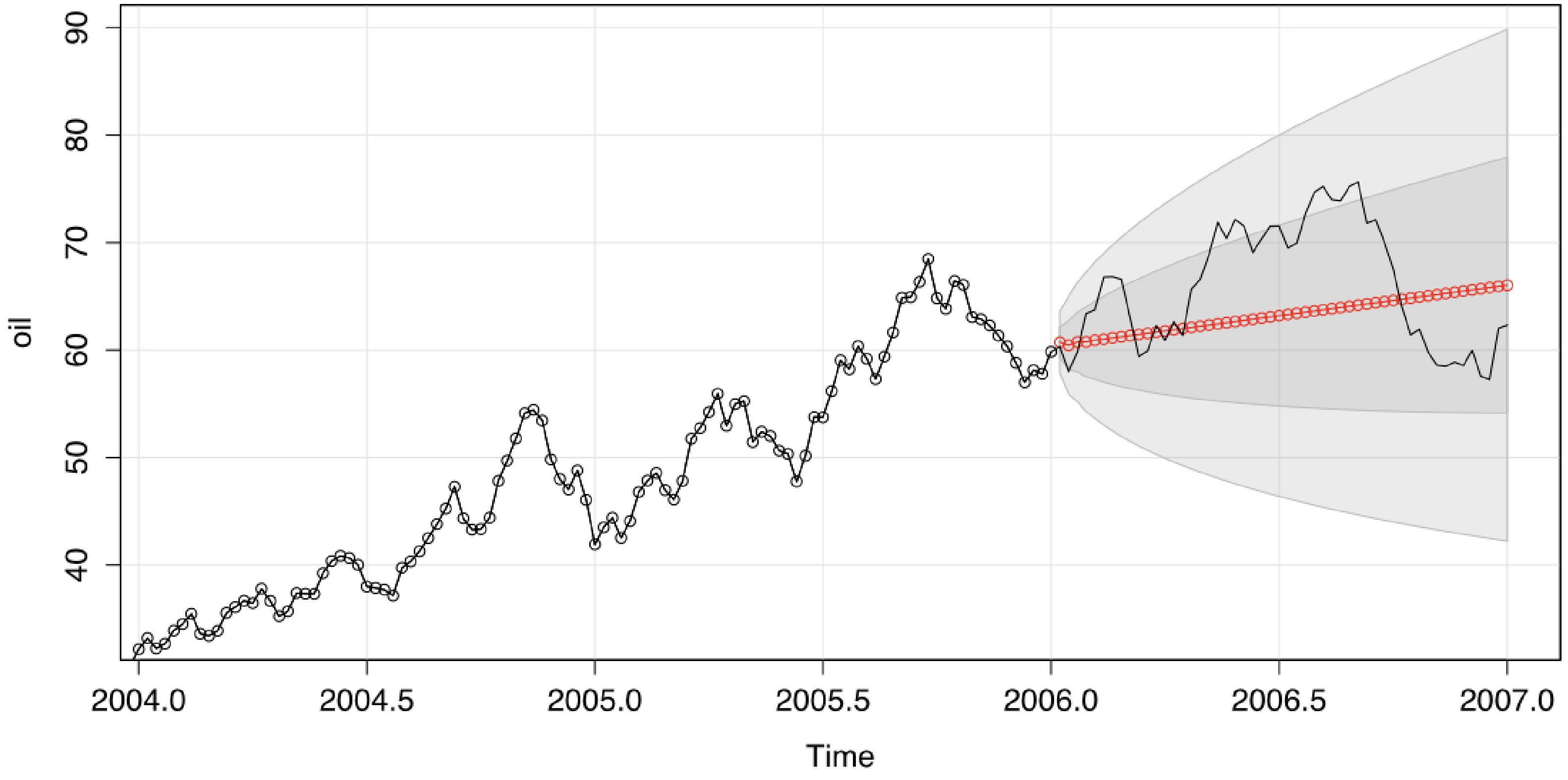
Forecasting ARIMA Processes

- 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)
```



Let's practice!

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